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Cash Shortage in the Former Soviet Union

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Abstract

An unexpected shortage of banknotes emerged during 1992 in the former Soviet Union. The cash shortage is explained by the asymmetry in the monetary union that prevailed, under which one member (the Russian Federation) controlled banknote production while every member could create deposit money. Interest rate rigidity forestalled an equilibrating adjustment in demand for banknotes. The possible efficiency costs of the cash shortage are explored.

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Summary

The newly independent republics of the former Soviet Union and the Baltics faced shortages of banknotes, starting in 1992 until the introduction of separate currencies by the republics. Prolonged cash shortages are historically rare, and seem to be associated with the break-up of federal states. This paper analyzes the causes and consequences of the cash shortage in the former Soviet Union.

The cash shortage is documented through reports of restrictions on access to cash from banks; the emergence of different exchange rates for deposit rubles from different republics; and faster inflation of prices of goods that could be paid for in deposit rubles. Evidence is presented that real cash balances fell precipitously in the former Soviet Union, especially in the non-Russian republics.

A monetary union is modelled: every member has unlimited capacity to create deposit money but only one member (for example, the Russian Federation) is capable of producing cash rubles, while the payment technology requires that cash be used to make retail purchases, as in the former Soviet Union. Under such an asymmetric monetary union, cash shortage is an equilibrium outcome. Inflation will be high, but not as high as in a monetary union without any constraints on cash creation by any member. Creating a cash shortage can be beneficial for the issuing country and disadvantageous for the other members of the union, who therefore have an incentive to introduce their own currencies. In the absence of countervailing forces, the asymmetric monetary union may be unstable.

This paper uses a cash-in-advance model to demonstrate how a rise in real interest rates can reduce demand for cash until it matches supply. Otherwise, quantitative rationing of cash or deviations from a one-for-one exchange rate between cash and deposits will be needed. The last two mechanisms may induce the diversion of resources out of the more productive sector and depress current consumption still further.

I. Introduction

At the time of the dissolution of the Soviet Union, economic policy makers and advisers were concerned about a monetary overhang, that is, the presence of too many rubles relative to the demand for them. The release of this monetary overhang, it was feared, might lead to a burst of inflation. Inflation has indeed been very high in the former Soviet Union and the Baltics (FSU), although hyperinflation has not been reached in the ruble area.

In the event, there emerged a quite unexpected shortage of rubles, specifically cash rubles. The newly independent republics of the FSU, including the Russian Federation, the only republic with the facility to print rubles, faced cash shortages for prolonged periods until the introduction of separate currencies by the republics. Media reports during 1992 and parts of 1993 described how the functioning of the economy was hampered by the physical shortage of cash rubles. The aim of this paper is to analyze the causes and consequences of the cash shortage in the FSU.

While episodes of "tight" money are common, a protracted and generalized cash shortage is an unusual phenomenon. 1/ Cash shortages have indeed sometimes arisen in the midst of hyperinflation, for example at the start of the German hyperinflation in 1923, but only for very short periods. Panama, which uses the U.S. dollar as its currency, suffered a cash shortage when it was cut off from the supply of banknotes during its confrontation with the U.S. Cash shortages have also affected countries that had their banknotes printed abroad and that temporarily lacked the foreign exchange to pay the printer, such as Albania in mid-1992.

Currency shortages have occurred during the disintegration of large states or empires with a centralized monetary authority. For example, Dornbusch (1992, p. 401) reports a cash shortage in 1918-1919 in the constituent parts of the former Austro-Hungarian empire, and the introduction of 25, 100, and 100,000 crown notes by Vienna to counter the shortage. 2/ The break-up of Yugoslavia in recent times also led to the emergence of cash shortages in some of the former Yugoslav republics. In the spring of 1991, the National Bank of Yugoslavia in Belgrade stopped the delivery of cash Yugoslav dinars to Croatia and Slovenia when these two

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1/ However, even the authors have on occasion found themselves a bit short. Contributions will be acknowledged.

2/ In the context of Austria, de Bordes (1924) (p. 168) reports: "The shortage of money has been decidedly grave during the enormous rise in prices in June, July, and August, 1922. .... In those days one could not pick up a Viennese newspaper without finding complaints regarding the shortage of money. Industries had the greatest difficulty in collecting sufficient quantities of notes to pay the wages; the banks would not undertake, even for their best customers, to supply the necessary notes for that purpose at fixed dates."

republics declared their intention to secede. During the suspension of the move to independence between July and October, 1991, in the absence of cash deliveries from Belgrade and before the introduction of national currencies, there was a cash shortage in Croatia and Slovenia. 1/ The monetary consequences of the break-up of the Soviet Union may have had parallels with those of the disintegration of Austro-Hungary or Yugoslavia.

The alternative popular explanations of the cash shortage in the FSU are, at best, incomplete. On the supply side, the cash ruble shortage might be explained by the inability of the Central Bank of Russia (CBR) to run its printing press fast enough to satisfy the demand. 2/ Yet, technical difficulties do not seem to provide a fully satisfactory explanation of a generalized shortage of cash rubles in all denominations: why not print extra zeroes after the last denominational digit in the currency notes, and thereby increase the effective supply of currency? With regard to the non-Russian republics of the FSU, the cash shortage has been explained as the result of the failure of the CBR to supply cash, since the CBR controls the printing presses. Such an explanation leaves open the question of why the CBR should behave this way, and does not account for signs of cash shortage in the Russian Federation itself. If the limitation induced by the CBR on the convertibility of deposit money into banknotes is interpreted as an effort to restrain inflation, one must ask why the CBR did not make an equal effort to slow the expansion of deposit money.

On the demand side, high inflation in the FSU might be taken as an explanation of the cash shortage; as prices and the stock of deposit rubles rose, demand for cash kept pace. Meanwhile, the removal of widespread restrictions on deposit withdrawals by enterprises when the central planning apparatus was dismantled, together with the disruption in the internal payments system, reinforced the upsurge in the demand for currency. Yet these demand side explanations presume that the authorities were unable or unwilling to meet the increase in demand.

The popular explanations of the cash shortage fail to address several questions: why prices could not adjust to eliminate the problem, either by a relative decline in the price of goods paid for in cash or by a rise in the interest rate on bank deposits, and why the policy makers did not augment the supply of cash to meet the demand. Is there a plausible

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1/ "When dinar bank notes supplies were at a standstill and in conditions of high inflation, Slovenia faced a shortage of bank notes, especially at peak demand periods when salaries and benefits were paid. In early September, an acute shortage forced the Bank of Slovenia to put into circulation bank notes that had already been withdrawn." Annual Report of the Bank of Slovenia, 1991. Appendix 1, p. 43.

2/ According to the Washington Post,(p. A30, August 9, 1992): "The printing presses are working overtime. In an attempt to keep pace with the demand for cash, the government printed 260 billion rubles in July alone -- more money than was printed in the entire Soviet Union from 1961 to 1991."

economic story that does not evoke irrational policies, exogenous technological problems, or question begging assumptions about preferences?

In this paper it will be shown that the cash shortage in the FSU can be explained as the equilibrium outcome of a monetary union under which every member had unlimited capacity to create deposit money but only one member, the Russian Federation, was capable of producing cash rubles. This asymmetry, in conjunction with the special role of cash in making certain purchases in the FSU, led to the cash shortage. Furthermore, it will be shown that such an asymmetric monetary union will have higher inflation than one with a unified monetary authority, but not as high as one without any constraints on cash creation by any member; that government deficits will be higher than in a unified state and they will be financed primarily through seigniorage; and that creating a cash shortage can be beneficial for the issuing country and disadvantageous for the other members of the union. Therefore, the disadvantaged members of the union will have an incentive to introduce their own currencies, making the asymmetric monetary union unstable in the absence of countervailing forces. Inflation is not assumed to be intrinsically bad, and no country has an incentive to limit the creation of deposit money.

A cash shortage can be defined as the suspension of full convertibility of sight deposits at banks into cash at par. We consider a cash in advance model with the possibility of intertemporal substitution, and examine how a cash shortage can arise from an unanticipated decline in the supply of cash. Of course, with perfectly flexible prices, there can be no true shortages and hence no quantitative rationing or deviations from a fixed, one to one exchange rate between deposit and cash money. Except for extreme cases involving very large unanticipated declines in the supply of cash, interest rate flexibility is sufficient to ensure equality between ex-ante demand and the available supply of cash. In the FSU republics, rigidity in administered interest rates led to cash shortages, with distributional and possibly efficiency effects on the economy.

The plan of the paper is as follows: Section II describes the peculiar role of cash in the Soviet financial system and the emergence of cash shortages in the FSU; the basic model is presented in Section III; Section IV describes the functioning of a monetary union with asymmetric control of cash production, and analyzes how a cash shortage might affect economic behavior; an epilogue and conclusions are contained in Section V.

II. The Role of Cash in the Financial System of the FSU

In a well-functioning market economy, there is free substitutability of currency into deposits and vice-versa at a fixed, one-to-one exchange rate, so the components of money are entirely demand determined. The public can hold as much currency or deposits as it likes subject to the maximum of aggregate money supply, and the two are very close substitutes. The literature on the demand for components of money, namely currency and deposits, emphasizes factors such as the relative costs and returns on

holding currency and deposits, real income, volume of retail trade, volume of travel, urbanization, and tax evasion. 1/

1. Deposit and cash rubles

The composition of money in the Soviet Union was highly distorted by conditions in other markets, administered prices and interest rates, and the centralized economic control mechanism. 2/ These institutional features of the Soviet Union were closely connected to the problem of cash shortage that arose after its break-up.

The menu of financial assets was extremely limited in the Soviet Union, and restrictions applied as to who could hold what. The peculiarities of the monetary system in the Soviet Union has led to the description of the system as having two semi-independent monetary circuits--one for the households and the other for enterprises. Households received their wages in cash, deposited excess cash with banks, and, in the absence of checks or other non-cash means of payment, withdrew cash to spend on goods and services.

Enterprises had very little freedom in cash management. They needed plan authorization to operate bank accounts, and often could not even shift resources between affiliate bank branches. Interenterprise transactions were carried out in "account" or "deposit" money by making money transfers through the old interbranch settlement system. Cash withdrawals by enterprises were legally restricted to wage payments and sundry expenses, but if the central planning system had functioned smoothly the enterprises would have had little incentive to hold cash.

