Macroprudential policies on banking system

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Abstract: *The macro-prudential tool kit deals with those risks that contributed to the outbreak of the last economic crisis or materialized during it, namely the excessive credit growth, the excessive price assets growth driven by the credit growth, the excessive increase in leverage, the liquidity risk, the volatile capital flows and foreign currency lending. It can be argued that macro-prudential policies underestimated the systemic risks mentioned, although they were better positioned than other policies aimed at financial stability. The impact of macro-prudential policy is difficult to be determined, because is usually applied simultaneously and in the same direction with other macroeconomic policies. Thus, it is necessary a better coordination of policies and a better calibration of instruments in order to get a quick and effective response during their implementation. These must be in line with national specificities and the risks identified. Until the new macro-prudential tools introduced by Basel III will prove their effectiveness, the issue of finding proper tools is still open.*

Key words*:* banking system, risks, macro-prudential, liquidity, crisis
JEL Classification: E 58, E 59, E 60

1. Introduction

Europe, US and a large part of the world's economy suffered a banking crisis followed by a severe economic crisis. Banking crises are recurrent, triggering deep and lasting recession (Reinhart and Rogoff, 2009, Schularick and Taylor, 2011). The main channel through which the weaknesses of banks' balance sheets affect the real economy is to reduce the supply of credit (Bernanke, 1983). Banking crises occur after periods of accelerated growth of credit (Kindleberger, 1978 Gourinchas and Obstfeld 2012, Bordo and Meissner 2012). Pro-cyclicality in the banking system and in the credit supply is generated by excessive credit expansion which grounded future crises because banks do not have much equity in the game (Holmström and Tirole, 1997). In times of crisis there is a credit contraction caused by reduced capital position, since it is expensive, the optimum level is lower than that required and affects bank financing (Freixas and Rochet 2008 and Iyer and Peydro 2011, Gertler, Kiyotaki and Queralto 2011).

Alessi and Detken (2011), Borgy et al. (2009), Borio and Lowe (2002, 2004), Drehmann et al. (2010, 2011) and Schularick and Taylor (2012) have shown that indicators of excessive credit growth are very effective in signaling financial crises. Schularik and Taylor (2012), analyzing a set of indicators for a number of 12 developed countries for a period of 140 years, found that credit expansion was the best tool that can signal the financial instability in this period. Dell'Ariccia et al. (2012) reported similar information, after analyzing a sample of data for 170 countries since the 60's, a third of credit booms being followed by crises and two-thirds by periods of low performance (measured as the deviation of GDP growth from its long-term trend). Saurina and Jiménez (2006) show that there is a direct, albeit delayed, connection between the growth of credit and the increase of credit risk, a rapid increase in the loan portfolios being positively associated with an increase in non-performing loans in the future.

Studies to date contain sufficient evidence of loosening lending policies during periods of expansion, loans originated during booms having higher default rates than those granted in periods of moderate credit growth. Both lenders and borrowers are very optimistic about investment projects and this translates into low lending standards. During the crisis, banks suddenly become very conservative and restrict the credit policy, which will lead to a credit crunch, leaving the economy without funding. In addition, financial markets do not work perfectly, periodically being registered under-estimation of risks, which cannot be readily controlled. The value of collateral, which tends to be cyclical, plays an important role in the credit cycle. Additionally, competition between intermediaries may worsen financial stability. However, recording over a long period of low interest rates, low volatility and moderate inflation rates, such as the ones before the crisis, tend to encourage risk-taking by banks which are searching for yield (Jiménez, Ongena, Peydró and Saurina 2013). Also, it is widely accepted that, in essence, the banks behavior is pro-cyclical whatever regulatory, market or capital requirements.

Macro-prudential policies aim to reduce negative externalities from the financial system to the economy. They are designed to ensure overall stability of financial systems. Macro-prudential approach considers issues

affecting the market as a whole, distinct individual financial institution, problems that cannot be identified at micro-prudential level.

If a credit growth at a bank level may seem sustainable, it is possible that this trend will not be confirmed at the aggregate level. In an attempt to secure their individual stability, financial institutions may behave collectively threatening the system as a whole. The sale of assets, when the cost of risk increase makes sense from a micro prudential perspective, but when the measure is adopted by all institutions, asset prices will fall significantly, increasing volatility in asset markets. Thus, there may be a conflict between macro and micro supervision of the banking system.

Until recently it was thought that financial stability is given by each financial institution stability that will make sure the system as a whole, the fallacy of composition, an approach which underestimate systemic risks. Supervising the system components to ensure the overall stability was the approach of Basel I, the Basel II approach pursued within, and further contained a number of elements that have been shown to be pro-cyclical. A macro component was introduced only under Basel III.

While micro-prudential policy can exaggerate through administrative measures in its attempt to protect each credit institution and each depositor, macro-prudential policy can achieve a better balance between market discipline and administrative discipline, without trying to provide excessive protection (Isărescu, 2011).

The recent financial crisis highlighted the need to develop a new system of financial regulation and supervision, requiring the establishment of a new set of macro-prudential tools to control the credit growth.

Countercyclical macro-prudential policy tools can be used to solve cyclical vulnerabilities by slowing credit growth during periods of exuberance and maintaining the credit supply in times of recession.

It is difficult to measure the success or failure of macro-prudential policies, given the relevance of other policies for financial stability. In addition, transmission mechanisms are not fully known. Also, macro-prudential policies are complementary and do not replace macroeconomic policies (monetary and fiscal).

Schoenmaker (2012) draws attention to the rise of interest in micro-prudential supervision by creating the Single Supervisory Mechanism (SSM) and the relatively low interest on the implementation of macro-prudential policy at the EU level, while respecting local specificity of each Member State and risks they are facing. He argues that macro developments, such as the sharp rise in residential real estate prices, which determined the economic crisis, requires the placement of the instruments of macro-prudential policy at the European Central Bank, separated from micro-prudential supervisory function, with the national central banks support when it is necessary. It is thus indicated a matter of macro-prudential policy coordination at EU and national level.

However, skeptics argue that intensive application of macro-prudential policies can cause distortions and higher macroeconomic volatility (Calomiris, 2013). They believe that excessive risk taking is the main symptom of monetary policy and micro-supervision ineffective, which once corrected will lead to removing incentives for taking high risks in

periods of boom and implicitly no need for application of macro-prudential tools.

2. Objectives and Methodology

I intend to examine the macro-prudential policies applied at national level and how they influenced the financial position of banks, the financial system stability overall and the credit supply to real economy during the last crisis. International experience is relevant in assessing both the effectiveness of different instruments, and the possibility of adopting new tools. Issues presented could provide a starting point for more detailed analysis.

