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Monetary and Financial Policies for "de-euroization" - a Case Study of Recent Croatian Experience

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Abstract

We analyze the determinants of financial euroization in Croatia, one of the most euroized countries in Europe. We consider our results to be a useful case study for assessing the potential effectiveness of various standard and non-conventional monetary and financial policies in reducing the persistently high level of financial euroization in a rigid exchange rate regime environment. Our starting point, in accordance with the related literature, is that credit euroization is often caused by deposit euroization. Deposit euroization, on the other hand, is clearly caused by adverse expectations or uncertainty about the performance of the domestic currency, on the supply side. On the demand side, it depends on costs for banks of holding foreign currency liabilities relative to holding domestic currency liabilities. Furthermore, credit and deposit euroization often reinforce each other in a typical regulatory setting, where deposit institutions are required to limit their exposure to direct foreign currency risk. Our analysis finds empirical support for some of the theoretical determinants of financial euroization in 2000-2010. In particular, we conclude that deposit demand (credit supply) was instrumental in driving partial de-euroization in 2002-2007, driven by higher regulatory costs for banks of holding foreign currency liabilities and extending foreign currency loans relative to resorting to their domestic currency substitutes. We also find some evidence that measures aimed to preserve the financial stability in the country after the global crisis spilled over in 2008-2009 might have contributed to partial re-euroization in this later period. However, by preserving the credibility of the exchange rate regime, they also likely contributed to a halt in this trend in late 2010, when the exchange rate pressures subsided. Thus, it appears that monetary and prudential policies can be used effectively in normal times to reduce the level of both the deposit and credit euroization, even within the rigid exchange rate regime environment. It also appears that the policies aimed at preserving the stability of the exchange rate during turbulent times ultimately pay off, although they may contribute to the increase in the financial euroization level during periods of strong exchange rate pressures.

June, 2011

1. Introduction

Episodes of significant currency depreciations during the 2008-2009 global crisis have exposed some risks associated with the widespread practice of foreign currency lending in the Central and Eastern Europe region. The debt burden and debt-servicing burden have both steeply and suddenly increased in many countries (EBRD, 2010). As a consequence, the non-performing loan ratios in banks' portfolios soared (Rainer and Haiss, 2010, p. 4). To alleviate this problem, monetary authorities in countries with higher levels of credit euroization[1] were often forced to respond to the financial stability threats posed by domestic currency weakness by implementing monetary measures to support domestic currency. But these measures were inherently pro-cyclical, causing great uncertainty about the ultimate net-effect on the quality of banks' assets.

The above clearly illustrates the monetary policy dilemma faced by policymakers in small open highly euroized countries, when simultaneously faced with exchange rate pressures and economic downturn, hardly independent events. Attempting to preserve a stable nominal exchange rate level in these circumstances can clearly be shown to be pro-cyclical, while letting it adjust increases balance-sheet risks, possibly turning out to be pro-cyclical if the financial sector cannot absorb them. Clearly, the more rigid the exchange rate regime, the risks associated with letting the nominal exchange rate adjust become greater, and regardless of the regime-type, the expected cost of the exchange rate adjustment should be proportionate to the level of credit euroization at the time of the shock.

Importantly, the above is not the only monetary policy dilemma associated with high levels of credit euroization. Often in practice regulators limit the direct foreign currency exposure of financial institutions by requiring them to "cover" their foreign currency denominated lending by foreign currency denominated liabilities. Thus, asset euroization is often intimately tied to liability euroization by the means of regulation. On the other hand, many countries in the past have suffered from high and persistent deposit euroization, typically due to history of high inflation or other forms of political or financial instability. Thus, one way they could approach the problem of developing their credit markets, while at the same time maintaining sound foreign exchange risk management practices of financial institutions, was to allow or even

[1] We use the term "credit euroization" to denote the notion of dollarization of financial system assets in countries where the reference currency is Euro. Analogously, we use the term "deposit euroization" to denote dollarization of deposit institutions' liabilities in those countries. Furthermore, we use the term "financial euroization" as an umbrella term for both credit and deposit euroization, while we use the usual "currency substitution" term to denote the situation in which Euro notes and coins are used for carrying out daily transactions, rather than the domestic currency. More on terminology can be found in e.g. Ize and Yeyati (2003).

stimulate the development of foreign currency denominated lending. So, the dependence between credit and deposit euroization is a two-way street, possibly creating a vicious circle of total financial euroization.

On these grounds, a sensible policy advice for highly euroized countries would be to increase nominal exchange rate flexibility and act to reduce both deposit and credit euroization levels during good times, in order to make the financial system more resilient in bad times. This is precisely the advice to be found in most recent literature on credit euroization, such as Zettelmeyer et al (2010), Rainer and Haiss (2010), and Kokenyne et al (2010). This literature analyzes the causes and implications of credit euroization in theory and practice, as well as policies deemed to be successful at de-euroization in the past (or more precisely de-dollarization, in the case of Latin American economies).

In this paper, we test the robustness of their findings on the interesting case of Croatia, one of the most euroized countries in Europe. In particular, we first look at the causes of high and persistent euroization in the past, then examine the policies which have contributed to partial de-euroization in the period 2002-2007 and finally examine the drivers of subsequent re-euroization during the global crisis period 2008-2009.

Our analysis indicates that the monetary and financial policies implemented by the central bank in 2004-2010 likely have had a profound and expected impact on the evolution of both deposit and credit euroization in Croatia. In particular, these measures could probably be credited with partial de-euroization in 2004-2007, but may have also contributed to re-euroization later in the crisis period, 2008-2010. However, due to a large number of intertwined central bank measures, it is difficult to allocate this general effect to particular measures. The question of feedback between the deposit and credit euroization also appears to have a model-specific answer. Nevertheless, statistical evidence appears strong that the central bank measures to curb foreign borrowing and domestic credit growth by domestic banks have contributed, if not outright caused, partial financial de-euroization in 2004-2007, while crisis fighting central bank measures in 2008-2009 might have contributed to partial re-euroization during that period.

2. Literature overview

Causes and consequences of the so called unofficial (or spontaneous) euroization are surveyed in several recent articles (Ize and Levy-Yeyati, 2003, and Levy-Yeyati, 2006). The main consequence of high credit euroization of relevance to policymakers is the so called exchange rate-induced credit risk - a systematic risk of default by those who borrow in foreign currency while at the same time having no income/savings in foreign currency. This risk materializes when the domestic currency depreciates against the borrowing currency. This often happens during cyclical downturns, and measures to support the domestic currency in these circumstances are necessarily procyclical, inducing a typical monetary policy dilemma. Moreover, depreciation often affects the economy asymmetrically as households and small and medium service-oriented enterprises (and others not involved in export activities) are naturally unhedged against currency risk, putting additional obstacles before policymakers.

The main adverse consequence of a high level of deposit euroization is related to credit euroization. If banks are allowed (or required) to extend (mostly) domestic currency loans when majority of deposits are denominated in foreign currency, the whole banking system may become open to direct exchange rate risk of nominal depreciation of the domestic currency against (the basket of) borrowing currencies. There are two possible solutions to this problem often employed in practice: 1) fixing the nominal exchange rate (to EUR), or/and 2) imposing restrictions on banks' net-open (short) foreign currency positions. The first solution reduces the degrees of freedom of monetary policy, while the second solution either drives credit euroization or leads to underbanking of potential borrowers who are not naturally hedged against foreign currency risk and cannot purchase such a hedge at a reasonable price.

Regarding the causes of euroization, much more has been written on deposit euroization. High levels of deposit euroization are typically found in countries with history of high and volatile inflation or sharp nominal exchange rate depreciations. Scheiber and Stix (2009) provide cross-country econometric evidence that this history does not matter once the current quality of institutions is adequately accounted for in the analysis. However, their analysis confirms the positive effect of inflation volatility on deposit euroization through a more complex channel, the so called "*minimum variance portfolio dollarization ratio*" (following Ize and Yeyati, 2003) stipulating that deposit euroization is greater the greater is the ratio of inflation volatility to exchange rate volatility.