With central planning and the consequent limited need for liquidity to operate the system, the prevalent level of liquidity seems to have been low in the Soviet Union. 3/ In 1991, the currency to deposit ratio was 19 percent in the FSU as a whole, markedly lower than that in the People's Republic of China, India, Hungary and Poland, and higher only than that in

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1/ Irving Fisher (1911) argued that the relative demand for currency and deposits plays an important role in the explanation of business cycles. Continued interest in the study of the demand for currency and deposits is indicated by papers by Cagan (1958), Feige (1964), Hess (1971), Becker (1975), Santomero (1979).

2/ Throughout this paper, "money" in the FSU is defined as broad money, that is, currency plus deposits.

3/ There are obvious difficulties in compiling historical monetary statistics for the new republics when they were formerly part of the unified economic system of the Soviet Union. See Calogero, Nahr, and Stillson (1992) for a description of the problems in the context of the FSU, and De Bordes (1924) (pp. 34-38) regarding the Austro-Hungarian empire. Thus, monetary figures are illustrative and should be treated with caution.

the former Czecho-slovakia. 1/ 2/ In view of the anecdotal evidence of foreign currency notes circulating in the FSU in the 1980s, the exclusion of the foreign component of cash in circulation imparts a downward bias in the estimates of the currency-to-deposit ratio. However, given the legal restrictions on the holding of foreign currency, it is unlikely that the bias is very significant. Furthermore, foreign currency notes and cash rubles were not perfect substitutes in so far as shops, depending on their ownership, accepted one but not the other.

Per capita money-holding in the FSU in 1991 was about US$40 or US$4039, depending on what exchange rate--the interbank market rate of Rub 169.2 per U.S. dollar or the official rate of Rub 1.67--is used to convert the ruble figure on money-holding into U.S. dollars. 3/ Use of the market rate leads to an estimate of per capita money holding in the FSU of less than one third that in India, one seventh of that in the People's Republic of China, one fifteenth of that in Poland, and one thirty-fifth to one fortieth of those in Hungary and the former Czechoslovakia in 1991.

2. The emergence of a cash shortage

During the reforms in the late 1980s and the break-up of the Soviet Union at end-1991, the monobank system was replaced by two-tier banking systems, and automatic state or central bank guarantees covering all enterprise losses were weakened. 4/ Furthermore, with price liberalization in end-1990 and April 1991, quantitative restrictions started to become less prevalent. The consequent improvement in the "true" purchasing power of cash led to an upsurge in demand for it. Simultaneously, households' entitlement to cash was augmented through a decree issued by the Union Government in mid-1991 to increase household

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1/ The countries have been chosen for illustrative purposes: the People's Republic of China for being a centrally planned and developing economy, India as a market-based developing economy, and the former Czechoslovakia, Hungary and Poland as central European emerging market economies.

2/ The currency-to-deposit ratio varied widely among the republics from 10 percent in Belarus to 87.7 percent in Turkmenistan in 1991. A large part of this variation may be due to the different degrees of development of the banking system and industrialization in the republics.

3/ Per capita money was derived as the ratio of aggregate money holdings to aggregate population in thirteen republics of the FSU in 1991. Data for 1991 were not available for Tajikistan and Uzbekistan.

4/ For a description of the reforms during the late 1980s, see Woody (1990), and the IMF, World Bank, OECD, and EBRD (1991). The rules limiting enterprises' cash transactions were removed in 1988, but under the prevailing central planning regime their behavior did not change substantially until late 1991 and early 1992. Restrictions were reapplied in Russia from January 1992.

deposits with the respective republican savings banks in order to compensate for the rise in the cost of living. 1/

By end-1991 the Union-wide financial institutions had collapsed and independent central banks had started to operate in each republic. However, a form of monetary union survived. In particular, the supply of cash rubles continued to be controlled by only one member, the Russian Federation, which had the printing presses. 2/ The banks in the republics started operating through regional and national clearing centers, which in turn were connected through correspondent accounts at the CBR.

In early January 1992, the Minsk Agreement signed by all the republics, except Estonia, Georgia, Latvia, Lithuania, and Ukraine, established the Common Currency Arrangement (CCA) to lay down the procedure for obtaining cash rubles from the CBR. From January 1, 1992, the CBR had opened new correspondent accounts with each of the central banks in the fourteen other republics to replace the old unitary and centralized correspondent account of each republic with the rest of the Soviet Union. Under the CCA, cash rubles could be obtained by a republic from the CBR against a counterpart debit from the correspondent account it maintained there. The centralization of correspondent relationships ensured that individuals could not freely make interrepublican payments for capital account transactions.

Payment orders could be executed only after clearing, and lack of adequate computing and communication facilities and of experience led to inordinate delays in the payment systems both within republics and between them. According to some reports, a payment order could take as long as three months to be executed. Delays and uncertainties in receiving payments made through the banking system led to a strong preference for cash as a transactions medium in the FSU. 3/

These transformations of financial institutions and payments arrangements in the FSU was accompanied by reports of a shortage of cash

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1/ This compensation of 40 percent of the original value of deposits became known as the "Gorbachev premium". The Gorbachev premium was initially funded by the issue of long-term Union Government debt to the savings bank. The ambiguous status of this debt after the dissolution of the Union led to the initial freezing of these augmented deposits until 1994; however, Russia withdrew the freeze in mid-1992, and some other republics followed suit.

2/ In a legally anomalous way, the issue of currency rubles remained the responsibility of Gosbank (USSR) between January 1, 1992 and the end of May 1992, although the Gosbank itself had ceased to exist. From June 1, 1992 the Central Bank of Russia assumed full liability for all rubles circulating both within Russia and in the other FSU republics.

3/ There were reports of enterprises delivering cash by truck or plane against delivery of goods (see for example "Billions Bleed out of Russia as its Wealth is Sent Abroad," The New York Times, Feb. 1, 1993).

rubles, and at times vigorous complaints by some republics that they were being unfairly denied cash. Sometimes bank customers who wanted to withdraw their deposits in cash were unable to do so freely because of restrictions imposed by the banks. For example, "on April 24, firefighters in Rakvere, northeast Estonia, blockaded a bank until it paid their salaries, which had been unpaid for nearly two months ... [V]ehicles obstructed the entrance to the bank for 45 minutes, after which the protest's leaders emerged with 50,000 rubles... First aid officials in Tallinn say that around four pensioners a night are treated after collapsing in the overnight bank queues" (Baltic Independent, Vol. 3, No. 109, May 8-14, 1992, p. 5). 1/ Prices for transactions in cash and in account money started to diverge, and significant discounts available on cash transactions were advertised in newspapers.

3. Magnitude of the cash shortage

Claims of a cash shortage may be expressions of other problems, such as the general disorganization of the financial system or "whining" by some republics for a larger share of seigniorage. Enterprises' complaints of limited availability of banknotes may reflect their lack of liquidity of any kind. In this section, evidence is presented that there was a true shortage of cash rubles in the Russian Federation and elsewhere in the FSU.

Assessing the magnitude of the cash shortage is made difficult by the paucity of reliable data. Perhaps the most direct evidence is provided by Koen and Phillips (1993), who report that in June 1992 the stock of wage arrears due to the shortage of cash at banks reached 30 percent of the wage bill in Russian industry. Furthermore, by July 1992 more than 90 percent of all arrears on social allowances and wages were due to the cash shortage.

A second indicator of the extent of the cash shortage is provided by the emergence of different exchange rates between deposit rubles from different republics. While one cash ruble could be used to purchase one deposit ruble in every republic, the value of bank deposits in various republics, although nominally all denominated in rubles, started to diverge during 1992. For example, in August 1992 the central bank in Latvia initiated a system of differentiated exchange rate vis-à-vis the Latvian ruble for the balances in the correspondent accounts with various central banks in states of the FSU. The rates for end-December 1992 are presented in Chart I. As can be seen, the rates could diverge substantially and one kind of FSU deposit ruble could be only half as valuable as another. The different rates presumably reflect differences in bilateral payments

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1/ Some localities resorted to extraordinary measures. For example, in mid-March 1992, it led the municipal Government in the south Estonian town of Tartu to introduce its own currency to combat the acute shortage of ruble. The "municipal currency" was withdrawn about a month later when the Estonian authorities promised to supply Tartu with a sufficient amount of cash (Baltic Independent, Vol. 3, No. 106, April 17-23, 1992, pp. 1 and 5).

balances. One republic's surplus in its correspondent account with some other republic could not be used to meet its deficit with a third, so flows of deposit money could not equalize the rates. However, if cash had been freely available, it would have been possible to arbitrage between these rates by shipping cash until the divergence was eliminated.

No data is readily available on rates at which deposit rubles could be exchanged for cash rubles within republics, but these are implicit in the large differences of the exchange rates of the U.S. dollar against cash and non-cash rubles reported in newspapers in the different republics. Convertible currencies, like other commodities, commanded a significantly higher price in terms of non-cash rubles than cash rubles. The availability of foreign currency notes softened the problem of cash shortage; currency substitution, initially fuelled by overvaluation of the ruble, high inflation, and lack of policy credibility, was stimulated by the cash shortage problem. Nevertheless, a net increase in the supply of foreign currency notes can be achieved only through the delivery of exports over time, and the availability of a stock of foreign banknotes in the FSU did not remove the fundamental problem of lack of free convertibility of existing bank deposits into cash.

A third sign of the cash shortage was the divergent movements in the consumer price index (CPI) and the producer price index (PPI). Items included in the CPI are largely consumption goods that had to be paid for in cash. Items included in the PPI are largely raw materials, intermediate goods, and wholesale merchandise, which could be paid for in deposit rubles. In 1992, for example, in the Russian Federation the PPI increased by 3275 percent while the CPI increased by only 2318 percent; in Lithuania the increases were 2370 percent and 1260 percent, respectively. A part of the difference may be due to differences in the speed of price liberalization and index number problems (see Lequiller and Zieschang, 1994). 1/ However, part of the divergence may be due to the rapid growth in deposit money and bank credit fueling PPI inflation, while the limited availability of banknotes held down CPI inflation.

