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## Substitution between domestic and foreign currency loans in Central Europe. Do central banks matter?

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EUROPEAN CENTRAL BANK

EUROSYSTEM

**WORKING PAPER SERIES**

**NO 1187 / MAY 2010**

**SUBSTITUTION  
BETWEEN  
DOMESTIC AND  
FOREIGN CURRENCY  
LOANS IN CENTRAL  
EUROPE  
  
DO CENTRAL BANKS  
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# SUBSTITUTION BETWEEN DOMESTIC AND FOREIGN CURRENCY LOANS IN CENTRAL EUROPE

## DO CENTRAL BANKS MATTER? <sup>1</sup>

by Michał Brzoza-Brzezina<sup>2</sup>, Tomasz Chmielewski<sup>3</sup>  
and Joanna Niedźwiedzińska<sup>4</sup>



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## Abstract

In this paper we analyse the impact of monetary policy on total bank lending in the presence of a developed market for foreign currency denominated loans and potential substitutability between domestic and foreign currency loans. Our results, based on a panel of four biggest Central European countries (the Czech Republic, Hungary, Poland and Slovakia) confirm significant and probably strong substitution between these loans. Restrictive monetary policy leads to a decrease in domestic currency lending but simultaneously accelerates foreign currency denominated loans. This makes the central bank's job harder.

JEL: E44, E52, E58

Keywords: Domestic and foreign currency loans, substitution, monetary policy, Central Europe

# 1 Non-technical summary

Since the widespread introduction of inflation targeting strategies in many countries, the role of monetary and credit aggregates has substantially decreased. Money and credit are not treated as intermediate targets anymore and central banks, as well as analysts, pay much less attention to their developments than they used to back in the 1980's. Still, money and credit matter in monetary policy analysis of inflation targeters for several reasons. First, credit creation is considered an important driving vehicle transmitting monetary policy decisions on interest rates to the economy. Second, developments in monetary and credit aggregates can yield useful information about future real and nominal developments. Third, credit creation can be useful in assessing the overall created liquidity, even if, in the short and medium run, it does not affect consumer prices. As a result, inflation targeting central banks pay attention to money and credit developments, treating them as one of the inputs to their monetary policy decision making process.

In this paper we ask the question what impact central banks have on bank lending in the presence of a developed market for foreign currency loans. We think of domestic and foreign currency loans as of close substitutes. Since the domestic central bank affects only the price of one of these goods (i.e. domestic credit) its impact on the total amount of loans granted can be small.

We analyse empirically domestic and foreign currency loan developments in a panel of four biggest Central European countries: the Czech Republic, Hungary, Poland and Slovakia. All these countries have a substantial share of foreign currency loans in total loans to the private sector. We show that domestic and foreign currency loans are close substitutes in the analysed countries. Domestic interest rates affect negatively domestic currency loans, but at the same time they affect positively foreign currency loans. Hence, consumers, facing higher borrowing costs in domestic currency simply turn to foreign credit. Our estimates show that after a monetary tightening foreign currency loans substitute a non-negligible part of domestic currency loans in the analysed countries. This effect may pose a constraint on the ability of domestic monetary authorities to affect overall credit creation and hence, provide monetary stability. Nevertheless, it should be noted that despite the presence of substitution, the effect of higher domestic interest rates on total lending remains negative.

## 2 Introduction

Since the widespread introduction of inflation targeting strategies in many developed and emerging market countries, the role of monetary and credit aggregates has substantially decreased. Money and credit<sup>1</sup> are not treated as intermediate targets anymore and central banks, as well as analysts, pay much less attention to their developments than they used to back in the 1980's. Still, money and credit matter in monetary policy analysis of inflation targeters for several reasons. First, credit creation is considered an important driving vehicle transmitting monetary policy decisions on interest rates to the economy (e.g. Mishkin (1996), Bernanke and Blinder (1988)). Second, it has been shown in many countries that developments in monetary and credit aggregates can yield useful information about future real and nominal developments (Borio and Filardo (2004), Fischer et al. (2006), Gerlach and Svensson (2003)). Third, it has been argued that credit creation can be useful in assessing the overall created liquidity, even if, in the short and medium run, it does not affect consumer prices. This liquidity, it is argued, flows to capital or real estate markets, where it can generate price bubbles. These bubbles can threaten financial system and price stability in the future. As a result, inflation targeting central banks pay attention to money and credit developments, treating them as one of the inputs to their monetary policy decision making process.

In this paper we do not attempt to prove the usefulness of credit aggregates for monetary policy. Assuming that the analysed central banks care about credit creation<sup>2</sup> and may want to curb (or boost) lending, we ask the question what impact central banks have on bank lending in the presence of a developed market for foreign currency loans. In other words, we think of domestic and foreign currency loans as of close substitutes. Since the domestic central bank affects only the price of one of these goods (i.e. domestic credit) its impact on the total amount of loans granted can be small.

We analyse empirically domestic and foreign currency loan<sup>3</sup> developments in a panel of four biggest Central European countries: the Czech Republic, Hungary, Poland and

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<sup>1</sup>Throughout the paper the terms “loans” and “credit” will be used interchangeably.

<sup>2</sup>This can be seen for instance from their Inflation Reports, Financial Stability Reports and minutes of MPC meetings, e.g. CNB (2006), MNB (2006), NBP (2007), NBS (2008).

<sup>3</sup>The notion of foreign currency loans is understood here broadly – as including foreign currency denominated loans (that can be, technically, paid and repaid in a local currency after indexing any cash flows to changes in an exchange rate).



Slovakia. All these countries follow inflation targeting<sup>4</sup> strategies and all have a substantial share of foreign currency loans in total loans to the private sector.

Our study is not the first approach to credit expansion in Central and Eastern Europe. The investigated topics include e.g. estimating equilibrium level of credit-to-GDP for the new EU Member States and potential speed of the catching-up process (e.g. Boissay et al. (2005), Backé et al. (2006), Kiss et al. (2006), Sirtaine and Skamnelos (2007)), the possible impact of future euro adoption on the credit market developments in accession countries and the risk of crises related to excessive credit expansion (a short overview of the empirical literature on that issue can be found in Brzoza-Brzezina (2005)). This area of research concentrated primarily on indicating problems related to rapid credit expansion but at the same time it pointed at risks associated with high share of foreign currency loans in those countries. Commenting the results of their studies, several of the cited authors (e.g. Kiss et al. (2006), Sirtaine and Skamnelos (2007)) mark that high share of foreign currency denominated loans in private sector borrowing may be an additional concern for monetary policy in some countries, since a monetary tightening may rather lead to increased foreign currency indebtedness than to a credit growth slowdown. The issue of limited potential efficiency of monetary tools as a response to a credit boom related to currency mismatch is also noticed in other studies, e.g. in Hilbers et al. (2006) and Backé and Wójcik (2006), although it is never the main point of interest. A more explicit discussion of domestic and foreign currency lending can be found in a paper on the bank lending channel in Hungary by Horváth et al. (2006). The findings presented there seem to support the existence of a substitution effect between the two types of credit, though it must be stressed that the analysis is concentrated on the supply side of the market.<sup>5</sup> A similar study was conducted on monetary transmission in Poland by Wróbel and Pawłowska (2002). Analysing responses of private sector credit to monetary policy shocks, the authors formulate a hypothesis that their results may also point to a presence of the substitution effect. On the whole, the question of substitutability between domestic and foreign currency denominated loans and its consequences for monetary policy has been signalled in the reviewed studies, however, it was not a main research topic.

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<sup>4</sup>Slovakia entered the euro-area in 2009, but our sample does not include this period. Hungary followed a fixed exchange rate regime until 2001. Excluding Hungarian data for this period from the sample does not change our results.

<sup>5</sup>The authors investigate whether there is an asymmetric adjustment of bank loan supply to changes in interest rate, conditioned on specific characteristic of individual banks. They use panel data on Hungarian banks and follow Kashyap and Stein (1995, 2000).

Recently, after the draft of this paper had been prepared, some studies treating more explicitly domestic and foreign currency lending in Central and Eastern Europe have been conducted. Below we briefly discuss findings of Basso et al. (2007), Rosenberg and Tirpák (2008) and Csajbók et al. (2009).

The paper by Basso et al. (2007) deals with financial dollarization<sup>6</sup> in transition economies<sup>7</sup> and tries to explain determinants of such a phenomenon. The authors find that the increasing presence of foreign banks in the financial sector and the interest rate differential matter for the dollarization of loans to the private sector. They also point at the trade-off between inflation and real exchange rate variability as well as at the openness of an economy as factors explaining financial dollarization (though in the later case – just in loans for corporations). While Basso et al. (2007) investigate determinants of currency composition of both credits and deposits, Rosenberg and Tirpák (2008) concentrate on foreign currency borrowing.<sup>8</sup> They find that differences in patterns of foreign currency borrowing between countries – with Estonia and Latvia being biased towards foreign currency lending and the Czech Republic, Poland and Slovakia still borrowing mainly in domestic currency – may be explained by the loan-to-deposit ratios, openness of an economy, and the interest rate differential. Preliminary results of Csajbók et al. (2009) who analyse household foreign currency borrowing in 10 new EU Member States, confirm the importance of the interest rate differential and exchange rate volatility. At the same time, the authors claim that if only variable rate loans are available, a monetary regime that actively smoothes the exchange rate by interest rate policy may create an additional incentive to borrow in foreign currency. Therefore, in their view, institutional features of bank lending may also be an important factor influencing households' choice of currency.

