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Exchange Rate Determinants in Russia: 1992-93

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Abstract

This paper examines the evolution of the exchange rate of the ruble vis-à-vis the U.S. dollar from exchange rate unification, in July 1992, to the end of 1993. The expected and actual paths of the exchange rate are related to the exchange and trade regime and to the stance of financial and exchange rate policies. An econometric analysis based on weekly data is offered, which suggests that monetary factors have a significant impact on the short run behavior of the exchange rate.

JEL Classification Numbers:

E31, E41, E52, E58, F31

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### Summary

The adoption of a unified exchange regime in July 1992 was a major step in opening Russia to the world economy and moving toward a market system. Notwithstanding political turmoil, collapsing output, very high inflation, large-scale dollarization, and occasional rumors about an imminent return to a system of multiple exchange rates, this decision has not been reversed. The expansion of the organized foreign exchange market has been vigorous, though it started from a minuscule base. By late 1993, regular spot auctions were being held at exchanges in six Russian cities, and two futures markets were active in Moscow. Over time, the various segments of the foreign exchange market have become increasingly integrated, even if seemingly unexploited arbitrage opportunities have not disappeared altogether.

Exchange rate policy has evolved roughly through three phases: (1) an unsuccessful attempt in the spring of 1992 to move to a formal target zone at the time of unification; (2) a managed float between mid-1992 and mid-1993; and (3) a system of notional target zones or at least a regime of large-scale smoothing in the second half of 1993. The real exchange rate appreciated by more than 150 percent in the 18 months following unification, thus reducing considerably, or possibly even reversing, what was perceived by many as the large undervaluation of the ruble in mid-1992. This pattern was broadly similar to what was observed in some countries in Central and Eastern Europe at the same stage of the transition.

In order to provide a more formal evaluation of the behavior of the exchange rate, a simple model of exchange rate determination is developed and tested on weekly data. The empirical results suggest that the interest rate differential and the expected inflation differential clearly have influenced the exchange rate of the ruble vis-à-vis the U.S. dollar in the short run. Moreover, the evidence seems to imply that market participants have been aware of the risks associated with high inflation.

The sturdiness of the central exchange rate equation is tested by using it for an out-of-sample projection. The abrupt depreciation of the nominal exchange rate in January 1994, in stark contrast to its near-stability in the previous half year, is well captured by the equation.



"The economic system of Russia has undergone and is undergoing such rapid changes that it is impossible to obtain a precise and accurate account of it. (...) Almost everything one can say about the country is true and false at the same time."

Keynes (1925, pp.18-19)

## I. Introduction

Through mid-1992, a system of multiple exchange rates operated in Russia. In the first days of July 1992, exchange rate unification took place. This represented one of the major economic reforms implemented in 1992, and followed the wide-scale liberalization of domestic prices in January. In a financial environment characterized by high inflation and considerable uncertainty, the evolution of this unified exchange rate was the object of much comment, both in Russia and abroad. So far, however, little systematic and no econometric analysis has been offered. In part, this is due to the fact that the evidence on the exchange rate itself and on its determinants was limited in scope and time. But, over a year and a half after unification, and despite the severe data limitations that remain, it has become possible to carry out a formal empirical investigation of the determinants of the exchange rate of the ruble. This paper is intended as a first step in that direction.

This paper abstracts from several key issues, mainly owing to the absence of sufficient quantitative information. In particular, the implications of the existence of a ruble area extending beyond the borders of the Russian Federation and which underwent several metamorphoses over time will not be discussed. Also, the quantitative analysis will focus exclusively on the bilateral exchange rate of the ruble vis-à-vis the U.S. dollar, and essentially on the interbank, non-cash exchange rate quoted in Moscow, notwithstanding the fact that this rate is not the one faced by many agents in their foreign exchange conversion operations.

Section II describes the external trade and exchange rate system as it evolved in the course of 1992-93, highlighting those changes that were most likely to affect the value of the exchange rate, and documents the development of the foreign exchange market. Section III relates the evolution of the stance of financial policies and of exchange rate policy to the expected and actual path of the exchange rate over the period under consideration. Section IV presents a set of econometric estimates based on a simple model of exchange rate determination. Section V concludes. A statistical appendix provides an overview of the data used.

## II. The exchange and trade system

This section reviews the steps in moving toward a unified, market-determined exchange rate, the related changes in exchange and trade arrangements and the development of the foreign exchange market.

1. Evolution of the exchange and trade system 1/

Liberalization of the exchange and trade system started in the late 1980s. The state monopoly in foreign exchange was relaxed somewhat, as enterprises were allowed to retain foreign exchange that could be used, within certain limits, for imports. External trade started to be decentralized, with enterprises being permitted to trade directly abroad instead of via the foreign trade organizations. The external borrowing and foreign exchange monopolies of the Vneshekonombank (VEB) were terminated. Licensed commercial banks were permitted to deal in foreign exchange and limited foreign exchange auctions were initiated (see below). These piecemeal liberalization measures were implemented in the context of continued price controls and growing financial instability. They contributed to boost effective demand for imports but did not stimulate exports, and therefore bore some responsibility for the rapid increase in external debt. 2/

Following the Supreme Soviet's approval of presidential guidelines calling for the introduction of currency convertibility, a commercial exchange rate replaced the official exchange rate for most transactions in November 1990 (the official exchange rate was kept only for the valuation of external claims and selected statistical purposes). The commercial rate was fixed in terms of a basket of five currencies and set at a level three times as depreciated as the official exchange rate. At the same time, some export quotas were increased, import taxes were reduced, and export taxes introduced for the main raw materials. There was also a tourist exchange rate which originally, in November 1989, had been set at a level 10 times more depreciated than the official rate. Finally, a parallel foreign exchange market had long existed and was becoming increasingly tolerated as the previous control system broke down and the incentives widened for bypassing official channels. The spreads between the fixed and more market-determined rates widened during 1991, as the increase in domestic liquidity resulted in a depreciation of the latter.

In January 1992 the exchange and trade system was partially liberalized. A substantial depreciation of the rate for commercial operations helped reduce exchange rate distortions. However, a multiplicity of exchange rates remained in place. For the 40 percent surrender requirement that was introduced for raw materials, a "special commercial exchange rate" of Rub 55 per U.S. dollar was applied. For the 10 percent surrender requirement applying to all exports, a so-called quasi-market rate established by the Central Bank of Russia (CBR) was used, which was initially set at Rub 110 per U.S. dollar, but was periodically adjusted.

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1/ What follows is a brief overview. A more detailed account is offered in IMF and others (1991), IMF (1992a, 1992b, 1993, 1994) and the annual IMF reports on exchange arrangements and restrictions. For a survey of experiences in Central and Eastern Europe, see Borensztein and Masson (1993).

2/ See Christensen (1994).

Alongside these controlled rates, several types of market rates continued to co-exist, including the interbank auction rate quoted on the Moscow Interbank Currency Exchange (MICEX), the rates offered by banks to individuals and the rates agreed in informal street trades. For government operations, several exchange rates were in effect. A rate of Rub 55 per U.S. dollar was applied for debt-service payments. A special rate of Rub 5.4 per U.S. dollar was used for so-called centralized import operations and services payments financed from the Hard Currency Reserve Fund (e.g., contributions to international organizations and business trips abroad for officials). A special accounting rate of Rub 10 per U.S. dollar was created for tax settlement with citizens who had income in foreign exchange. Finally, the official exchange rate was preserved for the valuation of external claims.

A set of major reforms of the foreign exchange and trade system were implemented in July-August 1992, including the unification of the exchange system and the introduction of convertibility of the ruble for current transactions. However, some of the accompanying measures were not taken: export quotas continued to apply to most goods, import subsidies remained large, foreign exchange reserves were not consolidated within the CBR, and there were delays in introducing the foreign exchange regulations.

The unification of the ruble was accomplished through the abolition of the special commercial exchange rate on July 1, of the quasi-market rate on July 3, of most of the special budgetary exchange rates on July 1, and of the remaining one on August 15. <sup>1/</sup>

The unification of the exchange system was expected to result in a large depreciation of the effective exchange rate applying to centralized imports, which accounted for about two-thirds of total imports during the first half of 1992, as import subsidies were to be confined to grain, medicine and imports under the World Bank's Rehabilitation Loan. The new regulations that took effect from August 15, however, had little effect on the domestic prices of centralized imports, as the multiple exchange rates were effectively replaced by explicit subsidies. The latter varied by commodity and averaged approximately two thirds of the foreign currency value of subsidized centralized imports.

On the export side, effective taxation was greatly reduced, as exporters ceased to be subject to the surrender requirement at an appreciated exchange rate. The repatriation requirement was maintained, with 50 percent of all export receipts having to be surrendered to the banking system at the interbank market rate, the banks in turn being obliged to sell 30 out of the 50 percentage points to the CBR. The Government subsequently introduced many exemptions to the surrender requirement, both

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<sup>1/</sup> See the official announcement by the CBR published in *Rossiskaya Gazeta* on July 3, 1992. The official Gosbank Ruble exchange rate (of about Rub 0.6 per U.S. dollar) continued to be quoted by the CBR and to be used for the valuation of old external claims.

for individual enterprises and for regions. It also appeared that the banks experienced difficulties in enforcing the surrender requirement.

The rules governing currency controls after unification were spelled out in a set of texts (in particular the September 1992 Supreme Soviet "Law of the Russian Federation on Foreign Exchange Controls and Foreign Exchange Controls Monitoring") which regulated movements of foreign exchange and provided for administrative enforcement. However, in practice, all current currency transactions could be carried out without any restriction, including forward import pre-payments of up to 180 days and unlimited purchases or sales of foreign exchange for legal current international transactions.

One major change in the exchange and trade system after unification was the implementation in January 1993 of a centralized exports scheme whereby the Government purchased a share of the quotas of exportables (in particular oil and gas) from Russian producers at domestic prices and in rubles, and received the foreign exchange revenues from their sale abroad, at world prices. Another noteworthy change was the authorization granted in April 1993 to banks holding general licenses to freely import and export foreign currency bank notes, treasury notes, coins and securities, provided customs regulations were observed.

Next, a number of regulatory measures were taken around mid-1993 that tended to boost the ruble, including: the introduction, as per a May 28 CBR instruction, of limits on banks' open foreign exchange positions, which apparently forced a number of banks to reduce their holdings of foreign exchange; the authorization granted to non-residents, starting July 15, 1993, to open ruble accounts in Russian banks and to sell hard currency on the MICEX; 1/ and the reduction of import subsidy coefficients for centralized imports. Moreover, the scope of the interbank foreign exchange market was broadened by the June 28 CBR decision to henceforth allow exporters to surrender foreign exchange to commercial banks rather than to the CBR (see Section II). 2/

## 2. Development of the foreign exchange market

Foreign exchange auctions were initiated by VEB in November 1989. Transactions volumes were modest, partly because of the restrictions imposed on the use of foreign exchange. In April 1991, these auctions were replaced

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1/ The authorization granted to non-residents from September 1 to buy foreign exchange on the MICEX may have operated in the same direction, since it increased the option value of their Ruble holdings.

2/ Exporters were still required to sell 50 percent of export earnings to the banking system within 14 days of repatriation. This measure increased the willingness to surrender in the first place insofar as the CBR used to be very slow in crediting the Rubles it owed exporters as a counterpart of the surrendered foreign exchange, thus imposing a significant inflation tax.



by an interbank foreign exchange market. Sessions took place each Tuesday at the Gosbank with representatives from 25 banks which had become members of the MICEX. The latter had been established in March 1991 as a joint stock company owned by commercial banks, finance companies and the CBR. In late 1991, weekly foreign currency auctions were also held at the Russian Exchange Bank.

From August 1991, Gosbank allowed the registration with commercial banks of foreign exchange transactions between enterprises. Recorded transactions amounted to about half of the volume of interbank auctions but actual interenterprise transactions in foreign exchange were probably at least as large. The exchange rate established in the interenterprise market often diverged from the interbank market rate since enterprises frequently agreed on various forms of side payments (e.g., the delivery of goods at the low official price rather than at the higher market price).

During the first half of 1992, the interbank market for foreign exchange remained embryonic (Table A1, Chart 1), and a large share of transactions consisted of CBR intervention sales. The thinness of the market, where volumes traded amounted to less than 5 percent of hard currency export receipts, was partly the consequence of highly negative real interest rates on ruble deposits and of the persistence of soft budget constraints, which encouraged enterprises to accumulate sizable foreign exchange deposits from retained export earnings. 1/ Regulations on the admission of new members to an expanded MICEX and on the modalities of currency transactions were adopted in February 1992. 2/ In April 1992, the frequency of sessions on the interbank market was doubled.

Following exchange rate unification, the U.S. dollar/ruble rates determined at MICEX auctions were used as the official foreign exchange rates of the CBR to be used by all banks for accounting purposes. The frequency of U.S. dollar/ruble auctions, which were being held on Tuesdays and Thursdays beginning in April 1992, was increased by the addition of Mondays and Fridays starting May 31, 1993, and shortly thereafter of Wednesdays (Table A2). Volumes traded rose substantially, from about 10 percent of exports to countries other than from the former Soviet Union in the second half of 1992 to about 40 percent in the second half of 1993.

While interbank auctions were still confined to Moscow and limited to U.S. dollars through mid-1992, other markets were subsequently established in St. Petersburg, Yekaterinburg, Novosibirsk, Vladivostok and Rostov (Table A3). 3/ Auctioning of other currencies also began, even though U.S. dollar transactions by far continued to dominate. Foreign currency trading outside of the MICEX grew, with the regional exchanges accounting for close to one fifth of U.S. dollar market turnover by the last quarter of

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1/ For further analysis, see Goldberg (1993).

2/ Published in *Biznes i Banki* (March 1992).

3/ Foreign exchange auctions were reportedly also taking place at the Moscow International Stock and Currency exchange.

1993, excluding direct interbank trading (Table A4). The rates quoted on the regional exchanges occasionally diverged from those recorded at the MICEX and broken cross-rates emerged from time to time, as the integration of the foreign exchange market remained stymied by the underdevelopment of the financial infrastructure (poor communication facilities, unreliable ruble payment system, lack of widespread forex dealing expertise). However, CBR intervention reportedly helped contain the dispersion in the rates quoted across exchanges. Moreover, efforts were made to facilitate arbitrage across exchanges: in late 1993, an Association of Russian Currency Exchanges was formed, aiming at the creation of a unified information and trading network; furthermore, the MICEX started to encourage bank participants in other auctions to establish a Moscow branch and to participate in MICEX auctions.