Interpretation of data on the evolution of monetary aggregates is more problematic. Lack of data not only obscures the actual situation, it also makes impossible the quantification of the relevant counterfactual scenario. Shortage of cash must be measured by comparison with a situation where demand for cash and other monetary assets can be freely exercised; one wants to know what demand for cash would have been, had there been no shortage. Available data allow only informal construction of that hypothetical situation.

The high and variable inflation experienced during this period throughout the FSU should have decreased the incentive to hold any type of money (cash or deposits); nominal interest rates on deposits remained so

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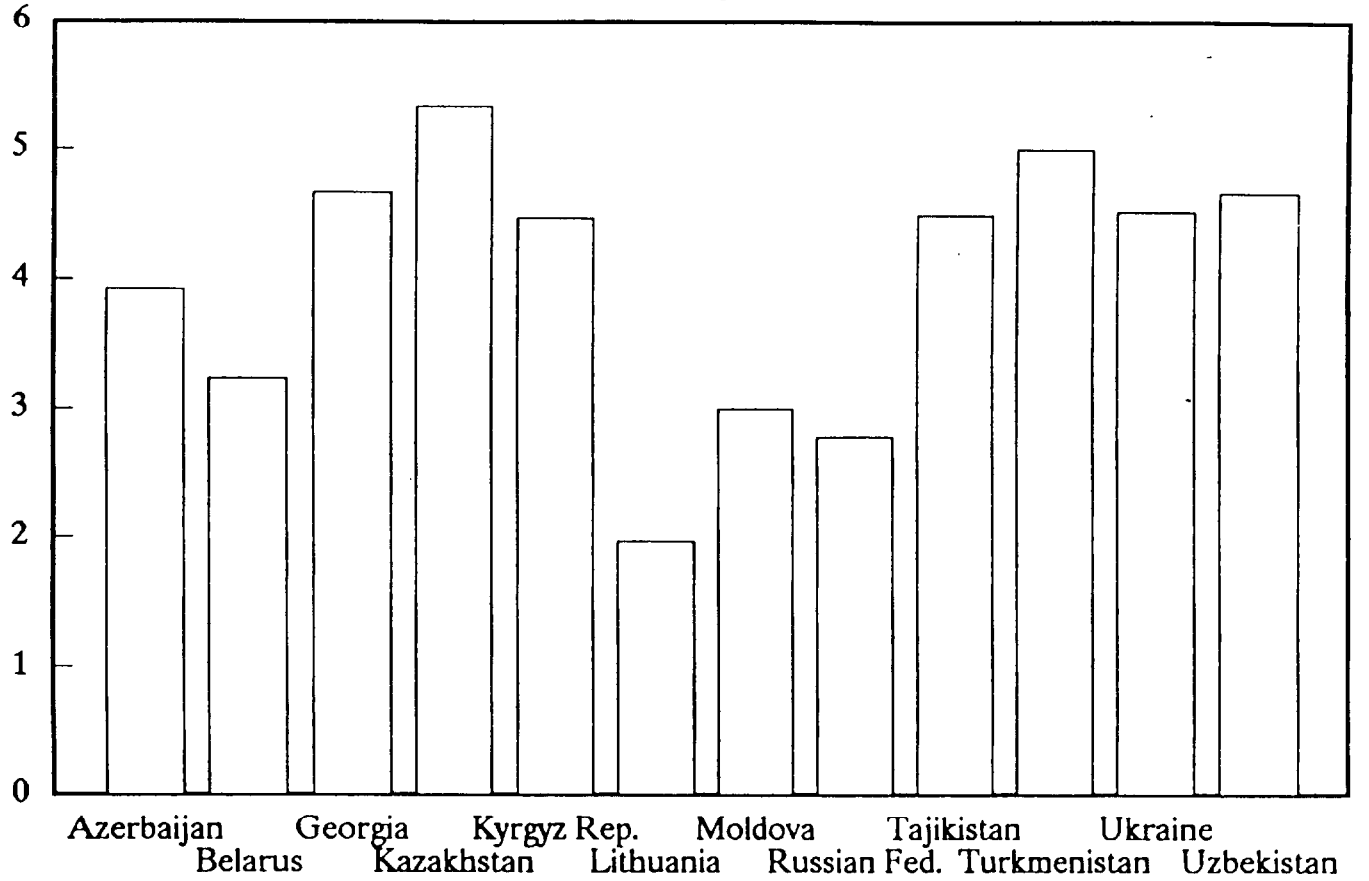
1/ The index number problem applies to both the PPI and the CPI, but the upward bias in estimated inflation rates itself increases with inflation.

Chart I.
Exchange Rates of Various FSU Rubles per Latvian Ruble, end–December, 1992



Source: Bank of Latvia
No data available for Armenia and Estonia.

low relative to inflation as to be almost negligible. However, in the light of international experience, the move to a decentralized, market-based system should have increased the demand for money, especially cash, in the FSU. The deterioration in the clearing, payment and settlement system should also have shifted demand away from deposits and towards cash. These factors affecting the demand for real cash and deposit balances were common to all the republics of the FSU. If there was no cash shortage in the Russian Federation (the only republic with the capacity to produce banknotes), some other republic that saw a relative decline in its cash holdings would have suffered a shortage; if there was a cash shortage in the Russian Federation, then other republics would have suffered a more severe shortage.

Thus, a fourth indication of the magnitude of the cash shortage is provided by a comparison of the estimated currency in circulation in the different republics of the FSU, as expressed in Table 1 as percent ratios of the currency in circulation in the Russian Federation. 1/ Part of the decline can be explained by the preemptive effort on the part of the CBR to limit the supply of cash and by a decline in demand for cash in anticipation of the introduction of new currencies, for example, in the Baltic republics in mid-1992, in the Kyrgyz Republic in May 1993, in Ukraine in December 1992, and in Belarus in stages from May 1992. However, except in Belarus and Ukraine during the second quarter of 1992, the ratios declined steadily throughout 1992. Thus, the pattern of seigniorage distribution after the dissolution of the Soviet Union seems to have shifted in favor of the Russian Federation, and any cash shortage was more severe in the non-Russian republics. Trade and capital movements will also have affected the distribution of currency, but their influence was limited by the disruptions to interrepublican transactions since 1991, caused, for instance, by the break-up of the interrepublican payments and clearing system.

1/ Data is available only on issues and withdrawals of banknotes by Republic. Insofar as interrepublican trade was paid for in cash, stocks in circulation will have differed from cumulative net issues. For some republics, such as Tajikistan, adjustments have been made to the cumulative net issues on the basis of an appropriate "migration" rate of rubles to derive an estimate of currency in circulation.

Table 1. Former Soviet Union:
Distribution of Currency in Circulation 1/

(percent of currency in circulation in the Russian Federation)

	1991	1992				1993	
	Dec.	Mar.	June	Sep.	Dec.	Mar.	June
Armenia	2.6	2.3	1.5	1.1	0.9	1.3	1.0
Azerbaijan	6.4	4.7	2.9	1.6	1.6	2.5	2.9
Belarus 2/	2.9	2.5	3.5	2.1	2.1	2.0	1.9
Estonia 3/	1.3	1.1	0.4	1.6	1.8	2.1	2.4
Georgia	3.7	2.0	1.9	1.7	1.4	1.0	2.2
Kazakhstan	8.4	8.4	7.0	7.3	8.3	9.3	10.0
Kyrgyz Rep. 4/	1.7	1.5	1.2	1.0	1.0	1.0	0.5
Latvia 5/	2.4	1.7	0.6	1.6	1.9	2.6	3.1
Lithuania 6/	4.4	3.1	2.2	0.8	1.1	1.1	1.2
Moldova	1.1	0.8	1.0	1.2	0.9	0.9	1.0
Tajikistan	1.3	1.1	1.0	1.2	0.9	0.9	1.0
Turkmenistan	1.5	1.4	1.1	0.5	0.7	0.8	1.0
Ukraine 7/	20.2	25.3	37.6	34.7	22.7	13.1	9.7
Uzbekistan	9.9	...	...	...	5.2	4.7	5.0
Total	67.4	...	...	...	50.1	43.0	42.7

Source: respective national banks.

1/ For countries with separate currencies, data were converted into rubles using the cross rates implied by the exchange rates between the US dollar and the local currency, and between the US dollar and the ruble.

2/ Belarussian rubles from January 1993.

3/ Estonian Kroons from May 1992.

4/ Som from May 1993.

5/ Latvian rubles from June 1992.

6/ Talonai from October 1992, and Litai from June 1993.

7/ Karbovanets from December 1992.

Table 2 presents data on the evolution of the real stock of currency in circulation at constant 1991 prices in each republic. From the end of 1991 to the middle of 1992, there was a precipitous decline in the purchasing power of the stock of currency in circulation in all the republics. The real value of cash outstanding typically recovered only with the introduction of new currencies. For example, Estonia introduced the kroons under a currency board arrangement from May 1992 and left the ruble area. Currency in circulation in real terms, after a sharp decline in the first half of the year, increased rapidly to more than 150 percent of its end-1991 value by the end of 1992. The increase in the stock of currency in real terms in Estonia was undoubtedly influenced by the credible stance of policies before and after the currency reform, but part of the increase was a reflection of the pent up demand for currency inherited from the era of cash shortage and the newly acquired ability of the Bank of Estonia to meet such demand. The evolution of currency in Latvia in the second half of 1992, after introduction of the Latvian ruble in June, points to the same conclusion. 1/

More ambiguous evidence is available from currency to deposit ratios from end-1991 through mid 1993. 2/ Currency to deposit ratios have tended to rise since 1991, for example, from 20 percent in Kazakhstan and 15 percent in Ukraine in December 1991 to 35 percent and 28 percent, respectively, in mid-1992. There are exceptions, notably in some republics such as Estonia and Latvia where the ratio fell sharply in anticipation of the introduction of new currencies. However, the ratio could be high because of an abundance of available cash, or because of restrictive credit creation, or because of an increase in the relative demand for cash. Thus, the currency-to-deposit ratio does not indicate unambiguously whether cash shortage in any of the republics in the ruble area was any more or less severe than that in the Russian Federation.

The currency-to-deposit ratio increased sharply in Belarus, Estonia, Latvia, Lithuania, and Ukraine after these republics introduced their own currencies despite, in some cases, a rise in the real interest rate available on deposits. For example, the ratio jumped from 8 percent in Estonia and 15 percent in Latvia in June 1992 to 29 percent in both republics three months later. The implication could be that the currency-to-deposit ratio was below its equilibrium level in these republics when they were still operating with the ruble, and that unconstrained demand for cash would have resulted in a higher ratio.

