LINK BETWEEN INFLATION, EXCHANGE RATES AND CURRENCY SUBSTITUTION IN RUSSIA

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Summary:

This study examines the relation between inflation, the exchange rate and currency substitution in Russia for the period including the recent economic crisis. Following a descriptive analysis, a simple vector autoregressive model (VAR) with four variables is estimated. The results suggest that the depreciation (appreciation) of the ruble lead to an increase (decrease) in currency substitution. On the other hand, there is no evidence that inflation Granger caused currency substitution in the post-crisis period.

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1.1 Introduction

During the 1990s, inflation was a significant phenomenon in the Russian economy. Price liberalisation and stabilisation has been one of the key policy issues in Russia's transition to a market economy even in the period after 1998, when inflation became relatively stable.

The concern with inflation is related to the following aspects. Firstly, inflation increases uncertainty for economic agents that can result in a decline in trust in the domestic currency and lead to substitution to foreign currencies for daily transaction or as a store of value. As a result the economy will become more vulnerable to external shocks since it induces a capital outflow that leads to an increase of foreign debt and, in addition, policy options of monetary authorities are reduced because it becomes difficult to control money supply. These problems typically emerged in the financial crisis in 1998 and might have been observed in recent time following the collapse of Lehman Brothers last September.

After the 1998 crisis Russia has been experiencing a stable but relatively high inflation. The annual average rate[1] was around 21 per cent in 2000 and declined to 13 per cent in 2008. That is considered to be a consequence of macroeconomic improvement that has been also reflected in smaller variability of inflation than before. As mentioned in a later part, however, the recent economic crisis after the so-called Lehman shock in the last year had a large negative impact on the Russian economy. The exchange rates of the ruble largely depreciated. Inflation, on the other hand, seems stagnated. Together with these phenomena one of the significant consequences is a surge in currency substitution. To consider the inter-relation of these factors the present study will examine the link between inflation, the exchange rate and currency substitution by employing vector autoregressive models.

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[1] The average rate for 1997, 1998 and 1999 was 15, 27 and 92 per cent respectively.

The analysis in this study will proceed as follows: The first section investigates the recent trend of inflation in Russia by using data published by the Central Bank of Russia (CBR). In the following section, a literature review on Russian inflation and currency substitution is provided. After that, econometric analysis is conducted to estimate the relations between inflation and currency substitution in the economy. In the last part, conclusions for this study are drawn.

1.2 Price development and currency substitution in Russia in the post-crisis period

After experiencing a period of hyper-inflation from the beginning of transition up to the mid 1990s, and temporarily stronger price increases in the aftermath of the financial crises in 1998, the inflation rate has been comparatively lower in recent years. In this part, the movement of inflation and currency substitution since 1999 is discussed. Figure 1 shows the development of inflation in Russia since 1997. From this figure one can see a relatively stable development after a sharp rise and fall during the financial crisis. Focusing on the post-crisis period, Figure 2 demonstrates that there has been a declining trend of inflation as a whole. It should be noted that the recent financial crisis has emerged during a period of continuously increasing inflation since 2007. At present it is likely that the quickly shrinking economic activity in Russia will reduce the inflation pressure.