The paper will focus on the study of:

i) macro-prudential policy interaction with monetary policy in ensuring financial stability;

ii) vulnerabilities addressed by macro-prudential policies;

iii) macro-prudential instruments.

i) Macro-prudential policy interaction with monetary policy in ensuring financial stability

The latest financial crisis has shown that there is a major conflict between monetary and financial stability. While monetary stability focuses on consumer prices, financial stability is considering changes in prices of assets, such as real estate market prices, and aims to reduce the pro-cyclicality of the financial system. Once the interest rate for monetary policy purposes is set, central banks are choosing the macro-prudential tools necessary to ensure the stability of financial cycles.

Cerna S. (2011) considers that monetary policy pursued by most central banks in the last decade, exclusively oriented towards price stability facilitated and even fueled credit expansion. The belief that keeping inflation low will automatically ensures the monetary and financial stability enabled the maintenance of the bubble for years. The monetary policy strategy called inflation targeting neglected the ability of credit to cause financial instability. Analyses performed by Crowe, Dell'Ariccia, Igan and Rabanal (FMI 2011) on a sample of 40 countries showed that monetary policy is an inappropriate tool which can create additional costs to solve the problem of indebtedness and sharp house prices growth, if it is not linked to a wider process of overheating. Thus, there is a positive link between monetary policy stance and the evolution of the real estate market. An increase in the monetary policy rate may cause a reduction in the GDP growth, but this is not reflected with the same intensity in the property prices.

Alberola, Trucharte and Vega (2011) believe that analyzing the interaction between monetary policy and financial stability is useful to delimit two time horizons, i.e. short and long term.

In the long term, the conclusion in economic theory is that there is no conflict between monetary stability and financial stability, the two concepts are mutually supporting, low inflation and stable long-term monetary policy tend to promote financial stability. Existing empirical data support this theory, showing that monetary instability is one of the main factors in the past episodes of financial instability. This complementarity shows that monetary policy measures taken in order to maintain price stability should not generally be contrary to the requirements needed to ensure financial stability.

However, recent events show that financial imbalances can accumulate in periods

when prices are stable. Consequently, price stability can be seen as a necessary but not sufficient condition for financial stability and short-term interaction between these two objectives is more complex than long-term relationship between them. Lindsay (1996) suggest that succeeding in maintaining low inflation rates could trigger too optimistic vision of the future to population and this false sense can lead to asset price appreciation. Thus, monetary policy should remain to the intended objective of maintaining price stability. Instruments other than monetary policy rate, including macro-prudential regulation and supervision may be more appropriate to address financial stability.

From today's perspective, it is clear that the long period of stable non-inflationary growth in the global economy (so-called The great moderation, Bernanke 2004) led to the elimination of perception that vulnerabilities producing macroeconomic instability can accumulate during periods of growth, characterized by an exaggerated optimism. The economic instability experienced in crisis reinforces the idea of the difficulty of monetary policy to counteract the effects of a financial crisis. Alberola, Trucharte and Vega (2011) believes that the interaction between the two policies has not been properly calibrated and that the implementation of macro-prudential policies to address both objectives requires an adaptation of the micro-prudential supervision tools at the system level, to strengthen individual institutions and the system resilience. Regarding the effect of tightening monetary policy in reducing excessive credit growth can be argued that this was one undesirable, at least in Eastern Europe, leading to accelerating foreign currency lending. Brzoza, Chmielewski and Niedźwiedzińska (2007) studying the effects of monetary policy in the presence of developed financial markets in terms of capital flows found that tightening monetary policy leads to a substitution of local currency financing in foreign currency financing (Czech Republic, Poland, Hungary and Slovakia). Empirical analyzes confirm this trend for other emerging economies.

Brzezina, Kolasa and Makarsky (2013) suggests that macro-prudential policies can at least partially cancel the effect of losing the monetary policy independence in the periphery countries of the European Union, including the fact that the interest rate set by the ECB could not answer to asymmetrical development of the periphery (Greece, Ireland, Portugal and Spain) and the central euro area. Using two models for the real estate market and for the banking system, they found that the loan to value - LTV seems to be more effective than the tools of capital adequacy, but to be effective must be implemented at national level. The countries of the periphery accumulated some imbalances since integration, property prices almost doubled in the period 1996 - 2006, while they stagnated or slightly increased in the rest of the Eurozone. This accelerated the GDP growth in these countries, and later, when the housing bubble ended determined a significant reduction of it. The accelerated growth of real estate prices has been identified as the main determinant of the divergence in GDP evolution between periphery and center area. The main source of asymmetric development was the sharp reduction of interest rates on the periphery as a result of accession to the euro zone, combined with easier access to cross-border funding.

ii). Vulnerabilities addressed by macro-prudential policies

Based on a panel regression analysis Lim C. et al. (2011) suggests that macro-prudential instruments may have an impact on four measures of systemic risk:

a) risks generated by strong credit growth and credit-driven asset price inflation;

b) risks arising from excessive leverage and the consequent de- leveraging;

c) systemic liquidity risk; and

d) risks related to large and volatile capital flows, including foreign currency lending.

Real estate crisis in the United States was determined by the unsustainable growth of credit and leverage and led to a recession, which was exported throughout the world, especially in countries which were facing internally an accelerated credit growth and unsustainable property prices (Crowe, Dell'Ariccia, Igan and Rabanal 2011). Also, Crowe et al. (2011) found that monetary policy is a blunt instrument to deal with asset prices bubbles.

For a number of related fiscal policy instruments (i.e. property taxes, transaction fees etc.) was found that, although they may be effective, in practice they might create distortions and also have a limited effect. Consequently, macro-prudential policy instruments, such as loan-to-value LTV, accompanied by dynamic provisioning policies are the most important and effective tools that can lead to deleveraging and control the rapid growth of house prices, unrelated to economic fundamentals. The crisis in the United States was based on property owners with a high LTV, which, amid falling house prices, did not want or were unable to repay their debts or to sale the collaterals. This generated a reduction in the value of the assets backed securities (ABS), generating chain effects. Studies show that in the United States, LTV increased significantly before the crisis, the great it was the LTV before the great were losses incurred after.

It is also recognized that residential real estate is an important preserver of wealth, if not the most important for the population (Crowe, Dell'Ariccia, Igan and Rabanal 2011).

Kiyotaki and Moore (1997) in their model showed that real estates properties, as collaterals, amplify economic fluctuations when the real estate market cycle is correlated with the credit cycle. There is thus a two-way process of amplification, property prices affect the rapid growth of credit during booms and the credit crunch during recession. Lambertini, Mendicino and Punzi (2010) and Gomes and Mendicino (2011) explains residential real estate bubble cycle through models that take into account fluctuations in the property owners' expectations about future macroeconomic developments.

