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**EXCHANGE-RATE UNIFICATION WITH
BLACK MARKET LEAKAGES:
RUSSIA 1992**

BY

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Abstract

In 1992 Russia unified the multiple exchange rates that had applied to international transactions. This paper describes the multiple exchange rate system that existed in Russia prior to mid-1992 and undertakes a theoretical exploration of the effects of the exchange rate unification that took place in July 1992. The model developed here allows for leakages between official and black markets and permits flexibility of the exchange rates in both official and parallel currency markets. Within this multiple exchange rate system with black market leakages, we trace the dynamic effects on official and parallel foreign exchange markets of changes in the types of policy instruments associated with Russia's exchange rate regime reform. These instruments include adjustments of pegged interbank market exchange rates, rates of foreign exchange surrender taxation and rates of taxation of capital-account transactions.

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I. Introduction

In this paper, we interpret the 1992 currency reforms of Russia and model their dynamic implications. Before modeling the implications of the reforms, the system preceding the reforms is discussed in depth. Section II argues that, prior to reform, the system of foreign exchange surrender encouraged non-repatriation of export earnings. Moreover, even when earnings were repatriated, the system further encouraged avoidance of the interbank market for foreign exchange. The fact that importers and foreign investors also received unfavorable terms in official foreign exchange markets created significant incentives for them to operate in black currency markets. As we demonstrate analytically and theoretically, the reforms implemented in July 1992 succeeded in increasing the relative attractiveness of official foreign exchange markets for all of these market participants.

Foreign exchange markets in Russia have undergone many changes during recent years.¹ Late in October 1991, the Russian authorities announced their intention to make the ruble internationally convertible. A two stage exchange regime reform plan was announced in the Spring of 1992. The first step, taken on July 3, 1992, involved a unification of the exchange rates that previously had applied to the foreign exchange surrender by exporting enterprises. The new unified rate applied to foreign exchange surrender was set approximately equal to the (more depreciated and floating) interbank market value of the ruble. The remaining step toward unification took place by mid-August, with the elimination of several highly appreciated exchange rates for the ruble that had been applied to centralized imports during the the first half of 1992.

In Section II of this paper we argue that the effects of the July 3, 1992 exchange rate unification should be discussed in terms of their impact on the total "effective" compensation of agents involved in trade. The "effective" exchange rate relevant for an exporter is a weighted average of the exchange rate applied to foreign exchange surrender and the exchange rate available to exporters in the interbank foreign exchange market. By framing our discussion in terms of the "effective" exchange rate, our conclusions regarding the expected impact of Russia's exchange regime reforms differ substantially from the conclusions one would draw from exclusively examining unadjusted exchange rates in interbank and black markets.

¹See Goldberg (1992a), *The Economic Review, The Economy of the USSR in 1991* (IMF 1992a) and *Economic Review, Russia* (IMF 1992b) for information on the exchange-rate regime in Russia in 1990 through early 1992.

The July 3, 1992 exchange rate unification sharply reduced the taxation of export earnings that previously had been imposed through unfavorable exchange rates applied to surrendered foreign exchange. For exporters, the effective value of the ruble was depreciated in the interbank market, providing greater incentives for participation in legal markets. In addition, the unification provided for more favorable exchange rates (in rubles per dollars) to be applied on both imports and some capital account inflows to Russia.² For importers, the effective value of the ruble was appreciated in interbank markets, also providing more attractive terms in legal channels of currency trade as compared with black market channels. Therefore, these actions provided incentives for substantial increases in the volume of legal foreign currency transactions by importers, as well as incentives for increased exporter transaction volumes.

In Section II, we also emphasize that exchange rate unification as implemented "Russian-style" differs in several respects from exchange rate unifications most commonly implemented by other countries. In Russia, the unification has referred to a merging of the multiple exchange rates that prevailed on current account transactions in official markets, while the parallel market for foreign exchange and capital account convertibility remain distinct.

Section III presents a formal model of the effects of "Russian-style" exchange rate unification. This model, a type of dual exchange rate framework, incorporates specific characteristics of the Russian system. The model assumes that the authorities maintain an official foreign exchange market. Two variants of the official market are considered, one with complete flexibility of official exchange rates and the other with limited exchange rate flexibility. In the latter case it is assumed that the Central Bank of Russia (CBR) sometimes intervenes to support the ruble through sales of official foreign exchange reserves. Controls on capital account transactions remain in place. The official market operates alongside fully flexible exchange rates in illegal but tolerated black markets. Substantial trade leakages occur between official and these black (or parallel) markets. These leakages result through under-invoicing of both exports and imports or through smuggling activity.

Section IV uses the model to examine the steady state and dynamic implications of changes in foreign exchange surrender taxation and of alterations in penalties on capital account transactions. These effects are traced across interbank foreign exchange markets, including an analysis of the dynamics of either foreign exchange reserve stocks

²The important exceptions are centralized imports which previously were priced at highly appreciated exchange rates.

and stabilization funds or interbank market exchange rates. The impact on the exchange rates observed in black markets also is considered. Simulation results are provided to illustrate the possible scale of the effects caused by the policy instruments.

The main conclusions of this analysis are:

- In a system with a pegged interbank exchange rate, a reduction in the foreign exchange surrender tax leads to an immediate jump depreciation of the domestic currency in the parallel market, followed by further parallel market depreciations almost summing to the full proportional value of the tax change.³ Official holdings of foreign exchange reserves initially improve sharply and then continue to improve by smaller and smaller increments.
- When the interbank exchange rate is heavily controlled via central bank intervention, a devaluation of the interbank exchange rate can lead to a short-run appreciation of the domestic currency on the parallel markets. Thereafter the parallel rate for domestic currency depreciates by an amount comparable to the interbank devaluation. In the long run, a devaluation of the interbank exchange rate has no effect on the exchange rate differential between black and legal markets.
- When the interbank market exchange rate is freely floating, a reduction in foreign exchange surrender taxes leads to a steady state appreciation of the domestic currency in the interbank market and to a steady state depreciation of the domestic currency in the parallel market.
- When the interbank market exchange rate is freely floating, exchange rates in the interbank and parallel markets adjust rapidly to their new equilibrium values following a policy initiative. This rapid adjustment contrasts sharply with the more prolonged adjustments that occur when interbank exchange rates are controlled.
- Within the current regulatory and enforcement climate, penalties on capital account transactions appear to exert only very limited effects on exchange rates and reserves.

³Throughout the paper, exchange rates are defined in terms of domestic currency per unit of foreign currency.

II. Description of the Russian Exchange Rate Regimes

II. 1 Interpreting the Pre-Unification Exchange Rate Regime in Russia

Simple numerical examples are useful for describing the implications of the foreign exchange system that existed in Russia prior to July 3, 1992.⁴ These examples show how the system created strong incentives for under-reporting of export earnings as well as for their retention of those export earnings in illicit accounts outside of Russia. This system also fostered under-invoicing of imports in official markets and import smuggling. In general, the legal internal currency markets taxed the transactions of both exporters and importers.

The implicit rates of taxation on exporters and importers changed over time. During 1992, three distinct periods of activity can be distinguished in Russian foreign exchange (FX) markets. We refer to the period through the end of April 1992 as the "pre-unification" period. The period from early May and the end of June 1992 we call the "interim" period, characterized by heavy foreign exchange intervention in an unsuccessful effort by the CBR to generate a sustained appreciation of the ruble in official markets. The period following July 3, 1992 is referred to as the post-unification period. Here we focus our attention primarily on the period prior to May 1992 and the period following July 3, 1992.⁵

Table 1 provides representative data on the pre-unification exchange rates and tax rates to be used in calculating the effective taxes on the earnings of a hypothetical Russian exporting enterprise under alternative (legal and illegal) scenarios. Two levels of foreign exchange (FX) surrender were in place. For approximately eighty percent of exports (by volume), half of all foreign exchange earnings had to be remitted to the government and exchanged into rubles at unfavorable terms for the exporters. The exchange rates applied to these remittances were the *special commercial* and *CBR market* exchange rates. The interbank market exchange rate, determined on the Moscow Currency Exchange (MCE), also was relevant for valuing some portion of foreign exchange earnings. During the first half of 1992, the interbank rate exhibited large swings. For our analysis, the benchmark interbank exchange rate to be used for this period is 150 rubles per U.S. dollar. The benchmark black market exchange rate for this period is 125 rubles per dollar. This choice of benchmarks implies that our estimates of the distortions caused by the legal foreign exchange system are conservative estimates.

⁴A more detailed analysis of the exchange rate system in Russia in 1992 is provided in Goldberg (1992b).

⁵The interim period is discussed in detail in Goldberg (1992b).

