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Alexey Ponomarenko, Alexandra Solovyeva  
and Elena Vasilieva

Financial dollarization in Russia:  
causes and consequences



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Alexey Ponomarenko, Alexandra Solovyeva and Elena Vasilieva\*

## Financial dollarization in Russia: causes and consequences

### Abstract

We review some aspects of financial dollarization in Russia, applying the main relevant theories to analyze the dynamics of several dollarization indicators. An econometric model of the short run dynamics of deposit and loan dollarization is estimated for the last decade. We find that ruble appreciation was the main driver of the de-dollarization that occurred then and of the later episode of renewed dollarization. We estimate the overall (and sectoral) currency mismatches of the Russian economy. The results show a gradual improvement of the net foreign currency position of the public sector, where we have seen significant accumulation of international reserves by the Bank of Russia and repayment of government debt. Evidence is also presented for the significant currency risk vulnerability of the nonbanking private sector. Several existing empirical studies are examined in order to assess the growth losses of the Russian economy following the crisis of 2008, which was linked with the financial dollarization.

Keywords: Financial dollarization, currency mismatch, balance sheet effects, Russia.

JEL classification: E44, F34, G32.

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\* Research and information department, Bank of Russia. E-mail: paa11@cbr.ru (A. Ponomarenko), sas8@cbr.ru (A. Solovyeva), vea2@cbr.ru (E. Vasilieva). The views expressed in this paper are those of authors and do not necessarily represent the position of the Bank of Russia.

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Alexey Ponomarenko, Alexandra Solovyeva and Elena Vasilieva

## Financial dollarization in Russia: causes and consequences

### Tiivistelmä

Tutkimuksessa tarkastellaan rahoitusvarallisuuden dollarisaatiota Venäjällä monien eri indikaattorien avulla. Lainojen ja talletusten dollarisaation vaihteluita viime vuosikymmenen aikana selitetään ekonometrisellä mallilla. Tulokset osoittavat, että ruplan kurssivaihtelut ovat dollarisaation vaihtelujen merkittävin yksittäinen selittäjä. Lisäksi tutkimuksessa tarkastellaan sektoreittain ulkomaan valuutan määräisten varojen ja velkojen suhdetta (currency mismatch). Tutkimuksessa havaitaan, että julkisen sektorin tila on parantunut merkittävästi keskuspankin valuuttavarannon kasvun ja ulkomaisen julkisen velan supistumisen ansiosta. Yrityssektorilla taas ulkomaisten velkojen kasvu on johtanut valuuttakurssiriskin kasvuun. Lopuksi tutkimuksessa arvioidaan dollarisaation osuutta vuoden 2008 talouskriisissä.

Asiasanat: dollarisaatio, Venäjä, tasevaikutukset, currency mismatch

JEL: E44, F34, G32

## Introduction

Currency substitution has always been an important feature of the Russian economy. The hyperinflation that occurred in the early 1990s and the major depreciation events (most importantly, the currency crisis of 1998) increased the demand for reserve currency for holding savings. In subsequent years, however, ruble appreciation has led to extensive de-dollarization, only to be followed by a shift into foreign currency assets in late 2008. Alongside these developments, we have seen certain other aspects of financial dollarization. In a situation of rapid economic growth, an under-developed banking system, and tightly managed exchange rates; excessive reliance on foreign money markets has resulted in the creation of an abundance of foreign currency-linked liabilities.

Analysis of dollarization processes is an important element of the central bank's research agenda because overall economic performance as well as the implementation of monetary policy may be substantially impacted by changes in agents' currency preferences. Dollarization of the economy has a strong influence on the stability of a banking system that faces liquidity and solvency risks as external debt is being accumulated by different sectors of the economy while there is a demand for the domestic currency. The analysis of dollarization is also crucial for the conduct of monetary policy since dollarization hinders the central bank's efforts to act as lender of last resort and complicates its liquidity management and thus impedes the achievement of the ultimate goals of monetary policy, particularly during sudden stop episodes. Dollarized economies are highly exposed to the risks of currency and financial crises that threaten financial stability and disturb the macroeconomic balance. Consequently, the problem of financial dollarization is closely related to the issues of exchange rate policy and financial stability.

The aim of this paper is to analyze the drivers of these processes and review the possible consequences. The paper is structured as follows. *Section 1* provides a general description of the dynamics of certain dollarization indicators for Russia. In *Section 2* some econometric models of the short run dynamics of deposit and loan dollarization are presented. In *Section 3* we conduct a balance-sheet analysis and estimate currency mismatches for different sectors of the Russian economy. In *Section 4* we examine how dollarization might have affected Russian economic performance in view of the recent financial crisis, and *Section 5* concludes.

# 1 The evolution of financial dollarization in Russia

Dollarization<sup>1</sup> is peculiar to many emerging markets and to a number of transition economies where foreign currency substitutes for the domestic currency as a store of value, unit of account and means of payment. In the 1990s, a many restrictions on transactions on foreign exchange market were lifted in Russia. At the same time, the country had been going through a prolonged period of macroeconomic instability against a backdrop of sharp devaluations of the domestic currency and galloping inflation, which dampened activity in all sectors of the economy. In conditions of a dramatic drop in ruble purchasing power, the role of foreign currency (mainly the USD) had grown considerably and had since remained strong. The last decade was marked by unstable dynamics of the dollarization of the Russian economy, including periods of both accelerated growth and easing demand for foreign currency. We will review the different aspects of financial dollarization in more detail in this section.

**Deposit dollarization.** We use the ratios of foreign currency deposits to total deposits in the banking system and to broad money as indicators of the degree of dollarization<sup>2</sup>. It should be noted that after the introduction of euro, economic agents began to hold their foreign currency assets (cash and non-cash) in two currencies. At the same time, despite the prevalence of the US dollar, the share of euro denominated assets was gradually rising. Thereby the overall level of deposit dollarization (as well as the dynamics of foreign currency in circulation) was affected not only by the ruble-to-dollar exchange rate but also by ruble-to-euro rate.

As seen in Figure 1, the level of deposit dollarization in Russia was unstable (the share of foreign currency deposits in total deposits ranged from 43 to 12.8%). Note that there were two dramatic spikes in the level of deposit dollarization, both associated with crisis episodes, in 1998 and 2008-2009.

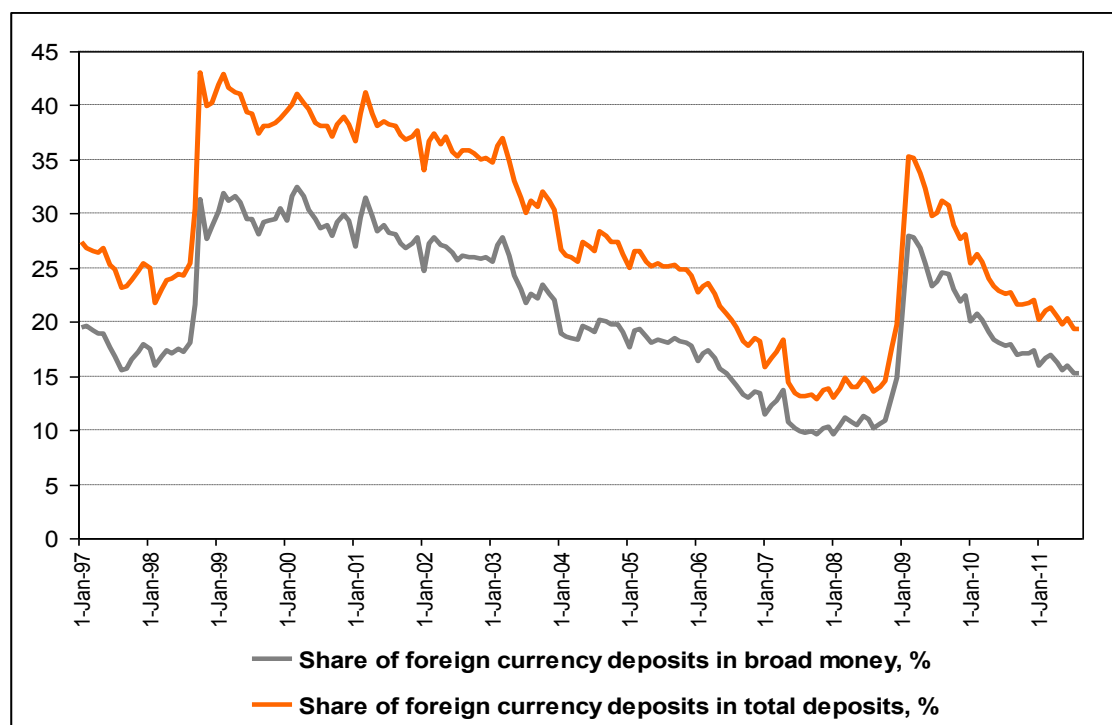
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<sup>1</sup> Traditionally the term “dollarization” implies replacement of domestic currency by US dollars as the medium of exchange, store of value and unit of account. After formation of European Monetary System and introduction of the single currency (euro), the new term “euroization” (completely analogous to dollarization) came into use. Euroization was quite typical for a number of transition economies, including Russia. We use the term “dollarization” to denote the replacement of the national currency by any foreign currency.

<sup>2</sup> Source: Banking System Survey, Monetary and Financial Statistics, Bank of Russia.



Figure 1 Deposit dollarization



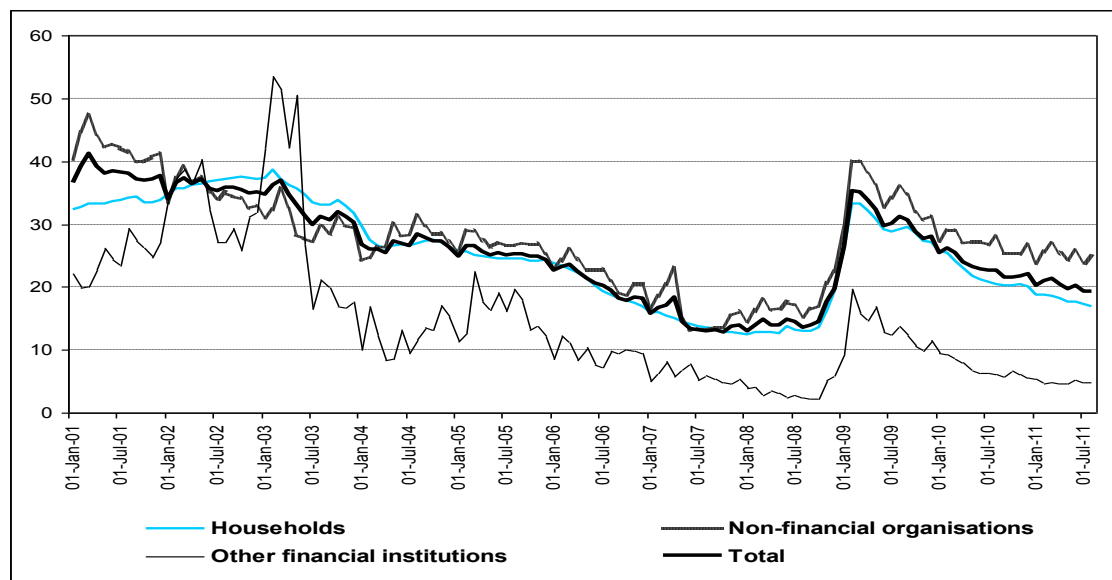
The period from 1999 to 2007 was characterized by a gradual decline in the level of deposit dollarization (especially, starting in 2003, when the ruble began to appreciate persistently). In spite of the volatile dynamics of ruble money supply and foreign currency deposits, the level of deposit dollarization had been falling persistently, from its maximum value of 40-43% at the end of 1998 to a minimum 12-13% at the start of 2008. It should be noted that, starting in mid-2007 the growth rate of foreign currency deposits began to rise and the trend towards de-dollarization stopped with the weakening of the ruble against the euro (while the ruble continued to strengthen against the US dollar).

