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Inflation in Transition Economies: How Much? and Why?

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Abstract

Following very high inflation rates at the beginning of the reform process, most transition countries have succeeded in lowering their inflation to more moderate rates. Inflation rates in the Baltics, Russia, and other countries of the former Soviet Union are now typically in the range of 10–60 percent. This essay examines whether a further reduction in inflation may be necessary. It concludes that low inflation may be important for achieving remonetization of the economy and sustained output growth.

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SUMMARY

Following very high inflation rates at the beginning of the reform process, most transition countries have succeeded in lowering their inflation to more moderate rates. Inflation rates in the Baltics, Russia, and other countries of the former Soviet Union are now typically in the range of 10–60 percent. This essay examines whether a further reduction in inflation may be necessary.

The main benefit of inflation is the potential seignorage revenue. In the Baltics, Russia, and other countries of the former Soviet Union, both seignorage and inflation tax revenues have been declining since the early 1990s, reflecting the demonetization that these economies have suffered. Indeed, money demand in these countries appears to be highly elastic with respect to inflation. Evidence from other countries, moreover, suggests that demonetization and remonetization are asymmetric processes: higher inflation leads to lower money demand, but a lower inflation rate does not automatically raise money demand. Rather, there is a threshold level of inflation—somewhat less than 10 percent a year—above which remonetization is unlikely to occur.

The main cost of inflation is its impact on output growth and volatility. Again, evidence from other countries suggests a significant negative relationship between inflation and output growth. Going beyond standard regression analysis, a nonparametric technique known as Tree Classification can be used to find threshold inflation rates at which low growth is likely to occur, *taking account of threshold effects of other variables* (such as investment or trade openness). Defining high growth as per capita GDP growth rates above 2 percent a year (the median of the data set), this technique identifies a threshold effect at 10 percent inflation a year, above which high growth is unlikely to occur.

I. INTRODUCTION

Low inflation has long been a key objective of Fund-supported programs. This emphasis on lowering inflation harkens back to the days of the Bretton Woods system when fixed exchange rates were de rigueur. Under fixed exchange rates, an inflation rate above the “world level” would result in drawings from the Fund simply bleeding out again through the balance of payments. With greater exchange rate flexibility, however, and larger swings in equilibrium real exchange rates (in the face of, or financed by, private capital flows), the case for very low rates of inflation may be less compelling.

Over the past decade—driven by perceived economic and political costs of inflation—the industrialized countries have made major strides toward achieving inflation rates below 3 percent per annum. These countries are unlikely to want to return to higher inflation rates. Nor should they. At the other extreme, countries with inflation rates that border on, or reach, hyperinflationary levels should obviously make combating inflation a priority. But for countries with “moderate” rates of inflation—perhaps in the range of 20 to 60 percent per year—the need to lower inflation further is an open question. The transition economies provide a good case in point: with further real exchange rate appreciations expected, limited sources of budget revenue, and significant relative price adjustments still ahead, aiming for industrialized country inflation rates at this stage might make little sense.

This essay discusses “appropriate” inflation targets towards which countries with currently moderate rates of inflation might wish to aim. Particular reference is made to the transition economies—especially the Baltics, Russia, and the Other republics of the former Soviet Union (BRO)—but many of the arguments apply to, and are drawn from, the experience of other countries as well.

Our results may be summarized briefly. Section II considers the traditional argument for (at least moderately) high inflation; to wit, the seignorage or inflation tax which governments—otherwise strapped for sources of financing—can raise. We find that money demand in the BRO countries has been very inflation-elastic so that the “revenue-maximizing” rate of inflation—though still high—is well below typical estimates. Moreover, the high elasticity of money demand means that the incremental revenue from an increase in the inflation rate is small. Put simply, most of the potential inflation tax revenues are captured at much lower rates of inflation. Drawing on international evidence, we also show that the processes of de-monetization and re-monetization are asymmetric: High inflation causes de-monetization, but lower inflation does not necessarily cause a corresponding re-monetization. Instead, there is a threshold effect whereby re-monetization is unlikely to occur unless inflation falls below 10 percent per year.

Section III turns to the costs of inflation. There is some evidence that only those transition economies that have achieved at least some price stability have been able to grow. With few observations, structural breaks, and substantial measurement problems, it is difficult to argue that the relationship between low inflation and positive growth is unambiguous, let

alone causal. Again, evidence from other countries is useful. Based on a large data set of Fund members since 1960, we find that high inflation countries tend to have lower growth, and greater variability of output growth. This deleterious effect on growth—which operates through lower investment and lower productivity growth—is discernible at inflation rates above 10 percent per year and is particularly pronounced at inflation rates above 40 percent per year. These results are consistent with, if somewhat sharper than, the findings of others. Our analysis goes beyond much of the existing literature, however, by considering the interactive effect of inflation and other independent variables, using decision-theoretic techniques.

Section IV provides some brief concluding remarks.

II. INFLATION, MONEY DEMAND, AND THE INFLATION TAX

Over the post-war period, inflation rates have varied markedly across time and countries (Chart 1).² Inflation in the upper-income countries peaked in the aftermath of the first oil shock—when the median inflation rate reached 14 percent per year—but fell sharply during the 1980s. Inflation in the middle and lower income countries peaked somewhat later, at median rates of 17 and 21 percent respectively.

Against this background, the experience of the transition economies—and the BRO countries in particular—has been exceptional. Leaving aside the effects of their initial price liberalizations, these countries continued to experience very high rates of inflation several years into their reform programs. Average inflation for the BRO countries was 1,100 percent in 1992, 3,000 percent in 1993, and 1,120 percent in 1994, before declining to 300 percent in 1995 and 53 percent in 1996 (Table 1).³ It is not difficult to see why. Faced by budget deficits which, as a percentage of GDP, were often well into the double digits, and limited administrative capacity to tax market economies, governments often had little recourse but to resort to the inflation tax.

²These charts are based on an annual data set of all Fund members from 1960–96; see also World Economic Outlook, October 1996.

