Skiki vono ko shtuvalo?
The Seignorage Loss from Monetary Stabilization in Ukraine

by

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Working Paper No. 196

July 1997

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After the dissolution of the Soviet Union, many of the transition economies experienced significant rates of monetary expansion and associated inflation in the general price level. In the Ukraine, for example, inflation--as measured by either the consumer price index or the wholesale price index--climbed as high as 75% and 133% *a month* during the most inflationary periods. One reason for the high rates of inflation can be found in a relatively undeveloped tax infrastructure (in the face of significant budgetary stress) and a newly established authority for monetary policy, which, together, induced the government to resort to money creation to generate seignorage revenue.

The classical studies of the revenue from money creation, as in Cagan (1956) are, for the most part, static in nature and analyze different *steady state* monetary policies, inflation rates, and levels of seignorage revenue. In such models, the monetary authorities typically face a trade-off between a permanently higher rate of money growth--generating higher seignorage--and the associated inflation and lower level of demand for real cash balances--generating lower seignorage. The revenue maximizing growth rate of money growth occurs where, on the margin, the seignorage gains from higher money growth are just matched by the losses arising from inflation and lower real balances.

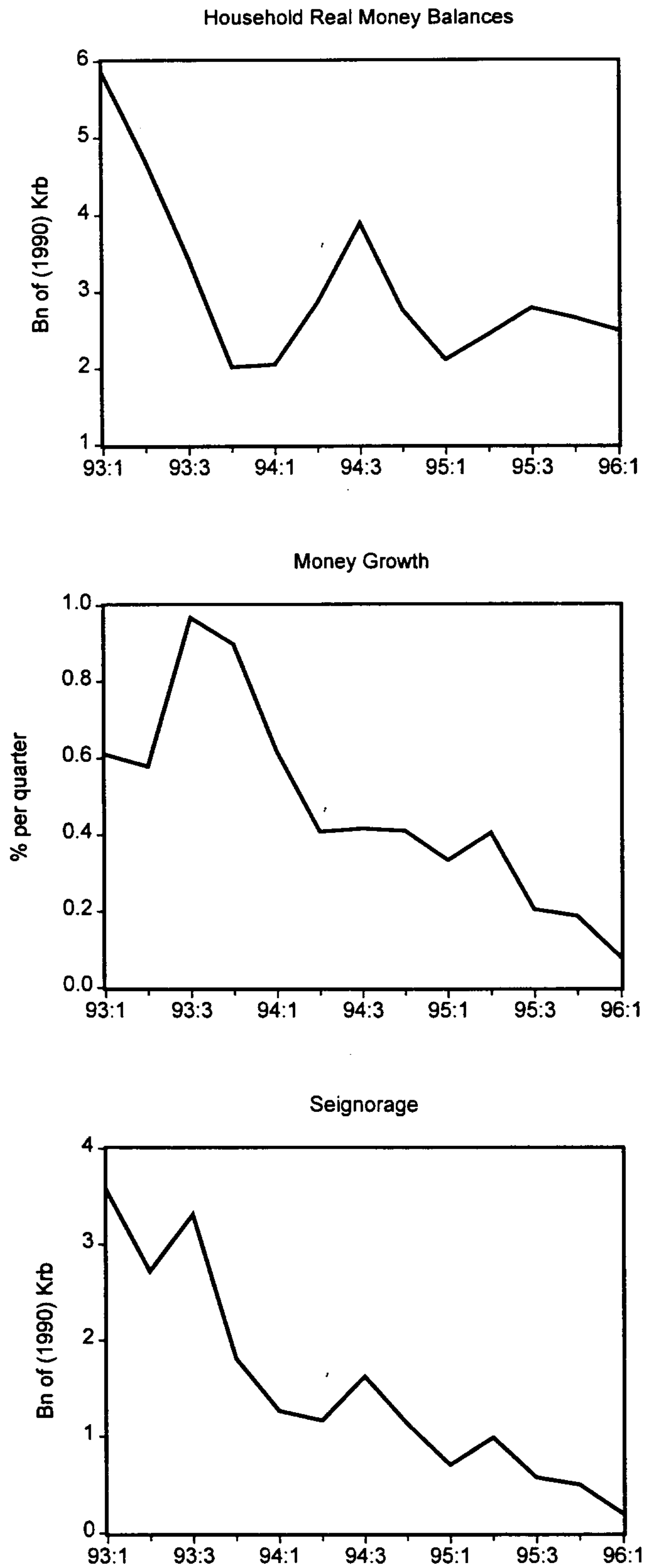
Here, we take a slightly different view of the seignorage process. Much empirical research--summarized and discussed, for example, in McCallum (1989) has established the validity of a *stock adjustment* model of money demand. In this setting, an exogenous shock--say a change in expected inflation--induces a gradual portfolio adjustment and a sluggish alteration in the demand for real money balances. The seignorage gain or loss associated with higher inflation then evolves slowly over time. Thus, the typical steady-state calculations may give a distorted view of the seignorage gains or losses which may actually occur.