Figure 1: Inflation in Russia, 1997.1-2009.5
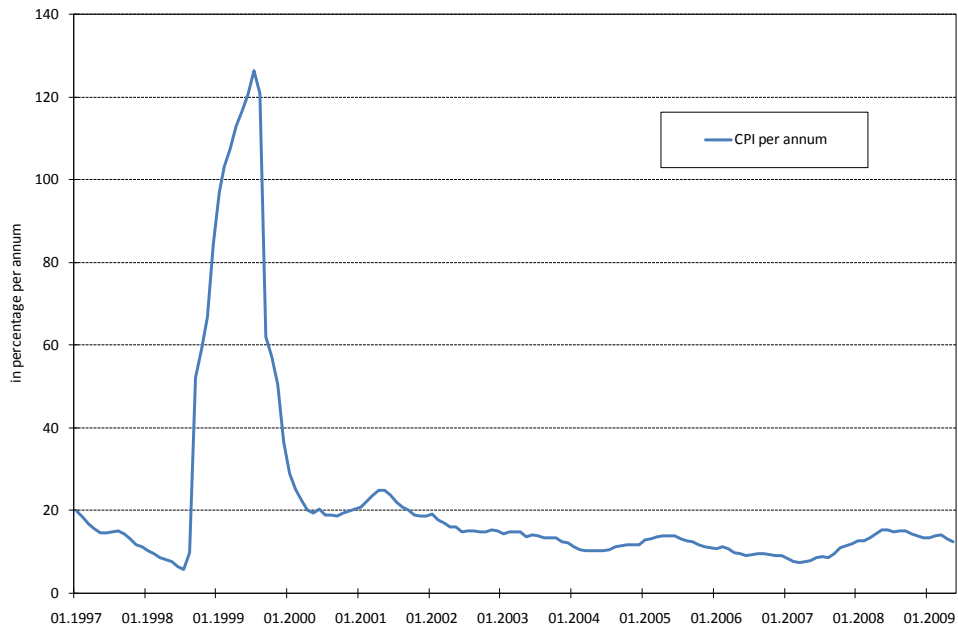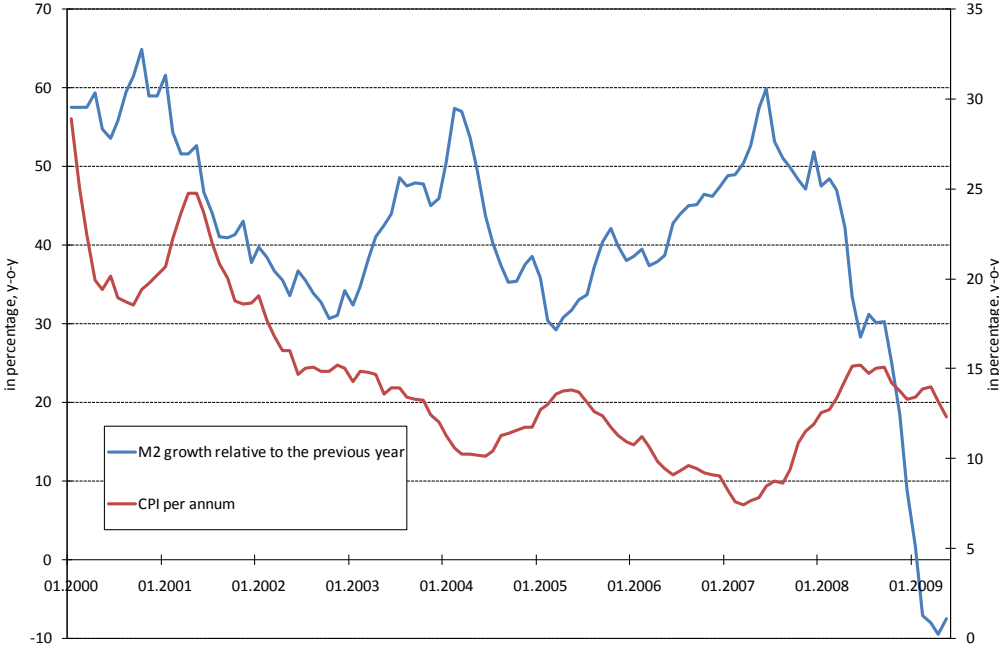

Source: CBR.