At the same time, deposit euroization should be distinguished from currency substitution, a term usually reserved for describing the use of foreign currency (cash) as usual means of payment and a store of value. Currency substitution is usually found in countries with history of banking crises, especially when they resulted in forced conversion of foreign currency deposits into domestic currency or in some other form of restrictions being placed on the disposal of foreign currency deposits. Often, after a successful stabilization of the banking system such countries faced increased deposit euroization (with the proportionate decrease in currency substitution), as foreign currency cash and foreign deposits flowed back into the domestic banking system. For a description of this phenomenon in Croatia in the 1990s see Feige et al (2002).

On credit euroization, Zettelmeyer et al (2010) survey the existing literature and provide their own econometric evidence. They find the following main causes and catalysts of credit euroization: 1) institutional weaknesses, especially if regular cyclical fluctuations often resulted in economic crises in the past, 2) history of volatile inflation, 3) lower cost of foreign currency loans, especially when combined with a perceived state guarantee for the case of major exchange rate disturbance, 4) *de facto* rigid exchange rate regime, regardless of the *de iure* setup, 5) high accessibility of banking services, 6) cheap and accessible foreign funding for domestic banks, and 7) expensive or inaccessible instruments for hedging foreign currency risk, especially when banks' net foreign currency exposures are subject to regulatory limits and when deposit euroization is also high.

Rainer and Haiss (2010) undertake their own cross-country econometric investigation of drivers of credit euroization, and identify factors very similar to Zettelmeyer et al (2010). They then drill down their results to find that 1) cheap and accessible foreign funding of domestic banks drives credit euroization, regardless of the share of foreign ownership in the banking sector, and that 2) extending more foreign currency loans to households is more correlated with higher household deposit euroization, while supple foreign funding appears more important for higher levels of corporate credit euroization. Like the other authors above, they conclude that policies should be designed to curb both deposits and loans in foreign currency if one wants to reduce the level of credit euroization.

Regarding the specific policy aimed at reducing credit euroization, Zettelmeyer et al recommend a large number of specific measures in four categories: 1) reforming macroeconomic policies and institutions, primarily for building a more flexible exchange rate regime in a low inflation environment; 2) developing markets for local currency debt instruments, with a sovereign lead;

3) increasing the price of foreign currency borrowing and decreasing the scope for legal uses of foreign currency through monetary and prudential regulation; and 4) building foreign currency reserve buffers for periods of exchange rate pressures, including arranging contingency lines with the ECB and IMF.

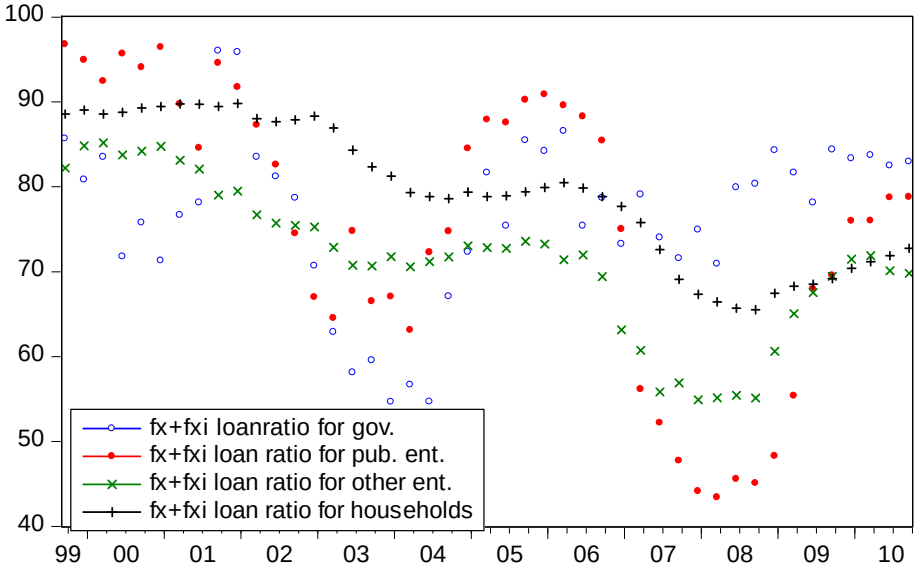
Kokenyne et al (2010) also address specific measures to reduce financial (both credit and deposit) euroization. Like Zettelmeyer et al, they are also strong advocates of a flexible exchange rate regime as a first step in this direction. They, however, argue that low inflation and flexible exchange rate are not sufficient of themselves, but that monetary and prudential measures aimed at making foreign currency borrowing more expensive may need to be employed initially and temporarily when financial euroization is persistent. They also explain why forcible de-euroization attempts have failed in the past, and like other authors argue strongly against them. In addition, for countries which decide to fight credit euroization, but at the same time choose to retain their rigid exchange rate regimes, they stress the importance of building symmetrical and credible exchange rate targets. Specifically, they argue that the monetary authorities in such countries should be expending equal effort in not allowing trend appreciation (which could drive credit euroization) and not allowing trend depreciation (which could drive deposit euroization).

3. History of euroization in Croatia

Euroization in Croatia in earlier periods has been studied by Šonje and Vujčić (1999), Feige (2002), Kraft (2003), and Kraft and Šošić (2006) among others. Due to lack of adequate data on credit euroization, their quantitative analysis is mostly focused on deposit euroization. In this context, they identify two distinct periods in the recent Croatian history - the currency substitution period during the war years 1991-1995, and the repatriation of foreign currency savings period of 1996-2001. The first period was marked by high inflation, political uncertainty and foremost by freezing of foreign currency household savings held at banks in the early 1990s. These factors clearly caused high holdings of foreign currency cash both for transactions and as a store of value, as well as precautionary transfers of foreign currency savings abroad. The second period was marked by a steady inflow of foreign currency savings converted from cash and foreign accounts into savings at domestic banks.

Those authors argued that the prolonged period of high deposit euroization after the successful disinflation program in 1994 and the end of the war in the late 1995 was due to the deep trauma of these experiences, resulting in the so called "persistent" deposit euroization. This conclusion is reinforced by findings of other economists who analyzed the habits of Croatian households outside of the banking sphere. For instance, introduction of "housing savings banks" in 1998 met a lukewarm welcome by households, until they were allowed to link their savings to foreign currency in the second half of 1999, when this form of savings started growing rapidly (Tepuš, 2006). Similarly, standard life-insurance contracts hardly existed in Croatia until both the premiums and payouts were allowed to be linked to EUR (Stipić et al, 2009). Finally, heavy government borrowing (Figure 1) in or linked to foreign currency throughout the 1995-2010 period contributed to credit euroization directly, but probably also indirectly by making foreign currency and indexed borrowing acceptable by all parties, and by failing to establish the yield curve for purely HRK denominated borrowing.

