Financial Euroization: The Role of Foreign-owned Banks and Interest Rates*

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Abstract

This paper develops a model to explain the determinants of financial euroization. Expanding on the existing literature, our framework allows interest rate differentials to play a role in explaining the accumulation of foreign currency (Euro) denominated loans and deposits. It also accounts for the increasing presence of foreign (global) banks in the local financial sector. Using a newly compiled data set on transition economies and employing a standard panel as well as a panel-VAR methodology, which takes account of endogeneity of regressors, we find that increasing access to foreign funds leads to higher credit euroization, while it decreases deposit euroization. Interest rate differentials matter for the euroization of both loans and deposits.

JEL classification: E44, G21

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1 Introduction

Why do households and firms in many countries borrow in foreign currencies? Why do they hold deposits in foreign currencies? This paper addresses these questions theoretically and empirically using a newly compiled data set on transition economies, a region which has not been traditionally the focus of the so-called "financial dollarization" literature. As noted in a recent survey, this lack of attention by the literature is all the more surprising given that the holdings of foreign currency denominated (mostly Euro) assets and liabilities is indeed prevalent, and in some cases growing, among the formerly planned economies (Levy-Yeyati (2006)). Moreover, high exchange rate exposure has been recently highlighted as a potential source of macroeconomic and financial instability in a number of central and southeast European economies (Winkler and Beck (2006), Standard and Poor's - RatingsDirect (2006)).

Most of the empirical literature analyzing financial dollarization or euroization - defined as the holding by residents of a share of their assets and/or liabilities denominated in foreign currency - has concentrated on the determinants of either credit or deposit dollarization[1], but typically not both (e.g. Nicolo, Honohan, and Ize (2005)). This tendency occurs not only due to the lack of data but also due to the characteristics of the main theoretical models of financial dollarization developed by Ize and Levy-Yeyati (2003) and Ize (2005). In such models uncovered interest rate parity implies that in equilibrium depositors and borrowers choose the same currency composition, thus one can concentrate only on one side of the market. Therefore, banks are mere intermediaries and equilibrium interest rates are fully determined by the interaction between borrowers and lenders.

Firstly, the result that credit and deposit euroization are always matched is not broadly supported by our data. In transition economies the shares of foreign currency loans and foreign currency deposits are often negatively correlated (see Table 1).

[1]While dollarization and euroization refer to the same economic phenomena and will be used here interchangeably, euroization seems to be a more appropriate choice, given that the Euro is the predominant foreign currency in the transition economies.

Secondly, market participants seem to believe that interest rate differentials and, most importantly, the share of foreign-owned banks or global banks played an important role in affecting the level of euroization. Subsidiaries of foreign owned banks had an easier time borrowing abroad to fund a substantial growth of domestic credit which - to keep the banks' exposures matched - was granted in foreign currencies. This process was motivated by their attempt to capture market shares in yet undeveloped credit markets which until recently were not only highly profitable but were also expected to grow substantially in the medium term.[2]

Therefore, in explaining euroization it is important to explicitly account for three key features: (i) the difference between euroization of credit and deposits; (ii) the role of foreign-owned banks in driving foreign currency lending; and (iii) the role of interest rate differentials.

We extend the Minimum Variance Portfolio approach of Ize and Levy-Yeyati (2003), explicitly modelling how competition among banks and the fact that banks have an open facility to accumulate foreign liabilities affect local currency and foreign currency interest rate differentials. Introducing imperfect competition in the banking sector and allowing the funding of domestic credit with foreign liabilities results in a departure from the uncovered interest rate parity. We are, therefore, able to address the common argument that interest rate differentials between loans in foreign and local currency are a factor behind credit euroization - an argument that has been neglected in previous studies.

We then focus on the main contribution of the paper, building on the insights from our theoretical model to empirically analyze the main determinants of Financial Euroization using two different methodologies. Firstly, we follow the literature and estimate a standard panel regression, although our data set is monthly while in most cases a yearly data set is used. As Levy-Yeyati (2006) points out, using lagged variables in the panel regression can only mitigate the possible endogeneity of the main regressors, but does not eliminate it. While commonly recognized, due to lack of instruments,

[2]For evidence of the importance of targets for future market shares for foreign-owned banks active in the region such as ING and Raiffeisen see de Haas and Naaborg (2005).

this problem has not been effectively tackled by the literature[3]. In view of that and the fact that we have a panel with a fairly long time dimension, we also estimate a panel vector autoregressive regression (panel-VAR).

There are two main advantages in using a panel-VAR estimation. First, all variables are considered endogenous, which may be a more adequate procedure when including interest rates. Second, we are able to obtain orthogonalized impulse response functions isolating the response of innovations to the main variables on the levels of credit and deposit euroization.

The empirical evidence corroborates our hypothesis that increasing foreign presence coupled with the accumulation of foreign liabilities in the banking sector is an important factor explaining euroization in transition economies. We show that access to foreign funds increases credit euroization but it decreases euroization of deposits thus increasing the currency mismatches in the agents' portfolios in these countries. A wider interest rate differential on loans positively affects loan euroization, while an interest rate differential on deposits has a negative effect on deposit euroization. Our results confirm the relevance of the minimum variance portfolio theory of dolarization put forward by Ize and Levy-Yeyati (2003). We also find that higher degree of openness leads to higher corporate euroization but does not impact household euroization.

Our paper is related to a number of contributions in the financial dollarization (FD) literature. Our model follows both the contribution of Ize and Levy-Yeyati (2003) and Jeanne (2003), departing to include a monopolistic banking sector that can acquire funds from abroad. To our knowledge only Catao and Terrones (2000) provide a theoretical model of FD focused on the banking side. However, in their model FD is determined not only by the interest rate set by the banks but mostly by the assumption that investors have different collateral capabilities. Therefore, despite its novelty, the model does not allow one to isolate the impact of market and legal imperfections and banking activity on FD.

[3]Levy-Yeyati (2006) finds suitable instruments for some of the regressions and variables presented, but he does not include interest rates.

The role of banks in driving foreign currency holdings has been addressed empirically in transition economies only by Luca and Petrova (2003), who concluded that banks, in attempting to match currency composition of their assets and liabilities, drive credit euroization in these economies. Nicolo, Honohan, and Ize (2005) and Ize and Levy-Yeyati (2003) also focus on the determinants of foreign currency denominated holdings, confirming the minimum variance theory. Our empirical analysis advances on these contributions in a number of ways. Firstly, we include interest rates and a measure of banking balance sheet structure, showing they are relevant to explain euroization in transition economies. Secondly, we analyze both credit and deposit euroization, finding that some variables have asymmetric effects on each of them, explaining the negative inter-temporal correlation observed in the data. Thirdly, we also employ a panel-VAR estimation that takes account of endogeneity problems.

The remainder of the paper is organized as follows. Section 2 presents a model of the currency choice while section 3 provides solutions and model implications. An overview of the data and methodology is presented in section 4, section 5 presents the estimation results and section 6 concludes.

2 Model

The economy is populated by an infinite number of banks $i \in [0, 1]$, two representative households and a deposits and loans Dixit-Stiglitz CES "aggregator". We assume that all economic agents live for two periods.

2.1 Households

Households maximize utility given a stream of income choosing the amount of deposits and loans in local and foreign currency (implicitly determining consumption in each period). Both local and foreign currency denominated assets are risky. While the return on the first one might fluctuate due to inflation, the return on the second one will fluctuate due to changes in the real exchange rate.

The two representative households differ in their discount factor. While household H has a discount factor of β_H, household G has a discount factor of $\beta_G < \beta_H$. Both households have identical endowments in both periods (Y),[4] hence the relationship between the interest rate charged by banks and their implicit interest rate $(1/\beta_j)$ determines whether the household $j = H, G$ decides to take a loan or make a deposit.

In equilibrium (formally stated below) the economies' gross interest rates will be between $1/\beta_H$ and $1/\beta_G$. Note that due to imperfect competition in the banking market there will be four interest rate indexes, two for deposits, R_d and R_d^*, and two for loans, R_l and R_l^*. Asterisks are used to denote foreign currency denomination. For a set of parameter values all four equilibrium rates will be within that interval. Hence, the household with low discount factor will find it better to borrow and consume more today and the other will find it better to save and consume more tomorrow. That way, a household that makes deposits (loans) does not take loans (deposits).

