Risk Premia in the Ruble/Dollar Futures Market

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INTRODUCTION

This article analyzes risk premia for the Russian market for Ruble/U.S. Dollar futures. The market for futures on the Ruble/U.S. Dollar exchange rate has been open only since November, 1992. The Ruble/U.S. Dollar futures market started with an initial trading volume of approximately \$300,000 a day, and has grown substantially in the first three years of its existence. Also, by the end of 1995 the market is being used by a much wider variety of traders than when it first started to operate.

Evidence of risk premia in foreign currency futures and forward markets is widely cited in the literature for well-developed futures markets, such as for the Western European and U.S. currencies.[1] Yet, over the last years, futures contracts have been created for weaker currencies as well, including, e.g., Brazilian, Mexican, and Russian currency futures.

Whether risk premia exist in the market for Ruble/U.S. Dollar futures is of obvious interest to American and other investors who are participating in Russian markets at an increasing rate and, therefore, have

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[1]For a review of this literature, see, e.g., Hodrick (1987). Recent research includes works by, e.g., Bessembinder (1992, 1993), Cavaglia et al. (1994), Cooper (1993), and Jabbour (1994).

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an exposure in Rubles. For these agents, the risk premia present in the futures market represent the costs/benefits associated with hedging their exposure. Similarly, the risk premia are of prime importance to Russian banks and importing and exporting corporations who want to hedge their exposure in U.S. Dollars. An economy as large as the Russian economy represents large trade potential to the U.S. as well as to many other outside countries.

This study rejects the hypothesis that the futures price is an unbiased estimate of the future spot price for the Ruble/U.S. Dollar futures market. The difference between the current futures price and the future spot price appears to be related to the current futures price, the current spot price, and to the spread between the current futures and spot price, as well as to the time to maturity of the futures contract. This implies time-varying risk premia, which are often significantly different from zero both in economic and statistical terms. This study also finds that it is useful to divide the sample period into three subperiods according to the nature of the participants and the trading volume in the market. The risk premia behave quite differently in the three subperiods, being most stable in the last period, which started in the spring of 1994. Over the three subperiods the relationship between the spot and the futures market appears to have become stronger. Also, in the last subperiod the behavior of the Ruble futures returns is very similar to the behavior of the returns on Deutsche Mark, British Pound, and Japanese Yen futures. On the other hand, there is no evidence that the Ruble/U.S. dollar futures market is closely related to other Western currency futures markets, nor that this relationship is becoming stronger over time. Thus, although there appears to be a clear development towards a more stable and mature currency futures market in Russia, the evidence presented here suggests that this market is still segmented from other Western currency (futures) markets.

This article is organized as follows. It provides some background information on the Russian currency futures market, describes the estimation procedure and the data, and then presents the empirical results. The final section gives a summary and conclusions.

THE MARKET FOR RUBLE/U.S. DOLLAR EXCHANGE RATE FUTURES

Futures trading on the $1000 Ruble/U.S. Dollar exchange rate contract started in November, 1992 on the Moscow Commodity Exchange

(MCEX).[2] In January, 1995, trading began in a $5000 contract.[3] Trading in the U.S. Dollar itself takes place on the Moscow Interbank Currency Exchange (MICEX) during ½-hour sessions each morning from Monday until Friday. Trading in the futures contracts takes place in a sequence of sessions of approximately 20 minutes each, starting with the shortest maturity contract and ending with the longest maturity contract. When the MCEX first started to trade futures contracts on the U.S. Dollar, contracts were available for delivery in one, two, and three months. These were traded one session per week. Nowadays, contracts are available for delivery up to 15 months, each of which is traded in five sessions per week.

Looking at the history of Ruble/U.S. Dollar futures trading on the MCEX, one can distinguish three subperiods [Yakovlev and Bessonov (1995)]. The first subperiod covers roughly the period from November, 1992 until the fall of 1993. Trading started at a rather low volume in this period, approximately $300,000 to $400,000 per day, and the only participants were small and medium size financial firms[4] that only traded for speculative reasons.

The second subperiod is the period from the fall of 1993 until the spring of 1994. During this period, trading volume increased from $1.0 million per day to a level of approximately $3.0 million per day. In this period banks also started to participate in the futures market, as well as so-called Voucher Investment Funds.[5] Obviously, since banks also trade at the MICEX, banks trade both for hedging and speculating purposes.

Finally, the third subperiod commenced in the spring of 1994 and lasted until the end of this study's sample period. In this subperiod, trading volume has grown even further to a level of $35 million per day at the end of 1995. In addition to banks, investment funds, and other financial firms, many other corporations have come to participate in the market both for hedging and speculating purposes. During the third subperiod the activity of speculators seems to have diminished and that of hedgers to have increased. At the beginning of 1995, the percentage of Russian firms importing from the U.S. that reported using Ruble/U.S.

[2]Previously there was trading in contracts with a size of $10. However, the trading volume in that contract was insignificant.

[3]In addition to futures on the Ruble/U.S. Dollar exchange rate at the MCEX, futures are traded on several other assets like sugar, gasoline, aluminum, and Deutsche Marks.

[4]These firms were usually former brokers on the MCEX and other exchanges.

[5]Vouchers are securities given to Russian citizens by their government, which enable them to participate in the privatization of national wealth. Initially, each citizen obtained an equal stake in national wealth, which (s)he could either sell or put in a Voucher Investment Fund. Such investment funds may use these Vouchers for other investment purposes.

Dollar futures contracts to hedge their currency risk has increased to 15% [Yakovlev and Bessonov (1995)].

Compared to the other futures traded on the MCEX, the Ruble/U.S. Dollar futures contract has become the most actively traded contract. Although the Ruble/U.S. Dollar futures market clearly has been growing substantially, its size is still small when compared with the spot market. At the end of 1995, daily volumes in the spot market were of the order of magnitude of \$100 million per day, i.e., approximately 3 times as large as the futures market, and occasionally the trading volume was even in the order of \$600 million per day.

One final thing to note about the market for Ruble/U.S. Dollar futures is that it restricts trade for investors outside Russia, which makes it essentially a domestic market. One implication of this restriction is that, in determining the futures prices, agents will be concerned about the interest rates on both Rubles and U.S. Dollars that can be earned on Russian deposits. In other words, the market for Ruble/U.S. Dollar futures contracts is in fact a Eurodollar[6] futures market and, moreover, a domestic market. Because of this feature, there is no reason to expect a close relationship between the Ruble/U.S. Dollar futures market and markets for Western currencies.

