Currency Substitution during Hyperinflation in the Soviet Union 1922-1924[1]

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1. Introduction

The subject of currency substitution has enjoyed increasing interest during the last twenty years. Two reasons seem to be particularly responsible for this development.

At least since Hayek suggested that private currency competition might be useful as a means to eradicate inflation (Hayek 1975), many scholars have worked in this field (Selgin 1988). The proposal to introduce parallel currencies instead of a unified currency in the European Community is based on the same idea and has been supported by several authors (Vaubel 1978, Starbatty 1982, Bofinger 1985). To be successful, all these plans presuppose, firstly, flexible exchange rates or at least sufficiently wide bands around parities, for otherwise Gresham's law would work; and, secondly, that relatively small differences in the rates of inflation of different currencies are sufficient for the better money to drive out the bad. Thus a relatively high elasticity of substitution as a consequence of increasing differences of rates of inflation (or interest rates or expected changes of exchange rates) is assumed by these proposals, at least implicitly.

Secondly, currency substitution has been used to explain the instability of money demand functions observed since the introduction of flexible exchange rates in 1973 (McKinnon 1982). McKinnon has argued that national price levels and rates of inflation are determined

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mainly by world money and not by national money supply because national demands for money are strongly influenced by international interest differentials and expected changes of exchange rates. But the relationship thus assumed again presupposes a relatively high elasticity of currency substitution as a consequence of changes in these variables.

2. Models and Empirical Tests

Most authors employ for their empirical estimates of the elasticity of currency substitution customary money demand functions, in many cases together with additional assumptions. The latter become necessary since, in most cases, no data are available on the amount of the substituting money, because it is not issued by national monetary authorities, is not legal tender or because its use is illegal. It follows that most empirical work has to apply additional hypotheses to be able to estimate indirectly the extent of currency substitution. Some authors assume that exchange rates for the national currency are changed by currency substitution and that this change influences money demand. Thus, without including currency substitution, at least indirectly, as an explanatory factor, the money demand function would be unstable. Taking the exchange rate as an independent variable into the money demand function, stabilizes the latter by supposedly taking into account indirectly currency substitution (Fasano-Filho 1986, Baade and Nazmi 1989).

The hypothesis that changes in exchange rates can be interpreted as being caused by currency substitution, is, however, of doubtful validity. The literature criticizing it stresses that capital movements including capital flight rather than currency substitution may be mainly responsible for changes of exchange rates (Cuddington 1983, Willett 1987). This would mean that domestic interest-bearing assets (i.e. mainly assets denominated in domestic currency) would be substituted by foreign assets, but not foreign for domestic money.

Because of these and similar problems, direct estimates of the elasticity of currency substitution are preferable. Four papers trying

to do this may be mentioned. El Erian (1988) estimates an equation for Egypt which directly refers to currency substitution. Here the quotient of (legal) demand and savings deposits denominated in US$ to the sum of these deposits plus the corresponding deposits in national currency is taken as the dependent variable. Explanatory variables are the same variable lagged, the difference of domestic and foreign interest rates and the expected change of the exchange rate. The latter is operationalized by taking the difference between present black market and official market exchange rates. The coefficients estimated show the right signs and are significant except for the coefficient of the interest rate differential. R^2 is greater than 90%. An estimate for Yemen leads to similar results.

De Vries (1980) estimates an equation for the change of the quotient of Canadian to US$ notes in Canada and of guilder notes to US$ notes in the Dutch Antilles. He uses a microeconomic model in which the change of interest rates in both currencies and capital gains (or losses) because of changes of exchange rates are taken as explanatory variables. It turns out that the quotient of the interest rates in the two currencies is especially relevant for substitution.

A third paper by Neldner (1987) tries to estimate currency substitution directly for West Germany. But since no other figures are available, the quotient of short-term claims of non-bank firms to M_1 or to demand plus time deposits, respectively, is taken as an independent variable. Explanatory variables are foreign and domestic interest rates and the cost of holding money. To exclude income effects Slutsky elasticities of substitution are estimated.

Finally Canto and Nickelsburg provide a direct estimate for Argentina of the growth rate of real deposits in US$ as a proportion of the total real stock of money as an independent variable. As the explanatory variable, the rate of change of the exchange rate is used. Moreover, the costs of currency substitution in different regimes of exchange controls are taken into account by considering different time periods.

From this literature it seems to follow that the elasticity of currency substitution is rather low. To quote Neldner (1982, p. 640): "These

elasticities indicate the actual degree of currency substitution to be rather low". de Vries gets similar results (1988, p.512, Abstract) " ... we conclude that the elasticity of currency substitution is very small and negative".