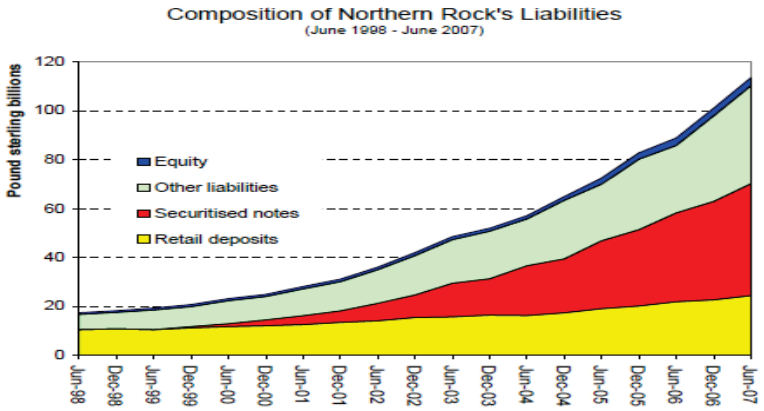
Macro - Prudential Working Group Research Network (MARS) created under the European Central Bank in order to improve macro-prudential supervision in the EU, mentioned in its Report on the first two years of the macro-prudential research network that most studies prepared highlighted the role played by the real estate prices in the economic crisis in the European Union. Other studies prepared in this working group suggest that recessions are more severe when bank financing plays an important role in crisis. However, the ways of transmission of financial instability are related to constraints in the supply and demand for loans, which affects the household consumption plans.

Excessive credit growth is also reflected

in the banks liabilities, changing the funding pattern. Normally core funding is the retail resources. But they grow in line with the population's revenues. When is recorded a credit boom these resources are not sufficient to finance the credit growth, so that other sources are attracted to support lending. In conclusion, the financial cycle can be reflected in the funding structure (Shin 2011). Shin (2010) suggest that in addition to excessive credit growth or deviation of credit growth relative to GDP (Basel III), which in some countries cannot be defined with precision, it is necessary to carefully monitor the liabilities of banks, namely the increase of wholesale funding relative to core funding.

The most relevant example considered by Shin (2011) is the evolution of the financing structure of Northern Rock (figure 1), which shows an accelerated growth of wholesale funding, while the bank' leverage increased significantly.

Fig. 1: Northern Rock funding structure

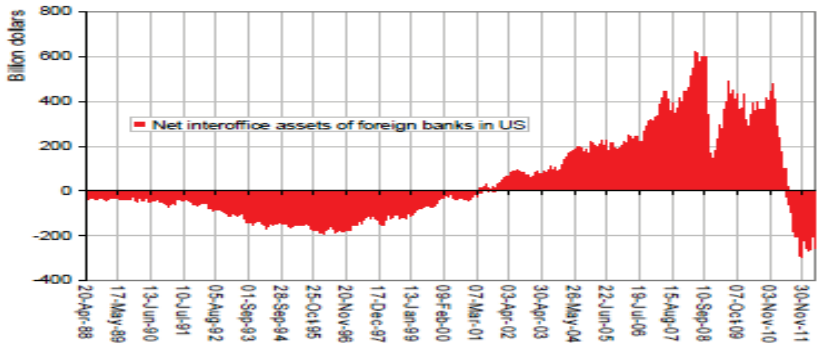


Source: Shin H., Macroprudential policies beyond Basel III, 2011

From 1998 to 2007, the date of falling, the bank' balance sheet increased 6.5 times, retail sources being supplemented with wholesale resources. The rapid growth of non-core funding in open emerging economies occurs as a result of increased capital flows denominated in foreign currency. An increase in non-core liabilities is accompanied by a reduction of the debt maturity.

A BIS study (2010), quoted by Shin (2011), describes how branches and subsidiaries of foreign banks in the US have borrowed money on interbank markets, then channeled these funds to headquarters. Baba, McCauley and Ramaswamy (2009), IMF (2011) and Shin (2012) found that before the crisis a large part of the US capital market bonds were issued by European banks. The figure 2 highlights intra net assets of subsidiaries and subsidiaries of foreign banks in the US.

Fig.2 Net interoffice assets of foreign banks in US

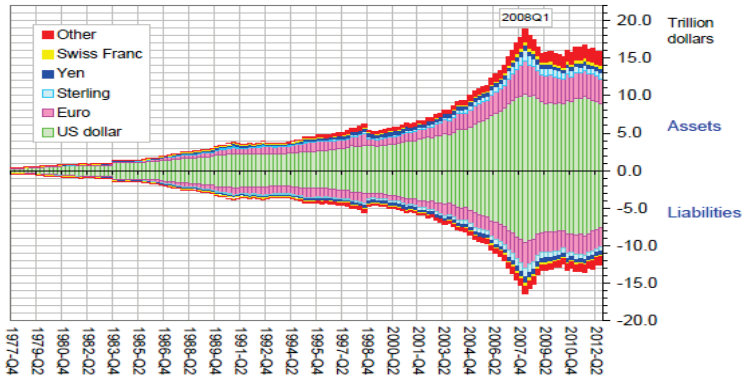


Source: Bruno V., H. S. Shin, Assessing Macroprudential Policies: Case Of Korea, 2013

Usually, intra net assets of the head-quarters to branches are negative, since they act as points of granting loans. However, in the period 2001 - 2011, their volume turned positive, branches becoming sources of funding for European banks. The net position of subsidiaries reflects the extent to which European banks with global representation supplied other parts of the world with dollars. This level is considered to be one of the main elements of supply push factor generated by wholesale funding.

The US dollars has played a dominant role in increasing international capital flows, as it is highlighted by Borio and Disyatat (2011) and Obstfeld (2012). In the figure 3 appear the assets denominated in foreign currencies outside the state of origin (the volume of assets in US dollars outside the US, the volume of assets in euro outside the euro area etc.) and it shows the role played by the US dollars.

Fig.3 Foreign currency assets and liabilities of BIS reporting banks, classified according to currency



Source: Bruno V., H. S. Shin, Assessing Macroprudential Policies: Case Of Korea, 2013

iii). Macro-prudential policy tools

Macro-prudential tools palette is wide. They were usually applied to reduce systemic risk, either the time dimension or the distribution of risks in the financial system (TD - time dimension, CD - cross dimension). Claessen, Ghosh and Mihet (2012) identified a wide range of macro-prudential policy tools, some being applied more frequently or as a result of the crisis. However, International Monetary Fund (Lim C. et al., 2011), based on countries experience, found that some macro-prudential policy instruments were most frequently used, such as: caps on the loan-to-value ratio LTV, caps on the debt-to-income ratio DTI, ceilings on credit or credit growth, reserve requirements, countercyclical capital requirements and time-varying/dynamic provisioning, limits on net open currency positions/currency mismatch and limits on maturity mismatch.