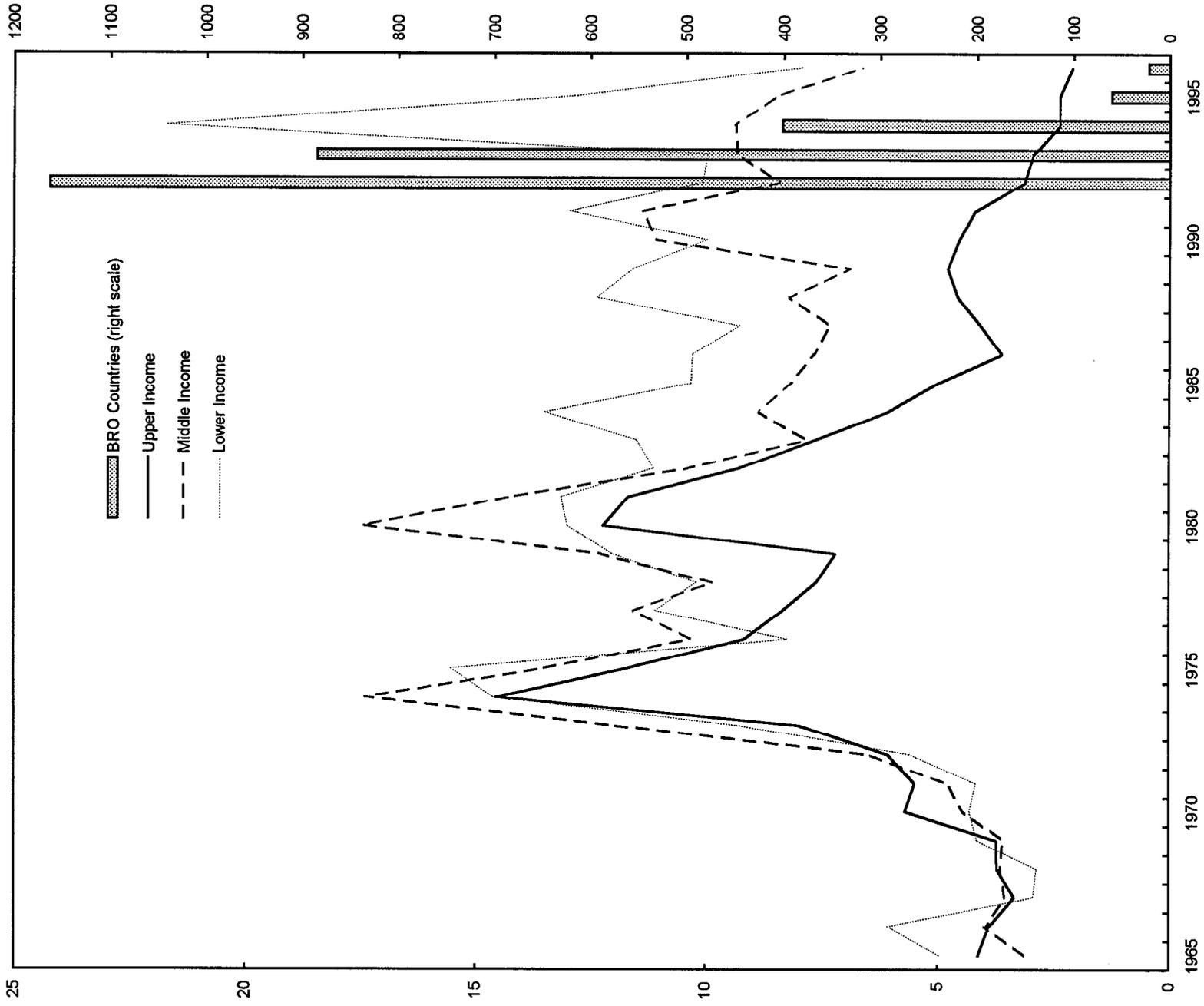
³Median inflation rates for the period 1992–96 were: 1,200 percent, 880 percent, 400 percent, 60 percent and 22 percent.

Table 1: Baltics, Russia, and Other Countries of the Former Soviet Union

	End of period Inflation				
	1992	1993	1994	1995	1996
Armenia	1,241.2	10,896.1	1,884.5	32.1	5.8
Azerbaijan	...	1,293.8	1,788.0	84.5	6.7
Belarus	1,557.8	1,994.0	1,959.5	244.2	39.1
Estonia	942.2	35.7	41.6	28.8	15.0
Georgia	1,178.5	7,484.1	6,473.6	57.4	13.9
Kazakstan	2,960.7	2,169.0	1,160.3	60.4	28.7
Kyrgyz Republ	1,257.0	766.9	95.7	32.0	34.9
Latvia	958.2	34.8	26.2	23.3	13.2
Lithuania	1,162.5	188.8	45.0	35.5	13.1
Moldova	2,198.4	836.0	116.0	23.8	15.1
Russia	...	841.6	202.7	131.4	21.8
Tajikistan	...	7,343.7	1.1	2,135.2	40.6
Turkmenistan	1,328.5	1,261.5	445.9
Ukraine	2,001.0	10,155.0	401.1	181.4	39.7
Uzbekistan	910.0	884.8	1,281.4	116.9	64.4
Average	1,091.2	2,995.0	1,120.3	296.6	53.2
Median	1,162.5	884.8	401.1	60.4	21.8

	GDP growth				
	1992	1993	1994	1995	1996
Armenia	-52.3	-14.8	5.4	6.9	6.5
Azerbaijan	-22.1	-23.1	-18.1	-11.0	1.3
Belarus	-10.0	-10.7	-12.5	-10.2	-0.1
Estonia	-21.6	-8.4	-0.1	2.9	3.1
Georgia	-44.8	-25.4	-11.4	2.4	10.5
Kazakstan	-2.9	-10.4	-17.8	-9.0	1.1
Kyrgyz Republ	-13.9	-15.5	-20.1	1.3	5.5
Latvia	-37.7	-24.2	1.0	1.3	3.0
Lithuania	-34.9	-14.9	0.6	-1.6	2.5
Moldova	-29.1	-1.2	-31.2	-3.0	-8.0
Russia	-14.5	-8.7	-12.6	-4.0	-1.3
Tajikistan	-29.0	-11.0	-21.5	-12.5	-7.0
Turkmenistan	-5.3	-10.2	-20.0	-10.4	-3.0
Ukraine	-17.0	-14.2	-22.9	-11.8	-10.0
Uzbekistan	-11.0	-2.3	-4.2	-0.9	1.6
Average	-23.1	-13.0	-12.4	-4.0	0.4
Median	-21.6	-11.0	-12.6	-3.0	1.3

Chart 1: Median Inflation
(in percent per year)



Both seignorage and inflation tax revenues, as a fraction of GDP, have fallen steadily from their peaks in 1993 and now typically amount to less than 2 percent of GDP (Table 2).⁴ The decline in the inflation tax revenue reflects both lower inflation rates and—at least until 1996—falling real money balances. The average (unweighted) ratio of base money to GDP for the 15 BRO countries fell from 11.7 percent in 1993, to 9.1 percent in 1994, and 6.3 percent in 1995.

A simple way to characterize this de-monetization is by means of a money demand function of the form:

$$\ln\left(\frac{M}{PY}\right) = \alpha + \beta \left(\frac{\pi}{1+\pi}\right)^\gamma \quad (1)$$

Given the extraordinary range of inflation rates observed, the assumption of a constant elasticity of money demand with respect to inflation is likely to be violated. The functional form (1) thus provides a convenient generalization of the standard Cagan money demand function (to which it collapses when $\gamma=1$).⁵

Estimating (1) for a panel of the BRO countries over the period 1993-1996 yields coefficients of -2.54 (t-stat: 8.63***), -2.06 (t-stat: 7.00***), and 1.40 (t-stat: 2.24**) for α , β , and γ respectively. Estimating (1) in first differences yields coefficients of -1.98 (t-stat: 5.52***) and 1.28 (t-stat: 3.28***) for β , and γ respectively. Obviously, given the data problems, such estimates cannot be taken terribly seriously. Nonetheless, both sets of estimates do suggest highly inflation-elastic money demand.

Given an estimated money demand function, a common exercise is to calculate the implied inflation rate at which the inflation tax revenue is maximized, π^{\max} . Based on our estimates of β and γ , the implied π^{\max} is about 90 percent—high, but well below more typical

⁴The inflation tax revenue is defined as $R/Y = [\pi/(1+\pi)](M/Y)$ where π is end-period inflation, M is the average stock of base money, and Y is nominal GDP; seignorage is simply $[M-M(-1)]/Y$.

⁵Easterly et al. (1995).