This impression is supported by casual observations for times of high or hyperinflations. They show that rather high differences of the domestic rate compared to foreign rates of inflation are necessary to lead to a substantial or even complete substitution of the domestic money. On the other hand, in at least four such cases, a full removal of the domestic inflating money by the forces of substitution can be documented (see *Table 4*; Bernholz 1989). Still, at the end of the German hyperinflation in 1923, currency substitution had not completed its task in spite of monthly rates of inflation (wholesale price index) of 1162% in August and 2437% in September. Crude estimates put the amount of foreign curencies held in August at 2-3 billion gold marks. Moreover, about 1.1 billion gold marks of value stable emergency money seem to have been used before the currency reform of November 1923, whereas 80-800 million gold marks of the inflating money circulated during those last three months of the hyperinflation (Lansburgh 1929, Holtfrerich 1980). These observations and the estimates discussed above seem to show that currency substitution is of minor importance for small or moderate differences in rates of inflation and becomes only important at rather substantial differences.

3. The Soviet Hyperinflation and Currency Substitution

We have seen that the indirect estimation of currency substitution often used in the literature poses problems, since substitution is not measured directly and since, consequently, additional hypotheses have to be tested together with it, which are not beyond doubt.

But even the direct estimation of the elasticity of substitution has been confronted with the problem that mostly somewhat doubtful monetary aggregates had to be selected because no other data were

available. These problems suggest a look at the currency substitution which occurred in 1922-24 during the end of the Soviet hyperinflation for during this period the rouble currency was widely substituted by the *Chervonetz*, newly created at the end of 1922, and this at a flexible exchange rate between the two currencies. Also since this was the result of official policies, monthly data are available for the rouble and *chervonetz* note circulation, the rates of inflation as measured in both currencies and for the exchange rate between the two currencies. Thus we are able to get direct estimates of the elasticity of currency substitution, depending on the difference between the rates of inflation and the relative change of the exchange rate.

3.1 The Development of Hyperinflation and the Currency Reforms to End It

The Russian and later Soviet inflation and hyperinflation during and after World War I, follow the pattern well-known from other inflations. Growing budget deficits were financed mainly by money creation (Figs. 1a, 1b). As a consequence, the real stock of money, as measured by banknotes in circulation over the cost of living index, first increased during the beginning of inflation. With rising inflationary expectations and increasing flexibility of prices, the real money stock decreased steadily and dramatically (Figs. 2, 3). Finally, hyperinflation was reached (Figs. 4, 5), in which not only a misallocation of resources damaged the economy, but also a decrease in revenues from the inflation tax and from other taxes took place (Fig. 1a). The latter happened because of time-lags between the assessment, payment and expenditure of tax revenues (Olivera-Tanzi effect, Tanzi 1980). In the Soviet Union these negative consequences were strengthened by the "War Communism" of the civil war, by foreign military intervention and the war with Poland.

After the end of warfare in October 1920, (the peace treaty with Poland was signed in Riga on 18 March 1921) and the debacle of "War

Communism", it was decided in 1921 to return, to a certain extent, to capitalism with free markets in the "New Economic Policy". But such a policy also implied the need to begin with a stabilization of the currency.

The currency reform was undertaken in two steps. First the State Bank, founded in 1921, was empowered by decree of 11 October, 1922, to issue banknotes denominated from 1 to 50 *Chervonetz,* with one *Chervonetz* supposed to be equal to 10 pre-war gold roubles. A coverage of the new banknotes to the amount of 25% in precious metals and stable foreign exchange was prescribed. 75% of the banknote circulation had to be balanced by short-term assets and loans, which could be easily called back (Griziotti Kretschmann 1928). It is important to realize that the Treasury continued to issue the rapidly inflating ruble notes, since it was not able at that time to cover expenditures by ordinary taxes and non-inflationary borrowing. Note also that the exchange rate between the two currencies was, on the whole, freely determined in the market.

The second step of the currency reform was followed by the law on 6 February 1924. All rouble notes had to be exchanged into new "gold" roubles of 1924 (with 10 roubles = 1 *chervonetz*) until 10 March. 50,000 roubles of the 1923 issue were set equal for this exchange to one "gold" ruble. Because of two earlier conversions at the beginning and end of 1922 at 10,000:1 and 100:1 this meant a total devaluation of all pre-1921 rouble issues at a rate of 1:50 billion. By decree of 14 February 1924, the issue of old notes by the Treasury was ended. At the same time, an upper limit was set for the amount of new roubles below 10 roubles (= 1 *chervonetz*) which could be put into circulation.

The second reform ended hyperinflation at one stroke, though a moderate inflation remained. The real stock of money increased (Fig. 6). However, in March 1924, a crisis developed because of a shortage of token money and of rouble notes below 10 roubles. Following this the proportion of money in small denominations was increased. It rose from 20.4% of total currency circulation on 11 March to 32.4% on 1 May 1924.

3.2 Currency Substitution during the Last Year of Rouble Hyperinflation

Between the first and the second steps of the currency reform, the hyperinflation in terms of rouble notes issued by the Treasury went on. This was, however, not true in terms of *chervontsi* notes issued by the State Bank. Here only a relatively moderate inflation took place (see Table 1). As a consequence, the exchange rate of the *chervonetz* went up from 117 so-called Sovsnak-roubles in January 1923 to 500,000 in March 1924, when the second currency reform took place (Table 1, first column). Note that one *chervonetz* was equal to 10 new roubles of March 1924, and thus to 500,000 Sovsnak-roubles of 1923.