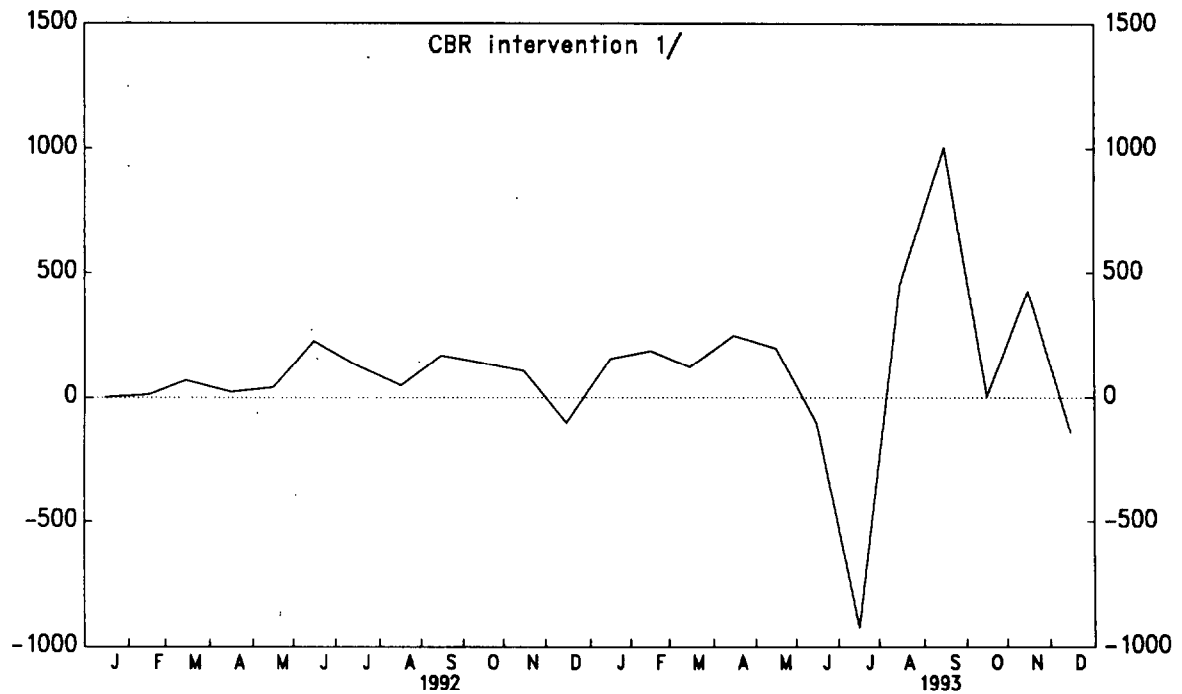
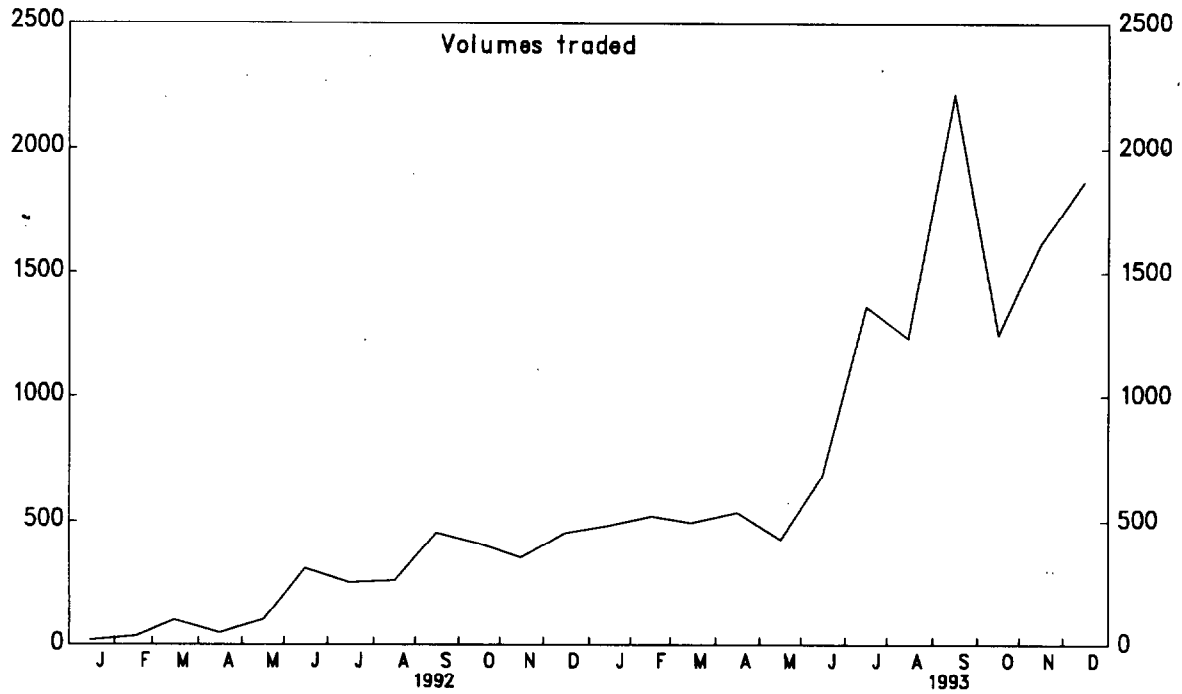
The prominent ten or so MICEX participants were also engaged in interbank direct dealing transactions using telephones or Reuters dealing terminals. These banks bought from and sold to customers and traded on their own accounts as well. In the summer of 1992, the bulk of these transactions consisted of customer rather than interbank trading, with banks merely acting as brokers. By the end of 1993, such transactions had grown to an estimated one-third of the MICEX auction turnover, about half consisting of interbank trading. However, the uncertainty of ruble value dates and the lack of complete mutual confidence in other banks--due to incomplete disclosure of bank information, which discouraged the establishment of credit lines--hampered a more rapid development of these foreign exchange transactions. A few banks had set up credit lines among themselves and were trading on firm (contractual) order basis, but all other trading was done on non-firm (pre-payment) order basis.

A credit auction house specializing in small-scale transactions--the Moscow Interbank Financial House (IFH), with 80 member banks--commenced operations in November 1992, supplying bid and offer U.S. dollar/ruble and DM/ruble rates on a daily electronic information system facilitating direct dealing among members. Trading was initially slow but by the fourth quarter of 1993 had risen to an average of about US\$6 million per week.

Turning to derivative instruments, trading of ruble/U.S. dollar futures contracts began at the Moscow Commodity Exchange (MCE) in October 1992. By late 1993 trading was taking place three times a week. In November 1992, the Moscow Board of Trade (MBT) launched its own ruble/U.S. dollar futures contracts, holding daily sessions. Futures trading subsequently extended to deutsche mark contracts. Both markets, and especially the MBT, were extremely thin, owing largely to the importance of counterparty risk and also to the lack of technical expertise of market participants. The volumes recorded in December 1993 for each delivery date were typically on the order of half a dozen \$100 contracts per session on the MBT; and a few hundred \$1,000 contracts and a few thousand \$10 contracts per session on the MCE.

## VOLUMES TRADED ON THE MICEX

January 1992 - December 1993  
(Monthly totals, in millions of US dollars)



Sources: MICEX; and CBR.  
1/ Net sales of US dollars.



Finally, a few banks offered forward contracts to customers wanting to hedge their import payments. 1/

Intervention by the CBR played an important role in the determination of the exchange rate (see Section III below). Until the recent establishment of its own trading room where direct interbank operations became feasible, the CBR placed its orders through the MICEX. Limited intervention also reportedly took place on the St. Petersburg exchange. The sole intervention currency was the U.S. dollar. Following exchange rate unification, the share of CBR intervention in total MICEX turnover remained large, averaging one third if measured by monthly net totals. 2/

The CBR was not, however, the only official institution involved in exchange market operations. The Ministry of Finance (MOF) also held a substantial portion of the reserves of the monetary authorities in the form of foreign exchange and gold. It had its own sources of foreign exchange revenues, including the aforementioned centralized export scheme. Some transactions by the MOF on the foreign exchange market were reported in November 1993, but no reliable information has been made available on such operations. The MOF reportedly also tried to organize a consortium of commercial banks in December 1993 to sell centralized foreign exchange resources on the MICEX.

### III. Financial policies and exchange rate behavior

In addition to the structural changes in the exchange and foreign trade systems, described above, the path of the exchange rate in 1992-93 reflected the evolution of the stance of financial policies 3/ and the exchange rate policy objectives pursued by the authorities. Three periods may be distinguished: the run-up to unification in 1992, when the possibility of establishing a nominal exchange rate anchor was actively discussed and a sharp nominal appreciation of the interbank exchange rate took place; the first year following unification, from mid-1992 to mid-1993, during which the nominal rate depreciated in stepwise fashion; and the second half of 1993, when the authorities engaged in large-scale exchange rate smoothing.

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1/ In early 1994, the Russian Commodities and Raw Materials Exchange as well as the Moscow Central Stock Exchange also began trading in currency futures, while trading in foreign exchange options was taking place at the Hermes exchange. Also, the MICEX announced that it would launch its own forex futures and options. This proliferation of financial markets, which technologically requires little more than a few computers and phone lines, contrasts with the sluggishness of adjustment in the "production sphere".

2/ The size of CBR transactions on the MICEX is also influenced, ceteris paribus, by the prevailing surrender requirement rules. Since the latter did not remain unchanged, the time series of intervention volumes should be interpreted with caution.

3/ For details on the evolution of financial policies, see IMF (1993, 1994).

# 1. Unification and target zone schemes

As exchange rate unification was being considered in the first half of 1992, some policymakers were proposing that unification be accompanied by exchange rate anchoring. For example, then Deputy Prime Minister Gaidar (1992) argued that "it is important to "anchor" the price level by pursuing tight monetary and fiscal policies, and by stabilizing the value of the ruble against international currencies. (...) We want to stabilize the ruble at a realistic rate, (...) consistent with average monthly wages of about US\$ 100 later this year. (...) We have asked the Group of Seven leading industrial countries to provide us with a stabilization fund similar to that provided for Poland". A similar line was taken in a Policy Memorandum signed by Gaidar and then CBR Chairman Matiukhin (1992) and by a number of foreign observers, such as Fischer (1992). In this context, a specific target zone scheme involving a  $\pm 7.5$  percent band around a central parity of about Rub 60 to 80 per U.S. dollar was envisaged by some. 1/ This would have entailed a very substantial further real appreciation and, by July 1992, a monthly U.S. dollar wage of the order of US\$ 70-90. 2/

The interbank exchange rate did appreciate substantially, from Rub 160 per U.S. dollar at the end of March to 113 at the end of May, helped by the increase in the CBR refinance rate from 20 to 50 percent in April and from 50 to 80 percent in May, 3/ as well as by substantial CBR intervention on the MICEX (Tables A5 and A1). In the second half of June, however, the rate started to depreciate, notwithstanding continuing CBR intervention, to Rub 144 per U.S. dollar by end-month.

As it turned out, the exchange rate was unified but not pegged and, after a brief spell of appreciation in early July (to Rub 130 per U.S. dollar by mid-month), it started to depreciate steadily. 4/

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1/ Konstantin Kagalovsky, then in charge of negotiations with the International Monetary Fund and the World Bank, mentioned a central parity of Rub 80 to the *New York Times* (May 6, 1992). Then Minister of Economy Andrei Nechaev was envisaging a rate of Rub 60 to 80, according to the *Financial Times* (May 15, 1992). The latter source also mentions the reluctance of the CBR to go along with such a scheme.

2/ That there was room for significant real appreciation was a widespread, if not unanimous belief. See for example Lipton and Sachs (1992).

3/ Quoted, per annum, non-compounded rates. If the non-compounded rate is  $i$  percent and the maturity of the deposit or loan contract is one year, the corresponding compounded rate is  $[(1+i/(12 \times 100))^{12} - 1] \times 100$  percent.

4/ Wolf (1994) argues that under the circumstances it was preferable not to peg.

## 2. Exchange rate floating in the first year

From mid-1992 to mid-1993, the exchange rate policy followed by the authorities could be described as a managed float (as acknowledged, for example, in the CBR's annual report for 1992). Most of the time, the CBR modulated its intervention so as to maintain a relatively steady rate of nominal depreciation, averaging some 16 percent per month. 1/ Within the period, however, and more or less in parallel with the evolution of the real interest rate differential, the real exchange rate weakened substantially, through October 1992, recovered between November 1992 and January 1993, and subsequently remained in the neighborhood of its mid-1992 level (Chart 2).

The evolution of the nominal exchange rate was broadly in line with expectations as recorded in surveys of market participants or as reflected in the futures markets. A large scale poll conducted in July-August 1992 suggested that the vast majority of operators anticipated substantial nominal depreciation in the near future. 2/ Evidence from the futures markets, available from the fall of 1992 onwards, also points to the fact that by and large the trend rate of depreciation was anticipated (Table A6 and Chart 3, first page). In that regard, one summary measure is the expected rate of depreciation at a horizon of one month associated with the quotes on the foreign exchange futures contracts (Table A7), which averaged 15 percent (on the MCE) and 25 percent (on the MBT) during the first half of 1993. 3/ Furthermore, until April 1993 at least, the monetary authorities did not send any signals to counteract bearish expectations. 4/

## 3. Exchange rate smoothing in the second half of 1993

During the second half of 1993, the nominal exchange rate depreciated by less than 20 percent (end-December over end-June) while monthly domestic consumer price inflation averaged 20 percent (Table A8, Chart 4). At the same time, real ruble money contracted sharply, while gross CBR foreign exchange reserves accumulation surged in the third quarter and declined somewhat in the fourth (Chart 2).

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1/ Only two months stand out as outliers in this regard: October (with a much larger rate of depreciation) and December (with a small appreciation).

2/ See Pavlov (1992).

3/ The rates for small contracts tend to be more depreciated than those for larger contracts. Since the relevant underlying asset market may well be the cash one for small contracts and the non-cash one for larger contracts, the larger depreciation associated with small contracts could be linked to the fact that on the spot market cash rates tend to be more depreciated than non-cash rates.

4/ On April 9, 1993, for example, then Minister of Finance Boris Fedorov told *Finansovye Izvestia* that the Ruble could fall to 1,500 to the dollar by July.

More specifically, the nominal rate appreciated by some 12 percent between mid-June and end-July, and then stabilized at a plateau of about Rub 1,000 per U.S. dollar through mid-September (Chart 5). The political crisis associated with the dissolution of the Supreme Soviet in late September caused the rate to depreciate sharply to a then historical low of Rub 1,299. It subsequently recovered somewhat and then remained within a  $\pm 5$  percent band around a notional benchmark of Rub 1,200 per U.S. dollar through the end of the year. To a large extent, the relative stability of the nominal rate over this period was the result of a shift in policies that took place around mid-1993.

In line with the joint CBR-Ministry of Finance agreement to implement the measures spelled out in the Systemic Transformation Facility program supported by the IMF, the CBR refinance rate was raised in steps from 100 percent end-May to 170 percent by July 15 (Chart 6). It was further raised in September, to 180 percent, and in October, to 210 percent, in accordance with a September 22, 1993 government ordinance entitled "On Urgent Measures to Ensure Financial Stability" stipulating that the CBR, in coordination with the Ministry of Finance, adopt measures "to protect the national currency of the Russian Federation and prevent sharp fluctuations of its rate".

Around mid-1993, the Ministry of Finance started a public campaign in support of the stabilization of the nominal exchange rate, in the form of a series of press releases and of a Rub 50,000 public bet by the Minister of Finance himself that the exchange rate would remain stable through September 1. <sup>1/</sup> On June 24, 1993, the Ministry of Finance issued a statement declaring that "the financial condition of the country will be improving in the next three months, and the inflation index [rate] will be down to less than 15 percent per month. (...) The exchange rate of the ruble against the dollar has entered a period of relative stability and is likely to stay at the level of about Rub 1,100 per dollar. Large amounts of foreign exchange are expected to appear on the market by the end of the year, which will make it possible for the exchange rate to come closer to the purchasing power parity." <sup>2/</sup>

On August 10, 1993, another press release from the Ministry of Finance indicated that "The Russian ruble exchange rate against the dollar has been relatively stable for two months. The growing popularity of the ruble compelled the Central Bank to switch from its previous standard of Rub 1,100 to Rub 1,000 per dollar (plus/minus 5 percent). The gap between the market rate and the ruble's buying capacity has shrunk notably. (...) The country's currency reserves have actually increased by several billion dollars in the past two months. (...) The coordinated tactics between the Central Bank and the Finance Ministry in recent months reveal their desire

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<sup>1/</sup> See *Interfax News Bulletin*, July 12 1993.

