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# The literature on the interaction of fiscal risk and financial stability— a survey

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## **Abstract**

The article reviews the literature on related aspects of financial crises. First, we analyze how fiscal policy may become unsustainable, be it because of worsening fundamentals or increasing financial turmoil. We pay particular attention to the literature on the role of financial institutions and the nexus with the sovereign. This nexus may mean that sovereign stress is transferred to the banks, via holdings of sovereign debt or vice versa, on account of the implicit (or explicit) guarantee from the sovereign that banks may have. Secondly, we review the determinants of connectedness amongst financial institution and between banks sovereigns. The indicators of connectedness can help understand how systemic risk builds up. Finally, we analyze how the debate on macroprudential policy has evolved to tackle the issue of system-wide financial stress.

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## 1. Introduction

The interaction between fiscal and financial stress has gained prominence in the recent crisis, as the combination of a deterioration of the credit quality of sovereigns and a credit crunch led to heightened financial fragmentation and deepened the downturn in stress countries.

The relationship between fiscal policy, debt sustainability and financial crises has been around for a long time. In the 80s, the key mechanism for developing a financial crisis was through unsustainable fiscal policies that would lead to monetary financing, and so, an unsustainable exchange rate (Flood et al, 1998). The seminal papers on the Government's intertemporal budget constraint are part of this strand of the literature (Trehan et al, 1988).

The article reviews related aspects of financial crises. First, we analyze how fiscal policy may become unsustainable. This can be due to fiscal fatigue, the idea that a sovereign, which behaves responsibly in normal times, may, at some point stop adjusting its fiscal balance even as debt rises. This lack of adjustment can lead to the unsustainability of public debt. As a result, putting in place the mechanisms necessary to avert this scenario is crucial to safeguard debt sustainability. This involves also the mechanisms that may help avoid the unsustainability of debt due to a sharp rise in the funding cost of the sovereign, which may or may not be related to changes in fiscal policy.

Financial crises may be deepened by the nexus between the sovereign and banks in a given country. First, this nexus may mean that sovereign stress is transferred to the banks, via holdings of sovereign debt or vice versa, on account of the implicit guarantee from the sovereign that banks may have. We review the literature on the drivers and consequences on the buildup of sovereign bond holdings and other aspects that may lead to a rise in the interconnectedness between the sovereign and banks. Finally, we analyze how the debate on macroprudential policy has evolved to tackle the issue of system-wide financial stress.

## 2. Fiscal fatigue: main aspects

The idea of fiscal fatigue uses the framework set up by Bohn, who analyzed whether fiscal policy in the US was sustainable, in the sense that it reacts to an economic shock that raises the debt to GDP ratio by increasing its primary balance, which would eventually stabilize debt. A large part of the literature that has examined the issue is empirical, although a recent theoretical framework can be found in Ghosh et al (2013).

Several studies have addressed this question via single country analysis (Bohn, 2008) and panel analysis, while others, like Canzoneri et al. (2001), employ a VAR approach. In general, for developed countries, the literature finds is that the primary balance reacts positively to an increase in the debt-GDP ratio.

Much of the literature deals with country or region-specific fiscal response functions. For instance, Ballabriga and Martinez-Mongay (2005) show that primary balances increase as a response to higher government debt in the EU.

Bohn's (1998) work showed that the reaction of the primary balance to a rise in government debt could be considered an indicator of the sustainability of the fiscal stance. If an economic shock that leads to an increase in the debt stock is followed by a strengthening of the primary balance, fiscal policy can be deemed sustainable.

Bohn (1998) results go in line with the finding in later research regarding developed countries: he finds fiscal policy in the USA in the 20th century reacted positively to rises in public debt, and so concludes that fiscal policy was, by that measure, sustainable.

Several authors have used the same methodology for European countries: see for instance Wyplosz (2006), and Staehr (2008). Piergallini and Postigliola (2012) use the methodology for Italy and Mello (2008) for Brazil. They all find that fiscal policy reacted responsibly, in that it rose in response to an increase in debt.

## 2.1 Fiscal policy and the cycle

One of the main determinants of fiscal policy is the economic cycle. A classic result of this literature has been that fiscal policy typically is counter-cyclical in developed economies, while it is pro-cyclical in emerging economies (Ilzetki and Vegh (2008), Afonso et al. (2008)). Staehr (2008) finds a similar result within Europe: fiscal policy is much more anticyclical in Western Europe than in Eastern Europe.

Egert (2010) confirms that fiscal policy is counter-cyclical in the OECD, although this is less clear in the case of highly indebted countries. Similarly, Sutherland et al. (2010) find that the size of the counter-cyclical response of discretionary fiscal policy depends on the initial fiscal stance and debt level.

According to Wyplosz (2006), the cyclically-adjusted balance reacted more strongly to the business cycle before the countries entered the euro area than afterwards, while the discretionary component was procyclical prior to entry, as countries tried to meet the accession criteria, but became a-cyclical afterwards.

Ilzetki and Vegh (2009) argue that to the extent that tax revenues have a cyclical component, this introduces an automatic co-movement between government balances and the cycle. As a result, the procyclical finding for developing countries may not reflect policy intentions but rather the fact that the structure of tax revenues is less cyclical there. They use a component analysis, looking at government consumption and revenues and correcting for the fact that tax revenues are endogenous to the cycle by using tax rates as instruments. They find that fiscal policy is less procyclical than had been found earlier.

Afonso (2008), also using an EU panel, finds a counter-cyclical response of fiscal policy, with the primary balance improving with increases in the output gap.

Other studies have found that the reaction to the cycle is often asymmetric: while counter-cyclical in downturns, it is either a-cyclical or mildly pro-cyclical in upswings. As a result, debt accumulated during downturns is not fully paid back during good times (Lee and Sung, 2007; Leigh and Stehn, 2009).