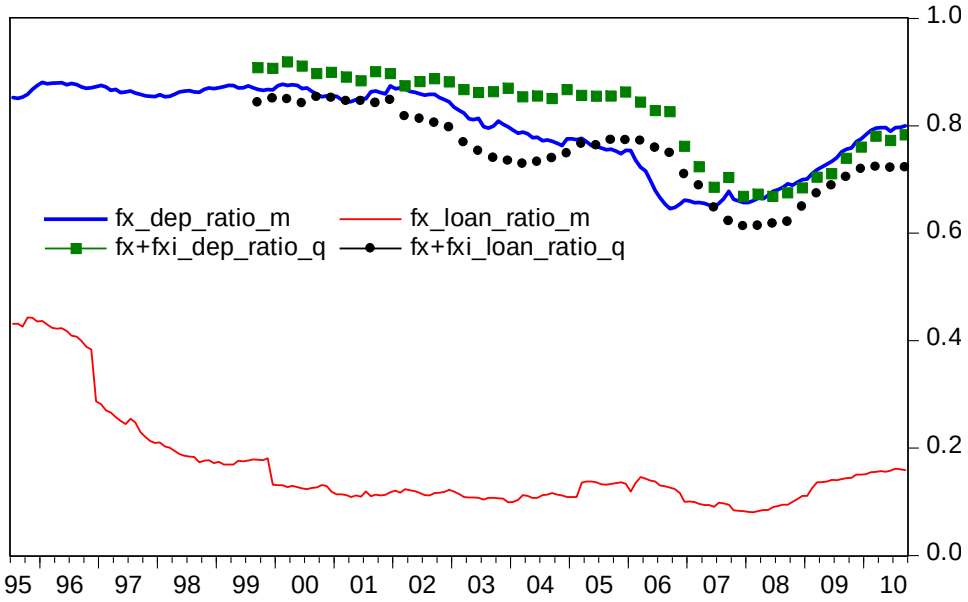
Figure 1. Bank credit euroization in Croatia, 2000-2010



In 1999, Vujčić and Šonje argued that the only way to develop the domestic loan market under these circumstances was to allow foreign currency (including foreign currency-linked) lending. More precisely, they argued that this was the only way to develop the loan market without fully exposing the entire financial sector to direct foreign currency risk which would automatically occur had loans been extended in domestic currency, without indexation. And, that is precisely what the monetary authority had done: foreign currency and indexed lending, both to households and enterprises, has been allowed, while banks' net-open foreign currency position has been limited by regulation, ever since 1995.

Banks fulfilled this regulatory requirement by extending domestic currency (HRK) loans which were indexed to foreign currency (mostly EUR, but an important pre-crisis episode of heavy CHF-indexed lending was also observed). On the liability side, they mostly attracted foreign currency savings (EUR, and some USD mostly in the Southern parts of the country) and foreign funding (primarily loans and deposits from their EU-based owners). Foreign currency loans on the asset side and foreign currency-linked deposits on the liability side have had a much smaller part to play, with the former usually extended to corporate clients to pay for their imports, and the latter being solicited from the public as part of a regulatory arbitrage scheme which ran from 2004 to late 2006 when this regulatory gap was closed. An obvious consequence is that (when treating foreign currency-linked instruments as part of the foreign currency class) deposit and credit euroization in Croatia moves together (two dashed lines in Figure 2).

Figure 2. Credit vs. deposit euroization in Croatia, 2000-2010



Due to the lack of data for earlier periods, in this paper we reexamine the phenomenon of credit euroization in Croatia mostly during 2000-2010. To this end, we use three datasets, each with its own merits. The quarterly dataset based on banks' statistical/supervisory reports runs from 1999Q3 to 2010Q3, it provides for a very detailed breakdown of banks' assets and liabilities[2] into their HRK, FX, and FX-indexed components, but it contains only 45 observations. Measures of deposit and credit euroization based on these data are shown as dashed lines in Figure 2.

There is also a monthly dataset from the same source, which runs from January 2004, has a total of 81 observations, and covers most of the interesting period in the context of central bank behavior. However, it provides only the aggregate currency breakdown, i.e. each of the three categories includes transaction deposits (M1), government deposits, foreign borrowings, and lending to those sectors, which should ideally be excluded from the analysis or analyzed separately. Finally, monthly data from the monetary survey, covering the period from December 1993 can only be used for a descriptive analysis of deposit euroization, because they treat HRK loans and deposits indexed to foreign currency as "pure" HRK loans and deposits. This type of aggregation should not affect the measure[3] of deposit euroization much (thick solid line in

[2] The monthly dataset providing this same granularity only runs from June 2006, thus not allowing us to study the effects of important monetary and prudential measures initiated before that date on credit euroization, so we do not use these data in our analysis.

[3] All measures in this paper are based on "quasi-effective" figures, that is, foreign currency and foreign currency-linked instruments are first revalued by dividing their end-of-period HRK amount reported by the end-of-period HRK/EUR exchange rate and then multiplying by 7.3 which roughly corresponds to the average HRK/EUR exchange rate for the entire period analyzed. Other bilateral exchange rates are not used in the calculation.

Figure 2), with the exception of the 2004-2006 period, but it makes no sense to measure credit euroization while bunching together foreign currency-linked loans and pure HRK loans (thin solid line in Figure 2).

The stylized features of the evolution of financial euroization in Croatia can be read directly from Figure 2, in conjunction with accounts of monetary history provided by the previously cited authors, and the most recent crisis period described in more detail in the next section of this paper. In short, deposit euroization was extremely high in the entire post-war period until about December 2001, regardless of the measure used (between 85 and 88 percent, using monetary survey data). The quarterly measure of credit euroization (treating indexed loans as foreign currency loans) shows that it too was very high in the period prior to the first quarter of 2002 (varying in the narrow range between 84 and 85 percent). Credit euroization measure based on monthly data, which treats indexed loans as pure HRK loans, shows a steeply declining trend in the period prior to 2000, likely reflecting (at times abrupt) exchange rate movements and the rise of household lending (which is almost entirely HRK lending, with or without indexation) from virtually zero in the war-years to about two fifths of total banking assets at the beginning of 2000[4].

Notably, euroization measures in this post-war stabilization period do not show the expected rise in deposit euroization due to foreign currency repatriation. However, the conversion of Euro legacy currencies in the second half of 2001 does appear to show a mild and temporary positive (expected) effect. Some time after the peak of this process in January 2002 (for more details on Euro-conversion see Kraft and Šošić, 2006), a clear trend of "de-euroization" develops, with the end-dates depending on the measure observed. For deposits, "de-euroization" lasts until the third quarter of 2006 by the monthly measure, and by the end of 2007 judging by the quarterly measure. The difference can probably be explained by a change of regulation in the last quarter of 2006 equating indexed deposits with foreign currency deposits for the purpose of some important monetary measures to be described later.

For loans, de-euroization runs in two waves, also until the end of 2007. A temporary and mild reversal in the period from the second quarter of 2004 until the end of 2005 should probably be attributed to the rise of long-term loans to households which were at the time almost all denominated in foreign currency (first EUR and later CHF), and the stock of which grew at a

[4] The large drop in Dec. 1999 reflects a methodological change to account for the privatization of the second largest bank in the country.

very rapid pace during this period. The similarly rapid reduction of the credit euroization ratio which followed in 2006-2007 could probably be attributed to the governments' strategy to reduce foreign currency denominated borrowing, with implementation beginning in 2006 (see Government of Croatia, 2010). However, it could have also been a consequence of the introduction of longer-term "pure" HRK loans in that period, as a response of banks to central bank measures aimed directly at making foreign currency and indexed lending more expensive.

The third is the period of "re-euroization", when the share of foreign currency and indexed deposits rose from the low of 67 percent at end-2007 to 78 percent by the end of third quarter of 2010, and the analogous share for loans rose from 61 to 72 percent in the same period. Notably, re-euroization started in early 2008, but it intensified after the Lehman Brothers event which symbolizes the peak of the global crisis. While a spike in exchange rate volatility in the late 2008 and early 2009 is certainly the first choice for explaining this process, it is conceivable that other factors played an important role, as well.

Most importantly, the central bank acted forcibly to release foreign currency liquidity and sterilize HRK liquidity in this period to stem off heavy exchange rate pressure. The measures employed (for details, see Galac, 2010) effectively reduced the regulatory cost of holding foreign currency liabilities relative to HRK denominated liabilities, and these measures have not been reversed since. Thus, they should have had a direct positive effect on deposit euroization. Moreover, 2008 and 2009 were marked by massive, if not panic, outflows of hot money from the Croatian stock market. The point in case, open equity investment funds had about HRK 16 billion under management in October 2007, and only HRK 2.5 billion in February 2009. While it is difficult to decompose this change into its valuation and flow components, it is likely that a non-negligible amount of this flow found its way back from equities into foreign currency savings deposits, and abroad.