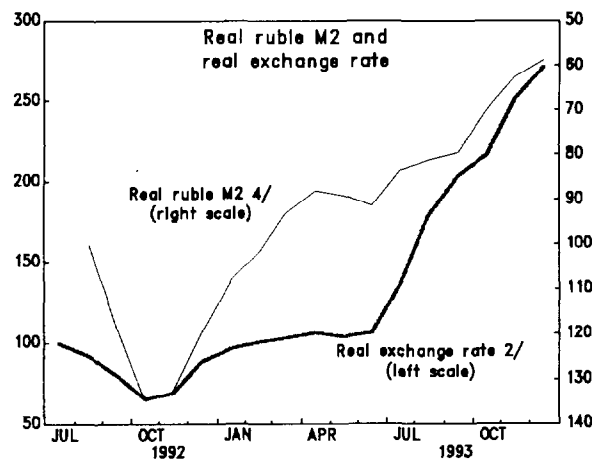
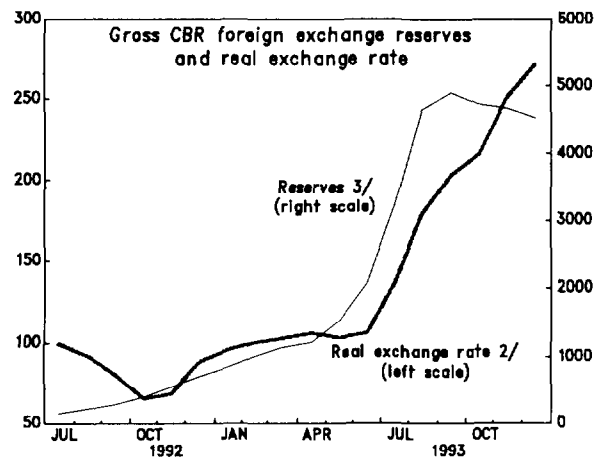
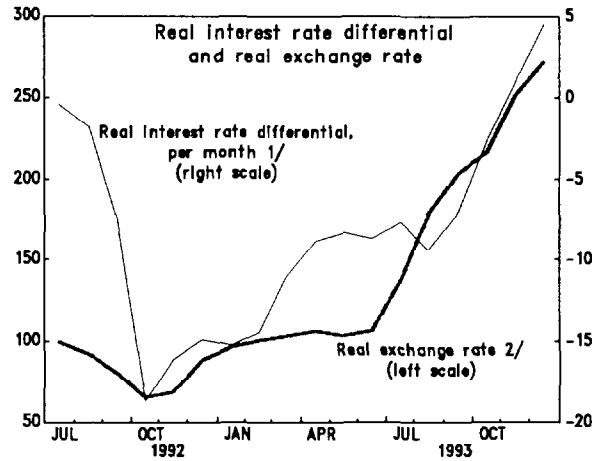
<sup>2/</sup> The full text of a number of press releases issued in 1993 by the Ministry of Finance appears in an appendix to the report on 1993 that this ministry published in early 1994.



CHART 2

# INTEREST RATES, RESERVES, MONEY, AND THE REAL EXCHANGE RATE

July 1992 - December 1993  
(Monthly Observations)



Sources: CBR; MICEX; Goskomstat; US Bureau of Labor Statistics; and authors' calculations.

1/ Based on CBR refinance rate and LIBOR, and contemporaneous consumer price inflation.

2/ Based on MICEX exchange rate and consumer prices in Russia and in the United States;

July 1992 = 100.

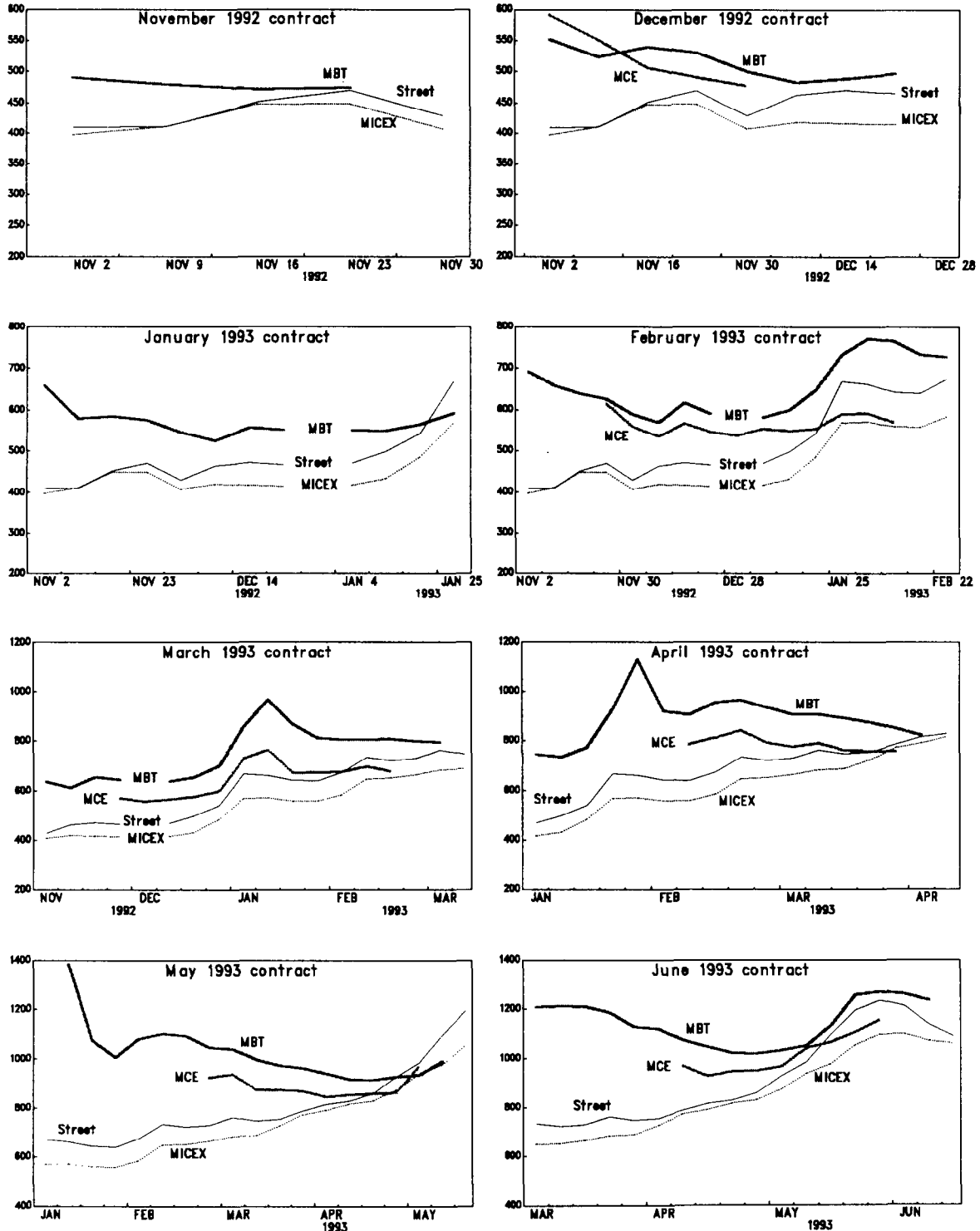
3/ At the beginning of the month, in millions of US dollars. Excludes gold and Fund proceeds.

4/ Real ruble M2 is lagged one month, July 1992 = 100.



## SPOT AND FUTURE EXCHANGE RATES

November 1992 - June 1993  
(Weekly averages, in Rubles per US dollar)

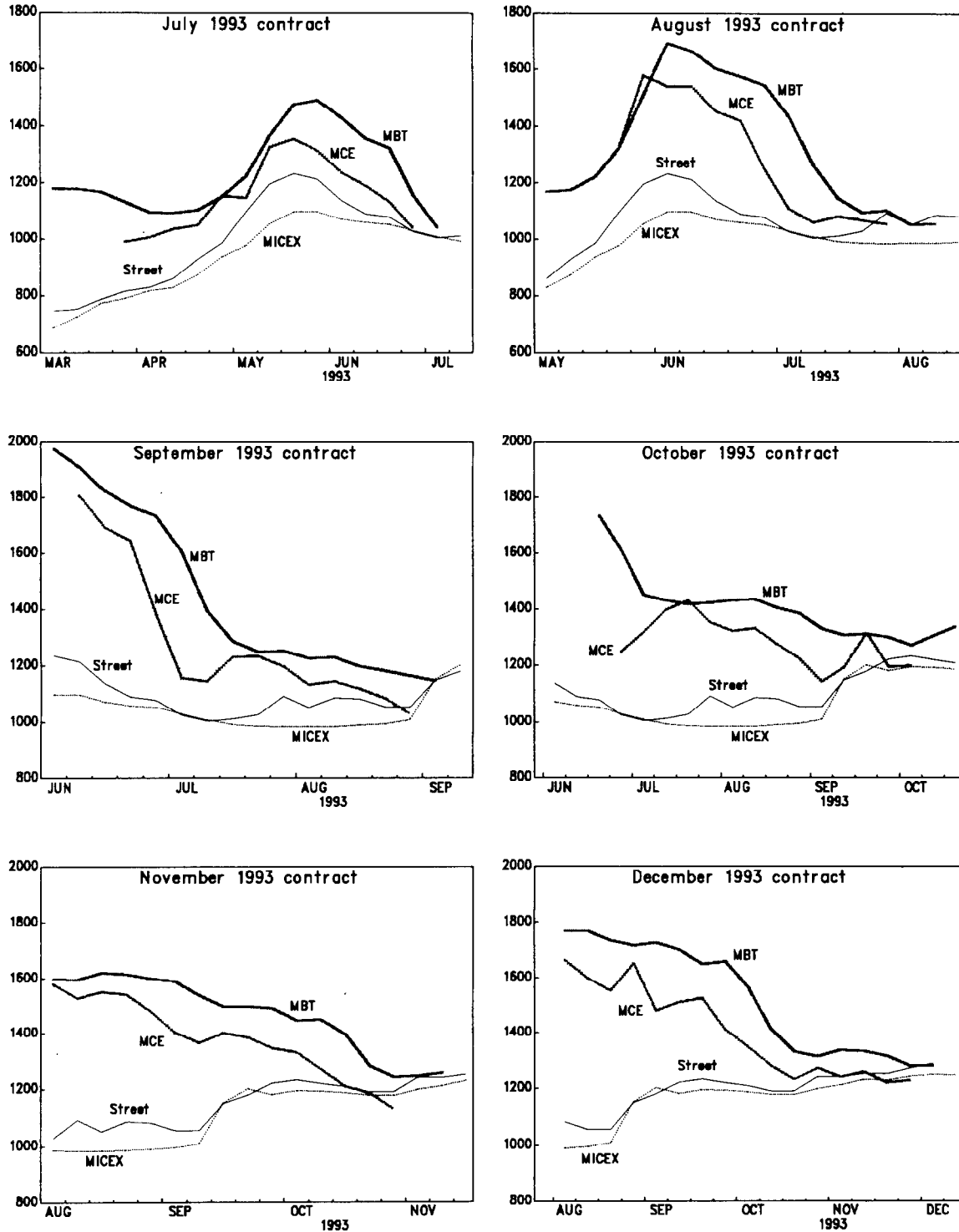


Sources: MICEX; Commercant; MBT; and MCE.



## SPOT AND FUTURE EXCHANGE RATES

July - December 1993  
(Weekly averages, in Rubles per US dollar)

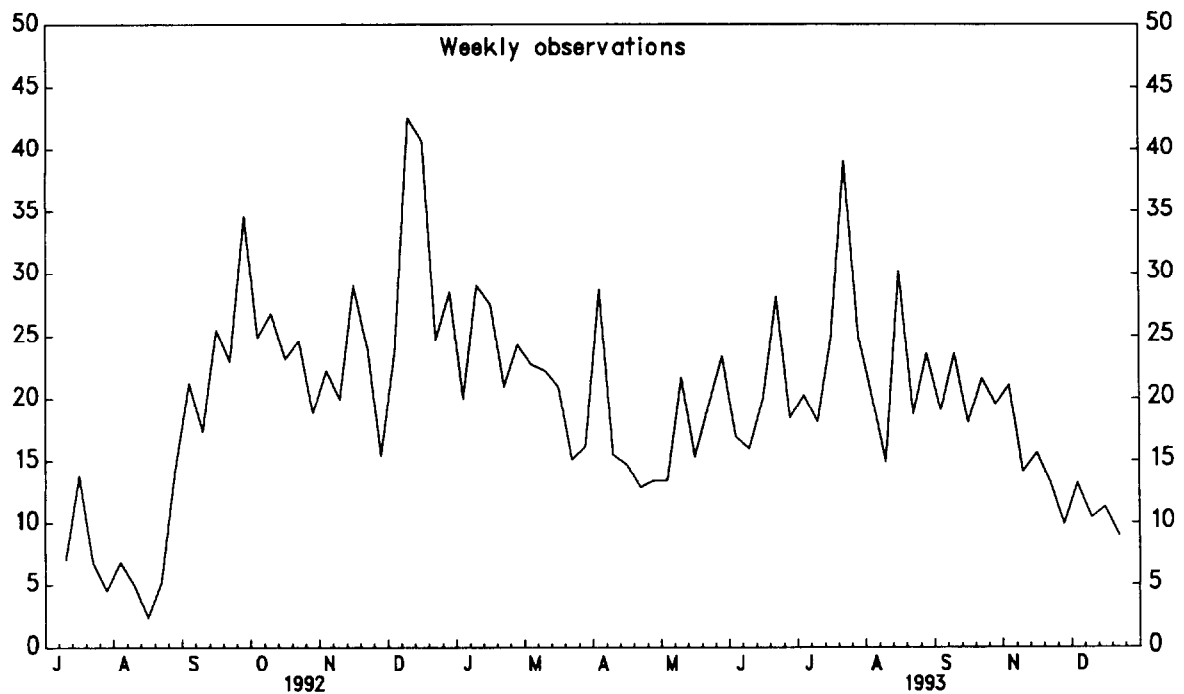
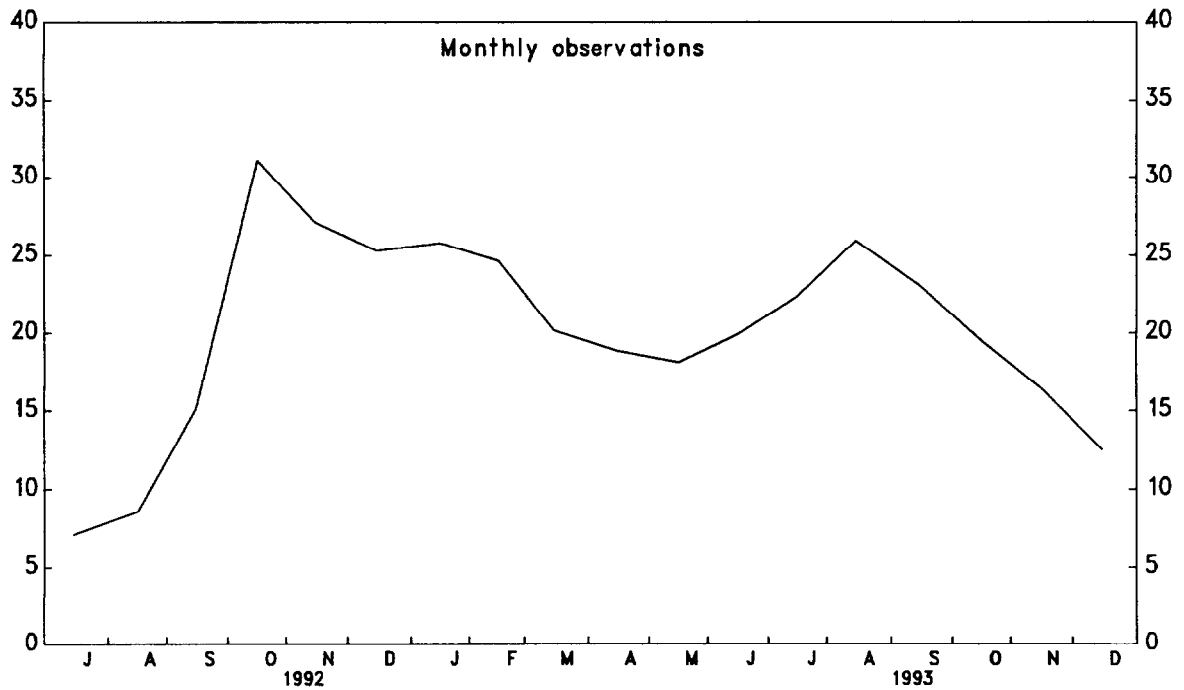


Sources: MICEX; Commerciant; MBT; and MCE.