In period one households choose the demand for loans, the demand for deposits[5] and the portfolio compositions, or the set (D, L, α_d, α_l), where D = total deposits, L = total loans, α_d = portion of deposits in foreign currency (deposit euroization) and α_l = portion of loans in foreign currency (loan euroization). In order to simplify the exposition and the solution of the model each household is split into two units: (i) the investor and (ii) the fund manager.

The investor solves a certainty equivalent problem selecting D and L, taking as given the expected average returns, defined as $E[\bar{R}_d] = (1-\alpha_d)R_d + \alpha_d R_d^*$ for deposits and $E[\bar{R}_l] = (1-\alpha_l)R_l + \alpha_l R_l^*$ for loans, and the portfolio

[4]Endowments, as consumption, total deposits and loans, are in real terms. This does not affect the results of the model. Households may actually have unlimited access to an exchange rate spot market in each period.

[5]Throughout the paper we state that households demand loans and deposits, considering that both are products that banks sell to households. However, deposit "demand" is upward sloping as it represents a supply of funds.

allocations $(\alpha_d,\ \alpha_l)$[6]. The investor's $j = H, G$ problem is

$$\max_{\{D,L\}} \frac{(Y - D + L)^{1-1/\sigma}}{1 - 1/\sigma} + \beta_j \frac{(Y + E[\bar{R}_d]D - E[\bar{R}_l]L)^{1-1/\sigma}}{1 - 1/\sigma}$$

The fund manager allocates the deposits (D) and loans (L) determined by the investor into foreign currency denominated deposits and loans (d^*, l^*) and local currency denominated deposits and loans (d, l) to maximize expected return and minimize the variance of the resulting portfolio, where

$$\begin{aligned} D &= d + d^*, \quad d = (1 - \alpha_d)D \quad \text{and} \quad d^* = \alpha_d D \\ L &= l + l^*, \quad l = (1 - \alpha_l)L \quad \text{and} \quad l^* = \alpha_l L \end{aligned}$$

Hence, for deposits

$$\max_{\alpha_d} E[\bar{R}_d] - q\frac{VAR[\bar{R}_d]}{2}. \tag{1}$$

The average return on deposits $\bar{R}_d$ is given by

$$\begin{aligned} \bar{R}_d &= (1 - \alpha_d)\hat{R}_d + \alpha_d \hat{R}^*_d, \text{ where} \\ \hat{R}_d &= R_d - \mu_\pi, \quad \hat{R}^*_d = R^*_d + \mu_S, \end{aligned}$$

and μ_π and μ_S are the risk components due to inflation and real exchange rate respectively by which the rate indexes need to be adjusted to get the actual returns ($\hat{R}_d$,$\hat{R}^*_d$) in period 2. These have zero mean, variances given by $S_{\pi,\pi}$, $S_{S,S}$ and covariance by $S_{\pi,S}$. Finally, q indicates the weight of the variance term in the fund manager's objective function.

The portfolio choice is therefore given by

$$\begin{aligned} \alpha_d &= \frac{R^*_d - R_d}{q(S_{\pi,\pi} + S_{S,S} + 2S_{\pi,S})} + \frac{S_{\pi,\pi} + S_{\pi,S}}{(S_{\pi,\pi} + S_{S,S} + 2S_{\pi,S})} \\ &= \frac{R^*_d - R_d}{q(S_{\pi,\pi} + S_{S,S} + 2S_{\pi,S})} + \lambda_{MVP} \end{aligned} \tag{2}$$

[6]Note that the certainty equivalent assumption allow us to solve the investor problem independently of the portfolio composition decision. Hence, the variance of the return does not affect the total deposit and loan decisions (no precautionary motive). Combining both decisions would increase the complexity of the model without significantly changing the results.

where, as in Ize and Levy-Yeyati (2003), λ_{MVP} affects euroization positively and is defined as

$$\lambda_{MVP} = \frac{S_{\pi,\pi} + S_{\pi,S}}{(S_{\pi,\pi} + S_{S,S} + 2S_{\pi,S})}$$

The loans decision problem is similar to (1), though now fund managers minimize the expected payment and the variance. The loans portfolio choice is therefore given by

$$\alpha_l = \frac{R_l - R_l^*}{q(S_{\pi,\pi} + S_{S,S} + 2S_{\pi,S})} + \lambda_{MVP}. \tag{3}$$

The equations determining the portfolio choice are the same as in Ize and Levy-Yeyati (2003). However, in their case $\alpha_d = \alpha_l = \lambda_{MVP}$ as they assume UIP holds. In our case banks choose interest rates such that households find it optimal to increase α_l if loan differential $(R_l - R_l^*)$ increases and to decrease α_d if deposit differential $(R_d - R_d^*)$ increases.

2.2 Deposits and Loans Aggregator

The introduction of a deposits and loans aggregator allow us to incorporate monopolistic competition in the banking sector. The aggregator sells CES deposit and loan indexes to households and buys individual banks' deposits and loans from each bank in order to minimize the cost for loans and maximize the gains for deposits. We assume perfect competition so the aggregator makes no profits. As it is standard with Dixit-Stiglitz CES indexes, we can derive the individual banks deposits and loans demands and the respective interest rate indexes:

$$d_i = \left[\frac{R_d}{rd_i}\right]^{-\theta} d \quad , \qquad d_i^* = \left[\frac{R_d^*}{rd_i^*}\right]^{-\theta} d^* \tag{4}$$

$$l_i = \left[\frac{rl_i}{R_l}\right]^{-\theta} l \quad , \qquad l_i^* = \left[\frac{rl_i^*}{R_l^*}\right]^{-\theta} l^* \tag{5}$$

where

$$\frac{1}{R_d} = \left[\int_0^1 \left(\frac{1}{rd_i}\right)^{1-\theta} di\right]^{\frac{1}{1-\theta}}, \qquad \frac{1}{R_d^*} = \left[\int_0^1 \left(\frac{1}{rd_i^*}\right)^{1-\theta} di\right]^{\frac{1}{1-\theta}} \tag{6}$$

$$R_l = \left[\int_0^1 (rl_i)^{1-\theta}\, di\right]^{\frac{1}{1-\theta}}, \qquad R_l^* = \left[\int_0^1 (rl_i^*)^{1-\theta} di\right]^{\frac{1}{1-\theta}} \tag{7}$$

Where rd_i, rl_i, rd_i^* and rl_i^* are bank i's local and foreign currency deposit and loan rates, and d_i, l_i, d_i^* and l_i^* are the demand for bank i's local and foreign currency deposits and loans for $i \in [0,1]$. R_d, R_l, R_d^* and R_l^* are the respective interest rate indexes, introduced in the household problem.

2.3 Banks

Each bank i chooses deposit and loan interest rates for foreign and local currency $(rd_i^*, rl_i^*, rd_i, rl_i)$ to maximize its expected second period profits and its loan market shares given the demands for loans and deposits. Although we do not model why banks exist and where they derive their market power from, banks may be providing liquidity and hence reducing the cost of credit ((Freixas, Parigi, and Rochet 2000)). The assumption that banks have market power is also supported by empirical evidence ((Simons and Stavins 1998)).

Banks start with an amount of funds (F), comprised of the banks' capital and its foreign liabilities, of which some are denominated in foreign currency and some in local currency. Banks can use F to offset loans, hence we do not force the market of loans and deposits to match but allow banks to use these funds to close the gap. The parameter ϕ indicates the portion of funds that are denominated in foreign currency.

Banks are assumed to have balanced currency positions thus loans must

be equal to funds plus deposits for each currency. Given prudential regulations limiting the net open foreign exchange positions this assumption is not unreasonable.

Bank i solves the following problem[7]:

$$\max_{\{rl_i, rl_i^*, rd_i, rd_i^*\}} \quad E\Bigg[(rl_i - 1)\, l_i + (rl_i^* - 1) l_i^* - (rd_i - 1)\, d_i - (rd_i^* - 1) d_i^* + \gamma \left(\frac{l_i}{l} + \frac{l_i^*}{l^*} \right) \Bigg] \tag{8}$$

subject to demand functions (4) and (5) and

$$l_i = d_i + (1 - \phi) F \tag{9}$$

$$l_i^* = d_i^* + \phi F \tag{10}$$

where γ reflects how much the bank cares about loan shares. We include loan market shares in the banks' objective function for two main reasons. Firstly, as shown by de Haas and Naaborg (2005), foreign banks do set targets for future market share for their subsidiaries in transition economies. Secondly, given that we solve a two period model, loan market shares serve as a proxy for future profits. Alternatively one could solve an infinite period model, assuming banks maximize the future stream of profits. However, that would increase the complexity of the problem. In any case, the main qualitative results of our model do not change if loan market shares are dropped from the banks' objective function.