Finally, the first three quarters of 2010 saw stable deposit and loan euroization measures, at the levels last seen in early 2006, before their great albeit temporary reduction. These may be some early signs that the re-euroization process of 2008-2009 has come to its natural end.

4. Monetary and prudential measures and financial euroization in Croatia

From the previous section it appears probable that financial euroization in Croatia, in the period 2002-2009 was at least in part shaped by central bank macroprudential measures. During those years, the central bank was in the business of "leaning against the wind", trying to reduce the pace of rapid credit growth fueled by abundant foreign funding[5], often in the form of FDIs flowing into the almost wholly foreign-owned Croatian banking sector. As a side effect, these measures increased the cost for banks of holding foreign currency deposits and extending foreign currency loans relative to their HRK denominated counterparts in 2002-2007, while the opposite is true for 2008-2010. Thus, they should have affected the evolution of financial euroization in the country. A more detailed description of these measures is provided below.

A uniform reserve requirement (RR) for domestic and foreign currency deposits was introduced in 2000. The requirement was decreased in two steps from 23.5% in 2000 to 19% in 2001. From there, during the boom years, the rate was only lowered again in December 2004 to 18%, and 17% in February 2006. Finally, as part of the countercyclical package during the global crisis, the central bank reduced the RR rate to 14% in December 2008 and to 13% in February 2010.

More notably, the central bank also required that a certain portion of the reserve requirement on foreign exchange deposits be held at the central bank in the form of a HRK denominated deposit. By increasing this proportion, the central bank could drain liquidity from the banking system. This kuna holding requirement (KHR) was raised in several steps from only 25% in 2003 to some 75% in early 2009, when the central bank was waging an all-out defense of the Kuna in the face of the strongest depreciation pressures the CNB had faced since the end of high inflation in the 1990s. KHR changes could have easily had an indirect impact on the level of deposit euroization in Croatia, since it effectively applied HRK required reserve rules completely under the control of the central bank to a large portion of foreign currency deposits.

Croatia's cautious approach to foreign exchange liberalization, aimed at limiting hot money inflows, may have also had an impact on the evolution of financial euroization in Croatia. While current account convertibility was introduced in 1995, capital account liberalization proceeded much more slowly. The Foreign Exchange Law of 2003 allowed Croatian companies to hold

[5] For more details see Kraft and Galac (2011).

foreign currency deposits in domestic banks. The prohibition on Croatian residents giving loans to non-residents was removed in mid-2010, while the ban on citizens opening bank accounts abroad was maintained until end-2010.

The first macroprudential measure, introduced at the beginning of 2003, was a credit growth reserve (CGR). Specifically, the measure defined a set of items on banks' balance sheets and certain off-balance sheet items. If the sum of these items grew more than 4% in a given quarter, the bank would be required to purchase special CNB bills paying only 0.5% interest. The amount of bills to be purchased was twice the excess of credit growth over the 4% maximum.

The measure remained in force throughout 2003, but was withdrawn as of the beginning of 2004. It was reintroduced in 2007, but with some modifications. However, the amount of central bank bills required to be purchased was only 50% of the overrun. This was raised to 75% in December 2007. The credit growth reserve appeared quite successful on the surface as very few banks exceeded the credit growth limits, but it was accompanied by heavy disintermediation, with leasing portfolios and direct foreign borrowing growing rapidly whenever CGR was in place. Thus, this measure could have had an indirect impact on credit euroization in Croatia by altering the currency composition of the new loans granted during the periods when the measure was in effect.

The credit growth reserve was formulated in nominal terms, so by keeping the CGR in place, the central bank gave commercial banks a strong motivation to avoid currency depreciation, which may have contributed to the success of the central bank's defense of the exchange rate in the first quarter of 2009. The CGR was finally withdrawn in November 2009, when depreciation pressures had substantially receded.

When the credit growth reserve expired at the end of 2003, it was initially replaced by a capital requirement for rapidly-growing banks. This measure compelled banks whose assets and off-balance sheet items grew by more than 20% to retain a portion of dividends, unless the bank's capital adequacy ratio exceeded a high level. In addition, the measure required banks to form general provisions for unidentified losses. Because the limit for asset growth was set at the relatively high level of 20% in 2004, and because the measure did not take effect if capital adequacy levels were high, the dividend retention provisions rarely kicked in during 2004 and 2005. However, lowering the growth limit to 15% in 2006 made the dividend-retention measure relevant.

The general provision has a capital-like function. Thus, this measure, like other measures which induced capital-raising by banks, could have affected the deposit euroization dynamics directly, since capital is HRK-denominated by definition. It also could have affected the credit euroization indirectly by inducing slower bank credit growth which could have had an effect on the currency structure of the stock of bank credit. Afterwards, as the global crisis set in, bank credit growth rates began declining, so there was a significant drop in new general reserves formed in both 2007 and 2008. Beginning 2009 the measure was abandoned altogether, but an even stricter replacement measure was already in its place: since beginning of 2008 banks growing faster than 12% per annum had to maintain a higher than usual minimum capital adequacy ratio. However, lower bank credit growth and capital-raising efforts during the crisis have made this measure non-binding for most banks.

The Marginal Reserve Requirement (MRR) was introduced in July 2004 as a way to slow down capital inflows. In particular, the MRR aimed at banks' foreign funding sources. The MRR initially applied only to the increase in banks' foreign liabilities, with a reserve of 24% required. The measure was extended to cover deposits or other assets of leasing companies, in an effort to close one of the significant loopholes in the credit growth reserve measures of 2003. The MRR rate was increased in numerous steps, reaching 55% in 2006. At this rate, it seemed that foreign borrowing would provide very little profit for banks.

Foreign borrowing nonetheless continued. However, the large jump in the MRR from 40% to 55% in early 2006, in conjunction with higher risk weights on foreign currency-linked loans to unhedged borrowers since mid-2006, to be described below, created strong incentives for banks to increase their capital rather than continue foreign borrowing. These balance-sheet adjustments should have had an effect on the dynamics of the widely defined deposit euroization measure (which includes capital items), at least in 2006 and 2007 when the largest increases in banks' capital were observed.

In the immediate aftermath of the failure of Lehman Brothers in September 2008, several large foreign-owned banks experienced substantial deposit withdrawals. To allow the parent banks to support their subsidiaries, the central bank removed the MRR completely in October. The parent banks did support their subsidiaries, initially with deposits and short-term loans, so that bank deposit withdrawals of October and November of 2008 were largely reversed.

Chronologically the first of the macroprudential measures (introduced together with CGR), the foreign currency liquidity requirement (FCLR) required banks to hold higher foreign currency liquidity as a form of self-insurance for the contingency of runs on foreign currency deposits. It required the holding of liquid foreign assets with a maturity of no more than 3 months to cover the reserve requirement. In this sense, the asset side of the regulation was less onerous than an ordinary reserve requirement. In addition, the FCLR was lowered in numerous steps, and was never increased.

There were attempts to evade the FCLR. After its enactment in 2003, banks began to offer local currency deposits indexed to an exchange rate, usually EUR. Until the central bank altered its regulation in September 2006, these deposits, which display the same currency risk as "pure" foreign currency deposits, were not covered by FCLR. This is the likely explanation for why the monthly measure of deposit euroization had been falling in the entire period from 2003 to 2007, while the quarterly measure, treating indexed deposits as foreign currency deposits only fell after the third quarter of 2006.