Table 1: Pre-Unification Period: Exchange Rate Regime Data		
Commercial Exchange Rate	Applied to 40 percent FX surrender requirement (relevant for 80 percent of exports by volume)	55 rubles/\$
CBR Market Exchange Rate	Applied to 10 percent FX surrender requirement (relevant for 100 percent of exports by volume)	90 rubles/\$
Interbank Market Exchange Rate	Applied to sales and purchases of foreign exchange transacted on the interbank FX market	150 rubles/\$
Profit Tax Rate	Marginal (and generally progressive) tax rate on profits of enterprises. Range: 32%. Taxes are paid in rubles.	32 percent

Table 2 presents the alternative transaction scenarios for exporters under the pre-unification regime. An exporter could choose illegal non-repatriation of export earnings, retaining these earnings as foreign currency, as in Scenario A, or converting them into rubles at black market exchange rates, as in Scenario B. Alternatively, the exporter could choose legal repatriation of export earnings, as in Scenarios C and D. If repatriation of export earnings occurred, foreign exchange surrender requirements would be enforced. The remaining foreign exchange under the control of exporters either would be retained in foreign currency accounts at commercial banks, as in Scenario C, or sold in interbank foreign exchange markets, as in Scenario D. A fifth quasi-legal possibility for an exporter, Scenario E, was for export earnings to be converted into foreign goods described as "necessary imports for production." These goods then would be imported into Russia and resold in domestic markets. For evaluating the profitability of these scenarios, all computations shown in Table 2 are based on earnings stated as a percentage of every dollar earned abroad.⁶

⁶These calculations do not account for the probability of being caught engaging in illicit activity nor do they account for the penalties from such activities. In principle, the expected penalties and the required compensation for engaging in risky activities should be included in computations of the effective exchange rate. These calculations are provided for the exporters subject to both the 40 percent and the additional 10 percent foreign exchange surrender requirements. Analogous computations could be generated for those exporters subject only to the 10 percent foreign exchange surrender requirement.

Table 2	Tax and Revenue Flows on Alternative Methods of Reporting and Valuing Export Earnings (Pre-Unification)			
Scenario	ruble receipts from FX surrender requirements with 50 % surrender	rubles paid as profit taxes on \$1 of export earnings	dollars remaining	ruble earnings
A. \$1 Earned but not repatriated	0 rubles	0 rubles	\$1.00 cash	0 rubles
B. \$1 Earned, not reported but repatriated via black markets @ 125 rubles/\$	0 rubles	0 rubles	0 dollars	125 rubles
C. \$1 Earned then repatriated & retained in FX accounts	31 rubles (avg. FXS @ 62 rubles/\$)	24.32 rubles (.32*(31+.5*90))	\$0.50 noncash	31 rubles (pre-tax) 6.68 rubles (after tax)
D. \$1 Earned then repatriated & converted in interbank market @ 150 rubles/\$	31 rubles (avg. FXS @ 62 rubles /\$)	33.92 rubles (.32*(31+.5*150))	0 dollars	106 rubles (pre-tax) 72.08 rubles (after tax)
E. \$1 Earned then converted into imported goods for barter trade	0 rubles	40 rubles (.32*(125))	0 dollars	125 rubles (pre-tax) 85 rubles (after tax)

The compensation of exporters for transactions channeled through official markets requires some explanation. First, for every dollar of foreign currency earned and repatriated by an enterprise, the foreign exchange surrender rules required 50 cents to be converted immediately into rubles. The effective exchange rate on this 50 percent of

earnings was 62 rubles/\$,⁷ which compared with the rate of approximately 150 rubles/\$ in the interbank market and 125 rubles/\$ observed in black markets.⁸

Assume, as in scenario D, that the enterprise sold the remainder of its export earnings in the interbank market. For every original dollar of export proceeds, he ultimately received a total of 106 rubles (*prior to profit taxation*).⁹ This implies that if an enterprise were to report foreign exchange earnings, the surrender system imposed an average export tax rate of 29.3 percent calculated relative to the interbank market rate,¹⁰ or an average export tax rate of 15.2 percent calculated relative to the black market exchange rate. For many producers, the goal of avoiding this export taxation induced under-invoicing or non-repatriation of foreign exchange earnings.

The calculations presented for scenario D assumed that the enterprise sold its post-surrender export earnings in the interbank markets in exchange for rubles. However, enterprises had another option for utilizing their foreign exchange earnings. The second option, illustrated in scenario C, was for enterprises to retain their residual foreign exchange earnings in accounts in Russian commercial banks. However, the tax burden on firms was much higher when they converted their foreign exchange in the MCE than it was when earnings were retained in their foreign currency accounts.¹¹ This feature, termed in Goldberg and Karimov (1991) as the "tax haven effect on retained earnings", also created significant incentives for exporters to avoid the interbank foreign exchange market, also may have contributed significantly to the reluctance of exporters to convert foreign exchange earnings into "cash" (i.e. ruble currency) via the interbank market.

From Table 2 we can compute the numerical relevance of this "tax-haven effect" associated with the non-conversion of foreign exchange earnings into rubles. Suppose a firm kept its residual foreign exchange earnings in accounts at the CBR, without converting them to dollars (Scenario C). Accounting practices in Russia ensured that these earnings were valued in rubles for profit taxation purposes and that taxes were paid

⁷Of the foreign-exchange surrendered, eighty percent is compensated at 55 rubles/\$ and twenty percent at 90 rubles/\$. [$.8(55)+.2(90)=62$ rubles/\$.]

⁸In May 1992 the ruble appreciated by approximately 20 percent in nominal terms in the MCE, from approximately 150 rubles/\$ to approximately 120 rubles/\$. In the first half of June 1992, the ruble appreciated further, to a high of 112.3 rubles/\$. This appreciation of the ruble, caused by heavy intervention foreign exchange sales by central banking authorities, served to increase the effective tax on using official markets since it reduced the effective compensation of exporters.

⁹Fifty percent are surrendered at the rate of 62 R/\$ and 50 percent at converted at the rate of 150 R/\$. Therefore $.5(62)+.5(150)=106$ R/\$.

¹⁰Calculated as $(150R/\$-106R/\$)/150$ R/\$. This computation assumes that the foreign-exchange earnings net of surrender are sold at the interbank rate of 150 rubles/\$.

¹¹Export taxes, often not paid because of exemptions or illegal circumventions, are omitted from our examples.

in rubles. For measurement of the profit tax base, the value of dollar balances in accounts left at the central bank were computed using the CBR market exchange rate. This valuation method assigned a conversion rate of 90 rubles per dollar on retained earnings accounts. Alternatively, if the export revenues were converted into dollars at the interbank market, the profit tax liabilities of exporters were computed using a conversion rate of 150 rubles/\$.

The consequence of this system was that for every dollar of foreign exchange earnings a profit tax of 24.32 rubles was paid if the dollars were not converted into cash rubles, whereas a profit tax of 33.92 rubles was paid if the dollar earnings were converted into cash via the interbank market.¹² This implied that the profit tax burden on exporters could be reduced by almost 30 percent when foreign exchange earnings were not converted into rubles through internal currency markets and instead were retained in foreign currency accounts at commercial banks.

Scenario E provided yet another alternative for exporters, one which was only marginally legal and which provided exporters the means by which to evade foreign exchange surrender requirements. In this case, the incentive to avoid foreign exchange surrender taxes also provided an exporter with the incentive to become an importer of goods. Instead of repatriating foreign currency earnings, the exporter could purchase foreign goods by specifying that they were necessary productive inputs for the firm. These imports later could be resold in domestic markets. For our computations in Scenario E, the ruble value of these imports is based on the black market exchange rate. Assuming that the revenues from these resales were reported, the returns to a quasi-legal activity were in between the returns to purely legal and to the illegal transactions presented by the first four scenarios.¹³

Thus, avoidance of high foreign exchange surrender taxes provided one explanation for cross-border barter transactions with counter-parties outside of the ruble area. The exporter was able to avoid foreign exchange surrender taxes, thereby receiving more favorable terms on export transactions channeled through legal markets. In contrast to the returns on black market activities, the exporter remained obligated to pay profit taxes on the transactions.

Exchange Rates on Capital Account Transactions: In the first half of 1992, the CBR did not clarify which exchange rate was to be applied to foreign direct investment inflows. If

¹²These calculations are on marginal dollars earned. In practice, profit taxation is levied on revenues net of expenditures on production inputs.

¹³Roger Gordon provided the useful suggestion that Scenario E be included in Table 2.

foreign capital inflows into Russia were converted into rubles using the "commercial" exchange rate (55 rubles/\$), the rubles purchased by foreign investors were three times more expensive than rubles purchased at interbank market exchange rates. This regime could be interpreted as imposing a significant tax on capital account transactions.

Exchange Rates on Import Transactions: During 1992, importers had considerable freedom to purchase foreign currency in the interbank markets. Two general categories of import activity need to be distinguished. Prior to unification, centralized imports were priced at numerous budgetary exchange rates introduced in February 1992 and ranging from 1.7 rubles/\$ to 70 rubles/\$. For the remainder of Russia's imports, as previously noted, during the Spring of 1992 the interbank rate was approximately 150 rubles/\$ compared with about 125 rubles/\$ in black markets. Clearly, this system also created incentives for importers to avoid official markets through under-invoicing imports and smuggling goods across borders.¹⁴

In summary, the foreign exchange system in place in Russia prior to the July 3, 1992 unification provided strong disincentives for exporters to repatriate foreign exchange earnings and strong incentives for under-reporting of both export and import transactions. If foreign exchange was earned but not repatriated by exporters, the exporting enterprise evaded both foreign exchange surrender requirements and profit taxation. If foreign exchange earnings were repatriated, they were unlikely to be sold in the interbank markets, owing to the "tax-haven" effect on retained earnings. Also, foreign capital inflows into Russia may have been discouraged, in part, by highly appreciated conversion exchange rates for the ruble that were applied to inflows.

For Russia, it is very important that "effective" exchange rates are used in analyses of changes in the foreign exchange regime. For example, this adjustment enables us to resolve some seemingly paradoxical features of the relationship between official and black market exchange rates. In Russia, the apparent black market premia on foreign exchange transactions were *negative* prior to unification: the "free market" value of the ruble on auction and interbank markets was more depreciated than the black market exchange rate. This is quite unexpected, since countries experiencing balance of

¹⁴Acting as a force in the opposite direction, some enterprises may have been willing to pay the interbank market premium since it enabled them to transact legally and to pay for imports using "noncash" balances. The shortages in cash rubles in the first half of 1992 may have restrained some of the impetus for importer leakages into black markets.

payments difficulties and capital flight usually have positive black market exchange rate premia.