In the present paper, we use quarterly data for the Ukrainian economy to estimate a stock adjustment money demand function in order to answer two important questions of monetary policy, namely

- What is the revenue maximizing rate of money growth in the short run and the long run?
- What is the seignorage loss due to monetary stabilization *per se*?

As can be seen in Figure 1, seignorage declined precipitously--from approximately 3.5 billion (constant 1990) karbovanets in the first quarter of 1993 to around .2 billion karbovanets in the first

Figure 1


Household Real Money Balances
Bn of (1990) Krb
6
5
4
3
2
1
93:1
93:3
94:1
94:3
95:1
95:3
96:1
Money Growth
% per quarter
1.0
0.8
0.6
0.4
0.2
0.0
93:1
93:3
94:1
94:3
95:1
95:3
96:1
Seignorage
Bn of (1990) Krb
4
3
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0
93:1
93:3
94:1
94:3
95:1
95:3
96:1

quarter of 1996. During the same time period, the level of household real money balances fell from nearly 6 billion karbovanets to around 2.5 billion karbovanets, while the rate of money growth dropped from a high of nearly 100 percent per quarter to less than 10 percent per quarter. This paper attempts to answer the following fundamental question of monetary policy and public finance: *of the total decline in seignorage since the peak value in 1993, what portion can be attributed to reduced money growth--the monetary stabilization--as opposed to other factors such as the persistent drop in real economic activity--the output decline?*

While the subsequent analysis focusses on the (presumed) loss in seignorage, we emphasize that the monetary stabilization has *without doubt* produced significant benefits to the Ukrainian economy--benefits in the form of a reduction in ill-advised policies aimed at controlling inflation (*e.g.*, price controls and subsidies), fewer relative price distrotions, and a more stable currency--all of which can be expected, over time, to have a positive influence on economic performance.

I. Money Demand

We propose to estimate the following stock adjsutment model of the demand for real money balances:

$$m_t - p_t = a_0 + a_1 \cdot t + a_2 \cdot (m_{t-1} - p_{t-1}) + a_3 \cdot \pi_t + a_4 \cdot y_t \tag{1}$$

where m = logarithm of nominal money demand, p = logarithm of the price level, t = time, π = expected inflation, and y = logarithm of real output. In order to assure consistency in the timing of nominal money balances (a stock variable measured at the end-of-period) with the price level (a flow variable measured as an average within-period), the nominal money balances series as employed in equation (1) is computed as the geometric average of end-of-period nominal money balances

$$m_t = \frac{(m_t^* - m_{t-1}^*)}{2}$$

where m^* = logarithm of end of period nominal money balances. We expect, on conceptual grounds and on the basis of previous empirical work, a negative time trend (capturing improvements in payments technology), a gradual adjustment in money demand, a negative effect of inflation (a measure of the opportunity cost of holding cash balances), and a positive effect of real output (a proxy for transactions) on the demand for money. Thus, we anticipate that the estimated coefficient values will take on the signs

$$a_1 < 0 \quad 0 < a_2 < 1 \quad a_3 < 0 \quad a_4 > 0.$$

The data set employed in the estimation of the money demand function in equation (1) consists of quarterly observations over the period 1992 to 1996. Unfortunately, the data series are quite short, with (at most!) sixteen observations. Note, however, that the estimation of money demand functions with a compact data set is hardly without precendent; Gujarati (1968) estimates a money demand function of the form given in equation (1) with seventeen observations. Also, the data are of dubious quality, given the measurement problems inherent in the transition economies with, for example, significant shares of income-generating activity taking place in the informal sector. These two considerations may make us pessimistic about obtaining accurate coefficient estimates. However, it is also the case that in this short period of time, significant monetary changes have occurred which, in turn, implies that other influences on money demand--captured by the error term in the money demand function--is likely to be of relatively minor importance. Also, there are a number of series that can be used for each of the variables in the money demand function, which allows a robustness check on the results. These latter two considerations, then, give some reason for optimism about acquiring good parameter estimates.

Consider, to begin, the estimation of equation (1) using M2, the consumer price index, and real gross domestic product, respectively, as the empirical measures of nominal money, prices, and output. M2, obtained from the National Bank of Ukraine *Bulletin*, is measured net of foreign currency time deposits, while the consumer price index and real gross domestic product are gathered from the Ministry of Economy of Ukraine *Ukrainian Economic Trends*. Table 1 presents coefficient estimates obtained from various estimation procedures: ordinary least squares (OLS) and weighted least squares (WLS), two stage least squares (2SLS), and weighted two stage least squares (W2SLS)--in (log) levels and in first-differences.

In general, the coefficient estimates accord with our basic specification for money demand. In all equations, with the possible exception of the time trend, the coefficients are of the expected sign and of reasonable magnitude. There is evidence of a negative time trend and gradual adjustment in real money demand, as well as a negative effect of inflation (as the opportunity cost of holding money) and a positive effect of real output (as a transactions demand for holding money). Furthermore, the coefficient estimates are quite robust to estimation method.