1/ The Latvian ruble was initially introduced as an interim currency to circulate at par and alongside the Russian ruble. The Latvian ruble was delinked from the Russian ruble on July 20, 1992, and started to float against all foreign currencies, including the ruble. During 1992, the percentage increase in currency in real terms in Latvia was smaller than in Estonia, partly because of the difference in the timing of the currency reform in the two countries.

2/ These ratios are available from the authors on request.

Table 2. Former Soviet Union:
Real Currency in Circulation 1/

(In billions of rubles, end of period, December 1991 prices)

	1991	1992				1993	
	Dec.	Mar.	June	Sep.	Dec.	Mar.	June
Armenia	4.34	1.94	1.25	1.62	1.28	1.30	0.97
Azerbaijan	10.76	3.76	3.69	2.89	1.97	2.97	4.67
Belarus 2/	4.77	1.30	2.23	2.28	2.30	2.04	1.93
Estonia 3/	2.12	0.63	0.35	1.90	3.21	5.52	11.13
Georgia	6.10	2.55	1.46	2.22	1.48	1.12	2.55
Kazakhstan	13.96	4.23	3.36	5.28	5.79	4.49	5.33
Kyrgyz Rep. 4/	2.88	0.92	1.12	1.35	1.32	0.90	0.50
Latvia 5/	4.00	1.26	0.55	2.10	3.41	6.66	14.16
Lithuania 6/	7.38	2.90	2.92	1.23	1.59	1.77	2.40
Moldova	1.83	0.33	0.54	0.68	0.41	0.39	0.43
Russian Fed.	167.00	40.88	51.74	85.33	76.62	65.27	70.87
Tajikistan	2.11	0.42	0.58	1.09	1.20	0.89	0.70
Turkmenistan	2.50	0.94	1.19	0.92	1.72	1.03	0.99
Ukraine 7/	33.80	12.71	21.36	5.69	14.82	5.04	2.53
Uzbekistan	16.00	...	...	...	...	...	...
Total	279.56	...	...	...	...	...	...

Source: respective national banks.

1/ For countries with separate currencies, data were converted into rubles using the cross rates implied by the exchange rates between the US dollar and the local currency, and between the US dollar and the ruble.

2/ Belarussian rubles from January 1993.

3/ Estonian Kroons from May 1992.

4/ Som from May 1993.

5/ Latvian rubles from June 1992.

6/ Talonai from October 1992, and Litai from June 1993.

7/ Karbovanets from December 1992.

Under normal circumstances and a market environment, interrepublican trade flows and capital movements should have led to the same prices, exchange rates vis-à-vis non-ruble currencies, and interest rates in the various republics of the FSU, and an equalization of the cash shortage problem in all the republics. Divergent movements in exchange rates as well as inflation and interest rates in the republics of the FSU from 1991 to mid-1993 suggest that this self-correcting mechanism was working at best slowly through trade flows, rather than through large and rapid capital movements, which were largely prohibited. 1/

III. Cash and Deposit Supply in a Monetary Union

The disintegration of a country or an empire into separate states can result in an asymmetric monetary union under which every member has unlimited capacity to create deposit money but only one member is capable of producing cash. The form of monetary union that operated in the FSU may have led to the cash shortage.

A number of authors have recently studied the operation of a monetary union, mostly in relation to the eventual establishment of the European Monetary Union (see for instance Cassella (1990), Frenkel and Goldstein (1991), or Giovannini and de Cecco (1989) passim). A familiar result is that a monetary union without a unitary monetary authority will tend to have high inflation and government expenditure, and low taxes, because each constituent region has an incentive to try to maximize its seigniorage, while passing much of the inflationary cost on to others. 2/ This literature can be adapted to the peculiarities of the institutions of the FSU, namely, the need to use cash for making certain payments, and the dichotomy between the monopolistic supply of cash and the competitive supply of deposit money.

It is useful to think first of an economy in which the government is prepared to convert all claims on itself into cash money on demand. Transactions demand for cash, demand for saving deposits, and the supply and demand for loans will result in a certain equilibrium set of interest rates, prices and inflation.

There are two countries, country one and country two (denoted by an asterisk). 3/ Each period t a new cohort of worker-consumers is born in

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1/ For example, during 1992, while the CPI went up by almost 27 times in Kazakhstan, the increase in Turkmenistan was only 7 1/2 times. Part of this divergence reflects differences in the methodology used in the construction of price indices, as well as the relative speed of price liberalization.

2/ It could be argued that economic policy in the Federal Socialist Republic of Yugoslavia illustrated these biases.

3/ One could generalize the model to include an arbitrary number of countries.

country 1 (2), which is endowed with a stock of labor L (L*), and which lives for two periods. 1/ Symbols are listed in the appendix. Labor and output are not storable, but is sold to firms. Both cohorts alive in any one period consume, with the old spending their savings and the young spending a fraction $(1-s_t)$ $((1-s^*_t))$ of their labor income. Firms invest the labor in a constant returns to scale production technology yielding fL (fL*) later in the period. There are two goods, the consumption good available in quantity q_t (q^*_t) that can be bought only for cash, and a (local) public good g_t (g^*_t) that can be bought by government for cash or deposit money; the public good could be the continued operation of loss-making enterprises. A unit of output can be costlessly converted into a unit of either the consumption or the public good, so $f(L+L^*) = q_t + g_t + q^*_t + g^*_t$. Trade is possible between the two countries.

At the end of a period t-1 banks in country 1 have liabilities $D_{t-1} = s_{t-1}W_{t-1}L$ towards the old cohort, where W_{t-1} is the nominal wage in the period just ended, and claims M_t on the government. Note that banks have positive net worth and interest accrues in the period in which it is paid. Banks lend B_t to firms at interest $(1+R_t)$ at the start of period t. The firms use the funds to buy the available labor stock L at the going nominal wage W_t. The young, having sold their labor, deposit their savings s_tW_tL with the banks, retaining the rest in cash to pay for their consumption. The old then withdraw their deposits, with interest paid at a rate I_{t-1}. At this stage, banks have minimum liquidity. Banks face a cash in advance constraint on the amount of lending that they can undertake:

$$0 \leq M_t - B_t + s_tW_tL - (1+I_{t-1})s_{t-1}W_{t-1}L,$$

but they do not wish to leave funds idle, so

$$M_t = (1-s_t)B_t + (1+I_{t-1})s_{t-1}B_{t-1} = (1-s_t)B_t + (1+I_{t-1})D_{t-1}, \qquad (1)$$

which is just equal to nominal consumption expenditure by all cohorts in the period. The situation in country 2 is analogous.

When an explicit solution is required, the consumers of the t-th cohort are assumed to have a Cobb-Douglas utility function over their consumption in period t $(q_{t,t})$ and t+1 $(q_{t,t+1})$

$$U(q_{t,t}, q_{t,t+1}) = q^{\alpha}_{t,t} + \rho q^{\alpha}_{t,t+1}, \ \alpha < 1,$$

which is maximized subject to their budget constraint

$$P_{t+1}q_{t,t+1} = (W_tL - P_tq_{t,t})(1+I_t).$$

1/ This overlapping generations structure is a simple way to introduce the intertemporal considerations that help determine the allocation of wealth between cash and deposits. The model could be adapted to allow for longer-lived individuals, but the dynamics would be more complex.

Using the identity $(1+I_t)P_t/P_{t+1} = 1+i_t$ the real interest rate, it is easy to establish that

$$s_t = \frac{1}{1+\rho^{1/(\alpha-1)}(1+i_t)^{\alpha/(\alpha-1)}} . \qquad (2)$$

1. A unitary monetary authority

The government of the two countries is unified. It is equally concerned about consumption by every cohort in both countries. The government is also concerned about the provision of the public good. In particular, the government's welfare function is assumed to be 1/

$$V_t = (1-\gamma)\ln(q_t + q^*_t) + \gamma\ln(g_t + g^*_t), \; 0 < \gamma < 1. \qquad (3)$$

The government pays for its purchases of the public good by creating $\Delta(M+M^*)_t$ in new money. With a price level P_t (the two goods will have the same price because of perfect substitutability in production, and the possibility of trade ensures price equalization between the countries), expenditure on the consumption and public goods is $M_t + M^*_t = P_t(q_t + q^*_t)$ and $\Delta(M+M^*)_t = P_t(g_t + g^*_t)$, respectively. Given the level of production, the price level is

$$P_t = \frac{\Delta(M+M^*)_t + M_t + M^*_t}{f(L+L^*)} .$$

Therefore, the welfare function for each period can be written

$$V = K + \gamma\ln(\Delta(M+M^*)_t) - \ln(\Delta(M+M^*)_t + M_t + M^*_t),$$

where $K = \ln(f(L+L^*)) + (1-\gamma)\ln(M_t+M^*_t)$. To maximize welfare, the government chooses $\Delta(M+M^*)_t$ to satisfy the first order condition

$$\frac{\gamma}{\Delta(M+M^*)_t} - \frac{1}{\Delta(M+M^*)_t + M_t + M^*_t} = 0,$$

so that

$$\Delta(M+M^*)_t = \gamma(M_t + M^*_t)/(1-\gamma). \qquad (4)$$

1/ With fixed output and no storage, the government does not have to consider intertemporal issues if it is indifferent about the distribution of consumption between cohorts.

and $M_{t+1} + M^*_{t+1} = (M_t + M^*_t)/(1-\gamma)$. Hence,

$$P_t = \frac{M_t + M^*_t}{(1-\gamma)f(L+L^*)}, \tag{5}$$

and inflation is $P_t/P_{t-1} = 1/(1-\gamma)$.

In the goods market, production and consumption of the consumption good is $(1-\gamma)f(L+L^*)$, and production of the public good is $\gamma f(L+L^*)$. If it were costless, the government could equally well impose an equivalent tax and avoid inflation altogether; seigniorage rights yield no special benefit. It is assumed that wages and lending rates are such, that firms make zero profits. Since firms' receipts equal total spending, for firms in country 2 for example,

$$(1+R_t)B^*_t = P_t f L^* = \frac{(M_t + M^*_t)L^*}{(1-\gamma)(L+L^*)}. \tag{6}$$

It will be assumed henceforth that $\mu = M^*_t/M_t = L^*/L$. 1/ Thus, country 2 banks receive $M^*_t/(1-\gamma) = M^*_{t+1}$, which will be the liquidity available next period.