The first order condition of the bank problem, incorporating the equilibrium conditions (individual bank rates are equal to rate indexes, explained below) are: (9), (10) and

$$\gamma\theta - L(1 - \alpha_l)(R_d(1 + \theta) + R_l(1 - \theta)) = 0$$

$$\gamma\theta - L\alpha_l(R_d^*(1 + \theta) + R_l^*(1 - \theta)) = 0$$

[7]The second period realization of individual bank rates have the same risk components defined in the household problem, μ_π and μ_S (e.g. $rl_i = E[rl_i] - \mu_\pi$). As banks are risk neutral and these have zero mean, they do not affect bank i's problem.

2.4 Equilibrium

The equilibrium is defined as a set of individual banks' interest rates $\{rd_i, rd_i^*, rl_i, rl_i^*\}_{i=0}^1$, interest rate indexes $\{R_d, R_d^*, R_l, R_l^*\}$ and loan and deposit demands $\{d, d^*, l, l^*\}$ such that given interest rates, aggregate demand solves the households' problem, given aggregate demand and interest rate indexes, the set $\{rd_i, rd_i^*, rl_i, rl_i^*\}$ maximizes bank i objective function for all $i \in [0, 1]$ and the interest rate indexes (6) and (7) hold. As all banks are equal this last conditions in fact imply that bank rates and rate indexes are equal.

3 Model Solution and Main Implications

Given the assumption on the functional form of the utility function of the household our model exhibits non-linearities that prevents us from solving it analytically. Hence, in order to obtain its main predictions we assume the following parameter values[8]. We set $\beta_H = 0.99$ and $\beta_G = 0.65$. These discount factors are chosen to allow for a wider range of specifications for other parameters of the model for which the equilibrium rates are still within the range $[1/\beta_H, 1/\beta_G]$. Income (Y) equals 10 and $\sigma = 0.175$ making sure that loan and deposit demands are sensitive enough to interest rate changes. The model is solved for different values of F (smaller than 0.06), $\theta = 35$ and $\gamma = 0.00005$, which, given the other parameters, ensure the funds are never greater than 70% of total of deposits and banking spreads are around 7% (average in our sample). Finally, we assume that $\lambda_{MVP} = 0.5$[9].

Given that there has been a strong increase in foreign bank ownership ratios (both in number of banks and percentage of assets) coupled with raises in foreign liabilities in transition economies in the last ten years the main question to be analyzed with the model is how financial euroization is impacted by increases in the ratio of foreign denominated funds (ϕ) together with an overall increase in total funds F.

Figure 1 shows the result of changing the amount of funds and the proportion of funds in foreign currency for loans and deposits euroization. When

[8]The main predictions of the model are robust across different parameterizations.

[9]Where $S_{\pi,\pi} + S_{S,S} + 2S_{\pi,S} = 0.1$ and $S_{\pi,\pi} + S_{\pi,S} = 0.05$.

both variables are increasing (top right corner of Figure 1(a) and 1(b)) the foreign currency loans share (α_l) increases and the foreign currency deposits share actually decreases. If initial funds are high, banks have more leverage resulting in more sensitivity on foreign currency shares given a change in ϕ (higher inclination for higher values of F).

[Insert figure 1: Loans and Deposits Foreign Currency Share]

The fact that deposit euroization is negatively affected by an increase in ϕ might seem surprising at first. However, this can be explained by the way banks are managing total funds (deposits plus F). If funds (F) are more concentrated in foreign currency (ϕ increases) banks find it optimal to offer better rates on foreign loans, attracting more demand for these loans from households. Households, therefore, decide to shift their portfolio towards foreign currency loans but due to risk aversion still want some local currency denominated loans. As a result, banks need a source of local currency funds and offer better deposit rates for domestic currency deposits, which, in turn leads to a shift towards local currency in the households' deposit portfolio. Hence, the main implication from an increase in the proportion of funds in foreign currency is that loan euroization should increase while deposit euroization should decrease.

Note that when $\phi = 0.5$, banks have no "preference" between foreign and local currency loans and deposits, thus $R_d = R_d^*$ and $R_l = R_l^*$, which implies $\alpha_d = \alpha_l = \lambda_{MVP} = 0.5$. Our model, therefore, nests the MVP framework of Ize and Levy-Yeyati (2003).

Given that we obtain equilibrium rates for all the markets we can also calculate interest rate differentials (local currency minus foreign currency rates) for loans and deposits for foreign and local currency.

Interest rate differentials increase as ϕ and F increase. Hence, there is a positive co-movement between loan differential and loan euroization and a negative co-movement between deposit differential and euroization. This is consistent with the bank's fund management reasoning. As banks make foreign currency loans and local currency deposits more attractive both dif-

ferentials increase (local currency loan and deposits rates increase while foreign currency rates decrease). This induces households to take more foreign currency loans and make less foreign currency deposits. Note that the relationship between interest rate differentials and euroizations is easily verified by looking at the fund manager's first order conditions (equations (2) and (3)), since households will only deviate from the λ_{MVP} if the differentials move.

Therefore, our model shows that as the proportion of foreign liabilities in the banking sector denominated in foreign currency increases interest rate differentials move such that loan euroization increases and deposit euroization decreases. These implications are very robust across different parameter specifications and across two different extensions to our basic framework[10].

In the first extension we have also included risk neutral firms that make loans to finance investment opportunities. Corporate loan euroization moves in the same fashion as household loan euroization. The only additional implication is that the level of openness of the economy has a positive impact on firm loan euroization. Based on that we can extend the model implications to analyze corporate euroization as well.

In the second extension we have allowed banks to select the amount of foreign liabilities they decide to borrow from abroad given a foreign currency external borrowing rate R^*, endogeneising foreign denominated funds. We find that the lower the interest rate R^*, the higher the proportion of foreign currency denominate funds, which leads to higher loan euroization and lower deposit euroization, confirming the results of the basic model. The importance of this extension is twofold: (i) it ensures the assumption of exogenous funds is not driving the results, leading to a model close to a general equilibrium small open economy model and (ii) allows us to theoretically link foreign bank ownership to euroization movements. Higher the proportion of foreign owned banks in the domestic banking sector implies lower foreign currency borrowing rates (R^*), since these banks would have the facility to borrow directly from their parent banks. Hence, higher foreign bank pene-

[10]The detail results of these model extensions are presented in a technical appendix available from the authors upon request.

tration results in a higher share of funds denominated in foreign currency, ϕ. This link is also supported by our data (see section 4).

Note that Ize and Levy-Yeyati (2003) also point out that net foreign liabilities may have a negative impact on deposit euroization based on the ad-hoc assumption that loan and deposit differential remain equal. However, the framework here explicitly models the banking sector and the interest rate setting decision, obtaining the result based on the assumption that banks actively manage their funds. We also emphasize the link between the level of net foreign liabilities in the banking sector and the ownership structure of the banking sector in emerging economies.

4 Data and Methodology

4.1 Data

Our analysis is based on a unique monthly data set compiled mostly from national central banks for the panel of 24 transition economies. In line with the variables included in our theoretical model and suggested by the literature we collected data for credit and deposits denominated in foreign and domestic currency, and their respective interest rates. For the majority of the countries in our sample we can distinguish between individuals and firms, long term and short term financial euroization.

The time series available are of varying length resulting in an unbalanced panel. For some of the countries (Bosnia and Herzegovina, Serbia and Montenegro) no interest rate data is available or it is available only for loans but not for deposits (Russia). After examining our data set we decided to use data from January 2000 onwards to avoid the problem of dealing with the effects of the Russian crisis.

We construct a measure of the share of foreign loans taking a ratio of foreign currency denominated and total domestic credit. We calculate this ratio for overall credit[11], individuals and nonfinancial corporations (NFC).

[11]This measure refers to households and firms only. In some countries, however, a broader measure was used, as it was not possible to exclude government and financial institutions from domestic credit.

The share of foreign currency denominated deposits is constructed in the same fashion[12].

Table 2 shows our loan and deposit euroization data per country. As can be immediately seen, loan and deposit euroization are not exactly two sides of the same coin. There are countries in our sample that have loan euroization being higher than deposit euroization and vice versa. It is also apparent that household loan euroization is lower compared to firm euroization. This seems to be true for all the countries except of Croatia and Latvia. Deposit euroization, though being higher for households in general, is very much country specific. Long term loan euroization is prevailing, while there is no clear distinction between short term and long term deposit euroization (short term being defined as less than one year).