Available statistical data enable one to analyze the dynamics of foreign currency deposits and the level of deposit dollarization for households, non-financial organizations and financial organizations separately<sup>3</sup>. The level of deposit dollarization of non-financial organizations generally was higher (Figure 2) than for households (except in 2002-2003). As opposed to these two sectors, the level of deposit dollarization for financial organizations was considerably lower (except from mid-2002 to mid-2003) but much more volatile.

<sup>3</sup> Financial institutions are useful for money accumulation and redistribution. Financial institutions include investment funds, trust, leasing and factoring companies, commodity and stock exchanges, brokerage firms operating in the stock market, insurance companies, nongovernmental pension funds, the state's Deposit Insurance Agency and the open joint-stock company RUSNANO, established via reorganization of the state corporation Russian Corporation of Nanotechnologies.

Over the last three years, the shares of households' and non-financial organizations' foreign currency deposits were approximately the same (45-50% on average) while the share of financial organizations was insignificant (1-2.5% on average).

Figure 2 Deposit dollarization by sector (share of foreign-currency deposits in total deposits,%)



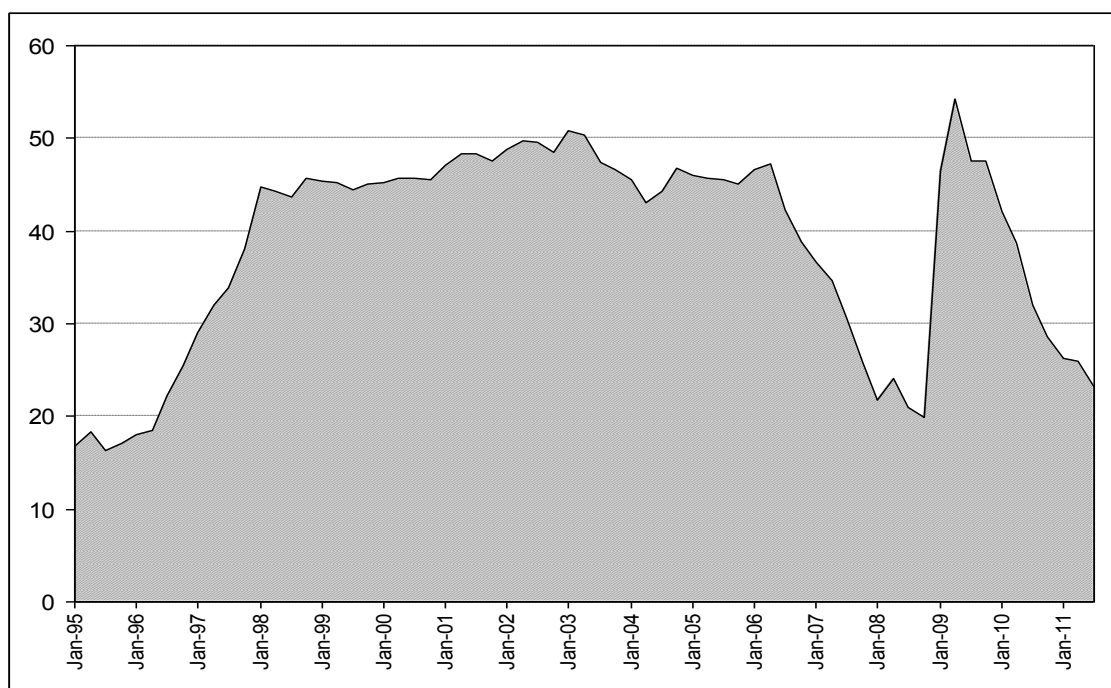
Latest world financial crisis, which had manifested itself in Russia most apparently in the second half of 2008, reversed the trend towards deposit de-dollarization. Against the background of a sharp depreciation of the domestic currency and a substantial increase in the level of overall macroeconomic uncertainty the total volume of foreign currency deposits in dollar terms more than doubled during the years 2008-2009. By the beginning of 2009, the level of deposit dollarization, measured as a share of foreign currency deposits in total deposits, was close to 33-35%. The highest level of dollarization was observed in the sector of non-financial organizations (almost 40% in early 2009).

The stabilization of the situation on foreign exchange market with the subsequent appreciation of national currency combined with gradual macroeconomic stabilization brought the level of deposit dollarization down. Households and financial organizations experienced the greatest reduction in deposit dollarization. Unlike the pre-crisis period, the level of deposit dollarization in the sector of non-financial organizations in 2009-2011 noticeably exceeded that of households. On the whole, by the middle of 2011 the level of deposit dollarization has not yet reached the pre-crisis level.

**Foreign currency in circulation.** The level of dollarization of the economy can also be characterized by the total volume of foreign cash that circulates domestically.

However, in this case one faces the problem of statistical measurement or indicator of dollarization. Our estimates of the volume of foreign cash circulating outside the banking system are based on Bank of Russia (CBR) statistics, namely the International Investment Position of the Russian Federation, Balance of Payments of the Russian Federation. According to this data the volume of foreign cash in circulation in Russia has been steadily decreasing since 2003 (Figure 3).

Figure 3 Foreign cash in circulation outside of banking system, USD bn

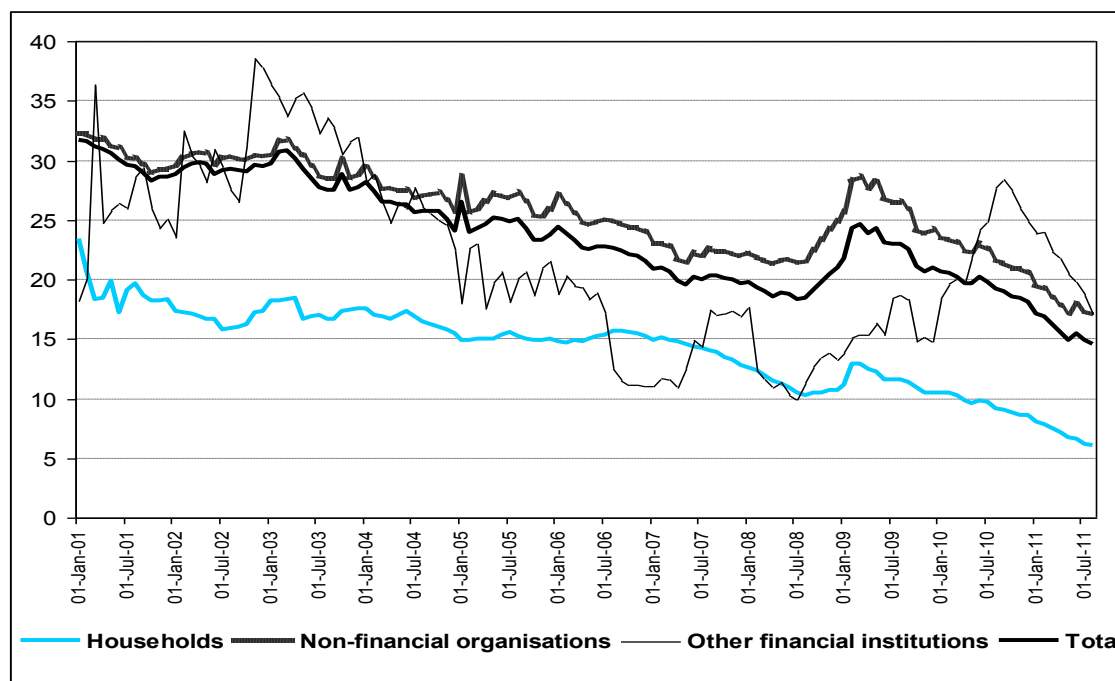


Ruble devaluation at the end of 2008 triggered unprecedented growth in households' demand for foreign cash. As a result, the total volume of foreign cash outside the banking system increased from approximately 21 billion US dollars at mid-2008 to more than 50 billion US dollars at the start of 2009. Starting in February 2009, as the foreign exchange market began to stabilize, the level of foreign cash in circulation began to fall so that by mid-2011 it had reached about 24 billion US dollars.

**Loan dollarization.** Prior to the most recent crisis, the level of loan dollarization was falling, albeit not as rapidly as was the level of deposit dollarization. Over the period from 2001 to mid-2008, the level of the former dropped from 32% to 18%, while the level of the latter dropped from 40% to 13-14%. A dramatic rise in loan dollarization occurred during the recent financial crisis, accompanied with a sharp depreciation of the domestic

currency. In the second half of 2009, the level of loan dollarization began to decline persistently and by mid-2011 it had reached 15%, which is notably below the pre-crisis level.

Figure 4 Loan dollarization (share of foreign-currency loans in total loans, %)<sup>4</sup>



Loan dollarization (in contrast to deposit dollarization) varied considerably across the sectors of the Russian economy. The share of foreign currency loans in the total volume of loans obtained by households was lowest for non-financial and financial organizations (Figure 4). The dynamics of dollarization of financial organizations' loans was the most volatile. It is noteworthy that, in the post-crisis period, dollarization of loans to financial organizations rose while it decreased in two other sectors. A steady decline in dollarization of financial organizations' loans did not begin until 2010.