The real wage in country 2 for example is $w^*_t = B^*_t/P_t L^* = f/(1+R_t)$. Thus, the locus of real wage and real interest rates that are compatible with the zero profit condition on firms is downward sloping; a shift along this locus corresponds to a shift in consumption between the first and second periods of life. 2/ For the analysis that follows, it is sufficient that in the steady state the real wage and real interest rates are consistent; it is not necessary to specify what mechanism or historical accident set them at any particular combination of rates. 3/

2. Independent monetary authorities

Suppose now that there are two governments, each capable of producing both deposit and cash money. Each feels responsible only for its own citizens, so the welfare functions become

$$V = \gamma \ln(g_t) + (1-\gamma)\ln(q_t) \tag{7a}$$

1/ It is not difficult to allow per capita money holding to differ.

2/ This indeterminacy is similar to that found in Sraffa (1960).

3/ When $\rho^{-1} = (i+i_t)$, that is, when the real interest rate i_t just compensates for the subjective rate of time discount, a cohort splits its consumption evenly across its life cycle.

$$V^* = \gamma \ln(g^*_t) + (1-\gamma)\ln(q^*_t) \tag{7b}$$

The price level is now determined by the sum of monetary expenditure by both governments and all consumers:

$$P_t = \frac{M_t + M^*_t + \Delta M_t + \Delta M^*_t}{f(L + L^*)}.$$

Therefore, the welfare functions can now be written as

$$V = K + \gamma \ln(\Delta M_t) - \ln(\Delta M_t + M_t + \Delta M^*_t + M^*_t), \tag{8a}$$

$$V^* = K^* + \gamma \ln(\Delta M^*_t) - \ln(\Delta M_t + M_t + \Delta M^*_t + M^*_t), \tag{8b}$$

where $K^* = \ln(f(L+L^*)) + (1-\gamma)\ln(M^*_t)$. The simplest Nash equilibrium will be assumed, and again intertemporal considerations are absent. To maximize welfare taking the actions of the other as given, each government chooses to increase money supply according to the respective first order condition

$$\gamma/\Delta M_t - 1/(\Delta M_t + M_t + \Delta M^*_t + M^*_t) = 0,$$

$$\gamma/\Delta M^*_t - 1/(\Delta M_t + M_t + \Delta M^*_t + M^*_t) = 0.$$

The first order conditions imply that

$$\Delta M_t = \Delta M^*_t = \gamma(M_t + M^*_t)/(1-2\gamma). \tag{9}$$

The price level is given by

$$P_t = \frac{M_t + M^*_t}{(1-2\gamma)f(L+L^*)} = \frac{P_{t-1}}{1-2\gamma}, \tag{10}$$

if a solution exists and inflation is $P_t/P_{t-1} = 1/(1-2\gamma)$. If $\gamma > 1/2$, there is no solution to the first order conditions in the positive quadrant and the second order conditions for maximizing welfare are not met. Inflation becomes infinite because each government places so little weight on consumption by its own consumers that it would expand the money supply without limit in an attempt to increase its share of available output.

Total production of the public good is $2\gamma f(L+L^*)$, evenly split between the two countries. Production and consumption of the consumption good is reduced to $(1-2\gamma)f(L+L^*)$, split between the two countries in proportion to their initial money holdings. The welfare of both countries is lower in the monetary union with independent money creation than when money creation is centralized, because of the distortion to allocation towards the public good. The monetary union will hold together only if there are other costs to dissolving it, perhaps associated with the disruption of traditional payments arrangements. The magnitude of the loss is monotonically increasing in γ in the relevant range ($0 < \gamma < 1/2$). There exists a steady

state equilibrium where real per capita consumption, the savings rate, and all real interest rates are constant, and where all nominal variables inflate at the same rate $1/(1-2\gamma)$.

No government would want to impose an equivalent tax on its half of the population and avoid inflation when through seigniorage it can in effect tax the other half of the population to some degree. This ability to "tax" the citizens of the other country accounts also for the expansion in consumption of the public good. However, each government has an incentive to provide transfers to its citizens if possible, though if both do so, there is no unique equilibrium and inflation tends to infinity.

Note that M_t and M^*_t can be reinterpreted as the stocks of cash available in the two countries, if both countries cannot produce enough banknotes to meet demand for the conversion of deposits into cash. Inflation is lower than if the full demand for cash were met, and the country with the larger supply of cash relative to demand benefits.

IV. Monetary union and monopoly supply of cash money

1. The political economy of a cash shortage

Suppose now that country 2 cannot create new cash money and country 1 begins to exploit its monopoly on the production of banknotes. At the start of period t the government of country 2 announces that it does not have the cash to meet all banks' claims on it, so that available cash $C^*_t = \sigma M^*_t$ is less than M^*_t, with $0 < \sigma < 1$; the smaller is σ, the more severe the shortfall in the supply of cash.

Individuals can obtain cash only from their local bank, that is, one cannot transfer deposits to the other country and obtain cash. Likewise, banks have claims only on the monetary authority of their respective country. Moreover, sellers of goods are equally willing to accept a government's deposit money as a consumer's cash, because deposit money can be used to repay banks, or perhaps because the government imposes this legal condition. 1/ It is assumed that "transactions technology" limits the use of non-cash means of payment; in an economy with very flexible transactions technology, a shortage of cash can be circumvented by greater use of checks, credit cards, etc., at low cost. For now, the confiscation of deposits and other taxes are ruled out, and all interest rates are free to adjust.

The degree of cash shortage and the allocation mechanism becomes important. If so little cash is available that the old cohort is rationed, its members die without being able to spend all their wealth. No real interest rate could be high enough to induce them to hold more deposits.

1/ The results are not substantially changed if the governments have to pay for their purchases in cash.

The old would be willing to exchange all their unused deposits for an arbitrarily small amount of cash.

If the cash shortage at the level of the banks is not too severe, only use of cash by the young cohort need be reduced. In the context of the FSU, a plausible story would run as follows: traditionally, firms pay wages only in cash, a fraction of which is deposited with banks as savings. When a cash shortage occurs, firms start paying wages by deposit transfers, which the young cannot freely encash; if the part of wages available in cash is less than what the young cohort would like to spend on current consumption at prevailing interest rates and prices, there is a cash shortage and excess supply of deposits at the retail level. The reduction in the supply of cash will be characterized by the constraint on country 2 banks that available liquidity must be allocated between lending to firms net of deposits by the young cohort, and deposit withdrawals by the old including interest:

$$\sigma M^*_t = (1-s^*)B^*_t + (1+I_{t-1})D^*_{t-1}. \tag{11}$$

Given that all expenditure on the consumption good must be in cash, the reduction in supply of cash depresses nominal demand below what it would otherwise be, so

$$P_t = \frac{\Delta M_t + M_t + \Delta M^*_t + \sigma M^*_t}{f(L+L^*)}.$$

The welfare functions become

$$V = K + \gamma \ln(\Delta M_t) - \ln(\Delta M_t + M_t + \Delta M^*_t + \sigma M^*_t), \tag{12a}$$

$$V^* = K^* + \gamma \ln(\Delta M^*_t) - \ln(\Delta M_t + M_t + \Delta M^*_t + \sigma M^*_t), \tag{12b}$$

where now $K^* = \ln(f(L+L^*)) + (1-\gamma)\ln(\sigma M^*)$. The simplest Nash equilibrium will again be assumed, and again intertemporal considerations are absent. To maximize welfare, the governments choose to increase money supply according to the first order condition

$$\gamma/\Delta M_t - 1/(\Delta M_t + M_t + \Delta M^*_t + \sigma M^*_t) = 0,$$

$$\gamma/\Delta M^*_t - 1/(\Delta M_t + M_t + \Delta M^*_t + \sigma M^*_t) = 0.$$

It follows that

$$\Delta M_t = \Delta M^*_t = \gamma(M_t + \sigma M^*_t)/(1-2\gamma). \tag{13}$$

The price level is $P_t = (M_t + \sigma M^*_t)/[(1-2\gamma)f(L+L^*)]$ (if a solution exists). Since, in the absence of cash shortage, the price level would have been $P_t = (M_t+M^*_t)/[(1-2\gamma)f(L+L^*)]$, the price level and inflation are

certainly lower than when both countries were free to produce their own cash. 1/ With the assumption that $M^*_t/M_t = L^*/L = \mu$,

$$P_t = \frac{(1+\sigma\mu)M_t}{(1-2\gamma)(1+\mu)fL}. \qquad (14)$$

Total production of the public good is still $2\gamma f(L+L^*)$, again higher than if the government was unified, evenly split between the two countries. With a more general welfare function allowing more substitutability between goods, one might expect the government of country 2 to reduce its expenditure somewhat to improve the consumption pattern. Production and consumption of the consumption good is still $(1-2\gamma)f(L+L^*)$, but consumers of country 1 are able to consume a disproportionate amount of it:

$$q_t/f(L+L^*) = (1-2\gamma)M_t/(M_t + \sigma M^*_t) = (1-2\gamma)/(1+\sigma\mu)$$

$$q^*_t/f(L+L^*) = (1-2\gamma)\sigma M^*_t/(M_t + \sigma M^*_t) = (1-2\gamma)\sigma\mu/(1+\sigma\mu). \text{ 2/}$$

Because there is insufficient cash to allow consumers in country 2 to use all their deposits, consumers in country 1 get to consume more. Country 1 with the monopoly on cash money production is made better off by creating a shortage of cash compared with the symmetric monetary union with independent monetary authorities (see III.2). Indeed, country 1 could be better off than if the monetary union were dissolved, even though the consumption pattern is still distorted towards the public good. Therefore, if there are fixed costs to dissolving the monetary union, country 1 may have the incentive and ability to pay off country 2 to stay in the union. For example, country 1 might provide country 2 with a certain quantity of new banknotes. Once country 2 develops the capacity to produce its own cash, country 1 loses this special incentive to preserve the union.