As stated above, the estimates in Table 1 pertain to a broad measure of real money balances, namely M2 (net of foreign currency time deposits). It should be recognized, however, that a substantial portion of these money balances are held by state enterprises which, in the context of calculating seignorage--our ultimate concern--should be subtracted from the broad measure of money. Specifically, money created by the government which, in turn, is held by government enterprises does not represent a claim on economic output and, thereby, should not be seen as a source of revenue. As stated by Havrylyshyn, Miller, and Perraudin (1994), the state cannot generate tax

Table 1
Money Demand
[Total M2 *net* of Foreign Deposits]

	OLS/WLS		2SLS/W2SLS	
	Level	Difference	Level	Difference
a_0	-1.07 (.70/.57)	—	-.95 (1.71/1.38)	—
a_1	-.02 (.01/.01)	.01 (.03/.02)	-.03 (.03/.02)	.01 (.07/.03)
a_2	.49 (.16/.13)	.56 (.16/.13)	.53 (.33/.26)	.39 (.20/.17)
a_3	-.53 (.10/.08)	-.59 (.10/.09)	-.68 (.35/.28)	-.46 (.13/.11)
a_4	.91 (.30/.24)	1.15 (.24/.20)	.89 (.67/.53)	1.38 (.29/.24)
R^2	.99	.91	.98	.90
SER	.08	.08	.09	.09
DW	1.50	1.64	1.43	1.64

Note: standard errors, in parentheses, relate to unweighted and weighted regressions respectively. 2SLS/W2SLS estimates use (twice) lagged inflation, money growth, and real money balances as instruments for contemporaneous inflation.

revenue by "taxing itself."

Accordingly, we narrow the definition of real money to exclude, as far as possible, the real money balances held by state enterprises. We define household money balances as the sum of total currency and household (domestic currency) deposits. Total currency is used because a decomposition of currency holding by households and enterprises is not available. Household deposits are calculated by multiplying total (domestic currency) deposits by the share of households in deposits (see *Ukrainian Economic Trends*).

Table 2 contains estimates of the coefficients of the demand function for household real cash balances. As in Table 1, the coefficients all carry the correct theoretical signs and are of reasonable size. A comparison with the estimates in Table 1 indicates that the only economically meaningful difference is a reduced magnitude of the elasticity of money demand with respect to real output.

In sum, the estimates of the coefficients of the Ukrainian demand for money are found to be theoretically consistent and fairly robust to alternative measures of money as well as to estimation procedure. Nevertheless, it is important to point out that the particular point estimates are different (in an economic sense) from point estimates found elsewhere in the literature. Specifically, comparing the results obtained here to results for an identical money demand function[1] for the United States estimated by Ghosh and Masson (1991), we may conclude:

- the elasticity of current real money balances with respect to lagged real balances is relatively small (*e.g.,* .39 to .56 as opposed to .68 for the United States);
- the elasticity of real money balances with respect to inflation is relatively small (*e.g.*, .46 to .68 as opposed to 1.39 for the United States); and
- the elasticity of real money balances with respect to real output is relatively high (*e.g.*, .39 to 1.38 as opposed to .184 for the United States).

As discussed below, these conclusions carry some rather trong implications for monetary policy in Ukraine.

II. Seignorage

The level of seignorage--or the revenue from money creation--is given by:

[1]Apart from the absence of a time trend.

Table 2
Money Demand
[Household Balances]

	OLS/WLS		2SLS/W2SLS	
	Level	Difference	Level	Difference
a_0	.02 (.33/.08)	—	-.09 (.49/.24)	—
a_1	-.03 (.01/.01)	-.02 (.02/.01)	-.03 (.01/.01)	-.02 (.02/.01)
a_2	.49 (.05/.04)	.51 (.07/.06)	.54 (.10/.08)	.55 (.09/.07)
a_3	-.63 (.03/.03)	-.63 (.04/.03)	-.67 (.12/.09)	-.64 (.05/.04)
a_4	.41 (.11/.09)	.48 (.14/.11)	.39 (.15/.12)	.43 (.15/.12)
R^2	.99	.97	.98	.97
SER	.03	.04	.04	.05
DW	2.00	2.45	1.99	2.49

Note: standard errors, in parentheses, relate to unweighted and weighted regressions respectively. 2SLS/W2SLS estimates use (twice) lagged inflation, money growth, and real money balances as instruments for contemporaneous inflation.

$$S_t = \mu_t \cdot exp(m_t - p_t) \tag{2}$$

where S = real seignorage and μ= geometric rate of money growth. Substitution of equation (1) into equation (2) then yields:

$$S_t = \mu_t \cdot exp(a_0 + a_1 \cdot t + a_2 \cdot (m_{t-1} - p_{t-1}) + a_3 \cdot \pi_t + a_4 \cdot y_t) \tag{3}$$

which can be seen to allow a decomposition of movements in seignorage which result from changes in money growth, technological improvement in payments procedures, gradual adjustment in real balances, movements in inflation, and fluctuations in real output. Of course, on theoretical and empirical grounds we expect some of these variables to be related to one another--such as money growth and inflation--and these relationships need to be taken into account in discussing the influence of these various factors on seignorage.