This development is not surprising if we look at the development of the amounts of *chervontsi* and of *sovsnaks* circulating (Table 2, first two columns). Apart from the more rapid increase of the *chervonetz* circulation in the months after the introduction of the new notes (until September 1923), the amount of rouble notes in circulation grew much more rapidly. The early stronger growth of the amount of *chervonetz* notes issued can be easily explained by currency substitution. People expected the *chervonetz* to be more stable than the rouble, which had totally lost its credibility, and the course of events justified these expectations. Of course, it is true that the positive expectation of the people was itself a factor in stabilizing the value of the *chervonetz*. Moreover, the resulting currency substitution lowered the real demand for roubles during these months (see column 3) and accelerated the inflation in terms of roubles. Taken together, this means that the demand for rouble notes declined because of inflation and of *chervonetz* substitution. We shall have to consider these causal relationships when trying to estimate relationships in the next section.

It is also important to point out that the total real stock of State Bank and Treasury notes and thus total real note demand increased (column 4) because of the lower rate of inflation as measured in *chervontsi*. The total real money stock grew from 11,753 million *chervontsi* in January 1922 to 36,535 in February 1924, whereas real rouble circulation declined from 11.397 to 6,508 million *chervontsi*. Still, the amount circulating was far below that of June 1914, with

255.35 million *chervontsi*. With the second step of the currency reform announced in February 1924, the real demand for rouble banknotes increased substantially.

4. Derivation of the Equation to be Estimated

We assume that total real demand for money is determined by

$$(1)\quad L^{\tau} = aY^{b}(1 + r + \pi^{*})^{-c}$$

where Y is real national income, r the real interest rate and π^{*} the rate of inflation as measured in the more stable money. a, b and c are constants. Note that total real money demand decreases with rising π^{*}. The real money demand for the less stable money is given by

$$(2)\quad L = g(1 + \pi - \pi^{*})^{-h} L^{\tau} \quad \text{with}$$

$$(3)\quad g(1 + \pi - \pi^{*})^{-h} \leq 100\%$$

Here π is the rate of inflation in terms of the less stable money, g ($0 \leq g \leq 1$) and h are constants. (2) and (3) imply that less of the relatively unstable money will be demanded with an increasing difference of the rates of inflation. It is important to realize that we assumed perfect foresight in (1) and (3) by setting expected rates of inflation equal to current rates.

The share of the real demand for the less stable money in total real money demand is given by

$$(4)\quad \frac{L}{L^{\tau}} = g(1 + \pi - \pi^{*})^{-h}$$

Finally, real supplies of the two currencies are given by M/P and M*/P*. Thus we get for total real supply M_r^{τ}:

$$(5)\quad M_r^{\tau} = \frac{M}{P} + \frac{M^{*}}{P^{*}},$$

where P and P* are the price levels expressed in the two currencies. Equating real money supplies with real demands we get from (4) and (5)

$$(6)\quad \frac{M/P}{M^*/P^* + M/P} = g(1 + \pi - \pi^*)^{-h}$$

Next we assume that

$$(7)\quad P = wP^*.$$

w is the exchange rate between the two currencies, P* and P are the price levels expressed in them. According to (7) we assume that the law of one price is valid for all goods in one country.

From (6) and (7) we derive

$$(8)\quad \frac{M/w}{M^* + M/w} = g\,(1 + \pi - \pi^*)^{-h}$$

Taking natural logarithms results in

$$(9)\quad \ln m = k - h \ln (1 + \pi - \pi^*)$$

with

$$m \equiv \frac{M/w}{M^* + M/w} \text{ and } k \equiv \ln g.$$

m is the share of the relatively less stable money in total money stock measured in terms of the more stable currency. Note that because of (3)

$$\ln m \leq \ln 100 = 4.60517$$

Also $m \geq 0$, so that

$$\ln m \geq -\infty.$$

(9) is one of the equations to be estimated in the next section.

5. Empirical Estimates

We have first to check, whether (7) is confirmed in the case of Soviet currency substitution, for it is well known that the relationship does not hold over extended periods between domestic and foreign currencies experiencing rather different rates of inflation (Bernholz 1982, Bernholz, Gärtner and Heri 1985).

Since the price level in *chervontsi* was initially determined by a legally fixed relationship, it is sufficient to show that the difference of the rates of inflation corresponds to the relative change of the exchange rate. Taking logarithms for (7) and differentiating with respect to time, it follows:

$$\frac{\dot{P}}{P} - \frac{\dot{P}^*}{P^*} = \frac{\dot{w}}{w}$$

$$(7a)\quad \frac{\dot{w}}{w} = \pi - \pi^*$$

We thus estimate the following equation

$$\frac{\dot{w}}{w} = A + B\,(\pi - \pi^*),$$

where we should get A = 0 and B = 1. Using the figures presented in Table 1, the result is as follows

$$(7b)\quad \frac{\dot{w}}{w} = \underset{(0.4734)}{6.2387} + \underset{(12.3467)}{0.8455}\,(\pi - \pi^*),$$

$$R^2 = 0.9214$$

with t-values in brackets. The result for A is not significantly different from zero, but that for B diverges significantly from 1. However, 0.8455 is sufficiently close to 1 that we can use (7). But to be on the safe side, we also estimate (9a) $\ln m = k - h \ln (1 + \frac{\dot{w}}{w})$ which we get by inserting (7a) into (9).