2. Response to a cash shortage

As has been shown, consumption in country 2 must fall. Moreover, ex post the old cohort earns an unexpectedly high real return on their savings because inflation is lower than expected. Therefore, the country 2 cohort born in period t must suffer a decrease in consumption in period t larger than the aggregate decrease. 3/

1/ Assume that the cash shortage has just started, so $\sigma M^*_t = M^*_{t-1} = (1-2\gamma)M^*_t$, and that $M^*_t = M_t$. Then $P_t = (1-\gamma)P_{t-1}/(1-2\gamma)$. Compared with inflation in the steady state with no cash shortage, given by equation (10), inflation is lower by a factor of $(1-\gamma)$.

2/ If the cash available to country 2 equals spending last period ($\sigma M^*_t = M^*_{t-1} = (1-2\gamma)M^*_t$), and if $M^*_t = M_t$, then $q/q^* = 1/(1-2\gamma)$.

3/ The lifetime utility of this cohort need not decrease if its consumption in t+1 is sufficiently high.

Various mechanisms can be envisaged that would produce these effects. First, the real deposit interest rate can be sufficiently high and/or income can be so low that people voluntarily decrease their demand for cash sufficiently. Second, access to cash can be rationed by quantity. Third, the exchange rate between cash and deposit money can be allowed to diverge from one to one; in equilibrium, the exchange rate will reproduce the effect of a rise in the real deposit interest rate. Fourth, the government in country 2 could simply tax away deposits. Finally, the price of goods that can be bought for cash could rise relative to those that can be bought with deposit money; for many goods (especially essentials), non-cash means of payment are not widely available in the FSU, so this last possibility may not be relevant.

a. Flexible interest rates

First, let us consider the case where rates of interest are flexible and free to adjust. Demand for the consumption good, and thus demand for cash with which to make purchases, can be brought into line with the available supply of cash by increasing the incentive to save, or by reducing incomes and wealth. When all prices including interest rates are free to adjust, it turns out that adjustment will be achieved through a rise in deposit interest rates. In equilibrium banks are still able to lend enough that firms can pay relatively high real wages, and the young are induced to substitute consumption tomorrow for consumption today.

Consider banks' lending behavior and the demand for credit and deposits. Taking first banks in country 2 where there is a cash shortage, they begin period t with claims M^*_t on the government. During the period, their liquidity outflow is σM^*_t, the young deposit $s^*_t B^*_t$, and their receipts from repayments by firms are $(M_t+\sigma M^*_t)fL^*/[f(L+L^*)(1-2\gamma)] = (1+\sigma\mu)M^*_t/[(1-2\gamma)(1+\mu)]$. Then at the end of period t

$$NW^*_t = \text{assets} - \text{liabilities}$$

$$= (1-\sigma)M^*_t + (1+\sigma\mu)M^*_t/[(1-2\gamma)(1+\mu)] - s^*_t B^*_t \qquad (15)$$

It is assumed that the banks set their interest rates so as to maintain their real net worth, so that in nominal terms

$$NW^*_t = (P_t/P_{t-1})NW^*_{t-1}.$$

Since $P_{t-1} = (M_t+M^*_t)/f(L+L^*) = M^*_t/fL^*$ and $NW^*_{t-1} = M^*_t - D^*_{t-1}$ at the end of period t-1, it is easy to show using (14) and (15) that

$$s^*_t B^*_t = \frac{1+\sigma\mu}{(1-2\gamma)(1+\mu)} D^*_{t-1} + (1-\sigma)M^*_t.$$

so, using (11),

$$B^*_t = \frac{(1+\sigma\mu)}{(1-2\gamma)(1+\mu)} D^*_{t-1} - (1+I_{t-1})D^*_{t-1} + M^*_t, \qquad (16)$$

which is clearly increasing in σ. Therefore, the nominal quantity of lending decreases, the more severe is the cash shortage.

One can now use (11) again to obtain

$$s^*_t = \frac{(1+\sigma\mu)D^*_{t-1} + (1-2\gamma)(1+\mu)(1-\sigma)M^*_t}{(1+\sigma\mu)D^*_{t-1} + (1-2\gamma)(1+\mu)[M^*_t - (1+I_{t-1})D^*_{t-1}]}, \qquad (17)$$

which can be shown using the relationship that $M^*_t > (1+I_{t-1})D^*_{t-1}$ to imply that the savings rate in country 2 decreases with σ. The effect of the cash shortage is distributed between a reduction in the quantity lent and an increase in the savings rate of the young in country 2.

The requisite change in savings behavior can be achieved through a suitable adjustment in the real interest rate on deposits. From equation (17), it can now be shown that, if $\partial s^*_t/\partial i^*_t > 0$, the real deposit interest rate required to achieve equilibrium will be decreasing in σ, that is, a cash shortage will raise the real deposit interest rate in country 2. The equilibrium real interest rate can be derived explicitly if a particular utility function is assumed, as in equation (2).

Since the real wage is given by $w^*_t = B^*_t/L^*P_t$,

$$w^*_t = \frac{(1-2\gamma)(1+\mu)f[M^*_t - (1+I_{t-1})D^*_{t-1}]}{(1+\sigma\mu)M^*_t} + \frac{fD^*_{t-1}}{M^*_t}, \qquad (18)$$

which is clearly decreasing in σ. The cash shortage decreases price and wage inflation below what it would be in a symmetric monetary union, but price inflation is more affected. Demand for cash will be depressed to meet reduced supply, and the capital gain of the old cohort will be accommodated, only by increasing the savings rate through a higher real interest rate, not by reducing the real income of the young cohort.

On the lending side, the zero profit condition for enterprises requires that loan repayments including interest equal total expenditure by consumers and government on goods produced by country 2 enterprises, so

$$(1+R^*_t)B^*_t = (M_t+\sigma M^*_t)L^*/[(1-2\gamma)(L+L^*)] = (1+\sigma\mu)M^*_t/[(1-2\gamma)(1+\mu)], \qquad (19)$$

which can be compared with equation (6). By definition the real lending rate r^*_t in country 2 is given by $(1+r^*_t) = P_{t-1}(1+R^*_t)/P_t$. Hence, using (14), $(1+r^*_t) = M^*_t/B^*_t$. Since B^*_t increases with σ, the real lending rate decreases, that is, the cash shortage raises real lending rates.

Banks in country 1 continue to face the cash in advance constraint (1). In equilibrium, enterprises in country 1 will receive revenues of $(M_t+\sigma M^*_t)L/[(1-2\gamma)(L+L^*)] = (1+\sigma\mu)M_t/[(1-2\gamma)(1+\mu)]$ with which to repay any borrowing. Therefore, for these banks

$$NW_t = \text{assets - liabilities}$$

$$= (1+\sigma\mu)M_t/[(1-2\gamma)(1+\mu)] - s_tB_t.$$

Reasoning analogous to that immediately above allows one to derive that

$$B_t = \frac{(1+\sigma\mu)D_{t-1}}{(1-2\gamma)(1+\mu)} - (1+I_{t-1})D_{t-1} + M_t, \tag{20}$$

so B_t is lower, the lower is σ. One can now use (1) to obtain

$$s_t = \frac{(1+\sigma\mu)D_{t-1}}{(1+\sigma\mu)D_{t-1} + (1-2\gamma)(1+\mu)[M_t - (1+I_{t-1})D_{t-1}]}, \tag{21}$$

which implies that the savings rate in country 1 increases with σ; a cash shortage in country 2 allows the young in country 1 to save proportionately less. Mutatis mutandis, the real wage is the same as in country 2 (see equation (18)). It is easy to show that $(1+r_t) = M_t/B_t$. Since B_t increases with σ, the real lending rate rises even in the cash-producing country 1.

b. Fixed rate of interest on deposits

Now suppose that the authorities in country 2 choose to fix the real interest rate on new deposits at a level $(i^*{}'_t)$ below the equilibrium rate required to achieve a voluntary savings rate given in equation (17). The young cohort must be forced to save a proportion $s^*{}'_t$ of their income; there will be a true shortage. For given expectations of the price level next period, the nominal interest rate must also be fixed (say at $I^*{}'_t$) below what it would be in case IV.2.a. 1/

It is assumed that competition among banks still ensures that their real net worth just remains constant in real terms during period t. Therefore, one can use the analysis above to derive that the amount of lending will still be given by equation (16), and the rate of forced savings satisfies (17). The real wage is still as in (18). Compared to

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1/ The relationship between nominal and real interest rates depends of course on the price level expected next period, which in turn depends on whether the monetary union survives and whether the cash supply remains restricted. Price expectations need not be specified here provided they are taken to be fixed.

case IV.2.a, the cohort born in period t has the same real income and savings rate, but receives a lower real return on those savings, so it must be worse off; the period t cohort loses not just to the t-1 cohort, which enjoys an unexpectedly high return on savings in period t, but also to the cohort born in period t+1, which enjoys higher share of the available output in period t+1 because the period t cohort earns little on its savings.

c. Fixed rate of interest on deposits and lending

The authorities could go further and fix both deposit and lending rates at below the rates which clear all markets (including the markets for cash and deposits). Let the fixed lending rate be $R^{*''}_t$, which is less than the rate R^*_t that obtains in case IV.2.a. If it is assumed that the banks continue to lend to firms until the firms expect to make zero profits, the quantity of lending in country 2 can be derived from (19) as

$$B^{*''}_t = \frac{(1+\sigma\mu)M^*_t}{(1+R^{*''}_t)(1-2\gamma)(1+\mu)}, \qquad (22)$$

which increases with σ. Since the quantity of lending in case IV.2.a. when interest rates adjust is $B^*_t = (1+\sigma\mu)M^*_t[(1+R^*_t)(1-2\gamma)(1+\mu)]^{-1}$ and by definition $R^{*''}_t < R^*_t$, the quantity of lending is now higher. The real wage rate is $w^{*''}_t = B^{*''}_t/P_tL^*$, so the real wage is also higher. The system is equilibrated through cash rationing. From (11), the rate of rationing is given by

$$1-s^{*''}_t = \frac{(1+R^{*''}_t)(1-2\gamma)[\sigma M^*_t-(1+I_{t-1})D^*_{t-1}]}{(1+\sigma\mu)M^*_t}, \qquad (23)$$

so clearly $ds^{*''}_t/d\sigma < 0$, and more rationing is necessary, the more severe the cash shortage. In country 1, nominal borrowing and the savings rate increase with σ, while the real wage is unchanged.

d. Adjustment of the cash-deposit money exchange rate

The young of country 2 can be induced to save more in period t without explicit rationing or interest rate adjustment if the banks no longer offer a one for one exchange rate for converting deposits into cash. In particular, suppose that the young in country 2 must give up e_t units of deposit money for each unit of cash money. For convenience, assume that real deposit and lending rates remain fixed as in section IV.2.c. 1/ Then the quantity of lending and the rate of savings will be the same as in that case, and are given in (22) and (23), respectively.

