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ABSTRACT

In recent years, an increasing share of private sector credit in the Emerging European markets of Central, Eastern and Southeastern Europe (CESEE) has been denominated in foreign currency, a process also referred to as credit euroization. Despite warnings from researchers and central banks, the inherent risks associated with foreign currency (FX) lending have been underestimated or neglected by banks and borrowers. The global financial crisis induced a materialization of these risk factors. The weakening of Emerging European currencies against the Euro and the Swiss franc led to a significant increase in the real costs of unhedged FX borrowing and consequently higher expected credit default risks for banks. The aim of this paper is to analyze the process of credit euroization in Emerging Europe and investigate the motives of borrowers and lenders to engage in FX lending. Building on a comprehensive review of the existing literature, a model of credit euroization is developed and tested empirically on 13 Emerging European countries over the pre-crisis period 1999 to 2007. We find evidence that underpins the concept of the foreign funds channel, as developed theoretically in this paper. The results suggest that credit euroization is driven by foreign borrowings, but that it is irrelevant whether the funds are channeled into the system via subsidiaries of Western banks (foreign bank channel) or via domestic banks borrowing abroad.

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1 INTRODUCTION

Emerging Europe, i.e. countries in transition from planned to market economies in Central, Eastern and Southeastern Europe (CESEE) has been one of the most dynamic growth regions in the past years. Robust economic growth and the anticipation of EU integration fostered financial deepening (Bonin, Hasan and Wachtel, 2009; Eller, Frömmel and Srzentic, 2010; Fink, Haisss and Vuksic, 2009). Rising incomes, the increase in banking sector activities and financial integration with more developed countries triggered an unprecedented credit growth throughout the region (Aydin 2008, 4; EBRD, 2010). The denomination of an increasing share of these credits in foreign currency has become a distinctive feature of the catching-up process in the region (Rosenberg and Tirpák 2008, 3). This phenomenon, which is also referred to as credit dollarization or credit euroization[1], however, exposes the financial system to a number of additional risk factors (Bordo, Meissner and Stuckler, 2010). Most importantly, 'the degree of loan dollarization determines the financial system's exposure to systemic credit risk in the case of large devaluations' (Ize and Levy-Yeyati 2003, 325). The situation is further aggravated by an increasing share of household foreign currency borrowing. Households normally do not have foreign currency income and thus are directly exposed to currency fluctuations. In the corporate sector, risks tend to be less pronounced, as firm's export revenues can, at least to some degree, provide a natural hedge to foreign currency debt (ECB 2008, 48)[2]. Given the apparently high risk factors, the questions arise what the motives are of lending and borrowing in foreign currency.

Credit euroization, however, is not uniform across the CESEE region (Figure 1). First, there are countries in Emerging Europe in which FX and FX indexed[3] loans contribute more than two thirds of total private sector lending. This applies to the Baltic countries, Serbia and Albania. Second, there is a comparatively large group of countries where between one third and two thirds of total private sector loans are denominated in foreign currency. This group consists of Croatia, Hungary, Romania, Bulgaria, Macedonia, Moldova and Poland. Lastly, there are three countries, where FX loans play a relatively minor role, namely Russia, Slovakia and the Czech Republic.

The Euro is by far the dominant currency for FX-Loans in the region. Figure 3 shows that, except for Hungary, more than 90% of all FX-Loans in the selected countries where data are available are denominated in Euro. In Hungary, two thirds of all FX-Loans are denominated in Swiss Franc. The US Dollar and the Japanese Yen play only minor roles in some countries.

Researchers, central banks and even rating agencies have monitored the spreading of FX loans in Emerging Europe for quite some time and pointed to the inherent risk factors associated with FX lending (see e.g. Waschiczek 2002, Epstein and Tzaninis 2005, Got and Ross 2006, Croatian National Bank 2006b, National Bank of Serbia 2007a, Magyar Nemzeti Bank 2006; Nandy, 2010). Bordo et al (2010) analyze the interaction of foreign currency debt, financial crises, and economic growth. They find strong evidence that both hard currency debts and currency inflows are associated with crises that show negative influence both short-term on growth and long-term

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[1] Both terms credit dollarization and credit euroization are used interchangeably in this paper and refer to the share of foreign currency loans in total loans in a particular country or sub-sector thereof (e.g. households, non-financial corporations, private non-financial sector, etc.).

[2] In fact, firms might even decide to take out an FX loan in order to reduce exchange risk arising from export activities.

[3] E.g. in Croatia, Swiss franc-indexed loans are of particular importance. See eg. CNB (2011, 44).

on output. For Eastern European countries they find that higher levels of foreign currency debt are associated with higher risk of losing economic growth in course of a currency crisis.

These warnings, however, appear to have been neglected, as FX loans continued to gain popularity in recent years. A possible explanation of the apparent underestimation of the risk factors of FX lending, relates to the fact that until shortly these risks did not materialize. This, however, has changed markedly since the onset of the global economic crisis. Worries have increased about potential spillover effects, stemming from the strong reliance on external funding (Walko 2009, 76). The economic crisis has unambiguously shown the risks arising from adverse foreign exchange movements. After the onset of the crisis, CESEE countries with flexible exchange rate regimes have recorded substantial depreciations of their local currencies (Fitch Ratings 2009, 13; IMF 2010, 68). Across Emerging Europe, currencies have depreciated up to 28% against the Euro and up to 33% against the Swiss Franc over the period June 2008 to April 2009 (Figure 2). This development significantly increased the debt burden of unhedged foreign currency borrowers, as both interest and redemption payments increased in local currency terms.

Figure 1: Share of FX loans in total private sector loans in Emerging Europe (2009)
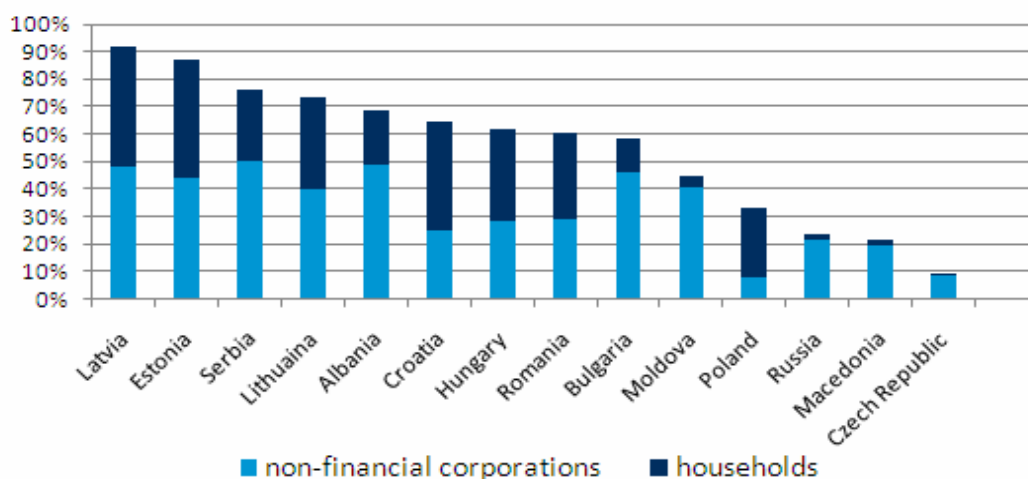
Note: Due to data restraints, the figures do not include FX indexed loans for Croatia and Macedonia.
Source: Author's own calculations, data from National Banks of the individual countries.

It is important to note that the increasing debt burden for FX borrowers is not just a paper loss. This can be seen from the fact that banks in the region significantly increased provisions for impairment losses over 2008 to 2010, reflecting their expectations on credit default rates. Table 1 shows that the five biggest Austrian banks, which are all major players in CESEE, on average more than doubled their provisions for impairment losses in 2008. The increases were even more significant in the first quarter of 2009. Raiffeisen Bank International (RBI), Erste Bank and Bank Austria increased the provisions by 370%, 127% and 222%, respectively. In this respect, RBI reported a significant increase of overdue loans in the first quarter of 2009, especially in the case of foreign currency loans (Raiffeisen International 2009b, 8). As a consequence, provisions for impairments had to be increased by 379% to €445 million, with the highest increases in the Ukraine, Russia, Hungary and Serbia. Generally, RBI reported a further increase in provisions

for impairment, 'primarily because of the combination of currency devaluation and a high proportion of foreign currency loans in countries like Ukraine, Romania and Hungary' (Raiffeisen International 2009, 7) amidst the crisis.

Figure 2: CESEE exchange rates vs. EUR and CHF 06/2008 – 04/2009
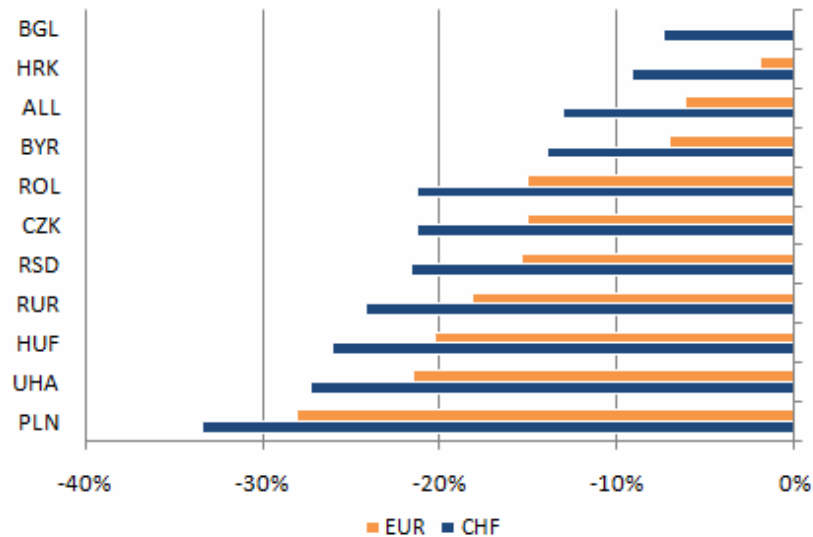
Source: Author's own calculation, data from EIU Country Data

The materialization of exchange rate risks associated with FX lending rather induced banks to take restrictive measures. In 2008, Erste Bank already stopped granting CHF-denominated credits in Austria and Hungary and tightened the criteria for obtaining EUR-denominated foreign currency credits, particularly reducing retail FX lending to households (Erste Group 2009a, 3). Similarly, Hypo Group Alpe Adria reported that it stopped all foreign currency lending activities in USD and CHF in the autumn of 2008 (Hypo Group Alpe Adria 2009, 56). In Hungary, which is among the countries with the highest share of FX loans, banks completely stopped granting loans denominated in Swiss Franc (CHF), which until then represented over 90% of new mortgage loans (Erste Group 2009a, 56). As part of the European Bank Coordination Initiative ("Vienna Initiative"), EU-based parent banks also pledged to keep their exposures and to recapitalize their CESEE operations if needed (Nitsche, 2010).