Table 2: Baltics, Russia, and Other Countries of the Former Soviet Union

Inflation Tax (In Percent of GDP)				
	1993	1994	1995	1996
Armenia	21.8	4.2	1.0	0.3
Azerbaijan	11.5	6.5	2.0	0.4
Belarus	4.9	5.0	2.6	1.5
Estonia	3.3	3.9	2.5	1.4
Georgia	4.9	1.5	1.0	0.4
Kazakstan	7.9	4.1	1.8	1.1
Kyrgyz Republ	5.6	3.2	2.3	2.6
Latvia	2.9	2.5	2.2	1.3
Lithuania	4.1	2.0	1.8	0.7
Moldova	5.9	3.7	1.6	1.3
Russia	4.9	3.5	2.3	0.7
Tajikistan	32.2	0.4	...	1.2
Turkmenistan	...	8.6	4.1	2.2
Ukraine	9.2	6.3	3.1	1.4
Uzbekistan	22.0	10.0	4.4	3.9
Average	9.4	4.4	2.2	1.4
Median	5.7	3.9	2.2	1.3

Seignorage: $(M - M(-1))/PY$ (In Percent of GDP)				
	1993	1994	1995	1996
Armenia	37.5	7.1	2.8	1.8
Azerbaijan	21.0	10.4	3.4	1.7
Belarus	7.8	9.5	4.3	3.0
Estonia	9.1	1.5	2.0	2.2
Georgia	9.5	2.9	3.2	1.0
Kazakstan	14.4	6.8	3.0	0.9
Kyrgyz Republ	6.9	4.5	6.1	2.2
Latvia	7.9	2.2	0.2	2.2
Lithuania	5.8	3.1	2.0	0.1
Moldova	8.7	5.4	2.8	0.9
Russia	8.4	5.1	3.0	1.0
Tajikistan	58.0	26.2	...	2.8
Turkmenistan	13.2	15.8	5.9	3.5
Ukraine	17.7	11.0	3.8	1.6
Uzbekistan	39.8	14.7	8.7	6.2
Average	17.7	8.4	3.4	2.1
Median	9.5	6.8	3.1	1.8

estimates which often range between 200 and 400 percent.⁶ Perhaps more importantly, the high elasticity of money demand in BRO countries means that the incremental inflation tax revenue from an increase in the inflation rate is quite small. At an inflation rate of 15 percent, for example, (1) yields 0.9 percent of GDP in inflation tax revenue; in order to double this revenue to 1.7 percent of GDP (the maximum possible) requires an inflation rate of 90 percent. Quite simply, most of the inflation tax revenue is captured at relatively low inflation rates.

The “money demand” function (1) has been estimated on base money in order to simplify the seignorage calculations. More generally the economic concept of a money demand function might be expected to apply to broad money (with or without foreign currency deposits). For a given broad money demand, base money—and thus seignorage—is maximized when the multiplier is at its lowest. This suggests that it may be possible to eke out larger inflation tax revenues by raising reserve requirements. In practice, however, the money multiplier in most BRO countries is already low—typically around 1.2—in part because the parlous state of commercial bank’s portfolios makes them reluctant to lend within existing reserve requirements) so the scope of raising more revenue in this manner is limited.

With rapidly falling inflation during 1995 and 1996, there has been some re-monetization of the BRO economies. But it has certainly been modest. Both the average and median base money to GDP ratio actually fell in 1995. Only in 1996 have there been signs of a recovery in real money demand, with the unweighted average of the base money to GDP ratio rising from 6.3 percent in 1995 to 6.6 percent in 1996. Even this modest evidence of re-monetization, however, might disappear were proper account taken of the growth of the informal sector in these economies. Moreover, with the exception of Moldova and Uzbekistan, those countries that did experience any significant re-monetization were starting from a very low base.

This raises the question of whether—and at what inflation rates—re-monetization might be expected to occur. Evidence from other countries is not especially encouraging.

⁶For example, Buitier (1996) reports seignorage maximizing inflation rates ranging between 133 percent and 476 percent for the transition economies. For the money demand

$$\pi_{\max} = \frac{(-\beta\gamma)^{-\frac{1}{\gamma}}}{[1 - (-\gamma\beta)^{-\frac{1}{\gamma}}]} = 0.90$$

function (1):

Ghosh (1996) uses an annual data set of all Fund members over the period 1960-90, and reports “re-monetization” functions of the form:⁷

$$\mu \equiv \dot{m} - \dot{p} = \alpha_0 + \alpha_1 \dot{q} + \alpha_2 \pi^e \quad (2)$$

where real broad money demand depends positively upon real output ($\alpha_1 > 0$) and negatively on inflation ($\alpha_2 < 0$). The rate of monetization of the economy is defined as:

$\mu = \Delta \log m - \Delta \log p$. Notice that, abstracting from the effects of real growth, the economy can monetize ($\mu > 0$) even with positive expected inflation, as long as $\alpha_0 > \alpha_2 \pi^e$. Estimating (2) over the full sample yields coefficients of 0.06, 0.58, and -0.25 for α_0 , α_1 and α_2 respectively. Abstracting from any real growth, therefore, monetization of the economy will be positive ($\mu > 0$) as long as inflation is less than 24 percent ($=\alpha_2/\alpha_0$)—and correspondingly higher or lower according to the rate of real output growth.

Now the interesting finding is that when the data set is split into periods of increasing and decreasing monetization, the results are quite different. Here *increasing* monetization is defined as ($\mu(t) > \mu(t-1)$)—which would include episodes in which the economy is de-monetizing ($\mu(t) < 0$) but at a slower rate than before—and *decreasing* monetization is defined correspondingly, *mutatis mutandis*.⁸ Over periods of decreasing monetization the inflation elasticity, α_2 , is -0.60 and is highly significant statistically. Over periods of increasing monetization, in contrast, the inflation elasticity, α_2 , is 0.03 and is statistically insignificant. Similar results are obtained if the data set is split into periods of monetization ($\mu > 0$) and de-monetization ($\mu < 0$) rather than increasing and decreasing monetization, or if sub-groups, based on per capita income, are considered instead.

De-monetization and re-monetization are thus asymmetric: High inflation can reduce the demand for money rapidly, but low inflation may increase the demand for money only gradually. The intuition for this asymmetry is straight-forward. Faced with high inflation,

⁷Notice that the rate of monetization depends upon the *level* of inflation. Other formulations are also possible (e.g. the rate of monetization depending upon the change of the inflation rate). This formulation fits well empirically, and has the implication that, *ceteris paribus*, and even with steady inflation rates, monetization in an economy with high inflation takes place more slowly than in an economy with low inflation. Econometrically, (2) is well-specified as long as the inflation rate is stationary—which it typically will be. The equation is estimated using lagged inflation as an instrument for expected inflation.

⁸There are 1,902 observations in total. There are 896 observations with increasing monetization $\mu(t) > \mu(t-1)$ and 880 observations with decreasing monetization. There are 1,414 observations with re-monetization $\mu > 0$, and 488 observations with de-monetization $\mu < 0$.

households and enterprises will find ways to conserve on money holdings. In effect, they will have the incentive to discover new “technologies” for operating with lower money holdings. Once inflation falls, there may be little reason to revert to previous habits unless the “shoe leather” costs are particularly high.

Does this mean that the inflation rate is irrelevant for re-monetization? No. In particular, there may be “threshold” effects whereby inflation needs to be below a certain level before re-monetization occurs. A probit estimate of the probability of re-monetization $\Pr(\mu > 0)$ on an indicator variable of inflation below 10 percent yields a coefficient of 0.55 (t-statistic: 7.51***), with 75 percent of the observations correctly predicted. Of course, the inflation rate itself is likely to be an endogenous variable; estimation by instrumental variables lowers the coefficient to 0.20 (t-statistic: 4.72***) but it remains statistically significant. Similarly, increasing monetization $\Pr(\mu(t) > \mu(t-1))$ requires an inflation rate below 6 percent (coefficient: 0.16, t-statistic 2.40**).

How does the re-monetization experience of the BRO countries compare? Of the six countries which showed any significant re-monetization in 1996—more than 5 percent (not percentage points)—increase in the ratio of base money to GDP, four had inflation rates at or below 15 percent. The two surprises are Belarus—where the data are rather suspect—and Uzbekistan, whose monetization ratio rose to 9.9 percent (from 8.3 in 1995) despite 64 percent inflation. There is at least some evidence, therefore, that the asymmetry between re-monetization and de-monetization observed in other countries is relevant for the BRO countries as well. Indeed, De Broeck, Krájnyák and Lorie (1996), using a panel of 6 transition countries (excluding the Baltics, Georgia, and Uzbekistan) in “stabilization time,” argue that there is a “ratchet” effect in the level of velocity whereby once it has risen because of previous inflationary levels, it has tended to remain high independently of the success in reducing inflation.⁹

Finally, it is worth remembering that the monetization ratio is only one measure of financial development. More generally, financial deepening will be associated with falling (equilibrium) real interest rates, narrowing spreads between lending and borrowing rates, rising volumes of intermediation, and falling ratios of reserve money to deposits.¹⁰ Low and stable inflation can help contribute to such financial deepening although, in the short-run, a steep fall in inflation may make more obvious the precarious state of unhealthy banks.