In this paper we concentrate on the Czech Republic, Hungary, Poland and Slovakia – i.e. Central European economies that in the period under review pursued IT strategy – and show that domestic and foreign currency loans are close substitutes in the analysed countries. Although domestic interest rates affect negatively domestic currency loans, they also affect positively foreign currency loans. Hence, consumers, facing higher borrowing costs in domestic currency simply turn to foreign credit. Although the results vary between

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<sup>6</sup>The term "dollarization" is used – in line with the literature – to describe a phenomenon of holding a part of residents' assets/liabilities denominated or indexed to foreign currency – regardless of it being the U.S. Dollar, Euro or Swiss Franc.

<sup>7</sup>The sample includes 24 transition economies – mainly of Central and Eastern Europe – but also other such as Azerbaijan, Kazakhstan and Tajikistan.

<sup>8</sup>The study analyses foreign currency borrowing in 10 new EU Member States plus Croatia.

countries, they show that the phenomenon may pose a constraint on the ability of domestic monetary authorities to affect overall credit creation and hence, provide monetary stability. Nevertheless, it should be noted that despite the presence of the substitution, the effect of higher domestic interest rates on total lending remains negative.

### 3 Model and data

Loan developments are difficult to model empirically. One reason is that we do not have a consistent economic theory about the determinants of loans. Standard microfounded models used for monetary policy analysis (e.g. Clarida et al. (1999), Rotemberg and Woodford (1998), Woodford (2003)) do not show any explicit role for loans. Only recently have general equilibrium models started to include a banking sector that grants loans (Bernanke et al. (1999), Gerali et al. (2009), Brzoza-Brzezina and Makarski (2010)). These models are, however, still in an early phase of development.

Moreover, recent advances in the analysis of monetary transmission (Bernanke and Blinder (1988), Kashyap and Stein (1995, 2000)) show that the loan market is relatively specific in the sense that we can expect loan demand and loan supply diverging frequently. In such a situation the observed quantity of new loans is a nonlinear (min) function of demand and supply. Such problems are relatively difficult to model empirically, in particular in the presence of short time series and uncertainty about the true data generating process.<sup>9</sup>

For the above mentioned reasons we decided to follow the approach used relatively often in the empirical literature. As to the choice of the model, this approach ignores the possible supply-demand disequilibria, assuming that in the long run the two market sides must be equal. Since, on the aggregate level it is difficult to identify supply side factors, this approach to modelling concentrates on the demand side of the market. Regarding potential determinants of loan demand, the standard approach accentuates primarily income (as measured by GDP) and the cost of borrowing (as measured by the real interest rate). Despite its limited theoretical appeal this approach has been successfully used for

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<sup>9</sup>One possible approach is based on the disequilibrium modelling technique developed by Maddala and Nelson (1974). It has recently been applied to modelling lending to enterprises in the UK (Atanasova and Wilson (2004)) and analysing the Polish loan market (Hurlin and Kierzenkowski (2002)). However, our experience with this estimator based on simulations, was rather negative. The proper estimation required not only much longer data series that were available to us, but also a specification of the estimated equations perfectly matching the data generating processes.

modelling loan demand in developed and developing countries (Calza et al. (2001), Calza et al. (2003), Hofmann (2001)).

Our approach differs slightly from the one presented above because of the specific question we ask. Analysing substitutability between domestic and foreign currency loans we recognise that the demand for any of these products should depend not only on its own price but also on the price of the potential substitute. This observation is in line with the results from the microfounded general equilibrium literature, where the demand for loans depends i.a. on the ratio of the respective interest rate to the average interest rate of its (imperfect) substitutes (e.g. Brzoza-Brzezina and Makarski (2010)).

Hence, modelling the (real) demand for both, domestic and foreign currency loans we refer to the same set of explanatory variables: real income, the real cost of borrowing in domestic currency and the real cost of borrowing in foreign currency:

$$l^D = f(y, r^D, r^F, e) \quad (1)$$

$$l^F = f(y, r^D, r^F, e) \quad (2)$$

where  $l^D$  and  $l^F$  stand respectively for real domestic and foreign currency loans,  $y$  denotes real GDP,  $r^D$  denotes the real domestic interest rate,  $r^F$  denotes the real foreign interest rate and  $e$  stands for the nominal exchange rate.<sup>10</sup>

It should be noted that the real cost of borrowing in foreign currency, from the point of view of a resident, involves the nominal foreign interest rate deflated by (expected) domestic inflation and the expected change in the nominal exchange rate. Since we do not have consistent data on borrowers' expectations regarding inflation and the exchange rate, we deflate the interest rates with current domestic inflation and add the current exchange rate as a proxy for future expectations about the exchange rate.

In order to verify the robustness of our results we also consider an alternative specification, where the real interest rates are substituted with the nominal interest rate spread<sup>11</sup>:

$$l^D = f(y, spread, e) \quad (3)$$

<sup>10</sup>An increase in  $e$  means a depreciation of the local currency.

<sup>11</sup>The spread is defined as a difference between the domestic and foreign nominal interest rate.

$$l^F = f(y, spread, e) \quad (4)$$

This reflects the notion that agents may simply look at nominal interest rate spreads instead of calculating real rates when comparing domestic and foreign loans.

As already stated, the analysis investigates credit developments in the Czech Republic, Hungary, Poland and Slovakia. Since there was no unified database with all necessary time series, the data has been collected from different sources (see Appendix 1). We use a panel of quarterly data for the period 1997Q1–2008Q4 which leaves us with 48 observations per country. It should be noted that our sample deliberately does not include the strongest effects of the financial crisis. The turmoil struck Central European countries only in 2008Q4 and had its strongest effect on their economies in 2009.<sup>12</sup> This included not only a serious slowdown but also substantial changes to banks' lending behaviour. First, banks substantially tightened lending standards. Second, facing constraints on access to international interbank liquidity, they additionally limited foreign currency borrowing. We believe that this is a temporary phenomenon and that, once financial markets have calmed down, pre-crisis patterns in foreign currency borrowing will resume. Nevertheless, the very strong and rather unique developments during the crisis could affect our results and in our view it was safer to exclude them from the sample.

Domestic and foreign currency loans to the private sector<sup>13</sup> were always expressed in units of domestic currency.<sup>14</sup> They were deflated in both cases with the domestic GDP deflator. The calculations were based on average quarterly stocks of loans.<sup>15</sup>

Real GDP was measured at market prices of 2000. Domestic and foreign real interest rates were measured as quarterly averages of 3 month interbank rates deflated with the respective domestic GDP deflator.

As to the foreign interest rate, we decided to use the Euribor 3M. Foreign currency loans in the analysed countries have been granted mostly in Euros and Swiss Francs. Since their interest rates as well as their exchange rates against Central European currencies

<sup>12</sup>Excluding 2008Q4 from the sample does not change the results.

<sup>13</sup>Private sector is defined as corporations, households and non-profit institutions serving households.

<sup>14</sup>Foreign currency loans included jointly all loans denominated in foreign currency (i.e. Euro, Swiss Franc etc.).

<sup>15</sup>Due to data limitation for Slovakia till the end of 2001 foreign currency loans are taken as outstanding amount at the end of period and since 2002 as quarterly averages.



are highly correlated<sup>16</sup>, using the Swiss Franc instead of the Euro would not change significantly the results of the analysis. The lack of data on the detailed structure of foreign loans makes it impossible to use a weighted interest rate. It was also impossible to obtain time series of loans corrected for the direct impact of exchange rates for all the analysed countries.

GDP and loans were seasonally adjusted, additionally GDP, loans and exchange rates were taken in logs. All variables were tested for the order of integration (see Table 2 in Appendix 2). The tests pointed relatively unambiguously to a unit root in the loan and GDP series and stationarity of the real interest rates, which is consistent with several external studies (e.g. Shively (2001), Carpolare and Grier (2000)). The case with the interest rate spreads and the nominal exchange rates was less clear-cut. In our baseline specification we decided to treat these variables as stationary. Including the exchange rate in first difference does not affect the results significantly. We do not test spreads in first difference, since this would impair the interpretation and comparability of our results. However, one should remember that spreads have already been included as robustness checks.

## 4 Results

We test two empirical specifications of our model. First, we approach equations pairwise, using a seemingly unrelated regression (SUR) approach. This has the advantage of directly showing the significance of various factors in affecting domestic and foreign currency loans. At the same time SUR allows taking into account the possible correlation of shocks to domestic and foreign currency loans.

Although this approach is able to show how domestic interest rates affect domestic and foreign currency borrowing, it does not enable running a simulation that would show the substitution effect and its evolution over time. This is because some explanatory variables (e.g. GDP) may be also affected by changing interest rates, and so, impact on loans indirectly. For this reason our main specification relies on VAR models that encompass all variables of equations (1) and (2) or (3) and (4).<sup>17</sup>

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<sup>16</sup>The correlation coefficient of Swiss Franc and Euro interest rates is about 88% and the correlation between exchange rates of domestic currencies (Czech and Slovak Koruna, Forint and Zloty) against Swiss Franc and Euro ranges between 89% and 96%.