[Insert table 1 - Loan and deposit euroization across countries (total, individual/nonfinancial corporate, short term/long term, 2000-2006]

To verify the implications of our theoretical model we calculate interest rate differentials for loans and deposits (ir_dif_d and ir_dif_l), defining the differential as foreign currency interest rate minus the domestic currency interest rate[13].

Our model suggests that euroization is also determined by λ_{MVP}. While the minimum variance portfolio rationale may be true, it relies on obtaining forward looking variances of inflation and change in the real exchange rate. As these are not observed, the most common alternative is to use historical information to calculate variances. This practice, however, introduces mismeasurement of λ_{MVP}, which may lead to wrong inference and even rejection of the theory. One possible alternative is to estimate the variances

[12]All these measures are constructed using stock variables if available. For countries where stock variables are not available, new business loans and deposits are used (e.g. Albania)

[13]In constructing this measure one year interest rates on the stock values are used if available. If not available longer maturity or new business measures are used. In case aggregate rates are not available, interest rates on loans and deposits by NFCs are used as proxies. For a few countries in the sample it is possible to distinguish between differentials faced by households and NFCs.

over the whole sample period, but this would introduce lookahead bias and make it impossible to account for unobserved heterogeneity in our empirical analysis. Thus, as a compromise, we estimate λ_{MVP} based on all historical information up to the observation point[14].

A number of countries in the region have exchange rate regimes referenced to the euro. Additionally, the proportion of foreign currency loans or deposits denominated in euro, for the countries where the currency split is available, is quite significant. Hence, our focus is on the euro/local currency exchange rate, which is only available since 1999. However, not accounting for pre 1999 exchange rate variability risks losing information that agents may take into account when forming expectations about future exchange rate variability. Therefore, we are faced with the challenge of choosing the relevant exchange rate for the pre 1999 period. For this period we estimate the variance of the change in the real exchange rate using either the US dollar exchange rate (*lambda_mue*) or the Deutsche Mark exchange rate (*lambda_mde*). Regression results using both variables are quite similar thus we report only the ones when *lambda_mue* was included.

Note that for currency board countries the variability of real exchange rate is directly linked to the variability of inflation, thus if a currency board is fully credible, λ_{MVP} is theoretically undefined. In other words, there would be no difference between local currency and foreign currency denominated assets. However, as the observed returns are in fact different these assets are not the same. Hence, one must decide how to estimate λ_{MVP} for currency board countries. In what follows we calculate λ_{MVP} as for the other countries relying on the small deviations of exchange rate due to transaction costs and/or bid/ask spread movements.

One of the implications of our model is that increasing ϕ (proportion of foreign currency denominated funds) leads to increasing loan euroization and decreasing deposit euroization. To test this hypothesis we construct an

[14]Various other possibilities were investigated, estimating λ_{MVP} over various moving window length (1 year, 2 years, etc.). After careful investigation it appeared that moving window methodology "forgets" periods of high variability and results in very volatile estimates of λ_{MVP}.

empirical counterpart of ϕ taking the ratio of foreign liabilities[15] of banks as a share of total funds net of deposits (i.e. foreign liabilities + capital). Implicit is the assumption that all foreign liabilities are denominated in foreign currency, which is the case for transition economies. Since no consistent measure of total bank capital is available we proxy it by assuming that the actual capital adequacy ratio of the banking system in each country is binding. It has to be noted that regulatory capital may differ from accounting capital. The constructed variable is defined as:

$$ratio = \frac{foreign\ liabilities}{foreign\ liabilities + total\ assets * CAR}$$

where CAR is the actual capital adequacy ratio of the banking system as reported by Barth, Caprio, and Levine (2004) and the accompanying data set provided by the World Bank[16].

While presenting our theoretical model we linked access to foreign funds to the level of foreign bank penetration in the domestic banking local system. The European Bank for Reconstruction and Development (EBRD) publishes two indexes of foreign bank penetration, one measuring the percentage of foreign ownership of total assets and one measuring the number of foreign owned banks. These are provided only yearly, and hence cannot be directly used in our empirical analysis. Nonetheless, we found a strong positive correlation between the level of foreign liabilities in the banking sector and both measures of foreign bank penetration for almost all the countries in our sample.[17]

As regards to the correlation between *ratio* and foreign bank penetration we found it positive for some countries and negative for others. On one hand, as foreign banks enter into the local financial system, through privatization or greenfield direct investments, total capital in the banking

[15]Note that all banks and bank-like institutions resident in a country are covered by the banking sector survey used to measure foreign liabilities. Specifically, "a subsidiary unit of a non-resident principal is regarded resident of the economy in which its operations are carried out" (International Monetary Fund (1984)), thus the mode of entry of foreign banks (subsidiaries versus branches) do not affect the foreign liabilities measure.

[16]Accessible at http://www.worldbank.org/research/projects/bank_regulation.htm.

[17]The technical appendix provides a more detail data analysis including these correlations.

sector increases leading to an overall improvement of the banking system and a decrease in *ratio*. On the other hand, foreign bank ownership leads to higher levels of foreign liabilities, which in turn increases *ratio*. Therefore, the variable *ratio* captures both effects of foreign bank penetration, higher levels of foreign liabilities and higher capitalization of the banking sector.

In order to incorporate a measure of competitiveness and market structure we calculate interest rate spreads in local and foreign currency ($spread\_lc$ and $spread\_fc$). We define spreads as the difference between the loan and deposit rates in each currency. As suggested by Barajas and Morales (2003) we also control for different exchange rate regimes by using a central bank intervention index ($interv$) that compares the variabilities of international reserves relative to broad money and the exchange rate. According to this index a country with low (high) variability in exchange rate and high (low) variability in international reserves is said to have a *de facto* pegged (floating) exchange rate regime.

The degree of openness of an economy is important to explain firm loan euroization. Besides that, it is important to control for real euroization, which can be proxied by the openness of the economy. Hence, we also include openness, computed as the ratio of total imports and exports to quarterly GDP ($open = \frac{imp+exp}{GDP}$), as an explanatory variable. Finally, we control for different levels of credit market development including a market depth variable ($depth$), which is calculated as a ratio of domestic credit to GDP. These three macro control variables ($interv$, $open$ and $depth$) are smoothed taking the moving average over 12 months.

4.2 Methodology

Based on the existing literature and the implications of our theoretical model we start our empirical analysis by estimating the following model:

$$share_{it} = \beta_1 ratio_{it} + \beta_2 \lambda_{it} + \beta_3 ir\_dif_{it} + \delta control_{it} + c_i + e_{it} \tag{11}$$

Where $share$ stands for euroization (loans or deposits), $ratio$ is the proportion of foreign currency denominated funds (as defined above, and which aims to capture foreign bank penetration) and ir_dif stands for the interest differentials (loans and deposits). Finally, $control$ comprise a vector

of variables including interest rate spreads (local currency and foreign currency) and the following macroeconomic controls: openness of the economy, exchange rate regime, and financial depth. After examination (Hausman specification test) fixed effects are included to control for unobserved heterogeneity.

Equation 11 is estimated via FGLS with panel heteroscedasticity and panel specific autocorrelation. Modified Wald test for groupwise heteroscedasticity rejects the null of $\sigma_i^2 = \sigma^2$ and partial autocorrelation function of the error term dies out quickly justifying AR1 structure for the error term.

Two specifications of equation 11 are considered. One specification has the levels of euroization as dependent variables and the other has the change in euroization as a dependent variable. As our variables for FD are calculated using stock measures they cannot capture well the changes in the euroization of the new loans and deposits. Since the measures of new business activity are not available we proxy it by looking at the changes in the stock variables. Finally, for each specification we run two main regressions, one including all countries in the sample and one excluding currency board countries.

Following the literature on financial euroization, moving averages or lagged variables (e.g. for interest rate differentials and spread) were employed in an effort to mitigate endogeneity problems. However, due to the persistency observed in the stock of deposits and loans we can not ensure endogeneity is not present in our estimation (see Levy-Yeyati (2006) for a more detail discussion).