Although the Ruble/U.S. Dollar futures market may be segmented from the Western currency futures markets, this does not imply that the Ruble/U.S. Dollar futures market is of no use to U.S. investors, since U.S. investors can (and do) participate in the futures market in indirect ways, e.g., via joint ventures. Also, when investing or trading in Russia, U.S.-investors can always negotiate on future exchange rates in which the Ruble/U.S. Dollar futures price will play an important role.

METHODOLOGY AND DATA DESCRIPTION

Methodology

If the market for Ruble/U.S. Dollar exchange rates is efficient, in the sense that rational and risk-neutral agents use all available information in determining both the futures price and the spot price of the exchange rate, then the current futures price for delivery in n periods, $F_t^{(n)}$, is an unbiased estimate of the exchange rate n periods from now, S_{t+n}, i.e.:

$$E[S_{t+n} \mid I_t] = F_t^{(n)} \tag{1}$$

[6]A Eurodollar is a dollar deposited in a U.S. or foreign bank outside the United States [see, e.g., Hull, 1993, p. 98].

where I_t denotes the information set available at time t. With risk-averse agents, the futures price need not equal the expected future spot price, but, in general, it will differ from the expected spot price by a risk premium:

$$E[S_{t+n} \mid I_t] = F_t^{(n)*}(1 + \hat{\pi}_t^{(n)}) \tag{2}$$

where $\hat{\pi}_t^{(n)}$ is the risk premium on a futures contract with n periods to maturity. For estimation purposes, it is more convenient to express (2) in logarithms, yielding the following:

$$E[s_{t+n} \mid I_t] = f_t^{(n)} + \pi_t^{(n)} \tag{3}$$

where $f_t^{(n)} = \log F_t^{(n)}$, $s_t = \log S_t$, and where $\pi_t^{(n)} = \log(1 + \hat{\pi}_t^{(n)})$ redefines the risk premium.

A standard procedure to test for the unbiasedness of the futures price as a predictor of the future spot price and to estimate the risk premium at the same time, is to estimate the following regression equation:

$$s_{t+n} - f_t^{(n)} = x_t'\beta + \eta_{t+n}^{(n)} \tag{4}$$

where x_t is a vector of explanatory variables that are elements of I_t and $\eta_{t+n}^{(n)} = s_{t+n} - E[s_{t+n} \mid I_t]$, i.e., the n-period prediction error. If the null hypothesis, that the futures price is an unbiased estimate of the future spot price, holds, then $\beta = 0$ and the prediction error is not autocorrelated for lags of order n and larger, i.e., $E[\eta_t^{(n)}\eta_{t+k}^{(n)}] = 0$, $k \geq n$. On the other hand, if there exist risk premia in the Ruble/U.S. Dollar futures market, then $x_t'\beta$ is an estimate of the risk premium $\pi_t^{(n)}$.

The section "Empirical-Analysis of the Risk Premia," presents estimates of (4) using as explanatory variables $f_t^{(n)}$, s_t and the current spread between the futures price and the spot price, $(f_t^{(n)} - s_t)$. These kinds of variables are often used in related literature. For instance, Cooper (1993) finds that risk premia in the Deutsche Mark, Swiss Franc, and British Pound futures and forward markets are related to their own spread $(f_t^{(n)} - s_t)$ as well as to the spreads of the other two currencies. Similar results are found in other studies [see, e.g., Baillie, Lippens, and McMahon (1983); Fama (1984); McCurdy and Morgan (1987); and Jabbour (1994)].

In a related branch of the literature, equilibrium risk premia are related to economic aggregates [see, e.g., Bessembinder (1993)]. Economic aggregates include variables such as unexpected inflation, the change in short-term Treasury Bill yields, the change in the term structure, the change in industrial production, and the return on the market portfolio. Alternatively, risk premia can be related to variables from equity, bond, and futures markets, such as equity dividend yields and "junk" bond premia [Bessembinder and Chan (1992)], and hedging pressure variables [Bessembinder (1992)]. Since data on this kind of variables for the Russian market are either unavailable or unreliable, such an analysis cannot be pursued for the Ruble/U.S. Dollar futures market.

Besides investigating the behavior of risk premia, this article also studies the relationship between the Ruble/U.S. Dollar futures returns and the returns on three Western currency futures returns: Deutsche Mark/U.S. Dollar, British Pound/U.S. Dollar, and Japanese Yen/U.S. Dollar futures returns. Unlike assets or currencies, futures contracts do not require any initial investment.[7] Therefore, whereas expected asset and currency returns contain a risk-free rate and possibly storage costs, convenience yields, and dividend yields (in the case of currency futures, the foreign interest rate) plus a risk premium, expected futures returns only reflect a risk premium. This can be seen also from eq. (3). Noting that at the delivery date $f_{t+n}^{(0)} = s_{t+n}$, eq. (3) can be rewritten as:

$$E[s_{t+n} \mid I_t] - f_t^{(n)} = E[f_{t+n}^{(0)} \mid I_t] - f_t^{(n)} = \sum_{j=1}^{n} E[r_{F,t+j} \mid I_t] = \pi_t^{(n)} \quad (5)$$

where $r_{F,t+j} = f_{t+j}^{(k)} - f_{t+j-1}^{(k-1)}$, the one-period futures return in period $t + j$. Equation (5) clearly shows that expected futures returns only reflect risk premia.

If there are common factors in the risk premia for the Ruble/U.S. Dollar futures and the three Western futures contracts, i.e., if the Ruble/U.S. Dollar futures market and the Western currency futures markets are integrated, then one can expect a certain comovement in the futures returns as well. If, on the other hand, the Ruble/U.S. Dollar futures market is segmented from the Western currency futures markets, implying that only local factors enter the risk premium, then one can expect a zero correlation between the Ruble/U.S. Dollar futures returns on the one hand and the Western currency futures returns on the other. As argued, the market for Ruble/U.S. Dollar futures contracts is essentially a domestic Russian market that bears no direct relationship to financial markets outside Russia. Therefore, the Ruble/U.S. Dollar futures returns are expected to be uncorrelated with the futures returns on the Deutsche Mark, British Pound, and Japanese Yen relative to the U.S. Dollar.

[7]Of course, futures contracts do require a deposit of an initial margin, but this should not be considered to be an investment.

Data Description

All observations that are available from November, 1992 until October, 1995 are used in this study. Monthly, weekly, and daily data are used. For the monthly data, the sample period yields at most 29 observations, for the weekly 145, and for the daily data 2848 observations. All data used are closing prices.