<sup>17</sup>It should be noted that both specifications used are linear, while the relationship between loans and interest rate spreads may be nonlinear. For instance, for small spreads agents may not even consider switching between currencies and so do not react to changing spreads. Similar things may happen for



Consistently with the unit-root tests, in all specifications GDP and loans were taken in log-difference. Therefore, in the SUR models the dependent variable was the quarter-on-quarter growth rate (i.e. change in log-level) of either real domestic currency loans or real foreign currency loans. Since there is always a considerable time lag between a decision to apply for a loan and the moment of granting the loan, we decided that all the variables would enter the estimated equations with the lag of one quarter. This also allows for mitigating the potential endogeneity problem present in the model (e.g. GDP affects loans, but loans affect GDP). We make only one exception to this rule – our models for foreign currency loans include additionally the current period first-differenced exchange rate. This is supposed to capture the direct "accounting" impact of the exchange rate on the foreign currency loans expressed in domestic currency units. Our empirical specifications for the SUR models are:

$$\Delta l_{i,t}^D = \kappa_i^D + \beta^D \Delta y_{i,t-1} + \gamma^D e_{i,t-1} + \lambda^D r_{i,t-1}^D + \theta^D r_{i,t-1}^F + \varepsilon_{i,t}^D \quad (5)$$

$$\Delta l_{i,t}^F = \kappa_i^F + \alpha \Delta e_{i,t} + \beta^F \Delta y_{i,t-1} + \gamma^F e_{i,t-1} + \lambda^F r_{i,t-1}^D + \theta^F r_{i,t-1}^F + \varepsilon_{i,t}^F \quad (6)$$

and

$$\Delta l_{i,t}^D = \kappa_i^D + \beta^D \Delta y_{i,t-1} + \gamma^D e_{i,t-1} + \lambda^D spread_{i,t-1} + \varepsilon_{i,t}^D \quad (7)$$

$$\Delta l_{i,t}^F = \kappa_i^F + \alpha \Delta e_{i,t} + \beta^F \Delta y_{i,t-1} + \gamma^F e_{i,t-1} + \lambda^F spread_{i,t-1} + \varepsilon_{i,t}^F \quad (8)$$

The estimation results are presented in Table 1. The main results are consistent across the two specifications. Both, domestic and foreign currency loans grow with GDP. The respective coefficients are always somewhat (though not significantly) smaller than one. As expected domestic currency loans react negatively both, to the domestic real interest rate and to the interest rate spread. They do not show any significant reaction to the foreign interest rate and the reaction to exchange rate movements is significant only in model (1). Foreign currency loans react positively to the current exchange rate. This reflects the "accounting" effect of transforming foreign currency loans into domes-

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sufficiently large spreads when everybody borrows in foreign currency and does not react to further changes in interest rates. We leave this issue for further research.

tic currency and for this reason cannot be given any further economic interpretation. The main result from the estimation is the positive reaction of foreign currency loans to domestic interest rates or spreads. This shows that, as expected in this paper, there is a significant substitution effect between domestic and foreign currency loans. Raising domestic interest rates trims domestic currency lending but boosts foreign currency loans.

Table 1: Estimation results: seemingly unrelated regression

Dependent variable	Independent variables	Model (5)-(6)	Model (7)-(8)
$\Delta l^D$	$\Delta y_{t-1}$	0.921***	0.837***
	$r_{t-1}^D$	-0.233***	
	$r_{t-1}^F$	-0.051	
	$spread_{t-1}$		-0.108**
	$e_{t-1}$	-0.005**	-0.003
	$const.$	0.030***	0.022***
R-squared		0.156	0.116
$\Delta l^F$	$\Delta e_t$	0.888***	0.884***
	$\Delta y_{t-1}$	0.915**	0.903**
	$r_{t-1}^D$	0.155*	
	$r_{t-1}^F$	-0.188	
	$spread_{t-1}$		0.153**
	$e_{t-1}$	0.000	0.000
	$const.$	0.013	0.012
R-squared		0.265	0.265
Breusch-Pagan test of independence		20.989***	20.124***

Note: \*, \*\*, \*\*\* denote significance at the 10%, 5% and 1% level respectively.

The presented models show that domestic monetary policy acts (at least to some extent) in a counterproductive way. However, they are not capable of answering the question about the magnitude of the substitution effect. This is because any simulation of domestic and foreign credit reaction to an interest rate shock conducted on their basis would be prone to the criticism that it does not take into account the indirect effects on loans via exchange rate or output reaction. For this reason we decided also to run a panel VAR<sup>18</sup> on our data and analyse the impulse responses of domestic and foreign currency loans to a domestic interest rate shock.

Similarly to what has been discussed above, we run two versions of the VAR models. The first one explicitly takes into account both domestic and foreign interest rates, whereas in the second version of the model only the interest rate spread is used. Additional variables used are common for both versions of the VAR specification: log-differenced foreign-

<sup>18</sup>We used the codes developed by Love and Zicchino (2006).

and domestic currency loans, log-differenced GDP and the log of the nominal exchange rate. Having in mind data limitations, we carefully analysed the optimal lag-length for the models. The VAR models with two lags (for both versions) proved to be the most stable, with a proper behaviour of residuals.

For the purpose of the appropriate shock specification for the impulse-response analysis, we considered a number of possible variable orderings<sup>19</sup>, having in mind our main research question, i.e. the response of domestic and foreign currency loans to a domestic interest rate shock. In the first version of the VAR model, with both foreign and domestic interest rates, we naturally consider the foreign interest rate independent of any domestic developments and order it first. In line with the mainstream approach to constructing monetary VARs, we order GDP as the first domestic variable and the domestic interest rate at the end. Both credit variables come before the domestic interest rate (with the foreign currency loans preceding the domestic currency loans – changing this ordering does not influence the results). Since we consider the exchange rate to be an important variable in deciding about the currency of a loan, we decided to place the exchange rate before the credit variables. So the final ordering of variables is as follows:  $[r^F, \Delta y, e, \Delta l^F, \Delta l^D, r^D]$ .

In the second version of the VAR model (with the spread variable) we place the spread instead of the domestic interest rate.<sup>20</sup> So for the second version of the VAR model the final ordering of variables is the following:  $[\Delta y, e, \Delta l^F, \Delta l^D, spread]$ .

As a robustness check we tried reasonable changes to this ordering, but the results were not qualitatively different. As a further robustness check we also used log-differences for the exchange rate. In this case significance of the impulse response functions slightly deteriorated, but overall conclusions were not changed. We present the relevant impulse response functions from both versions of the VAR model (together with 90% Monte Carlo confidence bounds) in Appendix 2. Most of the impulse response functions are in line with the consensus on the monetary transmission mechanism. GDP growth rate reacts negatively to a domestic interest rate or interest rate spread shock (Figures 7c and 10c). An unexpected tightening of domestic monetary policy also causes an initial appreciation of the exchange rate (Figures 7e and 10e). A depreciation shock to the domestic currency results in tightening of the domestic monetary policy (Figures 9d and 12d) and an increase in the GDP growth rate (Figures 9c and 12c). The depreciation shock has also an inter-

<sup>19</sup>For the impulse-response analysis we used the Cholesky decomposition.

<sup>20</sup>It is natural to consider most of the volatility in spread as coming from the domestic interest rate.

esting impact on the foreign currency loan growth rate (Figures 9a and 12a). An increase in the growth rate of the foreign currency loans observed in the first period is attributable to the "accounting" effect (as discussed in the further part of this section). After that there is a prolonged decrease in  $\Delta l^F$ , suggesting that potential borrowers react to the realisation of the exchange rate risk by reducing their demand for foreign currency loans.<sup>21</sup> The results obtained for the impulse response functions also seem to reflect the basic features of the previously estimated models, i.a. the negative reaction of the domestic currency loans (Figures 7b and 10b) and the positive reaction of the foreign currency loans (Figures 7a and 10a) to a domestic interest rate or interest rate spread shock.

On the basis of the estimated VAR models we are able to calculate a loan substitution effect. Broadly speaking, we define the substitution effect as the ratio of newly created foreign currency loans to destroyed domestic currency loans after a domestic interest rate or interest rate spread shock. Using the accumulated response of the foreign- and domestic currency loans in the periods following the shock, we are able to track the evolution of this substitution over time. More specifically, we define the substitution effect  $j$  periods after a shock ( $S_j$ ) in the following way:

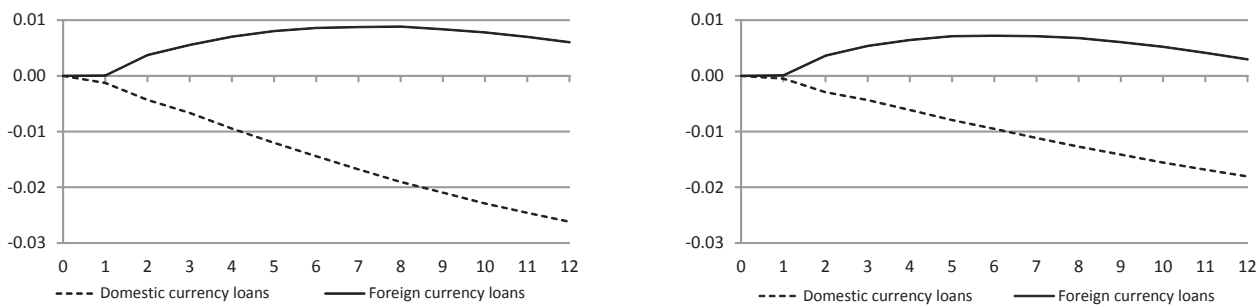
$$S_j = \frac{\widehat{l}^F \sum_{i=1}^j \widetilde{\Delta l_{T+i}^F}}{-\widehat{l}^D \sum_{i=1}^j \widetilde{\Delta l_{T+i}^D}} \quad (9)$$

where it is assumed that the domestic interest rate shock happens in period  $T$ . Further,  $\widetilde{\Delta l_{T+i}^F}$  and  $\widetilde{\Delta l_{T+i}^D}$  are the values of the impulse response functions for  $\Delta l^F$  and  $\Delta l^D$  respectively, after a domestic interest rate or interest rate spread shock. Finally,  $\widehat{l}^F$  as well as  $\widehat{l}^D$  denote the reference values for foreign- and domestic currency loans, respectively (see details below). The substitution effect for  $j = 0$  is not defined since  $\Delta l^F$  and  $\Delta l^D$  do not react in the period where the domestic interest rate shock is occurring (both  $r^D$  and *spread* are last in the VAR ordering used).