The apparent discount on the black market exchange rate in Russia is an artifact of improperly calculating the relevant official exchange rate on trade transactions. Appropriate construction of the "effective" official exchange rate must include the additional forms of taxation that are levied on any flows channeled through the legal markets (i.e. via profit taxes and foreign exchange surrender). The more appropriate comparison is between the level of the *effective* exchange rate after profit taxation and the black market exchange rate (i.e. between 72.08 R/\$ and 125 R/\$), rather than between the interbank exchange rate and the black market rate (i.e. between 150R/\$ and 125 R/\$).¹⁵ In the Spring of 1992, the appropriately measured black market exchange rate premium was 42.3 percent, rather than -20 percent as computed using unadjusted measures.¹⁶

II.2. Exchange Rate Regime Reform in Russia, 1992

The July 3, 1992 move toward convertibility in Russia entailed a unification of the "official" multiple exchange rate system. While there is not a single standard definition of the term "exchange rate unification", Russia's unification differs in several respects from those undertaken by other IMF member countries. In Russia the unification referred to a merging of the multiple exchange rates in official markets, while the black market for foreign exchange and issues of capital account convertibility remained distinct. The exchange rate unification occurred at a floating exchange rate that stood at approximately 135 rubles per dollar in early July. This new effective (pre-profit tax) exchange rate was applied to export, import and capital inflow transactions and, in principle, would fluctuate with market forces.

Given this particular exchange system reform, the real effects of this type of reform could be classified as follows:¹⁷

¹⁵The sign of the black market premium is even greater when we compare the effective official exchange rate prior to profit taxes with the black market exchange rate. This example used an interbank exchange rate of 150 rubles/\$ for the computations on repatriated and fully converted dollar inflows. In May 1992 this interbank market rate appreciated to approximately 120 rubles/\$. This implies that the "effective" exchange rate on reported inflows is even lower than that discussed in Table 2.

¹⁶Another explanation for the observed negative premium relies on the maintained distinction between cash and non-cash transactions in Russia's monetary system. See Goldberg (1992b).

¹⁷See Goldberg (1992b) for further discussion. Throughout the discussion, we are emphasizing forces exclusively attributed to these exchange regime changes. We do not address the impact of credit-creation policies or of other government initiatives that may be initiated to undermine these reforms.

- The exchange rate unification eliminated the large and distorting "tax-haven effect" of retained earnings which arose because the exchange rates used for tax computation purposes differed across uses of foreign exchange earnings. The removal of the tax-based advantage of retained earnings accounts served to increase the relative attractiveness of interbank market transactions.
- By equating the exchange rates on foreign exchange surrender with other "market-determined" rates, the foreign exchange surrender tax was sharply reduced. This should tend to stimulate repatriation of foreign exchange earned by exporters and reduce international barter activity as a means of tax avoidance.
- For exporters, unification implied both a real and nominal effective depreciation of the ruble in interbank markets. This point, combined with the preceding points, increased the incentives for reporting of export earnings and consequently may imply increased volumes of foreign currency sold in official foreign exchange markets.
- For importers the exchange rate unification sharply lowered the "effective" ruble cost of transactions in legal markets. At the same time, since the unification measures acted to reduce the gap between the black market and interbank market exchange rates, these reforms increased incentives for importers to participate in legal foreign exchange markets.
- For foreign investors, the unification provided for interbank-market-determined exchange rates to be applied on foreign capital inflows into Russia. Previously, throughout the first half of 1992, the CBR had not clarified which exchange rate was to be applied to foreign direct investment flows.

III. A Model of Exchange Rate Dynamics and Foreign Exchange Market Reform

In this section we present an analytical model of the macroeconomic implications of the recent reforms of the exchange rate system in Russia. The analysis emphasizes exchange rate behavior as well as the movement of resources across the official foreign exchange markets and black markets in response to policy reforms. The implications of exchange rate unification are discussed under two alternative assumptions about the exchange rate regime that is in place when unification occurs: (1) a regime where the interbank market exchange rate is pegged by the CBR via foreign exchange intervention; and (2) a regime of freely floating exchange rates in interbank markets.

III.1 Relevance of the Literature on Dual Exchange Rate Regimes: The appropriate framework for analysis is a modified dual exchange rate regime model. Only some of the lessons from the dual exchange rate regime literature are applicable to the recent experience of Russia. This literature often assumes that markets are "two tier" in the sense that different exchange rates apply to different types of transactions. In general, the literature separates the market for the trade-related flows from the market for capital account flows.¹⁸ Research emphasis has been placed on the determinants of the spread between the fixed official exchange rate applied to trade transactions and the flexible exchange rate applicable to speculative or financial flows of foreign exchange.

For Russia, this two tier dual exchange rate analogy is not fully relevant. There is an official foreign exchange market, but the price of foreign currency in that market is flexible except during periods when the central bank uses its foreign exchange reserves to intervene in that market. Thus Russia's dual system may permit complete or limited exchange rate flexibility in official markets. Controls on movements of financial capital are in place in official markets, but the official market operates alongside fully flexible exchange rates in illegal but tolerated black markets.

The assumption of distinct tiers for trade and capital account transactions also is not relevant for Russia. Russian foreign exchange markets are characterized by leakages between legal and black markets, achieved in part by under-invoicing of exports and imports and by smuggling activity. A small recent segment of the literature on dual exchange rates addresses such cross-market transactions. Within this literature, we work with a reduced form macroeconomic model that uses the asset market approach to exchange rate determination as a building block.¹⁹ The model has two important features: i) an emphasis on macroeconomic activity with specified cross-border leakages, as in Bhandari and Decaluwé (1987), Guidotti (1988), and Agénor and Flood (1992); and ii) flexibility of exchange rates in both official and parallel markets, as in Flood and Marion (1982) and (1983), and in Aizenman (1986).

When we discuss exchange rate unification in Russia we are not considering unification of official and parallel markets (or of current and capital account transactions) as in Kiguel and Lizondo (1990), Lizondo (1987), and Agénor and Flood (1992). Instead, we are considering the unification of the multiple exchange rates applied to transactions

¹⁸For example, see Flood (1978), Marion (1981) and Aizenman (1985).

¹⁹In general, there are two modeling approaches to examining the effects of leakages in dual exchange rate models. The first approach applies reduced-form macroeconomic models and the second approach uses optimizing models of the behavior of representative consuming agents. Within the optimizing approach, Bhandari and Vegh (1990) consider the implications of unanticipated and permanent changes in commercial exchange rates when there are leakages across official and parallel markets.

in traded goods in official markets.²⁰ As was argued in Section II, for Russia this unification can be expressed in terms of appreciations or depreciations of the "effective" exchange rate applied to this set of transactions.

III.2 The Basic Framework

The basic framework is a model of a small open economy where all goods are traded internationally. Domestic currency is not held by foreigners. There is a domestic money market, and asset market equilibrium conditions determine rates of return on domestic investment opportunities, and provide the relationship between the black market exchange rate premium and expected future movements in black market rates. There is also a condition providing for balanced transactions in external markets.

The model permits leakages between the official market and the black market. These leakages occur due to the gap between the price of foreign exchange in the black market and the "effective" prices of foreign exchange faced by importers, exporters, and investors. As previously discussed, the foreign exchange surrender requirements in Russia have functioned as a tax on some of the foreign exchange earnings of exporters. In the Spring of 1992, the tax was almost 30 percent of the interbank rate. In the model this tax is introduced explicitly, adjusting the legal exchange rate received by exporters. It is assumed that importers are not explicitly taxed in this manner. Therefore, the leakages from under-invoicing of official exports are associated with the difference between the official exchange rate (i.e. the interbank rate) adjusted for foreign exchange surrender taxes, and the black market exchange rate. The leakages due to under-invoicing of imports are due to the gap between the interbank exchange rate and the black market exchange rate.

Treatment of financial flows is complicated by the form of convertibility in place in Russia. Technically, there is a distinction between access to official markets by resident and non-resident entities. In practice there are ways to circumvent any such distinction. Our theoretical exposition therefore ignores this differential treatment of residents and non-residents. Financial investments can take place over domestic and foreign assets.²¹ In the context of the under-developed financial markets in Russia, the

²⁰However, if one considered a shift in the entire exchange rate system, for example from a floating to a fixed rate regime, one could draw upon recent advances in the area of stochastic process switching, as in Froot and Obstfeld (1991).

²¹Perhaps more appropriate comparisons in this case refer to purchases of shares in Russian enterprises or joint stock companies (although the returns can hardly be valued at risk-free rates!) with returns on

relevant investment opportunities may arise in curb markets. In Russia, the exchange rate applied to purchases of domestic assets by foreigners is the interbank market exchange rate less a substantial capital account tax.²² Repatriation of profits by foreigners is assumed to remain prohibited. Therefore, interest and dividend earnings from domestic markets are valued using the black market exchange rate less a transaction fee. Equations (1) through (5), provided below, represent our basic model of the dual exchange rate regime with leakages. The system formalizes the way that the foreign exchange surrender tax and the penalties on illegal capital transactions impact on foreign exchange markets. The model enables us to trace the dynamic effects of changes in these instruments.

$$m_t - p_t = \alpha y_t - \beta i_t \quad (1)$$

$$i_t = i_t^* + (E_t s_{t+1} - s_t) - \gamma (s_t - (e_t - \tau^k)) \quad (2)$$

$$p_t = \nu s_t + (1 - \nu) e_t \quad (3)$$

$$m_t = \theta R_t + (1 - \theta) D_t \quad (4)$$

$$R_t - R_{t-1} = \psi (e_t - \tau^x - s_t) - \mu (m_t - p_t) \quad (5)$$

All variables entered into equations (1) through (5) appear in logarithmic form. Equation (1) represents real money demand, where the demand for real money balances $m_t - p_t$ is increasing in real output, y_t , and decreasing in the nominal interest rate, i_t . Alternatively stated, the velocity of money is increasing in the return on domestic investment opportunities, which can be viewed as the rate of return realized in informal or curb markets.