⁹Ghosh (1996a) shows that the “long-run” co-integrating relationship between real money and output in Ukraine depends negatively upon the *inflation* rate. Thus inflationary periods will result long-term changes in the money-GDP ratio which are not reversed when inflation falls.

¹⁰See Johnston and Pazarbasioglu (1995) for an excellent discussion and summary of this literature.

In summary, most transition economies raised substantial amounts of inflation tax revenue in the early years of reform. These revenues declined rapidly, not only because inflation was reduced, but also because of falling real money balances. Estimated money demand function suggest highly inflation-elastic money demand which, in turn, imply that much of the potential inflation tax revenue is captured at relatively low inflation rates. Moreover, international evidence suggests that sustained re-monetization is unlikely to occur until inflation falls below 10 percent per year.

III. INFLATION AND GROWTH

While the main benefit of inflation is probably the seignorage that the government is able to raise, the costs of inflation are less readily identified. Such costs stem from the unexpected erosion of nominal assets and uncertainty about relative prices and are presumably manifested in lower output growth and worsening income distribution.¹¹

Although the long-run Phillips curve has been largely discredited, the experience of the industrialized countries does not give overwhelming support for the converse proposition—that inflation is *bad* for growth—either.¹² But the situation may be different for countries with higher inflation rates. An important study by Fischer et al. (1996) of the transition economies suggests that inflation stabilization precedes output growth. They find that, typically, output growth turns positive within two years of inflation falling below 50 percent. Table 3 provides an update for the transition economies, based on this rule. There are 36 observations (country-years) for which output growth has been positive in year t , with inflation below 50 percent in year t , $t-1$, or $t-2$. But there are also 26 observations where inflation fell below 50 percent (in years t , $t-1$, or $t-2$) and output was still negative, and 25 observations where output growth was positive even though inflation in year t or $t-1$ was greater than 50 percent. Econometric criticisms aside, any causal interpretation of such results is fraught with difficulty.¹³ Quite simply, the number of observations are too few for idiosyncratic effects to be convincingly captured by the error term. For this reason, other

¹¹Bulir and Guldewolf (1995).

¹²Fischer (1993), Rudebusch and Wilcox (1994).

¹³In Fischer *et al.* (1996), output growth appears to be regressed upon contemporaneous inflation. Since any reasonable money demand function also implies a negative relationship between output growth and inflation, there are obviously some identification problems. Indeed, even the relation between output growth and lagged inflation becomes suspect if—as seems reasonable—the informal sectors of the economy start growing before the recorded sector. In that case, higher output growth of the informal sector would result in higher money demand and thus *cause* lower inflation, thus giving the observed correlation even if inflation has no causal effect on (recorded or unrecorded) output growth. See also Berg, Borensztein, Sahay, and Zettelmeyer (1997) for other econometric criticisms.

Table 3: Growth and Inflation in Transition Economies

Inflation below 50 percent per year and positive output growth 1/

	1990	1991	1992	1993	1994	1995	1996
Armenia					♦
Azerbaijan					♦
Estonia	...					♦	♦
Georgia					♦
Kazakstan	...						♦
Kyrgyz Republic	...					♦	♦
Latvia			♦	♦	♦
Lithuania	...						♦
Uzbekistan	...						♦
Albania				♦	♦	♦	♦
Croatia							♦
Czech Republic					♦	♦	♦
Hungary					♦	♦	♦
Poland				♦	♦	♦	♦
Romania				♦			♦
Slovenia					♦	♦	♦
Slovak Republic					♦	♦	♦
Total				3	7	9	17

Inflation below 50 percent per year and negative output growth 1/

	1990	1991	1992	1993	1994	1995	1996
Estonia	...				♦		
Lithuania	...					♦	
Moldova	...					♦	♦
Russia					♦
Albania			♦				
Bulgaria	♦	♦	♦	♦			♦
Czech Republic	♦	♦	♦	♦			
Hungary	♦	♦	♦	♦			
Romania	♦	♦	♦				
Slovak Republic	♦	♦	♦	♦			
Total	5	5	6	4	1	2	3

Inflation above 50 percent per year and positive output growth 2/

	1990	1991	1992	1993	1994	1995	1996
Armenia			♦	♦	♦
Azerbaijan					♦
Georgia				♦	♦
Kazakstan	...						♦
Kyrgyz Republic	...					♦	
Latvia			♦		
Lithuania	...				♦		
Albania				♦	♦	♦	
Bulgaria					♦	♦	
Croatia					♦		♦
Poland			♦	♦			
Romania				♦	♦	♦	♦
Slovenia				♦	♦		♦
Total			1	4	8	6	6

1/ Inflation below 50 percent in current period or at least one of the two previous periods.

2/ Inflation above 50 percent in current period or previous period.

researchers have tried to put more flesh on this bare bone correlation between stabilization and growth, by including measures of structural change in the regressions instead of inflation.¹⁴

In trying to draw lessons for the appropriate inflation rate for the transition economies, it is useful to go beyond their own experience, and to look at the evidence of other countries, for at least two reasons. First, and most obviously, growth is a complex process upon which many factors and idiosyncratic shocks might impinge, so a relationship based upon the shaky experience of a handful of transition economies thus far is unlikely to be convincing. Second, in the early years of reform, neither inflation nor output growth meant very much. Key prices were often controlled, de jure or de facto, and various studies have suggested that the output figures could be missing as much as one half of the economy. More generally, as market economies gradually emerge in the BRO countries, they will behave more like the economies of other countries, than like themselves a few years ago.

There is, in fact, mounting evidence that inflation can be disruptive for growth.¹⁵ Based on the data set used above, Chart 2 shows average per capita GDP growth rates, sorted by inflation categories—as well as a breakdown by the level of per capita GDP (in some cases there are very few observations so the results by income breakdown should be treated cautiously). The inflation categories are: below 3 percent, 3-10 percent, 10-20 percent, 20-40 percent, 40-100 percent, and above 100 percent. Breaking the inflation sample into discrete categories helps identify “threshold” effects.

For inflation rates below 10 percent there is little discernible effect of inflation on growth; indeed, per capita GDP growth is generally higher with inflation between 3 and 10 percent than it is with inflation below 3 percent. Beyond the 10 percent threshold, however, a negative relationship between inflation and growth becomes more pronounced. Countries with inflation above 40 percent had, on average, GDP growth 2 percentage points lower than countries with less than 10 percent inflation. And those with inflation rates above 100 percent had averaged GDP declines of 3 percent per year. It is also noteworthy that countries with high inflation had more *volatile* output growth (Chart 4).

In part, this negative relationship between inflation and growth may reflect nothing more than the coincidence that during the 1960s, especially, a favorable macroeconomic climate resulted in a predominance of low inflation and high growth observations. A first step to addressing this issue is to remove the annual means from the GDP growth rates so as to

¹⁴Thus Selowsky and Martin (1996) and Fischer, Sahay and Vegh (1996) use a cumulative “liberalization index” in their regressions; but see Berg et al. for a criticism of this methodology.

¹⁵Fischer (1993), Bruno and Easterly (1996), Judson and Orphanides (1996), Sarel (1996), and, more recently, IMF (1997).

