

POLICY RESEARCH WORKING PAPER

5772

Macroprudential Regulation of Credit Booms and Busts

The Case of Croatia

Evan Kraft
Tomislav Galac

The World Bank
Europe and Central Asia Region
Office of the Chief Economist
August 2011



Abstract

Croatia employed macroprudential measures to manage credit growth and capital inflows during the boom years of the 2000s, including reserve requirements on loan growth, a marginal reserve requirement on increases in foreign liabilities, foreign exchange liquidity minima, and elevated capital adequacy ratios. Although quantitative analysis is complicated by substantial overlaps among

measures, the econometric results in this paper suggest that the measures were most effective in requiring banks to hold high liquidity and capital buffers, and less effective in slowing credit growth and capital inflows. Larger buffers seem to have helped Croatian banks weather the financial crisis, making the adjustments to capital and liquidity during the crisis smaller.

This paper is a product of the Office of the Chief Economist, Europe and Central Asia Region. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The authors may be contacted at evan.kraft@hnb.hr and tomislav.galac@hnb.hr.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

Macroprudential Regulation of Credit Booms and Busts—The Case of Croatia

by

Evan Kraft and Tomislav Galac

JEL: G28, E32, E51, E58, E61

Keywords: financial regulation, macro-prudential policies

Macprudential Regulation of Credit Booms and Busts—The Case of Croatia¹

1. OVERVIEW

Croatia represents a case of active attempts to manage credit growth and capital inflows during the boom of the 2000s. These efforts at macroprudential management were made through a variety of measures such as the introduction of reserve requirements on bank liabilities, marginal reserve requirements on foreign liabilities, liquidity minima, and credit growth restrictions.

One motivation for the adoption of macroprudential policy measures in Croatia starting in 2003 was the concern that conventional monetary policy would not effectively curb credit growth. Croatian banks' access to foreign funding sources had improved, due in part to the presence of new foreign owners in many of the largest banks and also to eased conditions on international credit markets. Croatian banks had also received a significant windfall as a side effect of the introduction of euro banknotes in 2002—Croatian savers had large amounts of accumulated legacy currencies that they placed in banks in late 2001. Relatively little of this money flowed out of the banking system, creating substantial funding sources for credit expansion. (Kraft 2003 and Kraft and Šošić 2006) In addition, banks had accumulated excess reserves during the recovery from the 1998–99 recession as lending standards were tightened and credit growth was slow, but deposit growth continued apace. None of these factors could be directly controlled by conventional monetary policy.

At the same time, the restructuring of the banking system lowered the cost of credit on the supply side. Among the important cost-lowering factors were the removal of bad assets from the banking system through bank failure and bank rehabilitation, improvements in bank efficiency as a result of privatization, the introduction of new techniques and technology, and increased competition. (Kraft 2000, Galac 2005)

Furthermore, central bankers suspected that the price elasticity of credit demand was low in Croatia. Since many credit products, including housing and car loans, had been practically unavailable or extremely limited in Croatia, there was strong pent-up demand. In addition, weaknesses in the credit culture, such as the lack of a credit register and weak legal protection of creditors, likely led borrowers to believe that they would not face severe consequences if they failed to repay a loan, which reinforced credit demand. Finally, expectations of rising income, as well as aspirations for “European” living standards, also underpinned credit demand.

To limit credit growth, the central bank imposed a reserve requirement, known as the credit growth reserve (CGR), on increases in banks' loan portfolios in 2003. When loan portfolios grew more than 4 percent in a given quarter, banks were required to purchase low-yield central bank bills in an amount twice the overrun. This limit was removed in 2004, and imposed once again in an even stricter form in 2007.

¹ Background paper prepared as background to a forthcoming World Bank report titled “Golden Growth: Restoring the Lustre of the European Economic Model.” The views expressed in this article are exclusively those of the authors and do not necessarily represent the views of the (i) Croatian National Bank or its management, (ii) World Bank and its affiliated organizations, or (iii) the Executive Directors of the World Bank and the governments they represent. All errors and omissions remain entirely the responsibility of the authors. The authors may be contacted at evan.kraft@hnb.hr and tomislav.galac@hnb.hr.

The imposition of the CGR in 2003 reflected the central bank's assessment that the acceleration of credit growth did not primarily reflect one-off factors. While the euro cash conversion effect had been large, trend growth in credit had been increasing throughout 2000 and 2001, albeit from a low level. Over the course of 2002, the central bank became more and more convinced that credit growth would not decelerate substantially without policy intervention, and it moved to impose the CGR.

To address the problem posed by the capital flows underlying credit growth, the central bank also imposed a marginal reserve requirement on increases in banks' foreign liabilities in mid-2004. This requirement, too, was tightened over time.

The factors underpinning rapid credit growth, while including some idiosyncratic features, resembled those in other transition countries. However, Croatia's financial system is quite different from most other transition countries in one respect: it has an extremely high level of unofficial euroization. In particular, foreign exchange deposits and other liabilities make up about 75 percent of banks' balance sheets, and a similar percentage of bank assets are either denominated in foreign exchange or indexed to the exchange rate. This had major implications for monetary policy because the potential for balance sheet effects under high euroization made it desirable to manage the exchange rate rather tightly. (Mishkin 1997 discusses the general issue of balance sheet effects.) The persistence of high levels of Euroization also helped shape Croatia's approach to macroprudential policy.

Deposit euroization implied that the central bank's ability to play the role of lender of last resort (LOLR) in a deposit run was limited. This consideration was further underlined by the recent failure of the Argentine currency board, where arrangements for lines of credit to provide an LOLR in foreign exchange were perceived to have failed in the 2000–2001 crisis. In Croatia, concern about the lack of an LOLR in foreign exchange led to the imposition of minimum foreign exchange liquidity requirements in 2003.

At the same time, widespread indexation of the principal value of loans to the euro exchange rate meant that Croatian banks were exposed to foreign currency-induced credit risk (FCICR)—the risk that borrowers would be unable to meet increased loan payments after a substantial currency depreciation. (Cayazzo et al 2004) The central bank tried to address this potential problem by increasing risk weights on loans in foreign currency or indexed to an exchange rate in 2004.

Croatia experienced rapid credit growth and large current account deficits in the boom years despite the macroprudential measures taken. During the crisis, Croatia avoided major bank failures, but nonetheless suffered a large fall in GDP, an almost complete cessation of credit growth, and a very slow recovery. We believe that Croatia's approach was most effective at inducing banks to maintain sufficient liquidity and capital, allowing banks to enter the crisis period relatively well prepared. In this respect, Croatia's approach partly anticipated the thrust of the new "Basel III" prudential reforms. At the same time, the Croatian approach had less clear success in slowing capital inflows and credit growth, although it is difficult to determine whether any other approach would have been more effective. It is also difficult to evaluate the costs of the Croatian approach, since the side effects of the measures implemented were often difficult to capture in standard data reports, and economic effects such as misallocation of resources are not easy to establish.

The rest of this article is organized as follows: in Section 2 we provide background on the Croatian financial system; in Section 3 we describe the macroprudential indicators, when and why they were introduced, how they worked and how agents attempted to circumvent them, and what their results were; in Section 4, we provide a broader assessment of the effectiveness of the measures; and in Section 5, we discuss future challenges. Section 6 provides our conclusions.

2. BACKGROUND

2.1. Structure of the banking system

In the aftermath of its stabilization of high inflation in 1993, Croatia faced a strategic choice. Owing to the strong preference of Croatian savers for the German mark, Croatia could have attempted to eradicate the high degree of euroization it had inherited from the former Yugoslavia at the risk of dramatically limiting the size of the banking sector, or it could have accepted the presence of a strong deposit base in foreign currency in the hopes of rebuilding confidence in the banking system. Croatia chose the latter (Šonje and Vujčić 1999).

During the 1990s, both deposits and credit grew rapidly. Although a banking crisis in 1998–99 interrupted growth, renewed growth after 2000 led to the development of a banking system with one of the highest levels of banking assets, deposits, and loans to GDP among transition countries. In addition, loans to households, which had stood at only 6 percent of GDP in 1995, rose to over 35 percent in 2008, surpassing loans to enterprises. This increase included the development of strong markets for home mortgages and car loans in particular, with major impacts on both household consumption patterns and financial stability.

In part as a result of the 1998–99 banking crisis, EU banks took a dominant share in the Croatian banking system by 2000. Four of the largest banks were privatized to foreigners, while the largest bank, which had already been privatized to a dispersed set of domestic owners, was bought by an Italian bank. Furthermore, several foreign banks that had entered as greenfield investments gained market share through a combination of rapid growth and acquisitions. In the end, more than 90 percent of banking assets were foreign owned in Croatia as of 2000, and this percentage changed little over the ensuing decade.

Virtually all banks in Croatia primarily made loans indexed to foreign currency (the Deutschmark before 1999 and the euro thereafter) because of deposit euroization. Foreign banks were not especially different from domestic banks in this respect. However, several Austrian banks did play a leading role in the introduction of Swiss franc-indexed loans, beginning in 2004. This practice grew rapidly until the crisis, when it went sharply into reverse. To borrowers unable or unwilling to take currency risk into consideration, Swiss franc-linked loans appeared substantially cheaper than euro-linked loans (by roughly 100–150 basis points).

The Croatian financial system remained highly bank centered through the 2000s. Mandatory pension funds grew rapidly in this period, eating into banks' share of total financial system assets. However, these pension funds were usually owned by banks and did not represent competition in the business of intermediation. There were periods when investment funds, particularly stock funds, also increased their share, but most of them were also owned by banks,

and their asset size rapidly shrank with the fall in share prices in the second half of 2008.² For this reason, we will not pay great attention to non-bank financial institutions in this article.

2.2. Monetary policy instruments

The choice of monetary policy instruments in Croatia flows mainly from deposit euroization and strong capital inflows. Because of the foreign currency-induced credit risk in the banking system, the central bank has adopted a policy of broad exchange rate stability. The kuna-euro exchange rate stayed within an interval of +/- 6.5 percent during the whole 1993–2011 period. The central bank reacts more to the rate of change of the exchange rate than the level and generally has not announced any targets or target bands.