In order to account for possible endogeneity we also employ a panel-data vector autoregression methodology following Love and Zicchino (2006). This technique combines the traditional VAR approach, treating all variables as endogenous, with a panel data approach, which allows for unobserved country heterogeneity. The first order panel-VAR model is given by:

$$x_{it} = \Omega x_{it-1} + c_i + e_t \tag{12}$$

where x_{it} is a vector of variables containing $\{\lambda_{it}, ratio_{it}, ir\_dif_{it}, share_{it}\}$[18]. The model includes country fixed effects (c_i). These are eliminated before estimation by using a forward mean-differencing also referenced as "Helmert procedure". As discussed in Love and Zicchino (2006), this transformation allows the use of lagged regressors as instruments and the estimation of the coefficients by system GMM (see Arellano and Bover (1995) for detail).

We are interested in both the matrix of coefficients Ω, and the impulse response functions that describe the reaction of one variable to innovations in another variable in the system, while holding other shocks equal to zero. We adopt a Choleski decomposition of the variance-covariance matrix of residuals to ensure the necessary orthogonality to obtain these responses. That way the ordering of the variables in the vector x_{it} is important since it determines if an innovation to a variable has a contemporaneous effect or only a lagged effect on the other variables (see Hamilton, J. D. (1994) for detail).

Based on our specification λ_{it} is only affected by the other variables with a delay. This assumption is justified since λ_{it} represents the trade-off between the past volatility of exchange rates and inflation. We assume that $ratio_{it}$ affects ir_dif_{it} contemporaneously, but ir_dif_{it} only affects $ratio_{it}$ with a lag. The main reasoning supporting this assumption is that it is more likely that banks would face greater delays in adjusting the ratio between total capital and the level of foreign liabilities (FL) than in adjusting their interest rates.

Finally, $share_{it}$, our variable of interest, is affect by the other three variables contemporaneously since it is likely that an orthogonal shock on agents preference towards foreign currency denominated assets/liabilities will only affect exchange rate, inflation, bank's optimal capital/FL ratio condition with a lag. Nonetheless, we find that altering the order of variables may affect the quantitative results but the main qualitative results are unchanged. A further discussion is provided in the sensitivity analysis section.

Note that the Panel-VAR model used here is similar to the panel model

[18] We have not included control variables keeping the model as parsimonious as possible due to the increased number of regressors when we run a VAR of higher order.

in Attanasio, Picci, and Scorcu (2000). They estimate a dynamic model linking two variables but running each equation separately, focusing on obtaining its coefficients (translating to our model, the matrix Ω). However, we are also interested in the impulse response functions in order to analyze the outcome of an innovation on *ratio*, being able to test the implications of our theoretical model. In order to do so we need to allow for a non-diagonal variance-covariance matrix of residuals, making the panel-VAR model estimation used in Love and Zicchino (2006) a more adequate estimation procedure.

5 Estimation results

5.1 Standard Panel Regression

The main estimation results for the panel regressions are reported in tables 2 and 3. Table 2 reports regression results with the levels of euroization as dependent variable, while table 3 reports regression results with the change in euroization as a dependent variable. Results reported in columns 1 through 6 correspond to the regression for which all countries in the sample were included while columns 7 through 12 correspond to the regressions without currency board countries. In the odd columns of the tables we report estimation results where the dependent variable is loan euroization, while in the even columns we report results for deposit euroization. Estimations are carried out for total (columns 1-2 and 7-8), individual (columns 3-4 and 9-10), and nonfinancial corporate euroization (columns 5-6 and 11-12).

The hypothesis that we are looking to test and is endorsed by our model implications is that foreign banks, given their access to funds from their parent banks, accumulate foreign liabilities attempting to gain credit market share. This leads to movements in interest rate differentials that drive loan and deposit euroization together with the trade off between inflation and real exchange rate variances (λ_{MVP}).

Estimation results confirm the theoretical argumentation of Ize and Levy-Yeyati (2003), incorporated into our model, that the level of euroization is increasing with the increase in λ_{MVP}. Given that we used as much data to

estimate *lambda_mue* as it was available, this variable is quite persistent. That implies it is not only able to explain the changes in euroization but also the level for both individuals and firms.

It must be noted, though, that the coefficient on the regression on level appears to be negative for household and firm loan euroization (but not for total) when the currency board countries are included in the sample (Table 2 columns 3, 5). This artifact disappears if the currency board countries are dropped from the sample. As discussed above, theoretically, λ_{MVP} is not defined for currency board countries. It may be argued that λ_{MVP} should be dropped in case currency board countries are included, but then the model is misspecified with respect to non currency board countries. We also performed regressions with currency board countries excluding λ_{MVP} (not reported here). The qualitative results were unaltered.

The second main variable that determines euroization is our model is interest rate differentials. Estimation with the *change* in euroization as a dependent variable yields consistent results for all the specifications. The interest rate differential on loans has a positive effect on loan euroization, while the interest rate differential on deposits has a negative effect on deposit euroization. This is in line with the predictions of the model and appears to be the case for households and firms.

Although the empirical result support our theoretical implications there could be other factors driving interest differentials, and therefore influencing the currency choice. However, a traditional explanation for interest rate differentials, namely country/risk premiums, can not explain the empirical results obtained. If a higher loan and deposit interest rate differential is explained by a higher risk premium we should observe an increase in deposit euroization and a decrease loan euroization. That implies an opposite movement than the one observed in the empirical analysis.

Interest rate differentials have little explanatory power on the level of euroization. The level of euroization used in our estimation is calculated from the stock variables, which naturally responds less to interest rate differentials. Therefore, it is expected that interest rate differentials have stronger

explanatory power on new businesses than on stock variables.

In order to capture the level effect of interest rate differentials being created by banks in search for greater market share throughout our sample period we turn to the analysis of the impact of ratio (ϕ) on euroization. As predicted by the model, the share of funds in foreign currency ($ratio$) has a positive impact on loan euroization and a negative impact on deposit euroization. This result is very robust across specifications. This is in line with the view that increased foreign bank presence in the region, by allowing banks to have greater access to foreign funds, has contributed to loan euroization. Consistent with our model, access to foreign funds leads to lower deposit euroization.

Note that *ceteris paribus* one might expect that as total foreign liabilities increase, total loans in foreign currency will also increase reflecting an accounting identity of the bank's balance sheet. However, unless banks are using their parent banks' source of funds to increase market share (chasing the loan market) as our model predicts one would not observe the decrease in deposit euroization as indicated by our theoretical and empirical results. Moreover, the significance of the estimation results for the banking spread and credit market depth also lend support to our conclusions.

As it was observed with interest rate differentials, banking spreads appear to have higher explanatory power in the regressions with the change in euroization as the dependent variable. We find that a higher local currency spread decreases loan and deposit euroization,while as foreign currency spreads increase loan and deposit euroization also increase. This result can be rationalized by the fact that in these economies bank market power is comparatively high and banks are increasingly doing business in the currency with higher return, providing further evidence that banks are driving agent's currency choice. Luca and Petrova (2003) also provide evidence that banks and not firms are more important in the determination of euroization levels.

The signs of credit market depth ($depth$) coefficient seem to match with the signs of the coefficients of the $ratio$ variable (positive for loans and neg-

ative for deposits). That leads us to conclude that domestic credit growth in transitional economies is mostly driven by the influx of foreign funds (through the increase in foreign liabilities), once again supporting the view that increased foreign bank presence in the region, and the consequent increase in foreign funds, has driven the currency denomination of loans and deposits.

Two additional results contrast with the conclusions obtained by important contributions to the empirical literature and should be highlighted.

Levy-Yeyati (2006) shows that there is a highly significant and negative correlation between financial depth and deposit euroization. He then uses this result to conclude that there seems to be little empirical evidence that dollarized countries are compensated with the benefit of more liquid domestic financial markets. On the other hand, our results provide an explanation for this negative correlation and moreover show that the correlation between loan euroization and financial depth is significant and positive, thus providing empirical evidence in favor of the hypothesis that euroization and financial deepening may be strongly linked. This also reinforces the importance to look at both deposits and loan euroization to analyze the effects of asset substitution.

The results presented in Ize and Levy-Yeyati (2003) and Nicolo, Honohan, and Ize (2005) indicate that real dollarization, proxied by the level of openness, is not significant in explaining total financial dollarization. Our analysis, on the other hand, provides support to the real dollarization paradigm. Openness has a positive impact on corporate loan and deposit euroization with and without currency board countries. Given that we estimate euroization for household and firms separately we are able to identify that a country's openness to the international economy is contributing to corporate but not to household financial euroization. Therefore, the rejection of the openness hypothesis obtained in the other studies is related to the fact that they have focused on total euroization only in their analysis.