Figure 2: Inflation in Russia, 2000.1-2009.5
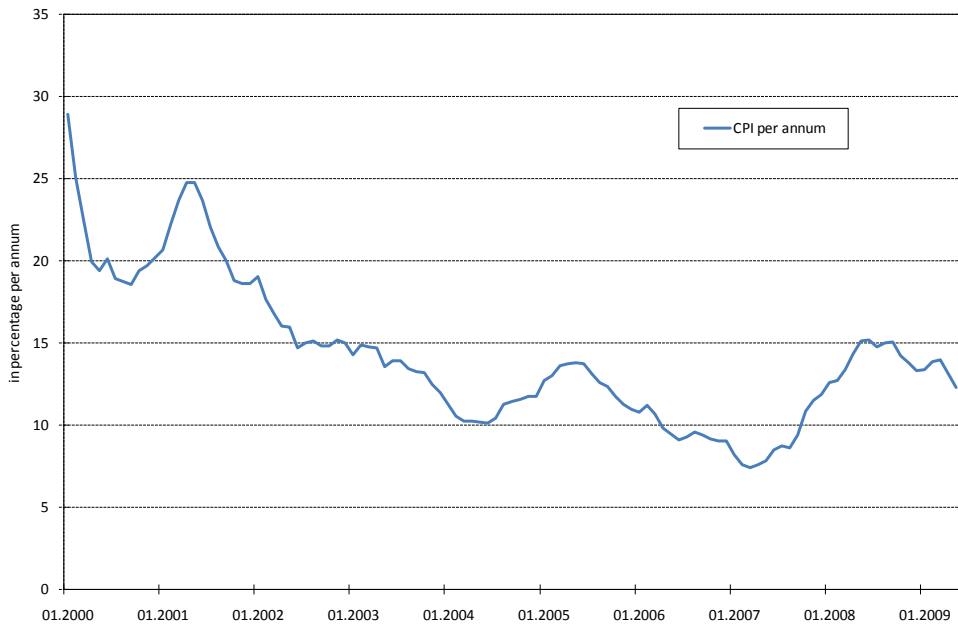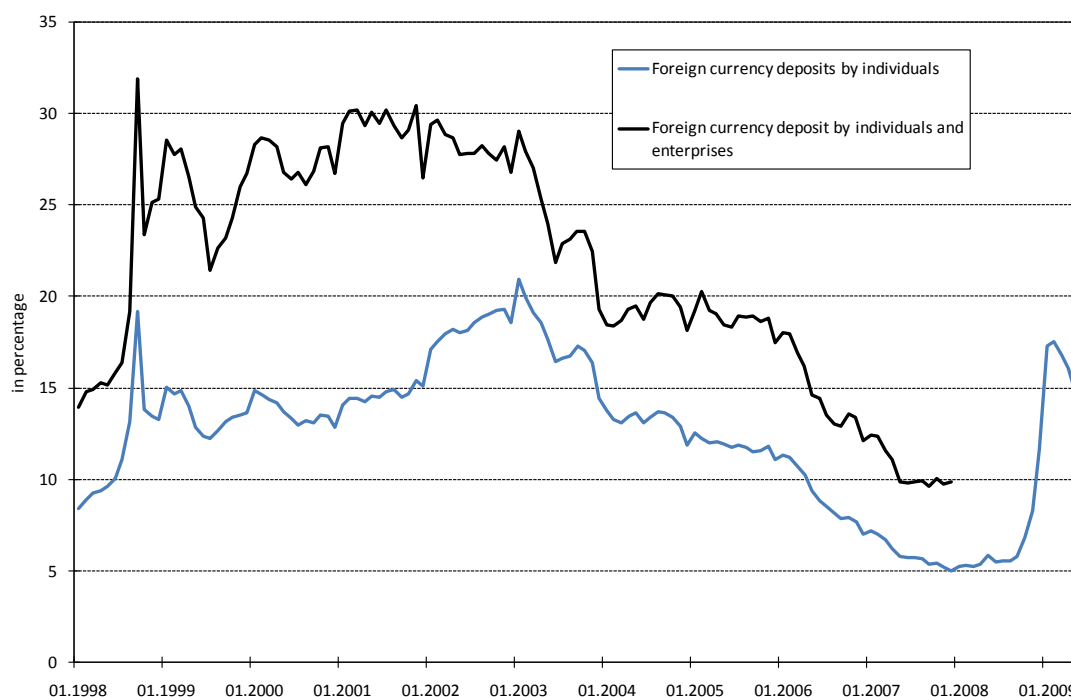

Source: CBR.

Figure 3 illustrates inflation and the money supply growth. From September 2008 the growth of money supply massively declined and turned negative in January 2009 since liquidities in the economy have drastically reduced reflecting a possible credit crunch. At the same time the preference of economic agents to foreign currency largely increased. As shown in Figure 4, the ratio of foreign currency deposits by individuals relative to ruble broad money (M2) jumped up. A similar kind of sudden increase could have been observed at the start of the 1998 crisis, when the ratio jumped to more than 30 per cent. Since the beginning of 2003 the declining trend of the ratio of foreign currency deposits to ruble broad money has been sustained for both individuals and individuals plus enterprises. At the end of 2007, the ratio for individuals reached its bottom at around 5 per cent. However, after the external shock in September 2008, the ratio of foreign currency deposits by individuals largely increased. This sudden rise suggests that, faced with a large economic fluctuation, the confidence of Russian residents in the domestic currency was lost relatively quickly.