The rate of return in curb markets is related to world market interest rates in equation (2), a logarithmic approximation of the relevant interest parity condition.²³ To derive the relevant interest parity condition, we postulate a hypothetical set of investment opportunities available to the domestic agent. This agent can purchase a domestic investment asset, which has a nominal rate of return i_t , or the agent can undertake a set of transactions to acquire a foreign bond or to place his money in a foreign bank account.

purchases of assets in foreign stock markets. Although not officially permitted, a market for trade in foreign stocks has developed in Russia.

²²This tax would be the difference between the interbank and commercial exchange rate.

²³Flood and Marion (1983) provide a formal derivation of a related expression used in dual exchange-rate regime models.

This account has a yield of i_t^* , denominated in foreign currency. The foreign asset is purchased through the parallel market at the spot exchange rate s_t , defined as domestic currency per unit of foreign exchange, and future dividends will be repatriated through the parallel market at the expected exchange rate $E_t s_{t+1}$ where expectations are formed based on the information available at time t . There is a fee on this transaction which depends both on the probability that the dealer will be caught (i.e. on the extent of enforcement), denoted by γ , and on the size of the black market exchange rate premium. The size of this premium depends on the effective exchange rate on capital account transactions, which is the interbank rate adjusted for taxes on capital purchases, τ^k .

Equation (3) reflects the fact that, when all goods are traded, the domestic price level p is a weighted average of the interbank exchange rate e and the black market exchange rate s .²⁴ This reflects the assumption that some traded goods are priced at the official market exchange rate, while other goods are sold via the black market. For empirical purposes, the coefficient v can take on one of two possible interpretations. First, and most formally, it is a proxy for the extent of illegal trade transactions within an economy. In this case, the share of transactions in the black market may be in the range of 30 percent of the value of trade. The alternative interpretation is that v proxies the extent of prices reflecting free market forces or marginal cost pricing. By this latter interpretation, v may represent more than 65 percent of the value of trade.²⁵

Equation (4) is a log-linear approximation that defines the domestic money stock, m_t , as a weighted average of domestic credit, D_t , and foreign exchange reserves, R_t . Both components of the money stock are denominated in terms of domestic currency. For Russia, the share of foreign currency assets relative to the total money stock in mid-1992 was at most 10 to 15 percent. For simplicity, domestic credit is taken as exogenous to our analysis.²⁶

Equation (5) reflects the evolution of central bank foreign exchange reserve stock R_t . This equation states that net exports channeled through official foreign exchange markets are increasing in the interbank exchange rate, but also are declining in the export

²⁴The level of the foreign price index is set at 1, so that its logarithm enters as zero.

²⁵Our model has not explicitly introduced the dynamics of non-traded goods. To the extent that the prices of these goods move with interbank or black market exchange rates, non-traded goods are implicitly introduced through parameters $1-v$ and v , respectively. Otherwise, the model could be extended to incorporate the specific processes behind the dynamics of non-traded goods prices.

²⁶Alternatively, one could introduce a government budget constraint where domestic credit creation is inversely related to the amount of revenues collected by the government through foreign-exchange-surrender taxes. Related discussions are provided in Pinto (1991). As specified, these collected taxes have no impact on aggregate demand, fiscal policies or domestic credit creation.

tax, τ^x , imposed by the structure of foreign exchange surrender rules described in Section II above. Due to the existence of leakages between legal and parallel markets via under reporting of export earnings, the larger is the effective parallel market premium, the lower is the amount of foreign exchange supplied to interbank currency markets. Official holdings of international reserves are inversely related to real money balances, with sensitivity μ . The real balance effect operates via its role in stimulating import demand. A high stock of real balances leads to high demand for imports, which increases the demand for foreign exchange and reduces central bank foreign exchange reserves.

Throughout the analysis we assume that output remains unchanged at level \bar{y} . This is a reasonable assumption for the time horizon of our model, since adjustments occur rapidly relative to the length of the adjustment period required for a production response to changes in interest rates and expected inflation.

IV. Russian-Style Exchange Rate Unification

In this section we examine the implications of the type of exchange rate unification undertaken by Russia in mid-1992. Recall that the unification was interpreted as a set of reductions in the foreign exchange surrender taxes and in the taxes on international capital flows, i.e. in both τ^x and τ^k . Relative to the initial interbank market exchange rate, the controlled interbank rate also was revalued. Throughout the analysis, it is assumed that the parallel market exchange rate is a fully flexible and forward-looking price. The interbank market exchange rate, by contrast, either can be freely floating (when the government is not intervening in the interbank markets) or is maintained at some controlled level (by central bank foreign exchange market intervention). In recent years, the central banking authorities in Russia have at times pursued each of these alternative approaches to exchange-rate determination. For a regime where the interbank exchange rate is controlled via intervention, we also examine the implications of adjusting the controlled interbank rate.

In the analysis below the adjustment process in response to policy initiatives is examined under two alternative scenarios. In the first scenario, the interbank market exchange rate is controlled by the central bank through foreign exchange intervention, so that $e_t = \bar{e}$ and R_t and s_t are determined endogenously. In the second scenario e_t and s_t are determined endogenously, with central bank holdings of international reserves R_t taken as exogenous to the system.

IV.1 Controlled Interbank Market Exchange Rate and Exchange Rate Regime Reforms

In this first scenario, interbank market exchange rates are controlled via central bank intervention in foreign exchange markets. This implies that $e_t = \bar{e}$ and R_t is endogenously determined. Using equations (1) to (5), the model reduces to two equilibrium conditions: a money market equilibrium condition from equations (1) to (4) and an external balance equation from equations (3) to (5). These equilibrium conditions yield a difference equation system, represented in general form as $BZ_t = CE_t Z_{t+1} + \delta u_t$,

where matrix notation is applied and $Z_t = \begin{bmatrix} s_t \\ R_{t-1} \end{bmatrix}$. Specifically, in Scenario 1 the system is given by:

$$\begin{bmatrix} -(\beta + \beta\gamma + \nu) & 0 \\ \psi - \mu\nu & 1 \end{bmatrix} \begin{bmatrix} s_t \\ R_{t-1} \end{bmatrix} = \begin{bmatrix} -\beta & -\theta \\ 0 & 1 + \mu\theta \end{bmatrix} \begin{bmatrix} E_t s_{t+1} \\ R_t \end{bmatrix} + \begin{bmatrix} -\beta\gamma + 1 - \nu & -(1 - \theta) & \beta\gamma & 0 & \alpha & -\beta \\ -\psi - \mu(1 - \nu) & \mu(1 - \theta) & 0 & \psi & 0 & 0 \end{bmatrix} \begin{bmatrix} \bar{e} \\ D_t \\ \tau^k \\ \tau^x \\ \bar{y} \\ i^* \end{bmatrix} \quad (6)$$

which then is transformed into the form $E_t Z_{t+1} = AZ_t + du_t$, by defining the matrices $A = C^{-1}B$ and $d = -C^{-1}\delta$. The vector Z contains one forward-looking and one pre-determined variable. Following Blanchard and Kahn (1980) and Taylor (1986), we can trace the response of the system to changes in the policy instruments contained within the vector u_t . For any difference equation system, one can consider the properties of the solution path to determine whether this path exists, whether it is unique or whether there is an infinity of solutions. For Scenario 1, the eigenvalues of the system guarantee that *the system has a unique saddle-point stable solution*. The eigenvalues and eigenvectors of the system and the proof of uniqueness are provided in the technical appendix.