It needs to be noted that since we are using panel data, the results on substitution are dispersed between countries. This effect results directly from the different share of the foreign currency loans in total loans (more specifically – the ratio  $\frac{\widehat{l}^F}{\widehat{l}^D}$ ). In order to be explicit about the magnitude of the different effects involved, we present the size

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<sup>21</sup>We attribute this effect to the demand side of the credit market since the banks offering foreign currency loans hedge the exchange rate risk, while loan takers usually do not.



(a) Model specification:  $r^F, \Delta y, e, \Delta l^F, \Delta l^D, r^D$

(b) Model specification:  $\Delta y, e, \Delta l^F, \Delta l^D, spread$

Figure 1: Accumulated impulse response functions for  $\Delta l^D$  and  $\Delta l^F$  after a monetary policy shock.

of the substitution effect in two ways. First, we present the accumulated impulse response functions for foreign- and domestic currency loan changes after the domestic interest rate shock (that is:  $\sum_{i=1}^j \widetilde{\Delta l_{T+i}^F}$  and  $\sum_{i=1}^j \widetilde{\Delta l_{T+i}^D}$ , respectively – see Figure 1). This gives the picture of the percentage change of created/destroyed loans and is free of any assumptions about the relative importance of foreign and domestic currency loans at the time of the shock. After a contractionary monetary policy shock domestic currency loans decrease while foreign currency loans increase. Together with the previously presented SUR results this documents robustly the presence of the substitution effect.

To be more explicit, however, we also apply these accumulated effects to the sample means of volumes of both credit types separately for each country considered.<sup>22</sup> This gives the possible numerical size of the substitution effect.<sup>23</sup>

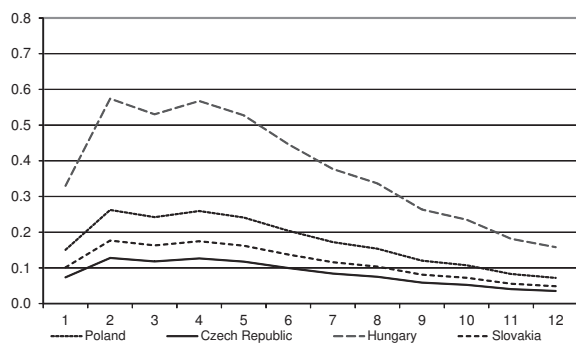
The results on the substitution effect are dispersed between countries<sup>24</sup> (see Figure 2). Within one year after the monetary policy shock the substitution effect ranges from about 12-14% in the Czech Republic to about 55-60% in Hungary. Consequently, the substitution effect in the Czech Republic may be considered negligible, with the results quite consistent across the model specifications used. However, its magnitude in Poland and, in particular, in Hungary cannot be ignored by policymakers.<sup>25</sup> It should be noted, however, that since

<sup>22</sup>So  $\widehat{l^F}$  is equal to the sample mean of the foreign currency loan value in a given country and  $\widehat{l^D}$  is the sample mean for domestic currency loans.

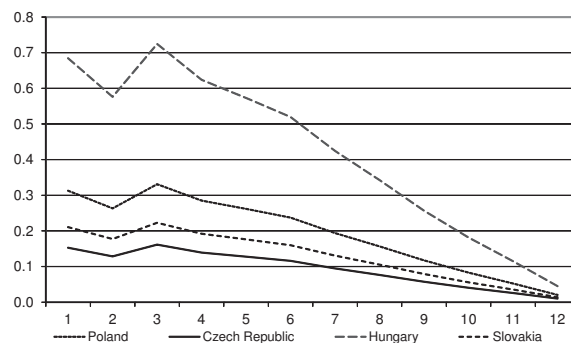
<sup>23</sup>We also considered presenting the substitution based on the last available information and not the sample mean, but we judge such an approach as potentially misleading since the last observation in our sample (2008Q4) already had been influenced by the financial crisis unfolding that, among other effects, resulted also in sharp depreciation of some currencies in our sample, artificially increasing the share of the foreign currency loans in total loans.

<sup>24</sup>This difference stems directly from and is proportional to the ratio  $\frac{\widehat{l^F}}{\widehat{l^D}}$ .

<sup>25</sup>It should be reemphasised here that these results are a simple consequence of applying panel estimates



(a) Model specification:  $r^F, \Delta y, e, \Delta l^F, \Delta l^D, r^D$



(b) Model specification:  $\Delta y, e, \Delta l^F, \Delta l^D, spread$

Figure 2: Estimated substitution effect based on average volumes of  $l^D$  and  $l^F$  in the sample.

all substitution coefficients remain below unity, the overall effect of a monetary contraction on total lending remains negative, despite the presence of the loan substitution.

As a robustness check, we also considered the potential impact of the "accounting" effect on our measures of substitution.<sup>26</sup> It turns out that after cleaning the impact of the "accounting" effect the estimated substitution effect is slightly higher, but overall conclusions of the paper do not change.

Given the simple approach our results should be regarded with some caution. Still, we believe that they document quite robustly not only the presence but also the nonnegligible size of the substitution effect in the region. All in all, this may complicate the central banks' influence on domestic credit creation and hence, impair the provision of monetary stability. One should also note that the presence of the loan substitution may change the patterns of monetary transmission. Switching from domestic to foreign currency loans may influence the exchange rate and, as a result, make the exchange rate channel more pronounced.

## 5 Conclusions

In this paper we analysed the impact of monetary policy on total bank lending in the presence of a developed market for foreign currency denominated loans. The relevance of this

to the different shares of domestic and foreign currency loans in the analysed countries and hence should be regarded with some caution.

<sup>26</sup>Since  $l_t^F$  is defined in terms of the local currency, it can be decomposed as  $l_t^F = l\_vol_t^F e_t$ , where  $l\_vol_t^F$  is the volume of foreign currency loans expressed in the original (foreign) currency. Therefore, in the definition (9) instead of  $\Delta l_{T+i}^F$  we use  $\Delta l\_vol_{T+i}^F e_T$ .



question is motivated by the potentially high substitutability between domestic and foreign currency loans. Since the central bank can only affect the cost of borrowing in domestic currency it cannot prevent lending in foreign currency and hence, may have only limited influence on total lending.

We based our empirical analysis on a panel of four biggest Central European countries: the Czech Republic, Hungary, Poland and Slovakia. The obtained results confirm that development of the market for foreign currency loans makes the job of the central bank more difficult. Although, as can be expected, a monetary tightening leads to a decrease in domestic currency lending, it has simultaneously an accelerating effect on foreign currency denominated loans. Therefore, instead of curbing credit growth, the central bank might rather end up changing the currency composition of new bank lending. Simulating the magnitude of the substitution effect shows a nonnegligible substitution between domestic and foreign currency loans in Poland and Hungary.

These results may be unpleasant for central banks. Although monetary authorities do not attempt to directly control the amount of credit in the economy, commercial bank lending plays an important role in their considerations. First, credit plays a significant role in the monetary transmission mechanism. Second, it has been shown in many countries that developments in monetary and credit aggregates can yield useful information about future real and nominal developments. Third, it has been recently argued that credit creation can be useful in assessing the overall created liquidity, even if, in the short and medium run, it does not affect consumer prices. Substitution between domestic and foreign currency loans weakens the central banks' indirect control over credit creation and hence, may make their job harder.

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## A Appendix 1: Data sources

The following sources of data for the econometric model were used:

1. Loans to the private sector:

- Loans denominated in domestic currency (i.e. Czech Koruna) to the private sector (households + non-financial corporations) in the Czech Republic – source: Czech National Bank (CZK millions)
- Loans denominated in domestic currency (i.e. Hungarian Forint) to the private sector (households + non-financial corporations + non-profit institutions serving households) in Hungary – source: National Bank of Hungary (HUF billions)
- Loans denominated in domestic currency (i.e. Polish Zloty) to the private sector (households + non-financial corporations + non-profit institutions serving households) in Poland – source: National Bank of Poland (PLN millions)
- Loans denominated in domestic currency (i.e. Slovak Koruna) to the private sector (households + non-financial corporations + non-profit institutions serving households) in Slovakia – source: National Bank of Slovakia (SKK billions)
- Loans denominated in foreign currency (all currencies other than domestic currency) to the private sector (households + non-financial corporations + non-profit institutions serving households) in the Czech Republic – source: Czech National Bank (CZK millions)
- Loans denominated in foreign currency (all currencies other than domestic currency) to the private sector (households + non-financial corporations + non-profit institutions serving households) in Hungary – source: National Bank of Hungary (HUF billions)
- Loans denominated in foreign currency (all currencies other than domestic currency) to the private sector (households + non-financial corporations + non-profit institutions serving households) in Poland – source: National Bank of Poland (PLN millions)
- Loans denominated in foreign currency (all currencies other than domestic currency) to the private sector (households + non-financial corporations +



non-profit institutions serving households) in Slovakia – source: National Bank of Slovakia (SKK billions)