## CONSUMER PRICE INFLATION

July 1992 - December 1993  
(Rates per month, in percent)

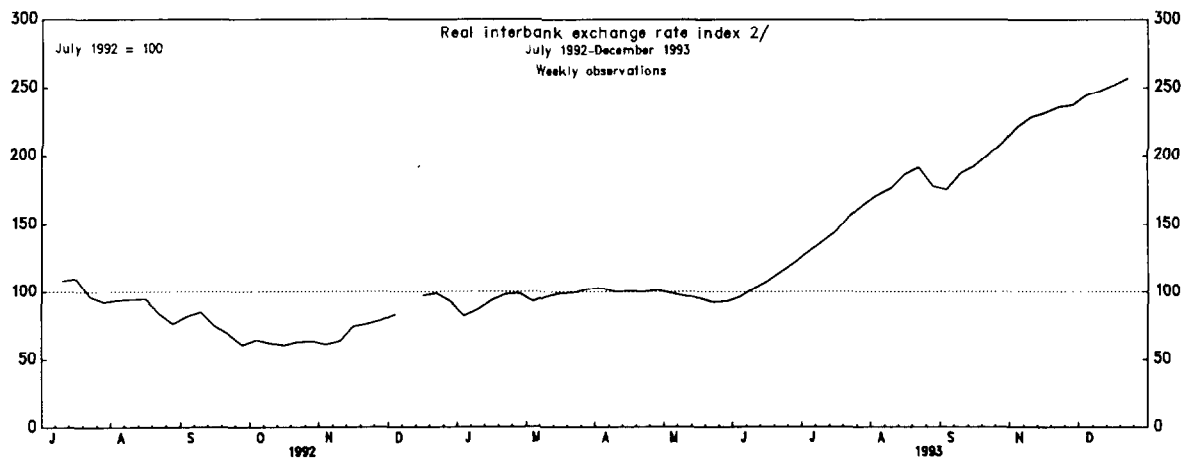
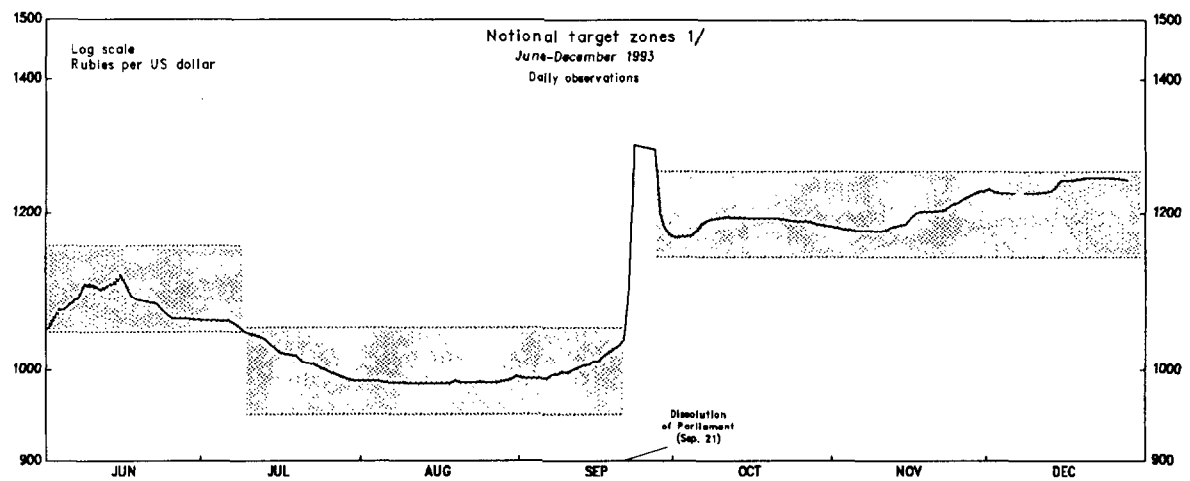
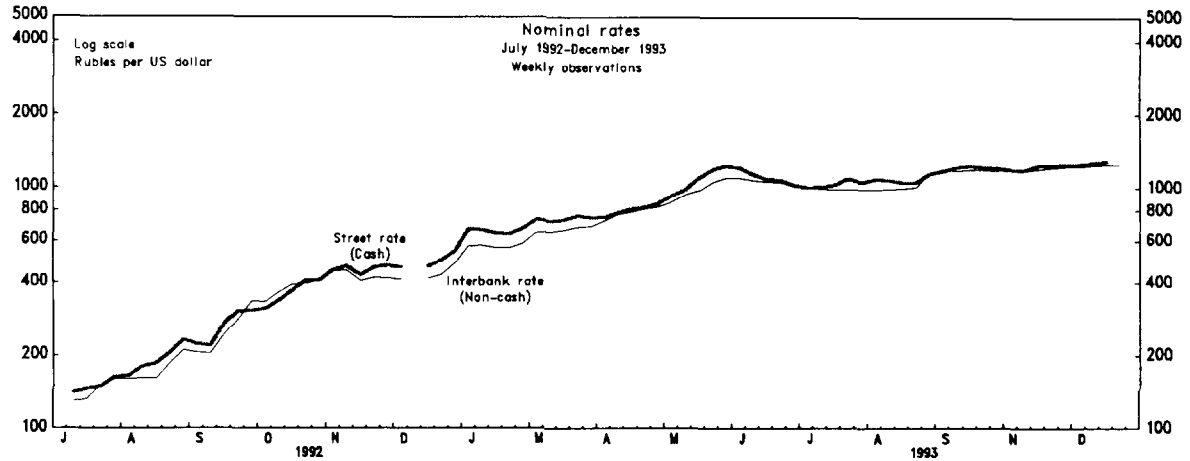


Sources: Goskomstat; and Center of Economic Analysis.





# SPOT EXCHANGE RATES



Sources: MICEX; Goskomstat; Commerciant; US Bureau of Labor Statistics; and authors' calculations.

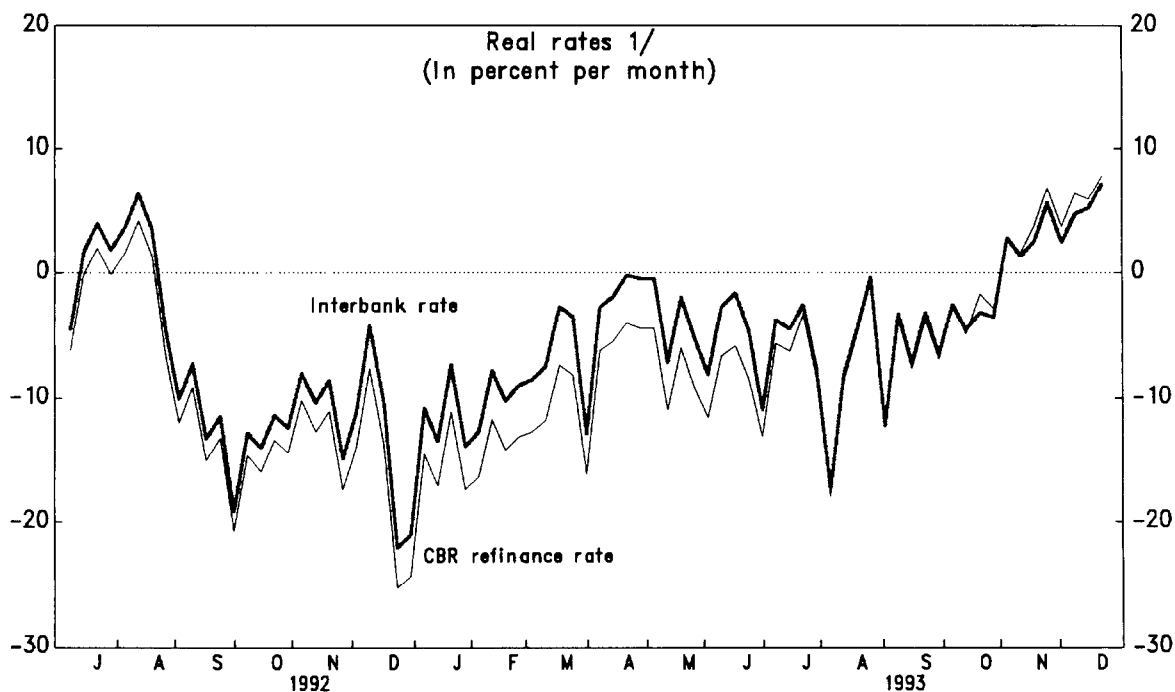
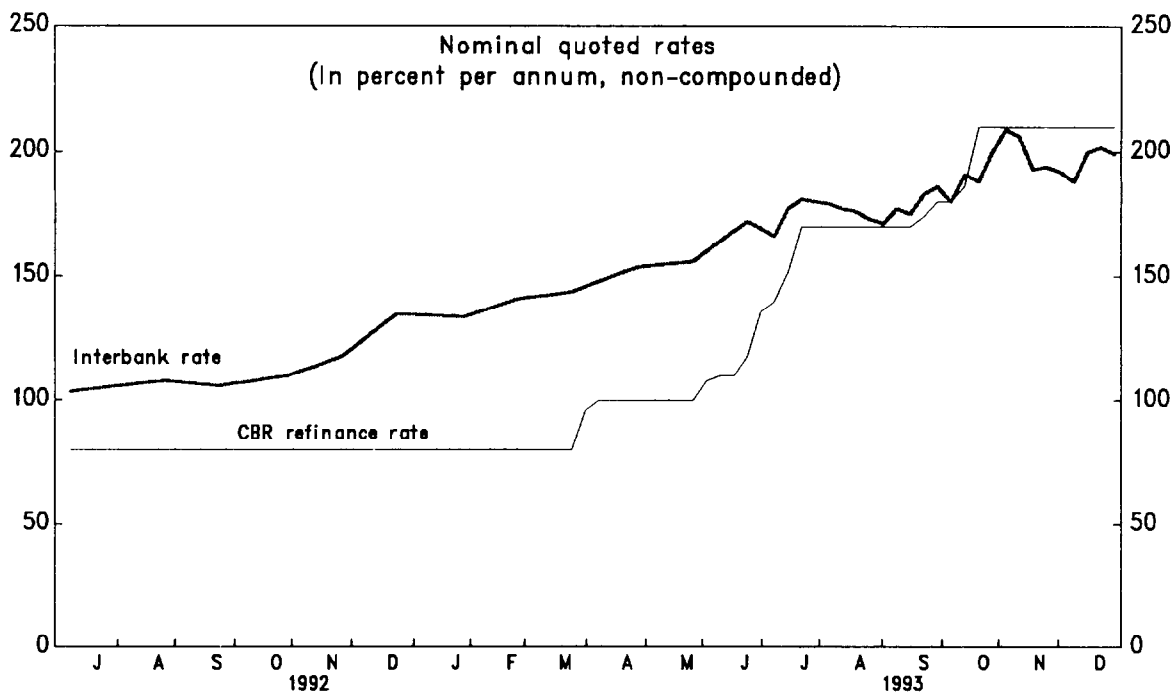
1/ Inferred by the authors from the policy statements cited in Section III.

2/ Based on MICEX exchange rate, weekly CPI in Russia, and monthly CPI in the United States.



# INTEREST RATES

July 1992 - December 1993  
(Weekly observations)



Sources: CBR; IMF; Goskomstat; and authors' calculations.

1/ Using contemporaneous weekly consumer price inflation as a deflator.



to facilitate the stabilization of the ruble, without strengthening it too abruptly and excessively to damage exports. (...) All the above factors indicate that the ruble will remain quite stable not only until the beginning of September, but until the end of this year. This trend, which became evident in August, is certain to chip away at the rate of inflation." That this was the joint policy of the Ministry of Finance and the CBR was suggested by central bank officials. 1/

After the September crisis, the Minister of Finance reiterated on several occasions that the ruble was likely to remain stable until the end of the year, at around Rub 1,200 per U.S. dollar, 2/ and the CBR continued to intervene in both directions, but on a smaller scale than during the summer.

With monthly inflation running well over 20 percent in the third quarter of 1993, market participants retained serious doubts about the sustainability, beyond the very near term, of a virtually stable nominal exchange rate, as indicated by the quotes registered on the futures markets (Table A6 and Chart 3, second page). Using the MCE US\$1,000 contract as a benchmark, the expected rate of depreciation at a 30-day horizon on average exceeded 10 percent, and the expected rate of depreciation at a 60-day horizon on average exceeded 20 percent (Table A7). 3/

The exchange rate policy pursued in the second half of 1993 by the monetary authorities could be characterized as one of large-scale smoothing, especially during the summer months. It could even arguably be described as a flexible target zone policy. As regards policy intentions, this is very clear from the above excerpts, which advertise an adjustable central rate and the width of the associated band. As regards policy implementation, this strategy led the CBR to lean heavily against the wind in June-July, when it purchased on net over US\$ 1 billion on the MICEX, and in August-September, when it sold on net close to US\$ 1.5 billion on the MICEX (Chart 1).

The combination of a very high domestic rate of inflation and of a very limited nominal exchange rate depreciation over a fairly long period implied a very sharp real appreciation (Chart 5). Symptoms of undervaluation were still abundant in mid-1993, typified by enterprise directors' complaints that the gap between the purchasing power of the ruble and the U.S. dollar "allowed any American student to buy a Russian plant with his stipend".

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1/ For example, Alexander Potemkin, head of the International Department at the CBR, told reporters that he was optimistic about the likelihood that "the government would be able to hold the Ruble's exchange rate to 1/1000, and possibly even lower, over the next few months." (*Delovoy Mir*, July 20, 1993).

2/ See for example the transcript of his November 4, 1993 press conference, Federal News Service, Kremlin Package, Moscow, November 4, 1993.

3/ Under the assumption of perfect inflationary foresight, this implies that some real appreciation was nevertheless deemed plausible ex ante.

Half a year later, symptoms of overvaluation had become apparent, with a number of domestic prices for tradeable goods far exceeding world prices and exporting enterprises imploring a large depreciation of the ruble. <sup>1/</sup> Also, by end-year, dollar wages in Russia had converged to the level registered on average in the Baltic states. <sup>2/</sup> Comparing to Central and Eastern European countries, they ended the year at about half of the level observed in Poland and the Czech Republic at the same stage of the transition, but well above the level recorded in Romania, and at the same level as in Bulgaria. Notwithstanding this evidence, it remains very difficult to assess how far the real exchange rate stood at any point during this period from an "equilibrium" rate, as different approaches produce very different answers (Table A9, Chart 7).

#### IV. Econometric Analysis

This section is devoted to an econometric analysis of the impact of monetary variables on the ruble-U.S. dollar exchange rate. The presentation of the analytical framework starts with the formulation of exchange rate expectations and portfolio behavior in the foreign exchange market. Next an exchange rate equation is derived. While the starting point is a fairly general one, an attempt is made to take explicitly into account the fact that in a high inflation environment, agents have expectations regarding the likelihood of stabilization. Empirical measures of the relevant theoretical concepts are then proposed. Finally, the estimation results are discussed.