Figure 2 displays the actual time series for the (log) level of household real cash balances and seignorage along with the fitted versions of equations (1) and (2) using the coefficients from the 2SLS/W2SLS estimates in Table 2, namely

$$a_0 =.09 \quad a_1 = -.03 \quad a_2 =.54 \quad a_3 = -.67 \quad a_4 =.39.$$

We note, in passing, that the use of the coefficient estimates obtained by other methods in Table 2 would lead to nearly identical policy conclusions.

As can be seen from the figure, actual (and fitted) household real cash balances contracted significantly during 1993, from 5.83 billion karbovanets in the first quarter of 1993 to 2.02 billion karbovanets in the fourth quarter of 1993, and since that time, with some fluctuation, has averaged approximately 2.67 billion karbovanets. The stabilization of the level of real cash balances during the 1994-1996 period can be seen as resulting from various offsetting forces. Improvements in payments technology, gradual adjustment of actual to long run, desired cash balances, and persistently contracting real output have all led to a fall in real money demand, while monetary stabilization and reduced inflation has led to a rise in real money demand; evidently, the net effect of all these forces has been to leave the level of real cash balances at a level of around 2.67 karbovanets.

Actual and fitted seignorage, on the other hand, has fallen throughout the period from 1993 to 1996, from a value of 3.56 billion karbovanets in the first quarter 1993 to .20 billion karbovanets in the first quarter of 1996. During 1993, the drop in seignorage might be thought to be a result of a drop in *both* money growth and real balances, while during the period 1994 to 1996 it must be seen as due to a reduced rate of monetary expansion alone. Implicit in this statement, however, is an assumption that the actual rate of money growth and inflation were below their respective revenue maximizing rates--so that a reduction in money growth would, indeed, lower seignorage--a point to which we now turn.

III. The Revenue Maximizing Rate of Money Growth in Ukraine

Table 3 presents estimates of the revenue maximizing rate of money growth in in the long run (after a full adjustment of money demand to its steady state growth path) and in the short run (taking as given the current level of real money balances). The long run revenue maximizing rate of money growth, μ^L, is given by the simple expression

$$\mu^L = -\left(\frac{1 - a_2}{a_3}\right).$$

The short run revenue maximizing rate of money growth, μ^S, is more complicated since in the short run--as opposed to the long run--the impact of a change in money growth on inflation is not one-to-one. Thus, we need to determine the short run relationship between money growth and inflation given the model of money demand in equation (1). To this end, take (first) differences of the money demand function to obtain

$$\mu_t - \pi_t = a_1 + a_2 \cdot (\mu_{t-1} - \pi_{t-1}) + a_3 \cdot (\pi_t - \pi_{t-1}) + a_4 \cdot \gamma_t \tag{4}$$

where γ = growth rate of real output. Then, solving for the contemporaneous inflation rate yields

$$\pi_t = \frac{-a_1 + \mu_t - a_2 \cdot \mu_{t-1} + (a_2 + a_3) \cdot \pi_{t-1} - a_4 \cdot \gamma_t}{(1 + a_3)}. \tag{5}$$

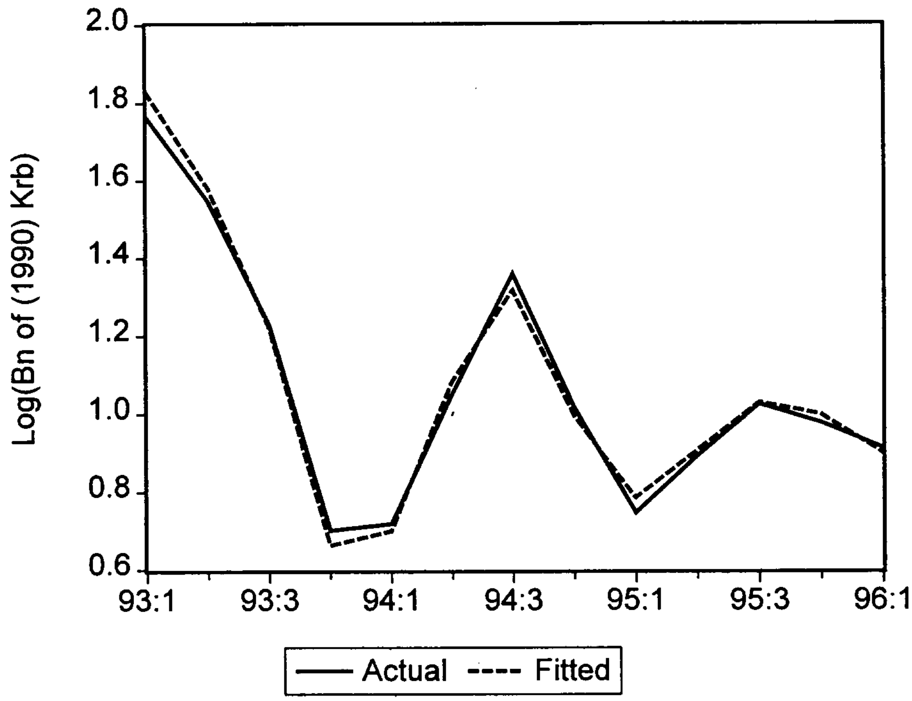
At a point in time, the effect of money growth on inflation is then