2. GDP at market prices of 2000 (Millions of national currency – i.e. Czech Koruna, Hungarian Forint, Polish Zloty and Slovak Koruna respectively)

- the Czech Republic, Hungary, Poland, Slovakia – source: Eurostat

3. GDP deflator (prices of 2000)

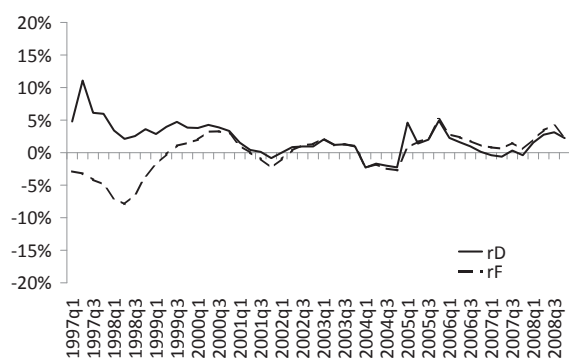
- the Czech Republic, Hungary, Poland, Slovakia – own calculations based on Eurostat data

4. Nominal interest rate – Interbank Rates (3 Month, Fixing)

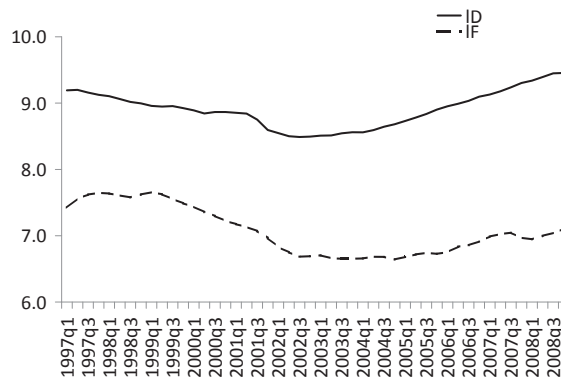
- the Czech Republic, Hungary, Poland, Slovakia, Euro Area – source: EcoWin

5. Nominal exchange rate – Euro exchange rates against national currency

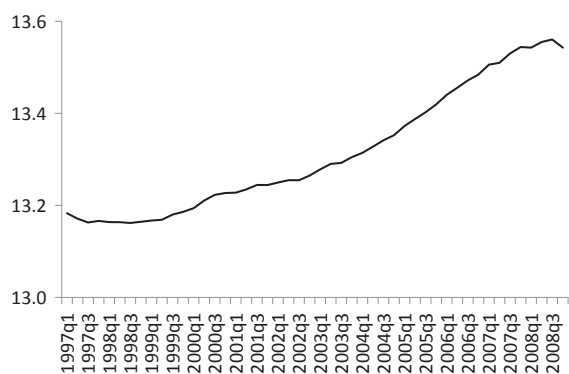
- the Czech Republic, Hungary, Poland, Slovakia – EcoWin data



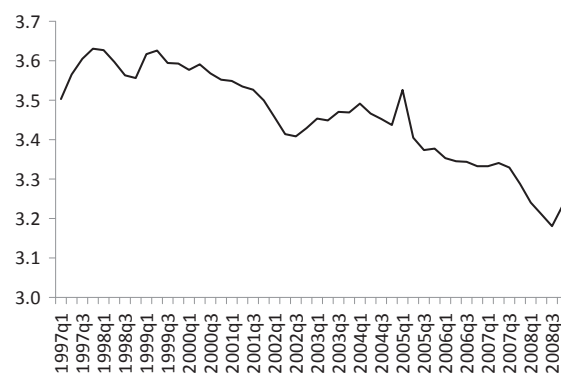
(a) Real interest rates



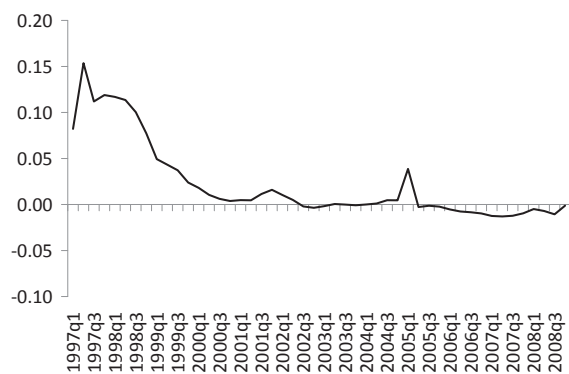
(b) Real domestic and foreign currency loans (log)



(c) Real GDP (log)

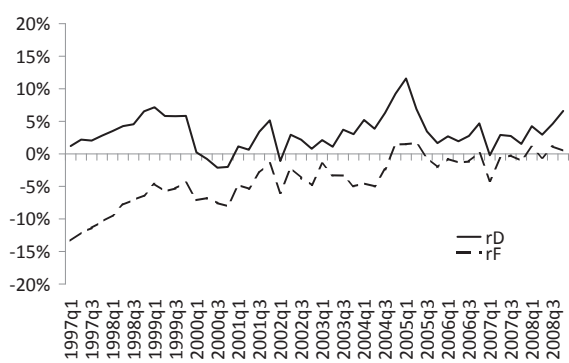


(d) Euro nominal exchange rate (log)

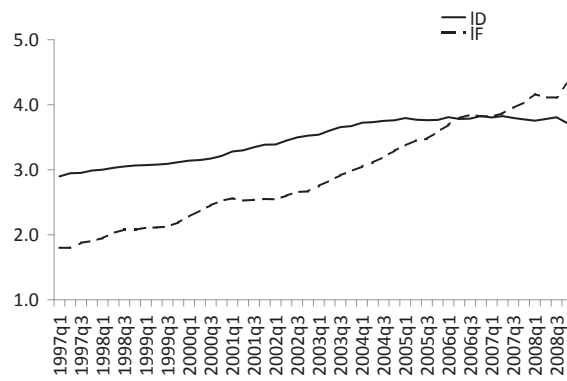


(e) Spread

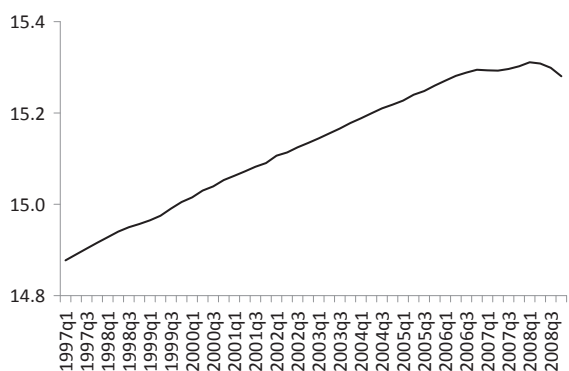
Figure 3: Data for the Czech Republic.



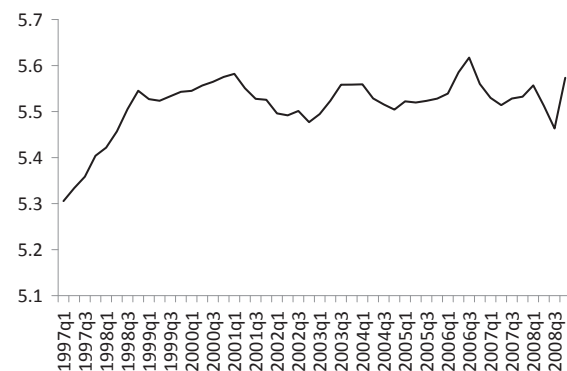
(a) Real interest rates



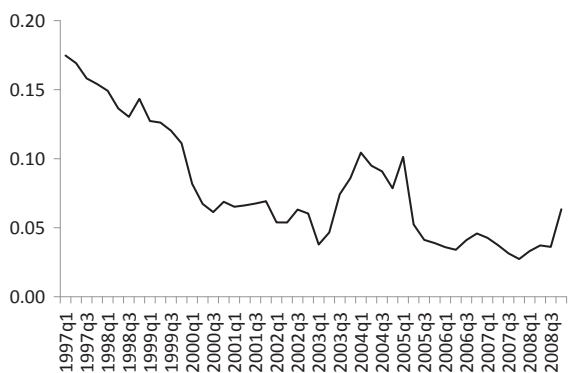
(b) Real domestic and foreign currency loans (log)



(c) Real GDP (log)

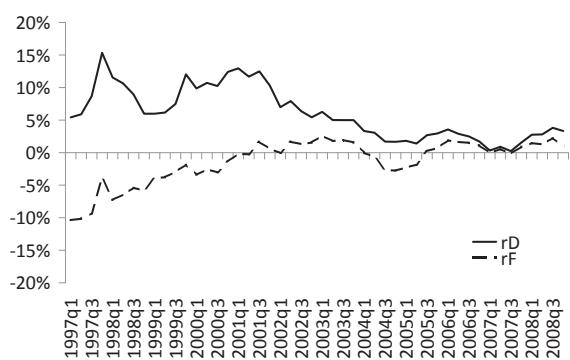


(d) Euro nominal exchange rate (log)

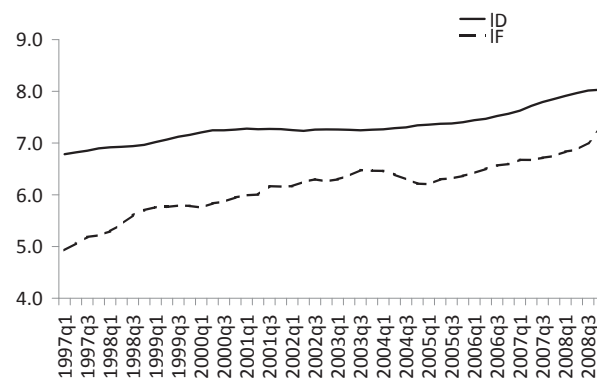


(e) Spread

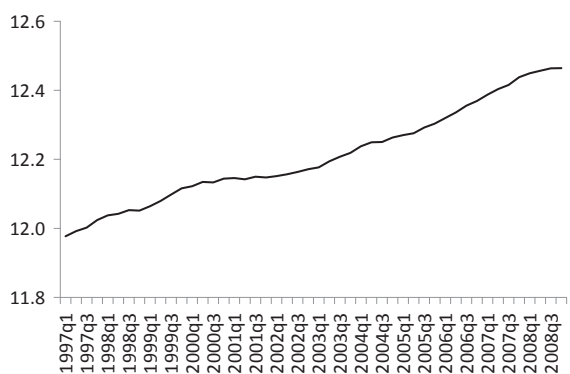
Figure 4: Data for Hungary.