Chart 2. Per capita GDP Growth

Percent per year

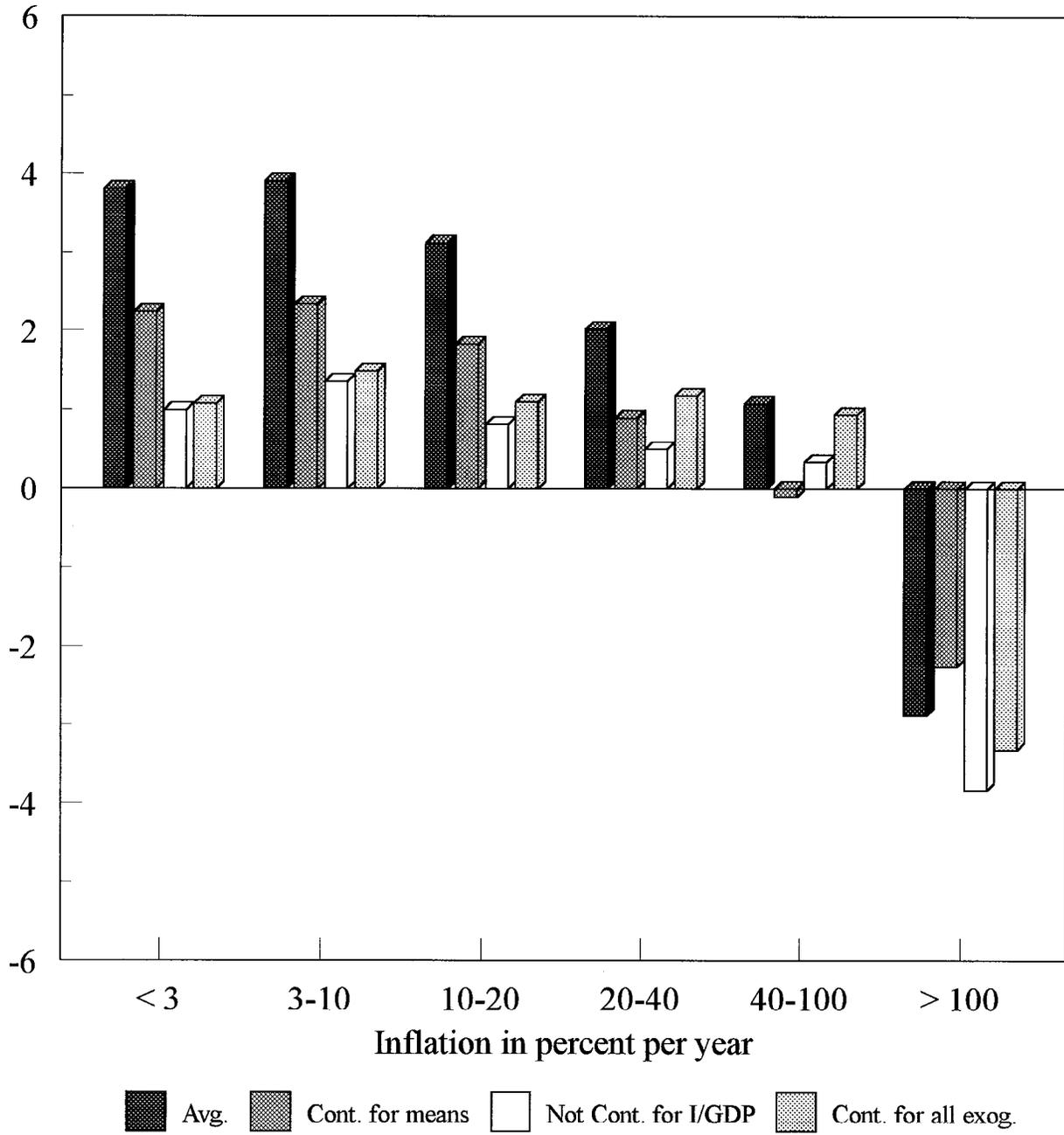
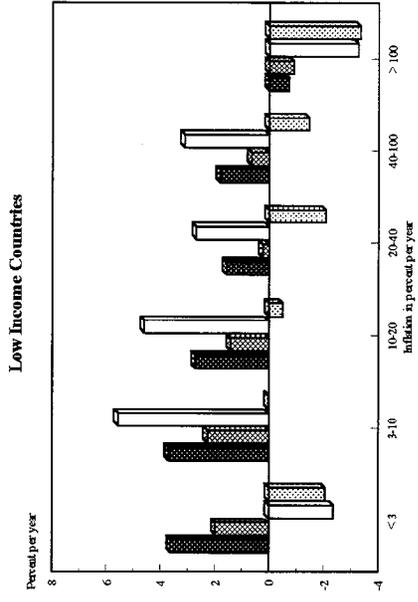
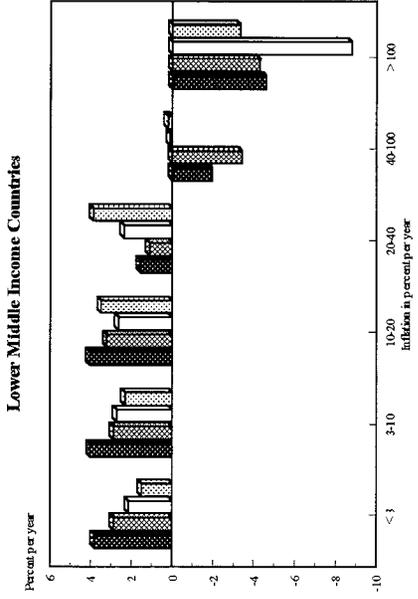
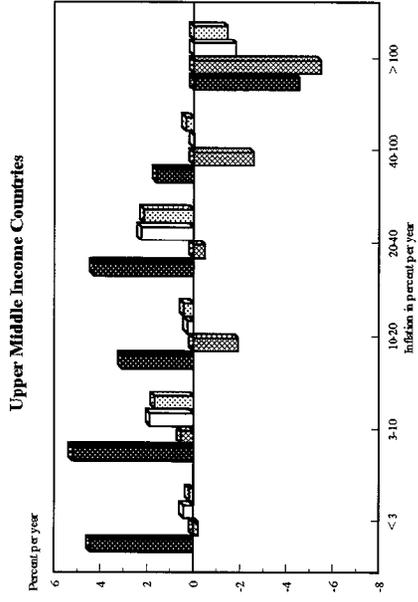
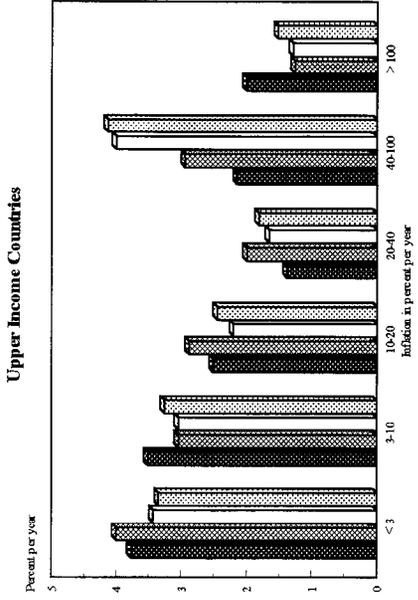


Chart 2. (cont.) Per capita GDP Growth



Avg.
 Cont. for means
 Not Cont. for I/GDP
 Cont. for all exog.