##### 1. A simple model of exchange rate determination

In the tradition of Dornbusch (1976) and Frankel (1979), it is assumed that there exists a long run equilibrium exchange rate, but that in the short run the spot exchange rate may differ from its long run equilibrium value, reflecting sluggish adjustment in goods markets. In such an environment, the expected rate of depreciation can be written as:

$$E_t s_{t+1} - s_t = \alpha_1 (S_t - s_t) + \beta_1 (E_t s_{t+1} - S_t) \quad (1)$$

where  $E_t$  denotes the expectation conditional on information available at time  $t$ ,  $s$  is the logarithm of the spot bilateral exchange rate in rubles per U.S. dollar, and  $S$  its long run equilibrium value. Parameter  $\alpha_1$  measures the speed at which the spot exchange rate converges to its long run equilibrium rate, and is positive. Parameter  $\beta_1$  reflects the extent to which changes in the expected long run equilibrium rate are reflected in changes in the spot rate. In the absence of "money illusion",  $\beta_1=1$ .

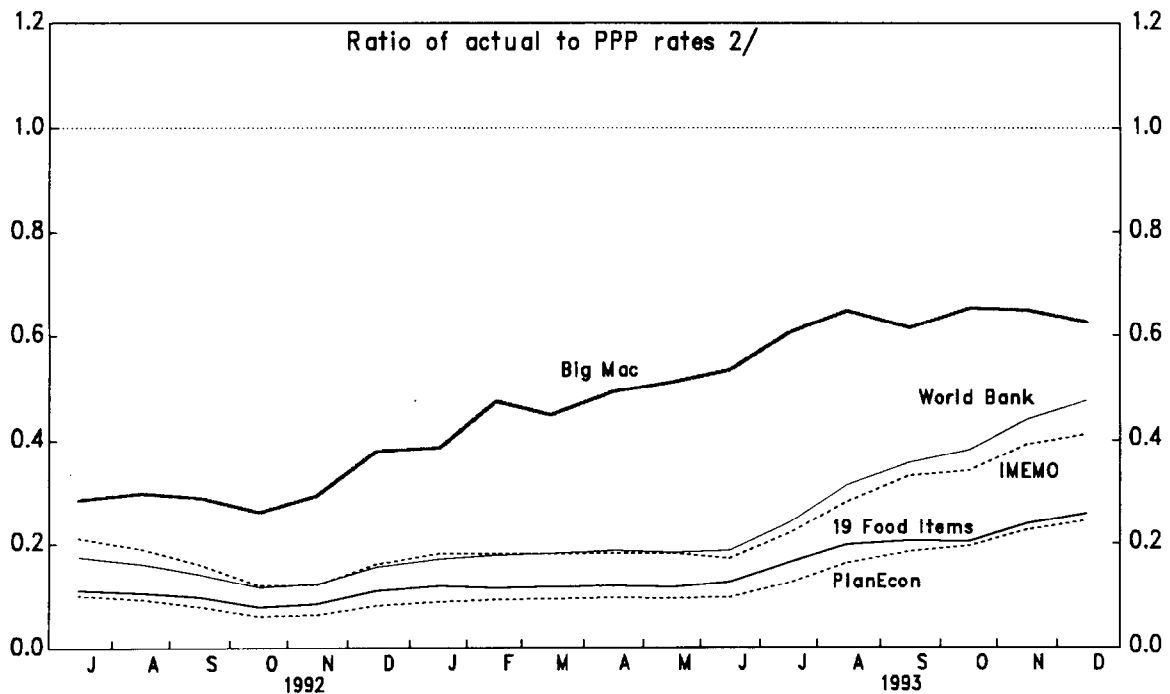
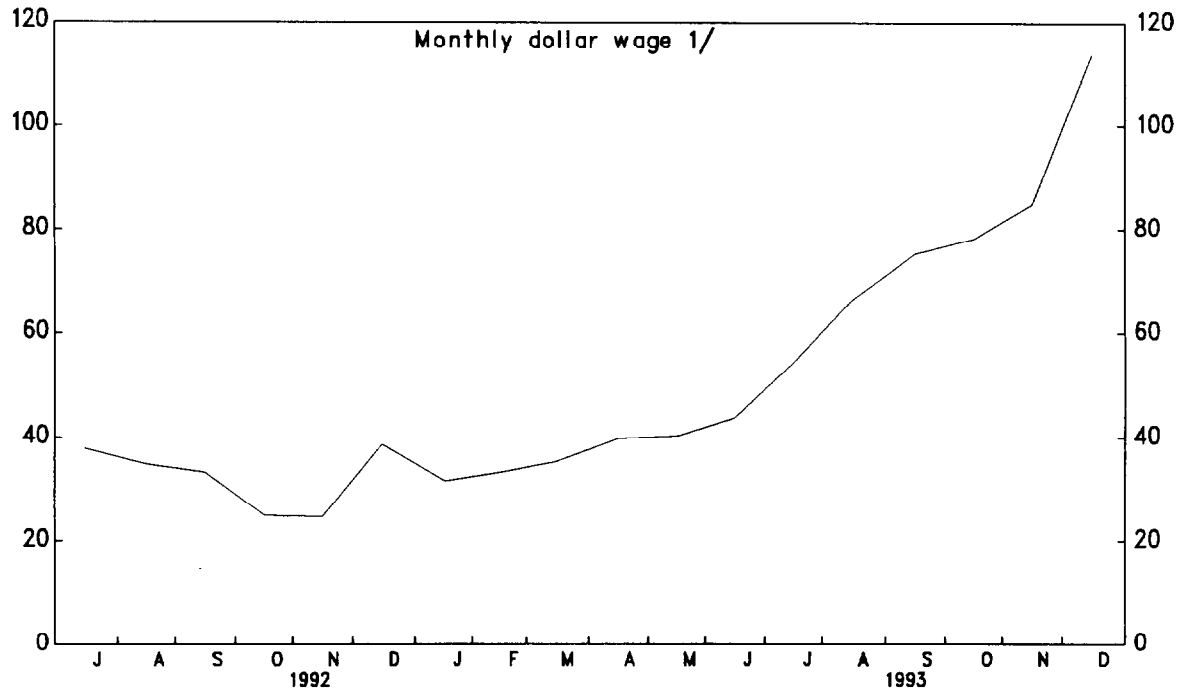
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<sup>1/</sup> See for example Narzikulov (1993).

<sup>2/</sup> Which stood at the top of the ladder, well ahead of the other states of the former Soviet Union.

# ALTERNATIVE REAL EXCHANGE RATE MEASURES

July 1992 - December 1993  
(Monthly observations)



Sources: Goskomstat; MICEX; World Bank; Center of Economic Analysis; PlanEcon; IMEMO; McDonald's Moscow; and authors' calculations.

1/ Based on MICEX exchange rate and on the average, economy-wide wage.

2/ In US dollars per ruble.





Residents hold interest bearing assets denominated in rubles and in U.S. dollars. Let

DA = logarithm of the stock of interest bearing assets  
denominated in rubles,  
FA = logarithm of the stock of interest bearing assets  
denominated in foreign exchange,  
 $i = \log(1+r)$ , where  $r$  is the nominal interest rate on ruble  
denominated assets,  
 $i^* = \log(1+r^*)$ , where  $r^*$  is the nominal interest rate on U.S. dollar  
denominated assets.

Portfolio allocation is a function of relative yields:

$$\omega_1 (DA_t - \Omega_t) = \alpha_2 [i_t - i_t^* - (E_t s_{t+1} - s_t)] \quad (2.a)$$

and

$$\omega_2 (s_t + FA_t - \Omega_t) = -\alpha_2 [i_t - i_t^* - (E_t s_{t+1} - s_t)] \quad (2.b)$$

with  $\omega_1$  and  $\omega_2$  the budget shares of the assets, i.e.,  $\omega_1 + \omega_2 = 1$ , and  $\Omega$  a scale variable defined as  $\Omega_t = \omega_1 DA_t + \omega_2 (s_t + FA_t)$ .

Relative yields determine the portfolio shares of the ruble assets and of the U.S. dollar assets converted in rubles at the spot exchange rate. Since residents will hold an additional amount of financial assets denominated in rubles when they expect the currency to appreciate and/or when the domestic interest rate increases relative to the foreign interest rate,  $\alpha_2 > 0$ . In the case of risk neutral economic agents,  $\alpha_2 \rightarrow +\infty$ .

Dividing both sides of equations (2.a) and (2.b) by  $\omega_1$  and  $\omega_2$ , respectively, subtracting equation (2.b) from equation (2.a), and rearranging terms, yields:

$$\alpha_3 [DA_t - (s_t + FA_t)] = [i_t - i_t^* - (E_t s_{t+1} - s_t)] \quad (3)$$

where  $\alpha_3 = (\omega_1 \omega_2) / \alpha_2 \geq 0$ .

Equation (3) describes equilibrium in the foreign exchange market. If economic agents are risk neutral ( $\alpha_2 \rightarrow +\infty$ ), or if there are no outside assets, the right hand side of equation (3) is equal to zero, and uncovered interest rate parity holds. In other words, the left hand side of (3) measures the risk premium.

Inserting equation (1) into equation (3) yields:

$$s_t = \alpha_4 S_t + \beta_4 (E_t S_{t+1} - S_t) + \delta_4 (i_t - i_t^*) + \gamma_4 (DA_t - FA_t) \quad (4)$$

where

$$\alpha_4 = \alpha_1 / (\alpha_1 + \alpha_3) > 0 \quad (5.a)$$

$$\beta_4 = \beta_1 / (\alpha_1 + \alpha_3) > 0 \quad (5.b)$$

$$\delta_4 = -1 / (\alpha_1 + \alpha_3) < 0 \quad (5.c)$$

$$\gamma_4 = \alpha_3 / (\alpha_1 + \alpha_3) > 0 \quad (5.d)$$

Equation (4) relates the spot exchange rate to the long run equilibrium exchange rate, the expected change in the long run equilibrium rate, the interest rate differential, and the relative stocks of interest bearing assets. The interpretation of the signs of the parameters is straightforward. Note that:

$$\alpha_4 + \gamma_4 = 1. \quad (6)$$

The latter constraint reflects the fact that the exchange rate clears the foreign exchange market through its impact on the expected return and the stock of assets denominated in foreign currency. Indeed, equation (1) shows how exchange rate expectations are driven by the divergence between the spot and the long run equilibrium rate, while the left hand side of equation (3) illustrates how the stock of foreign assets, measured in rubles, is adjusted to its desired level through changes in the spot exchange rate. Parameters  $\alpha_4$  and  $\gamma_4$  are weights which reflect the relative importance of each of these two adjustment channels. In the polar case where economic agents are risk neutral (or in the absence of risk),  $\alpha_3=0$  and the parameters reduce to:

$$\alpha_4 = 1 \quad (7.a)$$

$$\beta_4 = \beta_1 / \alpha_1 > 0 \quad (7.b)$$

$$\delta_4 = -1 / \alpha_1 < 0 \quad (7.c)$$

$$\gamma_4 = 0. \quad (7.d)$$

In other words, in the case of risk neutral economic agents the spot exchange rate restores foreign exchange market equilibrium only through its impact on the expected rate of return.

In order to estimate equation (4), the long run equilibrium exchange rate and the expected change in this long run equilibrium rate have to be modelled.

In principle, the concept of a long run equilibrium exchange rate involves a notion of current account equilibrium. Since the focus of this paper is on the impact of short run monetary factors on the spot exchange rate, it will be assumed that long run equilibrium conditions can be captured by using alternative measures of the purchasing power parity (PPP) rate. Three such measures are considered, based respectively on consumer goods prices (PPP1), on the price of a Big Mac sandwich (PPP2), and on the price of a basket of 19 basic food items (PPP3). <sup>1/</sup> As shown in Chart 7, these measures differ significantly, especially in level terms.

The long run equilibrium exchange rate is measured by taking a weighted average of these alternative measures:

$$S_t = \alpha_5 \text{PPP1}_t + \beta_5 \text{PPP2}_t + (1-\alpha_5-\beta_5) \text{PPP3}_t \quad (8)$$

where the weights stand for the proportions of agents considering measures PPP1, PPP2 and PPP3, respectively, to be the relevant ones. Note that  $0 \leq \alpha_5, \beta_5 \leq 1$ .

Also needed to operationalize the model is a hypothesis on the expected change in the long run equilibrium rate. The expected long run nominal equilibrium exchange rate is equal to the expected long run real equilibrium exchange rate adjusted for the expected relative long run price levels. Here, it is assumed that no changes in the real equilibrium rate are anticipated. Hence, only the expected changes in the long run price levels are to be specified.

It is posited that agents base their expectation of the long run price level on recently observed price movements. Furthermore, in the case of Russia, one should take into account that expectations are formulated in a high inflation environment. High inflation is not sustainable in the long run: either it degenerates into hyperinflation or stabilization comes about. Market participants closely monitor inflation developments and are assumed to formulate their expectations on the basis of the following scheme:

$$E_t S_{t+1} - S_t = [\text{MOV}(p_t - p_{t-1}) - (p_t^* - p_{t-1}^*)] + \beta_9 [\text{MOV}(p_t - p_{t-1})]^2 \quad (9)$$

where  $p$  and  $p^*$  respectively denote the logarithms of the domestic and foreign price levels, and  $\text{MOV}(\cdot)$  is an operator taking a lagged, ten-week moving average, anchored on the contemporaneous week. <sup>2/</sup> A priori, the sign of parameter  $\beta_9$  is undetermined. If  $\beta_9 > 0$ , market participants are expecting that inflation will degenerate into hyperinflation; if  $\beta_9 = 0$ , the recently observed inflation rate is expected to be sustainable in the long run; if  $\beta_9 < 0$ , stabilization is expected.

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<sup>1/</sup> These measures are described in more detail in Appendix I.

<sup>2/</sup> Experimentation with different lag structures did not alter any of the qualitative estimation results presented below.

Inserting equations (6), (8) and (9) into equation (4), yields:

$$\begin{aligned}
 s_t = & \phi_{10} + \alpha_4 (\alpha_5 \text{PPP1}_t + \beta_5 \text{PPP2}_t + (1-\alpha_5-\beta_5) \text{PPP3}_t) \\
 & + \delta_4 (i_t - i_t^*) + \beta_4 [\text{MOV}(p_t - p_{t-1}) - (p_t^* - p_{t-1}^*)] \\
 & + \gamma_{10} [\text{MOV}(p_t - p_{t-1})]^2 + (1-\alpha_4) (DA_t - FA_t)
 \end{aligned} \tag{10}$$

where  $\alpha_4, \alpha_5, \beta_4, \beta_5 \geq 0$ ,  $\delta_4 \leq 0$ , and the sign of  $\gamma_{10}$  is indeterminate.

An equation is thus obtained relating the spot exchange rate to a long run equilibrium exchange rate concept, an interest rate differential, an inflation differential and the relative ruble and U.S. dollar asset stocks.

## 2. Estimation results

First the unrestricted version of equation (10) is estimated using weekly data. 1/ The estimation period for the dependent variable ranges from mid-1992 to the end of 1993. 2/ The first result is as follows (with t-values between brackets):

$$\begin{aligned}
 s_t = & 2.16 + 0.86 (-0.12 \text{PPP1}_t + 0.65 \text{PPP2}_t + (1+0.12 - 0.65) \text{PPP3}_t) \\
 & (4.48) \quad (6.93) \quad (-0.61) \quad (6.62) \quad (-0.61) \quad (6.62) \\
 & - 54.00 (i_t - i_t^*) + 18.14 [\text{MOV}(p_t - p_{t-1}) - (p_t^* - p_{t-1}^*)] \\
 & (-6.33) \quad (2.53) \\
 & - 206.41 [\text{MOV}(p_t - p_{t-1})]^2 + (1-0.86) (DA_t - FA_t) \\
 & (-2.31) \quad (6.93) \\
 R^2 = & 0.98, \quad \text{Durbin Watson} = 0.75.
 \end{aligned}$$

This result is also reported as version (1) in Table 1. The interest rate on ruble denominated assets is measured by the Moscow interbank interest rate (using the CBR refinance rate instead did not yield better results). 3/ The estimated coefficients display the expected signs and high t-values, except for the coefficient associated with PPP1, which has a negative sign (but a low t-value).