Macro-prudential policy implementation depends on the financial and economic development of the country, the exchange rate regime and vulnerabilities to certain internal or external shocks. Frequently, these tools were used in combination at the same time or to complement other macroeconomic policies. Adjusting instruments according to different stages of the economic cycle have made them more effective and contribute to smooth the financial cycle stages.

Their effects were enhanced when they were used together with monetary and fiscal policies that pursued the same macro objectives.

Using multiple instruments had the advantage to cover more aspects of the same risk, reducing the possibilities of arbitraging the limitations, increasing thus the efficiency of the instrument. Uniform or targeted application of macro-prudential tools, when the risks were identified, has increased accuracy and efficiency of these instruments.

Some instruments were rules based while others were applied at discretion. However, there are some tools where the rules are difficult to define and regulators must remain free to make changes to their discretion. The use of macro-prudential policy implies costs and benefits must be considered in relation to those costs. In addition, the calibration may be difficult and can lead to dampen the economic growth when it does not impose or to create negative distortions in markets when the definition or implementations of tool s have deficiencies.

There are certain prerequisites that must be met in order to lead to successful implementation of macro-prudential policy, namely the existence of a rigorous regulatory framework, high quality supervisory processes and effective macroeconomic policies. Also, the institutional framework for the implementation of macro-prudential policies must be appropriate. Some instruments are seen as affecting the supply of credit, while others can affect the demand.

Some measures are intended to be time varying, on specific institutions or variable, depending on the national policy. Many of the macro-prudential tools are traditional instruments used in micro-prudential supervision, but when they vary in time may serve to macro-prudential policy goals of reducing the amplitude cycles. Countries who participated in an IMF survey (Lim C. et al. 2011) confirmed that macro-prudential policies are more effective in controlling risks listed above than monetary policy instruments and more flexible, with lower implementation and response times.

It was also found that emerging economies are more concerned with systemic liquidity risk while developed economies tend to use more policies related to credit risk.

Exchange rate regime appears to have a key role in the choice of instruments. Countries with fixed exchange rate regime or administered tend to use more macro-prudential policy instruments since the exchange rate regime limits the impact of monetary policy rate. In such countries, credit growth tends to be associated with increased capital flows since the implied exchange rate warranty acts as an incentive for financial institutions to increase credit supply through external funding. Measures related to credit risk, such as LTV's limits, credit growth limits, were usually used by these countries to manage the volume of loans when interest rates were inefficient. They also tend to use measures for liquidity (i.e. limiting the net open foreign currency position) to manage the risk arising from foreign financing. This was the case of emerging economies.

Depending on the objective, instruments were grouped into three categories, namely:

a) measures on credit risk (loan-to-value LTV, debt-to-income DTI, currency and credit limit growth);

b) measures on liquidity risk (net open foreign exchange position limit/currency mismatches, maturity mismatches, minimum reserve requirements, taxation on non-core funding);

c) measures on capital (countercyclical capital buffers, dynamic provisioning/time variable).

a) Measures on credit risk (loan-to-value LTV, debt-to-income DTI, currency and credit limit growth)

Quantitative restrictions on borrowers, instruments or activities have mainly focused on reducing the residual risk of borrowers and of the related collateral, LTV and DTI.

Fees and leverage effects can be applied to reduce the externalities generated by excessive credit growth. They can be also used to limit the non-core financing.

It turned out that in emerging economies such instruments were used more intensively than in developed countries, both before and after the crisis..When they were used, there was a clear statement of the objective pursued by the application of each instrument. This was based on macro-prudential regulatory framework, established to reduce systemic risk generated by the crises recorded at their level in the 90'. For these countries, the instruments were part of broader macro financial regulatory frameworks, which included the instrument of the exchange rate regime and the capital account management.

Many instruments, such as limiting LTV's, DTI, FX lending and risk weighting of assets were applied to specific sectors or for certain types of loan portfolios without causing a general reduction in economic activity.

Some countries have limited foreign currency lending, because such limits directly constraint the excessive growth of foreign currency lending in a way that other policies could not do. These tools were generally used in moments when tightening monetary policy was not desirable.

Some countries in Eastern Europe have used measures relating to credit risk, such as restricting foreign currency lending to correct the excessive growth of credit generated by the positive flows of capital. The instruments have had some effect in reducing the growth rate of FX loans but the tools were

affected by the migration to nonbank lending and by the direct lending performed by the parent banks.

A combination of several instruments was usually used when the credit cycle overlaped the economic cycle and it was a risk of excessive credit growth and overheating. In such cases macro-prudential policies have been implemented as part of broader policies to reduce excessive growth in demand and the accumulation of systemic risk, thus being complementary to macroeconomic policies.

The experience of many countries shows that often it was used a mix of tools to manage the same risk. Caps on LTV and DTI were frequently used concurrently in order to reduce rapid credit growth in the real estate sector. Limitations on LTV and DTI have been used for example in connection with loan size, the location and the value of real estate collateral (e.g. India, Hong Kong, Korea). Minimum reserve requirements used for macro-prudential purposes were applied differently, depending on currency or debt type, applied in bands or as a percentage if an increase in loans exceeded a certain threshold.

In my view, a good example is India, which applied intensively, since 2004, a series of macro-prudential policies, and in particular countercyclical policies in accordance with adjustments on monetary policy. Macro-prudential policies aimed time-varying risk weighting assets (RWA), provisioning policies for different sectors where there were rapid increases in credit in conjunction with rapid increases in asset prices and limitations of LTV's differentiated depending on loan or collateral value. Since 2005 India's central bank adopted a tighter provisioning policy for all assets, except for loans to SMEs and those for agriculture. In a six years period the RWA varied for residential real estate exposures between 50-125%, accompanied by a variation in the provisioning level from 0,25 to 2% (higher rates being applied on loans with promotional interest). Similar rates and limits were applied on commercial real estate exposures and on systemically financial non-banking institutions. The RWA was fluctuating depending on LTV, which was set depending on the loan value, lower limits being set for loans above a certain threshold. Although it was not adopted a dynamic provisioning policy, measures were similar, being created a stock of provisions to be gradually released.