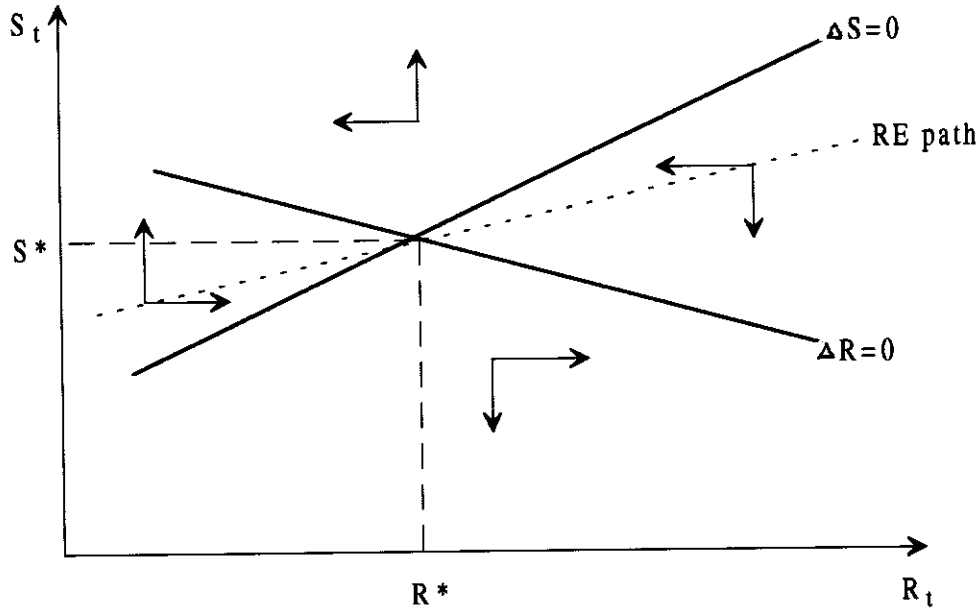
To provide the intuition for how this economy responds to changes in policy instruments, one can examine the dynamics of exchange rates and foreign exchange reserves around the two equilibrium conditions of the model. Money market equilibrium

is represented by the $\Delta s = 0$ curve (eq. 7) and external balance is represented by the $\Delta R = 0$ curve (eq. 8). These equations, derived from the first and second rows of the system given by (6), are:

$$\Delta s = 0: s_t = \frac{\theta}{v + \beta\gamma} R_t - \frac{\beta\gamma}{v + \beta\gamma} \tau^x - \frac{1 - v - \beta\gamma}{v + \beta\gamma} \bar{e} + \frac{1}{v + \beta\gamma} \left((1 - \theta) D_t - \alpha \bar{y} + \beta i^* \right) \quad (7)$$

$$\Delta R = 0: s_t = \frac{-\mu\theta}{\psi - \mu v} R_t - \frac{\psi}{\psi - \mu v} \tau^x + \frac{\psi + \mu(1 - v)}{\psi - \mu v} \bar{e} - \frac{\mu(1 - \theta)}{\psi - \mu v} D_t \quad (8)$$

where $\psi - \mu v > 0$ for reasonable parameter values.²⁷ Figure 1 presents a geometrical representation of the system.



- Figure 1-

An increase in the foreign exchange surrender tax shifts the external balance curve ($\Delta R = 0$) to the left; an increase in the foreign investment tax shifts the money

²⁷Recall that $-\mu$ is the sensitivity of the trade balance to real money balances, v is the share of second-economy goods in the price index, and $-\psi$ is the sensitivity of the official trade balance to the black market premium. Suppose $\mu \leq .20$ and $.25 \leq v \leq .65$. Using these shares at these specified limits, to satisfy $\psi - \mu v > 0$, we conservatively require $\psi \geq .13$.

market equilibrium condition downward, and a devaluation of the controlled interbank market ruble shifts the money market equilibrium curve downward and the external balance curve to the right. There is a unique rational expectations (RE) equilibrium path to the steady state.

The steady state values of parallel market exchange rates and central bank foreign exchange reserves, where the "*" superscript represents the steady state, are given by:

$$s^* = \bar{e} - \tau^x + \tau^x \left(\frac{\beta\gamma\mu}{\psi + \beta\gamma\mu} \right) - \tau^k \left(\frac{\beta\gamma\mu}{\psi + \beta\gamma\mu} \right) - D \left(\frac{\mu(1-\theta)}{\psi + \beta\gamma\mu} \right) - (\alpha \bar{y} - \beta i^*) \left(\frac{\mu}{\psi + \beta\gamma\mu} \right)$$

$$R^* = \frac{1}{\theta} \left(\bar{e} - \tau^x \left(\frac{\psi(\beta\gamma + \nu)}{\psi + \beta\gamma\mu} \right) + \tau^k \left(\frac{\beta\gamma(\psi - \mu\nu)}{\psi + \beta\gamma\mu} \right) - (1-\theta) D \left(\frac{\mu(\beta\gamma + \nu)}{\psi + \beta\gamma\mu} \right) + (\alpha \bar{y} - \beta i^*) \left(\frac{\psi - \mu\nu}{\psi + \beta\gamma\mu} \right) \right) \quad (9)$$

In the steady state, any changes in the controlled interbank exchange rate are precisely mirrored in the parallel market exchange rate. In general, changes in the "effective" exchange rate caused by changes in the foreign exchange surrender tax are not precisely mirrored in the parallel market exchange rate. Reductions in foreign exchange surrender taxation are correlated with a more depreciated ruble in the black market. For the special case of $\mu=0$, which arises when real money balances have no effect on demand for imports, the steady state black market exchange rate is precisely equal to the effective exchange rate on legal trade, defined by $s_t = \bar{e} - \tau^x$.

In the steady state, central bank reserves respond positively to a more devalued ruble in the interbank market. Official balances improve because the devaluation increases the domestic price index, which in turn requires a compensating increase in nominal money balances to restore money market equilibrium in the face of unaltered real money demand. Nominal money balances rise through reserve accumulation achieved via medium run current account surpluses.

In the steady state, foreign exchange surrender taxes are correlated with unambiguously greater leakages into the black market, and therefore lower foreign exchange reserve stocks.²⁸ τ^x has a large impact on reserves if ν , the importance of the black markets in the price index, is large, since this parameter dictates the size of the change in the black market premium induced by the change in the foreign exchange surrender tax. The effect of τ^x on reserves also depends on the extent of enforcement of

²⁸It is assumed that these tax revenues from foreign exchange surrender are not counted by the government as reserve stocks.

penalties in international capital markets, since the scale of enforcement determines the size of the interest rate response to a change in τ^* . In the steady state, increases in τ^* drive up the domestic interest rate, reduce real money demand, and trigger a loss of foreign exchange reserves.

Direct taxes on capital account transactions, τ^k , lead to a more appreciated ruble in the black market. The extent of this appreciation depends on the importance of the real balance effect on the balance of payments and, perhaps more importantly, on the degree of enforcement of capital account restrictions. In theory, holdings of international reserves can either increase or decline as a consequence of increased τ^k , depending on the balance of two opposing forces operating on the balance of payments: first, since the ruble appreciates in black markets the official trade balance improves as the official sector is made more attractive to exporters relative to the black market; and second, real balances rise as domestic prices fall, thereby stimulating import demands.

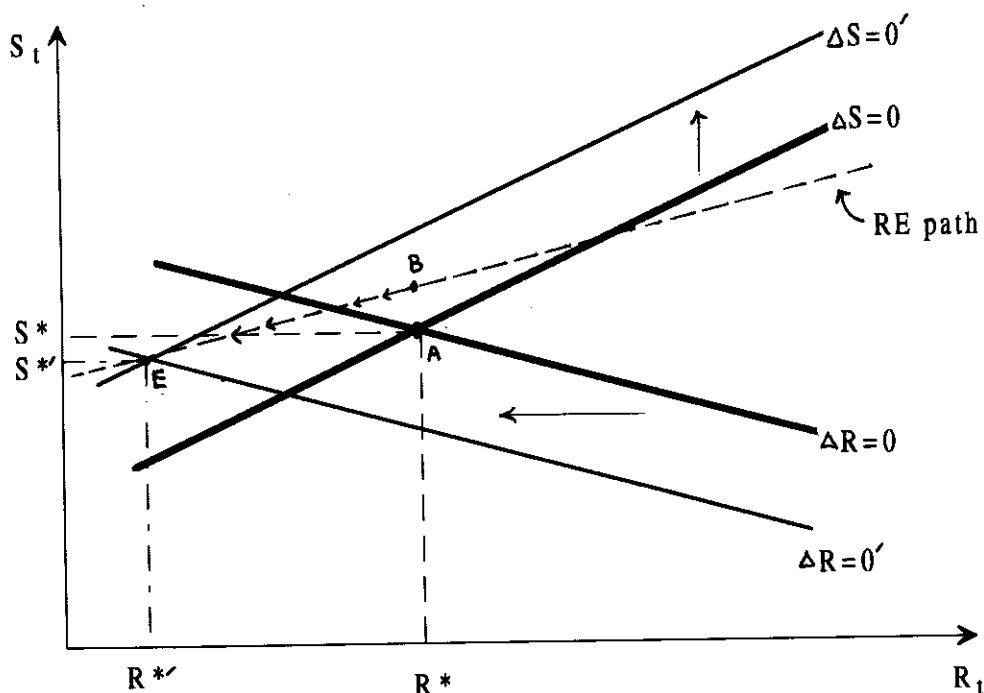
Recall that the Russian foreign exchange system reform entailed a combination of interbank exchange rate revaluation and reductions in export and capital account taxation. For this set of policy initiatives, along with the assumption that these initiatives are not pre-announced to the public, we trace out the dynamic adjustment path of black market exchange rates and reserve holdings.²⁹ For the case of controlled interbank market exchange rates, the results are shown geometrically in Figures 2 through 4. To provide intuition into the expected numerical scale of these adjustments, we provide simulation results using benchmark values of model parameters. In our model, increases and declines in these policy variables enter the system symmetrically. Therefore, one can analogously use these tables to interpret the effects of devaluation rather than revaluation of the pegged ruble in the interbank market, and increases in foreign exchange surrender taxes and capital account taxes.

²⁹In fact, pending unification was announced to the public, although the specific details of unification and the direction of change in the effective exchange rate on trade activities remained uncertain. Under preannouncement, some adjustment of the black market exchange rate would occur at the announcement date (setting into motion both black market exchange rate and reserve movements) and further adjustment would occur at the reform implementation date to the extent that implemented reforms differed from anticipated reforms. For a discussion of the effects of anticipated exchange rate reforms, see Agénor and Flood (1992).