1/ The data set is described in appendices I and II.

2/ For the price data on the right-hand side, the sample starts mid-April 1992, since a 10-week moving average is used for these variables.

3/ Note that interest rates are computed at a one-week horizon based on the quoted rates, with the necessary correction for compounding but implicitly assuming a flat term structure at the short end of the maturity spectrum.

Table 1. Main estimation results

Estimated equation:  $s_t = \phi_{10} + \alpha_4 (\alpha_5 \text{PPP1}_t + \beta_5 \text{PPP2}_t + (1-\alpha_5-\beta_5) \text{PPP3}_t) + \delta_4 (i_t - i_t^*) + \beta_4 [\text{MOV}(p_t - p_{t-1}) - (p_t^* - p_{t-1}^*)] + (\gamma_{10} + \mu \text{DUM}) [\text{MOV}(p_t - p_{t-1})]^2 + (1-\alpha_4) (\text{DA}_t - \text{FA}_t)$

Version	Type	$\phi_{10}$	$\alpha_4$	$\alpha_5$	$\beta_5$	$\delta_4$	$\beta_4$	$\gamma_{10}$	$\mu$
(1)	OLS	2.16 (4.48)	0.87 (6.93)	-0.12 (-0.61)	0.65 (6.62)	-54.00 (-6.33)	18.14 (2.53)	-206.41 (-2.31)	$\mu=0$
(2)	OLS	2.31 (4.68)	0.84 (6.55)	-0.24 (-1.20)	0.68 (6.43)	-49.52 (-5.79)	1.84 (1.38)	$\gamma_{10}=0$	$\mu=0$
(3)	OLS	1.99 (4.64)	0.82 (7.35)	-0.19 (-1.07)	0.50 (5.56)	-41.88 (-5.23)	17.78 (2.80)	-272.07 (-3.38)	78.41 (4.58)
(4)	OLS	2.64 (14.97)	$\alpha_4 = 1$	-0.13 (-0.87)	0.46 (6.54)	-54.30 (-18.97)	18.38 (2.86)	-282.16 (-3.48)	75.68 (4.39)
(5)	CORC	1.48 (4.19)	0.73 (10.59)	0.31 (8.41)	-0.05 (-4.57)	-14.68 (-2.04)	8.20 (1.02)	-123.92 (-1.17)	73.25 (2.44)
(6)	CORC	1.32 (5.15)	0.73 (10.69)	0.29 (8.15)	-0.05 (-4.66)	-11.49 (-2.08)	$\beta_4 = -\delta_4$	-164.35 (-2.15)	71.49 (2.39)

OLS = ordinary least squares, CORC = Cochrane-Orcutt procedure; t-values between brackets. The dummy DUM takes the value 1 for the period running through mid-1993, and 0 thereafter.

Version	$R^2$	Durbin Watson	Log of likelihood	Confidence level	$\rho$ 1/
(1)	0.98	0.75	79.80	1.000 2/	
(2)	0.98	0.72	76.97	0.983 3/	
(3)	0.99	0.74	90.01	not applicable	
(4)	0.99	0.86	88.51	0.917 2/	
(5) 4/	0.69	1.62	126.82	not applicable	0.96 (36.43)
(6) 4/	0.69	1.61	126.67	0.416 5/	0.97 (41.68)

1/ The associated t-statistic is indicated in parentheses.

2/ Confidence level to reject the null hypothesis when tested against version (3) of this table.

3/ Confidence level to reject the null hypothesis when tested against version (1) of this table.

4/ Diagnostic statistics are for the transformed data.

5/ Confidence level to reject the null hypothesis when tested against version (5) of this table.

The coefficient associated with the interest rate differential is related to the speed at which the spot rate adjusts to its long run equilibrium value ( $\alpha_1$ ) and the degree of risk aversion ( $\alpha_3$ ). Equations (5.a) and (5.c) and the earlier reported point estimates imply for  $\alpha_1$  a value equal to 0.016. 1/ In other words, after one week the spot exchange rate adjusts for 1.6 percent of a change in the long run equilibrium rate. The risk aversion coefficient comes out positive, at 0.003.

The negative sign of the coefficient associated with the quadratic inflation term suggests that the market expects stabilization. Nevertheless, it is worth examining the regression results if this term were to be left out. Version (2) shows that the value of the parameter associated with the inflation differential,  $\beta_4$ , drops sharply. However, at the same time, the diagnostic statistics indicate that the hypothesis  $\gamma_{10}=0$  can be rejected with a fair degree of confidence. 2/ Moreover, the description of policies and expectations in Section III implies that a distinct break occurred around mid-1993. A time dummy is used in version (3) to contrast the first year following exchange rate unification and the second half of 1993, the prior being that in the latter period, agents were more confident that stabilization would come about. This presumption is indeed strongly corroborated, as version (1) can be rejected when tested against version (3). Hence, the quadratic term and the associated time dummy are maintained in subsequent versions.

Still regarding agents' expectations, it is worth assessing the significance of the risk premium. Version (4) reports the estimation results for the case where it is assumed that the relative stock of ruble and U.S. dollar assets has no impact on the spot rate, i.e.,  $\alpha_4=1$ . The null hypothesis that there is no risk premium can be rejected when tested against version (3), but not with a very high degree of confidence.

The low values taken by the Durbin-Watson statistic indicate high positive autocorrelation. Therefore, version (3) is reestimated using a Cochrane-Orcutt procedure. Version (5) shows that the qualitative conclusions reached above are not invalidated. However, some differences deserve mention. The implied value of  $\alpha_1$ --the parameter measuring the speed of adjustment of the spot exchange rate to its long-run value--rises from 2 percent (per week) in version (3) to 5 percent (per week) in version (5). Also, the relative weights of the different PPP measures change. 3/

1/ Equations (5.a) and (5.c) imply  $\alpha_1 = -\alpha_4/\delta_4$  and  $\alpha_3 = -(1-\alpha_4)/\delta_4$ .

2/ The last column of the diagnostic panel in Table 1 shows the confidence level at which the restricted version can be rejected when tested against the less restrictive version (1). This is done by calculating to what extent there is a significant drop in the logarithmic likelihood value as one moves from the unrestricted to the restricted version, knowing that twice the difference of the logarithm of the likelihood function is Chi-square distributed with one degree of freedom.

3/ The sign of the estimated coefficient associated with PPP2 is theoretically unacceptable.

The elasticities with respect to the interest rate and inflation differentials come somewhat closer together in version (5). Version (6) serves to test the null hypothesis  $H_0: \delta_4 = -\beta_4$  against the alternative hypothesis  $H_1: \delta_4 \neq -\beta_4$ . It appears that one cannot reject the null, meaning that "money illusion" does not prevail in the foreign exchange market. <sup>1/</sup>

In sum, it appears that the interest rate differential and the expected inflation differential had a significant impact on the evolution of the ruble-U.S. dollar exchange rate. Moreover, the evidence seemed to suggest that market participants were well aware of the risks associated with high inflation. The hypothesis that the relative supply of interest yielding assets had a significant impact on the spot exchange rate was partly corroborated.

A number of further tests were carried out to assess the influence of particular institutional or policy changes on the spot exchange rate. For the sake of conciseness, and because on the whole no clear-cut impacts could be identified, the results are not reported. Presumably, the weak or seemingly non-existent influence of such factors results from the fact that in many cases changes in the rules are accompanied by many exemptions and are only partly and belatedly enforced.

Potential simultaneity was also tested for by reestimating the equations using instrumental variables. Indeed, one cannot a priori rule out a simultaneity bias induced by causality running from the exchange rate to domestic inflation and interest rates. The results suggested that there is no major simultaneity problem.

Finally, the hypothesis that the CBR intervened to achieve a certain exchange rate was tested using weekly data on CBR intervention on the MICEX. Notwithstanding the policy intentions and actions described in Section III, the econometric analysis did not support the conjecture that the CBR had any intervention strategy other than smoothing short-run fluctuations. However, this may be due to the fact that interventions were not circumscribed to CBR sales or purchases on the MICEX, as well as to our incomplete information on the very short-run exchange rate rules guiding the authorities' intervention, which reportedly changed fairly often or were not always fully clear.

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<sup>1/</sup> Appendix III shows the estimation results for alternative restrictions on the convex combination of alternative measures of the long run equilibrium exchange rate. Version (1') repeats for the sake of reference version (6) of Table 1. The next three versions incorporate restrictions on parameters  $\alpha_5$  and  $\beta_5$ . Versions (2') and (3') can be rejected with a fair degree of confidence when tested against version (1'). However, it is hard to reject version (4'), i.e., the version which uses PPP3 only.

## V. Conclusion

The adoption of a unified exchange regime in July 1992 was a major step in opening Russia to the world economy and moving toward a market system. Notwithstanding political turmoil, collapsing output, very high inflation, large-scale dollarization, <sup>1/</sup> and occasional rumors about an imminent return to a system of multiple exchange rates, this decision has not been reversed. The expansion of the organized foreign exchange market has been vigorous, though it started from a minuscule base. By late 1993, regular spot auctions were being held at exchanges in six Russian cities, and two futures markets were active in Moscow. Over time, the various segments of the foreign exchange market have become increasingly integrated, even if seemingly unexploited arbitrage opportunities have not disappeared altogether.

Exchange rate policy has evolved from what may be characterized as an unsuccessful attempt in the spring of 1992 to move to a formal target zone at the time of unification; to a managed float between mid-1992 and mid-1993; and to a system of notional target zones, or at least, a regime of large-scale smoothing in the second half of 1993. The real exchange rate appreciated by more than 150 percent in the 18 months following unification, thus reducing considerably, or possibly even reversing, what was perceived by many as the large undervaluation of the ruble in mid-1992. This pattern was broadly similar to what was observed in some countries in Central and Eastern Europe at the same stage of the transition.

In order to provide a more formal evaluation of the behavior of the exchange rate, a simple model of exchange rate determination was developed and tested on weekly data. <sup>2/</sup> The empirical results suggested that the interest rate differential and the expected inflation differential clearly have influenced the ruble-U.S. dollar exchange rate in the short run. Moreover, the evidence seemed to imply that market participants have been aware of the risks associated with high inflation.

The sturdiness of the relationship (version (6)) derived in this exercise can be tested by using it for an out-of-sample projection. Chart 8 shows the result for January 1994. The abrupt depreciation of the nominal exchange rate in the early weeks of 1994, in stark contrast to its near-stability in the previous half year, is well captured by the equation.

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<sup>1/</sup> On average in 1993, foreign exchange deposits in domestic banks were about as large as Ruble deposits, while reported CBR estimates of cash U.S. dollar holdings ranged from US\$5 billion (*Russian Economic Trends*, 1993, vol. 2, no.4), to US\$10 to 15 billion (*Moskovskie Novosti*, April 29, 1994), implying that they quite possibly exceeded holdings of Ruble cash.

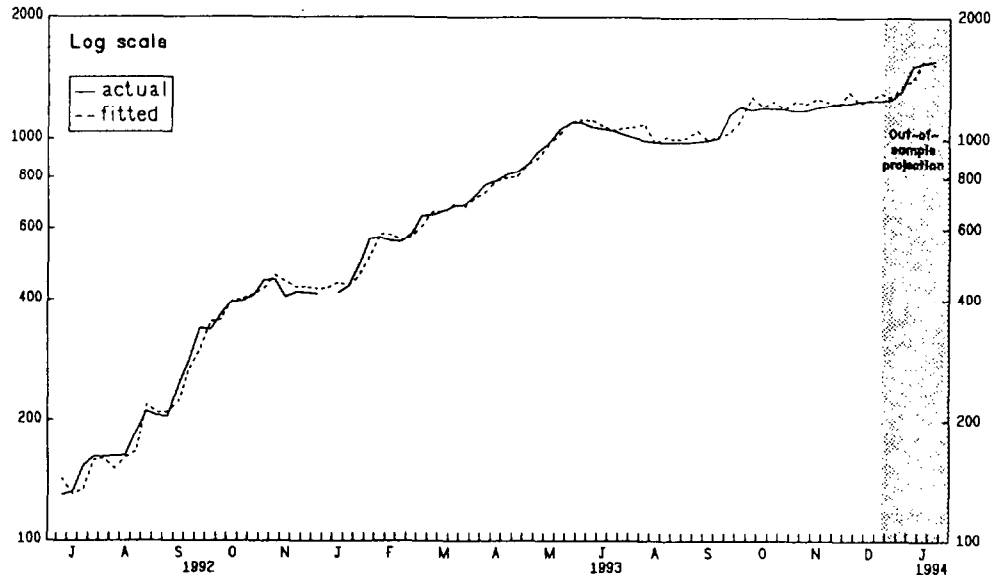
<sup>2/</sup> A limitation of the model is that it has no explicit role for cash monies. There exists no time series, however, for holdings of cash foreign exchange by residents.



CHART 8

# ACTUAL VERSUS FITTED EXCHANGE RATE

July 1992 - January 1994  
(Rubles per US Dollar)



Sources: MICEX; and authors' calculations.  
Based on version (6).



One area for further research would be to improve the modelling of the long-run equilibrium exchange rate level. The diagnostic statistics obtained in Section IV may constitute an indication that dynamic adjustment towards a long-term relationship has been poorly specified. It would thus be interesting to construct and try out more sophisticated measures of the long-run rate and alternative long-run convergence processes.

Data description 1/

Exchange rates

Spot rates

Interbank exchange rate: the rate as quoted on and published by the MICEX is used; there is no distinction between a buying and a selling rate.

Street rate: through March 1993, the average of the buying and selling rates published for Moscow in the weekly, English edition of *Commersant* is used. Thereafter, the daily observations as published in the daily, Russian *Commersant* are averaged. In most cases different buy and sell rates are provided for different locations within Moscow, and the mid-point of the range was used.

Futures

The futures series are weekly averages of the quotes recorded on the Moscow Commodity Exchange and the Moscow Board of Trade futures markets. The raw data were provided directly by the Moscow Commodity Exchange and the Moscow Board of Trade.

PPP rates

IMEMO: The Institute for World Economy and International Relations (IMEMO) computes a PPP rate based on the prices of consumer goods (food and non-food), which is published in *Russian Economic Trends*. In the text, this measure is denoted PPP1.

Big Mac: The price of a Big Mac in rubles in Moscow is compared to that of a Big Mac in the United States (average of the price in New York, Chicago, San Francisco, and Atlanta), which stood at \$2.19 in April 1992. The data on the price in Moscow were provided directly by Moscow McDonald's. In the text, this measure is denoted PPP2.

Basket of 19 food items: This assortment represents the minimum monthly food consumption required for a 45-year old, able-bodied worker as defined by the former U.S.S.R. State Committee for Labor and Social Problems. It includes (with volumes expressed on a per-year basis) rye bread (92 kg), wheat bread (86.7 kg), millet (18.1 kg), vermicelli (7.3 kg), sugar (24.8 kg), vegetable oil (10 kg), butter (3.6 kg), beef (42 kg), boiled sausage (2.2 kg), salami (1.1kg), milk (184.3 liters), sour cream (4.2 kg), hard cheese (2 kg), eggs (183), potatoes (146 kg), fresh cabbage (29.8 kg),

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1/ Most of the data needed to replicate the results presented in this paper are provided in Appendix II. The few series that do not appear therein can be obtained from the authors on request.

onion (10.2 kg), apples (11 kg) and cigarettes (96 packs). The U.S. price of this monthly basket in January 1991 was \$88.29, and is assumed to have risen in line with the average of all food prices in the U.S. during the period under consideration. In the text, this measure is denoted PPP3.