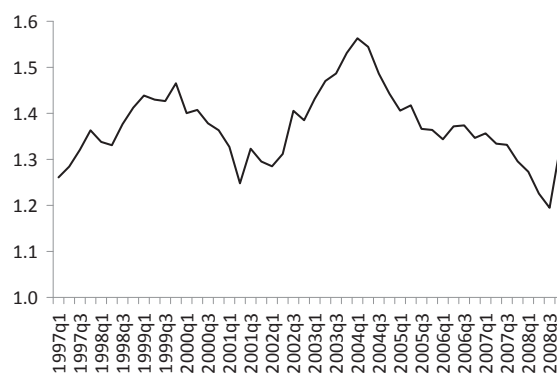
(a) Real interest rates



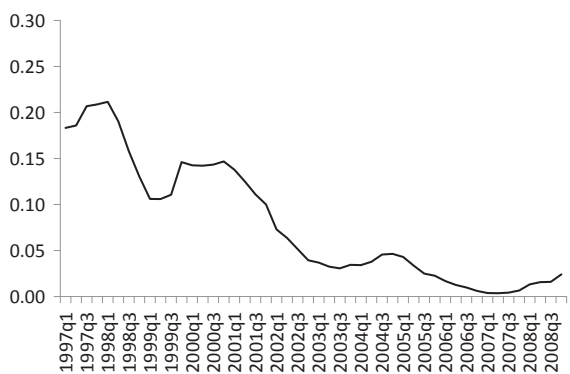
(b) Real domestic and foreign currency loans (log)



(c) Real GDP (log)

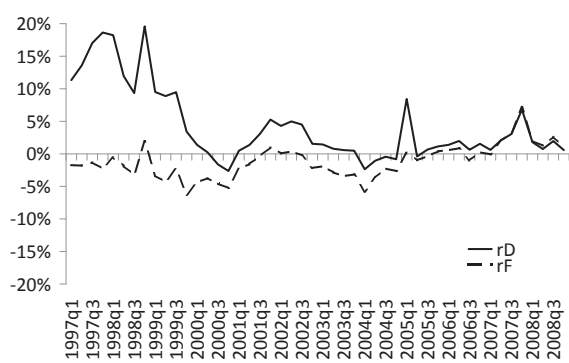


(d) Euro nominal exchange rate (log)

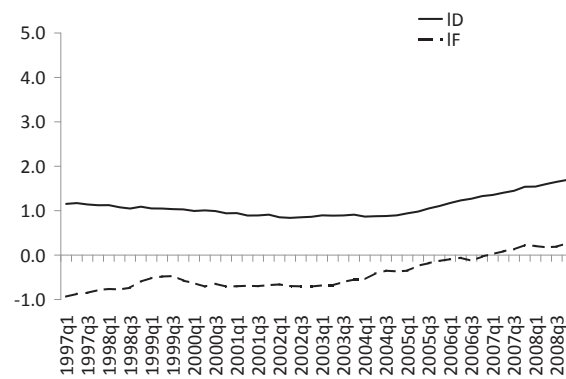


(e) Spread

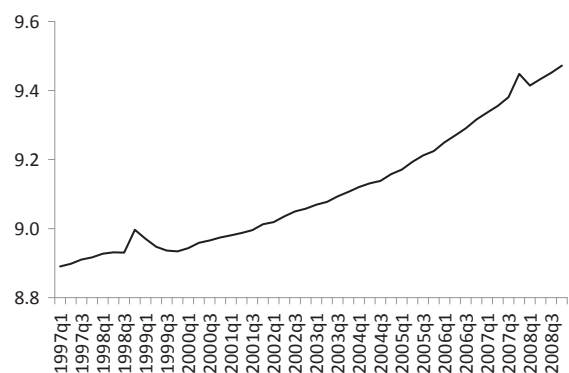
Figure 5: Data for Poland.



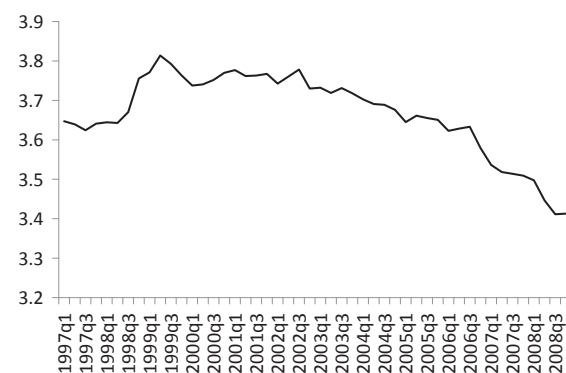
(a) Real interest rates



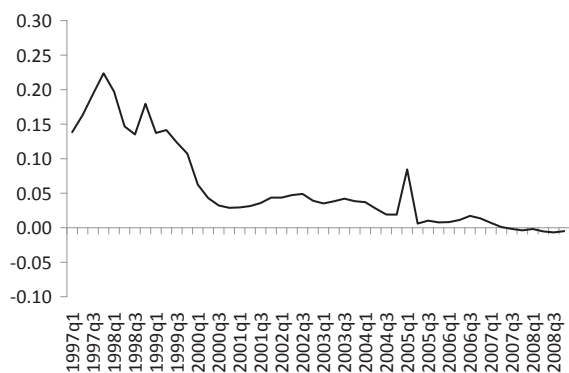
(b) Real domestic and foreign currency loans  
(log)



(c) Real GDP (log)



(d) Euro nominal exchange rate (log)



(e) Spread

Figure 6: Data for Slovakia.

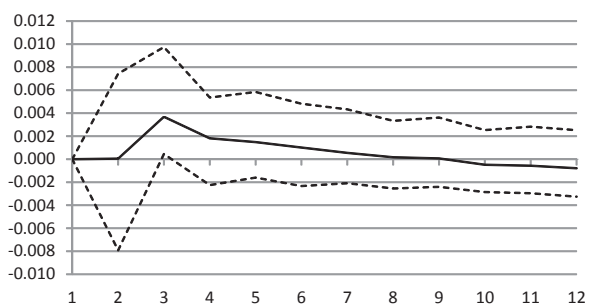
## B Appendix 2: Estimation results

Table 2: Panel unit root tests

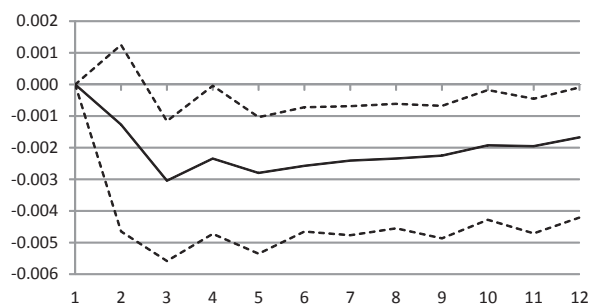
Variable	ADF		PP	
	Statistic	p-value	Statistic	p-value
$e$	12.78	0.120	15.17	0.056
$\Delta e$	82.80	0.000	82.73	0.000
$y$	3.39	0.907	7.04	0.532
$\Delta y$	41.58	0.000	59.16	0.000
$l^D$	7.30	0.505	1.33	0.995
$\Delta l^D$	15.30	0.054	35.98	0.000
$l^F$	3.33	0.912	1.50	0.993
$\Delta l^F$	63.46	0.000	63.48	0.000
$r^D$	21.49	0.006	18.06	0.021
$r^F$	16.11	0.041	12.62	0.126
$spread$	17.05	0.030	6.39	0.604
$\Delta spread$	116.54	0.000	120.15	0.000

Note:  $H_0$  assumes unit root. Lag selection according to Schwarz criterion. Individual intercepts assumed.