A. Revaluation of the Ruble in the Interbank Market:

The patterns of response of black market exchange rates and reserves to a revaluation of the pegged ruble in the interbank market are shown geometrically in Figure 2 and numerically in Table 3. From the initial state of the economy, the revaluation of the pegged interbank market ruble triggers a jump depreciation of the ruble followed by a period of ruble appreciation in the black market and losses of reserves in the interbank market. Ultimately, the new steady state is characterized by an appreciated ruble in the black market and a lower stock of central bank foreign exchange reserves.

In Figure 2, the initial revaluation of the pegged ruble causes a leftward shift of the external balance curve (from $\Delta R = 0$ to $\Delta R = 0'$) and an upward shift of the money market equilibrium curve (from $\Delta S = 0$ to $\Delta S = 0'$). The adjustment of the economy is from point A to point B and along the RE (rational expectations) path until the new steady state is reached at point E. If the influence of the black market on the overall price level of the economy is high, it is possible for the ruble to appreciate rather than depreciate in the black market in the very short run, before continuing with a similar pattern of adjustment.



- Figure 2 -

Table 3: Revaluation of the Pegged Ruble in the Interbank Market (maintained parameter assumptions: $\gamma = 0.1, \theta = 0.1, \mu = 0.2, \psi = 1.5$)						
Changes in exchange rates and reserves in each period and in the long run						
	change in period t	change in period t+1	change in period t+2	change in period t+3	change in period t+4	steady state (cumulative response)
$v = 0.25, \beta = 0.5$	+0.38	-0.37	-0.27	-0.20	-0.15	-1
R	0.00	-2.15	-1.59	-1.17	-0.86	-10
$v = 0.25, \beta = 2.0$	+0.02	-0.17	-0.14	-0.12	-0.10	-1
R	0.00	-1.64	-1.36	-1.13	-0.94	-10
$v = .75, \beta = 0.5$	-0.02	-0.15	-0.12	-0.11	-0.09	-1
R	0.00	-1.50	-1.27	-1.09	-0.92	-10
$v = .75, \beta = 2.0$	-0.10	-0.10	-0.09	-0.08	-0.07	-1
R	0.00	-1.39	-1.22	-1.08	-0.95	-10

To demonstrate the empirical relevance of the aforementioned adjustment in response to a change in \bar{e} , we calibrate the model with "reasonable" parameter values and trace the response of black market exchange rates and reserve stocks. Ultimately, the adjustment paths are quite sensitive to the choice of β , the interest elasticity of money demand, and to v , the share of prices in the economy (v) that are responsive to the black market exchange rate. The results are provided in Table 3.

When the share of the black market in the economy is relatively small, for example under fifty percent, a one ruble interbank exchange rate revaluation triggers an instantaneous depreciation of the ruble in the black market. This is followed by a period of ruble appreciation in the black market that more than compensates for the initial depreciation, and which ultimately fully reflects the revaluation of the pegged interbank ruble. When $v = 0.25$ and $\beta = 0.5$, a one ruble revaluation of the interbank exchange rate immediately leads to a .38 ruble depreciation of the ruble in the black market, followed by a .37 ruble appreciation in the next period and a further 0.27 appreciation in the second period. By contrast, when v is large, there is a small initial appreciation of the ruble in the black market, followed by a similar pattern of large and declining further appreciations.

Central bank foreign exchange reserves respond with a lag to the revaluation of the interbank market ruble. This revaluation causes a worsening of the official balance of

payments and a decumulation of foreign exchange reserves. The rate of decumulation of reserves declines over time as the black market exchange rate adjusts to restore the initial spread between the effective interbank exchange rate and the black market exchange rate. When $v = .25$ and $\beta = .5$, (the log of) reserves declines by 2.15 in the period immediately following the revaluation, and by 1.59 in the second period, and overall by a total of 10 units of foreign exchange.

Therefore, a revaluation of the pegged ruble in the interbank market will lead, all else equal, to:

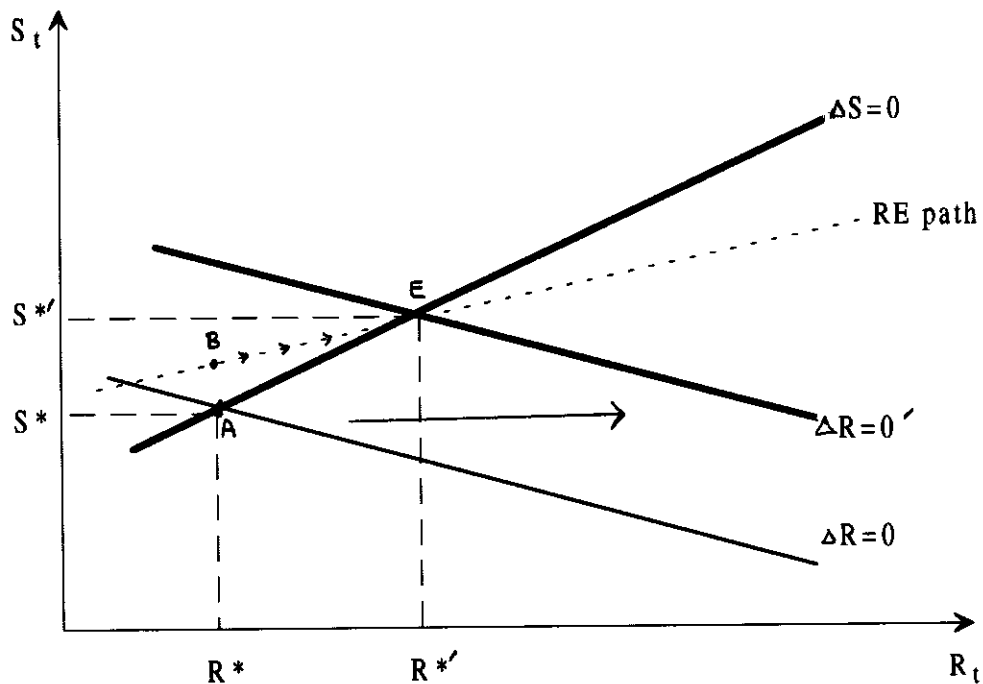
- A period of central bank decumulation of foreign exchange reserves with the rate of decumulation diminishing over time.
- In the long run, a fully offsetting appreciation of the ruble in the black market.
- When v is small, in the very short run there will be a jump depreciation of the ruble in the black market, followed by a period of cumulatively larger appreciations of the ruble in the black market.
- When v is large, in the very short run there will be a small jump appreciation of the ruble in the black market, followed by a period of cumulatively larger appreciations of the ruble in the black market.

B. A Reduction in the Foreign Exchange Surrender Tax:

As part of the Russian exchange rate unification of July 1992, the foreign exchange surrender tax was sharply reduced. The effects of this type of policy initiative are depicted in Figure 3. When τ^x is reduced, in the graphical representation this implies a rightward shift of the external balance curve (from $\Delta R = 0$ to $\Delta R = 0'$). Simulation results are provided in Table 4. While the size of the dynamic effects on the black market exchange rates and on reserves are sensitive to the parameter choices, the pattern of adjustment response is robust.

A decline in the foreign exchange surrender tax unambiguously leads to a jump depreciation of the ruble in the black market. This occurs since domestic interest rates immediately increase, reflecting expected further black market depreciations. This lowers the relative demand for domestic currency. Moreover, there are reduced leakages into the black market in the short run, since the legal returns to exporting are made more attractive due to lower taxation of export revenues (which implies a depreciation of the effective exchange rate on the ruble in legal markets). Ultimately, in the black market the ruble is expected to depreciate by slightly less than the decline in the foreign

exchange surrender tax. Changes in foreign exchange surrender taxes do not lead to short run black market exchange rate overshooting.



- Figure 3 -

Table 4: Impact of a Reduction in the Foreign Exchange Surrender Tax

(maintained parameter assumptions: $\gamma = 0.1, \theta = 0.1, \mu = 0.2, \psi = 1.5$)

	Changes in exchange rates and reserves in each period and in the long run					
	change in period t	change in period t+1	change in period t+2	change in period t+3	change in period t+4	steady state (cumulative response)
$v = 0.25, \beta = 0.5$						
S	+0.26	+0.19	+0.14	+0.10	+0.08	+0.99
R	0.00	+1.11	+0.82	+0.60	+0.44	+2.98
$v = 0.25, \beta = 2.0$						
S	+0.16	+0.13	+0.11	+0.09	+0.08	+0.97
R	0.00	+1.25	+1.04	+0.86	+0.71	+4.38
$v = .75, \beta = 0.5$						
S	+0.15	+0.12	+0.11	+0.09	+0.08	+0.99
R	0.00	+1.28	+1.09	+0.93	+0.79	+7.95
$v = .75, \beta = 2.0$						
S	+0.11	+0.10	+0.09	+0.08	+0.07	+0.97
R	0.00	+1.32	+1.17	+1.03	+0.91	+9.25

Reductions in foreign exchange surrender taxes exert less of an effect on central bank reserves than equally large devaluations of the pegged ruble in the interbank market. A decline in τ^x lowers the black market premium, and reduces leakages out of official markets and into black markets. As this occurs, the official balance of payments improves and reserves accumulate. This pattern continues, albeit at a slower and slower rate, until the premium on black market transactions adjusts to approximately its initial level.

Therefore, a reduction in the foreign exchange surrender tax of the type implemented by Russia causes:

- A jump depreciation of the ruble in the black market.
- Further depreciation of the ruble in the black market over time, until the cumulative depreciation almost fully matches the decline in the foreign exchange surrender tax.
- Foreign exchange reserves accumulation, with the rate of accumulation declining over time.