Figure 3: Inflation and money supply, 2000.1-2009.5

Source: CBR.

Figure 4: Ratio of foreign currency deposits relative to ruble broad money, 1998.1-2009.5


Source: CBR. Note: Due to the lack of consistent data foreign currency deposits by individuals and enterprises is shown only up to 2007.

Figure 5 shows the inflation differential between Russia and the US together with currency substitution since 2000. The widening gap of inflation between home and abroad might suggest a future change in exchange rate movement. After experiencing a sharp increase of the inflation differential between Russia and the US for the period 1998 to 1999, the deviation has been declining as a whole. While the inflation differential turned into an upward trend since 2007, the development of currency substitution was relatively stable. However, as already shown, currency substitution started to increase largely in September 2008. Considering that fact, it is probable that the expectation of economic agents for future exchange rate movements might have changed before the current crisis and this lead to a large increase of currency substitution combined with the recent crisis.

In the following, after reviewing some literature on currency substitution in Russia, regression analysis will be conducted based on the considerations of this section.

Figure 5: Inflation differential with the US and the ratio of personal and enterprise deposits in foreign currency relative to ruble broad money, 2000.1-2009.5
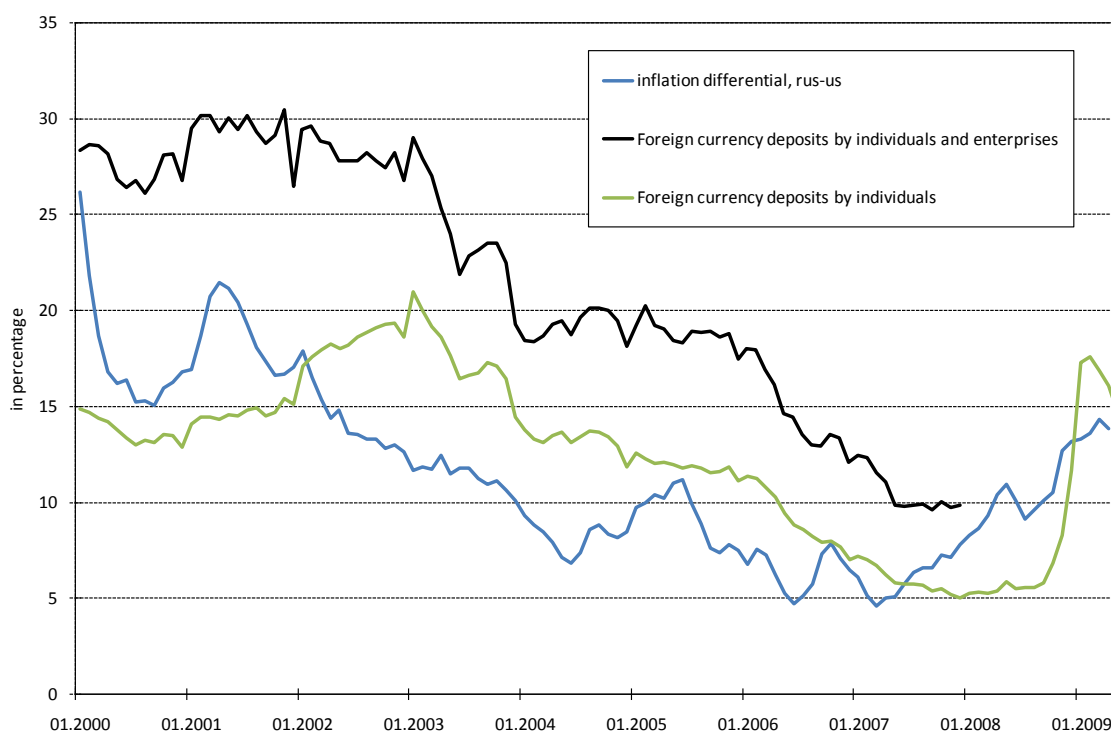
Source: CBR.

1.3 Literature

There are several studies that examined the relation between inflation and currency substitution in Russia[2]. Discussions in this part focus on recent studies for the period after 2000.