Central banks and governments also revised their policies towards FX lending (EBRD, 2010; Steiner 2011; UniCredit 2011a). The Ukraine prohibited FX lending to unhedged borrowers in October 2008, Turkey for FX lending to individuals in June 2009. Poland raised disclosure requirements for residential loans in FX, Romania applied stricter loan-to-value ratios, Hungary banned mortgage FX-lending and introduced additionally payment-to-income-ratios according to currency denomination for household lending and struck an agreement on FX mortgage loan conversion, Swedish banks had to revise their FX lending policies in the Baltics upon supervisory intervention, Croatia undertook a bouquet of measures. On the other hand, several countries relaxed previous FX-lending policies e.g. with regard to reserve requirements, provisioning, quotas, capital adequacy requirements at the time (Edgeworth and Toth, 2011; EBRD, 2010; Steiner, 2011). In some cases government intervention to combat the financial

crisis (e.g, subsidies, state-directed lending in) further influenced the currency mix towards local currency lending.[1] Drawing on a household survey, Beckmann, Scheiber and Stix (2011) report that CESEE households have come to perceive FX loans as riskier over the crisis, but that FX borrowing is still regarded highly attractive. Fidrmuc, Hake and Stix (2011) argue that the high persistency of household FX borrowing is rooted in the lack of alternative financial products. This suggests that FY borrowing is unlikely to vanish.

Table 1: Provisions for impairment losses in the early crisis

(€m)	2007	2008	%	Q1 2008	Q1 2009	%
Raiffeisen International	357	780	+119%	93	445	+379%
Erste Bank	455	1,071	+135%	163	370	+127%
Bank Austria/ UniCredit	483	1,012	+109%	103	332	+222%
Volksbank International	43	72	+69%	n/a	n/a	n/a
Hypo Alpe Adria Group	274	533	+95%	n/a	n/a	n/a

Source :Raiffeisen International 2009a, 2009b, Erste Group 2009a, 2009b, Bank Austria 2009a, 2009b, Volksbank International 2009, Hypo Group Alpe Adria 2009

In conclusion, this brief demonstration of the riskiness of FX lending, albeit based on anecdotal evidence, demonstrates the importance of theoretical and empirical research on this subject. A thorough understanding of the driving factors of households and corporations to engage in FX lending is necessary, in order for policy makers to tailor reactive measures. So far, most studies on this matter concentrated on FX lending to the private sector as a whole (with e.g. Basso, Calco-Gonzales and Jurgilas 2011 as a prominent exemption) or are concentrated on single or a few countries (e.g. Bogoev 2011 on Macedonia; Pellenyi and Bilek 2009 on Hungary; Braun, Kirschenmann and Ongena on Bulgarian firms; Chailloux, Ohnsorge and Vavra 2010 on Serbia; Metin-Özcan and Us 2009 on Turkey; Pann, Seliger & Übeleis 2011 on Austrian banks). This paper aims to fill this gap by estimating a model of credit euroization for households, corporations and the private sector separately.

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[1] Given these stronger regulatory changes amidst the crisis, we limit our empirical investigation to the pre-crisis period.

Figure 3: Currency denomination of FX-loans in selected CESEE countries, 2009
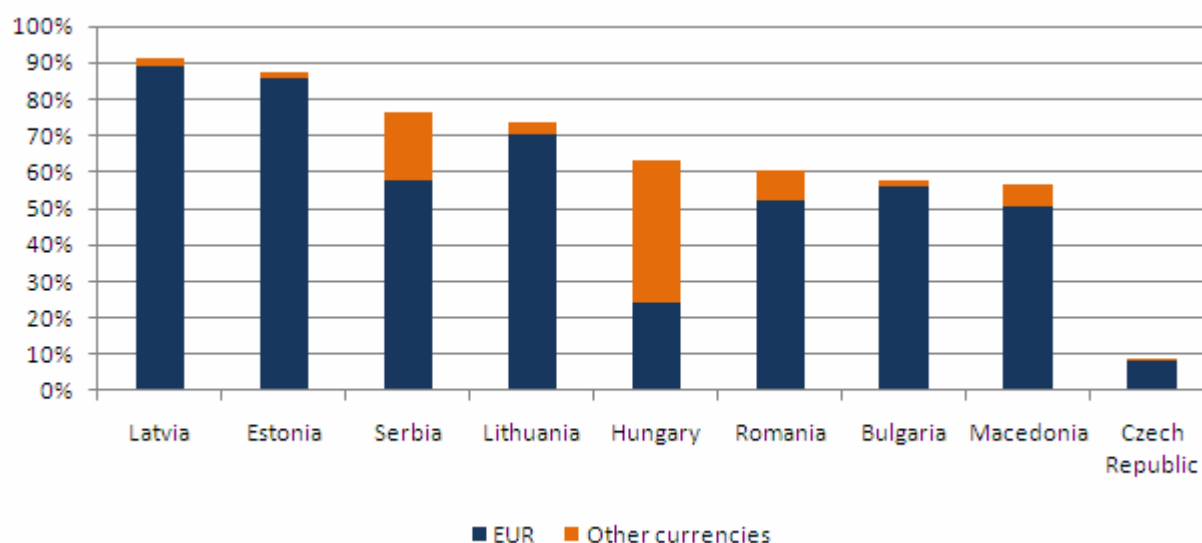
Note: Share of FX-loans in total private sector loans according to currency denomination; Macedonia: banking sector assets in foreign currency; For Hungary and Serbia other currencies consist mostly of CHF. All data as of end 2009.
Source: Author's own calculations, data from National Banks of the individual countries.

The remainder of this paper is structured as follows. Chapter 2 gives an overview of empirical studies on credit euroization. Based on the overview, chapter 3 introduces the concept of the foreign funds channel. Chapter 4 presents the empirical models. The methodology and underlying data are presented in chapter 5. Chapter 6 presents the results of the estimations. Chapter 7 concludes.

2 LITERATURE REVIEW

The existing literature on credit euroization can be divided into two streams. The first part consists of empirical surveys, where the respondents can be either national authorities (e.g. ECB 2006b) or individuals (e.g. Dvorsky et al. 2008b, Beer, Ongena and Peter 2010; Fidrmuc et al, 2011). The second part focuses on macroeconomic modeling of foreign currency lending. Quite a number of macroeconomic variables are used to explain cross-country differences and/or time trends in FX lending. Some of the more often used variables will be discussed in the following part.

A variable, which is believed to be one of the most important explanatory variables for credit euroization, is the ***interest rate differential***, i.e. the difference between the domestic lending rate and the foreign lending rate (Rosenberg and Tirpák, 2008; Zellemeyer, Nagy and Jeffrey, 2010). A lower interest rate on a loan denominated in a foreign currency directly lowers the relative cost of credit vis-à-vis a domestic currency loan, other things being equal. As a result, a positive interest rate differential (foreign interest rate is lower than domestic interest rate) should increase demand for FX loans. Empirical results on the role of the interest differential are mixed. For aggregate FX loans, Rosenberg and Tirpák (2008) find a positive and highly significant relationship between the interest differential and the share of FX loans in total domestic bank

loans. Similarly, Basso et al. (2011) find that the interest differential has a positive impact on loan dollarization. Additionally, they find that the interest differential is better in explaining changes in dollarization, as opposed to levels (Basso et al. 2011). The findings of Brown, Ongena and Yesin (2011) on SME-loans are in stark contrast to this. Using firm level data they find that the interest differential can explain cross-country differences in loan dollarization, but cannot explain country-level changes of loan dollarization over time (Brown et al. 2011, 40). Epstein and Tzanninis (2005) find evidence that the interest differential can explain short-term dynamics of foreign currency lending in Austria, but is poor in explaining long-term trends. Arteta (2005) finds no constant result for the interest differential across different model specifications. While most empirical studies rely on a stock measure of FX loans, Csajbók et al find a strong impact of the interest rate differential on a flow measure of household lending, whereas they use as proxy the share of new FX loans in total new loans. Instead of the interest differential, Bednařík (2007) uses the interest rate on foreign currency loans as an explanatory variable and finds that it is statistically significantly correlated with FX lending in three out of 4 cases, with negative coefficients in all cases (Bednařík 2007, 8).

Another variable used to explain credit euroization is the share of ***foreign currency deposits*** in total deposits. Banks are typically prevented by regulation to exhibit large currency mismatches on their balance sheets (Calvo 2002, 401). These would occur if banks receive deposits in foreign currency and lend in local currency. Banks thus try to align the amount of foreign currency loans they grant with the amount of foreign currency deposits they hold (Ozsoz, Regifo and Salvatore, 2010). Neandis and Savva (2009) show that short-run loan dollarization in transition economies is mainly driven by banks matching of domestic loans and deposits. Anecdotic evidence also suggests that foreign currency deposits are an important source of domestic funding for foreign currency loans (Erste Group 2009a, 51). Luca and Petrova (2008) find deposit dollarization for CEE countries to be one of the main determinants of credit dollarization, together with bank's net foreign assets (Luca and Petrova 2008, 864). Barajas (2003) finds that FX deposits correlate with FX loans, with a beta lower than one (Barajas 2003, 27). He explains the beta of less than one by the fact that reserve requirements and limits on open foreign exchange positions prevent banks from directly lending the total amount they receive from FX deposits (Barajas 2003, 27p). The EBRD (2010) also finds that the currency structure of bank deposits is a key determinant of FX lending.