Chart 3. Investment/GDP

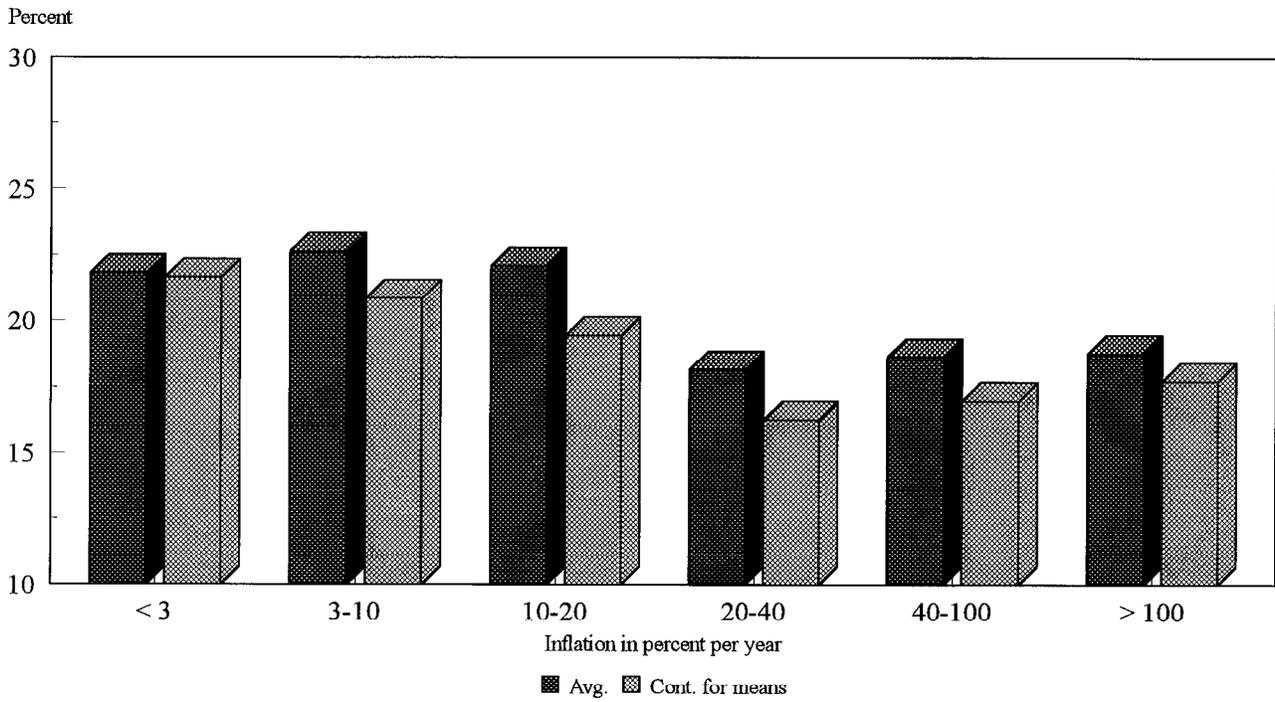
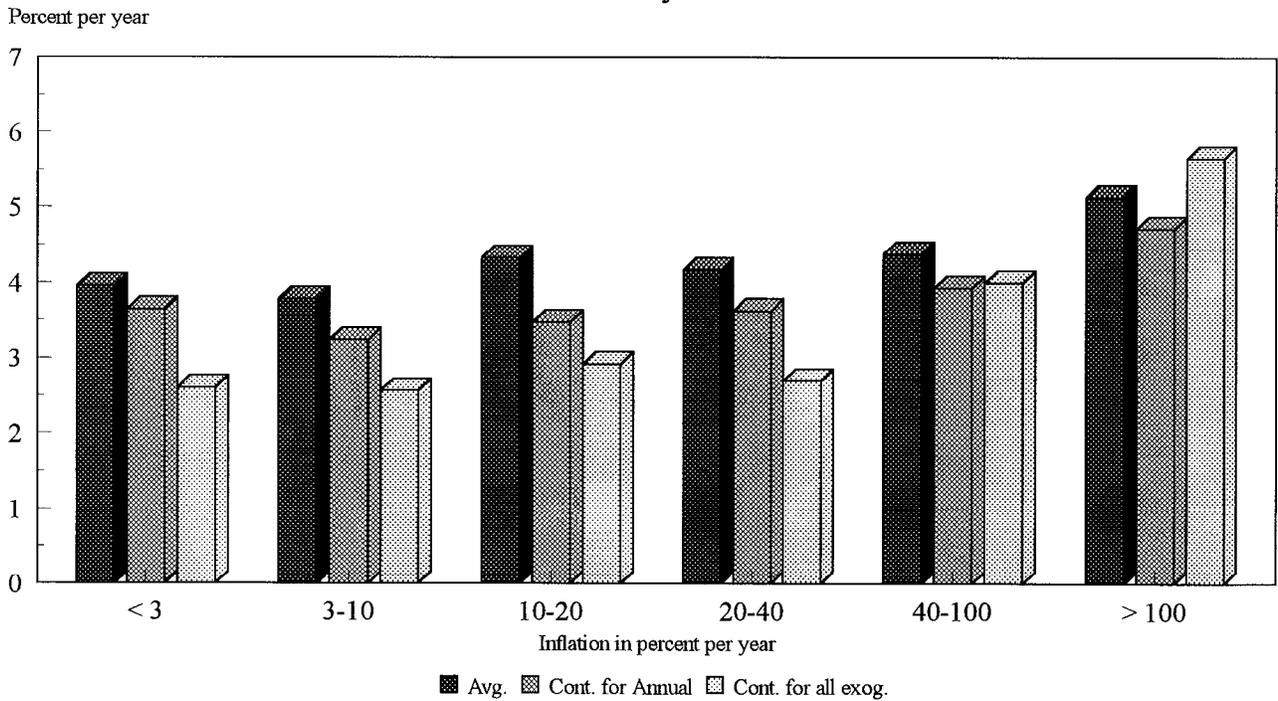


Chart 4. Volatility of GDP Growth



remove the effects of shocks—such as oil price shocks—that are common across inflation regimes within a given year. Doing so does not alter the basic finding of a negative relationship between inflation and growth—at inflation rates above 10 percent. Indeed, the differences become more pronounced and are statistically significant.

Why is high inflation associated with lower growth? First, higher inflation is associated with lower investment (Chart 3). Again, at inflation rates above 10 percent per year, there is a clear downward trend between inflation and investment—which persists if the annual means removed from the investment ratios (Chart 2, second set of bars). But even controlling for investment, inflation reduces GDP growth—that is, high inflation is associated with lower *productivity* growth as well. The penultimate set of bars in Chart 2 shows average growth rates controlling for various exogenous variables but *not* investment.¹⁶ Thus the coefficient on inflation captures both the direct effect on growth of productivity growth and the indirect effect through higher investment. Again, for countries with 20–40 percent inflation, per capita GDP growth is about 0.8 percentage points lower, about 1 percentage point lower for countries with 40–100 percent inflation, and almost 5 percentage points lower for countries with more than 100 percent inflation. The final set of bars controls for investment as well (to capture just the residual productivity effects). These results are not very strong, except for the upper-middle income countries, or at inflation rates above 40 per cent where growth is almost 4 percentage points lower (than in countries with less than 3 percent inflation).

One problem with breaking the sample into separate inflation categories is that the number of such categories, and their cut-offs, are arbitrary. It is reassuring, therefore, that similar results may be obtained by means of a regression of GDP growth on inflation (measured as a continuous variable), where instrumental variables are used for inflation because of potential simultaneity bias:

$$\begin{aligned} \Delta \ln(q) = & -0.02 \pi & +0.14 i/q & -0.10 \sigma_{TTS} & +0.03 \Delta \text{Trade} & -0.003q_0 & (3) \\ & (2.35^{***}) & (5.32^{***}) & (3.82^{***}) & (3.89^{***}) & (2.22^{**}) \end{aligned}$$

According to (3), inflation rates in the 40–100 percent range would imply about 1–2 percent lower per capita GDP growth (controlling for all other variables, including investment).