Matching assets and liabilities by currency is a basic principle of risk management. The Croatian national bank has imposed regulatory limits on banks' net-open foreign exchange position (NOP) since the early 1990's. By raising or lowering these limits, the CNB was able to affect credit conditions. The limit was lowered to 20% of the regulatory capital during the boom, and also there were efforts to better capture embedded options in some kinds of foreign-currency indexed loans. The limit was raised to 30% of the regulatory capital during the crisis to give banks more flexibility to accept foreign currency deposits or loans without necessarily having to extend indexed loans.

Currency matching may lower the direct exchange rate risk faced by banks, but the practice of extending mostly foreign currency-indexed loans opens banks' clients who are not hedged to that same risk. It is just a transfer of risk, not risk-reduction. In particular, in the case of permanent depreciation of domestic currency, not followed by a proportionate increase in incomes, this reduction of direct foreign exchange risk could easily be compensated for by an increase in the credit risk of unhedged borrowers (foreign currency-induced credit risk, or FCICR).

In Croatia, however, it became apparent that banks were not pricing the FCICR caused by extending indexed loans to unhedged borrowers, as loans to unhedged borrowers and hedged

borrowers bore the same interest rates. In response, the central bank adopted the prudential measure of increased risk weights for the calculation of the capital adequacy regulatory ratio for loans in or indexed to foreign currency to unhedged borrowers (FCICR risk weight add-ons). Banks were required to document whether borrowers had natural hedges, and if not, they were required to apply 25 percentage points higher risk weights for their loans. It turned out that very few borrowers were hedged, and banks were required to raise substantial amounts of capital. The central bank was able to increase these risk-weights by another 25 percentage points when it felt that risks were building up in the banking system as a whole at the beginning of 2008. However, the introduction of Basel II actually forced the Croatian National Bank to abandon this approach to FCICR in April of 2010.

The FCICR risk-weight add-ons were certainly a prudential measure intended to better align capital requirements with risk profiles at the level of individual banks. In practice, they might have had an effect on both deposit and credit euroization. Regarding the former, they had an impact by spurring capital raising by banks, and regarding the latter they just might have been the main driver of a sudden rise of pure HRK-denominated long term loans in 2007. However, their possible effect on de-euroization in Croatia must have been short-lived, as it was first interrupted by the sudden re-euroization during the escalation of the global financial crisis in 2008, and then they were put out of effect with the change of the bank risk management standards in 2010.

5. Determinants of euroization in Croatia - an econometric analysis

Given the data availability constraints, we analyze the determinants of overall bank credit and deposit euroization in Croatia using monthly data for the period from January 2004 until September 2010. Regardless of the specific model analyzed, the dependent variables are measures of the overall deposit and credit euroization, *dep_eur* and *cred_eur*. They are calculated as shares of foreign currency (including indexed) deposits and loans in the total amount of bank deposits and loans, respectively.

The initial set of independent variables is inspired by theory, foremost by the uncovered interest parity (UIP) condition. In the context of euroization in Croatia where we assume that banks set both deposit and loan interest rates, UIP condition could be interpreted as stipulating that any change in the euroization level would require that banks (temporarily) misprice risk premium for holding HRK denominated deposits or taking out HRK denominated loans. Put more simply, a change in the euroization level would require that the relevant interest rate spread under- or over-compensates for the exchange rate risk perceived by the non-banking sector.

On top of the UIP condition, in the case of a rigid exchange rate regime, inflation expectations may have a role in determining the credibility of the exchange rate target or band, and thus they should also affect the level of deposit euroization from the supply side. In the context of credit euroization, inflation expectations may also play a role if banks do not offer certain types of domestic currency loans at all (there is anecdotal evidence of such behavior in Croatia in the past, especially for important categories of long-term household loans, such as car and home loans). In this case, the (non-)existence of explicit, implicit, or expected wage-to-inflation indexation may (decrease) increase the relative demand for foreign currency (including indexed) loans.

On the deposit demand (loan supply) side, provided that their exchange rate and interest rate asset-liability gaps are not too large, banks rarely have to worry about (moderate) inflation since they operate on the margin. Nevertheless, an increase in expected inflation should put pressure on their domestic currency deposit rates, and consequently on their domestic currency loan rates, as well. If on the other hand a relatively large inflation is expected, especially relative to the inflation in the EUR area, that should affect bank behavior through its impact on exchange rate expectations, or the assessment of the credibility of the exchange rate target in the case of a rigid

exchange rate regime. A higher risk premium would then be required for holding domestic currency deposits, and a lower one for taking out foreign currency loans.

Given the above, independent variables initially considered for modeling financial euroization in Croatia include: 1) lagged values of dependent variables; 2) contemporaneous values of the HRK/EUR nominal exchange rate and CPI inflation; 3) contemporaneous and lagged interest rate spreads between interest rates for domestic currency deposits (loans) and foreign currency (indexed) deposits (loans); 4) dummy variables for different states of various central bank measures which alter the relative regulatory costs for banks of holding foreign currency (and indexed) liabilities or extending foreign currency (and indexed) loans against holding domestic currency liabilities and extending domestic currency loans; 5) dummy variables for extreme observations (outliers) on dependent variables which may or may not have a natural explanation; and 6) two auxiliary variables - Croatia's EMBI spread to measure external expectations about the exchange rate movements, and the share of blocked in total deposits to measure the effect of several large stock IPOs on bank deposit composition.

The presumption is that a judicious combination of the above variables (in their differenced or log-differenced form) in a financial euroization model for Croatia can capture some theoretically important unobservables, including the exchange rate and inflation expectations, and enable proper economic interpretation of the results. The model-building exercise also has to account for possible endogeneity due to simultaneity between deposit and credit euroization, as well as between these two measures and the interest rate spreads associated with each of them. Thus, we first approach this problem by formulating the following general form of a four-equation system of stochastic equations:

$$dep\_eur_t = a_{10} + \Sigma_{i=0}^{N_2} a_{12i} dep\_spr_{t-i} + \Sigma_{j=1}^{N_3} a_{13j} infl_{t-j} + \Sigma_{k=1}^{N_4} a_{14k} er_{t-k} + \Sigma_{n=t_{11}}^{t_{T1}} a_{17n} dep\_outlier_n + a_{18} ipo_t + e_{1t}$$

$$dep\_spr_t = a_{20} + \Sigma_{h=1}^{N_1} a_{21h} dep\_reg\_cost_{ht} + a_{221} dep\_spr_{t-1} + a_{222} cred\_spr_t + a_{223} cred\_spr_{t-1} + \Sigma_{l=1}^{p} a_{25l} dep\_eur_{t-l} + \Sigma_{m=1}^{q} a_{26m} cred\_eur_{t-m} + a_{27} embi\_spr_{t-1} + e_{2t}$$

$$cred\_eur_t = a_{30} + \Sigma_{i=0}^{N_2} a_{32i} cred\_spr_{t-i} + \Sigma_{j=1}^{N_3} a_{33j} infl_{t-j} + \Sigma_{k=1}^{N_4} a_{34k} er_{t-k} + \Sigma_{n=t_{11}}^{t_{T1}} a_{37n} cred\_outlier_n + e_{3t}$$

$$cred\_spr_t = a_{10} + \Sigma_{h=1}^{N_1} a_{41h} cred\_reg\_cost_{ht} + a_{421} cred\_spr_{t-1} + a_{422} dep\_spr_t + a_{423} dep\_spr_{t-1} + \Sigma_{l=1}^{p} a_{45l} dep\_eur_{t-l} + \Sigma_{m=1}^{q} a_{46m} cred\_eur_{t-m} + a_{47} embi\_spr_{t-1} + e_{4t}$$

with $e_i \sim N(0, \sigma_i^2)$ and all non-dummy variables in log-differenced or differenced form.