Rosenberg and Tirpák (2008) introduce the ***loan-to-deposit ratio*** as a measure of the extent to which funding comes from abroad. It is calculated as total loans to the non-financial private sector over total deposits from the non-financial private sector. The results reveal a highly significant and positive correlation of the loan-to-deposit ratio with FX lending (Rosenberg and Tirpák 2008, 14).

The literature suggests that foreign banks possess an advantage over domestic banks in obtaining foreign currency liquidity via funding from the parent bank (see European Central Bank 2006b, Calvo 2002). Foreign banks indeed play a key role across the CESEE region (Eller, Haiss and Steiner, 2006). Cahilloux et al (2010) argue that the abundant supply of foreign capital inflows has triggered easy access to FX lending in Serbia. Calvo (2002) argues that foreign banks, which refinance themselves in foreign currency, prefer to lend domestically in foreign currency, as regulation typically restricts them from exhibiting large open foreign exchange positions (Calvo

2002, 401). Rosenberg and Tirpák (2008) were among the first to include the variable *'asset share of foreign banks'* as a control in their model. The variable, however, was not significant in all model specifications. Rosenberg and Tirpák (2008) acknowledge that foreign banks have been able to raise funds at Euribor via their parent banks. However, they argue that some foreign banks, especially those from Italy and the US, have had bad experiences in lending in foreign exchange to households and therefore might prefer lending in local currencies (Rosenberg and Tirpák 2008, 14). Still, in many CEE countries the dominant market players are from Austria, Sweden and Germany, all of which have not shared this bad experience in the past. While Rosenberg and Tirpák (2008) focus on the New EU Member States, Brown et al. (2008) use a broader country sample of 26 emerging countries and find some evidence that the asset share of foreign banks is positively correlated with FX lending to SME's (Brown et al. 2008, 42).

Openness and economic integration of the economy is another often studied explanatory variables of credit euroization. Firms engaged in international trade often must handle large inflows and outflows of foreign currency. As a result, they might decide to borrow in foreign currency, in order to hedge their open FX positions (Basso et al, 2011). Openness of the economy is regularly measured in two ways. Some studies use exports over GDP (Honig 2009, Luca and Petrova 2008, Rosenberg and Tirpák 2008). Other studies use total trade and measure openness as exports plus imports over GDP (Arteta 2005, Basso et. al. 2011, Honig 2009, Rosenberg and Tirpák 2008). Keloharju and Niskanen (2001) analyze the determinants of FX lending on the firm-level. Their most important explanatory variable is exports in relation to net sales, which can be interpreted as a firm-level equivalent to exports over GDP. In applying the institutional-credibility view, Neandis (2010) argues that trade is the channel that expresses the anticipation for lower currency risk from EU accession and EU membership in CESEE. He finds that EU membership reduces deposit dollarization but increases loan dollarization.

Empirical findings on the role of the openness of an economy are mixed, though. Basso et al (2011) find a negative relationship between the openness of an economy and loan euroization on the general level, but a positive relationship once they use FX loans to corporate as the dependent variable. Luca and Petrova (2008) find that the real openness of an economy is positively correlated with credit dollarization. This result, however, is not robust across different specifications of the model (Luca and Petrova 2008, 864). Similarly, Rosenberg and Tirpák (2008, 16) find a positive, albeit not always significant, relationship between openness and credit euroization. Keloharju and Niskanen (2001) find exports in relation to net-sales to be the most important determinant of foreign currency loans on the firm-level. The variable is positive and highly statistically significant (Keloharju and Niskanen 2001, 489). Firms with a high export ratio are more likely to take out FX loans in order to hedge their open foreign exchange positions (Keloharju and Niskanen 2001, 487).

The type of *exchange rate regime* prevalent in a country is generally believed to influence the level of credit euroization. Arteta (2005) reports that there exist two competing views on the relationship between the exchange rate regime and currency mismatches. According to the majority view, fixed exchange rate regimes encourage currency mismatches, as economic agents feel to be protected from any kind of exchange rate fluctuation (Arteta 2005, 1; IMF 2010, 68). As a consequence, the risk of a loss through exchange rate fluctuations turns into a risk of credibility of the exchange rate regime. In countries with a floating exchange rate regime, on the

other hand, economic agents would be expected to match their foreign currency assets with their foreign currency liabilities in order to reduce the exchange rate risk (Arteta 2005, 1).

Supporters of the minority view, on the other hand, argue that the relationship might be exactly the other way around. Households in countries with flexible exchange rate regimes might be inclined to shift their savings into foreign currency deposits in order to seek insurance from adverse currency movements. As the substitution of domestic currency loans with foreign currency loans would for banks merely mean to trade currency risk for default risk, banks might not want to increase loan dollarization accordingly (Arteta 2005, 2). As a consequence, Arteta (2005) argues, a flexible exchange rate regime could actually result in a greater currency mismatch. He concludes that the question whether floating exchange rate regimes increase or decrease deposit and loan dollarization is an empirical question (Arteta 2005, 2).

The empirical investigations of the impact of the exchange rate regime on credit dollarization have produced mixed results. Arteta (2005) finds that floating exchange rate regimes decrease credit dollarization relative to deposit dollarization. The consequence is a greater currency mismatch in countries with a floating exchange rate regime (Arteta 2005, 11). In a similar manner Honig (2009) tests the impact of a floating regime dummy and a managed floating country dummy. The empirical results are not significant in all model specifications (Honig 2009, 9). To test for the impact of exchange rate regimes on dollarization Barajas and Morales (2003) construct an indicator of exchange rate intervention, which compares the degree of exchange rate variability to the variability of international reserves (Barajas and Morales 2003, 19). The empirical results show that the central bank intervention index has a positive impact on the share of foreign currency lending in total lending (Barajas and Morales 2003, 34).

Additionally, some studies included variables such as the *interest rate spread*, which measures the difference between local currency and foreign currency lending rates (Barajas and Morales 2003, Basso et al. 2011), the rate of *inflation* (Arteta 2005, Honig 2009, Ize and Levy-Yeyati 2003, Zettelmeyer et al 2010), the *exchange rate* directly (Brzoza-Brzezina et al. 2007, Luca and Petrova 2008, Epstein and Tzaninis 2005), the *past volatility of the exchange rate* (Rosenberg and Tirpák 2008, Luca and Petrova 2008, Brown et al. 2008), the *covariance between exchange rate and domestic prices* (Ize and Levy-Yeyati 2003, Luca and Petrova 2008), the level of *monetary credibility* (Jeanne, 2003), expected *euro-adaption* (Fidrmuc et al, 2011), an *index of central bank intervention* (Arteta 2005, Epstein and Tzaninis 2005), the *EBRD index of banking sector reform* (Rosenberg and Tirpák 2008), *economic development* (Brzoza-Brzezina et al. 2007, Honig 2009), an *index of government quality* (Honig 2009), *competition in the banking market* (Catao and Terrones 2000, Epstein and Tzaninis 2005), the availability of *fixed interest rate domestic currency loans* (Csajbók, Hudecz and Tamási, 2010), *migrant remittances* (Rosenberg and Tirpák 2008, Barajas et al 2009), *private consumption* (Steiner 2011), *housing prices* (Epstein and Tzannis 2005), or *firm-level FX revenues* (Brown, Ongena and Yesin 2011). Zettelmeyer et al (2010) find that the *ability to develop local currency capital markets* (as influenced by a countries´ size, level of development and proximity to a major currency areas) plays a role. Table 2 in the appendix presents an overview of empirical studies on credit euroization, including the tested variables and main findings. For a further meta-analysis of determinants of FX loans in CESEE, see also Crespo Cuaresma, Fidrmuc and Hake (2011).

3   FOREIGN FUNDS CHANNEL IN CREDIT EUROIZATION

The ability of banks to lend domestically in foreign exchange depends critically on their access to foreign funds (European Central Bank 2006b, 40). One source of supply is foreign currency deposits, which can in principal be obtained by all banks, regardless of its origination. Figure 3 shows the strong relationship between FX-deposits and FX-loans. The literature suggests that foreign banks possess another source of supply of foreign liquidity, which puts them in an advantageous situation: funding from the parent bank (see European Central Bank 2006b, Calvo 2002). Calvo (2002) argues that foreign banks, which refinance themselves in foreign currency, prefer to lend domestically in foreign currency, as regulation typically restricts them from exhibiting large open foreign exchange positions (Calvo 2002, 401). As a consequence, Calvo (2002) argues, the premium these banks charge on domestic currency loans will increase, which will in turn increase the incentives for borrowing in foreign currency. An interesting question therefore is, whether foreign banks are actually more engaged in FX lending compared to domestic banks. Rosenberg and Tirpák (2008) include the asset share of foreign banks as a control, but do not find a significant relationship with FX lending. Similarly, Haiss et al (2009) find that the asset share of foreign banks is not significantly correlated with FX lending to the private sector for a broad panel of CEE countries. Using firm-level data, Brown et al (2007) find weak positive influence of the asset share of foreign banks on the probability of firms taking out an FX loan. Basso et al (2011) estimate a ratio of foreign liabilities as a share of total funds net of deposits and find a strong positive correlation with the asset share of foreign banks (Basso et al 2011). They conclude that foreign bank penetration increases the foreign funds in the domestic banking system, which in turn increases credit dollarization and decreases deposit dollarization. Bogoev (2011) confirms the existence of a lending channel mainly through the foreign currency loan supply function for the case of Macedonia.