The LTV's limitations depending on loan value in conjunction with differentiated RWA proved to be an effective mix of instruments of macro-prudential policy. Lambertini et al. (2013), in a model analyzing real estate market, considers that a cyclical LTV based on credit growth may stabilize the economy better than the interest rate.

b) Measures on liquidity risk (net open foreign exchange position limit/currency mismatches, maturity mismatches, minimum reserve requirements)

Federico, Vegh and Vuletin (2012) identified on a sample of 52 emerging countries, that 74% of them used the minimum reserve requirements in a countercyclical way. Reserve requirements can be applied both on debts, and on specific classes of assets. Reserve requirements were used in connection with credit risk and liquidity risk as part of monetary policy, but can be used to determine the asset mix or as a tool to reduce cyclicality.

Given the systemic liquidity risk in times of recession, as evidenced by the last

crisis, Basel III introduced two indicators the LCR (liquidity coverage ratio) and the NSFR (net stable funding ratio). They will be used for monitoring highly liquid assets necessary to manage crisis situations and financing structure on a time horizon of one year.

Hahm, Shin and Shin (2011) showed that the percentage of non-core funding in stable deposits (especially non-core liabilities to foreign creditors) is one of the most relevant indicators of a country's vulnerability to credit and currency crises. Bruno and Shin (2011) identified that the global supply push is determinant for international capital flows.

In my opinion, a good example is the case of Korea, which since 2010 has implemented a set of tools that targeted the liabilities of banks, and thus the pattern of funding. Korea was affected by the liquidity withdrawal of foreign banks in the domestic market, given that in previous periods was recorded an accelerated growth of credit unsupported equally by domestic savings.

The aim was to reduce pro-cyclicality in banking system by reducing the wholesale funding, namely the cross border interbank liabilities, the not-core funding (not obtained from domestic savers, mainly from households).

The Korean authorities introduced a non-core liabilities levy to limit non-core liabilities of banks, applied to the amount of foreign currency debt of the banking system.

After the levy implementation, Bruno and Shin (2013) examined the evolution of the Korean banking system, compared with a group of five large countries in the region (Indonesia, Malaysia, Philippines, Thailand and Vietnam), demonstrating the positive effect of applying the non-core liabilities levy, Korea' vulnerability to crisis being reduced.

The instruments used by the Korean authorities on debts other than basic deposits are distinctive, acting directly on the banks cost of funding, unlike the capital instruments or those applied to control credit growth, such as caps on LTV or DTI. Such an approach has broadened macro-prudential policy toolkit. The study of Bruno and Shin (2013) on Korea's evolution confirms Borio and Disyatat (2011), Obstfeld (2012) and Gourinchas and Obstfeld (2012) studies on the importance of cross-border capital flows in determining the financial condition of nations, in special the flows intermediated by the banking sector.

In my view, this kind of levy on non-core liabilities can be explored in other ways. It can be applied as a limitation on maturity, limiting the short term funding, rather than imposing levies on short term non-core funding. Taking into account that emerging economies depend on capital flows in my opinion, is better to let the markets to set the cost for extending the maturity of funds, and not to cap the funds available in the economy. In my view, since the issue is the short term funding, and not the level of funding, the first must be fixed. This it is beneficial both for the local banking system, and for the global banking groups. Local banks may have access to funds to finance the real economy, while the global lenders may have safe placements, on long term, in emerging economies, which can provide good yields.

c) Measures on capital (countercyclical capital buffers, dynamic provisioning/time varying)

After the economic crisis started regulators have realized the importance of building up capital buffers to be used in recession and

thus helping maintaining the availability of credit. Another effect of this objective is reducing credit growth, and hence the booms financed by credit, given the increase in credit costs.

Capital and provisioning requirements may reduce the amplitude cycles, but are intended primarily to increase the system resilience (Basel III imposed countercyclical capital requirements while credit expansion or other indicators signals a period of risks accumulation). Thus, the minimum level of own funds of banks will fluctuate depending on the position of the cycle, increasing during periods of exuberance and decreasing during downturns. Also, Basel III introduced a leverage ratio and a capital surcharge on systemically important financial institutions to reduce the externalities generated by the interconnection of these institutions.

Analyzing the macro component introduced by Basel III, it can be argued that increasing the capital requirements may lead to the transfer of risks to unregulated sectors. The new liquidity standards may stimulate the public sector financing at the expense of economic sectors and individuals and promotes the direct funding of companies through the capital market and not through the banking system. Also, the leverage ratio may have cyclical effects, being insufficiently stringent to the top of the economic cycle and unnecessarily restrictive in the bottom of the cycle. In the United States authorities adopted since 1991 a leverage ratio, but the indicator was not adjusted in response to changes in time. The main weakness was that it was not applicable to investment banks after 2004. Therefore, the leverage increased significantly in investment banks.

Shin (2011) believes that Basel III is almost exclusively micro-prudential focusing more on individual capital adequacy of banks, rather than the system resilience. Focusing on a greater capacity to absorb losses, it does not directly control excessive credit growth in boom periods and lose sight of volatile short-term funding and short-term debt in foreign currency.

Repullo and Saurina (2011) criticize taking into account when determining the countercyclical capital requirements the deviation of credit in relation to GDP trend, indicator proposed by Borio et al. in 2010. They argue that in some countries the difference between credit and GDP tends to be negatively correlated with GDP growth. Periods of expansion and recession differ between the economic cycle and financial cycle while credit cycles and business cycle are not the same. In addition, during the boom, credit is growing faster than GDP and in normal times or in crisis, credit grows or decreases less than GDP.

Dynamic provisioning is also considered as a countercyclical tool that increases the stock of provisions, which will be released during recession.

Spain has since 2000 a dynamic provisioning mechanism, which is similar to setting up countercyclical capital requirements. Methodology for determining the dynamic provisions was different from setting up banks specific provisions for losses identified in their portfolios. The methodology takes into account existing latent loss in total loans in the banking system (statistically estimated) although they are not individually identified, leading to the build-up of provisions stocks during periods of expansion, which will be used in downturns.

The formula for calculating dynamic provisions is simple and transparent,

summarizing i) specific provisions determined for non-performing loans to a certain date; ii) determined proportion of general provisions on loan portfolio growth; and iii) a general provision based on a comparison of the average cyclical provisions recorded in the last credit cycle (at system level) with specific provisions determined at the time of calculation, for each bank.

This comparison is one that is the countercyclical element in times of expansion, when the level of non-performing loans is low, the specific provisions is reduced compared with the average provisioning on a cycle, the difference is positive and dynamic provisions fund is established. In a recession, the trend is reversed, specific provisions increases due to a rise of non-performing loans, the countercyclical component becomes negative and the stock of dynamic provisions is used.