The relevant figures for the estimation of (9) can be calculated from Tables 1 and 2, i.e.,we take notes in circulation measured in terms of the *chervonetz* price level as M/w and M*. M are the Treasury and M* the State Bank notes. We exclude from our estimation March and April 1924 because price indices for the rouble inflation were no longer calculated for them. Without taking a lag we get:

$$(10)\ \ln mt = 6{,}5535 \ - \ 0.6950 \ln (1 + \pi_t - \pi_t^*)$$
$$(21.388)\ \ (-6.8717)$$
$$R^2 = 0.7974 \ \ DW = 2.0341$$

Introducing a lag increases R^2 substantially and leads to significant coefficients for the lagged and unlagged variables:

$$(11)\ \ln mt = 7.0718 \ - \ 0.5101 \ln (1 + \pi_t - \pi_t^*) - 0.3254 \ln (1 + \pi_{t-1} - \pi_{t-1}^*)$$
$$(28.240)\ \ (-4.7070) \qquad\qquad (-2.6393)$$
$$R^2 = 0.8759 \ \ DW = 1.3119$$

As a consequence, (11) should be preferred to (10).

We have now to take into account the hypothesis that currency substitution increases inflation in terms of the substituted currency, i.e., π. As a consequence, $1 + \pi + \pi^*$ should be negatively dependent on m. Estimating the respective equation only with lag, we derive the following result:

$$(12)\ \ln (1 + \pi_t - \pi_t^*) = 8.3128 \ - \ 1.1473 \ln m_{t-1}$$
$$(21.116)\ \ (-6.8717)$$
$$R^2 = 0.7974 \ \ DW = 2.5109$$

The result with lagged and unlagged m is as follows:

$$(13)\ \ln(1 + \pi_t - \pi_t^*) = 8.261 \ - \ 1.3621 \ln mt \ + 0.2185 \ln m_{t-1}$$
$$(19.303)\ (-1.9132) \qquad\qquad (0.2888)$$
$$R = 0.7864 \ \ DW = 2.5122$$

This result is worse than (12). This makes sense since the π_t's and π_t^*'s refer to the month before the date for which the m_t's are reported. We thus prefer equation (12) to (13), since R^2 in (12) is slightly higher, the significance of the coefficient of ln m_{t-1} in (12) greater than that of ln mt in (13) and since the coefficient of ln m_t in (13) is insignificant. An increase in the difference of the rates of inflation in the two currencies consequently decreases m_t at the beginning of the next month.

The interpretation of the results in (10) - (13) is in tune with the results of a Granger test. For, according to this, ln $(1 + \pi_t - \pi_t^*)$ is Granger caused by ln m_{t-1}, whereas ln mt is Granger caused by ln $(1 + \pi_{t-1} - \pi_{t-1}^*)$ (with a probability of 82%).

Let us next check our results by estimating (9a). We get:

$$(14)\quad \ln mt = 6.8294 - 0.7595 \ln\left(1 + \frac{\dot{w}}{w_t}\right)$$
$$\qquad\qquad (21.839)\ (-7.3756)$$
$$R^2 = 0.795 \quad DW = 1.5026$$

$$(15)\quad \ln mt = 7.1307 - 0.4951 \ln\left(1 + \frac{\dot{w}}{w_t}\right) - 0.3475 \ln\left(1 + \frac{\dot{w}}{w_{t-1}}\right)$$
$$\qquad\qquad (30.946)\ (-4.6762) \qquad\qquad (-3.5798)$$
$$R^2 = 0.8969 \quad DW = 1.2475$$

Estimating $\ln(1 + \frac{\dot{w}}{w})$ as dependent on ln m we derive

$$(16)\quad \ln\left(1 + \frac{\dot{w}}{w_t}\right) = 8.0010 - 1.0388 \ln m_{t-1}$$
$$\qquad\qquad (0.5584)\ (-6.2651)$$
$$R^2 = 0.7912 \quad DW = 1.9393$$

$$(17)\quad \ln\left(1 + \frac{\dot{w}}{w}\right) = 8.3127 - 1.3809 \ln m_t + 0.2261 \ln m_{t-1}$$
$$\qquad\qquad (26.068)\ (-3.2404) \qquad\qquad (0.5513)$$
$$R^2 = 0.8673 \quad DW = 2.1964$$

These results correspond closely to those obtained in (10)-(13).

In this case we have quite analogous reasons to prefer (15) to (14) and (16) to (17). It is true that R^2 is higher in (17) than in (16), but the coefficient of ln m_{t-1} in (17) is insignificant and m_t occurs later than $\frac{\dot{w}}{w_t}$. The Granger test supports this interpretation. ln $(1 + \frac{\dot{w}}{w_t})$ is Granger caused by ln m_{t-1} and ln mt by ln $(1 + \frac{\dot{w}}{w_{t-1}})$, but the latter only with 0.52 probability.