Figure 4: FX-loans vs. FX-deposits, 2008
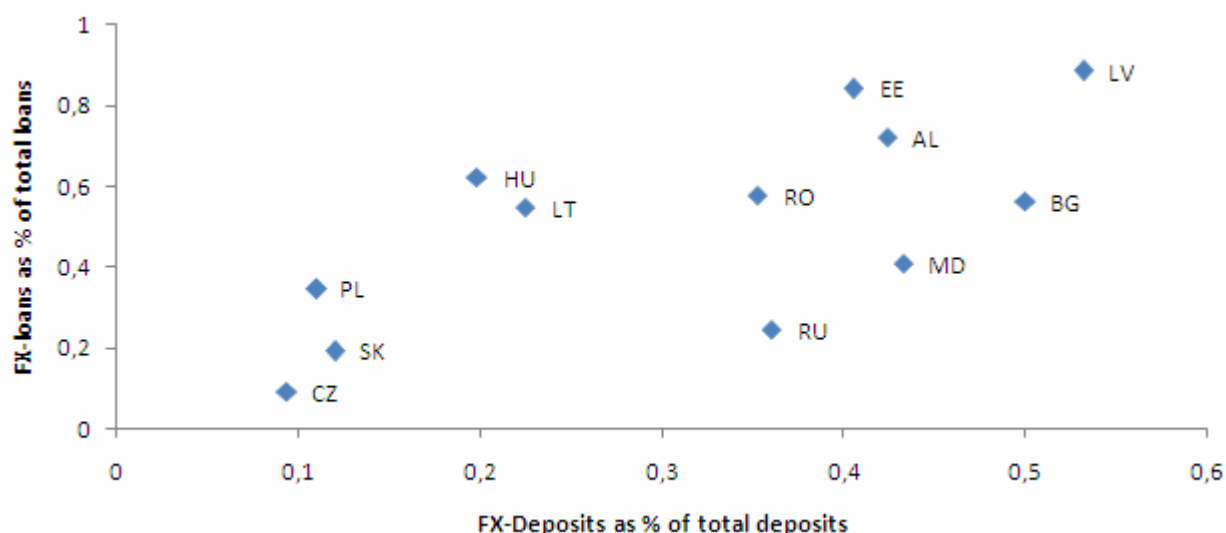
Note: Data from 2008; Deposits and loans in percentage of total deposits to the non-financial private sector; Serbia, Macedonia and Croatia excluded, as no data on FX-indexed deposits were available

Source: Author's own calculation, data from local Central Banks

Based on the findings of Basso et al (2011), we opt for a broadening of the approach and introduce the *foreign funds channel* in credit euroization, allowing foreign funds to enter the country not only through subsidiaries of foreign banks, but also through domestic banks borrowing abroad. The framework of the *foreign funds channel* is shown in Figure 5.

Banks have two possible sources of foreign currency supply. The first source is foreign currency deposits of residents. Secondly, to the extent that domestic supply of capital (i.e. domestic currency deposits, FX deposits, equity and in CESEE less important bonds) does not suffice to fund the desired (or demanded) pace of credit growth, banks might turn to foreign sources of capital to cover this "funding gap" (Lahnsteiner, 2011). This foreign supply of capital is presumed to be denominated in foreign currency, which is a quite conceivable assumption. Both sources of foreign funds increase the dollarization of banks' liabilities. Given that banks face prudent regulations on open foreign exchange positions, they have to balance their foreign currency liabilities with foreign currency assets. In principle, there are again two possibilities to achieve this: hedging transactions and by granting foreign currency loans.

The first possibility is to extend loans in local currency and hedge the open foreign exchange position with derivative instruments. In this matter, the foreign exchange swap is one of the most often used hedging instruments by banks in emerging economies (BIS 2008, 76). Banks use FX swaps primarily to gain access to foreign currency (e.g. euro), to hedge foreign currency assets (e.g. FX loans) or to provide foreign banks with local currency liquidity (The World Bank 2009a, 23). The dominance of the FX swap within interbank money market operations in the New EU Member States can be ascribed to the high asset share of foreign banks and subsequent 'parent-subsidiary liquidity relationships' and the high share of foreign currency lending (The World Bank 2009a, 23). According to Raczko and Wiegand (2010), swap markets played a particularly important role in the funding of FX loans for domestic CESEE banks by swapping domestic currency deposits into foreign currency.[1] Lahnsteiner (2011) argues that FX swap transactions also were used when FX-lending was funded by liabilities in domestic currency. However, as the maturity of foreign exchange swap transactions is usually shorter than that of loans granted, banks encountered rollover risk in this way.

The second possibility to eliminate an open foreign exchange position, created through foreign borrowing, is to lend domestically in foreign exchange. By actively promoting FX loans to domestic resident, banks can raise the foreign currency share of their assets and thus create a currency-balanced portfolio. However, by promoting FX loans, banks in effect trade foreign exchange risk for default risk (Arteta 2005, 2).

The decision to eliminate the open foreign exchange position, either through hedging activities or through FX lending, should be influenced by consideration on the costs associated with the two possibilities, amongst others. Specifically, from a pure financing point of view, if banks believe the costs of hedging to exceed the default risk associated with FX lending, they might choose the second option (i.e. to raise the dollarization of their assets by extending FX loans). On

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[1] Note that during the financial crisis, with e.g. the Zloty and the Forint depreciating, rolling over swaps required a vastly growing amount of domestic currency resources. See Walko (2009) and Raczko and Wiegand (2010)

the other hand, if banks expect the default risk of FX lending by borrowers (especially unhedged retail borrowers) to out weight the costs of hedging, they might choose to lend in domestic currency and hedge the resulting open foreign exchange position with derivatives (e.g. FX swap).

With regards to household credit, the World Bank (2009a) reports that banks had 'little interest in reducing their exposure to foreign currency-denominated loans because default rates were low and because of the ease of access, at the time, to foreign currency funding via wholesale markets or via Western European parent banks' (The World Bank 2009a, 54). This might, however, be subject to change, since the current economic crisis has considerably weakened some CESEE currencies, which resulted in an increase of the default risk of FX lending. UniCredit (2011b) argues that due to the crisis-induced higher cost of funding and the increased cost of country risk today, there is a now a need for a stronger focus on domestic funding.

Figure 5: The foreign funds channel in credit euroization
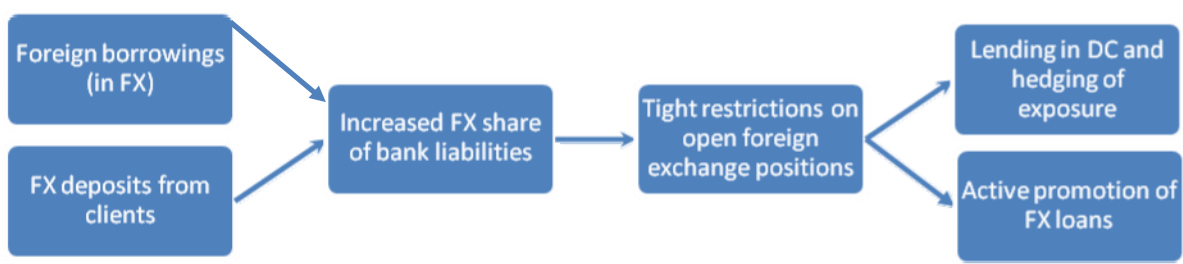
Source: Author's own illustration

4   MODEL

One of the main contributions of this paper is the differentiation between household and corporate credit euroization. Three models are specified, testing for credit euroization of corporate lending, household lending and for total credit euroization of private non-financial sector lending (i.e. households plus non-financial corporations).

4.1   Model I – Credit euroization of the private non-financial sector

The first model intends to explain credit euroization of the private non-financial sector. The dependent variable is FXL foreign currency denominated loans as a share of total loans to households and non-financial corporations (i.e. the private non-financial sector).The estimated equation is

$$FXL = \alpha_i + FXD + LRD + FXLFXDR + DCLDCDR + ASFB + AS5LB + TRADE_{EUR} + FLOAT_{PEG} + X_{it} + \varepsilon_{it}$$

with X_{it} being a vector of additional explanatory variables.

The most important explanatory variable is FXD foreign currency deposits as a share of total deposits of the private non-financial sector. The expectation is that an increase in foreign currency deposits results in an increase in foreign currency loans, as banks have to obey limits on open foreign exchange restrictions. The expected sign is thus positive.

The loan-to-deposit ratio LDR is a measure of the extent to which funding comes from abroad (Rosenberg and Tirpák 2008, 11). The expectation is that a higher loan-to-deposit ratio results in an increase in foreign currency lending. Based on the considerations of Rosenberg and Tirpák (2008) the variable FX loan-to-FX deposit ratio is constructed FXLFXDR, in order to capture the specific foreign currency part of foreign funding and test for the influence of the foreign funds channel as discussed in the previous chapter. For both the LDR and the FXLFXDR the expected sign is positive. While a higher FX loan to FX deposit ratio FXLFXDR is expected to lead to a higher share of FX loans in total loans, the variable DCLDCDR is included to control for the opposite effect. DCLDCDR measures the ratio of domestic currency loans to domestic currency deposits. The expected relationship between DCLDCDR and the share of FX loans is negative.

Based on Rosenberg and Tirpák (2008) the asset share of foreign banks ASFB is included as explanatory variable, in order to test for the influence of foreign bank (who are believed to have better access to foreign funding) on credit euroization.