Figure 1 illustrates the Ruble/U.S. Dollar exchange rate and the futures prices during the sample period. This figure shows that the Ruble depreciated quite dramatically during this period from approximately 500 Rubles/U.S. Dollar in November, 1992 to almost 5000 Rubles/U.S. Dollar in September, 1995. Also, Figure 1 shows that the futures prices are usually much higher than the spot prices, suggesting a big implied interest differential between the Ruble and U.S. Dollar interest rate (in Russia). This is confirmed by Table I, which shows that the average, minimum, and maximum futures prices are always much higher than the concomitant spot prices.

In relating the Ruble futures contracts to the Deutsche Mark, British Pound, and Japanese Yen futures contracts that are traded on the IMM, Wednesday-to-Wednesday closing returns are used, where the observations in the delivery month are excluded from the analysis. For the three Western currency futures contracts, data are obtained from Datastream. All exchange rates and futures prices are expressed as foreign currency per U.S. Dollar.

EMPIRICAL ANALYSIS OF THE RISK PREMIA

Results From Monthly Data

Equation (4) is estimated using monthly observations.[8] $f_t^{(n)}$, s_t and $(f_t^{(n)} - s_t)$ are used as explanatory variables. Futures prices are used for delivery in one, two, three, and four months. As noted by Hansen and Hodrick (1980), this gives rise to an overlapping samples problem in the latter three cases. To correct for this, standard errors as in Newey and West (1987) are calculated. The estimates of (4) are presented in Table II.

Table II shows that for futures with more than two months to delivery, the hypothesis that the futures price is an unbiased estimate of the future spot price can always be rejected. Both the current spot price s_t and the spread $(f_t^{(n)} - s_t)$ appear to have predictive power for the risk premium. Risk premia in the Ruble/U.S. Dollar futures market are both

[8]All estimations are processed using the software packages Mesosaur and Microfit.

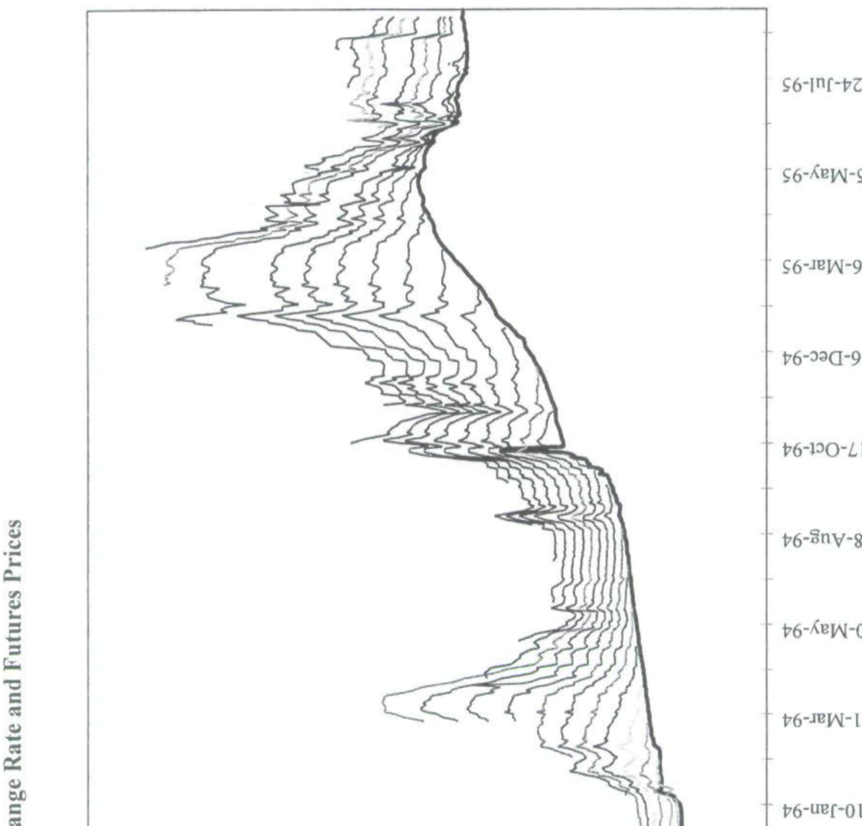

FIGURE 1
The bottom thick line indicates the spot exchange rate. All higher lines indicate futures prices for increasing maturities.

TABLE I

Summary Statistics of Daily Spot and Futures Prices: Sample Period 11/92–10/95

	S_t	F_t
Maximum	5130	8890
Minimum	398	510
Mean	2131	3727
Stand. dev.	1523	1844
N	774	2848

S_t = spot price in Rubles/$; F_t = futures price in Rubles/$.

TABLE II

Parameter Estimates of Risk Premium Regressions for Monthly Data; 11/92–10/95

	$s_{t+n} - f_t^n = \beta_n + \beta_1 {}^* x_t + \eta_{t+n}^{(n)}$					
	β_0	Std. Dev. (β_n)	β_1	Std. Dev. (β_1)	R^2	N
$x_t = f_t^{(n)}$						
$n = 1$	−0.12	[0.23]	0.01	[0.03]	0.01	29
$n = 2$	0.21	[0.37]	−0.03	[0.05]	0.02	27
$n = 3$	0.00	[0.85]	−0.01	[0.11]	0.00	22
$n = 4$	0.71	[0.97]	−0.09	[0.12]	0.03	19
$x_t = s_t$						
$n = 1$	−0.14	[0.21]	0.02	[0.03]	0.01	29
$n = 2$	4.67	[3.73]	−0.61	[0.48]	0.13	27
$n = 3$	20.59[a]	[8.82]	−2.66[a]	[1.16]	0.46	22
$n = 4$	26.46[b]	[8.36]	−3.40[b]	[1.10]	0.51	26
$x_t = (f_t^{(n)} - s_t)$						
$n = 1$	0.05	[0.05]	−0.65[a]	[0.30]	0.15	29
$n = 2$	0.07	[0.12]	−0.54	[0.55]	0.08	27
$n = 3$	0.41[a]	[0.18]	−1.77[b]	[0.49]	0.52	22
$n = 4$	0.64[a]	[0.23]	−1.93[b]	[0.56]	0.58	19

The table contains parameter estimates for the regression specified in the top row. *n* indicates the remaining maturity of the futures contract in months, f_t indicates the log futures price, and s_t the log spot price. The futures prices used are closing prices. All standard errors are Newey–West standard errors with lag window $n - 1$.

[a]Indicates that the parameter is significantly from zero at the 5% confidence level.

[b]Indicates that the parameter is significantly different from zero at the 1% confidence level.

economically and statistically significantly different from zero and, moreover, time-varying. This is clear from the values of the R^2, which are often quite high, and from the significant and rather large values of the regression parameters. The risk premia implied by these parameter estimates represent significant costs/profits for hedgers and speculators in this market.