Until now we have neglected two problems. First, m should be smaller than 100% and thus ln m ≤ 4.60517. As can be seen from (10) and (14), this is, however, not true for small values of $\pi - \pi^*$ and $\dot{w}/w$. Secondly, we have mentioned that no smaller denominations of *chervontsi* were issued than one *chervonetz* banknotes which corresponded to ten pre-war gold roubles. As a consequence, currency substitution had to become the more difficult the further it proceeded. Also, in the beginning, the substitution may have been somewhat hindered by the fact that people were used to paying with rouble notes. To take these problems into account, we also estimate a logistic function. Consider

$$(18)\quad m = \frac{100}{1 + e^{r x^s}},$$

with $x \equiv \pi - \pi^*$ and $x \equiv \dot{w}/w$, respectively. By rearranging terms and by taking logarithms we get

$$\frac{100}{m} - 1 = e^{r x^s}$$

$$(19)\quad \ln\left(\frac{100}{m} - 1\right) = r + s \ln x.$$

Estimation of (19) results in

$$(20)\quad \ln\left(\frac{100}{m_t} - 1\right) = \underset{}{-6.7448} + \underset{(5.49)}{1.6295} \ln(\pi_t - \pi_t^*)$$
$$\qquad\qquad\qquad\qquad\quad (-7.264)$$

$R^2 = 0.7152 \quad DW = 1.486$

$$(21)\ \ln\left(\frac{100}{m_t} - 1\right) = \underset{(-8.2368)}{-7.5437} + \underset{(3.5729)}{1.3524}\ \ln(\pi_t - \pi_t^*) + \underset{(1.1549)}{0.4951}\ \ln(\pi_{t-1} - \pi_{t-1}^*)$$

$$R^2 = 0.746 \quad DW = 0.9631$$

$$(22)\ \ln\left(\frac{100}{m_t} - 1\right) = \underset{(-6.765)}{-6.9625} + \underset{(5.0295)}{1.6697}\ \ln\frac{\dot{w}}{w_t}$$

$$R^2 = 0.6437 \quad DW = 0.96$$

$$(23)\ \ln\left(\frac{100}{m_t} - 1\right) = \underset{(-8.8198)}{-7.8221} + \underset{(2.5009)}{0.9947}\ \ln\frac{\dot{w}}{w_t} + \underset{(2.4192)}{0.9032}\ \ln\frac{\dot{w}}{w_{t-1}}$$

$$R^2 = 0.7543 \quad DW = 0.5889$$

These results are clearly inferior to those estimated in (10), (11), and (14), (15). Also only (20) shows no auto-regression and will thus be used later on.

To better evaluate the meaning of (11) and (20) we calculate total elasticities of substitution for m as depending on $\pi - \pi^*$. As can be seen from Table 3, the absolute value of elasticities increases with the difference of the monthly rates of inflation. Also, the figures for m show that this difference must be rather high to lead to any substantial currency substitution. Even if it amounts to 20% monthly, only about 7.4% or 13.43% of the more inflating currency are substituted according to the two functions, respectively. With 30%, 33.1% or 23.1% are substituted. Note that the values for m for $\pi - \pi^*$ below 20% are much above the admissible 100% for the logarithmic function. Thus an extrapolation beyond the range estimated is clearly not permitted. The logistic function does not show this default by construction. From it we would guess that the elasticity of substitution is very low for differences of monthly rates of inflation below 10%. But, as we have seen, the quality of the results estimated for this function was worse. The above results correspond to qualitative evidence from other episodes of inflation. During recent hyperinflation in Bolivia in the

1980s, Bolivian observers interviewed by the author estimated that at a monthly rate of inflation of about 60% two thirds of circulation had been substituted by US dollars. Similarly, it was only at very high domestic rates of inflation that currency substitution became a dominant factor during the German hyperinflation of the 1920s (Holtfrerich 1980, Lansburgh 1924). On the other hand, we know that differences of annual rates of inflation up to 15% in the Europe of the seventies and eighties were not sufficient to lead to any sizable currency substitution.

6. Conclusions

Currency substitution played an important role during the last 26 months of the Soviet hyperinflation of the 1920s (equations 11 and 15). The *chervonetz*, introduced in late 1922, rapidly substituted for the quickly inflating rouble. And this happened in spite of the fact that the smallest denomination was one *chervonetz*, equal to 10 pre-war (gold) roubles. The process was reinforced by a positive feedback mechanism, since the currency substitution accelerated the rouble inflation (equations 12 and 16). When the rouble currency was finally stabilized and hyperinflation ended in March by the reforms announced in February 1924, the percentage of roubles in total banknote circulation had fallen to 17.81% (Table 2). Not surprisingly, because of the lack of small *chervonetz* denominations, it increased after stabilization to 32.4% in April and to 44.35% in September 1924.