In addition to these mechanisms were established minimum and maximum limits in terms of total volume of such provisions to ensure a minimum and avoid excessive provisioning. Alberola, Trucharte and Vega (2011) showed that if Spain would have had only specific provisions, they would be grown in two years to less than 0.5% of total loans at about 2.5%, i.e. nearly five times when banks have no longer profits and capital was expensive and rare. Jiménez and Saurina Ongena (2013) show that dynamic provisioning in Spain generated countercyclical capital for banks and supported the supply of credit in times of crisis. The mechanism applied in Spain was based on a formula with parameters determined statistically and proved his effectiveness. However, this tool is not intended to cover the whole area of issues affecting banks.

In my opinion more research work must be done in order to determine if the dynamic provisioning mechanism, which can be applied at national level, could be a more appropriate tool than the countercyclical capital requirements introduced by Basel III.

3. Conclusions

Macro-prudential policy tools could be helpful, but their effects are still far from being fully understood, systemic risk is multidimensional and difficult to measure, and transmission mechanisms are not yet fully known. In addition, macro-prudential policies are not a substitute for traditional solid micro or macroeconomic policies while monetary and fiscal policies should remain effective against distortions and macroeconomic imbalances (Isărescu, 2011).

In view of the above, it could be concluded that, according to national specificities, the most effective tools that can reduce the accelerated credit growth without inducing distortions remain LTV and DTI, especially when monetary policy is less effective. Taxes on wholesale debt can have a stabilizing effect, reducing excessive growth of assets based on short-term volatile resources. In addition, taxes could reduce the vulnerabilities in open economies, namely the disintermediation risk generated by the sudden reversal of capital flows. These instruments could be supplemented to raise the maturity of funds, letting the markets to set the price for that. At the same time, limiting foreign currency lending may be effective in the build-up phase, when risks accumulate.

Regarding the tools to increase capital reserves, dynamic provisioning model has proved successful. This can lead to proper

risks coverage, if the probability of default at the banking system level is adequately estimated. By comparison, the countercyclical capital requirements introduced by Basel III could be less effective since it is difficult to delimit the GDP increase generated by productivity and technological progress.

In my view, the traditional instruments of macro-prudential policy remain effective in controlling systemic risk, but they need to be applied at national level and according to the identified risks.

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REFERENCES:

1. **Adrian, T. and H. Shin** (2008), *"Financial Intermediaries, Financial Stability, and Monetary Policy"*, Federal Reserve Bank of New York Staff Report, 346.
2. **Adrian, T., and H. S. Shin**, 2010, *Liquidity and Leverage*, Journal of Financial Intermediation 19.
3. **Adrian T and H Shin,** *"The changing nature of financial intermediation and the financial crisis of 2007–09"*, Federal Reserve Bank of New York Staff Report, no 239, April 2010.
4. **Adrian, T., and N. Boyarchenko**, 2012, *Intermediary Leverage Cycles and Financial Stability*, Staff Report 567, Federal Reserve Bank of New York.
5. **Aikman D, Haldane AG, Nelson BD** 2010. *'Curbing the credit cycle'*, prepared for the Columbia University Centre on Capital and Society Annual Conference, New York, November 2010.
6. **Alberola, E., C. Trucharte and J. L. Vega**, 2011, *Managing the risks of the new macro-prudential policy regime.* The Spanish Experience, Documentos Ocasionales N.º 1105.
7. **Alessi L., C. Detken** (2009). *Real-time Early Warning Indicators for Costly Asset Price Boom/Bust Cycles: A Role for Global Liquidity,* ECB Working Paper 1039.
8. **Allen, F., and E. Carletti.** 2011. *"Systemic Risk and Macroprudential Regulation."* University of Pennsylvania.
9. **Bernanke B., Mishkin F.**, *Inflation Targeting: A New Framework for Monetary Policy*, Journal of Economic Perspectives, vol. 11, n° 2, 1997.
10. **Bernanke, B.** (2004). *"The great moderation"*, speech given at the meetings of the Eastern Economic Association, Washington DC, February 20, 2004.
11. **Bernanke, B., and M. Gertler** (1999). *"Monetary Policy and Asset Price Volatility"*, in New Challenges for Monetary Policy, Federal Reserve of Kansas City.
12. **Bernanke, B.**, 1983, *Nonmonetary effects of the financial crisis in the propagation of the great depression,* American Economic Review 73, 257-276.
13. **Bernanke, B.,** 2009, *The Crisis and the Policy Response*, Stamp Lecture London School of Economics.

14. **Bernanke, B.,** 2011, *International Capital Flows and the Return to Safe Assets in the United States,* International Finance Discussion Paper 1014, Board of Governors of the Federal Reserve System.

15. **Bernanke, B., and Cara S. Lown,** 1991, *The Credit Crunch,* Brookings Papers on Economic Activity.

16. **Bernanke, B., and Mark Gertler,** 1989, *Agency Costs, Net Worth, and Business Fluctuations*, American Economic Review 79.

17. **Blanchard, O., G. Dell'Ariccia and P. Mauro** (2010). *"Rethinking macroeconomic policy"*, IMF Staff Position Note, 10/03.

18. **Bolton, P. and X. Freixas** (2006): *"Corporate Finance and the monetary transmission mechanism,"* Review of Financial Studies 19(3).

19. **Bordo, M. D., M. J. Dueker and D. C. Wheelock** (2000). *Aggregate Price Shocks and Financial Instability: A Historical Analysis*, NBER Working Paper 7652, April.

20. **Bordo, M. D., and C. M. Meissner,** 2012, *Does inequality lead to a financial Crisis*, Working Paper 17896, National Bureau of Economic Research.

21. **Borgy V, Clerc V, Renne J-P**. 2009. *'Asset-price boom-bust cycles and credit: what is the scope of macroprudential regulation'*, Banque de France Working Paper No 263.

22. **Borio, C.** (2009). *We are all macroprudentialists now*.

23. **Borio C., Furfine C., Lowe P.**, *Procyclicality of the Financial System and Financial Stability: Issues and Policy Options*, BIS Papers, n° 1, March, 2001.

24. **Borio C.**, *Implementing a macroprudential framework: blending boldness and realism*. Capitalism and Society 6(1) 2011.

25. **Borio C, Lowe P.** 2002. *'Asset prices, financial and monetary stability: exploring the nexus'*, BIS Working Paper No. 114.

26. **Borio C., Shim I.**, *What can (Macro-) prudential policy do to support monetary policy?*, BIS Working Papers, n° 242, December, 2007.

27. **Borio, C. and H. Zhu** (2008): *"Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism?"* BIS Working Papers No 268.

28. **Borio, C., and A. Crockett** (2000). *"In search of anchors for financial and monetary stability"*, Greek Economic Review, 20(2).