Many empirical studies have looked at the cyclical co-movements of fiscal variables in industrial and developing countries (e.g., Alesina and Tabellini (2005), Catao and Sutton (2002), Gavin and Perotti (1997), Kaminsky, Reinhart, and Vegh (2004), Talvi and Vegh (2005)). These studies document that primary balances are counter-cyclical in developed countries, and tend to be more procyclical in developing countries (Mendoza et al, 2008).

## 2.2 Impact of EMU

In order to derive policy conclusions, in particular regarding the effect of institutional changes, a number of studies examine how fiscal reaction functions change after an event that alters the economic structure of the country or the policymaking environment. This has been particularly the case in Europe, where several authors have analyzed the impact of the introduction of the Euro, and so the Stability and Growth Pact, on the government's reaction function.

Gali and Perotti (2003) find that membership of the euro area did not cause discretionary fiscal policy to become less counter-cyclical when compared to the EU countries that did not seek to join the euro. Ballabriga and Martinez-Mongay (2003), similarly, find that fiscal policies changed little with the introduction of the euro.

## 2.3 Taking into account government decisions

Alternatively, fiscal reaction functions can be understood as a problem where policymakers minimize a loss function subject to constraints afforded by the economy, such as the reaction of other agents (the private sector) to different government policies. The key then is to determine whether the change in the fiscal balance triggered by debt or another event is intentional.

One aspect to take into account when assessing government's policy intentions is the existence of persistence, over time, in the fiscal balance. This persistence component may be due to rigidities in the budget procedures, for instance stemming from the fact that part of a government's spending in a given year has been pre-committed. This seems to be greater in advanced economies (Fatas and Mihov, 2001; 2008). Paloviita (2012) finds that persistence has been lower in the crisis countries in the periphery than in the rest of the euro area. According to Afonso et al. (2010), persistence is determined by country income and public sector size.

In order to test for the importance of the government's intentions, as opposed to realized outcomes that may be affected by contemporaneous shocks to the economy, a part of the literature has distinguished between planned and realized fiscal balances.

Some studies do this by isolating variables that reflect policy decisions such as tax rates or discretionary spending categories (Ilzetzki and Vegh; 2008, Darvas; 2010). Others use real-time data to provide a more realistic picture of fiscal policy-making (e.g. Bernoth et al; 2008). Similarly, Castro(2013) uses quarterly data.

#### 2.4 Discretionary fiscal policy and automatic stabilizers

In order to obtain a measure of government's policy intentions, the cyclical component must be removed from tax revenue and primary spending items, thus obtaining the cyclically-adjusted primary balance. One approach consists in regressing the fiscal policy variable on a measure of the cycle and to interpret the residuals as the discretionary policy component. For instance, Fatas and Mihov (2003) use this approach and find that the residuals of the fiscal policy reaction functions of euro area countries diminished over time, indicating less reliance on discretionary fiscal policy in the run up to entry into the Eurozone.

This strategy was criticized by Gali and Perrotti (2003): in their view, this only captured the non-systematic part of discretionary policy. Instead, using cyclically-adjusted spending and revenue by category (Giorno *et al.*, 1995; Girouard and André, 2005) would provide a more reliable overall picture of the fiscal policy stance. In line with the results mentioned earlier, they find that discretionary fiscal policy became more counter-cyclical in the 1990s in most advanced countries. He finds that the introduction of the euro led member countries to use a more countercyclical policy.

For a more recent dataset, Fatas and Mihov (2009) find that discretionary policy was slightly pro-cyclical in the euro area countries, while the United States pursued a strongly counter-cyclical discretionary policy. Auerbach (2009) also shows that fiscal policy in the US was indeed countercyclical. This result holds for both the expenditure and revenue side for a long time period (between 1984 and 2009). He finds that spending responded more strongly than revenues. In contrast, the automatic stabilizers are found to react more strongly to the cycle in the euro area than in the United States.

Cimadomo (2007) shows that discretionary fiscal policy intentions are counter-cyclical in OECD countries, especially during expansions by looking at forecasts of cyclically-adjusted primary government balances. He also shows that the outcome of discretionary fiscal policy measured by ex post data becomes pro-cyclical. Beetsma and Giulliodori (2008) find that planned fiscal policy is counter-cyclical in non-EU OECD countries while it is a-cyclical in EU countries. Their results suggest that ex-post discretionary fiscal policy is a-cyclical and procyclical in non-EU OECD countries and EU ones, respectively. Bernoth *et al.* (2008) show for euro area countries that fiscal policy is usually planned to be countercyclical but biases in the execution of policy lead the fiscal stance to become pro-cyclical. Golinelli and Momigliano (2009) point out that the results reported above are

sensitive to robust checks such as alternative measures of the output gap: however, the finding that fiscal policy plans in the euro area are more counter-cyclical than fiscal outcomes still holds.

Jaimovich and Panizza (2007) use foreign partners' GDP growth as an instrument of the domestic cycle, given the feedback loops between fiscal policy and the cycle. Their result overthrows the finding of a pro-cyclical fiscal policy for developing countries. Ilzetzi and Vegh (2008) assess the robustness of the finding that developing countries pursue pro-cyclical fiscal policies while developed OECD countries are less pro-cyclical or acyclical by employing a battery of methods that control for endogeneity of the cycle variable (instrumental variables, GMM, simultaneous equations and VAR models). Lee and Sung (2007), by also using an IV approach also find that government spending is strongly counter-cyclical in most OECD economies, with a few acyclical exceptions.

Strawczynski and Zeira (2009) take a different perspective and analyze the reaction of fiscal policy to temporary and permanent output shocks rather than to cyclical fluctuations. They show that the reaction of general government deficits and spending to a temporary output shock is counter-cyclical and a-cyclical to a permanent shock.