Capital inflows to Croatia have been substantial. To avoid excessive appreciation, the central bank purchased foreign exchange from banks; but to limit potential credit expansion and keep monetary conditions from becoming too loose, it had to sterilize. However, sterilization via the issuance of central bank paper bearing market interest rates was abandoned at the beginning of 2003 because of the possibility of substantial central bank losses. Furthermore, it seemed possible that raising interest rates on central bank paper would not even succeed at controlling money growth in light of the ability of foreign banks to provide additional funding to their Croatian subsidiaries. This additional funding could have allowed the subsidiaries in turn to purchase any increase in central bank paper while also expanding lending at their *ex ante* desired rate. This led the central bank to look for sterilization instruments that would not in and of themselves directly occasion capital inflows.³

Additionally, there is some evidence that increased interest rates on domestic currency loans led to substitution into foreign currency-indexed loans. Kraft and Galac (2011) estimate a simple VAR model based on Brzoza-Brzezina et al (2010). The impulse response functions suggest that most of the decrease in domestic currency loans is compensated for by increased foreign currency loans. They also look at the effect of the central bank measures to increase the price of foreign currency (-linked) lending to borrowers who are not hedged against currency risk, from mid-2006 to early 2010. The conclusion is similar, at least in the pre-crisis period, but this time it is the increase in domestic currency lending that compensates for decreased foreign currency (-linked) lending.

It is interesting to note that neighboring Serbia chose to issue central bank bills despite these arguments. Ultimately, high interest rates did limit loan demand because the elasticity of loan demand was not in fact zero. But this approach, while relatively transparent in the sense that interest rates on central bank paper were formed in the market, allowing monetary policy to use an interest rate channel, was also quite costly and may have increased capital inflows and appreciation pressure.

The Croatian approach, in contrast, relied on high and uniform reserve requirements on bank deposits in both domestic and foreign currency, coupled with a marginal reserve requirement on increases in bank foreign liabilities. Remuneration of required reserves was kept

² For time series data on financial system shares through mid-2007, see the CNB Macprudential Bulletin #6, p. 29.

³ Naturally, any form of sterilization that succeeded in limiting the money supply would raise interest rates, *ceteris paribus*. There would always be a large positive differential between the interest rate on bank loans in Croatia and the interest rate on similar loans in the euro zone (unadjusted for risk). However, if sterilization were done via the issuance of central bank paper at market rates, the central bank would pay this market rate on its liabilities, whereas sterilization through increased reserve requirements at least would not create large interest costs for the central bank.

very low to limit bank earnings and thereby limit the basis for credit expansion. This approach did not feature a market-based interest rate and relied on reserve requirement rates and remuneration rates set by central bank decisions.

Fine-tuning was done via reverse repo auctions that provided liquidity for a one-week period. This instrument, introduced in 2005, was not expected to play a major part in managing the exchange rate or in controlling credit. Instead, it was used to allow banks to manage short-term fluctuations in funding. The reserve requirement and foreign exchange market interventions were the main structural instruments for creating or destroying money.

The Croatian reserve requirement deserves a more detailed explanation since it was responsible for much of the sterilization effort. A uniform reserve requirement for domestic and foreign currency deposits was introduced in 2000. The requirement was decreased in two steps, from 23.5 percent in 2000 to 19 percent in 2001. From there, the rate was only lowered again in December 2004 to 18 percent, and 17 percent in February 2006. The reserve requirement was lowered when it was desired to create lasting changes in the money supply; it was a structural instrument, not a fine-tuning instrument.

More notably, in terms of the management of capital inflows and domestic liquidity, the central bank required that a certain portion of the reserve requirement on foreign exchange deposits be held at the central bank in kuna. By increasing this proportion, the central bank could drain liquidity from the banking system. The kuna holding requirement (KHR) was raised in several steps, from only 25 percent in 2003 to approximately 75 percent 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 confronted since the end of high inflation. The KHR's role in the successful defense of the currency in the first months of 2009 should not be underestimated.

2.3. Characteristics of capital flows

Croatia experienced substantial capital inflows in the form of foreign direct investment (FDI) during the boom period. Privatization was an important source of FDI inflows. The privatization of Croatia's largest banks occurred mainly in 1999–2000, and the privatization of telecoms and the oil company spanned 1998–2003. Foreign investment was especially large in the banking, telecommunications, retail trade, and pharmaceuticals industries.

In addition, government foreign borrowing grew rapidly in the 1998–2003 period. A policy decision was made in late 2003 to focus government funding more on domestic sources. The establishment of mandatory pension funds in 2002 created an important domestic market for government paper. However, even when government bonds were offered on the domestic market, capital inflows were indirectly stimulated, because the purchasers were often foreign bank subsidiaries whose parent banks likely added to their investment in Croatia in order to purchase these government debt instruments.

The Croatian private sector also borrowed abroad, although more modestly than the government. These borrowings usually took the form of bank loans, including syndicated credits, and maturity periods for both government and private sector loans were relatively long.

At the same time, the Croatian stock market was not particularly attractive to foreigners during most of the boom period. Few shares were traded, and some of the most attractive companies, such as the leading banks, were actually de-listed when foreign owners bought them. In view of the high share of FDI, the relatively long maturity of most foreign debt (both public

and private), and the lack of substantial foreign involvement in the Croatian stock markets, Croatia had little to fear from “hot-money” flows. However, in a crisis, Croatian savers might well be able to very quickly transfer their savings to banks in neighboring Austria and Italy, so that the main concern was actually flight of deposits, along with flight from kuna instruments into foreign exchange (mainly euro) instruments.⁴

Croatia’s cautious approach to foreign exchange liberalization may also have limited hot-money flows. While current account convertibility was introduced in 1995, capital account liberalization proceeded much more slowly. The Foreign Exchange Law of 2003 allowed foreigners to participate in most capital markets in Croatia, but not in the primary market for short-term government debt. It also allowed Croatian companies to hold foreign currency deposits in domestic banks. The prohibition on Croatian residents giving loans to non-residents was removed only in mid-2010, while the ban on citizens opening bank accounts abroad was maintained until end-2010. Finally, relatively strict limits on pension fund foreign investments are still in place, especially for investing outside the OECD countries.

3. MACROPRUDENTIAL MEASURES AND THEIR EFFECTIVENESS

Croatia introduced macroprudential measures over the years 2003–2008. The measures aimed to slow credit growth, reduce capital inflows, improve bank capitalization, and bolster bank liquidity. In this section, we will describe the most important measures, give details on how they worked and when they were introduced, modified and withdrawn, and provide some assessments of their effectiveness.

Specifically, we will first discuss measures directly aimed at slowing credit growth and restraining capital flows. These measures could be seen as direct efforts to manage the credit boom, measures that had clear macro aims. Next, we discuss measures to ensure that banks kept sufficient foreign exchange liquidity, capital, and foreign exchange positions. These measures, while having macro impacts, had more of a prudential or micro impact on individual institutions. Finally, we discuss measures that were discussed but not implemented.

3.1. *The credit growth reserve*

The first measure, introduced in January 2003, was a form of tax on credit growth. 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 percent in a given quarter, the bank would be required to purchase special CNB bills paying only 0.5 percent interest. The amount of bills to be purchased was twice the excess of credit growth over the 4 percent maximum.^{5 6}

⁴ During the 1999 banking crisis, decreases in both kuna and foreign exchange deposits were observed. There was anecdotal evidence of savers withdrawing funds and driving to Austria or Italy to make deposits. However, the significance of this kind of behavior cannot be assessed definitively.

⁵ The measure became effective on January 15, 2003. It limited the growth rate in a given quarter, defined as the rate of change of the sum of credits granted (excluding credit to the Government), debt instruments purchased (excluding Croatian National Bank bills and Ministry of Finance paper), guarantees, letters of credit, credit lines and financing obligations, as reported on financial statements on an end-quarter basis. All of the items were standard reporting items, so that there were no measurement problems introduced.

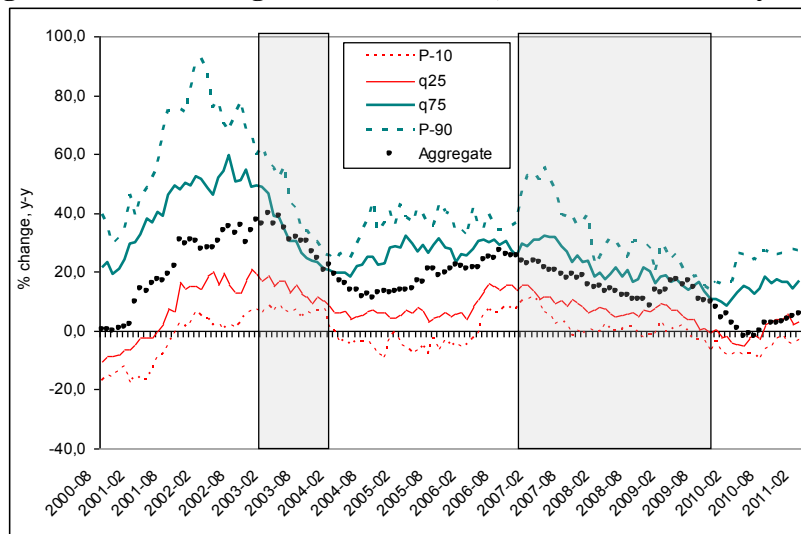
⁶ The 4 percent quarterly growth rate was adopted based on the central bank’s overall financial programming projections. The projections estimated the amount of bank credit required to finance the desired rate of GDP growth with an acceptable current account deficit.

The measure was aimed at limiting the growth rate of bank credit and remained in force throughout 2003, but was withdrawn as of the beginning of 2004. It was reintroduced in 2007, but with some modifications. The on- and off-balance sheet items were considered separately, and the maximum untaxed growth rate was lowered to 1 percent per month (i.e. the maximum growth of rate of credit a bank could grant without paying the tax was lowered from approximately 17.0 percent to 12.7 percent). Not only did this new limit lower the overall rate of growth of credit that banks could grant without paying the tax, it also decreased banks' flexibility to increase credit by a large amount in one month and then by a smaller amount in the following month.