29. **Borio, C., and P. Lowe** (2002). *"Assessing the risk of banking crises"*, BIS Quarterly Review, December 2004. Securing sustainable price stability. Should credit come back from the wilderness, BIS Working Papers, no.157.

30. **Borio, C.**, 2003, *Towards a Macroprudential Framework for Financial Supervision and Regulation*, CESifo Economic Studies 49.

31. **Brunnermeier, M, A Crockett, C Goodhart, A Persaud and H Shin** (2009), *The Fundamental Principles of Financial Regulation: 11th Geneva Report on the World Economy*, CEPR, London.

32. **Bruno V., Hyun Song Shin** *Working Paper 19084, Assessing Macroprudential Policies: Case Of Korea,* National Bureau Of Economic Research 1050, May 2013.

33. **Brzoza Brzezina M., M. Kolasa, K. Makarsky**. *Working Paper Series no 1589/September 2013. Macroprudential Policy instruments and economic imbalances in the euro area.*

34. **Calomiris, C. W.,** *Managing the risks of the new macro-prudential policy regime,* Columbia Business School, International Monetary Fund.

35. **Claessens S, Kose MA, Terrones ME**. 2011. *'How do business and financial cycles interact?'*, IMF Working Paper 11/88. Committee on the Global Financial System. 2010. 'Macroprudential instruments and frameworks: a stocktaking of issues and experiences', CGFS Publications no. 38.
36. **Cerna S.,** *Tintirea inflatiei: un bilant provizoriu*, Studii Financiare, Anul XIV – Serie noua– Vol.2 (48)/2010; Criza si redefinirea rolului bancilor centrale, Oeconomica, 4, 2010. Politica monetară în epoca postcriză.
37. **Costeiu, A. and Neagu, F**., 2013. *Bridging the banking sector with the real economy. A financial stability perspective*, ECB Macroprudential Research Network paper.
38. **Crowe, C. W., G. Dell'Ariccia, D. Igan, and P. Rabanal**. 2011. *"How to Deal with Real Estate Booms: Lessons from Country Experiences."* Working Paper 11/91, International Monetary Fund, Washington, DC.
39. **Dell'Ariccia G, Igan D, Laeven L, Tong H, Bakker B,** 2012. *'Policies for macrofinancial stability: how to deal with credit booms'*, IMF Staff Discussion Notes No.12/06.
40. **Dell'Ariccia, Giovanni, and Robert Marquez,** 2006, *Lending Booms and Lending Standards*, Journal of Finance 61.
41. **Dell'Ariccia, Giovanni, Deniz Igan, Luc Laeven, and Hui Tong.** 2012. *"Policies for Macrofinancial Stability: Options to Deal with Credit Booms."* Staff Discussion Note 12/06, International Monetary Fund, Washington, DC.
42. **Dewatripont M., X. Freixas** (eds.), *The Crisis Aftermath,* New Regulatory Paradigms, CEPR.
43. **Drehmann M, Borio C, Gambacorta L, Jimenez G, Trucharte C.** 2010. *'Countercyclical capital buffers: exploring options'*, BIS Working Paper 317.
44. **Drehmann M, Borio C, Tsatsaronis K.** 2011. *'Anchoring countercyclical capital buffers: the role of credit aggregates'*, BIS Working.
45. **Drehmann, M., C. Borio, and K. Tsatsaronis** (2011). *Characterising the financial cycle: don't lose sight of the medium term!,* BIS Working Paper no. 380, June.
46. **Drehmann, Mathias, and Leonardo Gambacorta,** 2012, *The Effects of Countercyclical Capital Buffers on Bank Lending,* Applied Economics Letters 19.
47. ECB 2012, *Report on the first two years of the macro-prudential Research network,* october 2012.
48. **Edge R, Meisenzahl R.** 2011. *The unreliability of credit-to-GDP ratio gaps in real time: implications for countercyclical capital buffers*. International Journal of Central Banking 7(4).
49. Financial Stability Board, International Monetary Fund, Bank for International Settlements. 2011. *'Macroprudential policy tools and frameworks: progress report to G20'*, 27 October.
50. **Georgescu, F**., *Reforma supravegherii bancare pentru asigurarea stabilitatii financiare si a cresterii economice durabile*, Bucuresti 18 iulie 2013.
51. **Giese, Julia, Henrik Andersen, Oliver Busha, Christian Castro, Marc Farag and Sujit Kapadia** Bank of England, *The credit-to-gdp gap and complementary indicators for macroprudential policy: evidence from the UK.*
52. **Goodhart, C** (2010), *"The Changing Role of Central Banks"*, BIS Working Papers, 326, Bank for International Settlements, Basel.
53. **Gourinchas, Pierre-Olivier, and Maurice Obstfeld**, 2012, *Stories of the Twentieth Century for the Twenty-First*, American Economic Journal: Macroeconomics 4.
54. **Hahm J-H, Shin HS, Shin K.** 2012. *'Non-core bank liabilities and financial vulnerabilities'.*
55. **Holmstrom, B., and J. TIROLE** (1997). *"Financial intermediation, loanable funds and the real sector"*, Quarterly Journal of Economics, 112.