Openness of the economy is generally viewed as having a positive influence on credit euroization. Researcher so far measured openness either as exports over GDP or exports plus imports over GDP (see e.g. Honig 2009 or Luca and Petrova 2008). These two measures are included as control variables (EXP_GDP, EXIM_GDP). For the preferred model in this paper, however, openness is measured as the share of trade (exports plus imports) to Euro Area countries and countries with a hard peg to the euro. The specification of the variable TRADE is based on the consideration that a dominant share of FX loans in CESEE is denominated in euro. If two relatively small countries with their own currencies trade with each other, the choice of contracting currency will depend on many factors, such as for example market power. If however, a relatively small country trades with a partner of the relatively large Euro Area, it is deemed more likely that the contracting currency will be the Euro. Following this reasoning it is thus more likely that in such a country a greater share of trade revenues are denominated in foreign currency (Euro), which would increase the incentives for firms to hedge FX inflows through financing in Euro. The expectation is thus that a higher share of trade with Euro-countries results in a higher share of FX loans in total loans.

To account for a possible influence of the exchange rate regime, a dummy variable is constructed that takes the value of 0 if a country runs a floating currency regime and the value of 1 in the case of a pegged exchange rate regime.

Additionally to LDR and FXLFXDR, which measure the degree to which financing comes from abroad indirectly, the variable loans from non-resident banks LNRB is trying to capture this

effect on a direct basis. The variable is taken from Beck et al. (2000) and is computed as loans from non-resident banks to GDP.

Bodnar (2008) finds some evidence that firms from the manufacturing industry are more likely to take out an FX loan. Therefore the variable INDU is included, which measures the share of manufacturing industry in GDP. The expected sign of INDU is positive.

Additionally, we included several control variables, such as inflation INFL, the nominal exchange rate of the domestic currency with the euro ER EUR, the real effective exchange rate RER, the interest rate differential between the local and euro area lending rate IRD_EUR, the real domestic interest rate RDI, the net interest spread NIS, GDP per capita GDP_PC, a dummy variable, which takes the value of 1 if a country belongs to the exchange rate mechanism II ERMII, an EU dummy EU and the EBRD index of banking sector reform EBRD. A complete list of variables can be found in Table 3 in the appendix.

4.2 Model II – Credit euroization of corporate lending

In order to test for possible differences between the lending behavior of corporations and households, the second model focuses entirely on the subgroup of non-financial corporations. The dependent variable is FX loans as a share of total loans to non-financial corporations FXL_C. The structure of the model is identical to the first model:

$$FXL_C = \alpha_i + FXD + LRD + FXLFXDR + INDU + TRADE_{EUR} + FLOAT_{PEG} + Y_{it} + \varepsilon_{it}$$

with Y_{it} being a vector of additional explanatory variables.

A number of corporation-specific variables are already included in the first model, namely exports over GDP *EXP_GPD*, exports plus imports over GDP *EXIM_GDP*, trade with euro-countries *TRADE_EUR* and manufacturing industry as a share of GDP *INDU*. In the second model, another corporation-specific variable is tested. Brown et al. (2008) find that foreign owned firms are more likely to take out an FX loan (Brown et al. 2008, 35). Based on this finding the variable foreign direct investment *FDI* is aimed to proxy foreign ownership in the domestic corporate sector. The expected sign is positive, meaning that more foreign ownership of corporations leads to a higher share of FX loans.

4.3 Model III – Credit euroization of household lending

The third model focuses on FX loans to households. The dependent variable is FX loans as a share of total loans to households.

$$FXL_H = \alpha_i + FXD + LRD + FXLFXDR + DCLDCDR + FLOAT_{PEG} + REMIT + HLR + Z_{it} + \varepsilon_{it}$$

with   being a vector of additional explanatory variables.

A household specific variable that is discussed in the literature is household remittances (see Rosenberg and Tirpák 2008). To test for a possible impact of remittances on credit euroization the variable REMIT is included, measuring migrant remittances as a share of GDP. However, migrant remittances are not expected to drive FX lending in CEE and are therefore included only

as a control variable.

If one analyses the development of FX lending over time, one can notice that in some countries FX loans were virtually non-existent until a certain date in the past. For example, in Hungary until 2003 FX loans to households were constantly below the level of 5% of total household loans. From 2004 onwards, however, they surged and reached 66.7% of total loans to households in 2008. The reason for this development is a gradual tightening of the housing subsidy system (which was only applicable to forint loans) from 2003 onwards (Walko 2008, 76). A similar pattern can be observed in Macedonia, where foreign currency lending to households was restricted before the liberalization in 2003 (National Bank of the Republic of Macedonia 2007, 27). Based on these and similar observations the variable household loan restrictions HLR is constructed. HLR is a dummy variable which takes the value of 0 if FX lending to households is restricted or prohibited in a particular country in a particular year and 1 otherwise.

For obvious reasons the corporation-specific variables EXP_GDP, EXIM_GDP, TRADE_EUR, INDU and FDI were not included in the third model.

5   DATA & METHODOLOGY

For the empirical analysis data on 13 CESEE countries[1] were collected for the time period 1999 to 2007. Data sources are the National Banks of the individual countries, the EIU Country Data and EBRD Banking Data. Table 3 in the appendix contains descriptive statistics on the individual variables. With the exception of the asset share of Austrian banks ASAB, all variables are recorded annually for the time period 1999 to 2007, resulting in 117 observations.

6   RESULTS

In this part we will present the results of the core model, i.e. the most robust model specification, after several robustness checks were performed. As robustness checks we tested for the effects of removing individual variables from the model and also for the effects of the exclusion of individual countries from the data sample.

The estimations were started with fixed effects (FE) panel data regressions and, for comparison, also random effects (RE) regressions. The scatter plots of the residuals revealed potential problems with heteroscedasticity. Therefore all estimations were performed using robust standard errors. The FE estimation revealed a strong autocorrelation of the residuals. With random effects the problem occurred that the procedure laid all weight on the 'between-estimator', thereby completely ignoring the information provided in the panel structure (time-varying information). In fact, the RE estimation came to the same results as a normal OLS regression. Additionally, also the RE estimations suffered from a strong autocorrelation of the residuals. Although the Hausmann test suggested fixed effects as the better estimator, in fact, both FE and RE were not applicable, due to time trends of the depended variable and the problems with strong autocorrelation of the residuals. To account for all these problems, first difference estimations were deemed as the most appropriate in this context.

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[1] Albania, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Russia and Slovakia

A closer examination of the scatter plots of the residuals and the independent variables revealed a possible non-linear relationship for FXD, FXLFXDR and DCLDCDR. More precisely, the scatter plots showed an inverted U-shaped relationship. To solve this problem, all three variables were additionally included in the squared form FXD2, FXLFXDR2 and DCLDCDR2.

6.1 Model I – Credit euroization of the private non-financial sector

The final model specification of Model I included only highly statistically significant variables. All variables had the expected sign. The overall R2 was 76%. As expected, foreign currency deposits FXL was found to be the most important determinant of foreign currency loans. This is in line with previous research (e.g. Rosenberg and Tirpák 2008, Haiss et al. 2008).

The FX loan to FX deposit ratio FXLFXDR, which was intended to capture the degree to which funding of FX loans comes from abroad, was also highly significant across all model specifications. Also the squared variable of the FX loan to FX deposit ratio FXLFXDR2 was significant, with a negative coefficient. This suggests that the growth rate of FX loans increases disproportionally high with an increase in the growth rate of FXLFXDR until a peak at 387% and then declines[1]. The ratio of domestic currency loans to domestic currency deposits DCLDCDR, which was intended to control for the opposite effect of FCLFCDR, had the expected negative sign and was also highly significant.

Both FXD and FXLFXDR together were intended to explain bank's supply with foreign currency, either through foreign currency deposits from residents, or, to the extent that there exist less FX deposits than FX loans (i.e. a high FX loan to FX deposit ratio FXLFXDR), through funding from abroad. It is important to note that using the variable FXLFXDR, one is not able to distinguish through which channel the foreign funds flow into the country: it can either be through foreign banks drawing on credit lines from their parent banks or domestic banks borrowing abroad. Still, the findings underpin the importance of foreign funding in the spreading of foreign currency loans in CESEE.

The results suggested further that trade with Euro-countries TRADE_EUR positively influences the growth of FX loans in CESEE. Interestingly, the variables exports over GDP EXP_GDP and exports plus imports over GDP EXIM_GDP, which researches have used to proxy openness of the economy (see e.g. Honig 2009, Luca and Petrova 2008), were both not significant. This further underpins the concept of trade with Euro-countries as an explanatory factor of credit euroization in CESEE, as opposed to overall trade in general, which the literature suggested so far. The argument is that the variable TRADE_EUR is better able to capture the relevant part of foreign trade that potentially induces firms to also borrow in foreign currency.

Finally, also the variable manufacturing industry as a share of GDP INDU was highly significant and had the expected positive sign. This finding is in line with Bodnar (2008), who found firm-level evidence that firms operating in the manufacturing industry have a higher probability to take out an FX loan. The results from this paper suggest that a higher share of manufacturing industry in GDP increases credit euroization. The argument is that industrial activity is more likely to be export oriented and/or foreign owned, as opposed to the service sector, which increases firm's exposure to foreign currency cash flows and/or includes many small locally owned services providers (e.g. in the tourism industry). This in turn increases the incentives for firms to hedge foreign currency inflows with equivalent borrowings in foreign currency.

The asset share of foreign banks ASFB was not significantly related with FX lending in CESEE.

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[1] Based on Cameron and Trivedi (2009) the peak is calculated as $peak = \frac{0.2847122}{2*0.0367785}$ (Cameron and Trivedi 2009, 244).

Even after introducing a threshold of 10%, as suggested by Haiss et al (2008 and 2009) to account for possible herd behavior, the variable was not significant. This finding is in line with Rosenberg and Tirpák (2008), who found that the asset share of foreign banks was also not significant in their model and highly correlated with openness (Rosenberg and Tirpák 2008, 14). Similarly, Haiss et al. (2008a) found that the asset share of foreign banks was insignificant in most model specifications and even appears to have a negative influence on FX lending. They concluded that financial sector FDI appears to have a rather positive impact on economic development in CEE (Haiss et al. 2008a, 9). Brown and de Haas (2010) and EBRD (2010) similarly do not support the proposition that foreign banks contribute more to FX-lending than domestic banks, particularly not to households, though both acknowledge that foreign banks may lend more in FX to corporate clients. Backer and Gulde 2010, on the other hand, find that foreign banks accounted for a substantial share of growth in FX lending to households. There may also be some country of origin differences, as Pann et al (2010) report that Austrian banks´ CESEE subsidiaries FX loan exposure was continually higher than the market average.