However, in the 2007 version of the measure, the amount of central bank bills required to be purchased was only 50 percent of the overrun. This was raised to 75 percent in December 2007. In this respect, the 2007 measure was slightly more lenient than the 2003 measure, mainly because monthly compliance was more demanding than quarterly compliance. The credit growth reserve was withdrawn in November 2009.

The credit growth reserve was a simple and direct way to limit credit growth. On the surface, it appeared quite successful as very few banks exceeded the credit growth limits and were required to hold the reserves. During 2003, excess growth was extremely rare. During 2007–2009, overruns were more common, although mainly by small banks or, in the case of larger banks, for a single month. Figure 1 shows the trend in bank lending.⁷

Figure 1. Bank credit growth distribution, June 2000–February 2011⁸



Since the credit growth reserve did not inhibit more rapid credit growth, it is interesting to reflect on the banks' decision to avoid holding the reserve. Simple calculations made using prevailing interest rates at the beginning of 2003 suggest that banks would make more profit by increasing lending by over 5 percent per quarter and holding the loan reserve than they would have by growing lending by only 4 percent. However, almost no banks did this. Two possible

⁷ Note that the figure does not show the exact aggregate targeted by the regulation. Instead, we have chosen to use simply loan growth. As is explained later in the text, this figure is less subject to the evasion activities of banks.

⁸ Note that the figure sorts banks by credit growth rates, so that P-10 refers to the 10 percent of banks with the slowest growth, q25 the 25 percent of banks with the slowest growth etc.

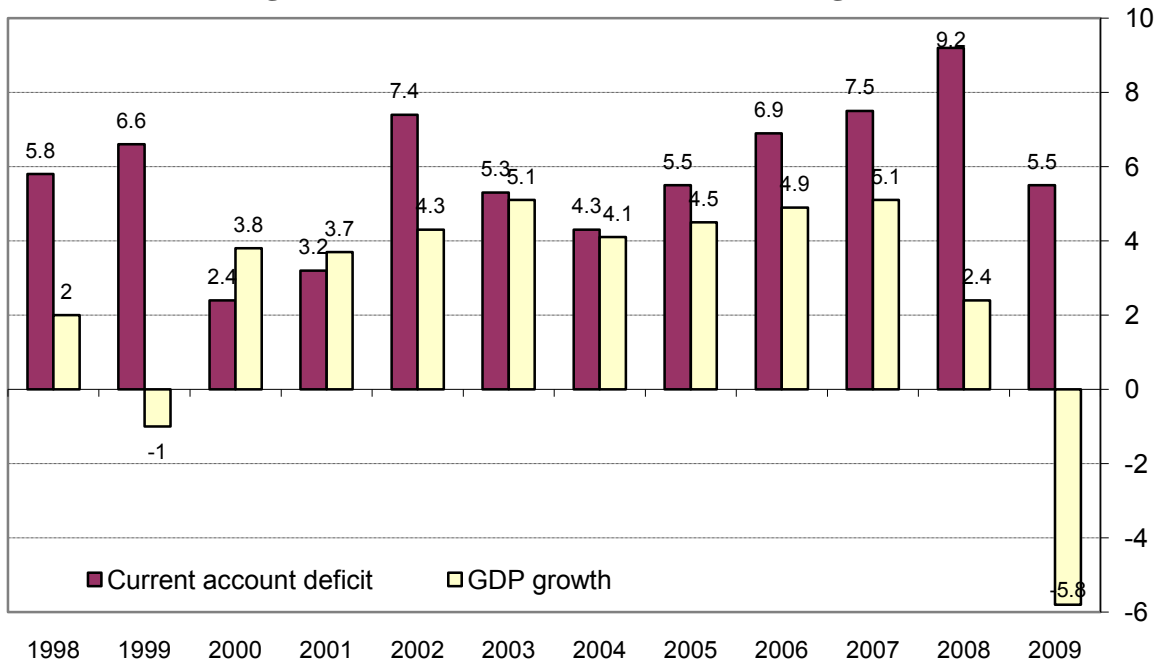
explanations for this are that (i) banks did not want to overtly oppose the central bank, and (ii) banks in fact used other evasive measures to allow them to stay within the growth limit while extending the amount of credit that they would have desired.

The latter explanation is plausible given the numerous evasive measures resorted to by banks. For example, banks cut back on holdings of securities and on unused lines of credit, both items included in the credit aggregate, and used this to offset growth above 4 percent in other categories. In addition, banks with affiliated leasing companies encouraged clients to take leases rather than loans. Finally, banks with parent banks abroad referred clients to the parent bank, with all of the screening and paperwork carried out in Croatia, but the final contracts and funding, at least formally, coming from the headquarters outside of Croatia (Galac and Dukić 2008).

The 2007 version of the credit growth reserve closed the line of credit loophole by limiting on- and off-balance sheet items separately and dealt with the leasing problems by capturing funding of the leasing company within the credit limit. However the issue of direct parent bank lending to clients was not resolved.

The CGR was removed at the beginning of 2004 since it was felt that bank credit growth had been successfully slowed and the current account deficit had improved.⁹ However, as Figure 1 shows, credit growth began to accelerate again in mid-2004, and the current account deficit moved upward (Figure 2). The central bank, aware that the CGR did produce evasion, tried a less direct approach with the marginal reserve requirement (MRR). It imposed the CGR again only when credit growth had become quite strong, the current account deficit was accelerating, and the central bank was convinced that the other measures in force, including the MRR, were not adequate.

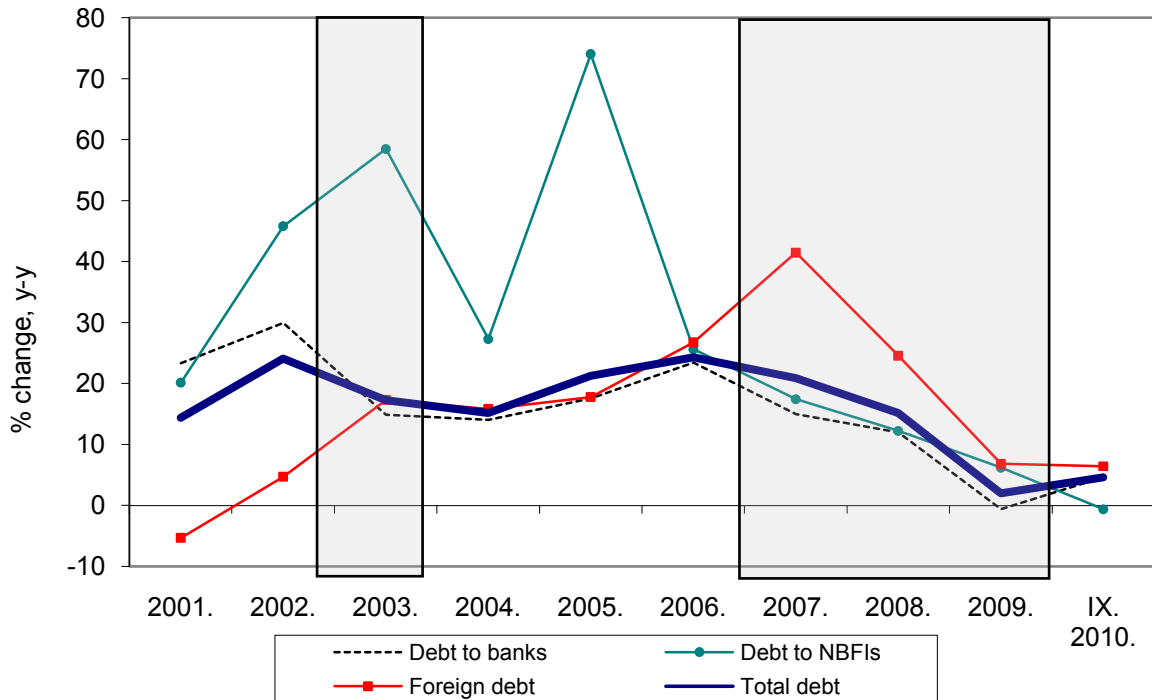
Figure 2. Current account deficit and GDP growth



⁹ The current account deficit fell from 7.4 percent in 2002 to 5.3 percent in 2003 and 4.3 percent in 2004. It then climbed to 5.5 percent in 2005 and 6.9 percent in 2006, leading the central bank to tighten its policy stance, including by imposing the CGR.

One way to gauge the impact of the credit tax is to look at the growth of the sum of on-balance sheet bank lending, leases granted, and foreign borrowing by Croatian agents. Figure 1 plots the growth of this broader aggregate as well as the growth of on-balance sheet bank lending. We see that the broader aggregate appears more stable and, both in 2003 and during the 2007–2009 period, shows less of an impact than the conventional bank loan aggregate.

Figure 3. Growth of debt of households and enterprises, 2001–2010



Nonetheless, one can see an impact of the imposition of the credit growth reserve in 2003 and in 2007, in that the broad aggregate does slow somewhat. Not all banks were able to use the evasion techniques effectively, and there very likely were customers who were unable to get loans because of the tax.

These desired effects of the reserve should be set against its costs, which included decreased transparency as banks scrambled to satisfy customers through more opaque channels, and distortion of competition as smaller banks were discouraged from growing rapidly to increase their market share. Smaller banks were also less likely to be able to use the evasion techniques described above.

Furthermore, it could be argued that the rapid growth of small banks intending to increase market share would likely have led to deteriorating credit quality. If so, the restrictions would have served a prudential purpose to the extent they were effective in limiting credit growth.

Because of concerns about the impact of the credit growth reserve on small banks, there was discussion of limiting the measure to large banks, or of creating a dual system of lower percentage limits for large banks than for small banks. However, it was feared that such an overtly differentiated approach would have been subject to legal challenge as discriminatory.