Based on an event study approach, Leigh and Stehn (2009) argue that the G7 countries eased discretionary fiscal policy during downturns in a timely manner on a number of occasions. Nevertheless, they also show that fiscal policy in non-Eurozone countries responded quicker and more often to downturns than in Eurozone members of the G7. Thus the difference between the Eurozone and other countries emerges, although they also find that discretionary fiscal easing occurs more often during economic recoveries in the former than in the latter.

## 2.5. Political economy and fiscal policy

Buti and van den Noord (2004) introduce political economy aspects and find that discretionary fiscal policy was influenced by political cycles after the introduction of the euro. Golinelli and Momigliano (2009) report similar results for those countries before the adoption of the euro. Elections seem to influence general government balances in other OECD countries over longer periods as well while government spending is not found to be influenced by electoral cycles (Strawczynski and Zeira, 2009). The main specification in Afonso and Hauptmeier (2009) also shows that elections are associated with a deterioration in primary government balances. Nevertheless, their result is not robust to alternative model specifications in which the coefficients either switch sign or become insignificant.

## 2.6 Cyclicity of the components

Lee and Sung (2007) report that total government revenues of OECD economies are countercyclical with respect to GDP growth and mildly pro-cyclicity of total government expenditure. At a higher level of disaggregation, current and capital expenditure and subsidies and transfers are found to be a-cyclical. On the

revenue side, income and commodity taxes react counter-cyclically whereas social security contributions appear insensitive to the cycle.

Lane (2003) shows that the cyclical behavior of overall government spending in OECD countries hides a heterogeneous response of the different spending components to the cycle. While public transfers and debt interest payments are counter-cyclical, current spending is pro-cyclical and government investment is pro-cyclical. In particular, government wages are more pro-cyclical than non-wage government consumption whereas government employment is a-cyclical. The cross-country variation in cyclical reactions is mostly explained by output volatility and institutional variables, in particular dispersed political power. Public sector wages are the main channel through which higher output volatility and more dispersed political power lead to more pro-cyclicality in government spending.

### 2.7 Debt sustainability: the fiscal limit

The relationship between the fiscal reaction function and debt sustainability was originally related to the debate on the interactions between monetary and fiscal policy. Leeper (2013) postulated that to the extent that governments issue substantial debt, when such economies are approaching their fiscal limits, debt can be devalued through higher inflation. He then develops a model showing that the source of inflation is fiscal policy. Once the fiscal limit is approach, the government must finance its deficit by printing money. These dynamics may lead to episodes of hyperinflations.

As a result of his contribution, a body of the literature analyzed how the fiscal limit could be determined. In Bi (2012), the fiscal limit depends mainly on the size of the government, the degree of countercyclicality of the policy responses, economic diversity, and political uncertainty. They justify non linearities in the behavior of sovereign risk premia: once they rise, they rise quickly. This, in turn, justifies the non-linearities in fiscal adjustment: little adjustment at low levels of debt, when the cost of additional adjustment does not seem to be justified, and then a rapid adjustment as the debt limit is approached.

### 2.8 The determinants of sustainability: sovereign spreads

For all the importance of the determinants of the primary balance, and the determinants of debt sustainability from fundamentals, a body of the literature has found that risk premia are often determined by other, exogenous, factors. To the extent that adverse shocks, not related to a given country's fiscal policy, can lead to shocks on the sovereign premia, and so alter debt sustainability dynamics, this can be thought of as a case of the interaction between financial markets and fiscal policy, and how the former can impact debt sustainability, even if the fiscal policy stance (and, possibly, the underlying macroeconomic conditions) remain unchanged.



Sovereign spreads are typically decomposed into the default risk (which is dependent on the assessment of the fiscal health of a given sovereign) and risk aversion, which tends to be related to market perception not related to actual debt sustainability dynamics of a given country. Sovereign risk can also be measured by sovereign credit ratings, CDS premia and other rankings of the country risk or sovereign creditworthiness. At first, this literature focused on emerging economies, in particular following the 1980s however, the advent of the Euro, and in particular the euro sovereign debt crisis brought about renewed attention to the issue from the perspective of developed countries.

Edwards (1986) estimates the determinants of bond spreads for a group of emerging countries using a panel of bond yield spreads spanning 1976-1980 and fixed effects to reflect the date of issuance of the relevant bond. He finds that the debt to GNP ratio raises bond spreads, but the gross investment to GNP, debt service to exports ratios, and maturity in years reduce sovereign bond spreads. In some cases he finds that the debt to exports ratio, the real effective exchange rate, and the oil price (the latter against expectations) are all positively and statistically significantly correlated to spreads, while reserves to imports and the manufactures production growth rate enter significantly but negatively correlated to sovereign risk. As such, the original contribution to the literature suggests a dominant role for country fundamentals.

Min (1998) finds for the early 90s a positive and significant effect of debt to GDP, debt service to exports, net foreign assets, exports growth, the real exchange rate, and inflation on one side, and negative effects of the terms of trade, foreign exchange reserves to GDP, maturity and imports growth on sovereign spreads.

Eichengreen and Mody (1998) find that a higher ratio of debt service to exports is associated with higher bond spreads. They also show the negative significance of the GDP growth rate, the issue size and the residual of a regression of the credit rating from fundamentals. The latter is a first effort to capture issues that are not related to country-specific macro fundamentals.

Much like Edwards (1986) and Min (1998), Eichengreen and Mody do not control for global risk aversion and do not consider fundamental variables individually as opposed to variables that relate to the state of world financial markets. In the early stages of this literature, the main concern seemed to be which fundamentals were better determinants of sovereign spreads, rather than the interactions between sovereign stress and financial markets.