Note from Table I that when the spot price is used as a regressor, there appears to be a clear maturity effect in the parameter estimates, indicating that risk premia are larger for the longer maturity futures contracts than for the shorter maturity contracts. This effect also shows up when the spread between the futures and spot price is used as a regressor, except for the one-month futures contracts. One reason for this strong maturity effect may be that bank credits are readily available for the shorter maturities, while for the longer maturities they are not, implying that interest rate risk is much more important for the longer maturities.

Note also that, although the risk premia themselves are quite large, the parameter estimates in Table II are comparable with results that are found for more established markets. For instance, when regressing the risk premium on the spread $(f_t^{(n)} - s_t)$, as is done in the last panel of Table II, the estimated slope coefficients as well as their standard errors are of the same magnitude as found by Fama (1984) and Cooper (1993) for well-developed markets such as the Deutsche Mark, British Pound, Swiss Franc, and Japanese Yen forward and futures markets. The explanatory power of the regressions that are reported in Table II seems to be considerably higher, however. The major problem with the monthly data used here is, of course, the small number of observations.

Results From Daily Data

One problem with daily data as opposed to monthly data is that the maturity of the futures contracts changes every day, since futures contracts are available only for delivery once a month. Thus, if on day t a futures contract is observed with 30 days to maturity, $F_t^{(30\text{days})}$, then on day $t + 1$ the contract has 29 days to maturity, i.e., $F_{t+1}^{(29\text{days})}$ is observed. With monthly data, on the other hand, observations on $F_t^{(1\text{month})}$, $F_t^{(2\text{months})}$, $F_t^{(3\text{months})}$, and $F_t^{(4\text{months})}$ are available *every* month. The implication is that the effect of the remaining time to maturity must be taken into account in Eq. (4), since risk premia will, in general, be different for different values of n. As with the monthly data, risk premia can be related to information that is present in the spot and futures market. Of course, once the spread between the spot and futures market and the futures

TABLE III

Parameter Estimates of Risk Premium Regressions for Daily Data: 11/92–10/95

Panel A: Dependent is $(s_{t+n} - f_t^{(n)})$	*Const*	n	$(f_t^{(n)} - s_t)$	$(f_t^{(n)} - s_t)^*n$	$f_t^{(n)}$	$f_t^{(n)*}n$
Parameter	−0.69[a]	0.030[b]	−1.47[b]	0.0035[b]	0.086[a]	−0.0035[b]
Std. dev.	[0.35]	[0.0037]	[0.23]	[0.00087]	[0.044]	[0.00044]
Panel B: Dependent is $(s_{t+n} - f_t^{(n)})$ *Subperiod*						
1	1.54[a]	0.016[a]	−0.99[b]	0.0056	−0.22[a]	−0.0023[a]
11/92–10/93	[0.64]	[0.0076]	[0.35]	[0.00306]	[0.091]	[0.00107]
2	−1.08	0.041[b]	−1.33[b]	0.0080[b]	0.151	−0.0056[b]
10/93–3/94	[0.94]	[0.0035]	[0.25]	[0.00054]	[0.128]	[0.00047]
3	−0.53	0.035[b]	−0.69	0.0015	0.060	−0.0041[b]
3/94–10/95	[0.41]	[0.0016]	[0.38]	[0.00088]	[0.052]	[0.00023]

The table contains parameter estimates based on daily data. The number of observations is equal to 2848. n indicates the remaining maturity of the futures contract in days. f_t the log futures price, and s_t the log spot price. The futures prices used are closing prices. All standard errors are Newey–West standard errors with lag window 150.

[a]Indicates that the parameter is significantly from zero at the 5% confidence level.

[b]Indicates that the parameter is significantly different from zero at the 1% confidence level.

(spot) price itself is used as a regressor, it is not possible to include the spot (futures) price as well. Therefore, in the analysis of the daily data both the spread and the futures price are used as explanatory variables, while the spot price is excluded from the regression:

$$s_{t+n} - f_t^{(n)} = (\beta_0 + \beta_1{}^*n) + (\beta_2 + \beta_3{}^*n)^*f_t^{(n)} + (\beta_4 + \beta_5{}^*n)^*(f_t^{(n)} - s_t) + \varepsilon_{t+n}^{(n)} \qquad (6)$$

where n is measured in days. Using all futures prices available, a total sample consisting of 2848 observations is obtained. Note that at each day t several futures prices are observed, which are stacked into one vector, contract by contract. To account for the dependence between the error terms $\varepsilon_{t+n}^{(n)}$, standard errors are again calculated as in Newey and West (1987).

The results of Eq. (6) are presented in panel A of Table III. Judged by the significant (both statistically and economically) effect of all the explanatory variables, the null hypothesis of the unbiasedness of the futures price as a predictor of the future spot price is overwhelmingly rejected. The estimated risk premia are significantly different from zero and highly time varying.

As noted, the operation of the Ruble/U.S. Dollar futures market can be divided into three subperiods according to the participants and the trading volume in the market. Therefore, Eq. (6) is estimated once more, allowing the parameters to be different for each subperiod. Panel B of Table III presents the estimates of the following regression equation:

$$s_{t+n} - f_t^{(n)} = \sum_{i=1}^{3} d_{it}(\beta_{0i} + \beta_{1i}{}^{*}n) + \sum_{i=1}^{3} d_{it}(\beta_{2i} + \beta_{3i}{}^{*}n)^{*}f_t^{(n)}$$
$$+ \sum_{i=1}^{3} d_{it}(\beta_{4i} + \beta_{5i}{}^{*}n)^{*}(f_t^{(n)} - s_t) + \varepsilon_{t+n}^{(n)}, \quad i = 1,2,3 \qquad (7)$$

where d_{it} is a dummy that is 1 in subperiod i, and 0 otherwise.

Once again, the results show that the risk premia are significantly different from zero and highly time-varying. This is also clear from Figure 2, which shows the predicted risk premia from Eq. (7) against time. Note here that for each day, several risk premia are plotted corresponding to the different futures contracts. The difference between the risk premia of the different contracts is especially clear in the third subperiod.

It is also clear from the estimates of eq. (7) that the coefficients are, indeed, different for the different subperiods. The results are especially apparent for the third subperiod, where the parameter estimates become much smaller compared with the second subperiod and to some extent also the first subperiod. The significant effect of the spread variables on the risk premia in the first two subperiods is no longer present in the third subperiod.