In addition, there was consideration of imposing stiffer limits on lending to households than on lending to enterprises. This idea was not implemented because of concerns that evasion could be organized by creating enterprises that in turn lent to households. In addition, many individual entrepreneurs are registered as craftspeople or are in the free professions and would be targeted by tighter limits on household lending. Any efforts to unravel these problems would have greatly complicated both the measure itself and implementation efforts.

It might also be asked whether different approaches involving increased risk weights or tighter liquidity requirements might have been used instead of the CGR. As we will explain below, higher risk weights were imposed on foreign currency-linked borrowing, and minimum capital requirements of 10 percent, above the Basel I standard of 10 percent, were imposed. A foreign exchange liquidity requirement was also enacted. However, with capital readily available and liquidity abundant, it would not have been easy to slow credit growth through such measures. Many banks had capital adequacy ratios over 20 percent and would therefore not have had much difficulty meeting higher capital requirements generated by higher risk weights. Banks with foreign owners also had ample liquidity buffers that would not have been exhausted by small changes in liquidity requirements.

In the end, the credit growth reserve is difficult to evaluate. It certainly was circumvented to a considerable degree, but it also created friction that slowed credit growth to some extent. Galac (2010) finds that the credit growth reserve did slow domestic lending by Croatian banks, but that this seems to have been offset by leasing and foreign borrowing, so that the measure's effect on total private sector debt turned out to be insignificant. This econometric evidence might be taken with a grain of salt, since there might have been some signaling effects of the credit growth reserve. It also seems that domestic (usually smaller) banks would not have been able to evade the tax by shifting loans to their parent banks. Thus, there might have been modest effects that do not reach statistical significance.

The credit growth reserve was not removed immediately after the outbreak of the crisis because of concerns about exchange rate depreciation. The credit growth reserve was formulated in nominal terms, so that a depreciation of the currency in fact increased the stock of credit by increasing the local currency equivalent of loans indexed to foreign exchange. To use a concrete example, if the exchange rate depreciated by 3 percent, all indexed loans, the largest category in most banks' loan portfolios, also grew by 3 percent.

By keeping the credit growth reserve in place, the central bank gave commercial banks strong motivation to avoid currency depreciation. This prevented banks from intentionally speculating against the kuna and may have contributed to the success of the central bank's defense of the exchange rate in the first quarter of 2009. This, in turn, prevented the activation of foreign currency-induced credit risk, limiting loan losses and helping avoid a larger banking crisis.

Only when depreciation pressures had substantially receded did the central bank lift the credit growth reserve, in November 2009. At that point, banks had greatly tightened lending standards, and there was little chance that any bank would exceed the credit growth reserve ceilings. Still, the withdrawal of the credit tax signaled that the central bank was shifting to a recession-fighting mode and would encourage a resumption of credit growth.

3.2. *The marginal reserve requirement*

The marginal reserve requirement (MRR) was introduced as a way to slow capital inflows and targeted banks' foreign funding sources in particular.¹⁰ The MRR initially applied only to the increase in banks' foreign liabilities, with a reserve of 24 percent required. The measure was extended to cover deposits or other assets of leasing companies in an effort to close one of the major loopholes in the credit growth reserve measures of 2003.

The MRR rate was increased in numerous steps, reaching 55 percent in 2006. At this rate, it seemed that foreign borrowing would provide very little profit for banks; nonetheless, foreign borrowing continued. Discussion with banks revealed that foreign borrowing continued despite the MRR because such loans were the only opportunity for banks to gain long-term funding sources. Growth in domestic deposits was inadequate to fund banks' credit expansion goals, therefore long-term funding sources were crucial to banks' participation in the housing loans market and in long-term loans for corporate investment projects. In light of the intense competition in these areas, banks may have been willing to accept low returns in order to build market share (Galac and Dukić 2008).

However, the large jump in the MRR from 40 percent to 55 percent in early 2006, in conjunction with higher risk weights on foreign currency-linked loans to unhedged borrowers since mid-2006, created strong incentives for banks to increase their capital rather than continue foreign borrowing. Several of the larger banks implemented substantial capital increases in 2006 and 2007, raising not only their capital adequacy ratios, but also the capital adequacy ratio of the whole banking system.

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, and deposit levels returned broadly to the pre-Lehman levels. Thus, the MRR's removal proved effective during the crisis.

Looking more broadly at the MRR's effectiveness during the boom, Galac (2010) finds fairly strong evidence that imposition of the MRR led banks to increase their capital, although he notes that it is difficult to disentangle this effect from the effect of other prudential measures. At the same time, he finds weaker evidence that the MRR actually led to decreases in gross foreign liabilities during the boom.

Before concluding this section, it should be mentioned that one bank attempted to fund its expansion plans by issuing bonds on the domestic market. Seeing this as an attempt to evade the spirit if not the letter of the MRR, the central bank implemented a 55 percent reserve requirement on funds raised by bond offerings. After that, no other bank issued bonds on the domestic market. The special reserve requirement, as this measure was called, was abolished shortly after abolishing the MRR.

¹⁰ The marginal reserve requirement was applied to the increase in banks' foreign liabilities over the initial stock as of July 31, 2004. Foreign liabilities were defined as all liabilities to foreigners, plus deposits or other assets of leasing companies held at the banks. The actual amount required to be held was calculated by multiplying this base by the MRR rate.

3.3. The foreign currency liquidity requirement

Chronologically the first of the macroprudential measures, the foreign currency liquidity requirement (FCLR) required that banks hold higher foreign currency liquidity as a form of self-insurance against runs against foreign currency deposits. Because of the high level of deposit euroization in Croatia, the central bank's ability to act as a lender of last resort in the case of a run on deposits could be somewhat limited. Moreover, while some have proposed contingent lines of credit as a way to provide an LOLR in foreign currency, the apparent failure of contingent lines of credit in the case of Argentina suggested to Croatian policy makers that such a solution would not be reliable.

The FCLR replaced an earlier measure that required banks to hold 53 percent of longer-term foreign exchange deposits in banks outside of Croatia. It required the holding of liquid foreign assets with a maturity of no more than 3 months to cover the reserve requirement.¹¹ 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.

It is therefore difficult to argue that the FCLR was used countercyclically. However, by not lowering the FCLR, the central bank was able to change the points at which other reserve requirements would become binding. Thus, a lowering of the regular reserve requirement without changing the FCLR might result in a bank being unable to free up any reserves at all. Such interactions between measures were at times quite important during the boom period in Croatia.

After its enactment in 2003, there were attempts by banks to evade the FCLR, for example by offering local currency deposits indexed to an exchange rate. Until the central bank altered its regulation in September 2006, these deposits, which display the same currency risk as "true" foreign exchange deposits, were not covered. This example reinforces the point that regulatory authorities have to be ready to closely monitor compliance and rapidly modify regulation to close evasion channels. In this case, the loophole was easy to close, but matters are often not so simple.

3.4. Limits on currency mismatch in banks' balance sheets

Matching assets and liabilities by currency is a basic principle of risk management. However, regulators have often found it necessary to limit banks' open foreign exchange positions. The Croatian National Bank (CNB) had imposed such limits since the early 1990s, but by raising or lowering these limits was able to affect credit conditions. Net open foreign exchange positions were limited to 30 percent of capital in 1995. Positions must be calculated daily, and reflect the sum of positions in each individual currency in which the bank does business.¹² The limit was lowered during the boom to inhibit currency risk. In April 2003, a

¹¹ The numerator of the ratio, foreign exchange assets, includes foreign currency cash and checks, foreign exchange transaction accounts, foreign exchange held with the central bank, foreign exchange deposits with a remaining maturity of less than 3 months, debt instruments issued by foreign banks and governments that are available for sale, and debt instruments issued by foreign banks and governments that are held to maturity but have a remaining maturity of less than 3 months. The denominator of the ratio includes foreign exchange deposits received, foreign exchange debt instruments issued by the bank, foreign exchange and indexed loans received, foreign exchange and indexed hybrid instruments, and any other financial obligations denominated in foreign exchange.

¹² The calculation of the open position requires calculation of net spot and net forward positions in each currency the bank uses. The individual currency positions are summed up. In addition, net positions in off-balance sheet items

new regulation was issued lowering the allowed open position to 20 percent and including embedded options in some kinds of foreign currency loans.

While this limit was certainly justified as a means of limiting overall financial system risk, most banks easily met them during the boom period. The regulation only affected a few banks, and the tightening of the regulation in 2003 did not seem to have significant effects. The limit was raised to 30 percent at the end of March 2010, giving banks more flexibility to accept foreign currency deposits or loans, without necessarily having to extend indexed loans. While this does seem to have facilitated banks' operations, it does not appear to have been particularly effective at restarting credit growth.

3.5. Higher risk weights on loans linked to foreign currency

Driven by the regulations limiting foreign currency mismatch and by basic risk management principles, banks extended loans to clients in kuna, but indexed the loan principal to an exchange rate. Most common in Croatia are loans in kuna whose principal is revalued at each installment based on the kuna-euro exchange rate.

After several years, it became apparent that banks were not pricing in the credit risk caused by extending these loans to borrowers whose income is purely in kuna. Loans to unhedged borrowers and hedged borrowers bore the same interest rates. This seems to be the result of a free-rider problem: in the case of small exchange rate changes, increases in defaults would be minor; but in the case of large exchange rate changes, all banks would experience increased defaults, and there would likely be strong pressure on the central bank and government to assume banking system losses.

Conversations with bankers revealed a different line of thought. Bankers most often argued that increased risk weights were unnecessary since the central bank would not allow a significant depreciation of the exchange rate. We would argue that this point of view indeed reflected a free-rider mentality and also a degree of disaster myopia.

This reasoning was especially suspect in the case of Swiss franc-denominated loans. As many countries discovered in 2008 and 2009, even a relatively stable exchange rate with the euro did not preclude swings of as much as 10 percent with the Swiss franc. Hungary in particular suffered from this problem.