Arora and Cerisola (2000) estimate the determinants of secondary market sovereign bond spreads for a sample of 11 large emerging countries in 1994-1999. They find a positive impact of the short-term US interest rate and of market volatility on spreads across all countries, in what can be considered a proxy for the effect of global risk aversion. Also, spreads are in large part explained by country-specific fundamentals, pertaining in particular to the external and fiscal position. They find a significant impact of the net foreign asset position, lower fiscal deficits and lower ratios of debt service to exports and debt service to GDP help decrease sovereign spreads.

Aronovich (1999) uses daily data on sovereign spreads to assess the determinants in the 1997-1998 period for three large Latin American countries. These are the implicit probability of default and the 30-year USTB rate, where the latter is used as a proxy of an exogenous change in global financial conditions.

Baig and Goldfjan (2000) test whether there was contagion from the Russian crisis to Brazil in the late 1990s, using daily data. They find evidence supporting the contagion hypothesis and report a negative impact of the long-term American interest rate on spreads. Nogues and Grandes (2001) also find a negative effect on sovereign spreads for Argentina in the late 1990s. In their paper, there is evidence of contagion but also of the relevance of country-specific factors, like fiscal deficits, GDP growth, the debt service to exports ratio, and institutional priorities.

Ferrucci (2003) investigates the empirical relationship between emerging market sovereign spreads and a set of common macroeconomic fundamentals, using EMBI spreads over the period December 1991-March 2003. The estimation technique posits a dynamic error correction model that allows short-run parameters to vary across groups, while restricting long-run elasticities. Their results point to markets pricing in macro conditions in sovereign risk. In particular, indicators like external debt, openness and current account balance affect the pricing of sovereign spreads.

However, non-fundamental factors like global liquidity conditions and US equity prices also play a role. This result is obtained by controlling for global risk aversion by using the spread between low and high-rating US corporate bonds and finds a negative impact on emerging market sovereign spreads: higher junk bond spreads lead to lower emerging market spreads.

Gonzalez Rozada and Levy-Yeyati (2006) analyze the impact of rates in developed countries on emerging market spreads in 1993-2005. They find that a large part of the emerging market bond spreads is explained by global factors like risk appetite (the spread of high yield corporate bonds in developed markets), global liquidity and contagion from other financial crises. The link between emerging country spreads and global factors is shown to remain relatively stable over the history of the emerging market class since 1993, is robust to the inclusion of country-specific factors, asymmetries, alternative risk appetite indicators or adjusted ratings, and helps provide accurate long-run predictions. Overall, the results highlight the critical role played by exogenous factors in the evolution of the borrowing cost faced by emerging economies. This is in line with Garcia Herrero and Ortiz (2005) conclusions on the influence of global risk aversion on Latin American sovereign spreads.

Remolona *et al.* (2007) analyze the components of sovereign CDS spreads, namely the expected loss from default (or sovereign default risk) and the sovereign risk premia. They find that risk premia account for much of the spread (ranging from two thirds to four fifths of the change in the spread).

They also estimate the determinants of sovereign default risk using the rating-implied probability of default. For this they use a sample of 23 emerging countries,

on which they run a panel regression with fixed effects, using annual data from 1990 to 2005. They find a significant relationship with country size, inflation, development, the current account deficit, and external debt. These results hold when considering debt intolerance, original sin and currency mismatch.

There are other areas of study that can be mentioned. First is on the determinants and dynamics of other measures of sovereign creditworthiness such as "distance to default", sovereign credit ratings, probabilities of default, analyzed by Rowland and Torres (2004) or Diaz Weigel and Gemmill (2006). Second, the strand of the literature studies the relationship between sovereign spreads and currency risk (Domowitz *et al*, 1998; Ahumada and Garegnani, 2005; Powell and Sturzenegger, 2000; Borensztein *et al*, 2001). Third, the pass-through from US interest rates to emerging market spreads (Frankel, 1999; Frankel *et al*, 2000; Kamin and von Kleist, 1999).

While the main issue studied pre euro area was the spreads in emerging countries, the formation, and in particular, the sovereign debt crisis, led to an increase in the academic interest on sovereign spreads in the EMU. The setup is similar to that used previously for emerging economies, where the determinants used and country-specific risk factors, global risk aversion conditions and financial market-specific issues, like liquidity.

Manganelli and Wolswijk (2009) find a relevant role for monetary policy on risk aversion and spreads. D'Agostino and Ehrmann (2013) focus on credit risk and surprises on macroeconomic indicators, such as the deviations of the forecasts of the key macro variables. Maltritz (2012) considers openness and the terms of trade.

For example, Attinasi *et al*. (2010) find a role for bank rescue packages and the ensuing shifting of risk from the private sector to the public sector has played a key role. However, the elasticity of credit premia to fiscal fundamentals (a measure of the price of credit risk) also increased during the crisis, partly owing to an increase in the degree of global risk aversion. Gerlach *et al*. (2010) finds that global risk interacts country specific fundamentals. This interaction and its impact on spread changes over time

The last broad category of determinants of sovereign bond spreads relates to liquidity conditions in bond markets, usually proxied by overall outstanding amount of public debt, bid-ask spreads and trading volumes. Favero *et al*. (2010) propose a model with endogenous liquidity demand where liquidity and aggregate risk interact, leading to a negative dependence of spreads on the interaction of the latter source of risk and liquidity. Higher aggregate risk, by reducing the attractiveness of alternative investment opportunities, implies that less compensation for liquidity risk is required for sovereign bonds.

Beber *et al*. (2009) find that credit premia are generally more relevant than liquidity premia for euro area sovereign bonds but, in moments of heightened market uncertainty, liquidity considerations may prevail.