56. International Monetary Fund, *Assessing the Systemic Implications of Financial Linkages: Global Financial Stability Report*, April 2009.
57. International Monetary Fund. 2011. *'Macroprudential policy: an organising framework'*, March.
58. **Isarescu M.**, *Macroprudentialitatea. Reglementarea, crizele financiare si politica monetara,* Dizertatie cu ocazia decernarii titlului de Doctor Honoris Causa al Universitatii Romano-Americane, 30 iunie 2011.
59. **Issing, Otmar:** *Monetary and financial stability - is there a trade-off* - Speech by Professor Otmar Issing, Member of the Executive Board of the European Central Bank, at the Conference on "Monetary Stability, Financial Stability and the Business Cycle", Bank for International Settlements, Basel, 28-29 March 2003.
60. **Jiménez, G., and J. Saurina** (2006). *"Credit Cycles, Credit Risk, and Prudential Regulation"*, International Journal of Central Banking, 2 (2).
61. **Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina**, 2012, *Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications,* American Economic Review 102.
62. **Jiménez, Gabriel, Steven R. G. Ongena, Jose -Luis Peydro, and Jesus Saurina Salas**. 2012. *"Macroprudential Policy, Countercyclical Bank Capital Buffers and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments."* Discussion Paper 2012–011, European Banking Center.
63. **Jord, O., M. Schularick, and A. M. Taylor** (2010): *"Financial Crises, Credit Booms, and External Imbalances: 140 Years of Lessons,"* NBER Working Paper No. 16567.
64. **Yellen, Janet L.,** 2011a, *Macroprudential Supervision and Monetary Policy in the Post-Crisis World,* Business Economics 46.
65. **Kaminsky, G., and C. Reinhart** (1999). *"The twin crises: The causes of banking and balance of payments problems"*, American Economic Review, vol. 89, no. 3, June.
66. **Kiyotaki, Nobuhiro, and John Moore**, 1997, *Credit Cycles*, Journal of Political Economy 105.
67. **Kapadia, S., M. Drehmann, J. Elliott, and G. Sterne** (2013). *"Liquidity risk, cash flow constraints, and systemic feedbacks"*, in J. G. Haubrich, and A. W. Lo (eds.), Quantifying Systemic Risk, University of Chicago Press.
68. **Kindleberger, C.** (1989). *Manias, Panics and Crashes: A History of Financial Crises, New York, Basic Books.*
69. **KOO, R.** (2008). *The Holy Grail of Macroeconomics: Lessons from Japan's Great Recession*, Wiley.
70. **Krugman P.**, *Întoarcerea economiei declinului şi criza din 2008*, Publica, Bucuresti, 2009.
71. **Lambertini, Luisa, Caterina Mendicino, and Maria Teresa Punzi** (2013) *'Leaning against boom-bust cycles in credit and housing prices.'* Journal of Economic Dynamics and Control 37(8).
72. **Larosière J.,** *Towards a New Framework for Monetary Policy*, Central Banking, vol. 20, n°3, 2010.
73. **Lim, C., Columba F., A. Costa, P. Kongsamut, A. Otani, M. Saiyid, T. Wezel, and X. Wu**, October 2011, *Macroprudential Policy: What Instruments and How to Use Them?* Lessons from Country Experiences, IMF Working Paper WP/11/238.
74. **Lowe, P.** (2002): *"Credit risk measurement and procyclicality,"* BIS Working Paper no. 116.
75. **Jiménez, G., Steven Ongena, José-Luis Peydró, Jesús Saurina.** Macroprudential Policy, *Countercyclical Bank Capital Buffers and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments*, 2013.
76. **Claessens, S., S. R. Ghosh, and R. Mihet**. 2013. *"Macro-Prudential Policies to Mitigate Financial System Vulnerabilities."* Journal of International Money and Finance.

77. **Minsky H.**, *Stabilizing an Unstable Economy*, Yale University Press, 1986.

78. **Minsky HP**. 1972. *Financial instability revisited: the economics of disaster*. Reappraisal of the Federal Reserve Discount Mechanism 3(1972).

79. **Mishkin, F.** (2008). *"How should we respond to asset price bubbles"*, speech at the Wharton Financial Institutions Centre and Oliver Wyman Institute's Annual Financial Risk Roundtable, Philadelphia, Pennsylvania, May.

80. **Neagu, F. and Irina M.**, *Working Paper Series no.1591/September 2013 Sudden Stop of capital flows and the consequences for the banking sector and the real economy*.

81. **Osborne, M., A. M. Fuertes, and A. Milne,** 2012, *In Good Times and in Bad: Bank Capital Ratios and Lending Rates*, Mimeo UK Financial Services Authority.

82. **Popa, C.**, 2011. *Monetary policy challenges in the CESEE region the case of Romania*, Post- Crisis Growth and Integration in Europe. Catching-up Strategies in CESEE Economies, pp. 167-170, Edward Edgar Publishing Ltd.

83. **Puri, M., J. Rocholl, and S. Steffen**, 2011, *Global Retail Lending in the Aftermath of the US Financial Crisis: Distinguishing between Supply and Demand Effects*, Journal of Financial Economics 100.

84. Raportul Cross (ECSC, 1986) *„Siguranța și eficiența sistemului financiar în sens larg și a sistemului de plăți"*.

85. **Reinhart, C., and K. Rogoff** (2009). *This time is different: Eight Centuries of Financial Folly*, Princeton University Press. — (2011). *"From Financial Crash to Debt Crisis"*, American Economic Review, 101.

86. **Reinhart C, Reinhart V.** 2008. *'Capital flow bonanzas: an encompassing view of the past and present'*, NBER Working Paper no. 14321.

87. **Reinhart, C. M., and K. S. Rogoff**, 2009, *The Aftermath of Financial Crises*, American Economic Review 99.

88. **Repullo, R., and J. Saurina** (2012). *"The countercyclical capital buffer of Basel III: a critical assessment"*.

89. **Repullo, R., J. Saurina, and C. Trucharte**, 2010, *Mitigating the Pro-cyclicality of Basel II,* Economic Vol. 25, Issue 64, October.

90. **Salas, V., and J. Saurina** (2003). *"Deregulation, market power and risk behavior in Spanish banks"*, European.

91. **Saurina, J.** (2009): *"Dynamic Provisioning: The Experience of Spain, in Crisis Response, Public Policy for the Private Sector,"* Note No.7, The World Bank.

92. **Saurina, J.** (2009): *"Loan Loss Provisions in Spain. A Working Macroprudential Tool,"* Working Paper.

93. **Sinha, A.**, Deputy Governor, Reserve Bank of India, Speech at Eleventh Annual International Seminar on Policy Challenges for the Financial Sector on *"Seeing both the forest and the trees - Supervising Systemic Risk"* co-hosted by the Board of Governors of the Federal Reserve System, The International Monetary Fund and The World Bank at Washington D.C., June 1-3 2011.

94. **Schularick, M., and A. M. Taylor**, 2012, *Credit Booms Gone Bust: Monetary Policy*, Leverage Cycles, and Financial Crises, 1870–2008, American Economic Review 102.

95. **Shin, H. S.,** 2011, *Macroprudential Policies Beyond Basel III*, Presentation on September 7 International Centre for Financial Regulation.

96. **Schoenmaker, D.**, *Central banks and macroprudential policy*. Some reflections from Coordination between the European and national level, 9 December 2012.

97. **Schoenmaker, D., and P. J. Wierts.** 2011. *"Macroprudential Policy: The Need for a Coherent Policy Framework."* Policy Paper 13, Duisenberg School of Finance, Amsterdam.

98. **Taylor J.,** *Discretion versus Policy Rules in Practice,* Carnegie-Rochester Conference Series on Public Policy, 39, 1993.

99. **Tinbergen, J** (1952), *On the Theory of Economic Policy*, North Holland, Amsterdam.

100. **Trichet, C.** (2005). *"Asset price bubbles and monetary policy"*, Speech at the Fifth MAS Lecture, Singapore.

101. **Van Norden S.** 2011. Discussion of *"The unreliability of credit-to-GDP ratio gaps in real time: implications for countercyclical capital buffers''*. International Journal of Central Banking 7(4).