$$\frac{\partial \pi_t}{\partial \mu_t} = \frac{1}{1 + a_3}$$

so that the short run revenue maximizing rate of money growth is

Figure 2

Household Real Money Balances



Seignorage

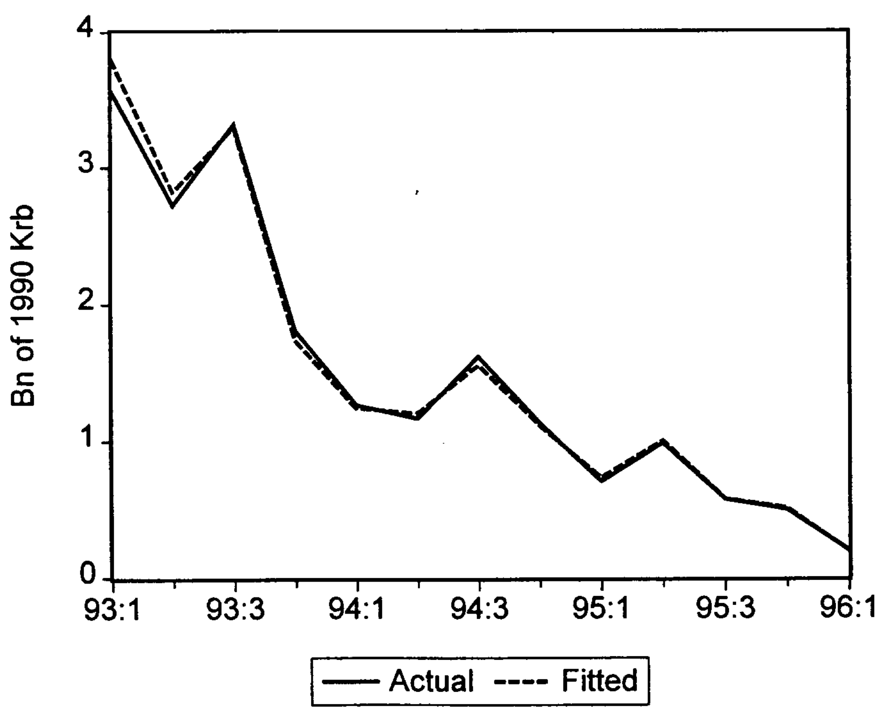


Table 3
Revenue Maximizing Money Growth Rates
[% per quarter]

	OLS/WLS		2SLS/W2SLS	
	Level	Difference	Level	Difference
μ^L	81	78	69	70
μ^S	59	59	49	56

$$\mu^S = -\left(\frac{1 + a_3}{a_3}\right).$$

As can be seen in Table 3, the long run and short run revenue maximizing rates of money growth are similar in magnitude, running between 69 and 81 percent per quarter for the long run and 49 and 59 percent per quarter for the short run. Perhaps surprisingly--at least at first glance--the long run revenue maximizing money growth rates exceed the respective short run rates. As it turns out, this is because in the particular system--given the parameter estimates presented in Table 2--changes in the money growth rate cause the inflation rate to "overshoot" its long run equilibrium value. Consequently, a permanent x percent increase in money growth causes a short run increase in inflation in excess of x percent which, in turn, reduces the short run demand for real balances by more than in the long run. Thus, to maximize revenue it is necessary to set a lower money growth rate in the short run than in the long run.

IV. Skiki vono ko shtuvalo?

We now turn to the question of the cost--in foregone seignorage revenue--of the monetary stabilization. Clearly--on conceptual grounds--it is inappropriate to attribute *all* of the drop in seignorage to the reduced rate of monetary expansion. First, the trend rate of growth of money demand has been estimated to be negative. Second, real output and, thereby, the transactions demand for money, has fallen thoughout the period. Third, the rate of money growth in the third and fourth quarters of 1993 was substantial higher--at 97 and 90 percent per quarter, respectively--than our estimates of the revenue maximizing rates of money growth (in both the short and long run). Thus, a portion of the drop in money growth--from, say 90 to 97 percent to 49 to 59 percent (in the short run) and 69 to 81percent (in the long run)--can be associated with an *increase* rather than a *decrease* in seignorage.

So, what was the true cost of the monetary stabilization? To answer this question, we compare the *actual* time path of seignorage, S, to a hypothetical, *constant money growth* time path for seignorage, S^c, where the latter is based on the realized money growth rate of 97 percent in the third quarter of 1993. The *seignorage loss to monetary stabilization, L,* is then

$$L = S^c - S.$$

The computation of the constant money growth time path for seignorage requires three steps:

- the computation of the *constant money growth inflation rate*--what the inflation rate would have been if money growth had remained constant at its highest value--in the thrid quarter of 1993--of 97 percent;

- the use of this hypothetical inflation rate for the computation of the *constant money growth level of real household real money balances*; and,finally
- the computation of the *constant money growth level of seignorage*..