Using all independent variables and lags of dependent variables as instruments an estimation procedure more efficient than OLS should be able to identify the first and the third equation in the above system as demand equations, and the second and fourth equation as supply equations, enabling economic interpretation. Where not explicitly stated otherwise, the three lags of dependent variables, change of inflation, and change of the exchange rate are used in the intial specification of the model to account for possible inertia (or mean-reversion) and quarterly window dressing. Then, following the rule of thumb for reducing the model selection bias in the stepwise backward elimination model selection procedure recommended by Maddala and Kim (1998), we remove from the model all variables with p-values for the coefficients greater than 0.25 in two successive steps, to focus on variables which independently have statistically significant explanatory power.

The final model with substituted 3SLS coefficients, all of which are significant at the 75 percent confidence level and most of them at more conventional levels is presented in Table 1. In the model, interest rate spreads do not appear to be important demand side determinants of the dynamics of financial euroization in a statistical sense. However, they do appear to react to central bank signals and general economic environment in a more or less expected manner. So, for the changes in the deposit interest rate spread, the impact of inflation, the existence of MRR, and the crisis is expectedly positive, and that of a lower FCLR rate is expectedly negative. Similarly, the crisis dummy and inflation have a positive impact on changes in loan interest rate spreads. Other coefficients with expected signs are mostly related to auxiliary dummy variables tying residuals related to outliers in the two euroization data series to zero.

Table 1. Model 1 of financial euroization in Croatia, 2004-2010

Estimation Method: 3SLS, with one-step weighting matrix
Sample: 2004M05-2010M09, N = 77 per eq.
Instruments: 3 lags of eur. measures + indep. var. + 1 lag of int. rate spreads

	dep_spr		dep_eur		cred_spr		cred_eur	
Ind. var.	coeff. est.	p-value	coeff. est.	p-value	coeff. est.	p-value	coeff. est.	p-value
const.	-1.41	0.074						
dep_eur_{t-1}								
$dep\ eur_{t-2}$			0.263	0.000				
dep_eur_{t-3}			0.171	0.028				
$cred\_eur_{t-1}$	-15.5	0.141					0.117	0.158
$cred\_eur_{t-2}$								
$cred\_eur_{t-3}$							0.428	0.000
dep_spr_t			0.002	0.063				
dep_spr_{t-1}								
$cred\_spr_t$								
$cred\_spr_{t-1}$					-0.339	0.001		
er_{t-1}								
er_{t-2}	-29.7	0.049						
er_{t-3}	-29.2	0.054			-19.0	0.010		
$infl_{t-1}$	42.5	0.077	-0.534	0.004				
$infl_{t-2}$			-0.336	0.074	16.1	0.177		
$infl_{t-3}$			-0.415	0.025	25.2	0.022		
ipo_t			0.650	0.000				
$embi\_spr_{t-1}$	-0.01	0.008						
crisis=1	3.45	0.001			1.00	0.065		
mrr>=24	1.27	0.114						
mrr>=40					1.01	0.055		
mrr>=55								
khr>=50					-1.19	0.027		
fcicr>=25								
fcicr=50								
fxi fclr								
fclr<=32								
fclr<=28.5								
fclr<=25								
fclr<=20	-2.24	0.003						
cgr>=50								
cgr=75					0.308	0.028		
fclr to 20			0.036	0.000			0.026	0.004
$fxi\ fclr_t$			-0.025	0.001				
$fxi\ fclr_{t-1}$			-0.042	0.000			-0.014	0.131
cgr to 75			0.032	0.000			0.010	0.248
$cgr\ to\ 75_{t-1}$			0.022	0.004				
jan. 05			-0.012	0.106				
mar.05			0.010	0.157			0.036	0.000
apr. 08			-0.028	0.000				
R^2	0.21		0.69		0.27		0.46	
Adj. R^2	0.12		0.62		0.20		0.42	
RSS	1.13		0.01		0.54		0.01	
DW	2.31		1.70		2.21		2.19	
Mean Y	-0.035		-0.001		-0.010		-0.000	
S.D. Y	1.20		0.013		0.60		0.013	
ESS	86.4		0.004		19.9		0.007	

It is however difficult to interpret a number of significant coefficients with unexpected signs. The most puzzling is the positive impact of the deposit interest rate spread on deposit euroization in the demand-side relationship. One plausible interpretation is that a higher deposit spread is interpreted by savers as a warning of adverse economic developments, but at the same time this level is never set at a level high enough to compensate for the increased exchange rate risk, at least in the sample at hand. A similar conclusion for an earlier period using single equation OLS estimation to model deposit euroization was reached by Kraft (2003).

Similarly, a negative impact of the exchange rate on interest rate spreads and the negative impact of inflation on deposit euroization are also perplexing. The latter could possibly reflect

the rise of the share in the total deposits of transaction deposits, that is, the fact that data are not inflation-adjusted. The former is more difficult to explain, as it could reflect banks' expectations of mean-reversion of the exchange rate in the context of a rigid exchange rate regime, but also it could just be a feature of the time-period analyzed. In that period, banks' demand for HRK funding was greater during boom years, when the exchange rate was falling (HRK appreciating), and the central bank was continually making foreign currency funding of all forms more costly, so it made sense to increase the deposit spreads to induce greater HRK savings. The same logic works in reverse for the crisis period.

It is also difficult to explain the absence from the above final model of the variables representing some presumably very important central bank measures. For example, existence of FCICR add-ons for risk-weights is not important in the loan interest rate spread equation, and the inclusion of foreign-currency indexed deposits into the FCLR base is not important in the deposit interest rate spread equation. Anecdotal evidence on the former would suggest that banks simply began offering long term HRK denominated loans, and on the latter that they stopped collecting indexed deposits. These notions, and more generally the robustness of the above model are examined next.

So, given the apparent inability of the interest rate spreads to explain statistically the evolution of financial euroization in Croatia, we revise our modeling strategy. Based on the above findings, we first assume that banks use (mostly) non-price signals to alter the currency composition of their assets and liabilities (primarily by rationing certain products and aggressively pushing others). As already mentioned, this is generally thought to be a reasonable assumption for Croatia. Then, we can attempt to assess the effect of independent variables on the deposit and credit euroization directly (without considering interest rate spreads) within the following two-equation system:

$$dep\_eur_t = a_{10} + \Sigma_{j=1}^{N_3} a_{11j} infl_{t-j} + \Sigma_{k=1}^{N_4} a_{12k} er_{t-k} + \Sigma_{n=t_{11}}^{t_{T1}} a_{13n} dep\_outlier_n + \Sigma_{h=1}^{N_1} a_{14h} dep\_reg\_cost_{ht} + \Sigma_{l=1}^{p} a_{15l} dep\_eur_{t-l} + \Sigma_{m=0}^{q} a_{16m} cred\_eur_{t-m} + a_{17} embi\_spr_{t-1} + a_{18} ipo_t + e_{1t}$$

$$cred\_eur_t = a_{20} + \Sigma_{j=1}^{N_3} a_{21j} infl_{t-j} + \Sigma_{k=1}^{N_4} a_{22k} er_{t-k} + \Sigma_{n=t_{11}}^{t_{T1}} a_{23n} cred\_outlier_n + \Sigma_{h=1}^{N_1} a_{24h} cred\_reg\_cost_{ht} + \Sigma_{l=0}^{p} a_{25l} dep\_eur_{t-l} + \Sigma_{m=1}^{q} a_{26m} cred\_eur_{t-m} + a_{27} embi\_spr_{t-1} + e_{2t}$$

with $e_i \sim N(0, \sigma_i^2)$ and all non-dummy variables in log-differenced or differenced form.

The 3SLS coefficient estimates of the initial model are shown in Appendix 1, and the final model obtained by backward elimination is presented in Table 2. The results appear quite different from those obtained with the previous model. First, one notes that both the deposit and credit euroization appear mean-reverting, as they display mostly negative autocorrelation structure. Their influence on each other is not clear: there is a significant contemporaneous and unexpectedly negative impact of deposit euroization on credit euroization, and marginally insignificant although expectedly positive reverse contemporaneous relationship. The lagged cross-correlations do not appear in the selected model, implying they were found to be highly insignificant during the model selection process.