In Croatia, the indexation contracts stipulated that monthly principal payments were based on the exchange rate at the end of the month, so that a 10 percent depreciation on, for example, the 15th of a given month would result in a 10 percent increase in borrowers' installments due on the last day of the month. This provided a very rapid transmission of exchange rate shocks to borrowers, likely producing strong effects on consumption and, over a longer period, on default rates.

The measure adopted to deal with lending indexed to foreign currency to unhedged borrowers was an increase in risk weights, introduced in June 2006. Banks were required to document whether borrowers had natural hedges, and if not, they were required to apply

such as guarantees in foreign exchange must be calculated, along with net positions in any other assets or liabilities whose value would change with currency fluctuations.

increased risk weights.¹³ It turned out that very few borrowers were hedged, and banks were required to raise substantial amounts of capital.

The increased risk weights on foreign currency borrowing were certainly a prudential measure intended to better align capital requirements with risk profiles at the level of individual banks. However, in light of the difficulty in precisely measuring the foreign currency-induced credit risk present in bank balance sheets, the precise amount of the increased risk weights was difficult to determine. In practice, the central bank was able to increase these risk weights when it felt that risks were building up in the banking system as a whole at the beginning of 2008.

In addition, the central bank made repeated public statements aimed at familiarizing borrowers with the risks involved in loans indexed to foreign currency, since it was clear that borrowers tended only to consider the interest rate offered, ignoring the currency risk.

Unfortunately, the introduction of Basel II actually forced the Croatian National Bank to abandon this approach to FCICR. One possible alternative was to use Pillar II of the new framework to require banks, on a case-by-case basis, to recognize the risks associated with unhedged borrowers. This could also be done via the Internal Capital Adequacy Assessment Process (ICAAP). It remains to be seen whether such an approach will be as effective as the rough and simple approach adopted by the CNB under Basel I.

3.6. Higher capital requirements for fast-growing banks

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 loans and off-balance sheet items grew by more than 20 percent to retain a portion of dividends, unless the bank's capital adequacy ratio exceeded a high level.¹⁴ If growth exceeded 30 percent, the capital adequacy ratio had to be even higher to avoid mandatory dividend retention. The growth rate limitation referred to a specific set of assets and off-balance sheet liabilities deemed to be credit related.

In addition, the measure required that banks form general provisions for unidentified losses. The general provision has a capital-like function. However, there is an important tension between this requirement and IAS 39, which requires that provisions be based on well-identified evidence of future losses. A similar problem plagued Spain's dynamic provisioning system, which required countercyclical general provisions. Croatia's system was simpler, but also subject to some of the same objections from an accounting point of view.

Since the limit for asset growth was set at the relatively high level of 20 percent 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. Most large banks did not have

¹³ Loans that otherwise qualified for a 50 percent risk weight, such as home mortgages, carried a 75 percent risk weight if the borrower was unhedged. Loans that otherwise qualified for a 100 percent risk weight carried a 125 percent risk weight to unhedged borrowers. These higher risk weights were raised another 25 percentage points in January 2008 (to 100 percent and 150 percent respectively).

¹⁴ The definition of credits was the same as for the CGR, including all loans and debt instruments purchased except for loans to the Government and Croatian National Bank and Ministry of Finance paper. Off-balance sheet items included letters of credit, bills of exchange, funding commitments, and lines of credit. The requirement to retain dividends did not apply to banks whose credit aggregate growth was below 30 percent if capital adequacy was above 15 percent. Higher capital adequacy was required to waive dividend retention at higher rates of growth. Finally, newly founded banks were not required to comply with this measure in their first three years of doing business.

portfolio growth high enough to exceed the limit, while most small banks had capital adequacy levels so high that they were exempt. However, the lowering of the growth limit to 15 percent in 2006 made the dividend-retention measure much more relevant, and that year alone accounted for over half of the total of general provisions formed over the 2004–2008 period (about HRK 1.7 billion in total). The general provisions formed in 2006 also accounted for almost one third of banks' after-tax profits for that year.

Afterward, as the global crisis set in, bank credit growth rates began to decline, resulting in a significant drop in new general reserves formed in both 2007 and 2008. In 2009, the measure was abandoned altogether, but an even stricter replacement measure was already in place: since the beginning of 2008, banks growing faster than 12 percent per annum had to maintain a higher than usual minimum capital adequacy ratio, proportionate to the share of non-core (potentially unstable) funding in their total funding structure. However, lower bank credit growth and capital-raising efforts during the crisis have made this measure non-binding for most banks for the foreseeable future. Only five smaller banks found it binding during 2008–2009 and had to increase their capital specifically because of this measure. Thus, overall, it appears that the above capital/provisioning measures had a positive impact on the capital buffers of the faster growing banks going into the crisis period.

It is also worth mentioning that Croatia enacted a minimum capital adequacy requirement of 10 percent in 1999. This was intended to offset the higher risks present on the Croatian banking market due to the challenges of the transition such as the lack of a credit culture, including the unfamiliarity of borrowers with the risks of debt, and the lack of a credit bureau (until 2004); weak creditor protection, including a very slow legal process; connected lending and unwarranted political influence and corruption; and a lack of historical data on which to base credit assessments. This higher capital minimum was not of course countercyclical, but it did serve to provide larger buffers against failure, giving banks and supervisors more time to respond to problems.

Finally, the Croatian National Bank adopted a further measure in January 2008 requiring that rapidly growing banks hold higher levels of capital. The measure set special, bank-specific capital requirements based on the rate of growth of credit and the bank's reliance on funding sources other than core deposits.¹⁵ In this way, the measure penalized banks that expanded their loan book by relying on non-deposit funding sources such as foreign borrowing.

Since this measure was imposed at the very end of the boom period, it did not directly limit banks' credit behavior. However, the measure remains an avenue for slowing credit growth, particularly in the future when Croatia adopts the euro.

3.7. Loan-to-value ratio limitations—a measure not taken

One suggestion to limit credit growth that was closely examined was the imposition of a limitation on loan-to-value (LTV) or loan-to-income (LTI) ratios. Some of these proposals were

¹⁵ Specifically, the base for calculating credit growth was the same as for the CGR and dividend-retention measures. The rate of secondary funding sources was calculated as the total liabilities minus deposits from households with a maturity of three months or more, divided by total liabilities. The required capital adequacy ratio was then calculated as $12 + 1.5 \left(\frac{\text{Credit growth rate} \times \text{Secondary Funding rate}}{73.4} - 12 \right)$. The constant 73.4 was chosen as the system-wide average secondary funding rate. The measure required that banks hold 12 percent capital adequacy plus a 150 percent penalty on credit growth above 12 percent, with the penalty multiplied by the degree to which the bank relied on secondary funding sources.

aimed particularly at household loans, especially home mortgages; however, in the end, the CNB chose not to implement such measures.

The arguments against using such measures were both prudential and social. On the prudential side, it was felt that the high risk weights already placed on home mortgages provided adequate buffers against possible losses. This was because the overwhelming majority of home mortgages were indexed to foreign currency (until 2004, euro indexation was predominant, but in the 2004–2008 period, Swiss franc indexation grew rapidly). Because of this, banks were required to place risk weights of 125 percent (150 percent in 2008) on these loans. In addition, banks still required that two people co-sign the loans, leading to a very high rate of recovery even when the original borrower was unable to pay.

Finally, banks were already fairly conservative in their practices regarding LTV ratios, which rarely exceeded 80 percent. In hindsight, one could object that these LTV ratios were based on high real estate prices resulting from unsustainable rates of price growth. However, this argument was not deemed to be strong in the Croatian case, in part because it was assessed that real estate prices in Croatia were undergoing a process of convergence to EU levels. This implied that the increase in real estate prices represented a trend rather than a cycle.

The social aspect of the loan-to-value limitation was the concern that rigid limitations would hit first-time borrowers and younger families disproportionately. Since home mortgages had not been widely and easily available for a long period prior to the early 2000s, there was a perception that there was a great deal of pent-up demand, particularly among these socially disadvantaged strata.

The CNB also decided against loan installment to income limits. It was believed that loans could easily be low risk even if loan installments exceeded a rule-of-thumb limit of 35 percent or 50 percent. In fact, Croatian banks were in the practice of allowing loan installments to reach a point where borrowers would have disposable income after loan repayment equal to an “existential minimum.” This existential minimum varied from bank to bank, sometimes ranging as low as the minimum wage and sometimes reaching figures two to three times higher than the minimum wage. The practice can well be criticized, especially considering that the calculation of the existential minimum did not take into account the possibility that exchange rate depreciation would increase the loan installment.

Still, the CNB felt that loan-to-income limitations would be unnecessarily restrictive and could hit lower-income borrowers too strongly. In particular, the widespread participation in the unofficial economy, with many households receiving a secondary or even primary income as unrecorded income, in part or as a whole would render large numbers of households virtually “unbankable” had the strict LTI policy been implemented.

Another possibility, discussed above in the context of the CGR, was to place a lower limit on household lending than on corporate lending. The administrative challenges of implementing such a measure, along with the possibility that implementing such a measure might have encouraged non-bank lenders to step in and offset any decline in bank lending to households, persuaded the CNB to eschew such measures. This decision was taken despite the widespread belief that bank lending was excessively skewed toward households.

3.8. A note on monitoring

All of the measures described above were monitored via reporting to the central bank. The FLCR and foreign exchange position limit had to be met daily. In the case of the FLCR, reports for each day were only sent for a whole month at a time, while the position limit was actually reported daily along with a set of reserve and liquidity reports. The CGR was monitored monthly, as was the MRR. The dividend restriction on rapidly growing banks was part of the quarterly prudential reporting framework.

The accuracy of these reports was confirmed by on-site inspections. The Supervision Department of the Croatian National Bank does on-site inspection of compliance with monetary measures, as well as compliance with prudential measures.

However, the greatest challenge was to detect the evasion channels used by banks. This was done through conversations with bankers, examination of bank reports off-site, and on-site examinations. The cat-and-mouse game, however, is ongoing, with the banks always a step ahead of the regulators.