Concerning currency substitution and inflation in Russia, Oomes and Ohnsorge (2005) estimated the monetary model for the period 1996 to 2004 by using various monetary aggregates. Estimating the short-run dynamics including two cointegrating vectors obtained from the money demand and the mark-up models, they confirmed that monetary aggregates including foreign currency holdings provided a stable long-run relationship for the money

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[2] The research that examined inflation and currency substitution in Russia during the 1990s includes Brodzky (1997), Buchs (2000), Friedman and Verbetsky (2001).

demand function and thus confirmed the importance of adding foreign cash holdings to monetary aggregate in the money demand function for Russia.

Harrison and Vymyatnina (2007) examined the determinants of currency substitution in Russia for the period from 1999 to 2005. Based on the portfolio balance model and distinguishing foreign currency held for transaction and assets, they found a long-run relationship between variables including inflation and output. As for currency substitution, its positive relation to inflation was confirmed based on the regressions for transaction and assets.

Considering the deepening economic relation with Europe, Dorbec (2005) examined the period from 1999 to 2004 to identify the determinants of currency substitution with particular emphasis on the euro by considering different market participants. One of the important implications of his study is that there is a difference in the behaviour of economic agents in relation to their reactions to exchange rate appreciations. While households respond to the change in exchange rate movements, enterprises do not change their behaviour. It suggests that it is more appropriate to distinguish between households and enterprises in studying currency substitution.

Overall, even though there exists a variety of literature, few studies cover the latter half of this decade. For this reason the present study will examine the link between inflation, the exchange rate and currency substitution in Russia in recent years and shed some light on the latest events since September 2008.

1.4 Empirical analysis

Based on the considerations mentioned above, this section is devoted to capturing the dynamic relations between inflation and currency substitution. Since this study focuses on short-run dynamics rather than long-run relationships, the analysis is conducted by applying vector autoregressive models (VAR). In this part, firstly, a brief explanation about used

variables is provided and data properties are examined to determine the order of integration. At the end of this section, the results obtained from the VAR estimation will be discussed.

1.4.1 Data and data properties

1.4.1.1   Choice of included variables and the sample period

The variables included in the VAR system are currency substitution as the share of personal deposits in foreign currency relative to ruble broad money (*CS_PDEP*), the consumer price index (*CPI*), the exchange rate against the US dollar (*EXR_USD*) and the money supply (ruble broad money, *M2*[3]). Since there is no consistent data for deposits in foreign currency by enterprises for the time period under consideration, *CS_PDEP* is used as a proxy for currency substitution. The exchange rate is represented in rubles per US dollar. All data are on a monthly basis and obtained from the CBR.

The sample covers the period from January 2000 to May 2009. Due to the strong variability during the financial crisis in 1998 and the lack of consistent data before that year, the estimation period comprises solely this decade.

1.4.1.2   Unit root tests

Before going to examine the relation between variables, data properties need to be confirmed by conducting unit root tests. The results by the ADF tests and the Dickey-Fuller GLS (DF-GLS) tests are shown in Table 1. The ADF tests in levels do not reject the null of the existence of a unit root for *CS_PDEP*, *EXR_USD* and *M2* while the unit root hypothesis was rejected for *CPI* in levels estimated with trend at five per cent significance level. On the other hand, the DF-GLS test did not reject the null hypothesis of a unit root for the variables in levels except *EXR_USD* with no trend. Concerning the differenced series, both tests

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[3] According to national definition by CBR. It includes cash in circulation and non-cash funds of resident non-financial and financial institutions and private individuals in rubles.

rejected the null for all variables. According to these results, all variables are integrated of, at most, order one.

Table 1: Unit root tests

	ADF: 2000m1 - 2009m5								
Dependent variable	Level with constant, trend[1]	lag	Level with constant[1]	lag	Dependent variable	1st difference with constant, trend[1]	lag	1st difference with constant[1]	lag
CS_PDEP	-1.984	1	-1.654	1	DCS_PDEP	-5.716 ***	0	-5.731 ***	0
EXR_USD	-2.299	1	-2.213	1	DEXR_USD	-7.092 ***	0	-7.119 ***	0
CPI	-3.773 **	1	-2.856	1	DCPI	-5.199 ***	0	-4.518 ***	0
M2	-0.475	1	-2.336	1	DM2	-5.956 ***	0	-5.390 ***	0
	DF-GLS: 2000m1 - 2009m5								
Dependent variable	Level with constant, trend[2]	lag	Level with constant[1]	lag	Dependent variable	1st difference with constant, trend[2]	lag	1st difference with constant[1]	lag
CS_PDEP	-1.933	1	-1.588	1	DCS_PDEP	-5.669 ***	0	-5.746 ***	0
EXR_USD	-2.046	1	-1.821 *	1	DEXR_USD	-3.773 ***	4	-3.386 ***	7
CPI	-0.993	1	1.016	1	DCPI	-3.933 ***	0	-3.355 ***	0
M2	-0.982	1	0.968	2	DM2	-5.990 ***	0	-2.824 ***	1