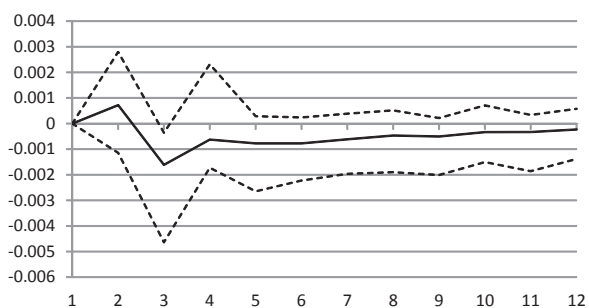




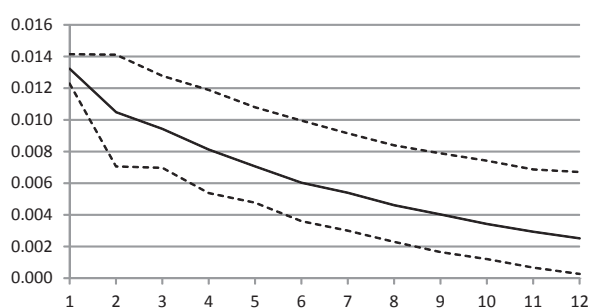
(a) Response of  $\Delta l^F$  to  $r^D$  shock



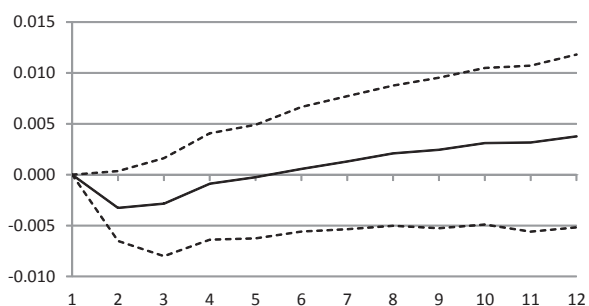
(b) Response of  $\Delta l^D$  to  $r^D$  shock



(c) Response of  $\Delta y$  to  $r^D$  shock

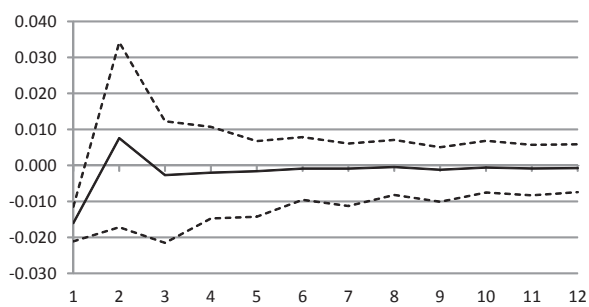


(d) Response of  $r^D$  to  $r^D$  shock

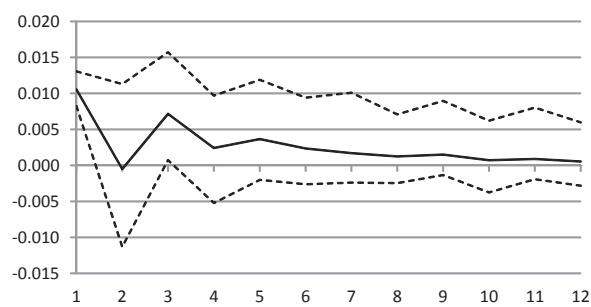


(e) Response of  $e$  to  $r^D$  shock

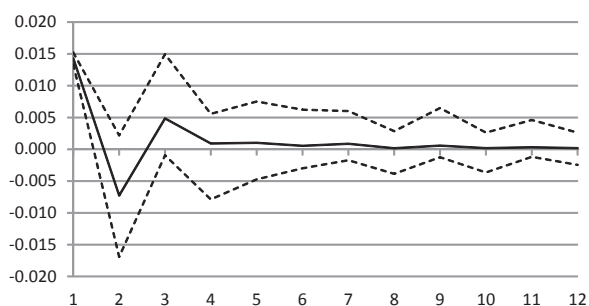
Figure 7: Impulse response functions for the VAR model with domestic and foreign interest rates. Domestic interest rate shock.



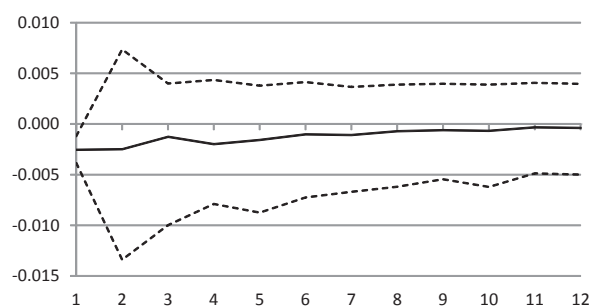
(a) Response of  $\Delta l^F$  to  $\Delta y$  shock



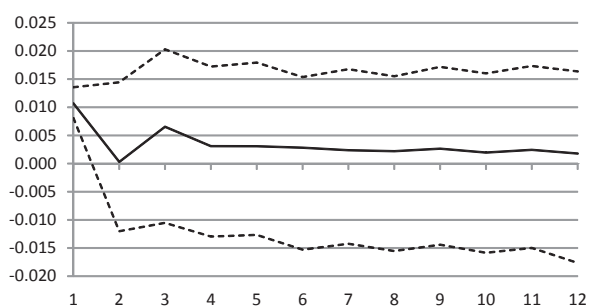
(b) Response of  $\Delta l^D$  to  $\Delta y$  shock



(c) Response of  $\Delta y$  to  $\Delta y$  shock

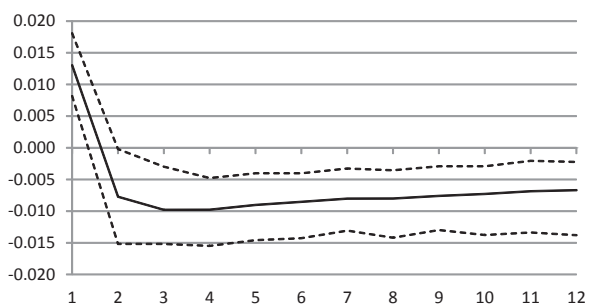


(d) Response of  $r^D$  to  $\Delta y$  shock

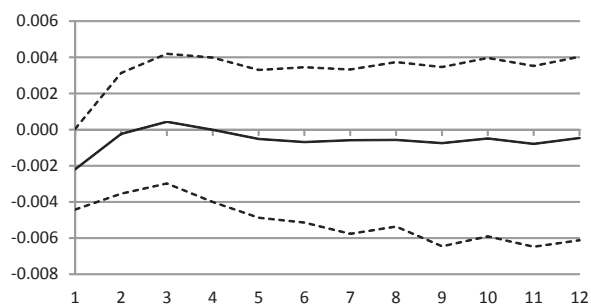


(e) Response of  $e$  to  $\Delta y$  shock

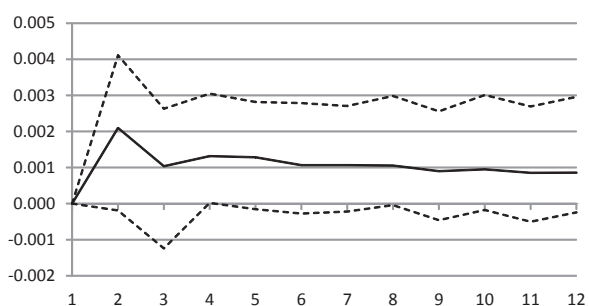
Figure 8: Impulse response functions for the VAR model with domestic and foreign interest rates. Domestic GDP growth rate shock.



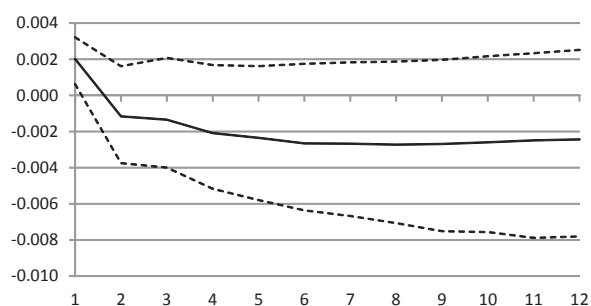
(a) Response of  $\Delta l^F$  to  $e$  shock



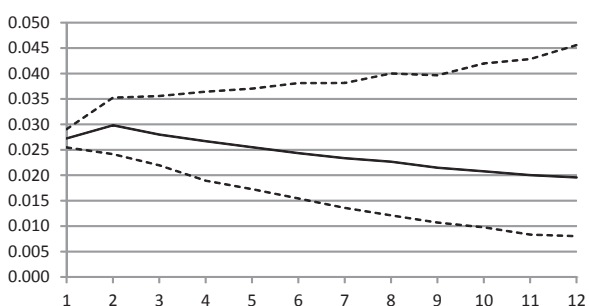
(b) Response of  $\Delta l^D$  to  $e$  shock



(c) Response of  $\Delta y$  to  $e$  shock

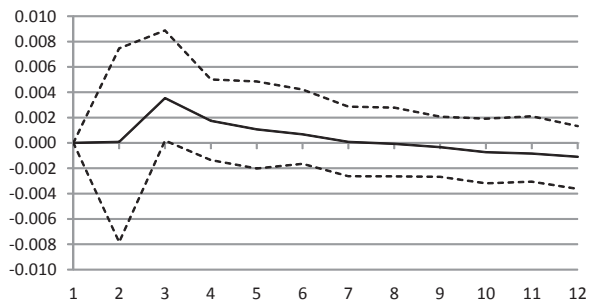


(d) Response of  $r^D$  to  $e$  shock

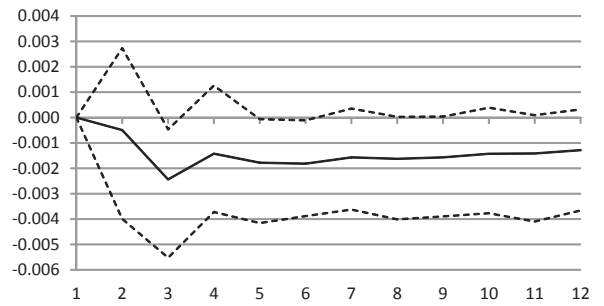


(e) Response of  $e$  to  $e$  shock

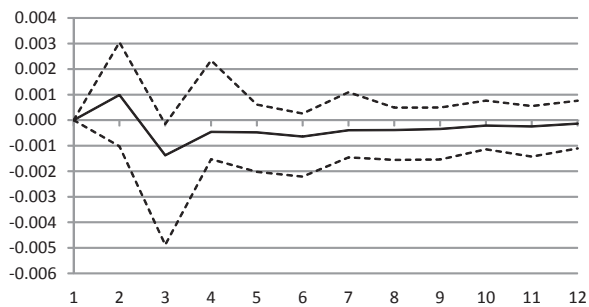
Figure 9: Impulse response functions for the VAR model with domestic and foreign interest rates. Nominal exchange rate shock (depreciation).