In general, we have seen that the constant money growth inflation rate is given by

$$\pi_t^c = \frac{-a_1 + \mu_t - a_2 \cdot \mu_{t-1} + (a_2 + a_3) \cdot \pi_{t-1} - a_4 \cdot \gamma_t}{(1 + a_3)}$$

where now we hold fixed money growth at 97 percent per quarter ($\mu_t = \mu_{t-1} = .97$) and we make use of the level 2SLS estimates for the coefficients of the money demand function. This yields

$$\pi_t^c = .77 - .28 \cdot \pi_{t-1}^c - .85 \cdot \gamma_t.$$

The top panel of Figure 3 shows the actual and constant money growth rates of inflation for the period from 1993.3 to 1996.1. The constant money growth inflation rate begins to diverge from the actual inflation rate in the first quarter of 1994--by some 50 percentage points. In the third quarter of 1994, the divergence reaches some 80 percentage points, and, by the first quarter of 1996 it attains a full 100 percent.

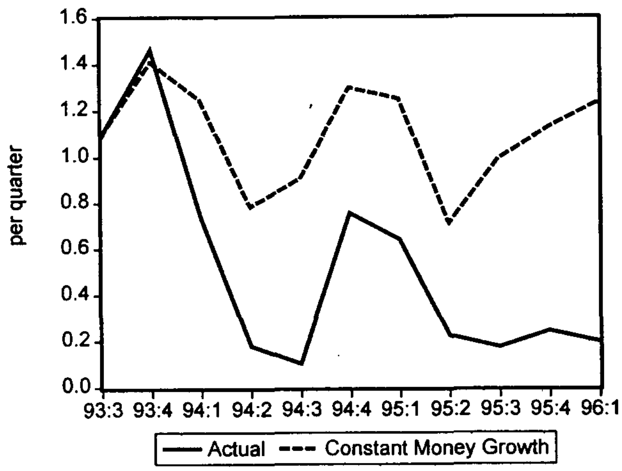
The associated constant money growth level of real household money balances, expressed in logarithms, is given by

$$(m_t - p_t)^c = .09 - .03 \cdot t + .54 \cdot (m_{t-1} - p_{t-1})^c + a_3 \cdot \pi_t^c + .39 \cdot y_t$$

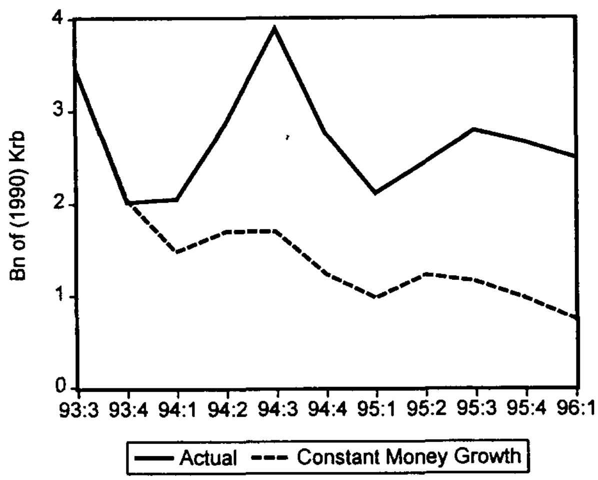
where once again the level 2SLS estimates have been used to parameterize the money demand function. The middle panel of Figure 3 shows the actual and constant money growth paths for the level of real household money balances. Evidently, the higher rate of inflation which would have arisen had money growth beeen held fixed at 97 percent leads to a marked reduction in real money balances. Specifically, by the first quarter of 1996, the level of real cash balances would have been .74 billion karbovanets as opposed to the actual level of 2.49 billion karbovanets.

Figure3

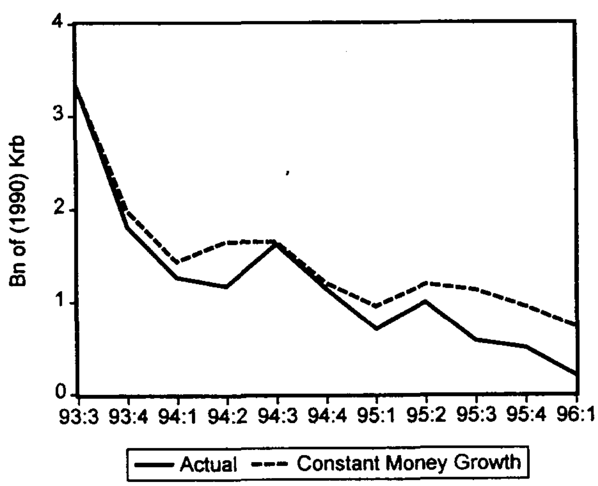
Inflation



Household Real Money Balances



Seignorage



Thus, while the reduced actual rate of money growth would have directly lowered the revenue from money creation, it also had the advantageous effect of inducing a lower actual inflation rate and, thereby, supporting a higher actual level of household real money balances. This latter effect indirectly raised the revenue from money creation. The net effect on seignorage is obtained from the constant money growth level of seignorage, given by

$$S_t^c = .97 \cdot exp((m_t - p_t)^c) = .97 \cdot exp(.09 - .03 \cdot t + .54 \cdot (m_{t-1} - p_{t-1})^c + a_3 \cdot \pi_t^c + .39 \cdot y_t).$$

The bottom panel of Figure 3 compares the constant money growth and actual levels of seignorage. As is clear from the figure, the constant money growth level of seignorage is higher in every quarter from the end of 1994 to the beginning of 1996.