Figure 6: Results of the final model specification of Model I

```
Linear regression                                    Number of obs =      104
                                                     F(  7,    97) =    45.63
                                                     Prob > F       =   0.0000
                                                     R-squared      =   0.7508
                                                     Root MSE       =   .03114

-----------------------------------------------------------------------------
             |              Robust
       D.fxl |    Coef.    Std. Err.      t    P>|t|    [95% Conf. Interval]
-------------+---------------------------------------------------------------
         fxd |
         D1. |  .9503634   .0955588     9.95   0.000    .7607056    1.140021
      fxlfxdr |
         D1. |  .2585564    .025644    10.08   0.000    .2076601    .3094527
     fxlfxdr2 |
         D1. | -.0330813   .0052314    -6.32   0.000   -.0434642   -.0226984
      dcldcdr |
         D1. | -.4747195   .0598861    -7.93   0.000   -.5935768   -.3558621
     dcldcdr2 |
         D1. |  .0704588   .0150505     4.68   0.000    .0405878    .1003298
    trade_eur |
         D1. |  .4045047   .0978392     4.13   0.000    .2103211    .5986883
         indu |
         D1. |  .5493155   .2698742     2.04   0.045    .0136899    1.084941
```
Note: Dependent variable is *FXL* foreign currency loans as a share of total loans to the private non-financial sector.
      Estimations are in first differences, using White robust standard errors to account for potential heteroscedasticity.
Source: Author's own calculations

6.2 Model II – Credit euroization of corporate lending

The results are similar to Model I, albeit with a few notable exceptions. First, foreign currency deposits FXD were not significant in the final model specification. However, the squared variable FXD2 was significant and had a positive sign. The general expectation was that FX deposits do not matter to the same degree for corporate FX loans as they do for household loans, as large corporate foreign currency loans are often directly extended by the Western parent bank and not by the CEE subsidiary. The finding that only FXD2 is significant could be interpreted as a manifestation of this phenomenon.

The FX loan to FX deposit ratio had the expected sign and also had a higher coefficient compared to Model III, which tests for household FX loans.

The proxy variable for trade with Euro-countries was also positively related to credit euroization of corporate lending. The impact, however, appears to be less compared to the general Model I, which is to some extent contrary to the expectations.

Contrary to the expectations, the variable manufacturing industry as a share of GDP INDU was not significant in the final model specification. If, however, Moldova and Russia (two less EU-integrated countries) and Croatia (very services-dependent, e.g. tourism) are excluded from the sample, the variable INDU turns significant with a sizable positive sign.

Figure 7: Results of the final model specification of Model II

```
Linear regression                                  Number of obs =      104
                                                   F(  6,    98) =    30.27
                                                   Prob > F      =   0.0000
                                                   R-squared     =   0.6398
                                                   Root MSE      =  .03783

-----------------------------------------------------------------------------
             |               Robust
     D.fxl_c |    Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
        fxd2 |
         D1. |  .9402007   .1388543     6.77   0.000     .6646488    1.215753
      fxlfxdr |
         D1. |  .2857607   .0366806     7.79   0.000     .2129693    .3585522
     fxlfxdr2 |
         D1. |  -.040741    .006897    -5.91   0.000    -.0544279   -.0270541
      dcldcdr |
         D1. | -.4840679   .0786829    -6.15   0.000    -.6402115   -.3279243
     dcldcdr2 |
         D1. |  .0720704   .0192152     3.75   0.000     .0339384    .1102023
    trade_eur |
         D1. |  .2399445   .0921379     2.60   0.011     .0570999     .422789
-----------------------------------------------------------------------------
```

Note: Dependent variable is *FXL_C* foreign currency loans as a share of total loans to non-financial corporations. Estimations are in first differences, using White robust standard errors to account for potential heteroscedasticity.

Source: Author's own calculations.

6.3 *Model III – Credit euroization of household lending*

The final specification of Model III contained more significant variables, compared to the first two models. However, the R2 of 49.8% was the lowest of the three models. As expected, the variable foreign currency deposits FXD was one of the main driving factors of household credit euroization. The inverted U-shaped relationship for FX deposits and FX loans appeared to hold, as FXD2 was also significant. This means that the growth rate of FX loans increases disproportionately high with an increase of FX deposits until a saturation is reached and then declines.

A puzzling result is that the loan-to-deposit ratio was significant and had a negative sign. This is contrary to Rosenberg and Tirpáks (2008) finding of a significant positive relationship between the loan-to-deposit ratio and credit euroization. The difference could result from the fact that Rosenberg and Tirpák used only FX loans to the non-financial private sector as dependent variable and did not distinguish between households and corporations. The findings in this paper support the hypothesis that FX loans to households are to a higher degree determined by domestic supply of foreign currency, i.e. FX deposits of residents, as opposed to foreign sources of foreign exchange. This is also supported by the evidence on the FX loan to FX deposit ratio

FXLFXDR, which had a lower coefficient for household FX loans compared with corporate FX loans. The domestic currency loan to domestic currency deposit ratio DCLDCDR was significant and had the expected sign.

According to our results, household credit euroization is also influenced by inflation INFL. A higher growth rate of inflation increases the growth rate of FX loans, albeit to a very small degree. This finding is contrary to the expectations, as inflation decreases the real burden of a domestic currency loan. The expected sign would thus be negative. A possible explanation would be that in times of high inflation borrowers fear counter measures of central banks to increase interest rates. Thus they might decide to switch to foreign currency lending. Furthermore, it is possible to think of the positive relationship between inflation and credit euroization as a manifestation of a hysteresis effect, stemming from bad experiences from past crisis, as argued by Backé et al (2007b) and Got and Ross (2006).

The interest differential IRD_EUR was significant, but did not show the expected sign. The effect, however, is relatively low with a coefficient of only -0.05. In this regard, however, one has to critically question the underlying data. Due to a lack of data on interest rates charged by banks for foreign currency credits, the IRD_EUR was calculated using average lending rates for the individual countries and the Euro Area. This, however, implies the assumption that the Euro Area lending rate is representative for the costs of a foreign currency loan in CESEE. This assumption can be criticized as being not valid, as it ignores the country specific and individual risk factors. Thus, the results with regards to the interest differential IRD_EUR should be treated carefully. Using interest rate differentials vis-à-vis euro money market rates, Csajbok et al (2011) find a significant impact on the share of new FX loans in total new loans. Based on central bank data, Steiner (2011) similarly confirms a positive impact of the interest rate differential on household FX loans.

Figure 8: Results of the final model specification of Model III

```
Linear regression                                    Number of obs =      104
                                                     F( 10,    94) =    12.64
                                                     Prob > F      =   0.0000
                                                     R-squared     =   0.4980
                                                     Root MSE      =   .05124
-----------------------------------------------------------------------------
             |               Robust
    D.fxl_h  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
        fxd  |
         D1. |   2.072722   .5368726     3.86   0.000     1.006749    3.138696
       fxd2  |
         D1. |  -1.486093   .5629664    -2.64   0.010    -2.603876   -.3683099
        ldr  |
         D1. |  -.1519483   .0620158    -2.45   0.016    -.2750821   -.0288145
     fxlfxdr |
         D1. |   .2272738   .0494145     4.60   0.000     .1291602    .3253874
    fxlfxdr2 |
         D1. |   -.021062   .0072405    -2.91   0.005    -.0354382   -.0066859
     dcldcdr |
         D1. |  -.2837331   .0701481    -4.04   0.000    -.4230138   -.1444525
    dcldcdr2 |
         D1. |   .0486925   .0119713     4.07   0.000     .0249232    .0724618
        infl |
         D1. |   .0021769   .0007027     3.10   0.003     .0007817    .0035722
     ird_eur |
         D1. |  -.0052033   .0018254    -2.85   0.005    -.0088276    -.001579
          eu |   .0296685   .0092484     3.21   0.002     .0113056    .0480315
-----------------------------------------------------------------------------
```

Note: Dependent variable is *FXL_H* foreign currency loans as a share of total loans to households. Estimations are in first differences, using White robust standard errors to account for potential heteroscedasticity.

Source: Author's own calculations

The EU dummy EU showed a positive relationship with credit euroization of household lending. This would suggest that the new EU Member States in the sample (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia) show a higher growth rate of foreign currency lending to households compared to non-EU Member States in the sample (Albania, Croatia, Moldova, Russia). A possible explanation would be that households in EU Member States anticipate the introduction of the Euro in due time and thus decide to borrow in Euro already today. Another effect could stem from exchange rate arrangements. Among the EU Member States, there are four countries (Bulgaria and the Baltic states) with a hard peg to the Euro, as well as the (at that time) Euro Area candidates and thus ERM II members. So, in principle the effect of the EU dummy could also from an anticipated Euro adoption, rather than from a mere EU membership per se.

Finally, an interesting result is that the asset share of foreign banks ASFB was not significant in most model specifications (also when a threshold of 10% was included, as discussed above), suggesting that there does not exist a directly measurable influence of foreign banks on credit euroization. This finding further strengthens the theory of the indirect influence of foreign capital on credit euroization via the foreign funds channel, as proposed in this paper.