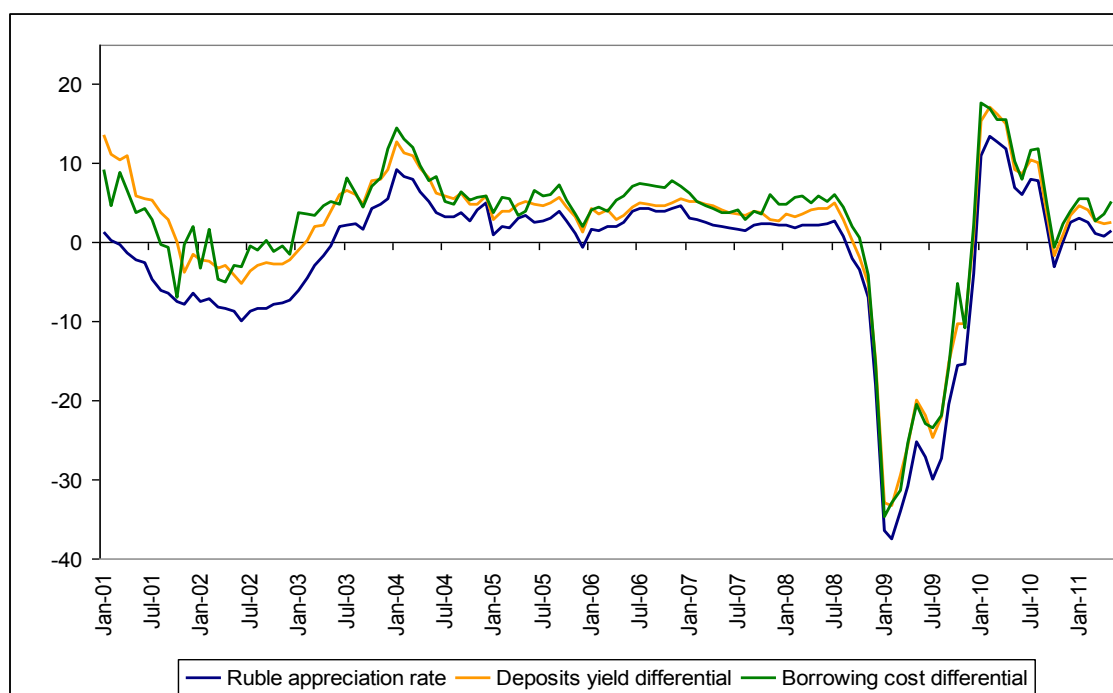
Loans to non-financial organizations accounted for the largest portion of foreign currency loans (80-95%). The share of foreign currency loans granted to households ranged from 3 to 18% (it rose dramatically in 2006-2007). Foreign currency loans to financial organizations represented only a small fraction in the total volume of foreign currency loans (1-4%).

Among the **drivers of domestic financial dollarization** the yield and borrowing cost differentials are usually regarded as the key factors (see e.g. Ize and Levy-Yeyati

<sup>4</sup> Source: Banking System Survey, Monetary and Financial Statistics, Bank of Russia.

(2005) and Levy-Yeyati (2006) for a review of the relevant theories). One obvious determinant of this indicator is the interest rate differential between deposits (loans) denominated in domestic versus foreign currency. Another is exchange rate appreciation expectations. We can estimate the interest rate differential as the difference between the ruble interest rate and the weighted average of euro and USD interest rates on deposits and loans. We can also proxy the exchange rate expectations by the realized annual ruble weighted appreciation rate against USD and euro. By summing these two we obtain a proxy for the implied deposit yield (borrowing cost) differential. Figure 5 demonstrates that the latter component mainly determined the variation of these indicators, suggesting that exchange rate fluctuations were more important for dollarization dynamics than interest rate differentials.

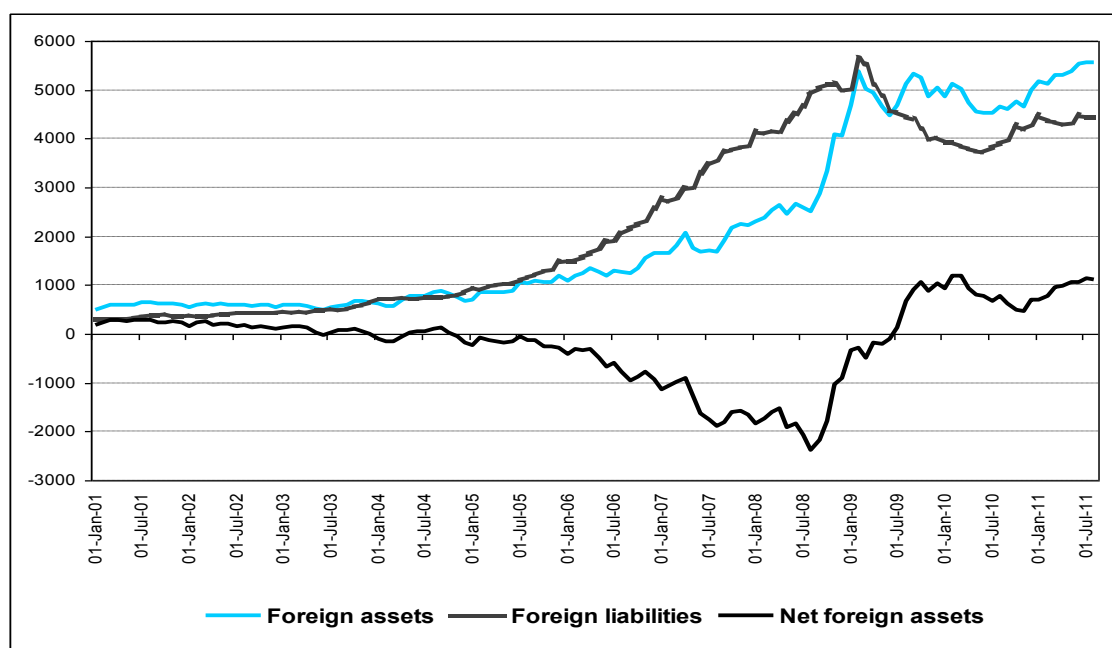
Figure 5 Implied deposit yield vs borrowing cost differentials (p.p.a) and exchange rate appreciation rate (y-o-y, %)



Motives for providing loans in foreign currency also depend on the level of development of the domestic financial markets. Rapid growth of lending by Russian banks and non-financial organizations in foreign financial markets (especially in 2005-2008) was due to better terms of borrowing abroad compared to borrowing on the domestic money market under the managed exchange rate regime. In addition, due to the underdeveloped state of the domestic money market, Russian banks were not able to satisfy an increasing demand

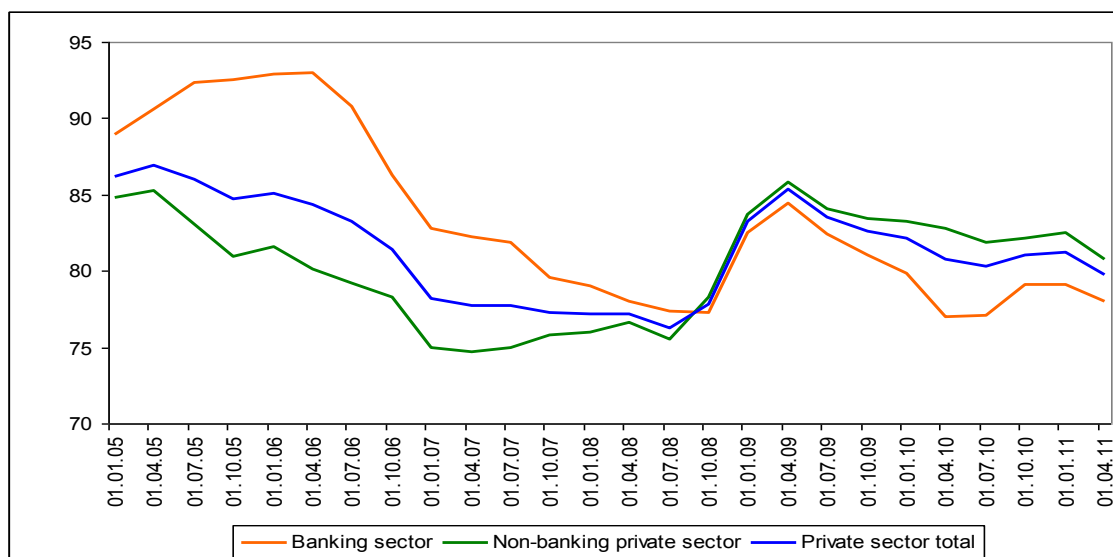
for loans from non-financial organizations. Therefore an increase in the degree of openness of the Russian economy together with enhanced dependence on international capital markets has led to the accumulation of foreign currency liabilities (Figure 6). In combination with notable dollarization of domestic liabilities, banks' currency matching behavior could be another driver of financial dollarization dynamics.

Figure 6 Net foreign assets of commercial banks (bn rubles)



The **dollarization of foreign debt** is another important aspect of financial dollarization. The reasons for the country being unable to borrow abroad in its own currency include the low level of institutional development, low credibility of monetary policy and questionable fiscal solvency (see Hausmann and Panizza (2003) for a review). All these factors could be relevant for Russia (particularly after the crisis of 1998) making it nearly impossible for the Russian private sector to borrow in rubles on the international markets in the early 2000s. The foreign debt was gradually being de-dollarized prior to the crisis of 2008 (Figure 7), immediately after which another rise in dollarization occurred. Interestingly, in the years following the crisis, the banking sector has managed to reduce its dollarized foreign debt faster than the real sector.

Figure 7 Foreign debt dollarization (share of foreign-currency debt in total debt, %)



## 2 Econometric analysis of financial dollarization

We conduct formal econometric analysis of domestic<sup>5</sup> deposit and loan dollarization to measure the impacts of different explanatory factors and analyze the short-term dynamics of dollarization. Our estimation strategy and choice of variables are closely related to a study by Neanidis and Savva (2009) that provides a comprehensive review of the modeling of financial dollarization in emerging markets. The benchmark specifications of our regressions are

$$\Delta DD_t = \alpha_1 * (1 - dum2008) * erf_t + \alpha_2 * dum2008 * erf_t + \alpha_3 * dum2005 * er\_comb_t + \alpha_4 * mbf_t + \alpha_5 * \Delta ratio_t + \alpha_6 * \Delta LD_t + \alpha_7 * ird_t + \alpha_8 * \Delta DD_{t-1} + \alpha_9 * \Delta DD_{t-2} + \alpha_{10} + \varepsilon_t \quad (1)$$

$$\Delta LD_t = \beta_1 * (1 - dum2008) * erf_t + \beta_2 * dum2008 * erf_t + \beta_3 * dum2005 * er\_comb_t + \beta_4 * mbf_t + \beta_5 * \Delta ratio_t + \beta_6 * \Delta DD_t + \beta_7 * ird_t + \beta_8 * \Delta LD_{t-1} + \beta_9 * \Delta LD_{t-2} + \beta_{10} + ut \quad (2)$$

We use changes in deposit dollarization ( $\Delta DD$ ) and in loan dollarization ( $\Delta LD$ ) as dependent variables.

<sup>5</sup> The formal econometric analysis of foreign debt dollarization is hampered by the shortness of time series available only at quarterly frequency.