The results of the multiple regression in Table III are comparable to the results of the simple regressions in Table II, although there are some apparent differences as well. For instance, the slope parameters for the spread in Table III are comparable to those of Table II. The maturity effect that was present for the slope parameters of the spread in Table II does not appear in Table III; however, since the parameter for $(f_t^{(n)} - s_t)^{*}n$ is usually insignificant and even positive. This difference between Table II and III is most likely due to the fact that part of the negative effect of the spread with an increase in maturity is already captured by $f_t^{(n)*}n$.

As with the monthly results, the estimated parameters for the daily regressions are also comparable with the results for well-developed forward and futures markets, as found by, e.g., Fama (1984) and Cooper (1993). For instance, the coefficient for $(f_t^{(n)} - s_t)$ has the same order of magnitude as found by those two authors, although Fama often finds coefficients of the opposite sign.

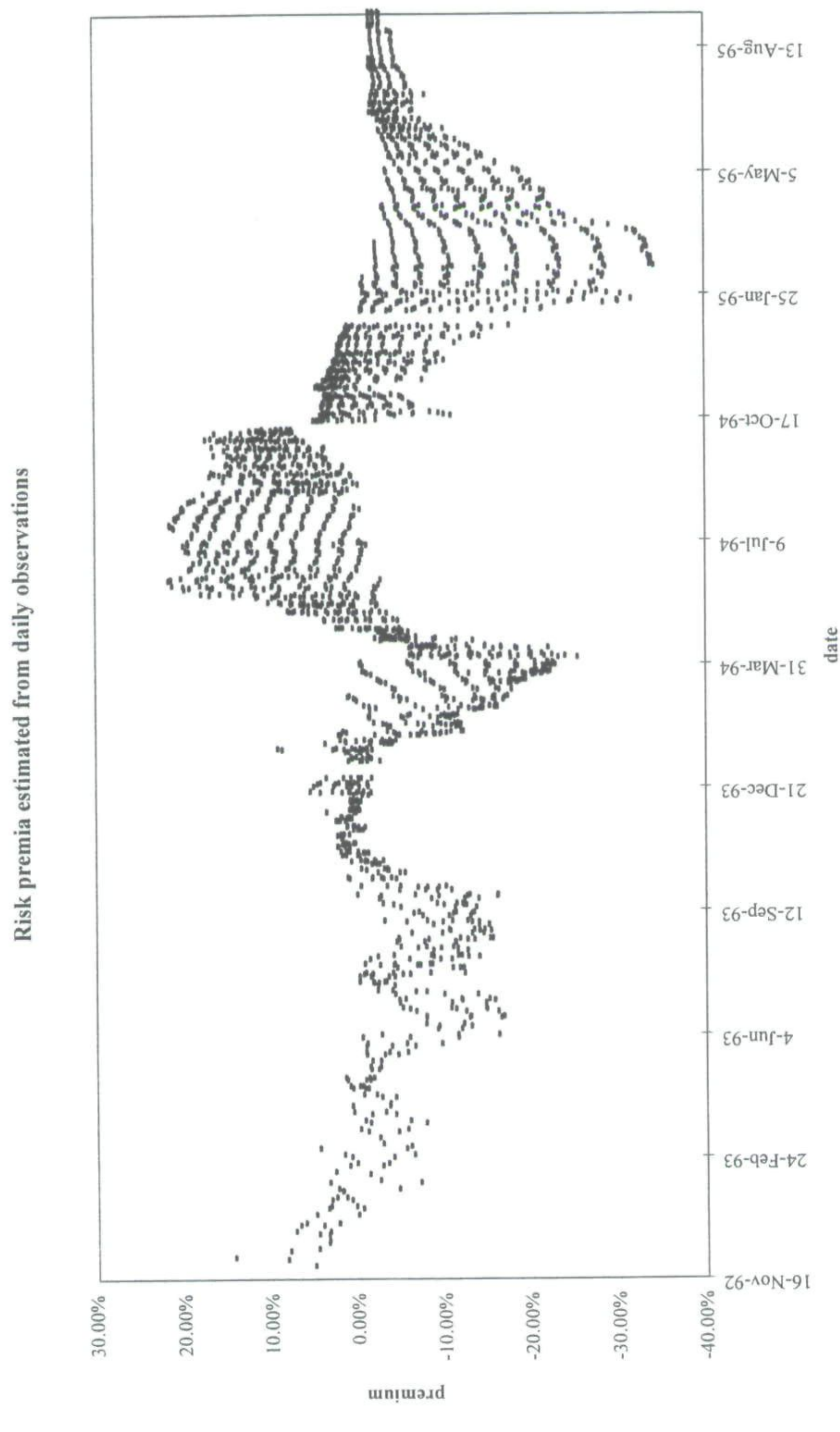

FIGURE 2
Estimated risk premia from daily regression analysis.

TABLE IV

Summary Statistics of One-Week Spot and Futures Returns

	$r(S)_t$	$r(F1)_t$	$r(F2)_t$	$r(F3)_t$
		Total Sample, 11/92–10/95		
Mean	1.6	−0.6	−0.7	−0.3
Std. dev.	5.1	4.9	5.0	4.0
Minimum	−24.8	−14.1	−20.5	−10.2
Maximum	28.6	25.8	19.3	14.0
N	145	145	124	90
		First Subperiod, 11/92–10/93		
Mean	2.2	−0.7	−1.3	—
Std. dev.	6.4	7.6	8.7	—
Minimum	−24.8	−14.1	−20.5	—
Maximum	18.0	25.8	19.3	—
N	44	44	23	—
		Second Subperiod, 10/93–3/94		
Mean	1.5	−1.0	−0.4	1.3
Std. dev.	3.8	4.7	5.3	5.6
Minimum	−4.1	−9.9	−9.3	−5.2
Maximum	18.5	12.3	13.0	14.0
N	26	26	26	15
		Third Subperiod, 3/94–10/95		
Mean	1.2	−0.4	−0.6	−0.6
Std. dev.	4.6	2.5	3.0	3.6
Minimum	−21.8	−5.7	−7.7	−10.2
Maximum	28.6	8.7	10.8	10.3
N	75	75	75	75

$r(.)_t$ means weekly return, *S* indicates spot price, *F1* indicates nearest-to-maturity futures price, *F2* indicates second nearest-to-maturity futures price, and *F3* indicates third nearest-to-maturity futures price. Maximum, minimum, mean, and standard deviation are in percentages per week. All returns are based on Wednesday closing prices.