[Insert tables 2 and 3]

5.2 Panel-VAR Regression

The Panel-VAR estimation assumes all variable are endogenous. Its results, therefore, can shed some light on the possibility that endogeneity problems in the standard panel estimation is driving our results. Moreover, given that we can incorporate innovations to our main variables we will be able to match the process of increased foreign bank ownership as an exogenous shock to the level of foreign liabilities in the banking sector, or analyze the impact of an exogenous shock to *ratio*. The estimation results are presented in Table 4, Figures 2 and 3. Table 4 shows the estimation results for total loan and deposit euroization. Reported numbers are the coefficients of regressing the row variable on the column variables. Figure 2 and 3 present the impulse responses of loan and deposit euroization, respectively, to shocks to the other three variables of our VAR. Following Love and Zicchino (2006) we also present the impulse responses 5% and 95% confidence intervals using Monte Carlo simulations.

The estimated coefficients of the Panel-VAR model of loan euroization confirm the results obtained in the standard panel estimation. *ratio*, λ_{MVP} and interest rate differential all contribute positively to loan euroization, although for the last two the standard deviation of the estimates is too high. In the case of deposit euroization, λ_{MVP} contributes positively while interest rate differential negatively, confirming the implications of the model. Note that based on the theoretical model an increase in *ratio* should impact positively both deposit and loan interest rate differentials. This is supported by the estimation results of the interest rate differential equations (second and fifth rows in table 4).

[Insert table 4 here]

The impulse response functions are also in line with the implications of the theoretical model. An exogenous shock to λ_{MVP} contributes positively to both deposit and loan euroization, while a *ratio* and interest rate differential shock contribute positively to loan euroization and negatively to deposit euroization[19]. Deposit and loan interest rate differentials increase

[19]We also run a Panel-VAR with the change in euroization, in addition to λ_{it}, $ratio_{it}$ and ir_dif_{it}. Confirming the results obtained in the previous section, shocks to interest rate

after an exogenous shock to *ratio* (impulse response not reported here[20])

[Insert figures 2 and 3 here]

Levy-Yeyati (2006) and Ize and Levy-Yeyati (2003) point out that λ_{MVP} measures the exchange rate pass-through in an economy. Therefore, one might expect that an economy that has a big portion of assets and liabilities denominated in foreign currency may have a higher degree of pass-through. Following this argument, not only λ_{MVP} explains euroization but euroization might explain λ_{MVP}. While employing a standard panel as ours or the one used by Levy-Yeyati (2006) this possibility cannot be investigated, using the orthogonal impulses responses we can. As mentioned above, on the one hand we find that an innovation on λ_{MVP} implies an increase in both deposit and loan euroization, confirming the minimum variance portfolio theory. On the other hand, an innovation on loan euroization has little impact on λ_{MVP}, while an innovation to deposit dollarization has a negative effect on λ_{MVP} (see figure 4). Hence, the reverse causality is not supported by the data.

[Insert figure 4 here]

5.3 Sensitivity analysis

5.3.1 Standard Panel Estimation

We test the robustness of our results in a number of different ways [21]. First, we used two different measures of λ_{MVP} (*lambda_mue* and *lambda_mde*), and results are robust across these two measures. Second, we estimated the model with and without the currency board countries, which produced very similar results with the only exception of λ_{MVP}.

Thirdly, because of better small sample properties we reestimate all of specifications of the model via OLS with heteroscedasticity and autocorrelation robust errors. The main qualitative results do not change.

differential impact positively on the change in loan euroization and negative on deposit euroization (see technical appendix for detail).

[20] All impulse responses are presented in a technical appendix available from the authors upon request

[21] The regression results are all reported in the technical appendix available from the authors upon request.

Fourthly, we re-estimate the empirical model for total euroization of deposits and loans (column 1 and 2 in Tables 3 and 4) dropping one country at the time from the sample. None of the estimated parameters reverse signs, although some loose significance, while others gain.

In all the regressions lagged values for *spread* and ir_dif are used. The same results are obtained when regressing on the contemporaneous variables.

5.3.2 Panel-VAR Estimation

The robustness of the panel-VAR results are verified in two ways[22]. Firstly, we have altered the order of the variables in the vector x_{it}, running the estimation with the following order $\{share_{it}, ratio_{it}, ir\_dif_{it}, \lambda_{it}\}$, implying that euroization can only be impacted by the other variables with a lag. Loan euroization still increases after a shock to *ratio*, interest rate differential and λ. Deposit euroization increases after a λ, decreases after a interest rate differential shock, but remains close to zero after a *ratio* shock. Therefore, the results are not driven by the identification assumption adopted.

In order to verify if the positive interest rate differential response to *ratio* is influenced by the identification assumption, we also estimate the model with the following order $\{share_{it}, ir\_dif_{it}, ratio_{it}, \lambda_{it}\}$, assuming interest rate differential is only impacted by *ratio* with a lag. The positive responses are still observed.

Finnaly, we have increased the number of lags in the panel-VAR. The impulse response analysis remain unchanged. We have also tested if the error terms of each VAR equation is white noise. For a few countries that is not the case but increasing the lags does not correct the problem.

6 Conclusions

We extend the Minimum Variance Portfolio model of Financial Dollarization to highlight that the existence of a banking sector with an easy access to foreign funds has an asymmetric effect on the share of loans and deposits

[22]Details of the estimation and tests are reported in the technical appendix

in foreign currency. We show how access to foreign funds leads to a departure from uncovered interest rate parity. While the banking sector is bound by the currency mismatch regulation such constraint does not apply to the currency composition of the depositors' or creditors' portfolios. Our contribution is in showing that access to foreign funds is the channel through which foreign bank presence in transition economies affects financial euroization.

The implications of the model are strongly supported by a newly compiled data set on transition economies. Our data and analysis indicate that euroization of deposits and its determinants is not generally matched by the euroization of credit indicating the need to focus on both sides of the market in theoretical and empirical studies.

The richness of our data set, split by households and firms as well as long term and short term, allows us to explore financial euroization in great detail. We observe that household credit euroization is lower compared to corporate euroization, which might be comforting knowing that households usually have less hedging capabilities. An important distinction between households and firms is that a country's openness to the international economy is contributing to corporate but not to household financial euroization, supporting the real euroization paradigm. Note that the explanatory power of our model is generally lower for household vis-a-vis total and corporate euroization. Hence, there are important determinants of household euroization that are not captured in our analysis. We believe that the level of remittances, which were not included in our analysis due to lack of data, could be one of these factors.

Our analysis nests the minimum variance portfolio framework. In line with previous studies, the trade off between inflation and real exchange rate variability is found to be a significant factor explaining financial euroization. Moreover, using the panel-VAR analysis we are able to confirm that the possible reverse causality between the level of euroization and the minimum variance portfolio, raised by Levy-Yeyati (2006), is not observed in the data, giving further support to the theory.

If uncovered interest rate parity holds then any interest rate differential that is observed on domestic and foreign currency denominated assets should be explained by an *expected* depreciation or appreciation of the currency. Thus, interest rate differentials should not affect the currency composition of loans and deposits.

In contrast with the literature we allow for uncovered interest rate parity not to hold necessarily, hence the interest rate differential can play a part. Confirming the implications of the model, our empirical results show that a higher interest rate differential on loans increases credit euroization. On the other hand, deposit euroization decreases when the interest rate differential on deposits increases. Hence, interest rate differentials matter.

One of the main features of transition economies is the increasing presence of foreign banks and the consequent influx of foreign funds. According to our model, as well as the empirical results, access to foreign funds increases credit euroization although it decreases euroization of deposits. Increasing currency mismatch in the agent's portfolios leads to higher credit risk (due to exchange risk) and a more fragile financial system. Thus the results presented here have important policy implications. De-euroization of credit and greater financial stability could be achieved by implementing controls on the currency composition of the net foreign liabilities in the banking sector. Clearly, such policy will have important costs as well given that the expansion of the credit market in these countries have been based on a sharp increase in foreign liabilities.