4. THE EFFECTIVENESS OF THE MEASURES TAKEN TO DEAL WITH THE CREDIT BOOM

As a result of the limited time frame and the overlapping of many of the measures, it is difficult to make reliable quantitative estimates of their impacts. Galac (2010) provides the most systematic econometric and quantitative analysis undertaken so far. Here we reinterpret, extend, and revise that analysis in several directions. First, we examine the effectiveness of attempts to control credit growth. Next, we look at measures aimed at discriminating among different forms of capital inflows, and last we look at measures whose goal was to boost liquidity and capital buffers.

On credit growth, as already discussed, Galac (2010) finds statistical evidence that the credit growth reserve (CGR) successfully reduced the pace of growth of credit extended by domestic commercial banks to the non-financial private sector. However, the same analysis suggests that the reduction of this credit growth measure was compensated for by an increase in foreign debt growth so that overall, the effect of the CGR on the pace of growth of total debt of the private non-financial sector was not statistically significant.¹⁶ Here, we repeat the empirical exercise from Galac (2010), breaking down credit growth into total, non-financial companies and households. The results are presented in Table 1.

The regression estimates in the equation for total debt (total of households and enterprises, foreign and domestic) are presented in the left section of Table 1. They correspond closely to those estimated by Galac (2010) on a shorter dataset and using a slightly different specification of the model. Thus, there is no statistical evidence on the effectiveness of the CGR at curbing overall corporate and household debt during the two periods of its implementation when viewed together. However, the middle and the right section of Table 1 indicate that the

¹⁶ The debt owed to domestic non-banking financial institutions is missing from the aggregate because monthly data on their operations is unavailable. As explained by Galac (2010), quarterly data on these institutions indicate that there was marked substitution from banks to leasing companies in particular during periods when CGR was active. This consideration highlights the ineffectiveness of the CGR regarding corporate and total debt, and weakens the argument for its effectiveness with respect to household debt, all presented in Table 1.

negative result may be entirely due to its inability to affect corporate borrowing, while there is strong evidence that household borrowing indeed slowed when CGR was active. This is broadly in line with what one could expect in the period analyzed, given the restrictions on natural persons banking abroad and a lack of such restrictions for legal persons after 2002. It also suggests that the CGR could have contributed to slowing down the household lending boom and perhaps even the current account deficit, which are certainly both aims of central bank policy. Finally, the unexpectedly positive and significant initial effect when the CGR is implemented or tightened, in all three specifications, can probably be explained by inertia, that is, prior loan commitments by banks that had to be honored even as the CGR began to bite.

Table 1. Credit growth and credit growth limits, 2000–2010

| N=120, 2001/01-2010/12 X (HAC std. errors) | Y=DLOG(Total_debt) | | | Y=DLOG(NFC_debt) | | | Y=DLOG(HH_debt) | | |
|---|--------------------|--------|---------|------------------|--------|---------|-----------------|--------|---------|
| | coeff. | s.e. | p-value | coeff. | s.e. | p-value | coeff. | s.e. | p-value |
| Constant | 0,0166 | 0,0023 | 0,0000 | 0,0134 | 0,0024 | 0,0000 | 0,0145 | 0,0020 | 0,0000 |
| Y(t-1) | -0,1603 | 0,0859 | 0,0645 | -0,0863 | 0,0917 | 0,3485 | 0,0459 | 0,1078 | 0,6713 |
| Y(t-12) | 0,1685 | 0,0919 | 0,0694 | 0,2382 | 0,1115 | 0,0348 | 0,2600 | 0,0908 | 0,0050 |
| CGR effective (t) | -0,0011 | 0,0016 | 0,4923 | -0,0006 | 0,0024 | 0,8122 | -0,0043 | 0,0019 | 0,0286 |
| CGR increased (t) | 0,0062 | 0,0014 | 0,0000 | 0,0040 | 0,0023 | 0,0860 | 0,0112 | 0,0030 | 0,0004 |
| EMBI Spread, Croatia (t-1) | 0,0000 | 0,0000 | 0,0001 | 0,0000 | 0,0000 | 0,0009 | 0,0000 | 0,0000 | 0,0001 |
| Outlier/2001-08 | 0,0404 | 0,0017 | 0,0000 | 0,0383 | 0,0027 | 0,0000 | 0,0504 | 0,0016 | 0,0000 |
| Outlier/2002-07 | 0,0242 | 0,0017 | 0,0000 | | | | 0,0357 | 0,0018 | 0,0000 |
| Outlier/2002-10 | 0,0208 | 0,0010 | 0,0000 | | | | 0,0329 | 0,0016 | 0,0000 |
| Outlier/2008-01 | 0,0234 | 0,0014 | 0,0000 | 0,0374 | 0,0022 | 0,0000 | | | |
| Mean Y | 0,0120 | | | 0,0110 | | | 0,0142 | | |
| SD(Y) | 0,0103 | | | 0,0116 | | | 0,0130 | | |
| Adj. R square | 0,3842 | | | 0,2499 | | | 0,4509 | | |
| AIC | -6,7250 | | | -6,2957 | | | -6,3744 | | |
| BIC | -6,4927 | | | -6,1099 | | | -6,1653 | | |
| HQC | -6,6306 | | | -6,2202 | | | -6,2895 | | |
| DW | 2,0955 | | | 2,1210 | | | 2,1027 | | |

Regarding capital inflows into the banking sector, Galac (2010) finds strong statistical evidence that the rate of the marginal reserve requirement (MRR) is positively associated with bank capital formation, in addition to some faint evidence that the existence of the MRR is negatively associated with banks' foreign borrowing. Here, we first examine whether the statistical evidence on bank capital formation is robust to the introduction of the prudential measures described in sections 3.5 and 3.6 into the analysis. To this end, three equations for monthly additions to the aggregate bank capital are presented in Table 2.

The first equation, which is similar to the one estimated in Galac (2010), shows that the results reflecting the effectiveness of the MRR at stimulating bank recapitalization are sensitive to the presence of other prudential measures in the model. However, the model implicit in the first equation may not be adequate because of the presence of extreme outliers for two months during the period analyzed. These were explicitly taken into account in the second equation, which significantly strengthened the results indicated by the model and suggested that the November 2006 outlier could possibly be connected to the introduction of foreign currency-linked liabilities into the FCLR base in the previous month. Since the MRR rate was already at its maximum at that time, it is possible that the cheapest way for banks to adjust to this change of the measure was to raise capital and then invest it in additional liquid foreign currency assets to

satisfy the FCLR. In contrast, the March 2007 extreme outlier cannot be related in a meaningful way to any important event.

Table 2. Prudential measures and bank recapitalization, 2001-2010

| N=121, 2000/12-2010/12 | Y=DLOG(Bank_capital) | | | | | | | | |
|---------------------------------------|------------------------|--------|---------|---------|--------|---------|---------|--------|---------|
| | X (HAC std. errors) | | | | | | | | |
| | coeff. | s.e. | p-value | coeff. | s.e. | p-value | coeff. | s.e. | p-value |
| Constant | 0,0024 | 0,0020 | 0,2230 | 0,0016 | 0,0017 | 0,3494 | 0,0016 | 0,0013 | 0,2289 |
| Y(t-1) | -0,0190 | 0,0728 | 0,7946 | 0,0524 | 0,0492 | 0,2892 | 0,0542 | 0,0487 | 0,2682 |
| Y(t-12) | 0,2287 | 0,1238 | 0,0673 | 0,3293 | 0,0837 | 0,0001 | 0,3308 | 0,0821 | 0,0001 |
| MRR rate % | 0,0001 | 0,0001 | 0,2168 | 0,0001 | 0,0001 | 0,3561 | 0,0002 | 0,0000 | 0,0009 |
| MRR effective | 0,0050 | 0,0043 | 0,2515 | 0,0036 | 0,0039 | 0,3528 | | | |
| gen. bank res. req. in place | -0,0029 | 0,0028 | 0,2946 | -0,0007 | 0,0022 | 0,7617 | | | |
| FCICR weights in place | 0,0045 | 0,0024 | 0,0599 | 0,0039 | 0,0024 | 0,1072 | 0,0038 | 0,0023 | 0,0962 |
| stricter gen. bank res. req. in place | -0,0016 | 0,0055 | 0,7682 | -0,0067 | 0,0041 | 0,1066 | -0,0074 | 0,0034 | 0,0294 |
| Outlier, 2006/11 | | | | 0,0448 | 0,0021 | 0,0000 | 0,0449 | 0,0020 | 0,0000 |
| Outlier, 2007/03 | | | | 0,0795 | 0,0025 | 0,0000 | 0,0796 | 0,0025 | 0,0000 |
| Mean Y | 0,0090 | | | 0,0090 | | | 0,0090 | | |
| SD(Y) | 0,0141 | | | 0,0141 | | | 0,0141 | | |
| Adj. R square | 0,1987 | | | 0,5266 | | | 0,5340 | | |
| AIC | -5,8486 | | | -6,3596 | | | -6,3906 | | |
| BIC | -5,6637 | | | -6,1286 | | | -6,2058 | | |
| HQC | -5,7735 | | | -6,2658 | | | -6,3155 | | |
| DW | 1,9579 | | | 1,9896 | | | 1,9853 | | |

Overall, the second equation in Table 2 indicates that there may be no single measure that alone stimulated bank recapitalizations in the 2004–2008 period. However, this result may be driven by the interaction of different measures due to overlapping periods of their implementation and/or the construction of the two MRR variables and the two general banking reserves variables, which may represent highly correlated pairs. Therefore, in the final step, the dummy indicator for the existence of MRR (found insignificant by Galac (2010)) and the dummy indicator for the existence of general bank reserves (highly insignificant in the second equation) are excluded from the second equation. The resulting third equation in Table 2 describes the data at hand just as well as the second equation, but unlike the latter, it provides strong statistical evidence about the positive relationship between the MRR rate and bank capital additions (in line with Galac (2010)), as well as an indication of a modest positive impact of FCICR risk weight add-ons.