ANALYSIS OF WEEKLY FUTURES RETURNS AND RELATION WITH OTHER FUTURES MARKETS

As outlined, expected futures returns are determined by risk premia. To gain some further insights into the risk premia in the Ruble/U.S. Dollar futures market, weekly returns on the Ruble/U.S. Dollar futures are compared now with returns in the Ruble/U.S. Dollar spot market as well as with returns in other futures markets.

Weekly Returns in the Ruble/U.S. Dollar Futures and Spot Market

Table IV shows some summary statistics for one-week returns on the Ruble/U.S. Dollar spot market and on the three nearest-to-maturity fu-

TABLE V

Correlations Between One-Week Spot and Futures Returns

	$r(S)_t$	$r(F1)_t$	$r(F2)_t$	$r(F3)_t$
		Total Sample, 11/92–10/95		
$r(S)_t$	1.00	0.30	0.34	0.39
$r(F1)_t$		1.00	0.94	0.89
$r(F2)_t$			1.00	0.96
$r(F3)_t$				1.00
		First Subperiod, 11/92–10/93		
$r(S)_t$	1.00	0.28	0.48	—
$r(F1)_t$		1.00	0.95	—
$r(F2)_t$			1.00	—
$r(F3)_t$				—
		Second Subperiod, 10/92–3/94		
$r(S)_t$	1.00	0.31	0.25	0.27
$r(F1)_t$		1.00	0.95	0.94
$r(F2)_t$			1.00	0.97
$r(F3)_t$				1.00
		Third Subperiod, 3/94–10/95		
$r(S)_t$	1.00	0.42	0.41	0.43
$r(F1)_t$		1.00	0.95	0.89
$r(F2)_t$			1.00	0.95
$r(F3)_t$				1.00

$r(.)_t$ means weekly return, S indicates spot price, $F1$ indicates nearest-to-maturity futures price, $F2$ indicates second nearest-to-maturity futures price, and $F3$ indicates third nearest-to-maturity futures price. All returns are based on Wednesday closing prices.

tures contracts. Table V shows the correlations between those returns. The first two things to note from Table IV is that the mean returns on the spot and the futures contracts usually have opposite signs, and that the absolute value of the futures returns is usually much smaller than of the spot returns. The large positive returns in the spot market are caused by the high interest rates that can be earned on the Ruble. For instance, it is not uncommon to observe interest rates between 100% and 500% per year on a Ruble deposit. On the other hand, except for the third subperiod, the variability of the futures returns is comparable with the variability of the spot returns, as measured by the standard deviations and the difference between the minimum and maximum returns. Also, the variability increases with the maturity of the contract, indicating the increasing importance of basis risk (i.e., interest rate risk) for the longer maturity contracts.[9]

[9]Note that for the whole sample it seems as if the variability of the longest-to-maturity contracts is lower than the variability of the shorter-maturity contracts. However, this is caused by the fact that

Another distinctive pattern in Table IV is the decrease in the variability of the futures returns over the three subperiods. Although the spot returns in the third subperiod are less volatile than in the first subperiod, there is an increase in volatility relative to the (short) second subperiod. The variability of the futures returns in the third subperiod is only about one third of the variability in the first subperiod and has become even smaller than the variability in the spot market. This suggests that the Ruble/U.S. Dollar futures is developing towards a more stable and mature market over time.

Table V shows the correlations between the spot and futures returns for the sample period as a whole as well as for the three subperiods. The correlations between the three futures contracts show that the returns on different futures contracts are consistently high during all subperiods. The correlation of the futures returns with the spot returns seems to be rather low, although it increases over the three subperiods. For instance, in the first subperiod the returns on the short maturity contracts have a correlation with the spot returns of only 0.28. This increased to 0.42 in the third subperiod. Together with the decrease in the variability of the futures returns, this increase in correlations indicates that basis risk is less important in the third subperiod than it was before, since it is the presence of basis risk that diminishes the correlation between the spot and the futures market, and that makes the futures market more volatile.

The decrease in basis risk is also consistent with the results in Table III which shows that the spread between the futures and spot price (the basis) has a significant effect on the risk premia in the first two subperiods, but not in the third subperiod. Thus, in the last subperiod there appears to be less (co)movement of the spread, or basis, in relation to the risk premia than in the first two subperiods.

Summarizing, looking at the variability, the results for the weekly futures and spot returns suggest that the Ruble/U.S. Dollar futures market is becoming more stable and mature over time. The correlations between the futures returns for different maturities are very high in all subperiods. On the other hand, the correlations between the futures and spot returns are rather low, although they increase over time. This increase is probably caused by the presence of basis risk which is less important in the third subperiod than in the first two subperiods.

Relationship to Other Futures Markets

The final part of this analysis investigates the relationship between weekly returns on the Ruble/U.S. Dollar futures and returns on three Western

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in the first subperiod no data are available for the longest-to-maturity contracts, while this appears to be the most volatile period.

currency futures: Deutsche Mark, British Pound, and Japanese Yen futures, all relative to the U.S. Dollar. If there are common factors in the risk premia for the Ruble/U.S. Dollar futures and the three Western currency futures, then one can expect a certain correlation between the Ruble futures and the Western currency futures. However, as hypothesized, a zero correlation is expected between the futures returns because the Ruble/U.S. Dollar futures market is essentially a domestic market, segmented from the Western currency futures markets.

Table VI provides summary statistics for weekly returns on the Ruble and the three Western currencies, as well as for the nearest-to-maturity futures contracts on these currencies, again for the whole sample period and for the three subperiods. Unlike the returns on the Ruble and the Ruble futures, the average returns on the Western currencies and currency futures are essentially zero for all subperiods. Also, for the Western currencies and futures, the variability of the returns is approximately the same for all three subperiods and much smaller than for the Ruble. However, during the last subperiod the Ruble futures returns become more comparable to the Western currency futures returns in terms of the descriptive statistics presented in Table VI. For the Ruble returns themselves this is not the case. This indicates once more the importance of the interest differential in the Ruble returns.

Although in the third subperiod the Ruble/U.S. Dollar futures are more like the Western currencies according to the statistics in Table VI, the correlations between the returns are very low, as can be seen in Table VII. The correlations between the Ruble (futures) and the Western currency (futures) vary between -0.125 and $+0.119$. As a means of comparison: the correlations between the weekly returns of the Western currencies (futures) are in the order of magnitude of 0.50. Also, there does not seem to be any pattern in the correlations over the three subperiods. This suggests that the Russian market for Ruble futures is indeed segmented from the established markets for Deutsche Mark, British Pound, and Japanese Yen futures in the U.S.