A rather serious shortcoming of these regressions—whether done with indicator variables for different inflation thresholds, or with inflation measured as a continuous variable—is that the estimated elasticity with respect to inflation is a partial effect, *evaluated*

¹⁶Terms of trade variability, trade growth (the sum of lagged export growth and import growth), the initial level of per capita GDP (coded so that a negative coefficient indicates convergence).

at the mean of the other independent variables.¹⁷ There is no reason why this should be the case. For instance, inflation may present a growth problem for countries that have low investment, or that are subject to terms of trade variability, but not—necessarily—in countries with the same inflation rate but high investment or low terms of trade variability. In principle, it would be possible to capture this by including many interactive indicator variables (e.g. one for $I/GDP < 0.20$ and $\sigma_{TTS} > 0.05$ and $\pi > 0.10$, etc.), but in practice this would be arbitrary and quite infeasible. Fortunately, there are more systematic ways of tackling this problem. One such method uses Classification Trees—a decision tree technique of classifying the dependent variable (in our case, output growth) according to the observed independent variables (inflation, investment ratio, etc.). This turns out to be a rather powerful and robust technique—for example, the results are invariant to monotone transformations of the variables.

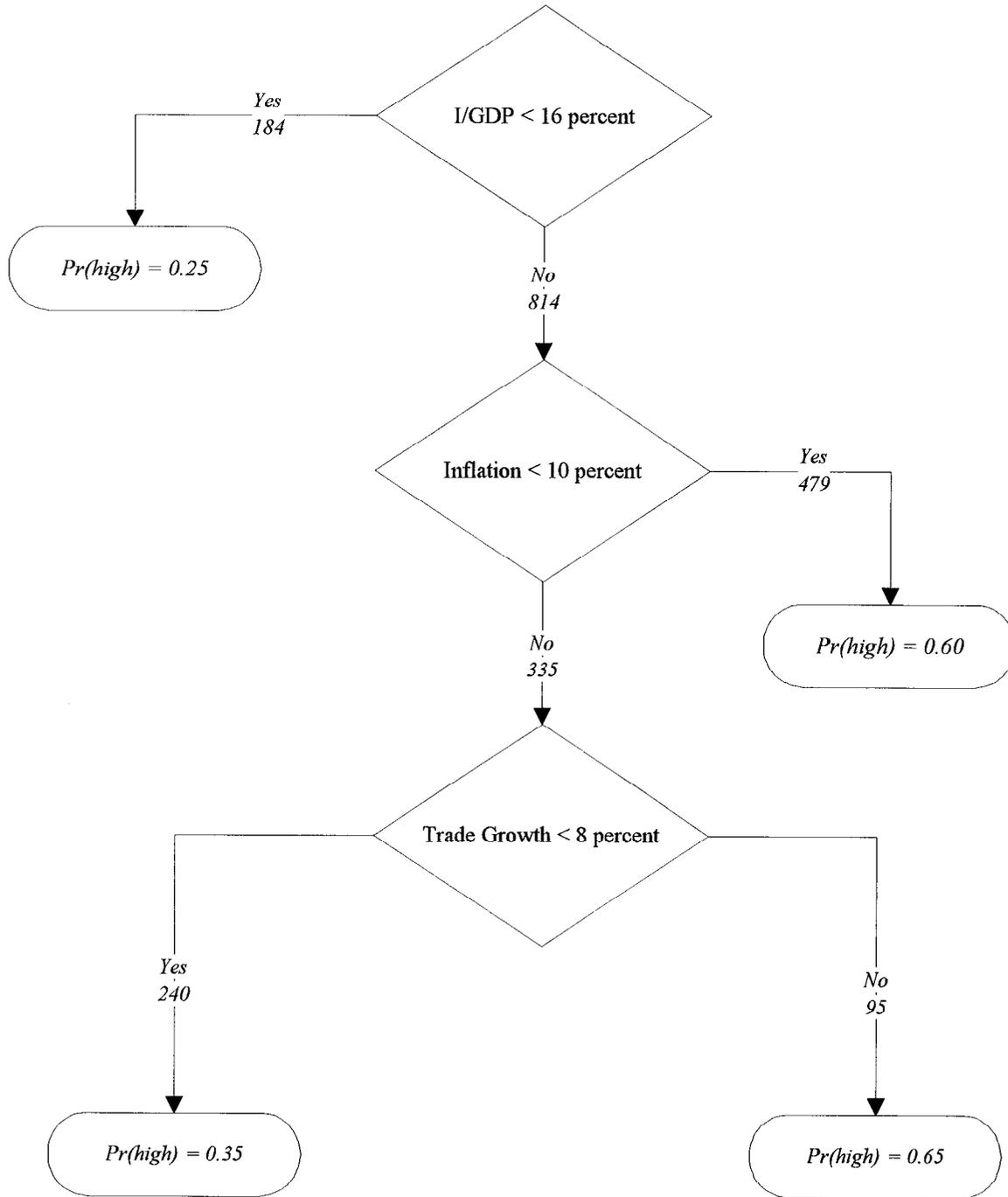
Chart 5 shows a simple classification tree. The dependent variable is an indicator, equal to 1 for greater than median per capita growth (with annual means removed).¹⁸ The algorithm *endogenously* chooses cut-off levels and rules from the set of independent variables (investment, inflation, lagged trade growth, terms of trade variability, and initial income) and produces a decision tree with associated conditional probabilities at each branch. The first rule is based on the level of investment: countries with an investment to GDP ratio of less than 16 percent (184 observations out of 998) are immediately categorized as low growth, and their probability of low growth is 75 percent. The remaining 814 observations go onto the next branch of the tree. The second rule chosen by the algorithm is whether inflation is less than 10 percent. Those countries with inflation rates below 10 percent (and an investment ratio above 16 percent) are classified as high growth, and their probability of high growth is 60 percent. Countries with inflation above 10 percent go to the third branch of the tree, where the decision rule is based on whether (lagged) export growth plus import growth is less than 8 percent. If trade growth is greater than 8 percent, then the conditional probability of high growth is 65 percent, and 35 percent otherwise.

Thus inflation turns out to be an important determinant of growth—unless investment is below 16 percent in which case, regardless of inflation performance (or the values of the

¹⁷A similar criticism applies to the studies cited earlier.

¹⁸The dependent variable does not need to be binary, or even discrete. See Ghosh and Wolf (1997) for other growth classification trees. The sample consists of all Fund members from 1960–90, excluding the transition economies.

Chart 5: Explaining GDP Growth (excl. Transition Economies)



other variables), the country is likely to have a low growth rate.¹⁹ Perhaps the most surprising result is the low cut-off level—10 percent per year—chosen by the algorithm as the determining criterion. Obviously, the growth rules that emerge from this technique are more complex than any simple slogan that “inflation is bad for growth.” But they are surely more plausible as well.

Chart 6 illustrates the growth classification tree when the data set is augmented to include 26 Central and Eastern European and BRO transition economies over the period 1991–96.²⁰ Since some of the transition economies have experienced growth despite relatively high inflation (mainly due to “rebound” effects), the addition of these observations might be expected to reduce the influence of inflation on growth. In fact, this is not particularly the case. While the structure of the tree is more complicated than before, two essential messages remain. First, there are strong interaction effects between investment, trade growth, and inflation which cannot be easily picked-up by standard regression analysis. And second, low inflation may be important for economic growth.