Euro area sovereign bond markets initially attracted attention from academia as a way to assess the impact of the EMU on the process of financial integration, as studied by Codogno *et al.* (2003), Baele *et al.* (2004), or Gomez-Puig (2006 and 2008). In these first studies, the standard definition of sovereign risk included its two main domestic components, market liquidity and credit risk, and an international risk factor which reflected investors' risk aversion. Some of the research then focused on systemic versus idiosyncratic risk. Geyer *et al.* (2004) and Pagano and Von Thadden (2004) stressed the importance of systemic risk in the behavior of yield differentials in EMU countries, while others showed that the idiosyncratic risk component in the movements of spreads was generally more important than the systemic risk, as shown in Gomez-Puig (2009), Dotz and Fischer (2010) and Favero and Missale (2012). Some studies suggested that movements across the Eurozone were a key determinant (Abad *et al.*, 2010).

However, the sovereign debt crisis in Europe which began in late 2009 has revived the literature on euro area sovereign spread drivers and attributed increasing importance to uncertainty and variables reflecting country-specific confidence and indicators of real activity (see, e.g. Georgoutsos and Migiakis, 2013). Favero and Missale (2012) find that credit risk has increased in importance as a determinant of sovereign bond spreads, while Buchel (2013) provides evidence that the market reacted to official statements during the crisis. Similar arguments can be found in other recent studies using data that extend beyond the crisis period such as Palladini and Portes (2011) or Beirne and Fratzscher (2013).

Many authors have stressed the importance of other fundamentals beyond the country's fiscal position to explain yield spread behavior after the outbreak of the crisis, as expressed in Mody (2009), Barrios *et al.* (2009), the IMF (2010), Bolton and Jeanne (2011) and Allen *et al.* (2011). Some studies have looked at the dynamic properties of sovereign spreads over time, testing whether there was a change in behavior during the crisis, as Pozzi and Wolswijk (2008), Gerlach *et al.* (2010), Aßmann and Boysen-Hogrefe (2012) and Bernoth and Erdogan (2012).

Sguerri and Zoli (2009) find that euro area sovereign risk premium differentials are mainly driven by a common factor, in line with the finding on the importance of global risk aversion. They do however find a change starting October 2008, with markets becoming progressively more concerned about the fiscal stability of countries and in particular, reacting to the impact of the contingent liabilities arising from problems in the national banking sectors.

Gomez Puig *et al.* (2014) similarly show that the rise in sovereign risk in central countries can only be partially explained by the evolution of local macroeconomic variables in those countries. They find that the importance of global variables increased in this period.

So the fiscal balance may be important, but is not the only factor that can lead to financial stress, as shown in particular by recent research. In this context, the behavior of banks during periods of sovereign stress plays a central role in the propagation of the latter and as such has been studied amply by the literature.

### 3. The dynamics of financial crises

A key area of study is how such crises unfold. While the first generation of the literature emphasized the role played by sovereign debt sustainability, later on, triggered particularly by the Asian crisis in the late 90s, a large body of the literature has been devoted to analyze market panic and the behavior of financial institutions in this context.

Some authors (Radelet et al. 1998) emphasize the role of financial panic as an essential element of the Asian crisis. At the core of the crisis were bubble-like large foreign capital inflows into financial systems that had not developed to the regulatory and supervisory tools to manage them and so became vulnerable to panic.

In a similar vein, some authors have explained financial crisis through the Minsky (Arestis et al. 2002) explanation of instability inherent to the financial sector. This view is supported by the finding that threats to growth and employment from the financial sector are much intensified in open, liberalized and, especially, developing economies.

When financial crises unfold, financial sector vulnerability and sovereign debt vulnerability may reinforce each other. Some authors have emphasized how not having your own monetary policy can lead to more fragile bond markets. In particular (De Grauwe et al. 2013) show that part of the rise in sovereign bond spreads was not related to fundamentals. Secondly, some fundamentals, like sovereign debt, ignored before the crises, became significant during the crisis. However, this is a usual finding even for countries with their own central bank, as shown above.

De Grauwe et al. 2013 repeat the analysis in countries that had their own currency but similar fundamentals in terms of debt and fiscal space than Eurozone countries. In these countries, however, they do not find evidence of heightened significance of fiscal fundamentals. Therefore, this may be a sign that, indeed, markets priced in the absence of a lender of last resort: in the presence of such a lender, one would expect the capital outflow to have materialized in other aspects, like a further currency depreciation, which in turn could have more expansionary effects than the rise in yields.

### 4. The interactions between banks and sovereigns

The interactions of banks and sovereigns was first studied in the context of defaults by developing countries. Some authors have modeled debt rescheduling as a game where the two players are the banks and the sovereign. In Bulow et al. (1987), debt rescheduling arises as the result of bank impatience because of the lost present value of their investments undermines their solvency and compromises their future, thus makes them willing to accept haircuts on debt payments. In this setting, strategic default arises naturally out of financial sector weakness and the corresponding lack of bargaining power by banks.

Reinhart and Rogoff (2009, 2011) find that banking crashes are followed by fiscal crises. They find that sovereign debt ratios typically rise after a banking crisis.

However, their use of annual data may hide more subtle interactions amongst the variables, as the interaction between banking risk and sovereign risk may take place within a year, and may change shape in that year.

In their setting, the rise in sovereign debt is not primarily due to the cost of rescuing the financial system, but the slower growth after a financial crisis leads to a rapid rise in the public debt ratios. The fact that slower growth follows financial crises has been documented by Abiad et al (2011): low growth stems from the scarcity of credit which typically follows banking crises.