Notes: ***, ** and * denotes 1%, 5% and 10% significance levels respectively. [1]Asymptotic critical values by MacKinnon(1996); [2]by Elliott, Rothenberg and Stock (1996).

Source: Author's calculations.

1.4.2 Estimations of the VAR model

In the following estimations, the VAR is employed to examine the dynamics between the variables. In general it is assumed that all variables are stationary in a VAR model. Therefore, in the case of non-stationary variables in levels, first differenced series for the VAR or vector error correction models (VECM) to obtain long-run coefficients are used. Differently from these approaches, this section applies the VAR to the level variables that are integrated of order one or zero, since the purpose of this study is to capture the dynamics of the relations of the variables. This is in accordance with suggestions by Sims (1980) and Sims, Stock and Watson (1990), who claimed that the information included in original series in levels can be lost by using differenced series in the VAR. They recommend estimating variables in levels. A problem, however, arises when estimating the VAR including non-stationary variables in levels: the ordinary F-test for Granger causality cannot be applied since it assumes that all

variables are stationary. For this reason, the present study applies the method developed by Toda and Yamamoto (1995) to confirm causality between non-stationary variables.

The test procedure is as follows. Firstly, the maximum order of integration of the included variables, d_{max}, is decided by using standard methodologies for testing unit roots such as the ADF test in section 1.4.1.2. Secondly, the optimal lag length of the estimated VAR model, k, is chosen by using the information criteria. Thirdly, the VAR model with the lag length $p = d_{max} + k$ is estimated. Finally, restrictions are imposed on variables with up to lag k and the null hypothesis of no causality is examined by using the Wald test. According to Toda and Yamamoto (1995), one of the advantages of this procedure is that it can be applied to non-stationary series without testing for cointegration of the variables.

1.4.2.1   Test results for Granger causality

As mentioned above, the tests for Granger causality were conducted based on Toda and Yamamoto (1995). The optimal lag length for the VAR including four variables, which was chosen according to the information criteria, is six. As calculated in section 1.4.1.2., the maximum order of integration of the variables is one. Then, the VAR with seven lags was estimated and a joint test for the variables up to the sixth lag was conducted.

Table 2: Granger causality test

Null hypothesis	Chi-square	p-value
CS_PDEP does not Granger cause CS_PDEP	131.5	0.0000
CPI does not Granger cause CS_PDEP	4.268	0.6404
CS_PDEP does not Granger cause CPI	3.409	0.7561
EXR_USD does not Granger cause CS_PDEP	13.00	0.0430
CS_PDEP does not Granger cause EXR_USD	3.553	0.7369
M2 does not Granger cause CS_PDEP	14.15	0.0280
CS_PDEP does not Granger cause M2	2.500	0.8684

Source: Author's calculations.

The results in Table 2 suggest that *EXR_USD* and *M2* Granger-cause *CS_PDEP* at five per cent significance level while the null hypothesis of no Granger causality for *CPI* was not rejected. *CS_PDEP*, on the other hand, does not Granger-cause *CPI*, *EXR_USD* and *M2* since the null of no Granger causality could not be rejected.

1.4.2.2   Results from the VAR estimation

Figure A1 in the appendix shows the effect of changes in *CS_PDEP*, *CPI*, *EXR_USD* and *M2* on *CS_PDEP*. A positive shock to *EXR_USD* by one per cent standard deviation (that means ruble depreciation) leads to an increase of *CS_PDEP* by around two per cent after three months at five percent significance level and subsequently, the positive effect gradually becomes smaller. The most significant impact was found in the response of *CS_PDEP* to a change of *CPI*. The positive effect reaches the highest at more than two per cent after 11 months and it decreases slowly but remains to be positive. However, as shown in the previous section, the test for Granger causality suggested that there is no causality from *CPI* to *CS_PDEP*.