The analysis suggests that there are two threshold levels of inflation. The first branch of the tree separates countries with more than 35 percent inflation (in which case the country is immediately classified as low growth, with 80 percent probability). A second threshold effect occurs at an inflation rate of 9 percent per year. Countries with more than 9 percent annual inflation have a conditional probability of experiencing high growth of 41 percent, whereas countries with lower than 9 percent inflation have a conditional probability of 55 percent.²¹

What can we conclude for the BRO countries? According to the official data, investment rates in most BRO countries are generally quite high. Indeed, so much so, that most of the data should be treated with a healthy dose of skepticism. But assuming that these countries pass the investment hurdle, the analysis above suggests that sustained output growth above 2 percent per year (the median growth rate in the data set)—other than perhaps some initial rebound from currently very low output levels—will likely require inflation rates in the

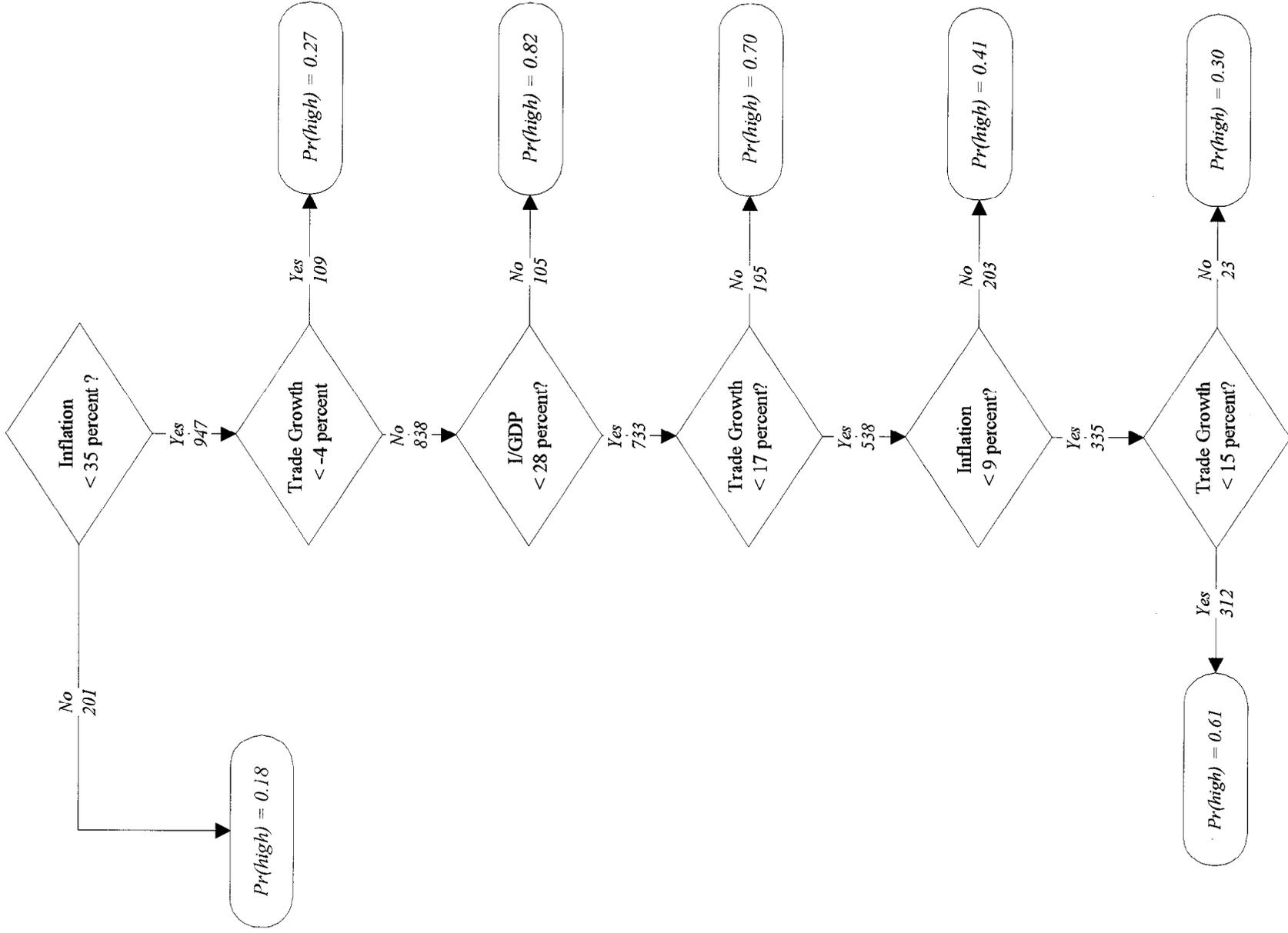
¹⁹Since investment may depend upon inflation, it is important to check the robustness of the results when investment is dropped from the list of potential independent variables. Doing so makes trade growth the first rule (countries with trade growth below -5 percent are classified as low output growth with 75 percent probability), but again inflation determines the second branch: countries with less than 9 percent inflation are classified as high growth, with 60 percent probability.

²⁰For most countries, the data start in 1992.

²¹The fit of the model may be assessed by the percentage of misclassifications. A total of 366 out of 1,148 observations are misclassified, so that about 70 percent of the observations are classified *correctly*.

order of about 10 percent per year. One advantage that the BRO countries do have, is their openness to international trade—a factor identified as being associated with high output growth, even in countries with greater than 10 percent inflation.

Chart 6: Explaining GDP Growth (Full Sample)



IV. CONCLUSIONS

The amount of seignorage collected, and the possible impact on growth, are perhaps the two most important considerations in deciding an appropriate inflation target. There are other considerations as well.

First, most transition economies—especially at the outset of the transition process—have undervalued real exchange rates. There are few direct measures of such undervaluation, but certain indicators—such as dollar wages—suggest that the undervaluation may be severe.²² The equilibrium real appreciation can, of course, be achieved either through higher inflation or through an appreciation of the nominal exchange rate. The political economy of exchange rate policy, however, makes the latter course less likely. A nominal exchange rate appreciation affects exporters directly, whereas imports will typically be a small fraction of the consumption bundle (or total inputs). Not surprisingly, the exporting and import-competing sectors will lobby harder against a nominal appreciation than the rest of the economy will lobby for it. While this may not be a good argument for higher inflation, it may well be a relevant one.

Second, many transition economies—and some non-transition economies—still have administratively set prices for key consumption items (heat, communal services, fuels) which need to be raised. Indeed, for the reasons discussed in Scacciavillani (1994), such price increases are likely to continue even when “100 percent” cost-recovery has been achieved. Such administered price changes may need to partially be (at least) accommodated in higher inflation targets.²³

Third, nominal wage indexation may make it difficult to lower inflation rates rapidly. This appears to be less of an issue in most transition economies (although Coorey et al. (1996) find that nominal wage increases help explain inflation), not least because—regardless of any formal indexation mechanism—in many of these countries there is a large discretionary element of the wage packet (paid in kind) or wages are simply in arrears.

Many of the transition economies have been able to reduce inflation to “moderate” levels over the past year or two. With significant real output declines since the start of the reform process, it is not surprising that—in many of these countries—the political will to bring inflation down further is weakening. There is thus the real possibility that these countries will continue with high—but not critically high—inflation rates for several years to come.

²²The reasons for this undervaluation are well-known; see Richards and Tersman (1995), and De Masi and Koen (1995). Richards and Tersman also argue that a further real appreciation may be expected because of Balassa-Samuelson reasons.

²³See Coorey, Mecangi, and Offerdal (1996) for a discussion.

The analysis presented here suggests that inflation rates much above 10 percent per year may not be innocuous. First, these countries have suffered severe de-monetization of their economies, and evidence from other countries suggests that re-monetization requires a low inflation environment. While monetization of the economy is not a goal in itself, it is typically associated with intermediation by the financial system and the efficient channeling of resources for investment and growth. Second, there is mounting evidence that low and stable inflation is an important ingredient in sustained output growth. Naturally, there are exceptions to this rule—typically countries that are particularly open or that have been able to sustain export growth. Conversely, there are arguments—some peculiar to the transition economies—for higher inflation. Given the costs of inflation, however, they may be less than fully compelling.

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