On the other hand, our results concerning the elasticity of currency substitution in the Soviet Union seem to show that the elasticity of currency substitution is rather small absolutely for moderate differences of the rates of inflation provided that we are allowed to extrapolate from the range estimated. And this result would be quite in agreement with the results obtained by other researchers. The absolute value of the elasticity increases, however, with the difference in inflation rates and the changes in the exchange rate. Currency substitution seems thus to become an important factor during episodes of rather high or

hyperinflations. In fact, we know of at least four historical cases in which the bad money has been driven out totally by good money (Table 4). It has to be admitted again, however, that the range of our empirical estimates has been limited to hyperinflation. Thus the extension of our argument to low or moderate inflation differentials may not be warranted, though it seems to correspond to our qualitative knowledge concerning other inflationary episodes.

If the latter conclusions are accepted, then the following additional results would seem to follow:

a) The instability of money demand functions during times of low or moderate inflations with flexible exchange rates can be explained at best to a negligible extent by currency substitution. It is much more probable that international capital movements have had a much greater impact by influencing exchange and interest rates.

b) Currency competition between private and/or public banks with the right to issue notes at their own discretion will only moderately help to limit inflation, given flexible exchange rates among these currencies. This follows since currency substitution becomes important only with rather high differences in the respective rates of inflation.

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Appendix

Currency Substitution during Hyperinflation in the Soviet Union 1922-1924

TABLE 1

Date (First of Month)	Exchange Rate (Soviet 1923 Roubles per *Chervonetz*)	Index of Prices for 26 Commodities (Soviet Roubles, $1913=10^{-6}$) Moscow	Russia	Cost of Living (*Chervontsi*, 1913=100)
11,1922	100	12.533	11.50	125.52
12	117	15.9663	17.23	124.98
1,1923	175	20.75	21.02	124
2	209	25.114	27.78	128
3	239.5	31.106	31.1	134
4	302	37.697	39.26	132
5	457	54.387	54.74	122
5	570	78.718	77.55	141
7	760	127.09	121.87	155
8	1120	195.15	187.83	184
9	2000	369.15	330.27	176
10	4000	638	648.23	172
11	7000		1102	162
12	13700		2312	168
1,1924	30000		5450	182
2	82000		17000	199
3	300000			206
4	500000			208

TABLE 2 - Hyperinflation in the Soviet Union: Introduction of Chervonetz and Currency Reform, 1922-1924

Date	*Chervontsi* Banknotes in Circulation (Thousand *Chervontsi*)	Rouble Notes in Circulation (Million 1923 Roubles)	Rouble N tes: All Treasury Issues (Thousand *Chervontsi*)	Total Money in Circulation (Thousand *Chervontsi*)
		(First of Month)		
1,1923	356	1994	11397	11753
	855	2624	12701	13556
	1604	3239	13514	15118
	2567	4482	14844	17411
	3754	6076	13298	17052
	4748	7051	12371	17119
7,1923	7000	9032	11885	18885
	11120	12400	11122	22242
	16518	15136	8342	24860
	21403	22702	5700	27103
	23417	53593	8073	31490
	23607	98839	7714	31321
1,1924	24917	178510	6912	31829
	27297	333018	5304	32601
	30027	866504	6508	36535
	31010	768101	10267	41277
	30144	750236	14445	44589
	28660		18676	47336
7,1924	29864		19200	49064
	30129		22172	52301
	33137		25094	58231
	34650		27617	62267
				67600
				72100

Source: Katzenellenbaum (1925)

TABLE 3 - Total Elasticity (η) of Substitution Dependent on Difference of Monthly Rates of Inflation

$\pi - \pi^*$	Logarithmic Function (Coefficients of Equation 12)		Logistic Function (Coefficients of Equation 20)	
	m	η	m	η
1	600	-0.418	99.8	-0.002
5	264	-0.696	98.41	-0.026
10	159	-0.76	95.22	-0.078
20	92.6	-0.796	86.57	-0.219
30	66.9	-0.809	76.9	-0.376
60	38	-0.822	51.83	-0.785
100	24.9	-0.827	31.88	-1.11
150	17.8	-0.83	19.47	-1.312
200	14	-0.831	13.14	-1.415

TABLE 4 - Advanced Inflations Ending in Total Natural Substitutions of Bad Through Good Money

Country	Period	Earlier Currency Reforms that Failed[1]	Kind of Good Money	Source
USA	1776-81	March 1780: new dollar bills 1:20	specie and state paper money	Phillips 170 sq] Bezanson [1951, 325 sq]
France	1789-97	February 1796: mandats territoriaux 1:30	gold and silver specie	Thiers [1840]
Peru	1875-87	September 1880[2] incas 1:8	silver coins	Garland [1908 58 sq]
Mexico	1913-17	June 1916: infalsificable currency 10:1	gold and silver specie	Banyai [1976, 73 sq] Kemmerer [1940 114-15]

[1] *By a currency reform, we understand a change of the monetary regime with the intention of establishing a new stable money. The mere removal of zeros or introduction of newly denominated paper notes is not considered to be a currency reform.*

[2] *From the report given by Garland it is doubtful whether a currency reform was seriously intended.*