The approach of Acharya (2013) is slightly different: he considers slow growth as the result of a credit boom pre crisis, which masked the underlying low potential growth. Also, their use of annual data could explain the fact that they do not find a feedback loop from public debt to banking crises. This may downplay the effect that bank bailouts and the subsequent rise of public debt can have on the reinforcement of bank and sovereign weakness.

At the core of this literature lie the links between the financial sector and fiscal sustainability. The relationship between both has been extensively documented by Reinhart and Rogoff. However, somewhat contrary to Reinhart and Rogoff (2009, 2011) the results of Mody et al (2012) show that it is not just private debt that causes a financial crisis. Rather, large public debt, a deterioration of the credit quality of the sovereign can also cause the financial panic.

#### 4.1. Sovereign-banks feedback loops

The characterization of sovereign-bank feedback loops has been studied by a large literature. The evidence on the links is quite varied.

Thukral (2013) uses a panel to study the role of financial sector variables on the determination of sovereign CDS spreads, and the results trigger his conclusion that there is bank dominance of sovereign financing conditions. Mody and Sandri (2011), using sub-periods similar to those in Acharya et al. (2013), who finds that the feedback between sovereign and bank risk changed. Instead of comparing CDS spreads, Mody and Sandri (2011) use sovereign spreads as the manifestation of sovereign fiscal risk, and the level of stock market capitalization of banks as a measure of banking system risk. They show that the euro crisis traces back to the demise of Bear Stearns. As bailouts of banks began to be priced in the market, sovereign spreads started to reflect higher fiscal solvency risk, especially in countries where growth was expected to slow down and had, as a starting point, high debt levels.

Candelon and Palm (2010) present further evidence that bailouts potentially undermine the sustainability of public finances. These financial rescues can enhance the transmission of risk from the banking sector to the sovereign through several channels, which include bailout disbursements, public deposits held with banks, the need for liquidity provisioning by the central bank acting as a lender of last resort, or the use of resources for bank recapitalization by the sovereign or, alternatively, the execution of public guarantees.

According to Honohan (2008), the link between banking crisis and sovereign risk may arise from the slowdown and the credit scarcity that usually follows a banking crisis. Such crisis tend to be long crises (lasting 2.5 years on average), and lead to sharp rises in public debt. The authors estimate that the median fiscal cost of a banking crisis stands at 15.5% of GDP.

Kollmann et al. (2012) also study the macroeconomic effect of financial sector rescues. They find that bank rescue operations can help cut short a financial crisis and improve macroeconomic performance. A key avenue of the recovery is that bank bailouts can help investment recover, consistent with Broner et al. (2014) or Popov and Van Horen (2013). However, they find evidence of a negative impact, as sovereign debt purchases by banks lead to a crowding out of private investment. Gray and Jobst (2011) and Gray et al. (2013) in contrast, show the potentially high impact on fiscal risk associated to the existence of contingent liabilities.

A key transmission mechanism is that domestic banks tend to be particularly vulnerable to restructuring. Noyer (2010) argues that by holding of non performing government bonds capital could decline and so threaten the solvency of weaker and more exposed institutions. IMF (2002) show in its review of the effects of four sovereign restructurings (Ecuador, Pakistan, Russia and Ukraine) the impact on the domestic banking sector. The paper finds that the channels of transmission vary: be it through losses on bond holdings or an increase in the interest rates on liabilities not matched by increased returns on government bonds and, as higher financing costs lead to corporate bankruptcies, and increase in NPLs.

Erce (2012) suggests that the degree of bank intermediation and the banking system exposure to the sovereign strongly influence a debt crisis ripple effect on the real economy. In addition, the moral suasion of authorities may lead to excessive holdings of sovereign debt by domestic creditors at below market yields (Diaz-Cassou et al., 2008). While this helps the government keep financing conditions more favorable, a government default in this context would trigger to a banking crisis.

There are other channels by which sovereign stress leads to banking stress, although many papers emphasize the role played by the holdings of sovereign debt by banks. In Darraq-Pires et al. (2013) the positive connection between sovereign and bank risk is due to banks investing in government securities. Along these lines, Angeloni and Wolff (2012) assess the impact of sovereign bond holdings on the performance of banks during the euro area crisis using individual bank data and sovereign bond holdings. They find that peripheral sovereign bonds affect banks' stock market valuations heterogeneously. While Italian, Irish and Greek debt appear to have negatively affected the market valuation of the banks holding them, such an effect is not significant for other peripheral sovereign debt of countries like Spain, suggesting that the specific characteristics of the banking sector (like its internationalization) may also play a role.

Acharya et al. (2013), document the high exposure of their sample banks to their own sovereign, which according to their theory should be a main channel through which stress feeds back from the sovereign to Banks.

Popov and Van Horen (2013) focus on the feedback from sovereign risk into banking risk by assessing the extent to which holdings of sovereign bonds detract the resources available for lending to the economy. This channel enhances the feedback loop by limiting growth and so further weakening the health of the sovereign. They find evidence that this was particularly relevant in the periphery.

Finally, sovereign rating downgrades further limit banks' access to foreign financing, leading to sudden stops or higher borrowing costs (Reinhart and Rogoff, 2012)

BIS (2011) shows four main channels through which a deterioration in the creditworthiness of a sovereign can pass through to the banking system. One channel of transmission is banks' holdings of sovereign government debt. Second, higher sovereign risk reduces the value of collateral that domestic Banks can be used for funding. Third, sovereign downgrades normally translate into lower ratings for banks located in the downgraded country. Lastly, increased sovereign risk reduces the value of the implicit/explicit government guarantees to banks.

Mody and Sandri (2011) show that sovereign spreads are affected by the domestic vulnerabilities of national banking sectors. Fiscal fundamentals can worsen the loop: the relationship seems stronger for countries showing large public debt.