World Bank: The World Bank (1993) derived estimates for GDP per capita in U.S. dollars in 1990 for all FSU countries. 1/ Implicit in these estimates are PPP exchange rates. The 1990 estimate for Russia is extrapolated by multiplying it by the ratio of the Russian to the U.S. consumer price levels. The Russian price level is obtained by linking monthly increases in the consolidated retail price index (through the end of 1991) and in the consumer price index (see below).

PlanEcon: the PPP series published by PlanEcon (1993) was built based on the estimates produced in the late 1980s by the U.S. Central Intelligence Agency. 2/ PlanEcon adjusted the latter and extrapolated the series using the U.S. CPI and a string of Russian retail and consumer price indices.

Duchêne (1993): this PPP rate is obtained using a methodology that attempts to correct for the so-called "Balassa bias" (i.e., for the fact that, as suggested by cross-country comparisons, the ratio of a country's observed market exchange rate to its long-run PPP level will be smaller the lower its income per capita).

### Interest rates

CBR refinance rate: For those weeks when it was adjusted, the weekly average is derived as an average of the daily rates weighted by the number of days during which the rate was in effect.

Interbank rate: For July 1992-June 1993, end-month data as reported in *Rating* are used, and the weekly data are constructed by interpolating the end-month observations; 3/ from July 1993 onwards, weekly raw data are used, derived as the weighted averages of the rates quoted on three (through September) and then two (thereafter) interbank exchanges, excluding the extrema.

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1/ In an earlier publication, the World Bank (1992) produced a U.S. dollar GDP estimate for Russia that stood about 10 percent below the revised one contained in World Bank (1993).

2/ See Central Intelligence Agency (1991).

3/ Weekly series were generated based on the monthlies by: 1) regressing the monthlies on the monthlies of a set of variables (such as the CPI and the exchange rate) that are available both at the monthly and weekly frequencies and that can be expected to be highly correlated with the series to be interpolated; 2) assuming that the relationship thus derived holds at the weekly frequency as well, which allows to produce an artificial weekly series.

Interest rates on US\$ denominated assets: it is assumed that the relevant rate is the London Interbank Offered Rate for one-month deposits. The data are downloaded from the Fund's International Financial Statistics tape.

### Prices

Monthly: For Russia, the urban CPI is used for 1992 and the expanded CPI for 1993 (see Koen (1994) for a detailed description of these indices).

Weekly: For Russia, the weekly CPI computed by the Center of Economic Analysis in Moscow is used, which is published in several newspapers (most regularly, in *Izvestia*). While this index is based on a limited sample of items and is less reliable than the broader based monthly CPI, it became increasingly used as the relevant measure of contemporaneous inflation during the period under consideration.

Foreign: For the overall CPI as well as for food prices, the U.S. price level as reported by the Bureau of Labor Statistics of the U.S. Department of Labor is used. Weekly data are obtained by linearly interpolating the raw monthly series.

### Money

The monthly ruble M2 series is the one published by the CBR in its annual reports. Its main components are cash in circulation and demand and time deposits of households and enterprises with the banking system. The variable called DA in equations (2) and following is measured by the ruble deposits component of M2. The variable called FA in equations (2) and following is measured by foreign exchange deposits held with the domestic banking system. 1/ Weekly money stock data were derived by interpolation. 2/

### CBR intervention on the foreign exchange market

Weekly data on the sales and purchases of U.S. dollars by the CBR on the MICEX are derived from daily data provided directly by the CBR. Monthly data on central bank intervention on the interbank market were published in the *Interfax News Bulletin* on February 2, 1993 for 1992 and by the Ministry of Finance (1994) for 1993.

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1/ Among the data used in this study, foreign currency deposits is one of the least reliable series.

2/ The same methodology is applied as for interest rates.

### Foreign exchange reserves

Monthly data on gross CBR reserves and foreign assets and liabilities of the government are published by the CBR in *Current Trends in the Money and Credit Sphere* and in the *Bulletin of the Bank of Russia (Operational Information of the Central Bank of the Russian Federation)*.

### Wages

The wage series used is the monthly wage series for the national economy compiled by the Goskomstat of the Russian Federation, which excludes some sectors (in particular, kolkhoz wages) and does not incorporate material help and social compensation payments received by workers (the combination of which amounted to about one tenth of the wage *stricto sensu* in 1993).

APPENDIX II

Table A1. Volumes traded on the MICEX  
(In millions of U.S. dollars)

		Total trading volume (gross)	CBR intervention (net sales of U.S. dollars)
1992	January	18	1
	February	33	11
	March	99	69
	April	47	22
	May	100	40
	June	309	224
	July	254	131
	August	261	49
	September	453	168
	October	409	137
	November	353	105
	December	453	-102
1993	January	485	155
	February	520	185
	March	495	122
	April	535	244
	May	428	197
	June	683	-102
	July	1,362	-923
	August	1,237	447
	September	2,216	1,005
	October	1,251	4
	November	1,616	425
	December	1,867	-143

Source: CBR.



Table A2. Daily exchange rate quotes on the MICEX  
(In rubles per U.S. dollar)

1992

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Jan 3	150.0		
Jan 14	180.0		
Jan 21	230.1		
Jan 28	230.0		
Feb 4	224.5		
Feb 11	210.0		
Feb 18	170.0		
Feb 25	139.0		
Mar 3	140.1		
Mar 10	140.0		
Mar 17	160.5		
Mar 24	160.4		
Mar 31	160.3		
Apr 7	159.7	Apr 2	160.0
Apr 14	155.0	Apr 9	155.7
Apr 21	150.5	Apr 16	154.0
Apr 28	143.6	Apr 23	150.0
May 6	128.0	Apr 30	hol.
May 12	127.6	May 7	hol.
May 19	126.6	May 14	127.4
May 26	118.0	May 21	123.0
Jun 2	112.6	May 28	113.0
Jun 9	112.4	Jun 4	112.5
Jun 16	118.5	Jun 11	112.3
Jun 23	146.0	Jun 18	129.0
Jun 30	144.0	Jun 25	146.6
Jul 7	130.5	Jul 2	134.8
Jul 14	130.2	Jul 9	130.3
Jul 21	151.4	Jul 16	135.4
Jul 28	161.1	Jul 23	155.7
Aug 4	161.4	Jul 30	162.2
Aug 11	161.7	Aug 6	161.5
Aug 18	162.5	Aug 13	162.5
Aug 25	168.1	Aug 20	162.6
Sep 1	210.5	Aug 27	205.0
Sep 8	207.9	Sep 3	210.5
Sep 15	204.0	Sep 10	203.0
Sep 22	241.0	Sep 17	205.5
Sep 29	254.0	Sep 24	248.0
Oct 6	342.0	Oct 1	309.0
Oct 13	334.0	Oct 8	334.0
Oct 20	368.0	Oct 15	338.0
Oct 27	393.0	Oct 22	368.0
Nov 3	396.0	Oct 29	398.0
Nov 10	403.0	Nov 5	399.0
Nov 17	448.0	Nov 12	419.0
Nov 24	450.0	Nov 19	448.0
Dec 1	417.0	Nov 26	447.0
Dec 8	419.0	Dec 3	398.0
Dec 15	418.0	Dec 10	419.0
Dec 22	415.0	Dec 17	416.0
Dec 29	hol.	Dec 24	414.5
		Dec 31	hol.

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1993

		Jan 5	417.0			Jan 7	hol.		
		Jan 12	423.0			Jan 14	442.0		
		Jan 19	474.5			Jan 21	493.0		
		Jan 26	568.0			Jan 28	572.0		
		Feb 2	572.0			Feb 4	572.0		
		Feb 9	561.0			Feb 11	560.0		
		Feb 16	559.0			Feb 18	559.0		
		Feb 23	576.0			Feb 25	593.0		
		Mar 2	649.0			Mar 4	648.0		
		Mar 9	650.0			Mar 11	653.0		
		Mar 16	662.0			Mar 18	667.0		
		Mar 23	684.0			Mar 25	684.0		
		Mar 30	684.0			Apr 1	692.0		
		Apr 6	712.0			Apr 8	740.0		
		Apr 13	766.0			Apr 15	779.0		
		Apr 20	786.0			Apr 22	795.0		
		Apr 27	812.0			Apr 29	823.0		
		May 4	hol.			May 6	829.0		
		May 11	859.0			May 13	886.0		
		May 18	934.0			May 20	940.0		
		May 25	960.0			May 27	994.0		
May 31	1,024	Jun 1	1,050			Jun 3	1,072	Jun 4	1,072
Jun 7	1,089	Jun 8	1,104			Jun 10	1,102	Jun 11	1,098
Jun 14	hol.	Jun 15	1,116	Jun 16	1,104	Jun 17	1,090	Jun 18	1,085
Jun 21	1,081	Jun 22	1,079	Jun 23	1,072	Jun 24	1,066	Jun 25	1,061
Jun 28	1,061	Jun 29	1,060	Jun 30	1,060	Jul 1	1,059	Jul 2	1,059
Jul 5	1,058	Jul 6	1,058	Jul 7	1,055	Jul 8	1,050	Jul 9	1,045
Jul 12	1,039	Jul 13	1,036	Jul 14	1,030	Jul 15	1,025	Jul 16	1,020
Jul 19	1,017	Jul 20	1,010	Jul 21	1,008	Jul 22	1,008	Jul 23	1,004
Jul 26	996.5	Jul 27	994	Jul 28	992	Jul 29	989.5	Jul 30	987
Aug 2	987	Aug 3	987	Aug 4	987	Aug 5	986	Aug 6	985
Aug 9	985	Aug 10	984.5	Aug 11	984.5	Aug 12	984.5	Aug 13	984.5
Aug 16	984.5	Aug 17	984.5	Aug 18	984.5	Aug 19	987	Aug 20	985
Aug 23	985	Aug 24	986	Aug 25	985.5	Aug 26	985	Aug 27	985
Aug 30	989	Aug 31	992.5	Sep 1	991	Sep 2	990	Sep 3	990
Sep 6	990	Sep 7	995	Sep 8	995	Sep 9	998	Sep 10	997
Sep 13	1,006	Sep 14	1,006	Sep 15	1,010	Sep 16	1,010	Sep 17	1,017
Sep 20	1,029	Sep 21	1,036	Sep 22	1,102	Sep 23	1,299	Sep 24	1,297
Sep 27	1,293	Sep 28	1,201	Sep 29	1,179	Sep 30	1,169	Oct 1	1,166
Oct 4	1,168	Oct 5	1,173	Oct 6	1,183	Oct 7	1,189	Oct 8	1,191
Oct 11	1,195	Oct 12	1,194	Oct 13	1,194	Oct 14	1,194	Oct 15	1,193
Oct 18	1,193	Oct 19	1,193	Oct 20	1,193	Oct 21	1,193	Oct 22	1,191
Oct 25	1,189	Oct 26	1,189	Oct 27	1,189	Oct 28	1,186	Oct 29	1,184
Nov 1	1,181	Nov 2	1,179	Nov 3	1,177	Nov 4	1,177	Nov 5	1,176
Nov 8	1,176	Nov 9	1,175	Nov 10	1,175	Nov 11	1,176	Nov 12	1,180
Nov 15	1,185	Nov 16	1,194	Nov 17	1,201	Nov 18	1,203	Nov 19	1,203
Nov 22	1,204	Nov 23	1,208	Nov 24	1,213	Nov 25	1,214	Nov 26	1,219
Nov 29	1,231	Nov 30	1,231	Dec 1	1,235	Dec 2	1,230	Dec 3	1,229
Dec 6	1,229	Dec 7	closed	Dec 8	1,229	Dec 9	1,229	Dec 10	1,229
Dec 13	1,231	Dec 14	1,237	Dec 15	1,247	Dec 16	1,247	Dec 17	1,247
Dec 20	1,250	Dec 21	1,250	Dec 22	1,250	Dec 23	1,250	Dec 24	1,250
Dec 27	1,249	Dec 28	1,247	Dec 29	hol.	Dec 30	hol.	Dec 31	hol.

Source: MICEX.

Table A3. Currencies quoted on exchanges across Russia 1/  
(Date of first trading session)

Currency	MICEX (Moscow)	SPCE <u>2/</u> (St. Petersburg)	SICE <u>3/</u> (Novosibirsk)	APICE <u>4/</u> (Vladivostok)	RICE <u>5/</u> (Rostov-on-Don)	UICE <u>6/</u> (Yekaterinburg)
U.S. dollar	Apr 1991	Jul 1992	Nov 1992	Feb 1993	May 1993	Sep 1992
Deutschemark	Feb 1993	Feb 1993	Mar 1993		Nov 1993	Oct 1992
Finnish mark		Mar 1993				
French franc					Nov 1993	
British pound					Dec 1993	
Italian lira					Dec 1993	
Japanese yen				Mar 1993		
Austrian shilling						Aug 1993

1/ Excluding currencies of other countries of the Former Soviet Union.

2/ Saint Petersburg Currency Exchange.

3/ Siberian Foreign Currency Exchange.

4/ Asian-Pacific Interbank Currency Exchange.

5/ Rostov Interbank Currency Exchange.

6/ Urals Regional Currency Exchange.

Sources: *Commersant*; and *Ekonomika i Zhizn'*, various issues.

Table A4. U.S. dollar trading across exchanges in Russia in 1993

	MICEX (Moscow)	SPCE (St. Petersburg)	SICE (Novosibirsk)	APICE (Vladivostok)	RICE (Rostov-on-Don)	UICE (Ekaterinburg)
(Volume in millions of U.S. dollars)						
January	485.1	38.8	1.4	--	1.8	--
February	519.6	29.4	2.6	--	12.0	--
March	494.9	33.5	7.3	1.5	9.0	--
April	534.8	33.6	9.1	0.6	16.3	--
May	428.3	26.5	12.4	1.5	15.1	--
June	682.5	60.8	21.8	15.4	24.9	0.1
July	1,361.7	114.7	34.2	32.9	34.4	2.8
August	1,236.9	134.2	41.3	38.8	34.2	5.2
September	2,216.2	132.0	49.4	33.5	51.1	7.5
October	1,250.5	173.2	57.6	48.8	56.1	6.3
November	1,616.4	146.6	53.7	56.2	57.2	4.2
December	1,867.0	143.2	59.9	53.2	58.2	6.6
(In percent of nationwide volume)						
January	92.0	7.4	0.3	--	0.3	--
February	92.2	5.2	0.5	--	2.1	--
March	90.6	6.1	1.3	0.3	1.6	--
April	90.0	5.7	1.5	0.1	2.7	--
May	88.5	5.5	2.6	0.3	3.1	--
June	84.7	7.6	2.7	1.9	3.1	--
July	86.2	7.3	2.2	2.1	2.2	0.2
August	83.0	9.0	2.8	2.6	2.3	0.3
September	89.0	5.3	2.0	1.3	2.1	0.3
October	78.5	10.9	3.6	3.1	3.5	0.4
November	83.6	7.6	2.8	2.9	3.0	0.2
December	85.3	6.5	2.7	2.4	2.7	0.3

Sources: MICEX; *Finansovye Izvestia*, December 3, 1993; *Ekonomika i Zhizn*, various issues; *Commerzant*, various issues; and authors' calculations.

Note: owing to inconsistencies across data sources, the numbers in this table should be interpreted as indicative of broad orders of magnitude.