Similar conclusions can be derived from Table VIII, which shows regression results from regressing the Ruble and Ruble futures returns on Western currencies and futures returns, respectively. Table VIII does not show any significant relationship, except when the Ruble futures returns are regressed on all futures returns simultaneously, but even then, the R^2 is very low. Thus, there appears to be no relationship between the market for Rubles and Ruble futures on the one hand and the Western currencies and currency futures on the other. This confirms the hypothesis that the market for Rubles (futures) is segmented from the Western

TABLE VI

Comparison of Weekly Returns of Rubles and Other Currencies

	Currencies				*Futures*			
	Ruble	*DM*	*BP*	*JY*	*Ruble*	*DM*	*BP*	*JY*
			Total Sample, 11/92–10/95					
Mean	1.6	0.0	0.0	0.0	−0.6	−0.1	0.0	−0.1
Std. dev.	5.1	1.4	1.3	1.5	4.9	1.4	1.3	1.6
Minimum	−24.8	−4.6	−3.1	−5.7	−14.1	−4.7	−3.1	−5.6
Maximum	28.6	5.0	5.2	6.5	25.8	5.1	5.3	6.6
N	145	145	145	145	145	145	145	145
			First Subperiod, 11/92–10/93					
Mean	2.2	0.0	0.0	−0.4	−0.7	−0.1	0.0	−0.4
Std. dev.	6.4	1.5	1.7	1.3	7.6	1.5	1.7	1.3
Minimum	−24.8	−2.7	−3.1	−2.8	−14.1	−2.9	−3.1	−2.8
Maximum	18.0	3.7	5.2	2.9	25.8	3.7	5.3	3.0
N	44	44	44	44	44	44	44	44
			Second Subperiod, 10/93–3/94					
Mean	1.5	0.1	0.1	−0.1	−1.0	0.1	0.0	−0.1
Std. dev.	3.8	1.1	1.0	1.5	4.7	1.1	1.0	1.5
Minimum	−4.1	−2.1	−1.3	−4.3	−9.9	−2.1	−1.4	−4.4
Maximum	18.5	2.4	2.4	1.6	12.3	2.3	2.4	1.7
N	26	26	26	26	26	26	26	26
			Third Subperiod, 3/94–10/95					
Mean	1.2	−0.2	−0.1	−0.1	−0.4	−0.2	−0.1	0.0
Std. dev.	4.6	1.5	1.0	1.7	2.5	1.5	1.1	1.8
Minimum	−21.8	−4.6	−2.5	−5.7	−5.7	−4.7	−2.5	−5.6
Maximum	28.6	5.0	3.6	6.5	8.7	5.1	3.7	6.6
N	75	75	75	75	75	75	75	75

The table contains summary statistics for weekly returns on the Ruble, Deutsche Mark (DM), British Pound (BP), and Japanese Yen (JY), as well as for returns on futures on those currencies. Maximum-minimum, mean, and standard deviation are in percentages. All returns are based on Wednesday closing prices. Futures returns are always for the nearest-to-maturity futures contracts.

currency (futures) markets and that there are no common factors in the risk premia in these markets. Although not reported here, these results also hold for the three subperiods.

As noted, there appears to be a difference in the returns on the Ruble futures and the Ruble itself because of the behavior of the basis. Especially in the first subperiods this causes the correlation between the Ruble and Ruble futures returns to be rather low. In Table IX daily observations of the annualized basis in the Ruble futures market are compared with the basis in the three Western currency futures markets. The annualized basis is defined as $365^*(f_t^{(n)} - s_t)/n$, where the maturity n is measured in days. Clearly, the basis of the Ruble futures is much larger (in absolute

TABLE VII

Correlations of Weekly Returns of Rubles (Futures) and Other Currencies (Futures)

	Currencies		
	DM	*BP*	*JY*
		Total Sample	
11/92–10/95	0.006	0.093	0.027
		Subperiods	
11/92–10/93	−0.093	0.045	0.001
10/93–3/94	0.084	0.103	0.010
3/94–10/95	0.058	0.150	0.064
	Futures		
	DM	*BP*	*JY*
		Total Sample	
11/92–10/95	−0.045	0.100	−0.014
		Subperiods	
11/92–10/93	−0.125	0.119	−0.088
10/93–3/94	0.080	0.031	0.092
3/94–10/95	0.021	0.109	0.011

The first part of the table contains correlations between weekly returns on the Ruble with weekly returns on the Deutsche Mark (DM), British Pound (BP), and Japanese Yen (JY). The second part of the table contains these correlations for the Ruble futures with futures on the other currencies as well. All returns are based on Wednesday closing prices. Futures returns are always for the nearest-to-maturity futures contracts.

terms) and much more variable than the basis of the Western currency futures, which reflects the fact that the implied interest differential is not only large, but also very volatile.[10] At the same time, however, both the magnitude and the variability of the annualized basis seem to decline over the three subperiods. This indicates once more the progression toward a more stable market and the diminishing importance of the basis on the futures returns.

Table X reports the correlation coefficients between the basis of the four currency futures. Because the bases of all currency futures contain a clear time trend, causing spurious correlations between them, the reported correlations in Table X are obtained after detrending every basis. While there are nontrivial correlations between the bases of the three

[10]The extreme negative basis in the third subperiod of − 142.6% corresponds to the sharp depreciation on October 11, 1994, which is known as *Black Tuesday*. As shown in Figure 1 as well, there was a sharp increase in the exchange rate that day, followed by a sharp decrease, which was followed only to a minor extent by the futures market.

TABLE VIII

Regression of Ruble (Futures) Returns on Other Currency (Futures) Returns

β_0	$\beta_1(DM)$	$\beta_2(BP)$	$\beta_3(JY)$	R^2
Currencies $r(S_{Ruble})_t = \beta_0 + \beta_1 r(S_{DM})_t + \beta_2 r(S_{BP})_t + \beta_3 r(S_{JY})_t + \varepsilon_t$				
1.6%**	0.02			0.00
(0.4)	(0.30)			
1.6%**		0.37		0.01
(0.4)		(0.33)		
1.6%**			0.09	0.00
(0.4)			(0.28)	
1.6%**	−0.57	0.78	0.17	0.02
(0.4)	(0.48)	(0.49)	(0.33)	
Futures $r(F_{Ruble})_t = \beta_0 + \beta_1 r(F_{DM})_t + \beta_2 r(F_{BP})_t + \beta_3 r(F_{JY})_t + \varepsilon_t$				
β_0	$\beta_1(DM)$	$\beta_2(BP)$	$\beta_3(JY)$	R^2
−0.6%	−0.16			0.00
(0.4)	(0.29)			
−0.6%		0.38		0.01
(0.4)		(0.32)		
−0.6%			−0.04	0.00
(0.4)			(0.26)	
−0.6%	−0.93*	1.10[a]	0.11	0.04
(0.4)	(0.46)	(0.46)	(0.31)	

The table contains OLS-estimates for the regressions specified in the table, $r()_t$ indicates a weekly return, based on Wednesday closing prices. *S* indicates a currency, while *F* indicates the nearest-to-maturity futures contract. A total of 145 observations is used for each regression. Standard deviations are in parentheses.
[a]Indicates that the parameter is significantly different from zero at the 5% confidence level.