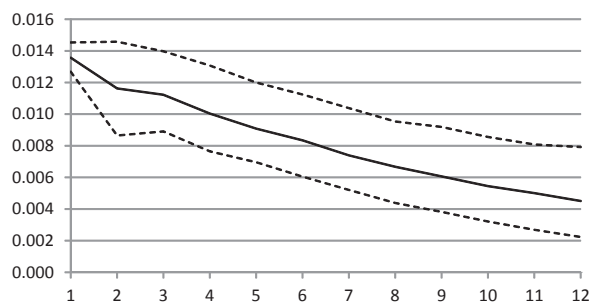
(a) Response of  $\Delta l^F$  to *spread* shock



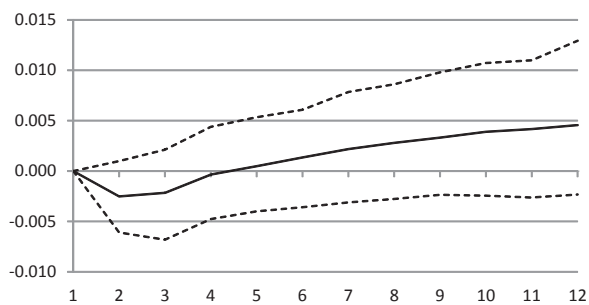
(b) Response of  $\Delta l^D$  to *spread* shock



(c) Response of  $\Delta y$  to *spread* shock

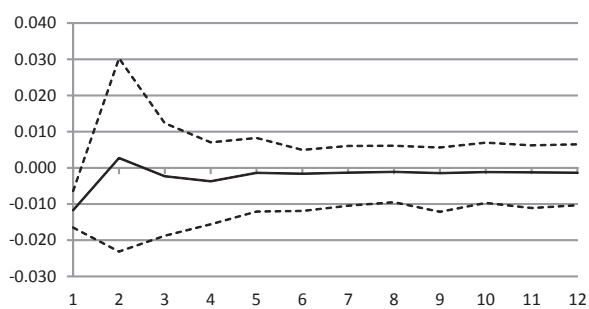


(d) Response of *spread* to *spread* shock

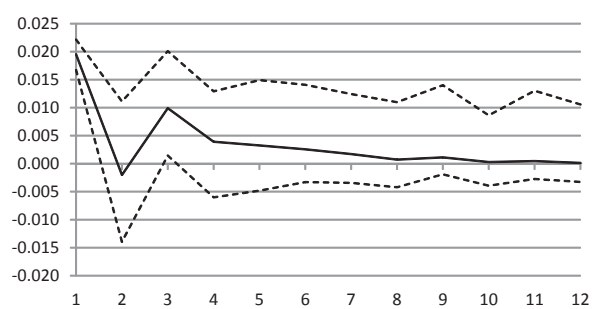


(e) Response of  $e$  to *spread* shock

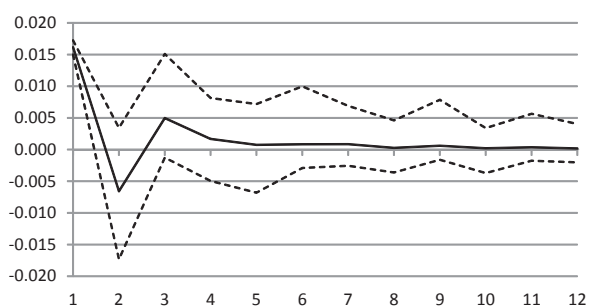
Figure 10: Impulse response functions for the VAR model with interest rate spread. Interest rate spread shock.



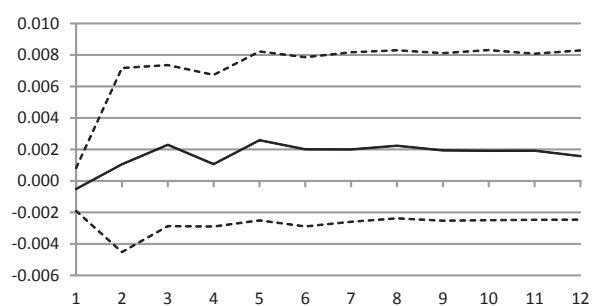
(a) Response of  $\Delta l^F$  to  $\Delta y$  shock



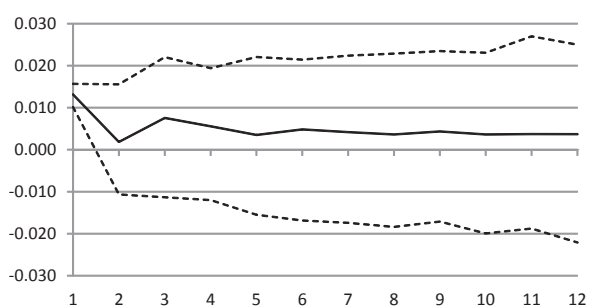
(b) Response of  $\Delta l^D$  to  $\Delta y$  shock



(c) Response of  $\Delta y$  to  $\Delta y$  shock

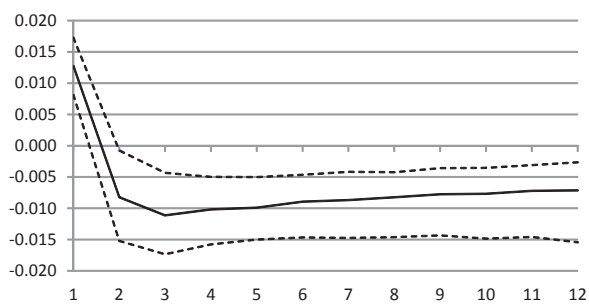


(d) Response of *spread* to  $\Delta y$  shock

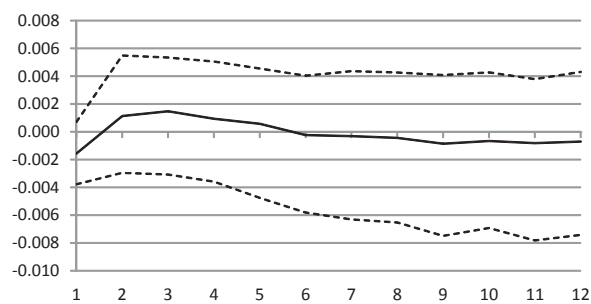


(e) Response of  $e$  to  $\Delta y$  shock

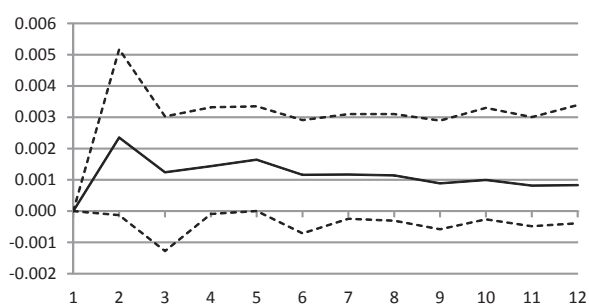
Figure 11: Impulse response functions for the VAR model with interest rate spread. Domestic GDP growth rate shock.



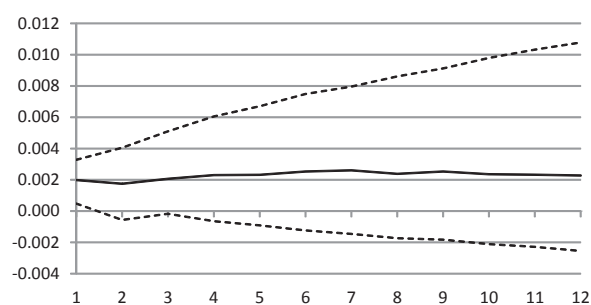
(a) Response of  $\Delta l^F$  to  $e$  shock



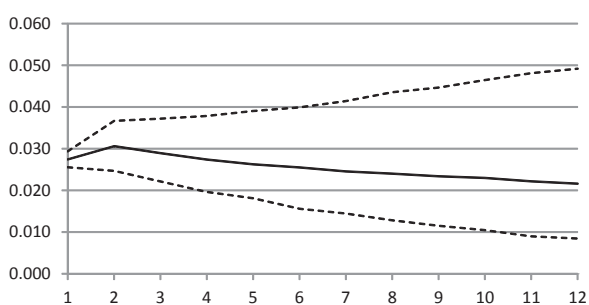
(b) Response of  $\Delta l^D$  to  $e$  shock



(c) Response of  $\Delta y$  to  $e$  shock



(d) Response of  $spread$  to  $e$  shock



(e) Response of  $e$  to  $e$  shock

Figure 12: Impulse response functions for the VAR model with interest rate spread. Nominal exchange rate shock (depreciation).