Inflation and exchange rate movements again display some expected and some unexpected correlations with the dependent variables. In the deposit euroization equation, the exchange rate movement does not appear to be statistically important, while lagged inflation changes have negative coefficients. As before, this could be a direct consequence of modeling nominal rather than inflation-adjusted quantities. In the credit euroization equation, exchange rate movements appear very important and carry expected positive signs on the coefficients, while inflation is mildly insignificant.

Table 2. Model 2 of financial euroization in Croatia, 2004-2010

Estimation Method: 3SLS, with one-step weighting matrix Sample: 2004M05-2010M09, N = 77 per eq. Instruments: 3 lags of dep. var. + indep. var.					
Eq #1 for dep_eur	coeff. est.	p-value	Eq #2 for cred_eur	coeff. est.	p-value
a_{10}	-0.009	0.002	a_{20}	0.010	0.040
dep_eur_{t-1}	-0.281	0.000	$cred\_eur_{t-1}$	-0.638	0.000
dep_eur_{t-2}	0.098	0.102	$cred\_eur_{t-2}$	-0.601	0.000
dep_eur_{t-3}	-0.170	0.011			
$cred\_eur_t$	0.135	0.102	dep_eur_t	-0.194	0.016
			er_{t-1}	0.437	0.000
er_{t-2}	-0.123	0.134	er_{t-2}	0.315	0.002
			er_{t-3}	0.193	0.055
$infl_{t-2}$	-0.295	0.029	$infl_{t-2}$	-0.232	0.104
$infl_{t-3}$	-0.363	0.008			
ipo_t	0.535	0.000			
mrr>=24	0.009	0.004	mrr>=24	-0.009	0.078
			mrr>=40	-0.013	0.019
mrr>=55	-0.004	0.100			
			khr>=50	-0.023	0.000
			fcicr>=25	-0.015	0.000
			fcicr=50	0.030	0.000
fxi fclr	-0.018	0.000	fxi fclr	-0.029	0.000
			fclr<=32	0.037	0.000
fclr<=28.5	0.018	0.000	fclr<=28.5	0.010	0.008
fclr<=25	0.011	0.001	fclr<=25	-0.022	0.005
			fclr<=20	0.016	0.016
cgr>=50	0.010	0.000	cgr>=50	0.010	0.000
fclr to 20	0.029	0.000			
			$fxi\ fclr_t$	0.019	0.004
$fxi\ fclr_{t-1}$	-0.023	0.001			
cgr to 75	0.020	0.002			
$cgr\ to\ 75_{t-1}$	0.036	0.000			
			mar. 05	-0.010	0.138
apr. 08	-0.012	0.068			
R^2	0.83		R^2	0.79	
Adj. R^2	0.77		Adj. R^2	0.71	
RSS	0.006		RSS	0.007	
DW	1.77		DW	2.07	
Mean Y	-0.0006		Mean Y	-0.0003	
S.D. Y	0.013		S.D. Y	0.013	
ESS	0.002		ESS	0.003	

Regarding central bank measures, the following picture emerges. First, periods of the existence of MRR and FCICR weight add-ons (before their increase) appear to be much more important for the change of credit euroization than deposit euroization, with the expected negative impact. Also, expected negative impact is found for the period after the indexed deposits were added to the FCLR base, both for the deposit and credit euroization. Similarly, both for the deposit and credit euroization, expected positive correlation is found between their changes and lower rates

of FCLR which appeared during the crisis period. Finally, the period when CGR was in effect, also mostly coincinding with the crisis period, displays positive correlation with changes in both the deposit and credit euroization. This should probably be explained by the primary effect of the CGR - a reduction of the bank credit growth - although without further analysis it is not exactly clear how this reduction could have increased the share of foreign currency loans in total.

Unlike in the previous model, the crisis dummy is not present in the final model, indicating that its effect is accounted for by other variables in the specification. While in the credit euroization equation this role could be reasonably assigned to the exchange rate, in the deposit euroization equation the only reasonable candidate for this role is a combination of the three FCLR dummies. These dummies were constructed in a way so that the estimated coefficients indicate that every time the FCLR rate was lowered this brought about an additional positive impact on changes of the deposit euroization ratio.

Regarding the feedback between the deposit and credit euroization, it appears rather weakly in the second model, while it is not explicitly modeled in the first model. It is however possible that this relationship is heavily confounded in the model by the dummies for those central bank measures which had an impact on both the deposit and loan side of the model. For this reason, we estimate a third version of our model, constructed in a manner so as to facilitate the identification of the feedback coefficients in both equations. Specifically, the third model is obtained by first imposing restrictions on the initial specification of the second model, and then performing backward elimination as before to obtain a more parsimonious specification.

The restrictions imposed are standard zero-restrictions on the coefficients next to dummies for those central bank measures believed ex-ante to influence only the other equation. Based on the discussion in the fourth part of this paper, zero-restrictions are imposed for CGR and FCICR related dummies in the deposit euroization equation, and for FCLR and KHR in the credit euroization equation, while MRR was allowed to influence both equations. The resulting parsimonious specification of the third model is presented in Table 3.

Table 3. Model 3 of financial euroization in Croatia, 2004-2010

Estimation Method: 3SLS, with one-step weighting matrix Sample: 2004M05-2010M09, N = 77 per eq. Instruments: 3 lags of eur. measures + indep. var.					
Eq #1 for dep_eur	coeff. est.	p-value	Eq #2 for cred_eur	coeff. est.	p-value
a_{10}	0.000	0.938			
dep_eur_{t-1}	-0.204	0.010	$cred\_eur_{t-1}$	-0.164	0.055
			$cred\_eur_{t-2}$	-0.224	0.011
dep_eur_{t-3}	-0.143	0.057	$cred\_eur_{t-3}$	0.211	0.010
$cred\_eur_{t}$	0.669	0.000			
$cred\_eur_{t-1}$	0.272	0.001	dep_eur_{t-1}	0.209	0.011
$infl_{t-3}$	-0.220	0.153			
ipo_{t}	0.664	0.000			
mrr>=40	0.012	0.005			
			fcicr>=25	-0.012	0.000
			fcicr=50	0.020	0.000
fclr<=32	-0.012	0.006			
fclr<=25	0.024	0.003			
fclr<=20	-0.010	0.178			
fclr to 20	-0.024	0.002			
fxi $fclr_{t}$	0.028	0.000			
fxi $fclr_{t-1}$	-0.024	0.001			
			cgr to 75_{t-1}	-0.014	0.085
			mar. 05	0.036	0.000
apr. 08	-0.034	0.000			
R^2	0.67		R^2	0.62	
Adj. R^2	0.59		Adj. R^2	0.59	
RSS	0.008		RSS	0.008	
DW	1.94		DW	2.2	
Mean Y	-0.0006		Mean Y	-0.0003	
S.D. Y	0.013		S.D. Y	0.013	
ESS	0.004		ESS	0.005	

The estimated feedback coefficients assume the expected signs and become significant in this model. The most important central bank measure on the deposit side is now change of the FCLR rate, which had contributed to re-euroization in the crisis period. The introduction of indexed liabilities into the FCLR base is only significant in the first two months after the fact, and not for the entire period after its implementation. On the credit side, CGR loses its significance, while initial introduction of FCICR weight add-ons remains highly significant with the expected negative sign. Finally, the inflation coefficient remains negative on the deposit side, while the exchange rate becomes insignificant in both equations, as well as inflation in the credit equation.