The *erf* variable is the exchange rate factor<sup>6</sup>. Because data are not publicly available on the structure of foreign currency deposits and loans in Russia we used the weighted average of ruble monthly depreciation rates against the USD and euro, with weights equal to those of the bi-currency basket that was introduced as an operational target by Bank of Russia in 2005 (before 2005 the USD appreciation rate was used to construct the *erf* variable). Judging by other subsidiary indicators, the weights of the bi-currency basket seem to be an appropriate measure of currency preferences in Russia. During the estimation period the weight attached to the euro in the basket has changed from 0.1 to 0.45. We estimate the coefficient of *erf* separately before and after the crisis of 2008 (for this, we use the *dum2008* dummy variable that equals 0 before September 2008 and 1 thereafter). In this we are able to examine whether the increased flexibility of the exchange rate had any effect on dollarization. (Barajas and Morales (2003), for example, argue that a pegged exchange rate regime encourages financial dollarization). We have also added the *er\_comb* variable, which is equal to the higher appreciation rate versus the ruble for the two currencies (USD and euro) at time *t*. The inclusion of this variable enables us to capture the effects of possible switching between foreign currencies if at least one of them is appreciating against the ruble, instead of decreasing the overall share of foreign currency deposits. Assuming the adaptive nature of expectations regarding the exchange rate dynamics, we use the appreciation rate in the form of a backward-looking 6 month moving average in constructing the *er\_comb* variable. Clearly this switching effect is only relevant if the two foreign currencies are regarded as alternatives. That was hardly the case while the euro continued to gain ground as a reserve currency in Russia. We therefore introduced the dummy variable *dum2005* (equal to 0 before January 2005 and 1 thereafter<sup>7</sup>) and estimated the coefficient for the *er\_comb* variable separately for the period beginning in 2005 (the coefficient for the former part of the sample was estimated but was insignificant and hence removed from the final specification).

Another category of explanatory variables is supposed to capture banks' currency matching behavior. As in Basso et al. (2011) we use the increase in the ratio of banks' foreign liabilities to total liabilities, net of deposits ( $\Delta$  *ratio*), as an indicator of changes in

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<sup>6</sup> The changes in exchange rate were transformed so as to be proportional to the mechanical re-evaluation effect at time *t* (see Honohan (2007) for details). That is, for deposit dollarization  $erf_t = (1 - DD_{t-1}) * DD_{t-1} * (e_t / e_{t-1} - 1)$ , where *e* is the ruble/foreign currency exchange rate. The *erf* variable in the loan dollarization equation was similarly constructed.



banks' balance sheet structure. We also include changes in loan dollarization and deposit dollarization as explanatory variables in loan and deposit dollarization equations accordingly.

Other variables in the model are the monetary base factor<sup>8</sup> (*mbf*), the differential between ruble interest rate and the weighted average of euro and USD interest rates on deposits and loans (*ird*), two lagged dependent variables that prevented autocorrelation of residuals, and a constant (the variables are shown on Figure 8 and summary statistics are reported in Table 1).

Table 1 Variables used in equations (1) and (2)

<i>Variable</i>	<i>Mean</i>	<i>Std Deviation</i>	<i>Min</i>	<i>Max</i>
$\Delta$ Deposit dollarization	-0.0014	0.0156	-0.0392	0.0887
$\Delta$ Loan dollarization	-0.0013	0.0057	-0.0171	0.0198
<i>erf</i> (deposit dollarization)	0.0002	0.0039	-0.0093	0.0301
<i>erf</i> (loan dollarization)	0.0002	0.0039	-0.0082	0.0296
<i>er_comb</i>	0.0074	0.012	-0.0088	0.0687
<i>mbf</i> (deposit dollarization)	-0.0041	0.0123	-0.0514	0.0435
<i>mbf</i> (loan dollarization)	-0.0042	0.013	-0.0535	0.0417
$\Delta$ <i>ratio</i>	0.0011	0.0252	-0.0586	0.082
Deposits interest rate differential	3.36	2.45	0.488	12.3
Loans interest rate differential	3.99	2.11	0.3	10.34

We used monthly data over the period January 2001 to June 2011. The use of earlier observations is impeded by data availability. The dynamics of the financial variables in the period following the 1998 crisis are also excessively volatile and their inclusion would render some of the time series non-stationary (in our sample, stationarity is confirmed by the KPSS unit-root test reported in Table 2). We consider the sample to be quite representative, as it includes the periods of both gradual de-dollarization and the partial return of dollarization in 2008.

<sup>7</sup> This period was chosen arbitrarily and coincides with the inclusion of the euro in the exchange rate target of the CBR. The results remain robust for the alternative periods starting in 2004 and 2006.

<sup>8</sup> Similarly to the exchange rate factor variable changes in monetary base were transformed so as to be proportional to the mechanical effect coming from presumed changes the nominal value of national currency deposits. That is, for deposit dollarization  $mbf_t = (1-DD_{t-1}) * DD_{t-1} * (m_t/m_{t-1}-1)$ , where *m* is the broad monetary base. The *mbf* variable in the loan dollarization equation was similarly constructed.

We report estimates of the benchmark model, including all explanatory variables as well as the specification that includes only statistically significant ( $t$ -statistic $>1.5$ ) estimates. In order to check for robustness of estimates and to take account of the possibility of explanatory factors being endogenous relative to dollarization, we calculated both OLS and GMM<sup>9</sup> estimates. In the latter case we used 3 lags of the dependent and explanatory variables, changes in oil price and USD/ruble exchange rate appreciation as instrumental variables.

Table 2 KPSS unit root tests results

<i>Variable</i>	<i>LM-statistic</i>
$\Delta$ Deposit dollarization	0.08
$\Delta$ Loan dollarization	0.07
<i>erf</i> (deposit dollarization)	0.07
<i>erf</i> (loan dollarization)	0.07
<i>er_comb</i>	0.08
<i>mbf</i> (deposit dollarization)	0.18
<i>mbf</i> (loan dollarization)	0.16
$\Delta$ <i>ratio</i>	0.17
Deposits interest rate differential	0.29
Loans interest rate differential	0.56

Null: the variable is stationary

Critical value of test statistic: at 10%-level-0.35, at 5%-level-0.46, at 1%-level-0.74

<sup>9</sup> We used the Quadratic Spectral kernel that was shown to be optimal in Andrews (1991). The bandwidth selection is also based on Andrews (1991). This approach yields results that are relatively robust to the regression set-up.

Figure 8 Variables used in equations (1) and (2)

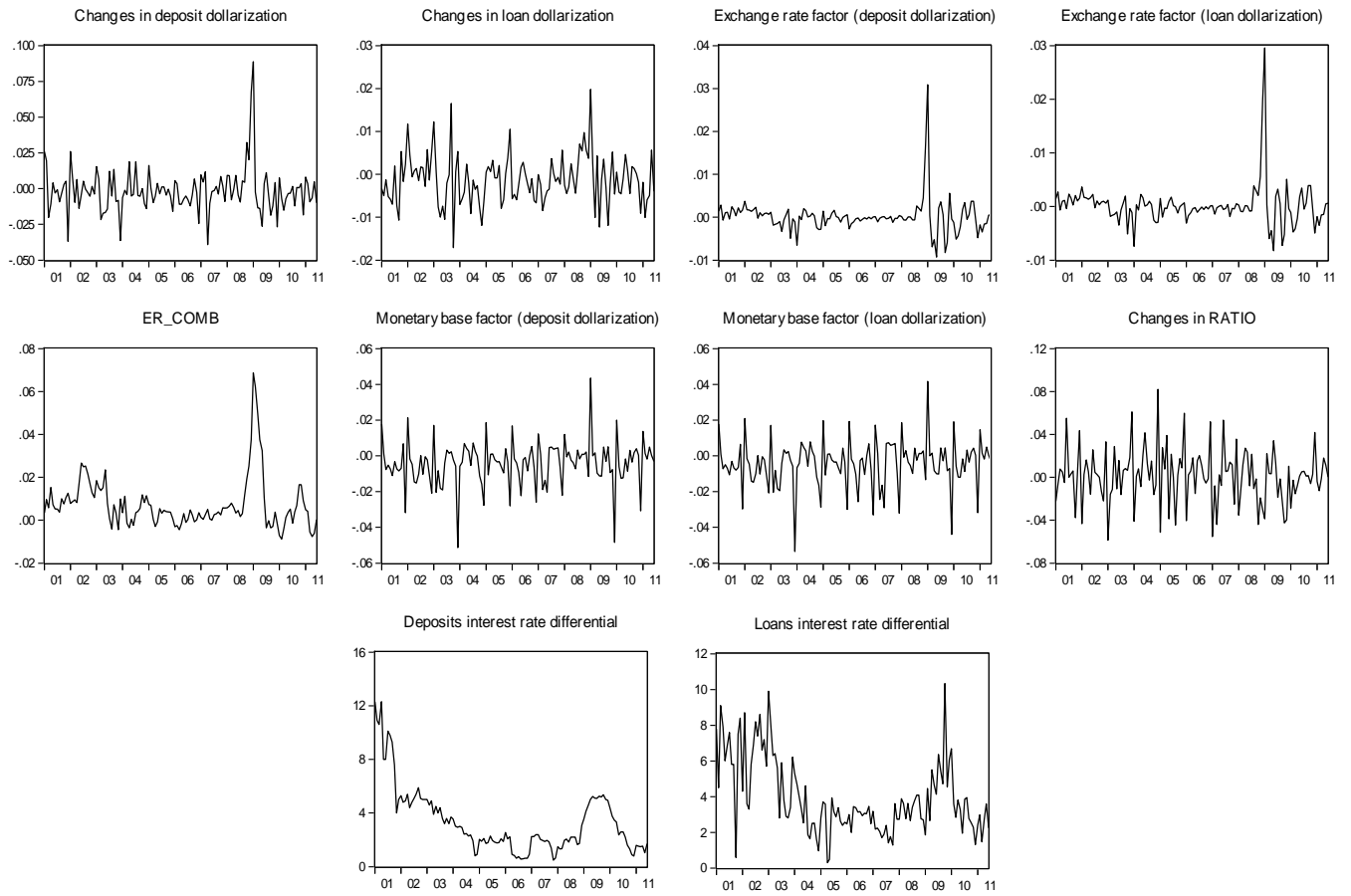


Table 3 Deposit dollarization equation (1)