C. A Reduction in the Foreign Investment Tax:

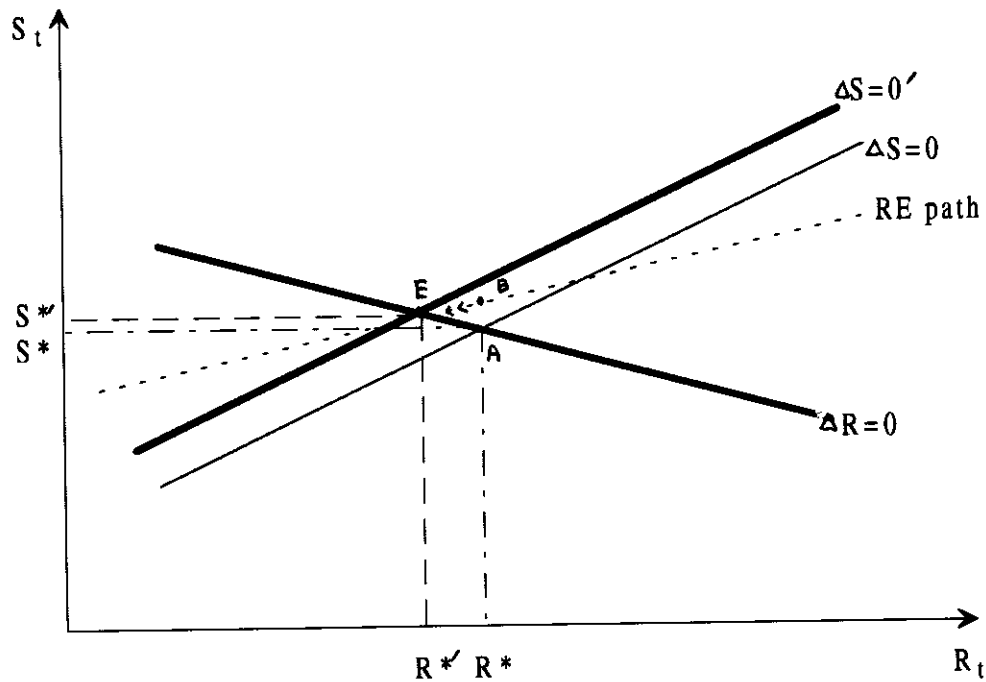
In the Russian exchange rate unification in July 1992 the implicit foreign investment tax was sharply reduced. This type of policy initiative is depicted in Figure 4 and simulated in Table 5. In Figure 4, a decline in τ^k causes an upward shift in the money market equilibrium curve, from $\Delta s = 0$ to $\Delta s = 0'$. When τ^k falls the domestic interest rate declines, leading to excess money balances. The money market clears via a jump depreciation of the ruble in the black market. This short-run ruble depreciation represents an overshooting of the steady state depreciation. Official foreign exchange reserves decline in response to the increased premium on black market transactions in rubles.

Despite the qualitative predictions of the theory, in the current environment we expect changes in the taxation of capital account flows to have very little impact on either the black market exchange rate or on central bank reserve stocks. The explanation for this result is quite straightforward: enforcement of penalties and international capital control measures are largely ineffective in Russia. This is reflected in the low value of γ that appears in our simulations.

Table 5: Impact of a Reduction in the Foreign Investment Tax

(maintained parameter assumptions: $\gamma = 0.1, \theta = 0.1, \mu = 0.2, \psi = 1.5$)

	change in period t	change in period t+1	change in period t+2	change in period t+3	change in period t+4	steady state (cumulative response)
$v = 0.25, \beta = 0.5s$	+0.05	-0.01	-0.01	-0.01	-0.00	+0.01
R	0.00	-0.07	-0.05	-0.04	-0.03	-0.48
$v = 0.25, \beta = 2.0s$	+0.07	-0.01	-0.01	-0.01	-0.01	+0.03
R	0.00	-0.10	-0.08	-0.07	-0.06	-1.88
$v = .75, \beta = 0.5 s$	+0.03	-0.00	-0.00	-0.00	-0.00	+0.01
R	0.00	-0.04	-0.04	-0.03	-0.03	-0.45
$v = .75, \beta = 2.0 s$	+0.06	-0.01	-0.01	-0.01	-0.00	+0.03
R	0.00	-0.08	-0.07	-0.06	-0.06	-1.75



- Figure 4 -

IV.2 Flexible Interbank Market Exchange Rates and Exchange Regime Reform

In this scenario e_t is endogenous and freely floating, and the central bank refrains from intervening in foreign exchange markets. Foreign exchange reserves act as a component of the money stock that the government controls. The system of equations we use for the analysis is identical to the previous system, except for a slightly more sophisticated specification of the current account balance. Equation (5') shows that the current account moves in response to three forces: i) the higher the effective black market ruble exchange rate premium, the more that export receipts leak into the black market (if exports decline the current account worsens); ii) the higher the available stock of real money balances, the more domestic agents import (if real money balances rise, the current account worsens); and iii) the higher the real interest rate, the smaller the amount of current expenditure, including current expenditures on imports (if real interest rates rise, the current account improves).

$$R_t - R_{t-1} = \psi(e_t - \tau^x - s_t) - \mu(m_t - p_t) + \varphi(i_t - (E_t p_{t+1} - p_t | I_t)) \quad (5')$$

Equation (5'), when combined with equations (1) through (4), gives rise to the system of adjustment of interbank and black market exchange rates presented in equation (10). As in the previous scenario, the first row of this system represents money market equilibrium and the second row represents external balance. The dynamics of the exchange rates are described by the following first order two-dimensional vector process:

$$\begin{bmatrix} v + \beta + \beta\gamma & 1 - v - \beta\gamma \\ -(\psi - v\mu) - \varphi(1 + \gamma - v) & \psi + (1 - v)\mu + \varphi(\gamma + 1 - v) \end{bmatrix} \begin{bmatrix} S_t \\ e_t \end{bmatrix} = \begin{bmatrix} \beta & 0 \\ -\varphi(1 - v) & \varphi(1 - v) \end{bmatrix} \begin{bmatrix} E_t S_{t+1} \\ E_t e_{t+1} \end{bmatrix} + \begin{bmatrix} \theta & 0 & 1 - \theta & -\beta\gamma & 0 & -\alpha & \beta \\ 1 + \mu\theta & -1 & \mu(1 - \theta) & \varphi\gamma & \psi & 0 & -\varphi \end{bmatrix} \begin{bmatrix} R_t \\ R_{t-1} \\ D_t \\ \tau^k \\ \tau^x \\ \bar{y} \\ i^* \end{bmatrix} \quad (10)$$

In Scenario 2, when there are two fully flexible exchange rates, both of which are forward looking, the adjustment path to the steady state is unique only if both eigenvalues of the system exceed unity in modulus. The eigenvalues and eigenvectors of

the system are provided in the technical appendix. For reasonable parameter values the solution path of the system is unique under rational expectations and is described by a jump from the initial steady state to the new steady state combination of interbank and black market exchange rates.

This means that both exchange rates will instantaneously adjust to clear the money market and the external accounts. Thereafter, the specific responses to changes in policy parameters are drawn from a comparative statics examination of the steady-state interbank and black market exchange rates, provided in equations (11) and (12). The steady-state black market and interbank market exchange rates are given by:

$$s^* = \tau^x \left(\frac{-\psi(1-v-\beta\gamma)}{\psi + \beta\gamma\mu + \phi\gamma} \right) - \tau^k \left(\frac{\gamma(\beta(\psi + \mu(1-v)) + \phi(1-v))}{\psi + \beta\gamma\mu + \phi\gamma} \right) + i^* \left(\frac{\beta(\psi + \mu(1-v)) + \phi(1-v)}{\psi + \beta\gamma\mu + \phi\gamma} \right) - y \left(\frac{\alpha(\psi + \mu(1-v) + \phi\gamma)}{\psi + \beta\gamma\mu + \phi\gamma} \right) + \theta R + (1-\theta)D \quad (11)$$

$$e^* = \tau^x \left(\frac{\psi(v + \beta\gamma)}{\psi + \beta\gamma\mu + \phi\gamma} \right) - \tau^k \left(\frac{\gamma(\beta(\psi - \mu v) - \phi v)}{\psi + \beta\gamma\mu + \phi\gamma} \right) + i^* \left(\frac{\beta(\psi - \mu v) - \phi v}{\psi + \beta\gamma\mu + \phi\gamma} \right) - y \left(\frac{\alpha(\psi - \mu v + \phi\gamma)}{\psi + \beta\gamma\mu + \phi\gamma} \right) + \theta R + (1-\theta)D \quad (12)$$

From (11) and (12) observe that any reduction in foreign exchange surrender taxes leads to an unambiguous appreciation of the domestic currency in the interbank market and an unambiguous weakening of the domestic currency in the black market. The mechanism is clear: when τ^x is reduced, the black market premium falls and leakages of export earnings into the black market decline. The cut in τ^x also reduces the aggregate price level and thereby increases the stock of real money balances. Also, as τ^x declines, so does the real domestic interest rate, thereby increasing the demand for real balances. The larger is v , the greater the overall amount of domestic currency appreciation in the interbank market and the smaller the amount of depreciation in the black market.³⁰

Reduced taxation of capital account transactions unambiguously raises the domestic interest rate (since there is a smaller penalty on international capital transactions). As

³⁰This requires $1 - v < \beta\gamma$, which is satisfied in our simulations provided that market forces comprise at least 20 percent of economic activity (i.e. if $v > .20$).

long as penalty enforcement is low, this interest rate effect is small and this policy initiative is not expected to have large effects on exchange rates. Nonetheless, reductions in τ^k lower the demand for real balances (due to increased interest rates), in addition to reducing the demand for imports and therefore for foreign exchange in the interbank market. The domestic currency unambiguously depreciates in the black market. In the interbank market the overall impact is not as obvious. It depends on the extent of the current account worsening due to the leakage effect -- caused by an increase in the black-market premium-- and the current account improvement due to the real interest rate effect on import demands.