Western currency futures, as might be expected, the correlation of the Ruble/U.S. Dollar futures basis with the Western currency basises is essentially zero. This is the case for the whole sample as well as for the three subperiods. The fact that these correlations are so low may be a bit surprising, since each basis is partly determined by the interest rates that can be earned on the U.S. Dollar. Recall, however, that in case of the Ruble/U.S. Dollar futures, the relevant interest rate is the interest rate that can be earned on Dollar deposits in Russia, i.e., a Eurodollar interest rate. Also, in Russia, credits for maturities longer than three months are usually not available, meaning that the basis is only an implied interest differential rather than an actual interest differential. Therefore, the results reported here for the annualized bases also suggest that the market

TABLE IX

Summary Statistics for the Annualized Basis of Ruble and Other Currency Futures

	Ruble	*DM*	*BP*	*JY*
		Total Sample, 11/92–10/95		
Mean	85.9	0.0	0.9	−3.2
Std. dev.	44.7	1.7	0.8	1.7
Minimum	−142.6	−4.9	−6.7	−24.3
Maximum	340.8	7.3	6.4	3.2
N	2923	2923	2923	2923
		First Subperiod, 11/92–10/93		
Mean	168.7	4.0	2.7	−0.2
Std. dev.	52.0	1.0	0.9	0.6
Minimum	0.0	−3.5	−4.5	−2.7
Maximum	340.8	7.3	5.4	3.2
N	216	216	216	216
		Second Subperiod, 10/93–3/94		
Mean	123.2	2.3	1.7	−1.4
Std. dev.	36.8	0.7	0.6	0.7
Minimum	19.0	0.0	0.2	−8.1
Maximum	215.2	5.7	4.7	1.1
N	383	383	383	383
		Third Subperiod, 3/94–10/95		
Mean	72.0	−0.7	0.6	−3.8
Std. dev.	31.3	0.9	0.4	1.4
Minimum	−142.6	−4.9	−6.7	−24.3
Maximum	175.8	6.6	6.4	2.2
N	2324	2324	2324	2324

The table contains summary statistics for the annualized basis. $365^*(f_t^{(n)} - s_t)/n$, of Ruble futures and Deutsche Mark, British Pound, and Japanese Yen futures. Statistics are based on daily observations. Mean, standard deviation, minimum, and maximum are presented in persentages. Futures contracts with less than one month to maturity are excluded.

for Ruble futures is segmented from the market for Western currency futures.

SUMMARY AND CONCLUSIONS

This article analyzes risk premia in futures contracts on the Ruble/U.S. Dollar exchange rates at the Moscow Commodity Exchange from November, 1992 until October, 1995. Using both monthly and daily observations the hypothesis that the futures price is an unbiased estimate of the future spot price is rejected. The difference between the current futures price and the future spot price appears to be related to the current spot/futures price, to the spread between the current futures and spot price (the basis), and to the time to maturity of the futures contract. This implies time-

TABLE X

Correlations of the Annualized Basis of Ruble and Other Currency Futures

	Ruble	*DM*	*BP*	*JY*
		Total Sample, 11/92–10/95		
Ruble	1.00	0.04	0.02	−0.06
DM		1.00	0.79	0.31
BP			1.00	0.30
JY				1.00
		First Subperiod, 10/92–10/93		
Ruble	1.00	−0.04	−0.02	−0.03
DM		1.00	0.70	0.26
BP			1.00	0.12
JY				1.00
		Second Subperiod, 10/93–3/94		
Ruble	1.00	−0.19	−0.09	−0.09
DM		1.00	0.71	0.18
BP			1.00	0.02
JY				1.00
		Third Subperiod, 3/94–10/95		
Ruble	1.00	−0.07	−0.14	−0.10
DM		1.00	0.62	0.40
BP			1.00	0.49
JY				1.00

The table contains correlations between the annualized basises, $365^*(f_t^{(n)} - s_t)/n$, of Ruble and Deutsche Mark, British Pound, and Japanese Yen futures. The correlations are based on daily observations. Futures contracts with less than 1 month to maturity are excluded.

varying risk premia, which are often both in economic and statistical terms significantly different from zero.

It proves useful to divide the sample period into three subperiods according to the nature of the participants and the trading volume in the market. The returns in both the spot and the futures market have become more stable over the three subperiods, indicating that the futures market is becoming more stable and mature. The correlations between the returns on the different futures contracts are consistently high over time. At the same time, the correlations between the futures returns and the spot returns are rather low, but increasing over time. This fact, combined with the fact that the decrease in variability in the futures market is less than the decrease in the spot market, suggests that basis risk is important relative to spot price risk in the futures market, but its importance is decreasing. It also suggests that the Ruble/U.S. Dollar futures market may not have been very attractive for foreign investors to hedge their Ruble/U.S. Dollar exchange risk, because of the rather high variability in the early periods and because of the weak relationship between the spot and futures market.

The risk premia also behave quite differently in the three subperiods. Also, the effect of the spread, which is essentially an interest differential, is highly significant, except in the third subperiod. This also indicates the decreasing importance of basis risk relative to spot price risk.

Judged by the estimated coefficients, the results for the Ruble/U.S. Dollar futures market are comparable to the results of similar studies on well-developed forward and futures markets. The major differences between the new Ruble/U.S. Dollar futures market and the more established markets are that the significance and the explanatory power of the variables for the risk premia are much higher in the Ruble/U.S. Dollar futures market, and that the variability of the risk premia themselves is much higher for this new market. Finally, the Ruble futures market is analyzed to determine its performance relative to the market for Deutsche Mark, British Pound, and Japanese Yen futures. Although in the last subperiod the behavior of the returns on Ruble futures is similar to the behavior of the Western currency futures returns in terms of simple descriptive statistics, there is no relationship between the Ruble futures returns and the Western currency futures returns whatsoever. This suggests that there are no common factors in the risk premia in these markets and that the Ruble futures market is segmented from the Western currency futures markets. The behavior of the basis of the Ruble futures, which seems to become more stable over time, also suggests that there is no consistent relationship between the Ruble futures market and the Western currency futures markets.

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