Similarly, Pisani-Ferry (2012) shows that one reason that sovereigns may be sensitive to the domestic banking sector is that the sector's size has become large relative to tax revenues. As a result, small problems in the banking system can become an issue for government solvency.

In periods of financial crisis, the implicit guarantee is likely to become effective, so markets may price in this higher probability of payout by the sovereign (Gray et al, 2008; Gerlach, Schulz and Wolff, 2010; Pisani-Ferry, 2012).

Reinhart and Rogoff (2009) show that historically public debt-to-GDP ratios are higher following a country's banking crisis. The deterioration of sovereign creditworthiness is, however, only partly due to cost of rescuing troubled banks. The main explanation is the economic slowdown caused by the banking crisis

Merler and Pisani-Ferry (2012), for example, establish that domestic government debt holdings are on the rise since 2008, thus raising the potential for negative feed-back loops between sovereign and banking stress. Wolff (2011) shows the supposed link between holdings of sovereign debt and banks' market valuations was not significant in the period July-October 2011 in Italy, Spain, Portugal and Ireland. Only a clear relationship between Greek holdings and market valuation was established.



Arghyrou and Tsoukalas (2010) posit that the mechanics of the EMU debt crisis are similar to those of a currency crisis: in this case, the systemic risk that would be seen in currency markets is diverted into the markets for sovereign bonds. As a result, sovereign bond spreads can be taken as an indication of stress that would eventually lead to abandonment of the currency regime.

Illing et al. (2014) show that the absence of LLR can lead to self-fulfilling crises even when fundamentals are good. The perceived weakness of the sovereign can lead to a deterioration of the quality of the guarantee that it has given Banks and so would justify the transfer of risk from the sovereign to Banks.

The dynamics presented by the literature suggest that the absence of a central bank that is willing to act as a lender of last resort increases the likelihood, in stress, of sovereign defaults. In turn, the perceived lack of fiscal muscle leads investors to Price in a bank default. While sovereign bond holdings may reinforce this loop, the transmission of stress can exist even if there are no sovereign bond holdings by the domestic banking sector.

#### 4.2. Regulation and the sovereign bank nexus

Banking regulation has been blamed partially for reinforcing the bank-sovereign feedback loop. As is explained in chapter 3, bank holdings of sovereign debt are generally not subject a risk weight in banks' capital requirement ratio.

To the extent that sovereign debt's riskiness arises from the expansionary bias in fiscal policy over the cycle, it can be avoided through more responsible fiscal policy in the upturn, as described in Cavallo and Izquierdo (2009) and Breton, Pinto and Weber (2012). A source of instability in the financial sector can be the fact that public debt is perceived as not being sustainable which can lead to sell off and a resulting vicious cycle (Acharya *et al.* 2011; Merler and Pisani-Ferry, 2012). This has been a particular concern recently, when the Eurozone crisis questioned the Reinhart and Rogoff (2009b) concept of graduation from serial default.

The sovereign stress has led to a number of proposals to change the regulatory treatment of sovereign debt: Hannoun (2011) argues that highly rated sovereign assets should receive a treatment consistent with their low risk. This would call for a differentiation amongst the different sovereign assets according to their creditworthiness.

Instead of doing away with the Basel standards that use the 0 risk weight on domestic debt holdings, Hannoun calls for the introduction of enhanced supervision of sovereign risk through instruments like further and stricter stress tests.

Praet (2013) highlighted that a regulation that treats banks' holdings of sovereign debt according to the risk they pose to banks' capital will prevent said banks from excessive use of central bank liquidity, which, in a currency union, according to Uhlig (2013) can lead to perverse incentives. Weidmann (2013) suggests that by biasing the demand towards sovereign bonds the regulation distorts the relative price signaled by interest rates. However, other have considered that some

shortcomings, and in particular the procyclicality of the capital requirement ratios call for a different treatment of sovereign exposures. In particular, Nouy (2012), considers using a Pillar II approach to extend sovereign risk, along the lines of Hannoun (2012), not least because the procyclicality of capital regulation can be especially problematic for sovereign bonds.

A key concern on this treatment is that the 0 risk weight has provided additional incentive to the exploitation of the carry trade (Acharya and Steffen, 2013). The absence of a capital requirement lowered incentives to lend to the real economy, particularly amongst the low-capitalized banks. As a result, the zero risk weight lets zombie banks continue operating, detracts resources from the economy and leads to perverse incentives in a currency union.

In this vein, Blundell-Wignall (2012) consider that the key may lie in the series of fiscal and structural policy measures being followed in the EU and aimed at tackling the underlying weaknesses of sovereign bond credit quality, which would eliminate the riskiness of those holdings and so the need for increasing its risk weight. The measures include credible fiscal consolidation plans, the enhancement of the ECB's role as liquidity provider of last resort, and the creation of effective backstops.

Of course, the findings of the literature on fiscal fatigue and fiscal sustainability are particularly important to this end. As such, countries that present the fiscal, institutional and growth strategies that allow them to avert fiscal fatigue can have a virtuous cycle by which their debt can safely be considered a risk-free asset, relieving the balance sheet of domestic banks and allowing public debt to play its role as a safe asset in times of distress.

The need for a safe asset is inherent to the workings of a financial system. As Nakaso (2013) showed, this impact can be seen through several avenues: for instance, sovereign bonds act as a benchmark for other assets, as mentioned by Dunne *et al.* (2007), thus used as a reference rate from which the additional risk factors are compounded to determine the price of other assets. By serving as a safe and stable source of collateral in financial transactions, attracting lower haircuts and margin requirements, they allow markets to function smoothly (Giovannini,2013).

Their role as an accepted source of collateral allows sovereign debt to play a similar role to that of fiat money in economies (Singh, 2013). In this way, sovereign debt posted as collateral can be used in other transactions, creating an effect which is similar to the monetary multiplier effect (Singh, 2011); and Claessens *et al.* (2012). Without an accepted, liquid, risk free asset, some financial transactions that require the use of collateral may never happen.