Table A5. Finance rate of the Central Bank of Russia  
(Per annum, as quoted)

Period	Rate
April 10 - May 28, 1992	50
May 29, 1992 - March 29, 1993	80
March 30 - June 1, 1993	100
June 2 - June 21, 1993	110
June 22 - June 28, 1993	120
June 29 - July 14, 1993	140
July 15 - September 22, 1993	170
September 23 - October 14, 1993	180
October 15, 1993 - April 28, 1994	210

Source: Central Bank of Russia.

Table A6. Weekly spot and futures exchange rates  
MICEX (spot) 1/ and MBT (futures) 1/ 2/

Week starting	Spot rate	Contract expiring in													
		Nov 92	Dec 92	Jan 93	Feb 93	Mar 93	Apr 93	May 93	Jun 93	Jul 93	Aug 93	Sep 93	Oct 93	Nov 93	Dec 93
11/02/92	398	490	553	659	693										
11/09/92	411	480	524	581	659										
11/16/92	448	472	540	585	640										
11/23/92	449	474	530	576	627										
11/30/92	408		501	547	591	637									
12/07/92	419		483	525	571	615									
12/14/92	417		489	557	617	656									
12/21/92	415		497	553	592	646									
12/28/92 3/	...	...	...	...	...	...									
01/04/93	417			552	582	639	746								
01/11/93	433			550	600	657	735								
01/18/93	484			565	649	701	774								
01/25/93	570			593	734	857	926								
02/01/93	572				773	967	1,130	1,385							
02/08/93	561				766	869	920	1,077							
02/15/93	559				733	812	905	1,008							
02/22/93	585				729	806	954	1,082							
03/01/93	649					807	966	1,103	1,211						
03/08/93	652					808	936	1,095	1,213						
03/15/93	665					801	906	1,048	1,212						
03/22/93	684					796	906	1,042	1,188						
03/29/93	688						892	998	1,130	1,180					
04/05/93	726						875	974	1,120	1,180					
04/12/93	773						851	963	1,076	1,168					
04/19/93	791						824	941	1,047	1,132					
04/26/93	818							919	1,022	1,097					
05/03/93	829							917	1,021	1,094	1,170				
05/10/93	873							929	1,033	1,103	1,177				
05/17/93	937							936	1,052	1,152	1,224				
05/24/93	977							991	1,134	1,225	1,327				
05/31/93	1,055								1,256	1,369	1,510	1,812			
06/07/93	1,098								1,271	1,477	1,696	1,976			
06/14/93	1,099								1,262	1,492	1,667	1,912			
06/21/93	1,072								1,236	1,431	1,604	1,825			
06/28/93	1,060									1,360	1,576	1,770			
07/05/93	1,053									1,324	1,546	1,737	1,735		
07/12/93	1,030									1,157	1,435	1,609	1,615		
07/19/93	1,009									1,043	1,267	1,395	1,450		
07/26/93	992										1,148	1,287	1,431		
08/02/93	986										1,096	1,249	1,419	1,599	
08/09/93	985										1,103	1,253	1,424	1,596	
08/16/93	985										1,054	1,226	1,431	1,621	
08/23/93	985										1,056	1,230	1,435	1,615	
08/30/93	991											1,197	1,405	1,601	1,767
09/06/93	995											1,181	1,386	1,591	1,769
09/13/93	1,010											1,166	1,331	1,540	1,734
09/20/93	1,153											1,148	1,309	1,500	1,717
09/27/93	1,202												1,314	1,500	1,727
10/04/93	1,181												1,300	1,494	1,701
10/11/93	1,194												1,272	1,449	1,650
10/18/93	1,193												1,306	1,452	1,661
10/25/93	1,187												1,339	1,397	1,568
11/01/93	1,178												1,284	1,415	
11/08/93	1,176													1,244	1,331
11/15/93	1,197													1,247	1,314
11/22/93	1,212													1,259	1,336
11/29/93	1,231														1,334
12/06/93	1,229														1,316
12/13/93	1,242														1,282
12/20/93	1,250														1,281
12/27/93	1,248														

Sources: MICEX; and MBT.

1/ Unweighted weekly averages.

2/ \$10 contracts for November 1992-January 1993; \$100 contracts thereafter.

3/ No transactions on the MICEX nor on the MBT due to holidays.

MICEX (spot) 1/ and MCE (futures) 1/ 2/

Week starting	Spot rate	Contract expiring in											
		Dec 92	Feb 93	Mar 93	Apr 93	May 93	Jun 93	Jul 93	Aug 93	Sep 93	Oct 93	Nov 93	Dec 93
10/19/92	368	461											
10/26/92	396	545											
11/02/92	398	592											
11/09/92	411	551											
11/16/92	448	507											
11/23/92	449	491	615										
11/30/92	408	478	561										
12/07/92	419		538										
12/14/92	417		568										
12/21/92	415		548	574									
12/28/92	... 3/		539	559									
01/04/93	417		556	568									
01/11/93	433		550	578									
01/18/93	484		555	601									
01/25/93	570		591	732									
02/01/93	572		593	766									
02/08/93	561		571	674									
02/15/93	559			677	788								
02/22/93	585			678	814								
03/01/93	649			700	843								
03/08/93	652			680	793								
03/15/93	665				778	927							
03/22/93	684				792	940							
03/29/93	688				763	875							
04/05/93	726				760	876							
04/12/93	773				759	871	969						
04/19/93	791					846	930	993					
04/26/93	818					855	949	1,008					
05/03/93	829					860	951	1,037					
05/10/93	873					865	968	1,051					
05/17/93	937					972	1,041	1,155					
05/24/93	977						1,067	1,149	1,332				
05/31/93	1,055						1,109	1,328	1,579				
06/07/93	1,098						1,158	1,357	1,541				
06/14/93	1,099							1,316	1,541	1,807			
06/21/93	1,072							1,238	1,454	1,694			
06/28/93	1,060							1,192	1,421	1,646			
07/05/93	1,053							1,131	1,251	1,385			
07/12/93	1,030							1,040	1,110	1,158	1,249	1,325	
07/19/93	1,009								1,062	1,147	1,320	1,475	
07/26/93	992								1,083	1,232	1,397	1,475	
08/02/93	986								1,070	1,233	1,432	1,578	
08/09/93	985								1,057	1,197	1,354	1,530	
08/16/93	985									1,134	1,324	1,553	1,719
08/23/93	985									1,147	1,333	1,543	1,745
08/30/93	991									1,120	1,276	1,482	1,666
09/06/93	995									1,085	1,224	1,403	1,601
09/13/93	1,010									1,030	1,145	1,365	1,556
09/20/93	1,153										1,193	1,401	1,653
09/27/93	1,202										1,316	1,385	1,482
10/04/93	1,181										1,196	1,346	1,512
10/11/93	1,194										1,200	1,331	1,529
10/18/93	1,193											1,271	1,412
10/25/93	1,187											1,210	1,349
11/01/93	1,178											1,186	1,282
11/08/93	1,176											1,129	1,232
11/15/93	1,197												1,273
11/22/93	1,212												1,242
11/29/93	1,231												1,261
12/06/93	1,229												1,221
12/13/93	1,242												1,229
12/20/93	1,250												
12/27/93	1,248												

Sources: MICEX; and MCE.

1/ Unweighted weekly averages.

2/ \$10 contracts for December 1992; \$1,000 contracts from February 1993 onwards; no quotations available for January 1993.

3/ No transactions on the MICEX due to holidays.

Table A7. Expected depreciation on futures markets  
(In percent)

Horizon	Expected rate of depreciation with respect to the spot Moscow interbank rate <u>1/</u>			
	<u>MCE 2/</u>		<u>MBT 3/</u>	
	<u>ahead of expiration by:</u> one month	<u>two months</u>	<u>ahead of expiration by:</u> one month	<u>two months</u>
Dec 92	27	...	18	...
Jan 93	...	...	30	24
Feb 93	21	30	34	41
Mar 93	16	28	30	32
Apr 93	17	34	27	38
May 93	10	33	16	43
Jun 93	9	20	14	30
Jul 93	17	17	25	16
Aug 93	8	31	19	47
Sep 93	15	11	22	43
Oct 93	13	28	2	37
Nov 93	9	29	20	17
Dec 93	7	22	10	32

Sources: MICEX; MCE; and MBT.

1/ Using the latest spot and futures rates registered one (respectively two) month(s) before the expiration of the contract. MCE contracts expire on the 15th of the month while MBT contracts expire on the 25th.

2/ \$10 contract for December 1992, \$1,000 contract thereafter.

3/ \$10 contract through February 1993, \$100 contract thereafter.



Table A8. Consumer price inflation

Weekly frequency  
(Week ending, in percent)

01/07/92	...	07/07/92	1.6	01/05/93	8.2	07/06/93	5.9
01/14/92	...	07/14/92	3.0	01/12/93	5.2	07/13/93	4.0
01/21/92	...	07/21/92	1.5	01/19/93	6.0	07/20/93	4.3
01/28/92	...	07/28/92	1.0	01/26/93	4.3	07/27/93	3.9
02/04/92	8.4	08/04/92	1.5	02/02/93	6.1	08/03/93	5.2
02/11/92	8.2	08/11/92	1.1	02/09/93	5.8	08/10/93	7.9
02/18/92	11.0	08/18/92	0.5	02/16/93	4.5	08/17/93	5.3
02/25/92	9.6	08/25/92	1.2	02/23/93	5.2	08/24/93	4.3
03/03/92	5.8	09/01/92	3.1	03/02/93	4.8	08/31/93	3.3
03/10/92	6.4	09/08/92	4.5	03/09/93	4.7	09/07/93	6.3
03/17/92	7.2	09/15/92	3.8	03/16/93	4.5	09/14/93	4.0
03/24/92	6.5	09/22/92	5.4	03/23/93	3.3	09/21/93	5.0
03/31/92	5.8	09/29/92	4.9	03/30/93	3.5	09/28/93	4.1
04/07/92	7.3	10/06/92	7.1	04/06/93	6.0	10/05/93	5.0
04/14/92	5.1	10/13/92	5.3	04/13/93	3.4	10/12/93	3.9
04/21/92	3.8	10/20/92	5.6	04/20/93	3.2	10/19/93	4.6
04/28/92	5.1	10/27/92	4.9	04/27/93	2.8	10/26/93	4.2
05/05/92	3.4	11/03/92	5.2	05/04/93	2.9	11/02/93	4.5
05/12/92	2.9	11/10/92	4.1	05/11/93	2.9	11/09/93	3.1
05/19/92	3.3	11/17/92	4.7	05/18/93	4.6	11/16/93	3.4
05/26/92	2.2	11/24/92	4.3	05/25/93	3.3	11/23/93	2.9
06/02/92	4.6	12/01/92	6.1	06/01/93	4.2	11/30/93	2.2
06/09/92	6.6	12/08/92	5.1	06/08/93	5.0	12/07/93	2.9
06/16/92	1.0	12/15/92	3.4	06/15/93	3.7	12/14/93	2.3
06/23/92	1.5	12/22/92	5.0	06/22/93	3.5	12/21/93	2.5
06/30/92	1.2	12/29/92	8.5	06/29/93	4.3	12/28/93	2.0

Source: Center of Economic Analysis.

Monthly frequency  
(Monthly averages, in percent)

1992				1993			
January	296.0	July	7.1	January	25.8	July	22.4
February	27.3	August	8.6	February	24.6	August	26.0
March	16.4	September	15.2	March	20.2	September	23.0
April	17.2	October	31.1	April	18.8	October	19.5
May	10.5	November	27.1	May	18.1	November	16.5
June	13.9	December	25.3	June	19.9	December	12.5

Source: Goskomstat of the Russian Federation.

Table A9. Alternative PPP estimates  
(Rubles per U.S. dollar, annual averages)

	1990	1991	1992	1993
Goskomstat	0.5	1.2	20	200
World Bank	1.2	2.5	43	450 <u>1/</u>
IMEMO <u>2/</u>	...	...	30	252
PlanEcon	0.5	0.9	15	142
Duchêne	1.1	2.5	42	...
Big Mac	4.5	15.8	125	535
Basket of 19 basic foodstuffs <u>3/</u>	...	...	19	171

1/ Projection.

2/ Institute for World Economy and International Relations, Moscow. Based on a basket of food and non-food consumer goods.

3/ The associated PPP rate is a lower bound (in ruble/U.S. dollar terms) because these goods are heavily subsidized.

Sources: Goskomstat of the Russian Federation (1993, 1994); World Bank (1993); *Russian Economic Trends* (Vol.2, no.4); PlanEcon (1993); Moscow Mc Donald's; Center of Economic Analysis; Duchêne (1993); and authors' calculations.

Table A10. Monetary aggregates  
(End-month)

	Ruble currency	Ruble deposits	Foreign exchange deposits	Foreign exchange deposits
	<u>(In billions of rubles)</u>			<u>(In billions of US dollars)</u>
1992				
July	643	1,951	1,132	7.0
August	804	2,592	1,566	7.6
September	950	3,516	2,534	10.0
October	1,146	4,526	4,100	10.3
November	1,380	4,589	4,749	10.6
December	1,678	5,462	4,538	10.9
1993				
January	1,903	6,545	6,227	10.9
February	2,279	7,021	6,539	11.0
March	2,559	8,331	7,671	11.2
April	3,309	10,092	9,353	11.4
May	4,020	11,941	11,824	11.5
June	5,113	11,087	12,053	11.4
July	6,261	15,943	10,449	10.6
August	7,307	17,812	11,007	11.1
September	8,409	17,517	16,132	13.8
October	9,826	18,874	16,986	14.3
November	10,952	20,149	17,946	14.6
December	13,304	23,414	18,278	14.7

Source: CBR.

Appendix III : Estimation results using alternative measures of the long run equilibrium rate

Estimated equation :  $s_t = \phi_{10} + \alpha_4 (\alpha_5 \text{PPPl}_t + \beta_5 \text{PPP2}_t + (1-\alpha_5-\beta_5) \text{PPP3}_t)$

$$+ \delta_4 ((i_t - i_t^*) - [\text{MOV}(p_t - p_{t-1}) - (p_t^* - p_{t-1}^*)]) + (\gamma_{10} + \mu \text{DUM}) [\text{MOV}(p_t - p_{t-1})]^2 + (1-\alpha_4) (\text{DA}_t - \text{FA}_t)$$

Version	$\phi_{10}$	$\alpha_4$	$\alpha_5$	$\beta_5$	$\delta_4$	$\gamma_{10}$	$\mu$
(1')	1.32 (5.15)	0.73 (10.69)	0.39 (10.05)	-0.05 (-5.53)	-11.49 (-2.08)	-164.35 (-2.15)	71.49 (2.39)
(2')	0.78 (5.14)	0.59 (10.56)	$\alpha_5=1$	$\beta_5=0$	-10.38 (-1.81)	-134.27 (-1.72)	95.13 (3.14)
(3')	0.30 (2.54)	0.42 (7.06)	$\alpha_5=0$	$\beta_5=1$	-9.32 (-1.52)	-160.33 (-2.11)	84.16 (2.99)
(4')	1.47 (6.42)	0.76 (11.52)	$\alpha_5=0$	$\beta_5=0$	-11.15 (-2.02)	-172.35 (-2.25)	59.93 (2.04)

Estimated using Cochrane-Orcutt procedure; t-values between brackets.

Version	$R^2$	Durbin Watson	Log of likelihood	Confidence level 1/	$\rho$ 2/
(1')	1.00	1.63	126.67	Not applicable	0.97 (41.68)
(2')	0.90	1.56	121.62	0.994	0.95 (27.90)
(3')	0.84	1.85	105.05	1.000	0.72 (8.61)
(4')	0.92	1.67	125.20	0.672	0.97 (45.63)

1/ Confidence level to reject the null hypothesis when tested against version (1') of this table.

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