Variable (t-statistics in parentheses)	Model [estimation method]		
	1 [OLS]	2 [OLS]	3 [GMM]
<i>(1-dum2008) * exchange rate factor</i>	1.37 (1.95)	1.61 (2.85)	1.56 (2.28)
<i>dum2008 * exchange rate factor</i>	2.04 (7.62)	2.14 (8.95)	1.28 (4.53)
<i>dum2005 * highest of USD/euro ap- preciation rate against ruble</i>	0.2 (2.17)	0.21 (2.28)	0.47 (3.64)
<i>monetary base factor</i>	-0.43 (-6.08)	-0.43 (-6.19)	-0.47 (-4.73)
<i>Δ foreign liabilities to total liabilities ratio</i>	-0.13 (-3.94)	-0.13 (-3.97)	-0.06 (-1.33)
<i>Δ loan dollarization</i>	0.14 (0.78)	-	-
<i>deposits interest rate differential</i>	-0.00 (-0.06)	-	-
<i>Δ deposit dollarization (-1)</i>	-0.03 (-0.48)	-0.03 (-0.56)	-0.06 (-1.15)
<i>Δ deposit dollarization (-2)</i>	-0.1 (-1.81)	-0.1 (-1.89)	-0.22 (-4.3)
<i>constant</i>	-0.00 (-0.36)	-0.00 (-0.88)	-0.00 (-3.07)
Model (2) residuals tests (p-value):	LM (1 lag)=0.07	LM (12 lags)=0.51	
Model (2) R <sup>2</sup> =0.73	ARCH-LM (1 lag)=0.47	ARCH-LM (12 lags)=0.95	

Deposit dollarization increases (more than the mechanical effect would imply since the coefficient is larger than unity) in response to ruble depreciation against the bi-currency basket. As discussed in Honohan (2007) the amplifying (higher than unity) coefficient also means that exchange rate fluctuations could have the destabilizing effect. The estimated magnitude of exchange rate effect is substantially higher than the estimates obtained by Neanidis and Savva (2009) or Honohan (2007) for a cross section of emerging markets<sup>10</sup>. This relationship seems not to have changed notably since the crisis of 2008. The presence of at least one foreign currency with a positive appreciation rate on the preceding period contributes to the dollarization growth. These results are quite robust in respect to the estimation method.

The monetary base expansion restrains deposit dollarization, although the pass-through is less than one-to-one.

<sup>10</sup> The comparison between these models should be conducted cautiously, since the set-up is not fully identical. For example contrarily to Neanidis and Savva (2009) and Honohan (2007) our model does not include the error correction term in the form of lagged deviation of actual dollarization measure from the trend.

There is a negative relationship between deposit dollarization and banks' foreign liabilities growth, which can be seen as evidence of currency matching by banks. The change in loan dollarization also has the "correct" sign but is statistically insignificant, as is the interest rate differential.

Table 4 Loan dollarization equation (2)

Variable (t-statistics in parentheses)	Model [estimation method]		
	1 [OLS]	2 [OLS]	3 [GMM]
<i>(1-dum2008) * exchange rate factor</i>	1.27 (5.76)	1.31 (6.12)	1.6 (64.7)
<i>dum2008 * exchange rate factor</i>	0.44 (2.32)	0.43 (2.53)	0.38 (84.4)
<i>dum2005 * highest of USD/euro ap- preciation rate against ruble</i>	-0.01 (-0.3)	-	-
<i>monetary base factor</i>	-0.01 (-0.25)	-	-
<i>Δ foreign liabilities to total liabilities ratio</i>	0.01 (0.69)	-	-
<i>Δ deposit dollarization</i>	0.07 (1.35)	0.06 (1.53)	0.08 (54.5)
<i>loans interest rate differential</i>	0.02 (1.07)	-	-
<i>Δ loan dollarization (-1)</i>	0.08 (1.15)	0.08 (1.14)	-0.26 (-155.7)
<i>Δ loan dollarization (-2)</i>	0.05 (0.49)	0.03 (0.43)	-0.06 (-17.4)
<i>constant</i>	-0.00 (-1.8)	-0.00 (-2.21)	-0.00 (-24.2)
Model (2) residuals tests (p-value):	LM (1 lag)=0.39	LM (12 lags)=0.88	
Model (2) R <sup>2</sup> =0.41	ARCH-LM (1 lag)=0.2	ARCH-LM (12 lags)=0.49	

Estimates of the loan dollarization equation provide evidence that the time-varying exchange rate effect is larger than the pure mechanical re-evaluation effect on the pre-crisis sample (meaning that it was borrowers rather than the banks that were willing to accept the exchange rate risk) and significantly lower after the crisis. That is consistent with our supposition regarding changes in borrowers' behavior following the increase in exchange rate volatility. Whereas during the earlier part of the sample borrowers seemed to perceive exchange rate risks as negligible, this changed in the latter half of 2008 when expectations of ruble depreciation became widespread. Receding demand for foreign currency loans during a currency crisis is well-documented (see for example Hale and Arteta (2009)), and we believe this was also the case for Russia. Even after the exchange rate dynamics stabilized,

borrowers continued to rebalance their portfolios without overt considerations about ongoing exchange rate changes. The alternative exchange rate variable - the highest of USD/ruble and euro/ruble - appreciation rates - does not seem to be relevant for loan dollarization.

The coefficient of the monetary base effect is small and not significant statistically. This may indicate that, while there is a fairly strong link between ruble deposit and monetary base growth, the relationship between monetary expansion and ruble loan supply may be less straightforward.

Finally we find a some evidence of currency matching behavior – this time the statistically significant variable is deposit dollarization rather than the foreign liabilities ratio.

Like the deposit dollarization equation, the interest rate differential here is not statistically significant.

Overall, we conclude that our estimates of deposit and loan dollarization drivers in Russia are similar to those usually obtained for emerging markets (as in e.g. Neanidis and Savva (2009) or Basso et al. (2011)). One peculiarity is the dominant magnitude of the exchange rate effect (excluding the most recent developments in loan dollarization) and the low significance of the interest rate differential. This latter result may be explained by households' (quite fair) perception that the difference in yields (in ruble terms) between foreign currency and ruble deposits was also mainly determined by exchange rate fluctuations. Evidence of banks' currency matching behavior also seems to be present, but it is not highly pronounced.

### 3 Balance-sheet analysis and currency mismatches

To assess the implications of financial dollarization for financial fragility we employ balance-sheet analysis. The methodology of balance-sheet analysis was devised by Allen and others (2002). The aim is to measure vulnerabilities due to mismatches in the structure of assets and liabilities at the sectoral level and assess the resulting macroeconomic risks. Balance-sheet analysis can be considered an important complement to more traditional methods of assessing financial stability based on analysis of flow variables, such as fiscal and current account balances. It is also widely used for financial crisis prediction.

We apply balance-sheet analysis in order to estimate currency mismatches among sectors of Russian economy over a period 2000 to 2010. Our goal is to determine what sectors were highly exposed to exchange rate risks during the global financial crisis of 2008.

We consider four sectors: government, Central Bank, banking sector and private nonbanking sector. The latter consists of households, non-financial commercial organizations and nonbanking financial organizations. We cannot examine them separately due to a lack of data. The main data source is the statistics of the Bank of Russia, notably the Credit Institutions Survey, Banking System Survey, Review of the Banking Sector of the Russian Federation and External Sector Statistics. Some data gaps remain but these are believed to be negligible.

For each sector we select the foreign currency accounts that can be regarded as claims or liabilities of the particular sector to other sectors, including the external sector (see Tables 5-8). As a basis for construction of these accounts we use the foreign currency balance sheet of a partially dollarized economy, as presented in Reinhart and others (2003). In order to take into account the specificity of Russian economy we exclude some accounts that we consider negligible or irrelevant and add some accounts that are found only in Russian practice.

Table 5 Government

<b>Government</b>	
<i>Assets</i>	<i>Liabilities</i>
Foreign-currency assets held abroad	Foreign-currency net bank credit
	External foreign-currency debt <i>Source: External Debt, External Sector Statistics, Bank of Russia.</i>
	Foreign-currency-linked domestic debt <i>Source: Review of the Banking Sector of the Russian Federation, Bank of Russia.</i>

Table 6 Central Bank

<b>Central Bank</b>	
<i>Assets</i>	<i>Liabilities</i>
Net foreign assets <i>Source: Central Bank Survey, Bank of Russia.</i>	Reserve requirements on foreign-currency bank deposits
	Foreign-currency deposits of banking sector <i>Source: Central Bank Survey, Bank of Russia.</i>

Table 7 Banking sector

<b>Banking sector</b>	
<i>Assets</i>	<i>Liabilities</i>
Foreign-currency bank loans <i>Source: Banking System Survey, Bank of Russia.</i>	Foreign-currency bank deposits <i>Source: Banking System Survey, Bank of Russia.</i>
Foreign-currency assets held abroad <i>Source: Credit Institutions Survey, Bank of Russia.</i>	External foreign-currency liabilities <i>Source: Credit Institutions Survey, Bank of Russia.</i>
Foreign-currency-linked government debt <i>Source: Review of the Banking Sector of the Russian Federation, Bank of Russia.</i>	
Foreign-currency net credit to the government	
Foreign-currency deposits held at Central Bank <i>Source: Central Bank Survey, Bank of Russia.</i>	

Table 8 Private nonbanking sector

<b>Private nonbanking sector</b>	
<i>Assets</i>	<i>Liabilities</i>
Foreign-currency cash holdings <i>Source: International Investment Position of Russian Federation, Bank of Russia.</i>	Foreign-currency bank loans <i>Source: Banking System Survey, Bank of Russia.</i>
Foreign-currency assets held abroad <i>Source: International Investment Position of Russian Federation, Bank of Russia.</i>	External foreign-currency liabilities <i>Source: International Investment Position of Russian Federation, Bank of Russia.</i>
Foreign-currency bank deposits <i>Source: Banking System Survey, Bank of Russia.</i>	Domestic foreign-currency bonds
Foreign-currency-linked government debt	

We exclude foreign currency-linked government debt to the private nonbanking sector because we assume that this sector does not hold foreign currency denominated sovereign bonds or if it does the position is negligible. We also assume that all of the private nonbanking sector's foreign currency bonds are owned by non-residents. Therefore, they are already included in external foreign currency liabilities of this sector. In Russia the banking sector does not generally issue credit to government. Thus we exclude foreign currency net bank credit to government from the balance sheets of the government and banking sector. By assuming that all foreign assets of government are held in the Bank of Russia as international reserves we are able to exclude this account from the government balance sheet. Finally, we exclude required reserves on foreign currency bank deposits from the balance sheet of the Bank of Russia because all reserves, irrespective of the currency in which deposits are denominated, are held at the Bank of Russia in rubles.