In summary, the results from the three modeling exercises indicate that the central bank measures likely have had a profound impact on the evolution of both deposit and credit

euroization in Croatia as hypothesized. According to the second and third models, they could probably be credited with partial deeuroization in 2004-2007, but may have also contributed to re-euroization later in the crisis period. However, due to a large number of separate yet related measures, many of them overlapping in a relatively short time-period, and with their parameters frequently changed, it is difficult to attribute this general effect to particular measures, and this effort appears largely model-specific. Inflation does not seem to play the role in the period analyzed, or if it does it is masked by its unexpectedly negative effect on both measures which should most likely be attributed to using nominal and not real stocks of loans and deposits in the analysis. Similarly, the exchange rate does not appear important, except in the credit euroization equation of the second model where it appears with the expected positive sign.

The question of feedback between the deposit and credit euroization also appears to have a model-specific answer. If one accepts the third model as closer to the true model, than there is a strong and expectedly positive relationship between the two, but there is no room for nominal exchange rate movements and less room for central bank measures in the explanation of financial euroization in Croatia. On the other hand, if preference is given to the second model, then these measures should be interpreted as having influenced directly both the credit and deposit euroization in the past. Regardless, statistical evidence is strong that the central bank measures to curb foreign borrowing by banks and domestic credit growth have contributed, if not outright caused, partial financial de-euroization in 2004-2007, while crisis fighting central bank measures in 2008-2009 might have contributed to partial re-euroization during that period.

6. Conclusion

Credit euroization in Croatia appears to have been a by-product of a complex political and economic environment in the country during the last twenty years. Additionally, in the last ten years, it appears to be strongly influenced by the monetary and financial policies of the central bank, in conjunction with banks' efforts to minimize the regulatory costs of holding liabilities through regulatory arbitrage. In this context, one should distinguish the period of high and persistent financial euroization prior to 2002, the period of partial de-euroization 2002-2007 (especially pronounced in 2006-2007), and finally the global crisis period 2008-2010 which featured partial re-euroization.

Pinpointing specific determinants of the evolution of financial euroization in Croatia prior to 2004 is difficult due to lack of adequate data. In the period 2004-2010, the central bank measures, thus regulatory costs, appear to have played a central role. This finding comes with the usual disclaimer related to difficulties in explicitly modeling exchange rate and inflation expectations. However, the econometric analysis at least suggests that extrapolation of inflation and exchange rate trends, as suggested in some of the cited literature, have not played a prominent role in driving overall trends in financial euroization in Croatia in the period under observation.

Our econometric analysis finds only weak evidence of the expected positive correlation between the changes in the levels of credit and deposit euroization. Graphical evidence, however, suggests a strong relationship between the two, at least in levels and over a period longer than one month. One possibility is that in our model the coefficients related to this relationship cannot be precisely identified due to the presence of variables driving the changes of both the deposit and credit euroization. There were a few important central bank measures with this expected double-effect implemented in the period analyzed, possibly explaining this finding.

In the final analysis, our findings should be interpreted as indicating that even within a context of a rigid exchange rate regime, a carefully chosen and vigorously implemented combination of monetary and prudential measures indeed can lead to a reduction in financial euroization during normal times, as also suggested by Kokenyne (2010). It also appears that the policies aimed at preserving the stability of the exchange rate in such a regime during turbulent times ultimately pay off, although they may contribute to the increase in the financial euroization level during periods of strong exchange rate pressures.

However, it should also be noted that, while policy measures seem to have had some effect in Croatia, they were far from creating full de-euroization in the sense of the literature: the euroization level, measured as foreign currency deposits in broad money, reduced by 20 percentage points and below 20% without major macroeconomic costs (see Erasmus, 2009, p. 9, fn 13). Also, most of the measures implemented were never touted as being implemented for the purpose of de-euroization, but rather they were specifically aimed at some other targets of central bank policies, so that their signaling effect could not have been accounted for in our analysis. Thus, it remains an open question, whether the central bank measures whose one side-effect in the particular time-period analyzed here was to reduce the level of financial euroization in Croatia would be as effective in practice if used to achieve the announced goal of de-euroization in different circumstances.

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Appendix 1

Estimation Method: 3SLS, with one-step weighting matrix
Sample: 2004M05-2010M09, N = 77 per eq.
Instruments: 3 lags of eur. measures + indep. var. + 3 lags of int. rate spreads

Eq #1 for dep_eur	coeff. est.	p-value	Eq #2 for cred_eur	coeff. est.	p-value
a_{10}	-0.005	0.256	a_{20}	0.015	0.007
dep_eur_{t-1}	-0.221	0.004	$cred\_eur_{t-1}$	-0.707	0.000
dep_eur_{t-2}	0.119	0.063	$cred\_eur_{t-2}$	-0.653	0.000
dep_eur_{t-3}	-0.117	0.105	$cred\_eur_{t-3}$	-0.106	0.238
$cred\_eur_t$	0.249	0.116	dep_eur_t	-0.274	0.041
$cred\_eur_{t-1}$	0.119	0.244	dep_eur_{t-1}	0.018	0.825
er_{t-1}	-0.030	0.799	er_{t-1}	0.366	0.003
er_{t-2}	-0.111	0.309	er_{t-2}	0.314	0.010
er_{t-3}	-0.012	0.911	er_{t-3}	0.321	0.009
$infl_{t-1}$	-0.139	0.434	$infl_{t-1}$	-0.281	0.131
$infl_{t-2}$	-0.388	0.027	$infl_{t-2}$	-0.440	0.034
$infl_{t-3}$	-0.377	0.011	$infl_{t-3}$	-0.142	0.418
ipo_t	0.548	0.000			
$embi\_spr\_cro_{t-1}$	0.000	0.343	$embi\_spr\_cro_{t-1}$	0.000	0.582
mrr>=24	0.008	0.102	mrr>=24	-0.013	0.040
mrr>=30	-0.001	0.819	mrr>=30	-0.012	0.066
mrr>=40	-0.001	0.907	mrr>=40	-0.020	0.049
mrr>=55	-0.004	0.175	mrr>=55	-0.006	0.088
khr>=50	0.005	0.381	khr>=50	-0.017	0.047
fcicr>=25	0.004	0.320	fcicr>=25	-0.014	0.000
fcicr=50	0.000	0.984	fcicr=50	0.031	0.000
fxi $fclr_t$	-0.014	0.019	fxi $fclr_t$	-0.035	0.000
$post\_Lehman_t$	-0.014	0.342	$post\_Lehman_t$	-0.030	0.051
fclr<=32	-0.007	0.554	fclr<=32	0.051	0.000
fclr<=28.5	0.019	0.000	fclr<=28.5	0.018	0.005
fclr<=25	0.022	0.008	fclr<=25	-0.016	0.044
fclr<=20	-0.007	0.346	fclr<=20	0.014	0.051
cgr>=50	0.009	0.106	cgr>=50	0.014	0.013
cgr=75	-0.006	0.318	cgr=75	-0.004	0.510
jan. 05	0.001	0.893	jan. 05	-0.003	0.784
mar. 05	-0.008	0.196	mar. 05	-0.010	0.132
apr. 08	-0.014	0.077	apr. 08	0.008	0.336
fclr to 20	0.033	0.000	fclr to 20	0.011	0.185
fxi $fclr_t$	-0.008	0.349	fxi $fclr_t$	0.025	0.002
fxi $fclr_{t-1}$	-0.024	0.002	fxi $fclr_{t-1}$	0.010	0.180
cgr to 75	0.027	0.001	cgr to 75	0.008	0.367
cgr to 75_{t-1}	0.034	0.000	cgr to 75_{t-1}	0.006	0.545
R^2	0.856		R^2	0.813	
Adj. R^2	0.727		Adj. R^2	0.654	
RSS	0.007		RSS	0.007	
DW	1.830		DW	1.912	
Mean Y	-0.001		Mean Y	-0.000	
S.D. Y	0.013		S.D. Y	0.013	
ESS	0.002		ESS	0.002	