Galac (2010) also attempts to quantify the impact of all central bank measures together on the building of bank capital buffers in the period leading up to the crisis through simulations. This analysis concludes that under several realistic counterfactual scenarios in which no new monetary and prudential measures drive capital-raising efforts in the 2004–2008 period, banks would have had an aggregate shortfall of capital of between HRK 11 billion and 13 billion (just under EUR 2 billion) at the height of the crisis, against the actually observed shortfall of around HRK 6 billion, with the difference of HRK 5 billion to 7 billion representing about 1.5 percent to 2 percent of end-2008 banking sector assets. This analysis also finds that under an extreme scenario in which the central bank would not have relaxed its prudential measures during the crisis, this difference could have been as high as HRK 22 billion. In either case, it appears

obvious that the counterfactual capital buffers would have contributed to the severity of the credit slowdown during the crisis.

In the context of our analysis, it is interesting to consider how much of the baseline difference of 5 billion to 7 billion in the shortfall of capital could be attributed to general banking provisions from section 3.6 of this paper, the only measure not explicitly considered in Galac (2010). First, it must be noted that although the measure was not explicitly part of the calculation, implicitly all monetary and prudential measures were included in the simulation, allowing us to leave the simulated figures unaltered. Data also indicate that of the general provisions formed in the 2004–2008 period, almost the entire amount of HRK 1.7 billion was formed prior to 2008, thus prior to the crisis. Therefore, the general provision measure can be credited with between one fourth and one third of the hypothetical reduction in the 2008 capital shortfall due to central bank measures.

Counterfactual simulations of liquidity buffers in Galac (2010) appear somewhat more benign. They indicate that under the 2002 monetary policy, *ceteris paribus*, banks' liquidity buffers built over the 2003–2008 period up to the Lehman Brothers episode would have been HRK 5 billion higher in the domestic currency segment and HRK 6.5 billion lower in the foreign currency segment. It is shown, although not explicitly stated, that the greatest driver of this outcome were increases to the kuna holding requirement (KHR), which was implemented in 2003 (three times), 2005, and 2009.

Therefore, the role of the FCLR and MRR was to partially compensate for the slower (than the counterfactual) build-up of traditional foreign currency required reserves during the period. It is arguable whether the FCLR and MRR reserves were more liquid; banks may have simply used them more readily during the height of the crisis than they would have used the latter (required reserves). In any event, although total foreign currency reserves accumulated up to the crisis peak were lower than the counterfactual, they appear to have been adequate in retrospect, since they provided enough of a cushion to preserve financial stability during the crisis. At the same time, building foreign currency liquidity buffers under the FCLR and MRR yielded a more restrictive monetary policy than would have been possible under the counterfactual, which in retrospect seems indisputable.

5. FUTURE CHALLENGES

Many of the key issues facing macroprudential policy in Croatia flow from the implications of the evolving European framework for banking supervision, financial stability, and cross-border cooperation. In this section, we will briefly review Croatia's experience with managing financial stability issues during the crisis and discuss the main challenges Croatia faces.

5.1. Cross-border cooperation during the crisis

The Croatian banking system has been largely under foreign ownership since 2000. Since all the foreign-owned institutions were subsidiaries as of the outbreak of the financial crisis, Croatian supervisors had full authority over these banks. While the issue of home-host cooperation is an important and delicate one, the crisis did not produce any major issues where such cooperation failed.

The biggest cross-border issues involved ensuring that foreign owners would and could stand by their subsidiaries, particularly in the turbulent weeks after the failure of Lehman Brothers. The central bank's move to lift the marginal reserve requirement in October 2008 facilitated foreign banks' efforts to provide liquidity support to their subsidiaries. Together, the foreign owners and the central bank, along with the Croatian Government, which raised the deposit insurance level from HRK 100,000 to HRK 400,000, succeeded in stabilizing the situation.

An additional concern as the crisis continued was that parent banks would seek to compensate for losses in their home markets through large dividend payments or capital decreases in the subsidiaries. Considerable moral pressure was exerted by the central bank to prevent this from happening. In addition, the Vienna Initiative proved to be a very important international effort to prevent foreign banks from abandoning markets in the Central and East European region. Overall, it seems fair to say that these efforts succeeded.

There were no failures of foreign banks in Croatia during the financial crisis. For this reason, the issue of burden sharing did not materialize. Since all the foreign banks were organized as subsidiaries, any recapitalization or restructuring would have come exclusively under Croatian law. However, if a foreign subsidiary were to fail in the future, it would be difficult to imagine the Croatian Government stepping in and using taxpayers' money to recapitalize the bank. More likely, the burden would be placed on the parent's owners, or the home country government.

5.2. Capital flows: Looking ahead

Although the financial crisis has substantially decreased capital inflows, it seems reasonable to think that Croatia will experience substantial inflows in the future. Croatian borrowers are likely to turn to European sources when they can because interest rates remain more favorable outside of Croatia, particularly in the euro zone. Croatia's expected accession to the EU and subsequent membership in the euro zone would likely erode this differential, but will not eliminate it quickly.

In addition, Croatian banks are likely to turn to international debt markets again. In the near term, the need for debt financing will be limited by slow loan demand from both domestic enterprises and households. However, once economic growth accelerates, one would expect a return to international debt markets by Croatian banks.

Another form of capital inflows that should be anticipated is FDI. Croatia's domestically owned banks, which are mainly small and medium sized, are already perceived to be attractive takeover targets for foreign banks seeking entry into the Croatian market. Even though tight regulation may limit profit rates relative to the high levels achieved in the past—the return on average equity of the Croatian banking system has fallen from a high of 16.1 percent in 2004 to only 6.4 percent in 2009—the growth potential of the Croatian market seems far greater than that of developed European markets.¹⁷ This implies continued FDI in the banking industry.

FDI in other sectors of the economy can also be anticipated, especially as EU accession improves the legal and regulatory framework. However, Croatia still has work to do on streamlining procedures for business establishment and decreasing corruption. These obstacles

¹⁷ Data from www.hnb.hr, "SPF". <http://www.hnb.hr/publikac/hpublikac.htm>

could continue to limit FDI, which until now has largely been concentrated in service sectors such as banking, retail, and telecommunications.

Inward portfolio investment could come from corporate borrowers tapping European bond markets and the Croatian Government. So far, very few corporate borrowers have achieved the degree of transparency and corporate governance needed to tap the bond markets, and few are large enough to justify the costs of issuing bonds. It seems unlikely that this will change dramatically in the near future.

Government, however, seems likely to continue to need to tap bond markets. Fiscal deficits have ballooned during the crisis, with the general government deficit rising from 1.4 percent in 2008 to 4.1 percent in 2009 and an estimated 5 percent in 2010 (according to the ESA 95 methodology).

As a condition of EU accession, Croatia is required to eliminate capital controls, the most important of which was the MRR. More precisely, controls may only be imposed for a six-month period, with another six-month period allowed with parliamentary approval. This presents a significant challenge to macroprudential policy since interest rate differentials and perceptions of high growth potential on the Croatian market could lead to a new surge of capital inflows in the future. The issue, of course, is not unique to Croatia, but it is one that needs to be addressed seriously.

Another implication of EU accession is the liberalization of capital outflows. Although yields on assets may be high in Croatia in nominal terms, investors may seek foreign assets for reasons of diversification, perceived security, or because certain types of assets are available only outside of Croatia. Moderate capital outflows that counterbalance capital inflows might even be beneficial from a macroeconomic point of view, as they would alleviate appreciation pressure. However, larger outflows could be destabilizing.

5.3. Home-host cooperation and the question of branches

Although it is not yet an EU member, Croatia participates in colleges of supervisors at the EU level. While cooperation has been fruitful in the colleges, there are important concerns going forward. First, current EU legislation on colleges gives great discretion to the home supervisor regarding the involvement of host country supervisors in the college. Theoretically, home supervisors have little obligation to include host supervisors in crucial decisions or even to inform them fully of developments in the home country bank or the bank group as a whole. Although a dispute resolution mechanism has now been established with the European Banking Supervision Authority, this has happened after the fact. Crisis resolution protocols and exercises have been created, but it is unclear whether these will be of great help in an actual crisis situation.

Another crucial issue for Croatia is the question of systemic branches. At present, none of the foreign banks in Croatia is present in branch form; once Croatia joins the EU, its supervisors will have no say over the establishment of branches by EU banks. Furthermore, there does not seem to be any legal barrier to existing subsidiaries changing into branches. If one of the largest Croatian banks were to convert from a subsidiary into a branch, it would constitute a systemic branch—a bank with market share perhaps as high as 10 percent or even 30 percent—that would not be subject to supervision by Croatian supervisors.

It is not clear whether such conversion would be attractive to bank owners. Taxation would be a crucial consideration as well as both the stringency of regulation and the nature of

enforcement. Reputation would also be of major importance, since a change in legal status could change depositors' perceptions of bank safety. The fact that a large retail branch has functioned successfully in Estonia (Nordea) suggests that conversion from subsidiary to branch might well be feasible.

The emergence of a situation whereby a systemically important institution is not under the supervision of national supervisors would be challenging to say the least. The nub of the matter is not national pride or even sovereignty, but simply that a large subsidiary in Croatia or any other small market would only represent a minor share of the whole parent bank group. This could mean that the home country supervisors would not have the necessary incentives to expend adequate resources on supervision of the systemically important branch. We believe that this is an issue that requires attention at the EU level, since it affects numerous countries other than Croatia. Under the current architecture of supervision in the EU, it seems reasonable to stipulate that host supervisors should keep their authority, or at least share authority with the home country, in suitably defined systemically important branches.

5.4. The definition of bank groups and macroprudential measures

Cross-border cooperation also raises the issue of defining bank groups. Even when the domestic bank is a subsidiary, other related members of the bank group may be under the direct ownership of the parent group. If this is the case, these non-bank group members may only be part of a group at the home country level and not at the host country level. This deprives supervisors and central banks of authority to levy many kinds of macroprudential measures on all of the bank group's affiliates in the host country.