1/ The case where only deposit rates are fixed is similar.

The savings rate will now depend on the exchange rate. Next period the one for one exchange rate is restored. Then the budget constraint of the cohort born in period t becomes

$$P_{t+1}q_{t,t+1} = [W_tL - e_tP_tq_{t,t}](1+I^{*\prime}{}_t).$$

It is assumed that consumers have a Cobb-Douglas utility function. Recalling that the real interest rate is given by $(1+i^{*\prime}{}_t) = (1+I^{*\prime}{}_t)P_t/P_{t+1}$, it can be established that, instead of (2), the savings rate is

$$\hat{s}_t = \frac{1}{1 + \rho^{1/(\alpha-1)}[e_t(1+i^{*\prime}{}_t)]^{\alpha/(\alpha-1)}} . \qquad (24)$$

which can be used in (17) to derive the equilibrating exchange rate.

e. With monetary confiscation

Suppose now that the situation is the same as described in IV.2.a except that governments can confiscate part of the money stock by raising taxes from their respective citizens. Country 1's government has no incentive to do so. It appears that country 2's government has an incentive to tax away or confiscate the full amount of excess deposit money held by its citizens $(1-\sigma)M^*_t$: the excess yields no benefit for the citizens, and by financing its expenditure with less money creation government 2 might be able to increase the real value of available cash money. It turns out that in this model, country 2 does not benefit from taxing its citizens because total nominal demand is not affected.

When the tax is imposed, country 2's citizens still spend σM^*_t on the consumption good. The government of country 2 spends $\Delta M^{*\prime}{}_t + (1-\sigma)M^*_t$ on the public good. Country 1 behaves as before. Therefore, total nominal demand is $\Delta M_t + M_t + \Delta M^{*\prime}{}_t + M^*_t$. The objectives functions can be written

$$V = K + \gamma \ln(\Delta M_t) - \ln(\Delta M_t + M_t + \Delta M^{*\prime}{}_t + M^*_t), \qquad (25a)$$

$$V^* = K^* + \gamma \ln(\Delta M^{*\prime}{}_t + (1-\sigma)M^*_t) - \ln(\Delta M_t + M_t + \Delta M^{*\prime}{}_t + M^*_t). \qquad (25b)$$

Using the first order conditions for maxima of (25a) and (25b), it follows that ΔM_t is still given by (13), and that

$$\Delta M^{*\prime}{}_t = [\gamma M_t + (1-\gamma)\sigma M^*_t]/(1-2\gamma) - M^*_t.$$

Therefore, total nominal expenditure, the price level and consumption of all goods is the same as in case IV.1. In other words, the confiscation of the excess stock of deposits that cannot be converted into cash by the public does not change any real variable or prices. However, banks' claims on government will be reduced, so the price level next period will be affected.

V. Extensions

1. Efficiency effects of a cash shortage

So far the model has not allowed the cash shortage to affect total output, because labor remains fully employed in the unique production process. Indeed, the goods markets need not be disequilibriated by a cash shortage; demand for goods remains equal to supply, although there will be indirect effects as the cash shortage may shift the demand and supply schedules compared to the steady state. 1/ It is necessary only that the ex post supply and demand for the components of money must be equal.

Neutrality may not be preserved if there is an alternative use for labor. In particular, it is assumed that labor can be used in a production process that does not require financing and that yields goods for immediate consumption. Using this "home" production technology, one unit of labor yields k units of output. The "factory" production function is assumed to be sufficiently superior, that normally no labor is used for home production ($f > k$; worker-consumers will use the home production technology only if the real wage is less than or equal to k). 2/ 3/

A labor switching (or shirking) mechanism is used here for several reasons, in addition to simplicity. Casual empiricism suggests that, on the margin, labor in the FSU can be diverted into the informal sector of trading and home production. Real interest rates have been so low and distorted that the availability of financing has been more important than its price, so a mechanism relying on adjustment to interest rates affecting investment behavior does not seem very relevant.

When interest rates are free to react to the reduction in cash supply, there is no incentive to resort to the alternative technology, because both wages and the deposit interest rate rise in real terms. However, when cash is rationed and the real deposit interest rate is kept low, the wages paid by firms become less valuable. Suppose that real wages are such that a worker-consumer devotes a proportion ϕ ($0 < \phi < 1$) of the labor to home production; this proportion is sufficiently low, that home production is

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1/ The cash shortage could be made even worse if the goods markets are also in disequilibrium. In several republics of the FSU, some prices are still controlled and the corresponding goods are somehow rationed.

2/ Calvo and Kumar (1994) use a similar framework, but assume that labor productivity in the informal sector determines the real wage. It is easy to work through the model presented here assuming a fixed real wage and allowing unemployment. They also point out that the model can be reinterpreted as one of labor shirking.

3/ The crucial distinction between "factory" and "home" production in the present model rests on the indirectness of the production process and use of bank credit. Interpretation of "factory" and "home" as formal and informal, respectively, may raise questions about appropriateness of the assumption of $> k$.

for own use and not sold. The rate of forced savings is still $s^{*\prime}$. Then a cohort born in period t with labor endowment L faces a budget constraint

$$P_{t+1}q_{t,t+1} = s^{*\prime}{}_t W_t(1-\phi)L(1+I^{*\prime}{}_t),$$

and

$$q_{t,t} = (1-s^{*\prime}{}_t)(1-\phi)Lw_t + k\phi L.$$

With the Cobb-Douglas utility function, the members of the cohort maximize

$$U = [(1-s^{*\prime}{}_t)w(1-\phi)L + k\phi L]^{\alpha} + \rho[s^{*\prime}{}_t w(1-\phi)L(1+i^{*\prime}{}_t)]^{\alpha}$$

with respect to ϕ. If a high real wage is available by selling labor to firms, the home production technology will not be used at all. At a critical real wage (w'), labor starts to be diverted to home production. It can be shown using the first order condition for maximizing utility and setting ϕ=0, that the cohort will devote some proportion of labor to home production if the wage rate is less than or equal to

$$w' = \frac{(1-s^{*\prime}{}_t)^{\alpha-1}k}{\rho s^{*\prime}{}_t{}^{\alpha}(1+i^{*\prime}{}_t)^{\alpha}+(1-s^{*\prime}{}_t)^{\alpha}}. \tag{26}$$

The critical wage w' will be greater than k (the critical level in the absence of rationing) if

$$s^{*\prime}{}_t > \frac{1}{1+\rho^{1/(\alpha-1)}(1+i^{*\prime}{}_t)^{\alpha/(\alpha-1)}}, \tag{27}$$

that is, if consumers are forced to save more than they would voluntarily at going real deposit interest rate (compare with equation (2)). It has been shown in cases IV.2.b. and IV.2.c. above that cash rationing (forced savings) will be necessary if the real deposit interest rate is fixed too low. Hence, for a range of values of k, worker-consumers of the young cohort will resort to the home production technology to circumvent the cash shortage. If indeed $\phi > 0$, output decreases because $f > k$.

The situation is similar when consumers are faced with a cash-deposit exchange rate different from unity. The period t cohort with labor endowment L faces a budget constraint

$$P_{t+1}q_{t,t+1} = \hat{s}_t W_t(1-\phi)L(1+I^{*\prime}{}_t),$$

and

$$q_{t,t} = (1-\hat{s}_t)(1-\phi)Lw_t/e_t + k\phi L.$$

The Cobb-Douglas utility function is maximized with respect to ϕ and $\hat{s}_t$, which are both decision variables. It can be shown using both first order conditions that the critical real wage at which the young cohort will start to devote labor to home production is

$$\hat{w} = e_t k, \tag{28}$$

which equals the real wage that, if converted into cash at the going exchange rate, would yield the same amount of the consumption good as can be obtained using the home production technology. As with rationing, for a range of values of k, a devaluation of deposit money will induce the diversion of labor into the lower productivity sector and a loss in output.

Thus, all mechanisms to resolve the cash shortage have drawbacks and limitations. Rationing, a depreciation of the deposit-cash exchange rate, or a large rise in the price of cash goods may induce a flight from the formal economy. When worker-consumers have the option of diverting labor to the informal sector, where productivity is lower but transactions are carried out without the intermediation of banks, cash rationing or a depreciation of the deposit-cash exchange rate raises the critical real wage, below which labor will move to the informal sector. Therefore, these mechanisms may induce a fall in output, and disintermediation. In the extreme where no cash is available to pay wages, worker-consumers would desert the formal sector entirely and concentrate all their efforts on producing for immediate consumption and sale for cash. Rationing may also lead to an increase in rent seeking.

In a more elaborate model one could include effects of the rise in real interest rates occasioned by the cash shortage even when all rates are free to adjust. There is a presumption that higher real rates will discourage investment and, over time, reduce output and consumption. If the cash shortage is very severe, the equilibrating real interest rate or exchange rate may have to be extremely high, which may bankrupt many firms and forestall productive investment, or wages in the formal sector may have to be very low and labor supply will be affected. Furthermore, the country which lacks the ability to produce banknotes has an incentive to introduce export barriers to prevent the other country obtaining goods through its seigniorage power. In any case, the cash shortage could have large real effects that are perpetuated through many periods.

2. Dynamic and strategic interactions

So far it has not been necessary to specify how the economies evolve after the first period of cash shortage. Two cases are of special interest, namely, when the monetary union is dissolved, and when it continues indefinitely.

First, when the monetary union is dissolved at the end of period t, each country has a single monetary authority, so there is no incentive to increase the money stock by a factor greater than $1/(1-\gamma)$ (see section III.1) provided that the exchange rate between the new currencies

floats freely. It is assumed that each country can then produce as much cash as it desires.