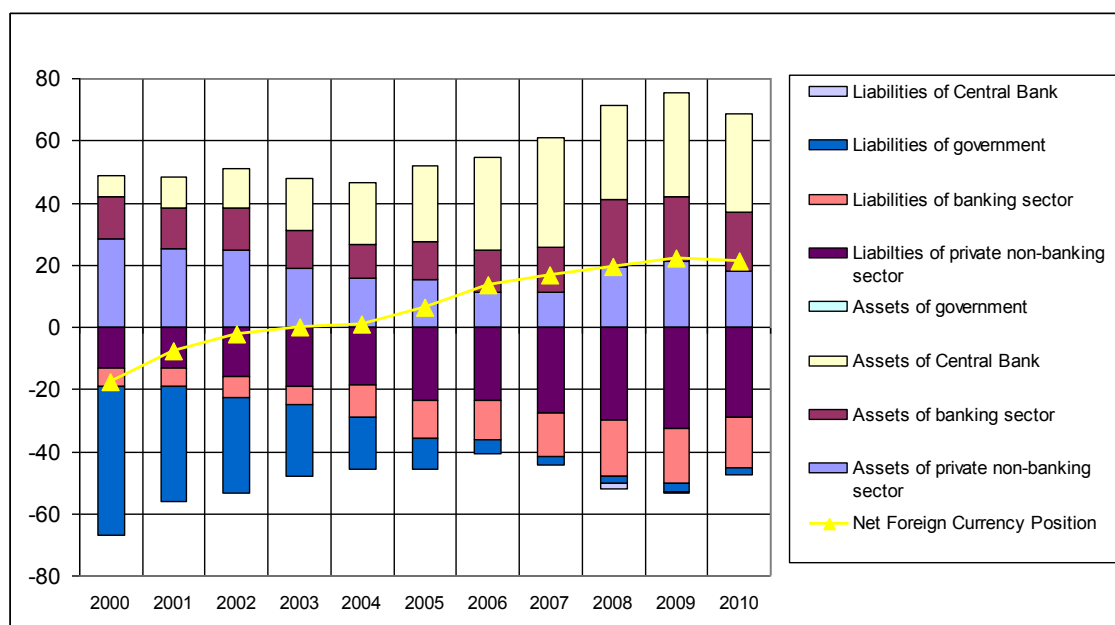
In December 2008 commercial banks were allowed to place foreign currency on deposit at the Bank of Russia. Therefore we include foreign currency deposits held at Cen-



tral Bank in balance sheets of banking sector and the Bank of Russia as assets and liabilities respectively.

After we have built the foreign currency balance sheets we estimate net foreign currency positions defined as foreign currency assets minus foreign currency liabilities. All foreign currency assets and liabilities are denominated in rubles, while net foreign currency position is calculated in percentage of GDP. Net foreign currency position can be considered as an indicator of a sector's vulnerability to movements in the exchange rate. In particular, if the net foreign currency position is negative, this means that this sector is vulnerable to exchange rate depreciation. Using net foreign currency positions for each sector we estimate net foreign currency position for private and public sectors and finally for the Russian economy as a whole.

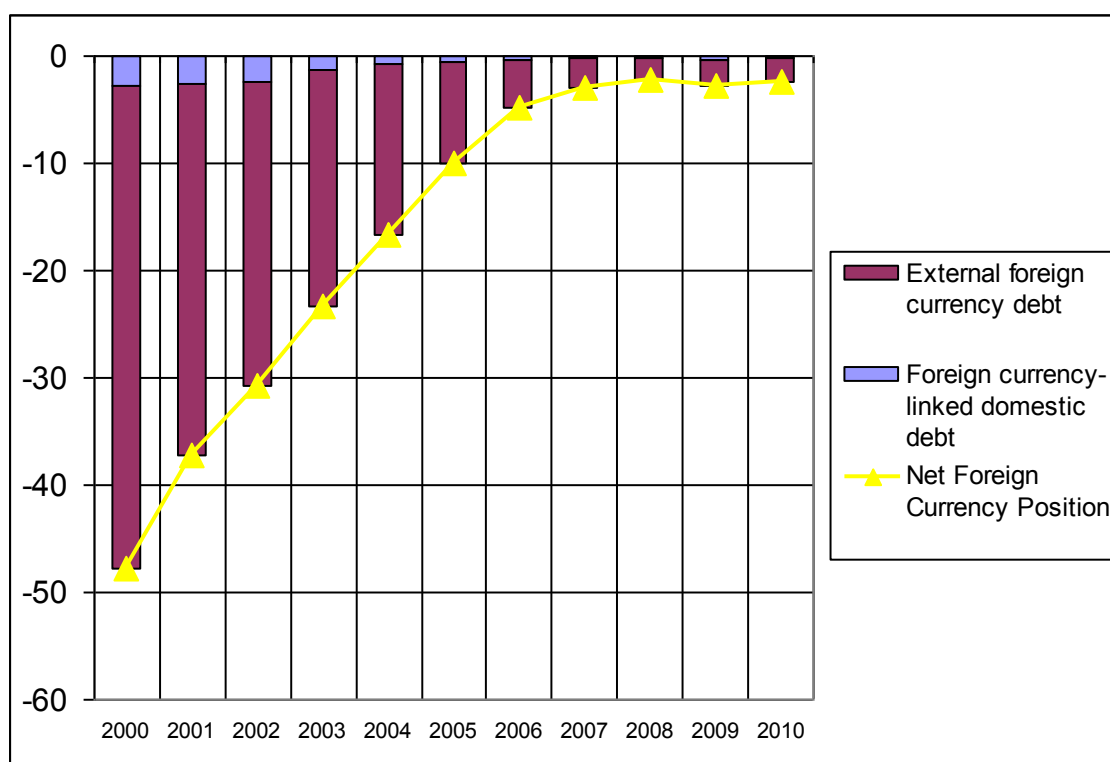
Figure 9 Currency mismatches of Russian economy, % of GDP



Our findings indicate that starting in year 2000 the net foreign currency position of the Russian economy (Figure 9) has been improving steadily. It has risen by about 40 percent of GDP since 2000 to about a positive 21 percent of GDP. We conclude that on the aggregate level the Russian economy was vulnerable to exchange rate depreciation up to 2004, when the net foreign currency position turned positive. Further increase in the net foreign currency position created a significant risk of ruble appreciation. However, the dynamics of net foreign currency positions in the different sectors of Russian economy display highly dissimilar trends.

The government's net foreign currency position (Figure 10) has improved dramatically since 2000. The sharp fall in net foreign currency exposure from 47 percent of GDP in 2000 to just under 2 percent in 2010 reflects a reduction in external foreign currency debt, mainly due to early repayments of debt to the Paris Club and International Monetary Fund, financed from the Stabilization Fund. The ruble appreciation that occurred between 2003 and 2007 has also contributed to the reduction. Thus, the net foreign currency position of this sector is not a cause of concern.

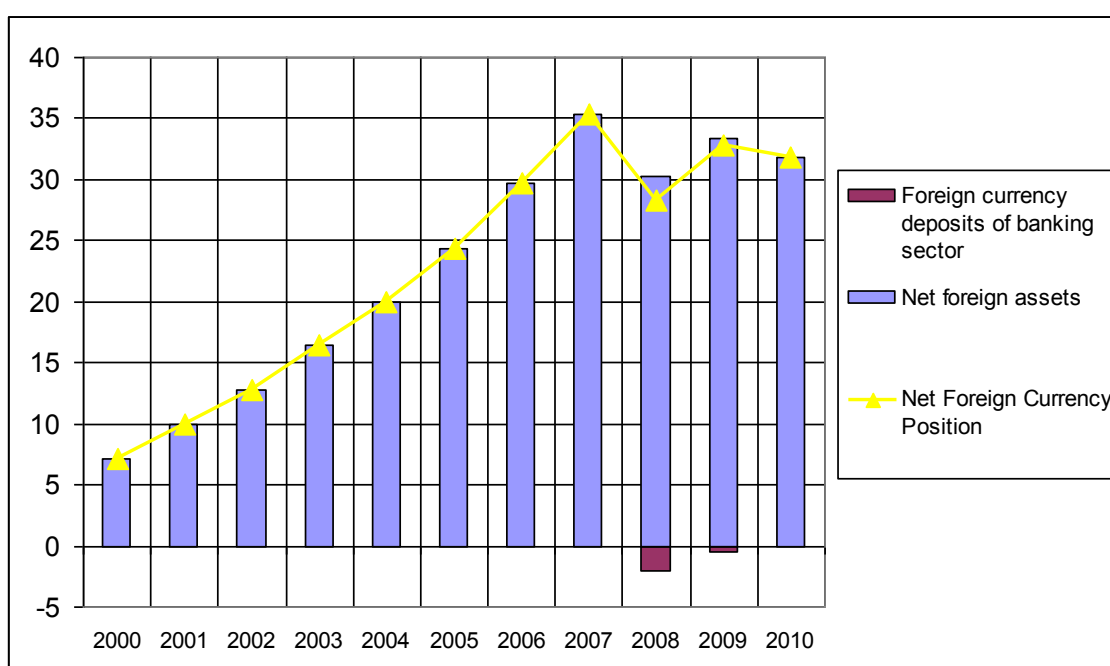
Figure 10 Currency mismatches of government sector, % of GDP



The CBR's net foreign currency position (Figure 11) has almost quadrupled during the period studied. The persistent growth of net foreign assets up to year 2007 was driven by several factors. An increase in the Bank of Russia's international reserves reflects large purchases of foreign currency in response to strong capital inflows and upward pressure on the ruble. Conversion of foreign currency holdings into rubles by individuals and companies, reflecting a decline in deposit dollarization, also contributed to the build-up of reserves. Enduring budget surpluses, stemming largely from substantial tax revenues from oil exports, led to a large accumulation of the Stabilization Fund, which was invested mainly in foreign currency denominated assets. Since the Stabilization Fund appears on the

CBR balance sheet, we consider it a part of the CBR's foreign currency assets, despite the fact that it is government owned. A slight decline in the net foreign currency position over the next three years can be regarded as a result of two opposing effects. CBR actions to stabilize the foreign exchange market in the face of huge capital outflows have had a negative effect on its net foreign assets, while a sharp devaluation of the ruble has had a positive effect. Thus the whole sector is subject to significant exchange rate risk in connection with ruble appreciation.