An example of this in Croatia involved leasing companies. In some of the country's bank groups, leasing companies were directly owned by the parent bank. This meant that the credit growth reserve could not be imposed on the bank and leasing company together, since these institutions did not form a bank group together. Instead, the banking group existed at the home country level, under the supervisory authority of the home country supervisors. This created a channel for evasion of the CGR.

While it seems reasonable to stipulate that the leasing company should not be consolidated with the subsidiary for prudential purposes, since the leasing company's loan losses would reflect the soundness of the parent bank and not the subsidiary, the macroprudential approach seeks to limit activities by all domestic credit granting institutions, which would indeed include both the bank subsidiary and the leasing company. In order to permit this kind of macroprudential regulation, it would be necessary to modify the definition of groups of credit institutions under the EU Capital Requirements Directive (CRD—EU Directive 48/2006) or define a different kind of group for macroprudential purposes.

Clearly, it would not be fair to force bank groups to comply with consolidated supervision at the group level and also at the host country level in cases such as these. However, there might be a case for host country consolidation to implement certain kinds of macroprudential measures. This point seems particularly relevant in light of the limited tools available to EU member states to control capital inflows, regardless of whether the country has adopted the euro. While one could argue that capital inflows to euro zone members should be regarded as analogous to regional flows within a single country, the principle of subsidiarity and the continued national sovereignty of EU member states could also be invoked in favor of measures to regulate capital flows. Furthermore, the experience of the financial crisis raises sharp questions about whether

conventional monetary policy instruments are adequate to stem the capital inflows that fuelled the credit booms of 2004 to 2008.

5.5. Basel III

If the essential ideas of Basel III are that banks should hold higher buffers of capital and liquidity, then Croatia certainly had a head start. Croatia's 10 percent minimum capital adequacy requirement was higher than the international standard and its higher risk weights for foreign currency-indexed loans to unhedged borrowers aimed to increase capital buffers, while the FCLR represented an important liquidity regulation.

The CRD (Basel II) in many ways represented a lowering of capital adequacy requirements. Risk weights on mortgage loans were only 50 percent in many cases, and a large portion of other loans to households actually could qualify for 35 percent risk weights. These lower risk weights alone served to decrease capital requirements. In addition, the CRD did not allow for the higher risk weights for FCICR used by Croatia. Overall, these provisions decreased risk weights to such an extent that the CNB estimated that the adoption of the CRD would increase the capital adequacy ratio of the Croatian banking system as a whole by 2 percentage points—and this is only in the standardized approach; the more sophisticated internal ratings-based approaches could well imply even larger increases in capital adequacy.

The CNB responded to this problem by raising the minimum capital adequacy ratio to 12 percent in the Credit Institutions Act, passed in September 2008. Beyond that, the main tool available under the CRD appears to be the ICAAP. This process requires banks to define the capital that they consider appropriate given their business activities and risk appetite. This internal assessment is then supervised by the CNB. The supervisors do have the power to compel banks to amend their ICAAP if it is inadequate. Through this process, the supervisors can require banks to consider risks unique to the Croatian market, including FCICR. In principle, ICAAP is conducted on a bank-by-bank basis, in contrast to earlier CNB decisions compelling all banks to implement higher risk weights.

In the area of liquidity, the CNB used its authority under the CRD to implement a regulation requiring banks to maintain liquid assets and expected cash inflows greater than expected cash outflows at one-week and one-month horizons. The measure defines categories of liquid assets with haircuts, although it also allows banks to utilize their own assessments of haircuts under certain conditions. This measure anticipates the liquidity requirements of Basel III, requiring substantial liquidity buffers that are expected to be resistant to liquidity shocks.

Furthermore, the regulation requires stress testing of liquidity, which was certainly not implemented adequately before the financial crisis. Only time will tell whether this new attempt to stress test liquidity will yield better results than the more straightforward linear measures employed in the past.

6. CONCLUSIONS

Croatia experienced a strong credit boom, which it made substantial efforts to manage. The monetary policy approach chosen attempted to dampen capital inflows by avoiding an interest rate-based sterilization policy. Instead, measures were taken to make foreign funding

sources more expensive using the MRR and to directly limit credit expansion. General reserve requirements were high and required reserves were remunerated at very low rates.

In addition, responding to the special challenges of extensive euroization and the difficulties in providing an LOLR in such a context, the central bank required banks to hold high levels of liquidity as a form of self-insurance. A tightly managed exchange rate was used to prevent the activation of credit risk resulting from lending in foreign currency to unhedged borrowers (FCICR).

Finally, the central bank implemented a number of policies aimed at forcing banks to hold large capital buffers. A legal minimum capital adequacy ratio of 10 percent, higher risk weights for lending indexed to foreign currency, and limits on dividend disbursement by rapidly growing banks were the key measures employed.

While it is difficult to provide reliable quantitative assessments of these measures, we suggest that the overall monetary approach was sound. Although capital inflows were strong and credit expanded rapidly, the exchange rate remained reasonably stable and a sharp depreciation crisis was avoided. Financial institution distress was avoided as well, quite unlike in the period after the Asian and Russian crises when a major episode of expensive bank closures took place in Croatia.

Direct credit controls seem to have worked in controlling lending by domestic banks, but were vulnerable to evasion through increased foreign borrowing and the use of leasing and balance sheet manipulation. Importantly, direct credit controls do appear to have been effective in slowing household borrowing. This is significant in light of concerns that bank lending was unhealthily skewed toward households during the boom. In addition, since many of the goods households purchased with credit were imported (above all, cars), the CGR may have curtailed imports somewhat and improved the current account deficit, a major problem for Croatia.

The marginal reserve requirement and introduction of FCICR risk weights, by contrast, seems to have been fairly effective at motivating banks to raise capital rather than borrow abroad, although such effects were not constant and certainly did not stop foreign borrowing altogether.

Finally, measures requiring that banks build up higher liquidity and capital have helped the banking system enter the financial crisis in a more robust condition. Since our simulation results find that the measures substantially reduced the amount of capital banks needed to raise once the crisis hit, we feel convinced that this proactive approach to capital raising lowered the cost of providing capital, thereby facilitating crisis management.

In general, while the econometric evidence about the effectiveness of individual macroprudential measures is not always very strong, it is possible that the measures succeeded as a package, since some of the measures undoubtedly reinforced the effectiveness of others. Thus, our attempts to isolate the effects of one measure may understate the effectiveness of Croatia's macroprudential approach as a whole.

While Croatia avoided major problems with cross-border coordination during the crisis, its experience suggests a number of important areas for further elaboration of the European financial architecture. Fiscal burden sharing and the treatment of systemic branches remain thorny issues that could be of crucial importance for Croatia if any of its large banks convert from subsidiaries into branches. It also remains unclear whether the possibilities open under the ICAAP will be as effective as Croatia's earlier approach of prescribing higher risk weights for

foreign currency-indexed lending to unhedged borrowers. These problems are not unique to Croatia, but also face a number of smaller European countries with a large presence by foreign banks, as well as those current and future EU members in which deposit or liability euroization plays a major role.

BIBLIOGRAPHY

- Brzoza-Brzezina et al. “Substitution between domestic and foreign currency loans in Central Europe—Do Central Banks matter?” ECB Working Paper 1187, 2010.
- Cayazzo, Garcia Pascual, Gutierrez and Heysen. “Toward an Effective Supervision of Partially Dollarized Banking Systems” IMF Working Paper WP/06/32, 2004.
- Croatian National Bank. “Macroprudential Bulletin” Number 6, December 2007.
- Croatian National Bank. “Standard Presentation Format”
<http://www.hnb.hr/publikac/hpublikac.htm>.
- Galac, Tomislav. “Results of the Third CNB Bank Survey: Croatian Banking in the Consolidation and Market Positioning Stage, 2000-2002” *Croatian National Bank Survey S-14*, December 2005.
- Galac, Tomislav. “The Central Bank as Crisis Manager in Croatia—A Counterfactual Analysis” *Croatian National Bank Working Paper W -27*, December 2010.
- Galac, Tomislav and Lana Dukić. “Results of the Fourth CNB Bank Survey” *Croatian National Bank Survey S-16*, December 2008.
- Kraft, Evan (2000) “The Lending Policies of Croatian Banks: Results of the Second CNB Bank Survey” *Croatian National Bank Survey S-3*, December.
- Kraft, Evan. “Monetary Policy Under Dollarization: the Case of Croatia” *Comparative Economic Studies*, Volume 45, Number 3, September 2003, 256-277.
- Kraft, Evan. “Foreign Banks in Croatia: Reasons for Entry, Performance and Impacts” *Journal of Emerging Markets Finance*, 2004: Volume 3, Number 2, 153-174.
- Kraft, Evan. “The Boom in Household Lending in Transition Countries: A Croatian Case Study and a Cross-Country Analysis of Determinants” *Comparative Economic Studies* September 2007: Volume 49, Issue 3, 345-366.
- Kraft, Evan and Tomislav Galac. “Substitution between domestic and foreign currency loans in Croatia” CNB, mimeograph, 2011.
- Kraft, Evan and Ljubinko Jankov. “Does Speed Kill? Lending Booms and Their Consequences in Croatia” *Journal of Banking and Finance*, 2005: Volume 29, Number 1, 105-121, with Ljubinko Jankov.
- Kraft, Evan and Vedran Šošić. “Floating with a large lifejacket: Monetary and exchange rate policies in Croatia under dollarization” *Contemporary Economic Policy*, 2006: Volume 24, October, 507-519.
- Mishkin, Frederic. “Understanding Financial Crisis: A Developing Country Perspective” in *Annual World Bank Conference on Development Economics 1996* edited by Michael Bruno and Boris Pleskovič, Washington: World Bank 1997, 29-62.
- Šonje, Velimir and Boris Vujčić. “Croatia in the Second Stage of Transition 1994-1999” Croatian National Bank Working Paper W-1, December 1999.