During period t, firms' receipts are in proportion to their share in total output, and are used to repay banks. Hence, banks in country 1 start period t+1 with claims

$$M_{t+1} = \frac{(M_t + M^*_t)fL}{(1 - 2\gamma)f(L+L^*)} = \frac{(1+\sigma\mu)M_t}{(1 - 2\gamma)(1+\mu)} \tag{29}$$

on its monetary authority. Therefore,

$$P_{t+1} = \frac{(1+\sigma\mu)M_t}{(1-\gamma)(1-2\gamma)(1+\mu)fL} = \frac{P_t}{1-\gamma}, \tag{30}$$

and subsequently inflation is $1/(1-\gamma)$ per period. In country 2, banks have claims

$$M^*_{t+1} = (1-\sigma)M^*_t + \frac{(1+\sigma\mu)M^*_t}{(1 - 2\gamma)(1+\mu)} \tag{31}$$

at the start of period t+1, reflecting both the liquidity that they could not use during period t due to the cash shortage, and the repayment of loans by firms. The price level rises to

$$P^*_{t+1} = \frac{1}{1 - \gamma}\left[\frac{1 + \sigma\mu}{(1 - 2\gamma)(1+\mu)} + (1-\sigma)\right]\frac{M^*_t}{fL^*} = \frac{1}{1 - \gamma}\left[P_t + \frac{(1-\sigma)M^*_t}{fL^*}\right], \tag{32}$$

which implies that inflation from period t to t+1 is higher than the new steady rate of $1/(1-\gamma)$, and may even be higher than $1/(1-2\gamma)$, the rate in the symmetric monetary union with independent monetary authorities (see section III.2).

Suppose now that the cash shortage is perpetuated indefinitely. Because country 2 runs a trade surplus, it obtains cash, adding to the stock available next period. However, the shortage is not self-correcting, but rather is perpetuated by the governments' additions to citizens' holdings of deposit money. In particular, at the start of period t+1 one period after the start of the cash shortage, the money stock in country 1 is given by equation (29). Country 2 has available as cash

$$C^*_{t+1} = \frac{(M_t + M^*_t)fL^*}{f(L + L^*)} = \frac{(1+\sigma\mu)\mu M_t}{(1+\mu)}, \qquad (33)$$

its share of cash expenditure, whereas the claims of banks on the monetary authorities are given by (31). Using the analysis from section IV.1, the equilibrium price level in period t+1 equals

$$P_{t+1} = \frac{(1+\sigma\mu)M_t}{(1-2\gamma)(1+\mu)^2 fL} \cdot \left[\frac{1}{1-2\gamma} + \mu\right] = P_t \cdot \frac{1+(1-2\gamma)\mu}{(1-2\gamma)(1+\mu)}. \qquad (34)$$

It can be shown by induction that the total stock of money, cash available to country 2, and the price level subsequently inflate at a rate of $(1+(1-2\gamma)\mu)/[(1-2\gamma)(1+\mu)]$ per period. 1/ Thus, inflation is certainly less than in a monetary union with two unconstrained sources of money creation $(1/(1-2\gamma))$, but more than under a unitary monetary authority $(1/(1-\gamma))$ provided that $\mu < 1/(1-2\gamma)$.

So far, the governments have been assumed to follow "Nash" behavior, that is, each takes the other's actions as given, where the amount to spend on the public good is the only choice variable. If country 1 could provide transfers to its citizens, it has more incentive to do so than when there is no cash shortage, because country 2 cannot retaliate by increasing the spending power of its own consumers. The equilibrium inflation rate tends to infinity and country 1 receives the full endowment.

Using a different equilibrium concept, the countries could engage in more "aggressive" forms of interaction. For example, it would be easy to designate one or the other country as a Stackelberg leader in the policy game, or to introduce consistent conjectural variations. One could also consider the consequences of expanding the strategy set available to countries. For example, country 2 has an incentive to erect export barriers, as indeed became widespread in the FSU. Export barriers would perpetuate the cash shortage by hindering the corresponding import of banknotes, but may help prevent the cash producing country enjoying its seigniorage gains.

3. Cash shortage in a cash producing country

There have been indications that cash has been in short supply in the Russian Federation itself from time to time. While these reported shortages may represent genuine difficulties with the production and distribution of banknotes, there may be conditions under which the authorities would intentionally constrain the cash supply. In the model given above, restricting cash to one's own citizens lowers inflation and

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1/ The cash shortage even increases over time in absolute, but not in relative terms.

thus increases the real value of the other country's monetary wealth; the other country's share of seigniorage is increased. At least two other mechanisms can be envisaged, under which the government of country 1 (the cash producer) would have an incentive not to satisfy demand from its citizens for cash.

First, the authorities in the cash producing country may have imperfect control over the creation of deposit money, yet dislike the distributional consequences of deposit creation or inflation in itself. For example, regional governments may be able to force local banks to supply them with credits in a bid for greater autonomy. 1/ Alternately, the central authorities may negotiate sequentially with a series of special interest groups, each of which can extract, and will be placated by, concessions in the form of "special credits" refinanced by the monetary authorities.

The inflationary, political, and distributional consequences of such fragmentation can be partially undone by restricting households' access to cash, so that a rise in their deposit balances cannot have full effect on nominal demand. In effect, a monetary overhang is created by rationing at the bank wicket, rather than at the shop counter. Some aspects of the conflict between the center and the periphery may parallel the conflict between countries in a monetary union.

The second mechanism is dependent on the conditions of a monetary union. Country 1 can benefit from limiting the cash supply to country 2 only if the citizens of country 2 cannot obtain cash from country 1's banks. Government 1 may attempt to stop its banks exchanging deposit money for cash with citizens from country 2, but the ban may be imperfectly enforced, and some citizens of country 1 may be prevented from obtaining cash, by mistake or because citizens from country 2 have offered bribes to obtain some of the banks' limited supply of cash. Suppose further that the ban is more effective, the more severe is the limitation on the supply of cash to country 1's banks, so citizens of country 1 get proportionately more of the cash supply, the greater is the shortage. Then government 1 may accept some restriction on the availability of cash to its own citizens, in order to exploit its monopoly on cash production.

VI. Conclusions and Epilogue

The newly independent republics of the FSU continued to operate with the Soviet and Russian ruble during much of 1992 and 1993. The lack of effective coordination between the republican central banks since the dissolution of the USSR led to the emergence of a cash shortage in the republics. The shortage manifested itself in the suspension of convertibility of deposits into currency at par. In the immediate

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1/ We are grateful to J. Braithewaite and J. Haley for suggesting this possibility.

aftermath of such a disintegration, every successor state has unlimited capacity to create deposit money but only one is capable of producing cash. There is an incentive for the state with the monopoly power of printing currency to deny seigniorage to others by reducing their access to cash. The unanticipated reduction in the supply of cash can lead to a cash shortage in these other states. The cash shortage in the Russian Federation itself--the country with the currency printing facilities--was probably the result of a deliberate attempt by the CBR to rein in inflation in an economy used to transacting mostly in currency, while political factors undermined control over the creation of bank credits and deposits. The pursuit of these strategies by the CBR resulted in the containment of ruble area inflation during 1992-93 below hyperinflation levels, even while they destabilized the monetary union.

The monetary contraction implied by a cash shortage would tend to raise the real interest rate in an unrestricted economy; wage inflation slows less than price inflation, so the compression of consumption is achieved by inducing a higher savings rate. Cash rationing should have disappeared if the rates of interest were allowed to adjust to make deposits more attractive relative to cash, yet the evidence suggests that the cash rationing persisted for more than a few weeks or months. If nominal and thus real interest rates are artificially held down, access to cash must be rationed, or banks will exchange one unit of cash money for more than one unit of deposit money. In either of these last two cases, those who experience the cash shortage will suffer relatively low consumption also in the future, because they earn a lower real return on their savings or suffer a capital loss on exchanging deposits for cash. Thus, preventing interest rates from adjusting increases the burden borne by the current generation, who may react by withdrawing their labor from the more productive sector. The interrepublican distributional effects arising from the Russian monopoly on cash production were unavoidable, but rapid adjustments in the rates of interest could have avoided the compounding of these distributional effects by a loss in efficiency.

In July, 1993 the Russian Federation decided to demonetize pre-1993 Soviet and Russian rubles. This move was interpreted as a further exercise in the CBR's monopoly over the cash supply; other republics would in effect be denied the use even of the outstanding stock of banknotes. At the time of writing, only Belarus and Tajikistan are pursuing monetary reunification with Russia, the other states have introduced their separate currencies.

The initial enthusiasm in non-Russian republics for maintaining the ruble area was motivated by the objective of maintaining intra-FSU trade and financing relations, an expectation that remaining in the ruble area would result in access to higher level of financing as well as subsidized energy supplies from the Russian Federation, and the realization that the introduction of a national currency does not improve macroeconomic

performance unless it is backed by prudent fiscal and monetary policies. 1/ Furthermore, time is needed to set up the institutional and policy framework for successful currency reform. Yet the disadvantages of a monetary union without a central authority but with an asymmetric distribution of strategies, in terms of redistribution and loss of output, seem to have proven greater than the advantages of maintaining an integrated monetary area. However, the determination of the optimal timing of any currency reform in the FSU republics goes beyond the scope of this paper.

1/ See Fischer (1982) for a discussion of general issues relevant in consideration of the case for a national money.

APPENDIX

List of variables

B_t	Banks' loans in period t
C_t	Cash available in period t
D_t	Banks' deposit liabilities at end of period t
e_t	Deposit money price of cash
$f(L)$	Factory production function
g_t	Government consumption in period t
I_t	Nominal deposit interest rate for funds deposited at t, to be withdrawn at t+1
i_t	Real deposit interest rate for funds deposited at t, to be withdrawn at t+1
$k(L)$	Home production function
L	Labor supply
M_t	Claims of banks on government at start of period t
NW_t	Net worth of banks at the end of period t.
P_t	Price level in period t
$q_{t,\tau}$	Consumption in period τ by the cohort born in t
R_t	Nominal lending interest rate for funds borrowed at start of t, to be repaid at end of t
r_t	Real lending interest rate for funds borrowed at start of t, to be repaid at end of t
s_t	Savings ratio of young in period t
V	Welfare
W_t	Nominal wage in period t
w_t	Real wage in period t
*	Denotes a variable relating to country 2

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