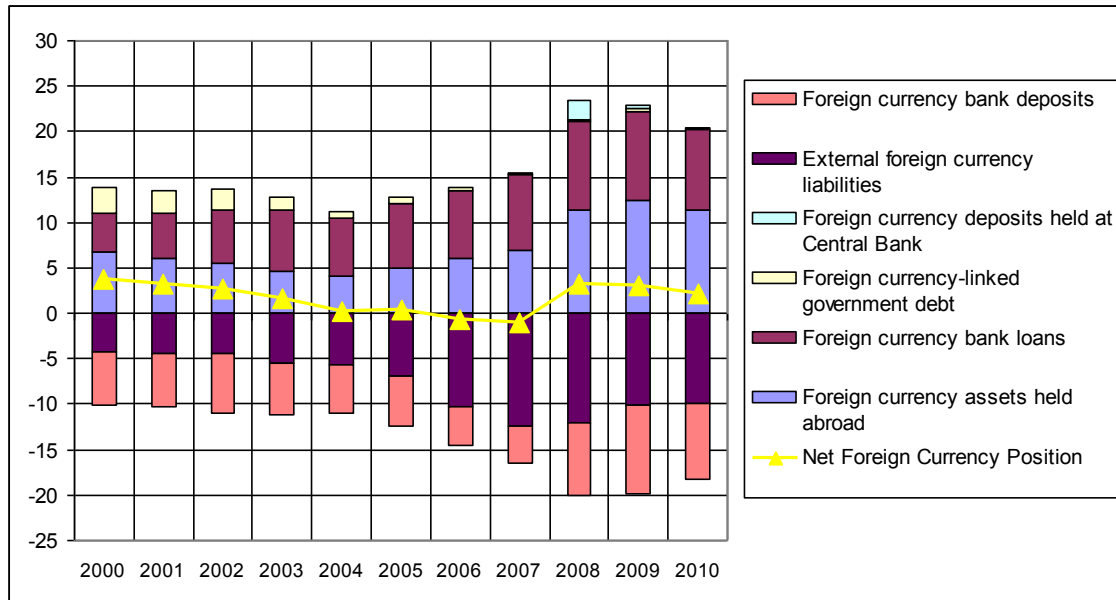
Figure 11 Currency mismatches of Central Bank, % of GDP



The net foreign currency position of the banking sector (Figure 12) had been deteriorating up to the end of 2007, mainly due to a substantial increase in external foreign currency liabilities. In fact, since a significant part of foreign assets of the banking sector were in the form of claims on the domestic nonbanking private sector, which were likely to become illiquid in the event of a sharp ruble depreciation, the banking sector seemed quite vulnerable to exchange rate risk. In 2008 there was considerable growth in foreign currency assets relative to foreign currency liabilities, so that the net foreign currency position turned out to be positive. This hike in foreign currency assets was mainly due to reallocation of CBR foreign currency reserves via direct purchases of foreign currency by commercial banks. Moreover, commercial banks were allowed to open foreign currency deposits at the CBR, which had become another foreign currency asset of the banking sector. The net for-

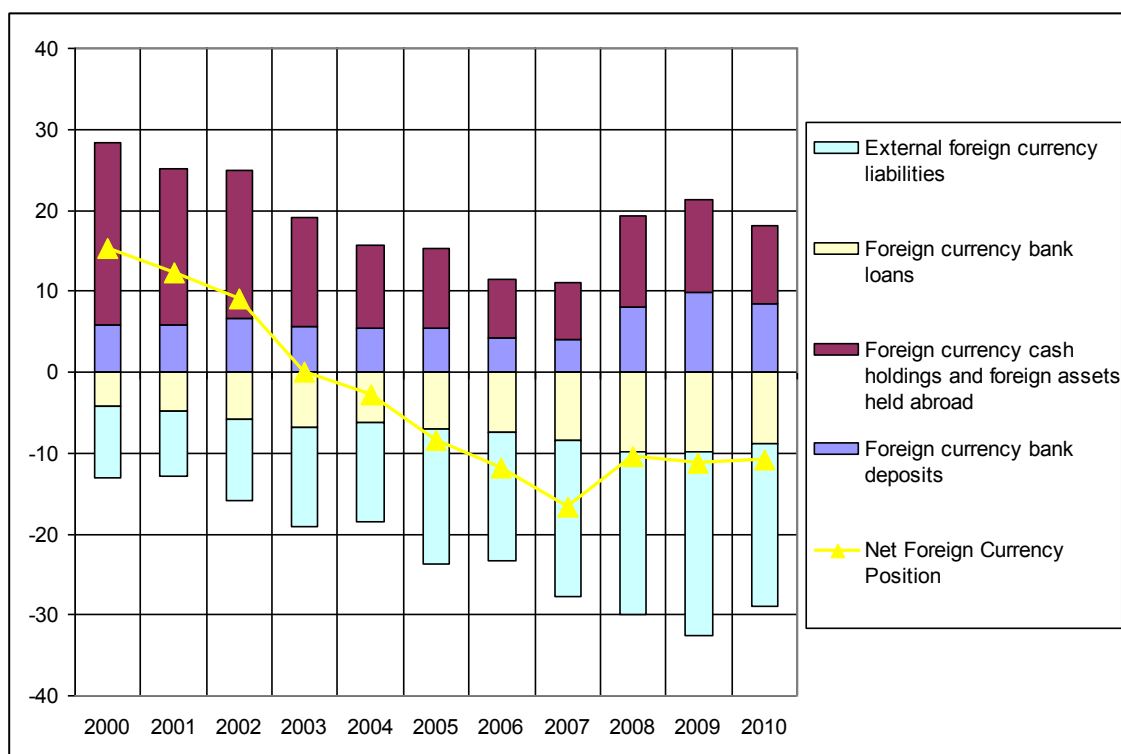
eign currency position of the banking sector at the end of 2010 was about 2 percent of GDP, which leads us to consider exchange rate risk of this sector to be minor.

Figure 12 Currency mismatches of banking sector, % of GDP



During the period 2000 to 2007 the net foreign currency position of the private nonbanking sector (Figure 13) gradually deteriorated, so that by the end of 2007 it had reached minus 17 percent of GDP. This decrease reflects a gradual decline in the foreign currency assets of this sector, including foreign currency deposits, along with an accumulation of external foreign currency liabilities, and can be considered a direct consequence of the ruble appreciation that began at the end of 2002. An increase in foreign currency deposits and external foreign currency assets led to some improvement in the net foreign currency position at the end of 2008. The next two years saw a marginal deterioration. As a result, net foreign currency liabilities amounted to slightly more than 10 percent of GDP thus making this sector quite vulnerable to ruble depreciation.

Figure 13 Currency mismatches of private nonbanking sector, % of GDP



From the negative foreign currency position of the nonbanking private sector we conclude that this sector has suffered the most from ruble devaluation at the end of 2008. Exchange rate risk vulnerability of the banking sector can be considered moderate. Due to its-substantial positive net foreign currency position, we conclude that the public sector is well protected against the consequences of ruble depreciation. At the same time this makes it quite vulnerable to ruble appreciation.

The metric of currency mismatches that we have use thus far does not take into account whether borrowers in foreign currency are hedged against exchange rate risk. Ranciere et al. (2010) introduce a new adjusted measure of currency mismatches that controls for lending to unhedged borrowers. We follow their approach in making some adjustments in the banking and private nonbanking sectors. We are able to obtain only approximate estimates because of the lack of data on the composition of assets and liabilities in both these sectors and on the extent to which private nonbanking sector borrowers of foreign currency are hedged.

We assume that firms in the oil and gas industry are hedged against exchange rate risk due to the fact that most of their revenues are denominated in foreign currency. Therefore, their foreign currency liabilities are not subject to exchange rate risk and should be

subtracted from the liabilities of the private nonbanking sector. We calculate the fraction of foreign currency bank loans to the oil and gas industry in total loans to non-financial organizations and as in Ranciere et al. (2010) extrapolate to the household sector. We do this under the simplifying assumption that the same fraction of bank loans to households corresponds to loans made by households receiving income from oil and gas industry. Then we subtract these „hedged“ bank loans from the liabilities of the private nonbanking sector and reduce banking sector assets by an amount equal to „unhedged“ bank loans. As for the external liabilities of private nonbanking sector, we also try to subdivide them into „hedged“ and „unhedged“. Using the data on external foreign currency debt securities, we are able to estimate the volume of foreign currency bonds in circulation issued by oil and gas firms and subtract it from the external foreign currency liabilities of the whole sector. Since we do not have data on the sectoral structure of external foreign currency loans, we assume that the fraction of external foreign currency loans going to oil and gas firms is equal to that of syndicated foreign currency loans going to the oil and gas industry. By eliminating these loans from external foreign currency liabilities, we obtain the adjusted foreign currency position.

Figures 14-16 show both adjusted and unadjusted net foreign currency positions of the banking sector, private nonbanking sector and the Russian economy as a whole over the period 2004 to 2010. Due to the fact that a significant share of foreign currency bank loans went to borrowers with no foreign currency income, the adjusted net foreign currency position of the banking sector shows that throughout the period studied the banking sector was vulnerable to ruble depreciation. As for the private nonbanking sector, its adjusted net foreign currency position has improved. This allows us to conclude that not only the private nonbanking sector but also the banking sector was subject to currency risk prior to the financial crisis of 2007-2008. Comparison of the adjusted and unadjusted currency mismatch measures shows that, by controlling for unhedged foreign currency liabilities, we can obtain a more accurate assessment of the exposure of different sectors of the Russian economy to exchange rate risk.