7   CONCLUSIONS

The descriptive statistics on Emerging European countries from Central, Eastern and Southeastern Europe (CESEE) discussed in the first part of the paper lead to the conclusion that the risks associated with foreign currency (FX) lending appear to have been neglected or underestimated by borrowers and lenders across the region. Despite many warnings of

researchers, rating agencies and central banks, FX lending continued to surge over the past years. This is probably due to the fact that until 2008 these effects did not materialize. The economic crisis, however, changed the situation markedly and led people to recognize the full extent of the risks associated with FX lending. The materialization of these risks led banks to dramatically increase the provisions for impairment losses, implying that they anticipated increasing credit defaults (which are to a great extend due to reckless FX lending). As a consequence, many banks reported that they fully stopped granting FX loans in most CESEE countries. From a borrower's perspective, the depreciation of local currencies in the wake of the financial crisis burdened them with increasing credit costs in local currency terms.

The results presented in the empirical section of this paper do not support the view that foreign banks are the sole driver of credit euroization in CESEE. The estimations lead us to conclude that the foreign funds channel appears to be a main source of supply with foreign capital and thus a driver of credit euroization in Emerging Europe. It seems to be irrelevant whether the funds are channeled into the economy via subsidiaries of western banks or via domestic banks borrowing from abroad. The newly introduced FX loan to FX deposit ratio, which was designed to measure the degree to which foreign currency supply comes from abroad, is significantly and positively related to credit euroization in all model specifications. This suggests that credit euroization is not only driven by foreign banks drawing on credit lines from their parent institutions and on lending these funds directly to local borrowers, but is also driven by domestic banks borrowing abroad. No significant relationship was found between the asset share of foreign banks and credit euroization.

We find that credit euroization of corporate lending increases with the share of trade with Euro area countries. Contrary to previous studies, which showed ambiguous results, we focused on trade with Euro are countries (as opposed to total imports and exports) and find a strong positive relationship with FX-lending. This suggests that credit euroization of corporate lending seems to be, at least partly, driven by the desire of firms to hedge foreign currency inflows arising from export activities, supporting the findings of previous studies (see e.g. Bodnar, 2008, Brown et al., 2008, Keloharju and Niskanen, 2001, Luca and Petrova, 2008, Rosenberg and Tirpák, 2008). The findings also suggest that corporate credit euroization increases with the share of manufacturing industry in GDP.

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9 APPENDIX

Table 2 Literature review of empirical studies on credit euroization

Author/Year	Sample	Period	Method	Dependent variable	Explanatory variables	Control variables	Key Findings
Arteta, C. (2005)	90 countries (reduced number in some specifications)	1990-2000 (annual data)	▪ Pooled OLS	▪ Credit dollarization ▪ Deposit dollarization ▪ Deposit-credit mismatch	▪ Intermediate exchange rate regime (binary indicator) ▪ Floating exchange rate regime (binary indicator)	▪ Index of restrictions on FX deposits ▪ Index of restrictions on FX credits ▪ Interest rate differential ▪ Trade/GDP ▪ Depreciation ▪ Time trend ▪ Maximum historical rate of inflation	▪ Deposit dollarization is higher under floating regimes ▪ Credit dollarization is lower under floating regimes ▪ Greater currency mismatch under floating regimes
Barajas, A., Morales, A. (2003)	14 Latin American countries	1995-2000 (monthly & annual data)	▪ Panel-data estimations ▪ OLS and fixed-effects	▪ Share of foreign currency lending over total lending (to the private nonfinancial sector) ▪ Foreign currency lending minus foreign currency deposits over GDP	▪ Foreign currency deposits as share of total deposits ▪ Interest rate spread ▪ Central bank intervention index ▪ Private sector credit/GDP ▪ Deposit insurance coverage ▪ Borrowings from overseas banks ▪ Borrowings from overseas banks/total for Latin America		▪ High correlation between FX loans and FX deposits, with a beta < 1 ▪ Significance of explanatory variables changes with model specifications ▪ Generally all explanatory variables seem to be positively correlated with dollarization ▪ Bailout expectations by banks (deposit insurance coverage) positively correlated with dollarization ▪ Significant positive correlation between central bank intervention index and dollarization ▪ Positive impact of interest rate spreads between domestic and foreign currency on dollarization ▪ Access to overseas bank lending positively related to dollarization
Basso, H., Calvo-Gonzalez, Jurgilas, M. (2011)	AL, AM, AZ, BA, BG, BY, CS, CZ, EE, GE, HU, HR, KZ, LT, LV, MD, MK, PL, RO, RU, SI, SK, TJ, UA	2000 - 2006 (monthly data)	▪ Feasible generalized least squares (FGLS) ▪ Data on household and corporate level	▪ Loan dollarization ▪ Deposit dollarization	▪ Proportion of foreign currency denominated funds ▪ Interest differential (loans, deposits) ▪ Interest rate margins (local currency, foreign currency)	▪ Openness of the economy ▪ Exchange rate regime ▪ Financial depth	▪ Share of foreign funds has positive impact on loan dollarization and negative on deposit dollarization ▪ Interest rate differential has positive impact on loan dollarization and negative on deposit dollarization (for households and firms) ▪ Openness of the economy increases deposit dollarization, but decreases loan dollarization. However, for corporate loans the relationship is positive for loans and deposits.

Author/Year	Sample	Period	Method	Dependent variable	Explanatory variables	Control variables	Key Findings
Bednařík (2007)	CZ, HU, SK, PL	1997-2006 (CZ, PL), 2002-2006 (SK), 2003-2006 (HU) (monthly data)	▪ OLS regressions for every country	▪ Log (FX loans in EURm)	▪ Log (FX deposits in EURm) ▪ Log (Inflation) ▪ Log (Nominal effectice exchange rate) ▪ Log (interest rate on FX loans)		▪ For the Czech Republic and Slovakia only the interest rate is statistically significant. ▪ The nominal effective exchange rate is negatively related to FX loans in the case of Poland and Hungary. ▪ FX deposits is only significant in the case of Hungary. ▪ The interest rate on FX loans seems to be the best explanatory variable, as it is significantly negatively correlated with FX lending in CZ, SK and HU.

Beer et al. (2010)	2,556 households in Austria	2004	▪ Analysis of survey data
			▪ Univariate tests
			▪ Multivariate (multinomial) logit regressions
				▪ Dummy variable 'households with a housing loan in foreign currency' (for the multivariate logit regressions)	Subjective dummy variables
					▪ Indifferent (interested in financial issues?)
					▪ Ignorant (informed about financial issues?)
					▪ Negligent (care about investment after decision?)
					▪ Passive (shop around?)
					▪ Risk aversion
					▪ Bank risk aversion
					▪ Stock risk aversion
					
					Objective variables
					▪ Distance to Swiss border
					▪ Log (Monthly income)
					▪ Log (Financial wealth)
					▪ Top wealth class dummy
					▪ Age
					▪ Married
					▪ Number of children
					▪ Number of adults
					▪ Civil Servant
					▪ Self-employed
					▪ Education
							▪ Households are more likely to take out a loan denominated in a foreign currency when they
							  ▪ have a low risk aversion
							  ▪ live closer to the Swiss border
							  ▪ have a higher income
							  ▪ are older
							  ▪ are married
							▪ High income households (top 5 percentile of wealth) are significantly more likely to take out a loan in foreign currency compared to other households.

Author/Year	Sample	Period	Method	Dependent variable	Explanatory variables	Control variables	Key Findings
Bodnar (2008)	698 non-financial corporations	Survey carried out from July to October 2007. Answers refer to 2006.	▪ Probit estimations ▪ Pooled probit estimations (including data from a previous survey)	▪ Dummy variable if the firm ▪ has FX debt ▪ has currency mismatch ▪ uses risk management tools	▪ Size (total balance sheet assets) ▪ Age of the firm ▪ Sectoral dummy ▪ Share of export revenue (proxy for FX income) ▪ Leverage ratio ▪ Ratio of long-term debt to total debt ▪ Profitability (ROA, profit margin) ▪ Dummy variable on short-term exchange rate expectations		▪ Firms are more likely to have FX debt if they ▪ are older (only age^2 is significant and negative, suggesting that the probability of having FX debt increases with age, but only up to a certain turning point) ▪ operating in the manufacturing industry ▪ have a higher share of export revenues ▪ have a higher ratio of long-term debt ▪ Foreign ownership is positively correlated with the probability of having FX debt in the pooled probit estimation. ▪ Exchange rate expectations and the leverage ratio both have no influence
Brown et al. (2011)	9655 firms from 26 transition countries	2005	▪ Panel data estimations	▪ Binary variable if with the value 1 if the most recent loan taken by the firm was denominated in a foreign currency	Firm-level ▪ Revenue currency ▪ Distress costs ▪ Opaqueness Country-level ▪ Interest rate differential ▪ Exchange rate volatility ▪ Inflation volatility ▪ Share deposits in foreign currency ▪ Asset share of foreign banks ▪ Share of bank's funding from abroad ▪ EBRD enterprise reform index	▪ International Accounting ▪ Small firm ▪ Age ▪ Duration ▪ Collateralized	▪ Many local currency earners take out FX loans → most likely unhedged ▪ Exporters and foreign firms borrow more in foreign currency ▪ Country-level results weak ▪ Significant, but only marginally positive, impact of the interest differential in one model specification ▪ Interest differentials can explain cross-country differences in loan dollarization, but cannot explain changes in dollarization across time within a particular country ▪ Enterprise reform index negatively correlated with the dependent variable ▪ Positive impact of foreign banks on foreign currency borrowing in some model specifications (impact is significantly stronger for foreign currency earning firms)
Brzoza-Brzezina, M., Chmielewski, T., Niedzwiedzinska, J. (2007)	CZ, HU, PL	1997-2007 (quarterly data)	▪ Panel data estimations	▪ Real loans to the private sector in domestic currency (deflated with GDP deflator) ▪ Real loans to the private sector in foreign currency (deflated with GDP deflator)	▪ GDP at market prices of the previous year ▪ Domestic and foreign real interest rates ▪ CHF nominal exchange rate against national currencies (quarterly averages)		▪ Monetary tightening leads to a decrease in dc-lending and an increase in FX lending ▪ GDP is positively correlated with both domestic and FX lending ▪ Higher interest rates (domestic and foreign) lead to a lower increase of (domestic and foreign) lending ▪ The exchange rate has no impact on domestic currency lending ▪ A depreciation in the foreign currency leads to a slower increase in FX lending (vice versa) ▪ An increase in the domestic interest rate leads to an increase in FX lending