Finally, in this simple model an exogenous injection of foreign exchange reserves depreciates the ruble in both interbank and black markets. This occurs because reserves act as a pure monetary stimulus, increasing both the supply of money balances and the demand for imports. Likewise, expansions in the supply of domestic credit clearly will depreciated the ruble in interbank markets and in black markets.

V. Concluding Remarks

This paper has sought to achieve two objectives. First, we have provided an interpretation of the exchange rate regime changes that have occurred in Russia in 1992. Second, we have provided a framework that enables us to consider some of the short run effects of exchange rate policy instruments.

We have stressed that the exchange rate regime in Russia should be interpreted as a type of dual exchange rate system, wherein a series of taxes drive wedges between the exchange rates observed on different classes of transactions. These distortionary taxes contributed to the deepening of black markets for foreign exchange and to the thinness of legal interbank markets for currency. The July 3, 1992 reforms in Russia reduced these forms of taxation of both importers and exporters. It should tend to deepen the degree of activity in legal foreign exchange markets. These reforms acted as a depreciation of the effective ruble per dollar exchange rate received by exporters on their foreign exchange earnings, and acted as an appreciation of the effective exchange rate paid by importers for their purchases of foreign currency.

Our theoretical work and the corresponding simulation results show that the effects of policy initiatives depend on the extent to which the central bank intervenes to control the interbank market exchange rate. When the interbank exchange rate is fully flexible, small changes in policy parameters can lead to immediate and one shot adjustment of

interbank and black market exchange rates. By contrast, when the interbank market exchange rate is tightly regulated through central bank intervention, the adjustment path of the black market exchange rates and reserves is more prolonged and in the very short run exchange rates can overshoot longer run equilibrium levels.

In closing, it is important to stress that our analysis had a limited objective, interpreting only the relatively short run effects of changing the foreign exchange regime in Russia. We have provided a stylized model for insight and intuition, but have not specified the paths for output adjustment in response to exchange rate changes or the role of more complicated interactions between exchange rates and prices.³¹ This paper, by highlighting only those policy initiatives that fall directly under the rubric of exchange rate policy and regulation, has not emphasized the other crucial forces that influence the value of the ruble. For example, the extremely loose monetary and fiscal policies of the Central Bank of Russia and the government contributed significantly to the capital flight out of Russia and the sustained depreciation of the ruble in the second half of 1992. Such policies are inconsistent with the goal of achieving a stable value for the ruble and bode poorly for any timely introduction of sustainable controlled exchange rates.

³¹For example, see Goldberg and Karimov (1991).

Technical Appendix

For Scenario 1, the eigenvalues of this system with a black market and multiple fixed official exchange rates are:

$$\lambda_i = \frac{((1+\mu\theta)(\beta+\beta\gamma+v)+\theta(\psi-\mu\nu)+\beta) \pm \sqrt{((1+\mu\theta)(\beta+\beta\gamma+v)+\theta(\psi-\mu\nu)+\beta)^2 - 4\beta(1+\mu\theta)(\beta+\beta\gamma+v)}}{2\beta(1+\mu\theta)}$$

For a unique solution, we require that the modulus of one eigenvalue exceed one in absolute value while the modulus of the other eigenvalue by less than unity in absolute value. This is guaranteed as long as the parameters of our model are positively signed.

$$H = \left[\begin{array}{c|c} 2\beta(\psi-\mu\nu) & \begin{array}{l} -\beta+(1+\mu\theta)(\beta+\beta\gamma+v)+\theta(\psi-\mu\nu) \\ -\sqrt{((1+\mu\theta)(\beta+\beta\gamma+v)+\theta(\psi-\mu\nu)+\beta)^2 - 4\beta(1+\mu\theta)(\beta+\beta\gamma+v)} \end{array} \\ \hline 2\beta(\psi-\mu\nu) & \begin{array}{l} -\beta+(1+\mu\theta)(\beta+\beta\gamma+v)+\theta(\psi-\mu\nu) \\ +\sqrt{((1+\mu\theta)(\beta+\beta\gamma+v)+\theta(\psi-\mu\nu)+\beta)^2 - 4\beta(1+\mu\theta)(\beta+\beta\gamma+v)} \end{array} \end{array} \right]$$

For Scenario 2, the eigenvalues of this system with a fully flexible interbank market exchange rate and a flexible black market exchange rates are:

$$\lambda_i = \frac{\phi(1-\nu) - \beta(\psi - \mu\nu) \pm \sqrt{K}}{2\beta\phi(1-\nu)}$$

where

$$K = (-\phi(1-\nu) + \beta(\psi - \mu\nu))^2 - 4\beta\phi(1-\nu)((1+\beta)(\phi(1-\nu) + (\psi - \mu\nu) + (1-\nu)\mu))$$

The unique solution to this problem requires the modulus of both eigenvalues exceed one. Through simulation analysis we have demonstrated that this is generally satisfied for the data ranges:

$$.5 \leq \beta \leq 2, \quad .1 \leq \mu \leq .2, \quad .25 \leq \nu \leq .75, \quad .5 \leq \psi \leq 1.5, \quad .5 \leq \phi \leq 1.5$$

The system can fail to have a unique solution for ψ very large (greater than 2) or very small (near zero) and for large ϕ (near 2).

Bibliography

- Agénor, Pierre-Richard and Robert Flood (1992), "Anticipated Exchange Rate Reforms", *International Monetary Fund Staff Papers* forthcoming.
- Aizenman, Joshua (1985) "Adjustment to Monetary Policy and Devaluation Under Two-Tier and Fixed Exchange Rate Regimes," *Journal of Development Economics* vol. 18 pp.153-169.
- Aizenman, Joshua (1986) "On the Complementarity of Commercial Policy, Capital Controls and Inflation Tax," *Canadian Journal of Economics* vol. 19 pp.114-133.
- Bhandari, Jagdeep and Bernard Decaluwé (1987) "A Stochastic Model of Incomplete Separation Between Commercial and Financial Exchange Markets," *Journal of International Economics* vol. 22 pp.25-55.
- Bhandari, Jagdeep and Carlos Végh (1990) "Dual Exchange Markets Under Incomplete Separation: An Optimizing Model," *International Monetary Fund Staff Papers* vol. 37 pp.146-167.
- Blanchard, Olivier and Charles Kahn (1980), "The Solution of Linear Difference Equations under Rational Expectations," *Econometrica* vol. 48 no.5 (July) pp.1305-1311.
- Flood, Robert (1978), "Exchange-Rate Expectations in Dual Exchange Markets," *Journal of International Economics* (February) vol.8 pp.65-77.
- Flood, Robert and Nancy Marion (1982), "The Transmission of Disturbances Under Alternative Exchange-Rate Regimes with Optimal Indexing," *The Quarterly Journal of Economics* vol.97 pp.43-66.
- Flood, Robert and Nancy Marion (1983), "Exchange-Rate Regimes in Transition," *Journal of International Money and Finance* vol.2 pp.279-94.
- Froot, Ken and Maurice Obstfeld (1991), "Exchange-Rate Dynamics under Stochastic Regime Shifts: A Unified Approach," *Journal of International Economics*, vol.31 (November) pp.203-29.
- Goldberg, Linda (1992b), "Foreign Exchange Markets in Russia: Understanding the Reforms," *Papers on Policy Analysis and Assessment #92/* (IMF: Washington DC).
- Goldberg, Linda (1992a), "Moscow Black Markets and Official Markets for Foreign Exchange: How Much Flexibility in Flexible Rates?" NBER working paper #4040.

- Goldberg, Linda and Ildar Karimov (1991), "Internal Currency Markets and Production in the Soviet Union," IIASA, Austria working paper (significantly revised version of NBER 3614).
- Guidotti, Pablo (1988), "Insulation Properties Under Dual Exchange Rates," *Canadian Journal of Economics* vol.21 pp.799-813.
- International Monetary Fund, (1992) *Economic Review: Russian Federation* (IMF: Washington, DC).
- International Monetary Fund, (1992b) *Economic Review: The Economy of the Former USSR in 1991* (IMF: Washington, DC).
- Kiguel, Miguel and Saul Lizondo (1990), "Adoption and Abandonment of Dual Exchange Systems," *Revista de Analisis Economico* vol. 5 (March) pp.3-23.
- Lizondo, Saul (1987), "Exchange Rate Differential and Balance of Payments Under Dual Exchange Markets" *Journal of Development Economics* vol.26 pp.37-53.
- Marion, Nancy (1981), "Insulation Properties of a Two-Tier Exchange Market in a Portfolio Balance Model," *Economica* vol.48 pp.61-70.
- Pinto, Brian (1991) "Black markets for foreign exchange, real exchange rates and inflation", *Journal of International Economics* vol.30 pp.121-135.
- Taylor, John (19986) "Stabilization Policy and Macroeconomic Fluctuations," in *Handbook of Econometrics* vol. III edited by Z. Griliches and M.D. Intriligator (Elsevier).