Figure 14 Adjusted currency mismatches of banking sector, % of GDP

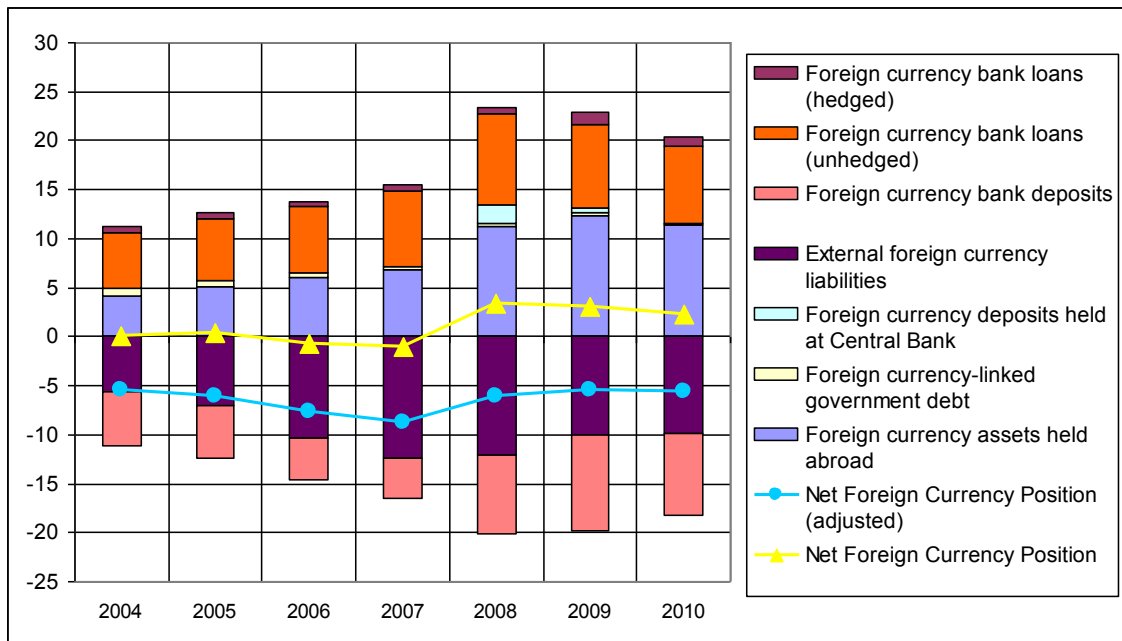


Figure 15 Adjusted currency mismatches of private nonbanking sector, % of GDP

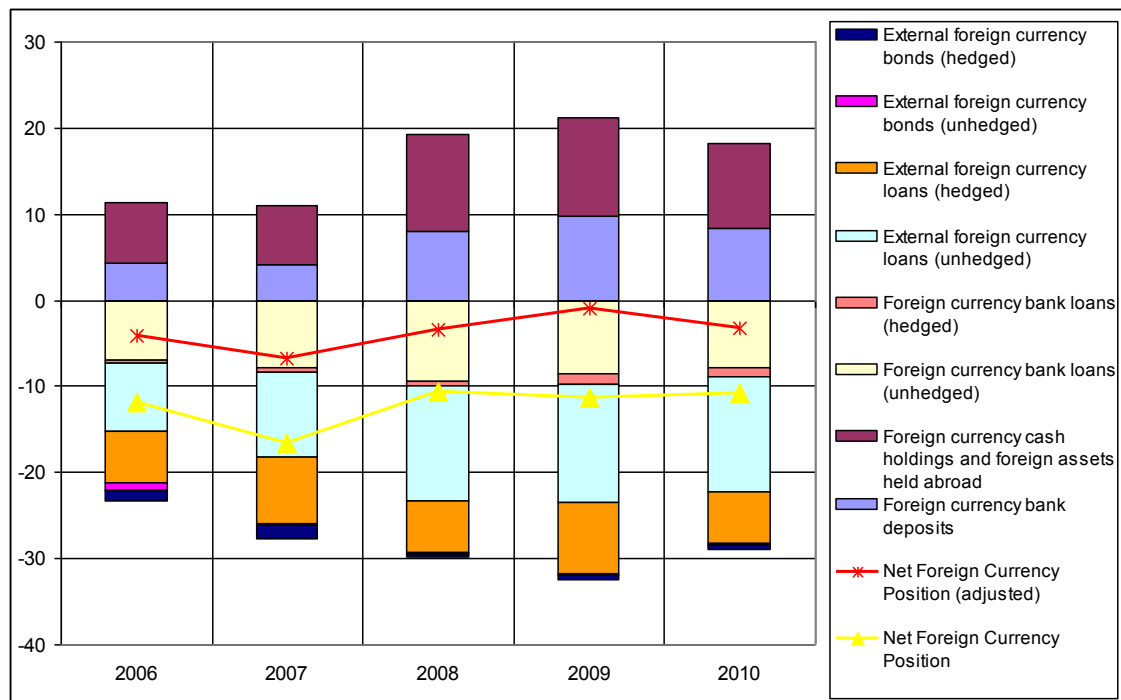
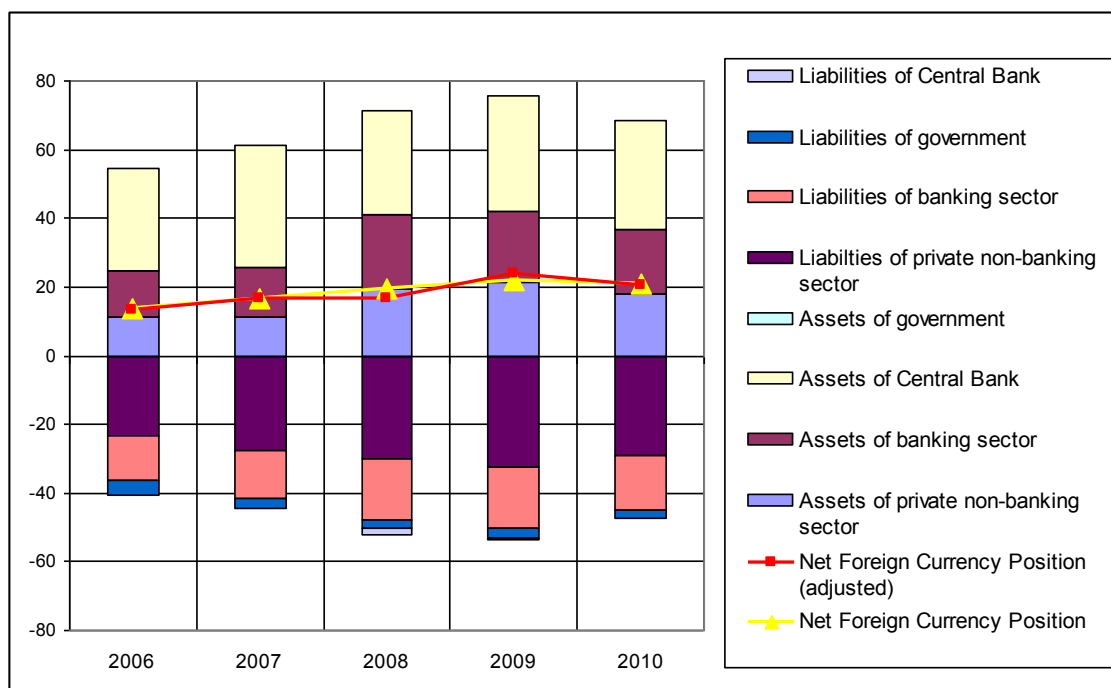


Figure 16 Adjusted currency mismatches of Russian economy, % of GDP



## 4 Financial dollarization and macroeconomic performance during the crisis

The recent global financial crisis has led to a rapid and sharp deterioration of economic activity throughout the world. One possible reason for emerging economies' vulnerability to the crisis was the high level of private sector liability dollarization. Liabilities dollarization can lead to balance-sheet effects that may hamper real sector performance in case of exchange rate depreciation. As a result, exchange rate depreciation may become contractionary, which would call for exchange rate stabilization measures. In fact, concern about the vulnerability of the Russian economy to balance-sheet risks may be viewed as a factor that largely determined the need for the Bank of Russia to attempt to stabilize the foreign exchange market in late 2008 and early 2009.

A number of recent empirical studies confirm the possibility of the contractionary effect of exchange rate depreciation in the presence of liabilities dollarization. Benhima (2011) investigates the impact of exchange rate flexibility on growth and finds it to be growth-reducing in highly dollarized countries. Similarly, Cespedes (2005) finds that the interaction between the real exchange rate and the level of external debt dollarization leads



to balance sheet effects that have a significant negative impact on output. In addition, findings of Bebczuk et al. (2006) indicate that it is investment rather than consumption that is most severely affected by a real exchange rate devaluation. In a more general setting, Furceri and Zdzienicka (2011) confirm the hypothesis that financial crises are more harmful in terms of output losses for countries whose banking systems are highly dependent on external financing. Using seven models from the above-mentioned papers, we estimate the expected growth losses due to ruble depreciation in the presence of liability dollarization following the crisis of 2008 (i.e. we applied the actual depreciation that occurred during the crisis to the pre-crisis levels of dollarization). Our estimates of the annual economic growth reduction are in the range of 0.1% to 3.7%. The median result, however, is only 0.4%. Five of seven models yielded an estimated growth loss of less than 1%. Therefore, considering the dramatic transition of the Russian economy from 7% pa GDP growth in 2000-2008 to a negative 7.8% in 2009, only a small fraction of post-crisis recession in Russia can be associated with financial dollarization.

## 5 Conclusion

Financial dollarization is the prominent feature of the Russian economy. Its level is highly unstable and displays sharp fluctuations in response to changes in the macroeconomic environment. We found that the ruble appreciation rate (against the USD and euro) was the main driving factor for the deposit de-dollarization that occurred and also for the later episode of deposit dollarization. This means that exchange rate fluctuations in Russia are usually amplified by changes in currency preferences. Loan dollarization was also found to depend positively on the ruble depreciation rate, although during the financial crisis the exchange rate effect was estimated to be smaller than the mechanical re-evaluation effect (reflecting the decrease in demand for foreign currency loans). There is also only slight evidence of currency matching behavior by the banks.

Such behavior, together with substantial borrowing from abroad, has led to the large currency mismatches in the real sector's balance sheet. The banking sector may seem to be less vulnerable to exchange rate risk, but, after taking into account the fact that a large part of banks assets are claims on domestic unhedged borrowers, we conclude that not only the private nonbanking sector but also the banking sector was subject to currency

risk prior to the financial crisis of 2007-2008. In conditions of financial turmoil (and ensuing capital-flow reversals and downward pressure on the domestic currency), this situation could threaten the macroeconomic stability of the Russian economy. Presumably this was one of the reasons for the Bank of Russia undertaking costly measures and conducting the “controlled depreciation”, spending a significant amount of foreign exchange reserves in the process

The presence of financial dollarization prior to the crisis probably contributed to the fall in GDP in 2009, but could hardly be considered among the most important factors behind the recession.

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## Appendix Data and sources

Adjusted net foreign currency position of banking sector: net foreign currency position of banking sector minus „unhedged“ foreign currency bank loans to private nonbanking sector (equal to total foreign currency bank loans to private nonbanking sector times the share of foreign-currency bank loans to oil and gas firms in total foreign-currency bank loans to non-financial organizations).

Adjusted net foreign-currency position of private nonbanking sector: net foreign-currency position of private nonbanking sector plus „hedged“ foreign-currency bank loans plus outstanding foreign-currency bonds issued by oil and gas firms and plus „hedged“ external foreign-currency liabilities (equal to total external foreign-currency liabilities times the share of syndicated foreign-currency loans to oil and gas industry in total foreign-currency syndicated loans).

Foreign cash in circulation outside of banking system: foreign-currency cash holdings of other sectors (annual). Source: International Investment Position of Russian Federation, External Sector Statistics, Bank of Russia. To obtain quarterly values we use the data on foreign-currency cash holdings of other sectors from the Balance of Payments of the Russian Federation. Source: External Sector Statistics, Bank of Russia.

Foreign-currency bank loans to oil and gas industry. Source: Statistics on deposits and loans, Internal Bank of Russia database.

Outstanding foreign-currency bonds issued by oil and gas firms. Source: Cbonds agency.

Foreign debt dollarization: share of foreign-currency debt in total debt. Source: External Debt of the Russian Federation, External Sector Statistics, Bank of Russia.

Net foreign assets of commercial banks. Source: Credit Institutions Survey, Monetary and Financial Statistics, Bank of Russia.

Syndicated loans. Source: Cbonds agency.

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Bank of Finland  
BOFIT – Institute for Economies in Transition  
PO Box 160  
FIN-00101 Helsinki

 + 358 10 831 2268

[bofit@bof.fi](mailto:bofit@bof.fi)

<http://www.bof.fi/bofit>