Author/Year	Sample	Period	Method	Dependent variable	Explanatory variables	Control variables	Key Findings
Honig, A. (2009)	66 developing countries	1988-2000	▪ OLS random effects ▪ OLS fixed effects	▪ Dollar credit/total credit ▪ Dollar deposits/total liabilities ▪ Dollar mismatch/total liabilities ▪ Total dollarization/(total credit + liabilities) ▪ Weighted dollarization ▪ Interest rate differential	▪ Managed floating dummy ▪ Floating dummy ▪ Government quality index	▪ (exports + Imports)/GDP ▪ Exports/GDP ▪ Money market interest differential ▪ Real GDP ▪ Real GDP per capita ▪ Real GDP growth ▪ Inflation ▪ Depreciation ▪ High past inflation ▪ Dollar share MVP ▪ FX loans allowed index ▪ FX deposits allowed index	▪ Government quality index negatively correlated with credit dollarization ▪ Indexes of currency regime not significant ▪ Very small negative correlation between inflation and credit dollarization ▪ Very small positive impact of depreciation variable on credit dollarization ▪ Positive impact of the variable 'high past inflation' on credit dollarization. The variable interacts with the government quality variable, reducing the latter's significance when included. ▪ "Dollarization is caused by a lack of faith in the government's ability to enact policies that promote long-run currency stability" (Honig 2009, 14).
Keloharju, M. and Niskanen, M. (2001)	44 listed Finish non-financial corporations	1985-1991	▪ Probit regressions	▪ Dummy variable taking the value 1 if a loan is denominated in a foreign currency and 0 otherwise	▪ Exports to net-sales ▪ Multinational dummy ▪ Log (Total book assets) ▪ Debt-to-book assets ▪ Industrial concentration ▪ Dividend yield ▪ Return-on-book assets ▪ Interest rate differential	▪ Year dummies controlling for increasing demand for FX loans after the restrictions were lifted (year dummy 1985, 1986, 1987, 1988, 1989, 1990)	▪ Export-to-net-sales is positive and highly significant. Companies raise FX debt to hedge their foreign currency exposures. ▪ The variable log (Total book assets) is positive and highly significant. This suggests that larger firms, which generally have a better international reputation, as well as better access to international capital markets, are more likely to borrow in foreign currencies. ▪ The interest differential is positive and significant. ▪ The variables industrial concentration, dividend yield and return-on-book assets have the expected sign but are not significant.
Luca, A. and Petrova, I. (2008)	AL, AM, AZ, BG, CZ, EE, GE, HR, HU, KZ, KG, LV, LT, MK, MD, PL, RO, RU, SK, SI, UA	1990-2003 (annual data)	▪ Pooled OLS with robust errors ▪ Fixed effects ▪ First difference estimator ▪ Fixed effects with AR(1) error ▪ Random effects with AR(1) error	▪ Credit dollarization (ratio of foreign currency credit to total credit extended by domestic banks to (non-financial) enterprises)	Bank variables ▪ Deposit dollarization ▪ Bank's net foreign assets (ratio of bank's foreign assets minus external liabilities to total domestic deposits Firm variables ▪ Share of tradeables in total domestic production (exports/GDP) ▪ Covariance between exchange rate and domestic prices	▪ Volatility of exchange rate depreciation ▪ Foreign interest rate (3 month UD dollar deposit rate) ▪ Rate of depreciation of the exchange rate	▪ Deposit dollarization (positive effect) and bank's foreign assets (negative effect) are the main determinants of credit dollarization ▪ Real openness of the economy (exports) has positive impact on credit dollarization (finding however not robust across different specifications) ▪ Positive effect of the covariance between the exchange rate and domestic prices ▪ Bank variables more significant than firm variables. Luca and Petrova (2007) conclude that bank's risk aversion is the main driver of credit dollarization, as they strive for currency-matched portfolios

Author/Year	Sample	Period	Method	Dependent variable	Explanatory variables	Control variables	Key Findings
Rosenberg, C., Tirpák, M. (2008)	BG, CZ, EE, HR, HU, LV, LT, PL, RO, SK	1999-2007 (quarterly data)	▪ OLS with country fixed effects	▪ Share of loans denominated in (and indexed to) foreign currency in total domestic bank loans to the non-financial private sector	▪ Interest rate differential between local and foreign currency ▪ Loan-to-deposit ratio ▪ Openness of the economy ▪ Index of Central Bank policies to influence foreign currency borrowing	▪ GDP per capita ▪ Asset share of foreign banks ▪ Size of the economy ▪ EBRD index of banking sector reform ▪ Exchange rate volatility ▪ ERMII and EU membership dummies	▪ Interest rate differential has positive and highly significant impact on foreign currency borrowing ▪ Loan-to-deposit ratio has highly significant positive influence on foreign currency borrowing ▪ Asset share of foreign banks is not significant ▪ Smaller countries tend to borrow more in foreign currencies ▪ Countries with large catch-up potential (low per capita income in 1998) are more likely to borrow in foreign currencies ▪ Results for exchange rate volatility ambiguous ▪ Openness of the economy increases foreign currency borrowing in the corporate sector. Remittances are negatively correlated with household foreign currency borrowing.
Tzaninis, D (2005).	AT	1987-2004 (quarter-ly)	▪ Long-run demand model ▪ Dynamic model (error-correction model, dynamic simu-lations)	▪ Stock of FX loans to households, divided by the GDP deflator	▪ Interest differential ▪ Nominal effective exchange rate ▪ Consumption expenditures of households ▪ Herd behavior (modeled as a logistic function) ▪ Residential property index ▪ Dummy variable for policy measures	▪	▪ FX loans are highly sensitive over the long-run to exchange rate changes and changes in consumption. Short-term exchange rate fluctuations do not seem to matter. ▪ The interest rate differential explains to some degree the short-term dynamics in FX lending ▪ Herd behavior explains much of the increase in demand for FX loans ▪ It seem that banks have lowered interest rates on FX loans in order to gain market share

Table 3: Descriptive statistics of the variables

Variable	Description	Obs	Mean	Std. Dev	Min	Max
FXL	Foreign currency loans (share of total loans)	117	0,47047	0,22289	0,08804	0,86486
FXL_C	Foreign currency loans to non-financial corporations (share of total loans to corporations)	117	0,51718	0,21543	0,14681	0,88513
FXL_H	Foreign currency loans to households (share of total loans to households)	117	0,32168	0,28839	0,00000	0,89822
FXD	Foreign currency deposits	117	0,34084	0,16433	0,09808	0,76461
FXD2	= (FXD)^2	117	0,14295	0,12813	0,00962	0,58463
LRD	Loan-to-deposit ratio	117	0,88282	0,40352	0,09423	2,56416
FXLFXDR	FX loan to FX deposit ratio	117	1,28939	0,86341	0,20264	4,28685
FXLFXDR2	= (FXLFXDR)^2	117	2,40162	3,47115	.041063	18,3770
DCLDCDR	Dc-loan to dc-deposit ratio	117	0,86968	0,65250	0,02664	3,77213
DCLDCDR2	= (DCLDCD)^2	117	1,17846	2,09001	.000710	14,2289
LNRB	Loans of non-resident banks	117	0,12985	0,10342	0,01078	0,55294
ASFB	Asset share of foreign banks	117	0,66247	0,27082	0,07419	0,99375
AS5LB	Asset share of 5 largest banks	117	0,66916	0,14686	0,41241	0,99446
ASAB	Asset share of Austrian banks	40	0,28849	0,17975	0,00000	0,61345
INFL	Inflation	117	5,74696	11,04567	-3,1670	84,3900
ER_EUR	Exchange rate LCU / EUR	117	-0,0143	0,10048	-0,5859	0,15456
RER	Real effective exchange rate	117	118,349	22,51345	57,9893	174,511
IRD_EUR	Interest differential local to euro area lending rate	117	7,95159	9,71843	-0,5904	60,6401
RDI	Real domestic interest rate	117	0,05475	0,05410	-0,2476	0,22056
IRV	Interest rate volatility	117	17,1399	20,44795	0,73940	120,243
NIS	Net interest spread	117	6,73253	4,24437	1,86700	26,0340
REMIT	Remittances / GDP	117	0,04253	0,07258	0,00015	0,34670
GDP_PC	GDP per capita	117	10874	4935	1404	24340
EXP_GDP	Exports / GDP	117	0,37436	0,16487	0,06921	0,77003
EXIM_GDP	(Exports + Imports) / GDP	117	0,87848	0,31257	0,35215	1,54960
TRADE_EUR	Trade with euro area countries and countries with a currency peg to the euro	117	0,30729	0,12587	0,09911	0,67192
FDI	Foreign direct investment inflow as a share of GDP	117	0,06015	0,04340	0,00897	0,29622
INDU	Manufacturing industry as a share of GDP	117	0,30676	0,05683	0,16776	0,41134
FLOAT_PEG	Dummy variable for floating (0) or pegged (1) exchange rate regime	117	0,41880	0,49549	0,00000	1,00000
ERMII	Dummy variable for participation in the ERM II	117	0,11966	0,32596	0,00000	1,00000
EU	Dummy EU member	117	0,25641	0,43853	0,00000	1,00000
EBRD	EBRD index of banking sector development	117	3,23932	0,63054	1,70000	4,00000
HLR	Household FX loan restrictions	117	0,92308	0,26762	0,00000	1,00000

Source: Author

Figure 9: FX loans in CESEE

Source: Data from local Central Banks

Figure 7: FX loans in CESEE (continued)

Note: For Serbia the data include FX-indexed loans (no data before 2007 available)

Source: Data from local Central Banks