FIGURE 1a
Russian/Soviet Hyperinflation, 1914-1921
Budget Deficit and Note Issue

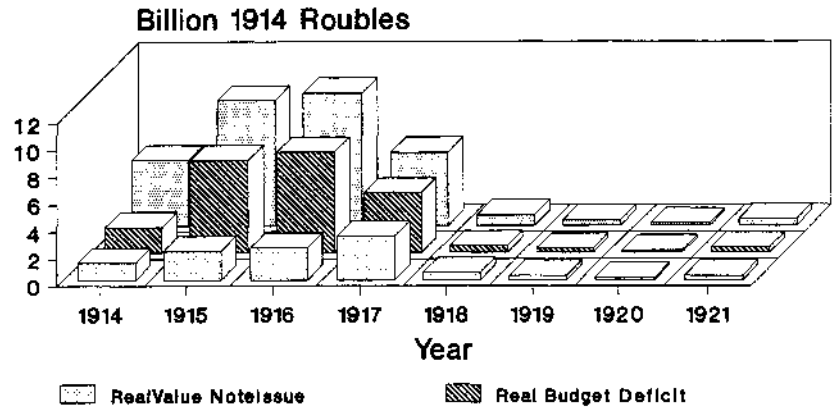
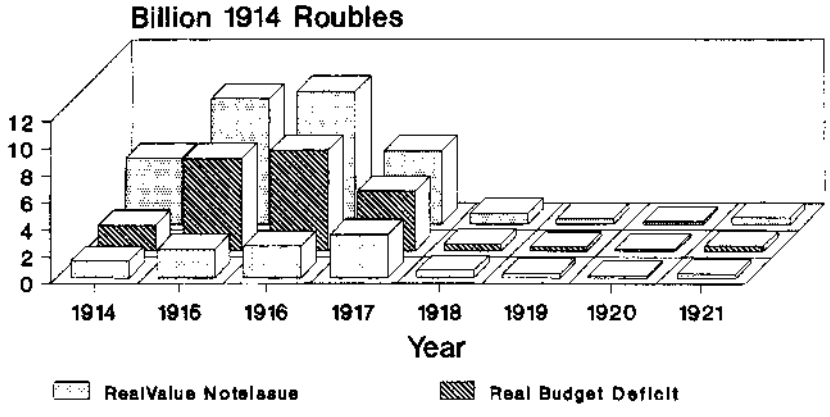
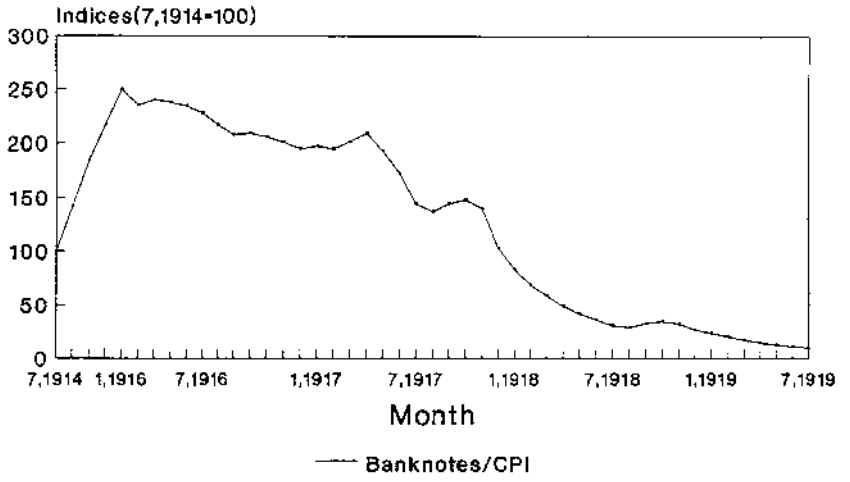


FIGURE 1b
Soviet Hiperinflation, 1922-1924 Budget Deficit and Note Issue



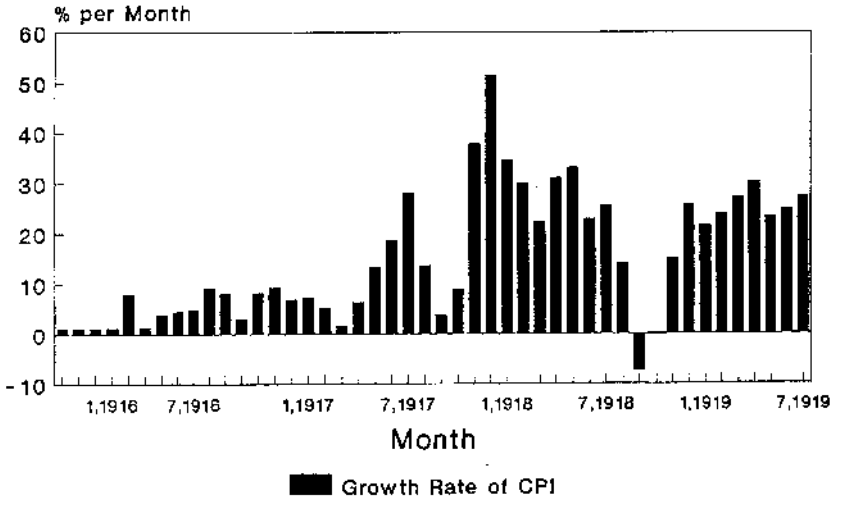
Figures for the subperiods of 1924 annualised to make them comparable