What is (to the present author) somewhat surprising, however, is the relatively small magnitude of the cost--in terms of foregone seignorage--of monetary stabilization. Figure 4 depicts the quarterly loss in seignorage income as a percentage of gross domestic output. On average, the loss in seignorage amounted to approximately 1.85 percent of output and, at certain times--such as the third and fourth quarters of 1994--was well below 1 percent of output.

Figure 5 underlines the previous point by decomposing the sources of the loss in seignorage over the period from 1993 to 1996 into a loss due to monetary stabilization and due to other sources--a downward trend and gradual adjustment in money demand as well as the output decline. Vividly, the seignorage loss due to monetary stabilization is overwhelmed by the loss due to the other sources--by the first quarter of 1996, of the total loss in seignorage of some 12 percent of output, only 4 percent is due to monetary stabilization and 8 percent to other forces.

It might be argued that the result of a low cost of monetary stabilization is due to (at least) three inappropriate assumptions: *(i)* the particular point estimates chosen for the specification of money demand; *(ii)* the choice of the benchmark period (the third quarter of 1993) and associated money growth rate (97 percent); and *(iii)* the (implicit) assumption that there are no real effects of monetary stabilization (other than the impact on the demand for real money balances). The first argument turns out to be without merit. Specifically, a review of the results in Tables 1 and 2 suggests, and calculations confirm, the robustness of the basic conclusion of a relatively small cost of monetary stabilization. The second argument has some validity. Since the chosen constant money growth rate of 97 percent lies above the revenue maximizing money growth rate (for all estimates, for the short and long run), the constant money growth level of seignorage is lower than if a constant money growth rate of 50 to 60 percent had been chosen. This, in turn, implies that the foregone seignorage attributed to monetary stabilization has been lower than it *might* have been had the National Bank of Ukraine chosen to maintain money growth in the range which would have maximized the revenue from money creation. Finally, the third argument is no doubt strictly correct--a monetary policy which reduces money growth from a near triple digit range to a near single digit range in the span