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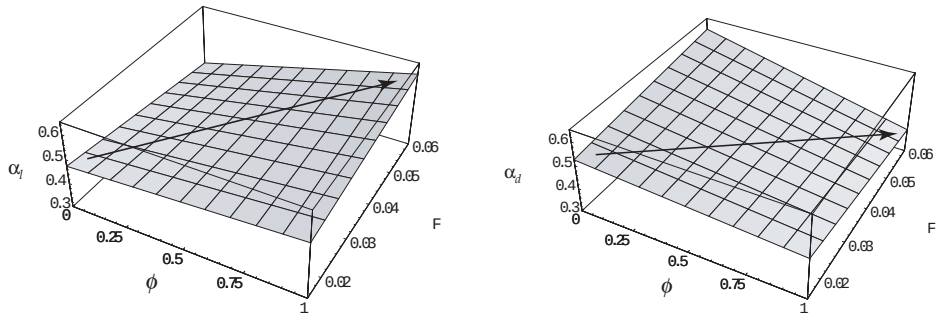


(a) Loan euroization (b) Deposit euroization

Figure 1: Loans and Deposits Foreign Currency Shares

Table 1: Loan and deposit euroization across countries (total, individual/nonfinancial corporate, short term/long term, 2000-2006)

Country	ls_tot	ls_ind	ls_nfc	ls_st	ls_lt	ds_tot	ds_ind	ds_nfc	ds_st	ds_lt	Corr†
Albania	0.68	.	.	0.64	0.77	0.31	0.26	0.54	0.47	0.2	0.0778
Armenia	.	.	.	.	.	0.75	.	.	.	.	.
Azerbaijan	0.62	.	.	0.59	0.69	0.59	0.89	0.38	.	.	-0.4538
Bosnia and Herz.	0.39	.	.	.	.	0.52	.	.	0.37	0.79	0.7088
Bulgaria	0.41	0.08	0.54	0.42	0.4	0.5	0.6	0.46	0.5	0.4	-0.8201
Belarus	.	.	.	.	.	0.57	0.51	0.63	0.59	0.56	.
Serbia and Mont.	0.35	0.06	0.41	0.17	0.51	0.63	0.78	0.48	0.63	0.66	-0.8333
Czech Republic	0.14	0.01	0.19	0.13	0.14	0.11	0.07	0.2	0.13	0	0.6954
Estonia	0.8	0.68	0.8	0.6	0.82	0.3	0.19	0.42	0.29	0.41	-0.5933
Georgia	0.83	.	.	0.75	0.91	0.94	.	.	0.93	0.96	0.8124
Hungary	0.35	0.13	0.39	.	.	0.17	0.15	0.21	0.18	0.01	-0.5577
Croatia*	0.78	0.82	0.73	.	.	0.65	0.79	0.36	.	.	0.8744
Kazakhstan	0.57	.	.	.	.	0.51	0.6	0.44	.	.	0.7933
Lithuania**	0.64	0.46	0.66	0.46	0.61	0.4	0.24	0.37	0.22	0.23	0.7076
Latvia	0.61	0.65	0.59	.	.	0.41	0.44	0.37	.	.	0.6675
Moldova	0.72	0.02	0.84	.	.	0.5	.	.	.	0.5	0.3912
FYR Makedonia	0.2	0.01	0.24	0.14	0.27	0.48	0.66	0.29	.	.	-0.2490
Poland	0.16	0.09	0.28	0.05	0.33	0.17	0.16	0.2	0.17	0.18	-0.2843
Romania	0.59	0.29	0.62	0.52	0.69	0.44	0.74	.	.	.	0.4952
Russia	0.31	0.2	0.33	0.23	0.51	0.39	0.32	0.63	0.4	0.41	0.6850
Slovenia	0.25	0.02	0.34	0.2	0.27	0.33	0.42	0.21	0.35	0.25	-0.0202
Slovakia	0.18	0.01	0.3	.	.	0.15	0.13	0.19	0.39	.	-0.7123
Tajikistan	0.7	.	.	.	.	0.57	0.81	0.47	.	.	-0.4376
Ukraine	0.43	.	.	0.35	0.53	0.35	.	.	0.26	0.44	0.7836
Total	0.47	0.21	0.47	0.35	0.51	0.44	0.46	0.39	0.4	0.42	0.5770

Source: National Central Banks

† Correlation of total loan and deposit euroization

* Adjusted for indexation

** Split into short term/long term and individual/nonfinancial corporate is for euro denomination only.

Table 2: Financial euroization estimation results (GLS) with and without currency board countries

	(1) l_share_tot	(2) d_share_tot	(3) l_share_ind	(4) d_share_ind	(5) l_share_nfc	(6) d_share_nfc	(7) l_share_tot	(8) d_share_tot	(9) l_share_ind	(10) d_share_ind	(11) l_share_nfc	(12) d_share_nfc
ratio	0.044**	-0.087***	0.015	-0.039**	0.153***	-0.271***	0.041**	-0.059***	-0.001	-0.022	0.062	-0.275***
	(2.51)	(-5.06)	(1.45)	(-2.50)	(4.61)	(-6.94)	(2.07)	(-3.20)	(-0.07)	(-1.08)	(1.43)	(-6.81)
open	-0.025*	0.046***	-0.018***	-0.002	0.047***	0.101***	-0.021	0.055***	-0.001	0.006	0.065***	0.065**
	(-1.92)	(2.74)	(-6.74)	(-0.13)	(3.07)	(3.43)	(-1.52)	(2.81)	(-0.59)	(0.27)	(4.85)	(2.02)
interv	0.004	0.004	0.000	0.002	-0.006	-0.024	0.017	-0.005	0.001	-0.003	0.009	-0.053**
	(0.45)	(0.43)	(0.06)	(0.20)	(-0.50)	(-1.21)	(1.64)	(-0.42)	(0.29)	(-0.25)	(0.56)	(-2.45)
lambda_mue	0.068**	0.289***	-0.052**	0.062**	-0.201*	0.356***	0.083***	0.199***	0.006	0.030	0.121	0.375***
	(2.21)	(8.22)	(-2.52)	(1.98)	(-1.92)	(4.99)	(2.61)	(4.30)	(0.45)	(0.67)	(1.16)	(4.56)
depth	0.053	-0.248***	0.306***	-0.280***	0.195***	-0.021	-0.011	-0.181***	0.021	-0.511***	-0.133	0.065
	(1.02)	(-7.09)	(11.87)	(-8.36)	(3.82)	(-0.37)	(-0.16)	(-2.70)	(1.35)	(-8.64)	(-1.49)	(0.80)
margin_fc	-0.000	0.000					-0.000	0.000				
	(-0.94)	(0.74)					(-0.72)	(1.00)				
margin_lc	-0.000	-0.000					-0.000	-0.000				
	(-0.58)	(-0.67)					(-0.31)	(-0.86)				
margin_fc_ind			-0.000	0.000					0.000	0.000		
			(-0.10)	(0.67)					(0.24)	(0.01)		
margin_lc_ind			-0.000*	0.000					-0.000	-0.000		
			(-1.90)	(0.04)					(-0.42)	(-1.19)		
margin_fc_nfc					-0.001	-0.000					-0.000	0.001
					(-1.38)	(-0.31)					(-0.80)	(0.74)
margin_lc_nfc					-0.001**	0.000					-0.000	-0.002*
					(-2.07)	(0.25)					(-0.75)	(-1.65)
ir_dif_l	0.000						0.000					
	(0.52)						(0.76)					
ir_dif_d		-0.000						-0.000				
		(-1.07)						(-0.40)				
dif_l_ind			0.000						0.000			
			(0.75)						(0.28)			
dif_d_ind				-0.001***						-0.001*		
				(-2.74)						(-1.81)		
dif_l_nfc					-0.000						0.000	
					(-0.84)						(0.18)	
dif_d_nfc						-0.001						-0.003**
						(-1.10)						(-2.38)
Log L	2751	2899	1877	2107	1539	1446	1968	2206	1381	1444	971	1027
N	850	921	476	591	456	561	625	696	307	422	281	388

Note: t-ratios in the parenthesis. *, ** and *** - significant at 10%, 5%, and 1%
l_share_tot, d_share_tot - total loan (l) and deposit (d) euroization, l_share_ind, d_share_ind - individual (ind) loan and deposit euroization, l_share_nfc, d_share_nfc - corporate (nfc) loan and deposit euroization, ratio - share of foreign funds in foreign currency, open - openness of the economy, interv - proxy for the exchange rate regime, lambda_mue - minimum variance portfolio (calculated using USD/EUR exchange rate),depth - financial market depth, margin_fc margin_lc - (loan-deposit) interest rate margin in foreign (fc) and local currency (lc), ir_dif_l ir_dif_d - loan and deposit interest rate differentials (local currency - foreign currency), dif_l_ind, dif_d_ind, dif_l_nfc, dif_d_nfc - interest rate differentials for individuals and firms.