In response to a change of one standard deviation of *M2*, CS_*PDEP* declines by around four per cent at five per cent significance level. The negative effect lasts relatively long after it reaches its peak after ten months.

The results in Figure A1 suggest that economic agents react fairly quickly to the depreciation of the ruble by switching from local currency to US dollar while the effect of the change of the price level on currency substitution is not clear since the assumption of no Granger causality was not rejected. The reason could be explained by the fact that the behaviour of economic agents is based not on the level of inflation but on its volatility.

1.5 Conclusions

The purpose of this paper was to investigate the relations between inflation, the exchange rate and currency substitution in Russia in the post-crisis period after 1998. The impulse responses obtained from the VAR model with level variables indicate that the depreciation (appreciation) of the ruble leads to an increase (decrease) of currency substitution. Granger causality between the ruble exchange rate and currency substitution was also confirmed. As expected, if domestic currency becomes weaker, economic agents, in particular in emerging markets, tend to switch to more reliable and stable foreign currencies. Such reaction could have been observed after the Lehman shock last September where personal deposits in foreign currency in Russia surged. With regard to inflation, on the other hand, Granger causality was not found even though the impulse response analysis showed a positive response of currency substitution to an increase of CPI. This result might suggest that market participants are basically not concerned about the high level inflation itself, but rather the variability of inflation which increases uncertainty in the economy and leads to an increase of the demand of foreign currency such as US dollars.

Some caveats must be given. Firstly, this study used personal deposits as a proxy for currency substitution due to the lack of consistent data covering the whole period. Deposits by other organisations, for instance, should also be considered. Secondly, it is necessary to take into account that currency substitution can emerge not only as means of store of value but also for transaction purposes, that is, as means of exchange. For examination of the latter, however, data for foreign currency circulation has to be available.

A suggestion for further research would be the consideration of other currencies. In this study the US dollar is used as a benchmark foreign currency. With regard to the closer

economic ties with Europe, the model could be extended by including variables related to the euro.