FIGURE 2



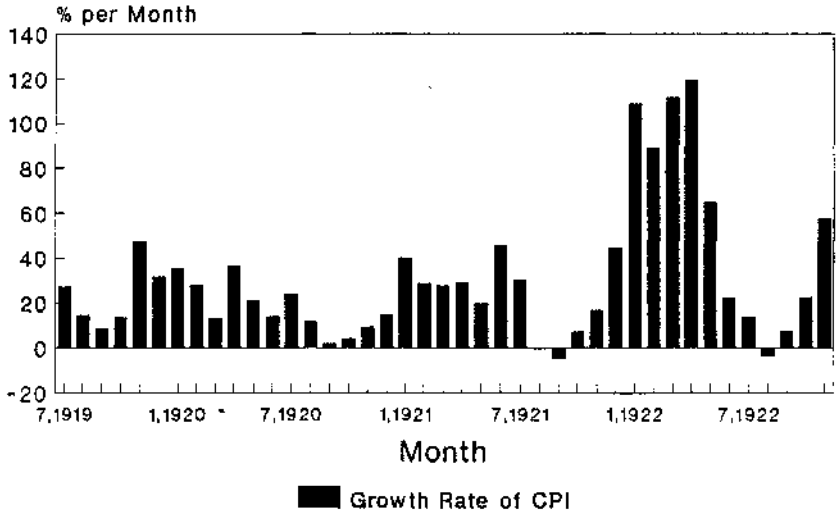
Development of Real Stock of Banknotes

FIGURE 3



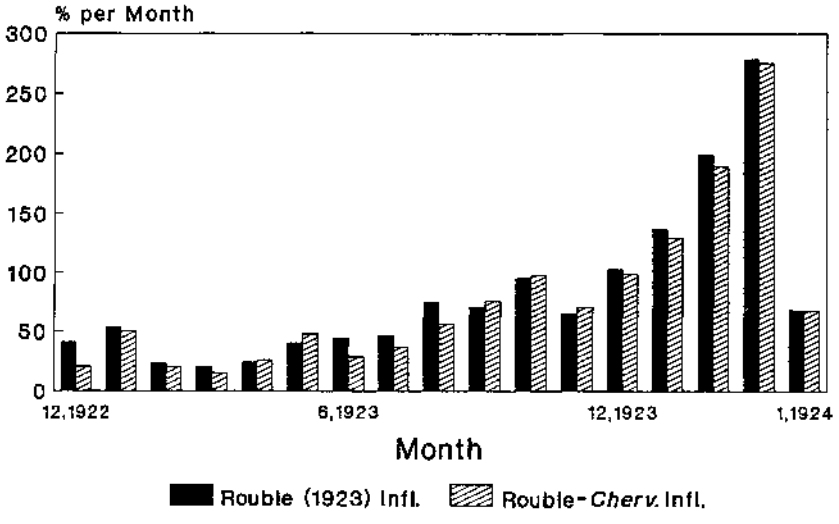
Consumer Prices, Rates of Inflation

FIGURE 4



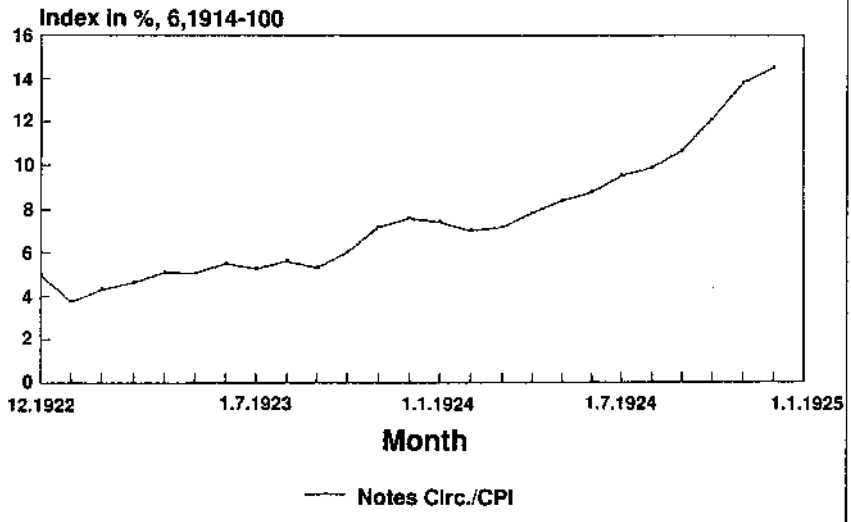
Consumer Price Inflation

FIGURE 5



Rouble & Rouble minus Chervonetz Inflation

FIGURE 6



Notes Issued by State Bank and Treasury