Table 3: Change in financial euroization estimation results (GLS) with and without currency board countries

	(1) Δl_sh_tot	(2) Δd_sh_tot	(3) Δl_sh_ind	(4) Δd_sh_ind	(5) Δl_sh_nfc	(6) Δd_sh_nfc	(7) Δl_sh_tot	(8) Δd_sh_tot	(9) Δl_sh_ind	(10) Δd_sh_ind	(11) Δl_sh_nfc	(12) Δd_sh_nfc
ratio	0.020**	-0.004	0.002	-0.036***	0.002	-0.008	0.012	-0.006	-0.002	-0.051***	0.022	0.005
	(2.47)	(-0.48)	(0.51)	(-3.72)	(0.20)	(-0.33)	(1.14)	(-0.66)	(-0.37)	(-3.81)	(1.13)	(0.19)
open	0.001	-0.006*	0.003	0.003	0.004	-0.004	0.000	-0.006*	0.005	-0.001	0.011*	-0.012
	(0.29)	(-1.94)	(1.45)	(1.00)	(1.10)	(-0.41)	(0.03)	(-1.86)	(1.61)	(-0.28)	(1.89)	(-0.96)
interv	-0.005*	0.004	0.006**	0.007*	0.001	0.005	-0.009*	0.005	0.010***	0.003	-0.004	0.008
	(-1.69)	(1.00)	(2.37)	(1.93)	(0.28)	(0.40)	(-1.84)	(1.01)	(3.19)	(0.39)	(-0.55)	(0.37)
lambda_mue	0.020**	-0.003	0.018**	0.019**	0.051***	-0.005	0.022*	0.004	0.024**	0.015	0.066***	0.008
	(2.46)	(-0.37)	(2.14)	(2.03)	(3.54)	(-0.19)	(1.79)	(0.42)	(2.09)	(0.84)	(2.85)	(0.20)
depth	-0.016**	0.014	0.011*	0.006	-0.022**	0.006	-0.000	0.004	0.014	0.022	-0.045	-0.007
	(-2.38)	(1.41)	(1.77)	(0.80)	(-2.21)	(0.27)	(-0.01)	(0.24)	(1.06)	(0.98)	(-1.50)	(-0.13)
margin_fc	0.000	0.001**					0.000	0.001**				
	(0.15)	(2.03)					(0.30)	(2.12)				
margin_lc	-0.000**	-0.000					-0.001**	-0.000				
	(-2.13)	(-0.63)					(-2.34)	(-1.10)				
margin_fc_ind			0.000	0.000					0.000**	-0.000		
			(1.55)	(0.01)					(1.98)	(-0.03)		
margin_lc_ind			-0.000	-0.000					-0.000	-0.000		
			(-0.98)	(-1.49)					(-1.02)	(-1.18)		
margin_fc_nfc					-0.000	0.001					-0.000	0.002*
					(-0.24)	(1.14)					(-0.14)	(1.78)
margin_lc_nfc					-0.001	-0.000					-0.001	-0.000
					(-1.57)	(-0.45)					(-1.39)	(-0.45)
ir_dif_l	0.000						0.000					
	(0.91)						(1.17)					
ir_dif_d		-0.001***						-0.001***				
		(-3.75)						(-3.86)				
dif_l_ind			0.000						0.000**			
			(1.64)						(2.12)			
dif_d_ind				-0.001***						-0.001***		
				(-3.39)						(-3.38)		
dif_l_nfc					0.000**						0.001**	
					(1.96)						(2.52)	
dif_d_nfc						-0.002*						-0.002**
						(-1.76)						(-2.36)
Log L	2797	2896	2207	2171	1625	1401	2013	2214	1488	1508	1027	999
N	846	917	475	586	455	556	621	692	307	418	281	384

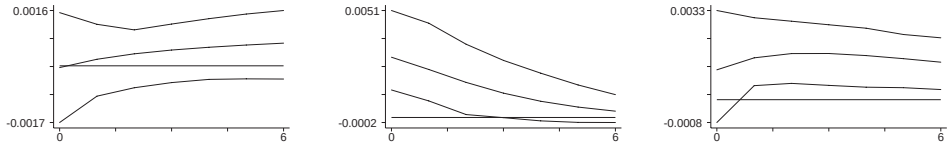
Note: t-ratios in the parenthesis. *, ** and *** - significant at 10%, 5%, and 1%

Δl_sh_tot, Δd_sh_tot - change in total loan (l) and deposit (d) euroization, Δl_sh_ind, Δd_sh_ind - change in individual (ind) loan and deposit euroization, Δl_sh_nfc, Δd_sh_nfc - change in corporate (nfc) loan and deposit euroization, ratio - share of foreign funds in foreign currency, open - openness of the economy, interv - proxy for the exchange rate regime, lambda_mue - minimum variance portfolio (calculated using USD/EUR exchange rate - mue),depth - financial market depth, margin_fc margin_lc - (loan-deposit) interest rate margin in foreign (fc) and local currency (lc), ir_dif_l ir_dif_d - loan and deposit interest rate differentials (local currency - foreign currency), dif_l_ind, dif_d_ind, dif_l_nfc, dif_d_nfc - interest rate differentials for individuals and firms.

Table 4: Panel-VAR: Financial euroization estimation results

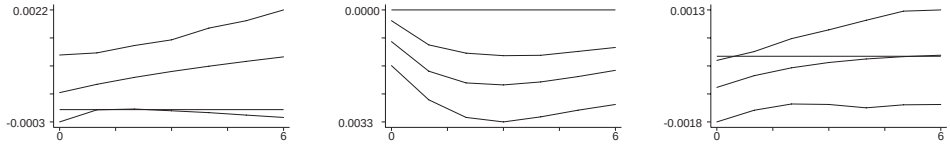
Loan euroization				
	$\lambda(t-1)$	$ratio(t-1)$	$ir\_dif\_l(t-1)$	$l\_share\_tot(t-1)$
$\lambda(t)$	1.04 (34.02)***	-0.0017 (-0.17)	-0.0003 (-2.33)	-0.0009 (-0.30)
$ratio(t)$	0.016 (0.38)	0.89 (38.21)***	0.0003 (1.04)	0.005 (0.42)
$ir\_dif\_l(t)$	-4.35 (-1.02)	4.37 (2.13)**	0.60 (14.44)***	-0.84 (-0.73)
$l\_share\_tot(t)$	0.07 (1.34)	0.074 (2.03)**	0.0006 (0.99)	0.53 (4.66)***
N obs: 907				
Deposit euroization				
	$\lambda(t-1)$	$ratio(t-1)$	$ir\_dif\_d(t-1)$	$d\_share\_tot(t-1)$
$\lambda(t)$	1.04 (41.12)***	-0.005 (-0.70)	-0.0003(-1.27)	-0.016 (-1.91)*
$ratio(t)$	0.024 (0.67)	0.88 (39.78)***	0.0002(0.47)	-0.015 (-0.73)
$ir\_dif\_d(t)$	0.0045 (0.00)	3.33 (2.98)***	0.58 (12.06)***	1.41 (0.97)
$d\_share\_tot(t)$	0.044 (1.35)	0.018 (0.88)	-0.001 (-3.14)***	0.86 (26.76)***
N obs: 931				

Note: t-ratios in the parenthesis. *, ** and *** - significant at 10%, 5%, and 1%



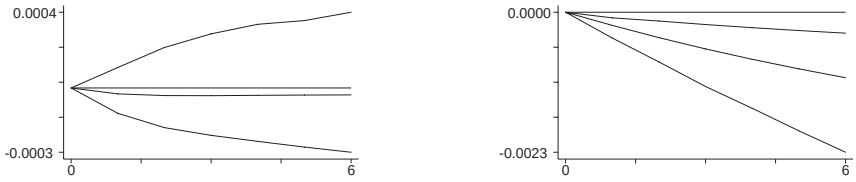
(a) λ shock (b) IR dif shock (c) *ratio* shock

Figure 2: Impulse Response Loan euroization



(a) λ shock (b) IR dif shock (c) *ratio* shock

Figure 3: Impulse Response Deposit euroization



(a) Loan Euroization shock (b) Deposit Euroization shock

Figure 4: Impulse Response λ_{MVP}

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