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Appendix:
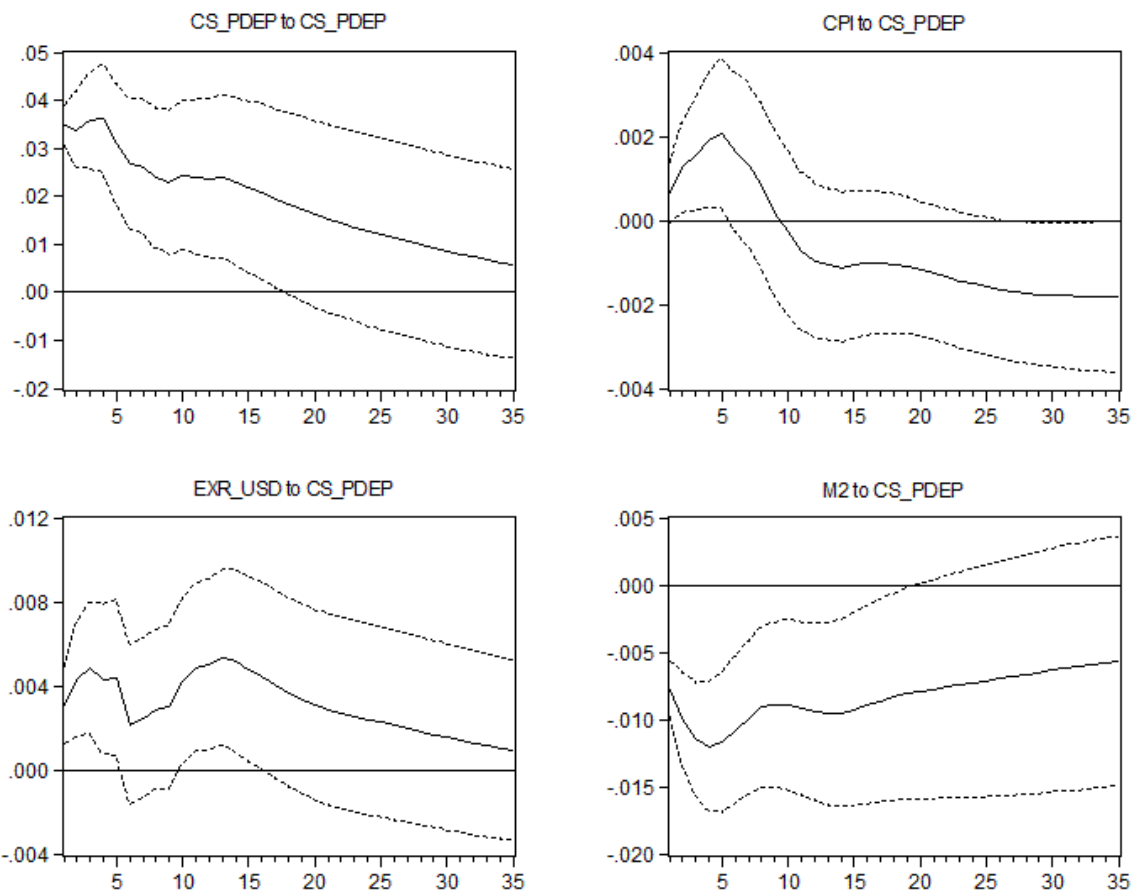
Figure A1: Impulse responses (1)
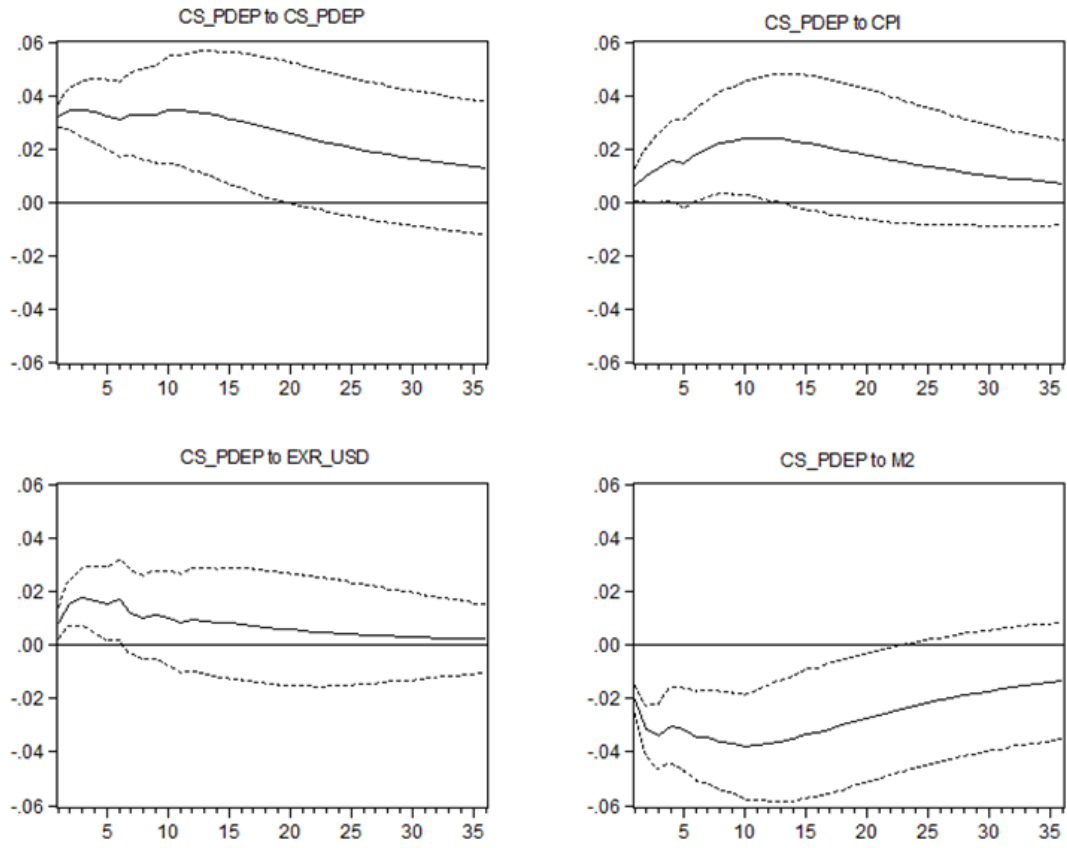
Source: Author's calculations.

Figure A2: Impulse responses (2)

Source: Author's calculations.