Figure 4

Monetary Stabilization and Seignorage Loss

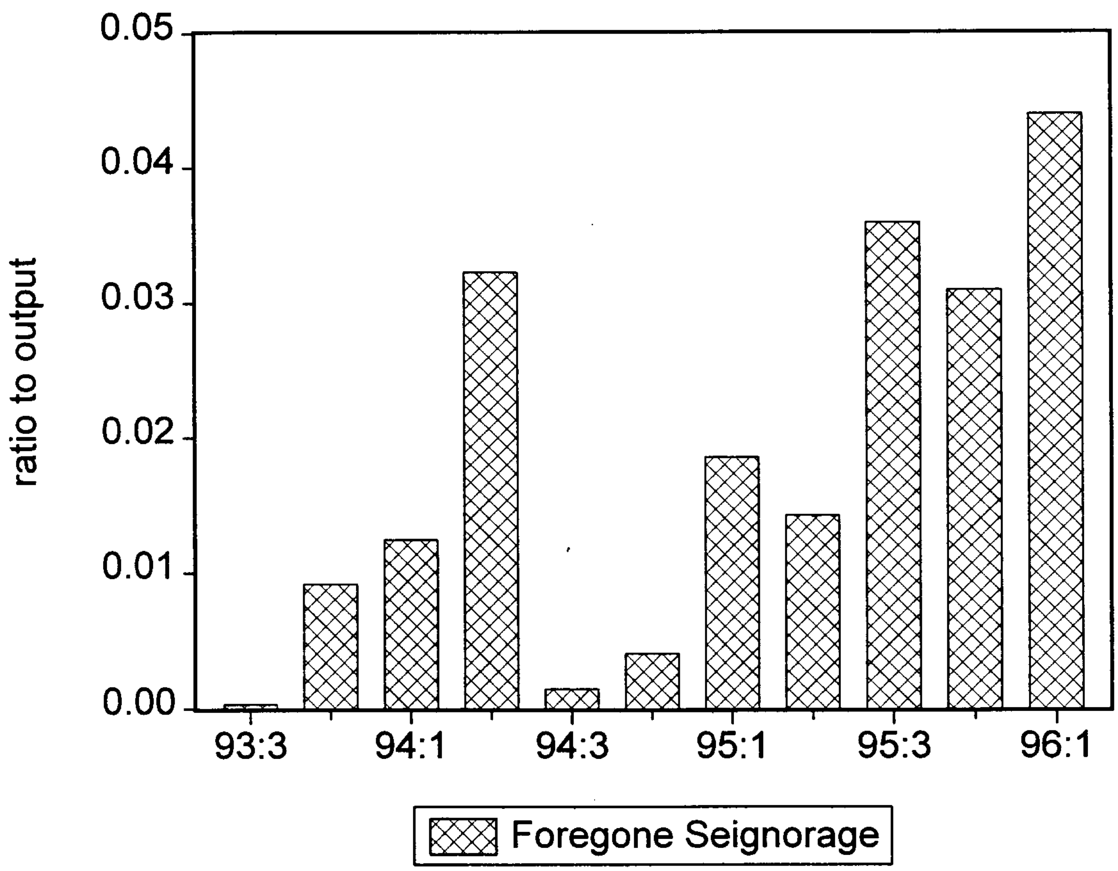
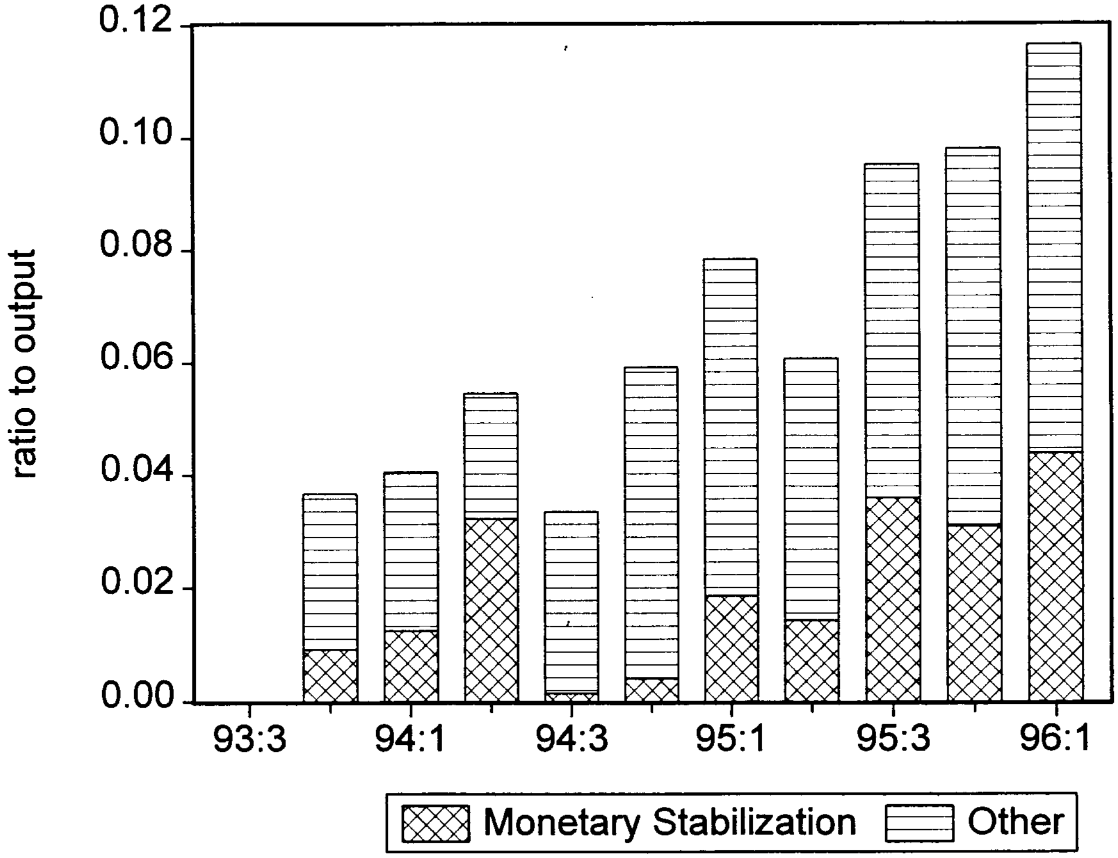


Figure 5

Sources of Seignorage Loss



of three years no doubt had some disruptive effect on the path of real output. However, it is rather traditional to ignore these sorts of effects in studies of the revenue from money creation (see, for example, the discussion in Barro (1991)). Also, what real effects might have occurred could have gone in either direction--for example, increased unemployment and lost output due to the initial shock versus increased investment and output gains due to higher confidence in the currency.

V. Conclusion

This paper has employed data from the monetary stabilization period in Ukraine--from the latter half of 1993 to the beginning of 1996--to investigate the costs of disinflation in terms of foregone seignorage revenue. The basic model is one in which

- the household demand for real money balances is of a stock adjustment form, so that there is gradual adjustement of money demand to reduced money growth and disinflation; and

- there are assumed to be no real effects of reduced money growth and inflation (aside from an impact on the level of real money)--at least during the period of time under study.

The basic result of the paper is that the cost of monetary stabilization *per se*--measured in terms of foregone revenue from money creation--was relatively small, averaging about 2 percent of gross domestic output (per quarter) and never climbing above 5 percent of output. Consequently, it would appear that the *benefits*from monetary stabilization--albeit rather difficult to isolate and no doubt rather long term in nature--are likely to match or even exceed the *costs* of such stabilization.

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