#### 4.3. Connectedness: amongst financial firms and with sovereigns

Finally, and as expected given its key role in the work of financial markets, safe assets are also integral to prudential regulation (IMF, 2012). Prudential requirements use safe assets in order to limit or prevent excessive risk taking in normal times. One can think that to the extent that both sovereign debt and money are backed by a country's central bank, they should be exchangeable

assets. Debt only becomes risky when a country stops being backed by its central bank.

Given the importance of financial stress, many resources have been devoted to understanding the workings of this stress. A key area of analysis is how stress can propagate from one financial institution to the system, or to other institutions, or from the sovereign to financial system and vice versa. This played a key role in the start of the global financial crisis in 2008-2009: understanding which institutions are systemic and which aren't is essentially to understand the costs and benefits of the resolution of a given institution.

As a result, much literature and policy effort has gone into determining what a systemically important institution is and how it should be dealt with. The Basel Committee on Banking Supervision has been a key player. In order to enhance the regulation of SIFIs, the first step was to identify them. To this end, the BCBS selected a number of indicators that reflect many dimensions of a bank: size, interconnectedness, the lack of readily available substitutes for the services they provide, their global (cross-jurisdictional) activity and their complexity. The size, interconnectedness and substitutability categories are in line with the guidelines of the IMF/BIS/FSB report submitted to the G20 Finance Ministers and Central Bank (BIS, 2011).

A part of the literature has analyzed the need for such a regulation from a particular perspective: the implicit subsidy in being too big to fail. Some authors find that the subsidy is large enough to distort firms' decisions, even beyond the banking sector (Baker et al, 2009).

Others (Thomson, 2009) take a more policy-oriented approach and not only propose a framework for identifying and supervising such institutions; they attempt to remove the advantages from being SIFIs and the perverse incentives that may arise. Size and interconnectedness would be the basic determinants for being considered a SIFI, and firms that are such by these two counts would be subject to the strictest regulations. In contrast, if a firm is highly correlated, it may not be subject to additional capital controls, but only to more strict disclosure arrangements. Finally, institutions that are neither large, nor interconnected or correlated but have a particular impact on the workings of a particular region would be subject to enhanced supervision.

## 5. Macroprudential policy

The recent financial crisis has shown the need for new instruments to deal with the global build-up of financial imbalances, which can eventually have severe macroeconomic consequences. In other words, we need a better understanding of how system-wide risk builds up. The starting point of this system risk is the aggressive risk taking by institutions, in a context of macroeconomic stability, overblew the size of financial balance sheets.

This lack of understanding was in part due to the confidence that the financial system would be able to adjust automatically, so that signs of growing debt and

leverage, particularly related to house Price booms (but not limited to the housing sector) were not tackled. As a result, low volatility and risk premia and the excessive risk taking they could entail were not considered a risk to the system. In this context, the role of financial innovation, deregulation and disintermediation in the creation of bubbles was not sufficiently recognized, and the consequences of financial imbalances was therefore ignored.

The role of the interactions across firms suggests there is a need to complement the traditional, micro approach, with a macro approach in regulation and surveillance. This need for a macroprudential approach has led to several policy initiatives to implement macroprudential policies (see Gorton and Winton, 2003).

The policy debate is, as a result, evolving around the range of macroprudential tools available, how they can be implemented and their effectiveness. The effectiveness has been analyzed both in terms of the economic impact of the new tools and the interactions with other policies, in particular monetary policy.

The global financial crisis has spurred a large policy and academic interest on the issue. In this section, we show the main contribution of a fast-growing strand of the literature. We will focus on the policy avenues that are open and that are informing the current policy debates, with a smaller emphasis in those areas that focus on regulation and supervision at the bank, or microeconomic, level.

A key issue will be the interactions between monetary policy and other prudential policies. In particular, part of the reasoning focuses on the impact of monetary policy on financial stability, and so, the role that may be played by macroprudential policy as a complement to monetary policy. These interaction are not well understood, on account of the Little-know interactions between the real economy and the financial system. Macroprudential policy and the related literature can be seen as an attempt to bridge that gap.

Clement (2010) shows that the term macroprudential was first used in the meetings of the Cooke Commission (today the BCBS) in the 1970s. Borio (2009) shows that the term was used to emphasize the links between financial regulation and supervision and the economic situation. Tucker (2009) and Mccauley et al. (1999) also show the tendencies of macroprudential policy when it started, and, in particular, its focus on managing the risks that arise from an increase in leverage.

In BIS (1986), one can find references to the payments system and the financial system. This was matched by the insight that what appear as prudent from an individual perspective may be dangerous from a systemic perspective (Blunden, 1987). In the early 2000s, there were several attempts to revamp macroprudential policy (Crockett, 2000).

However, the focus on macroprudential has risen in the current crisis, as can be seen in the references to the issue coming from policymakers (e.g. Shirakawa, 2009, Nijathaworn, 2009, Tumpel-Gugerell, 2009, Bini-Smaghi, 2009, Kohn, 2009, and Brouwer, 2010). In Borio et al (2003) and Orphanides and Williams (2010) the evolving target of monetary policy is analyzed.

Just as the academic literature had reached an agreement on what the target of monetary policy should be, the new work on macroprudential policy started. The key target for central banks should be price stability over the medium term. In some cases, central banks had a dual mandate, including an employment target.

As of now, there is still little agreement on what the target of macroprudential policy should be. Financial stability is often mentioned as the target, but an operational definition of what that means remains elusive. There are two main camps on this matter. First, those that define financial stability as the resilience of the financial system when faced with exogenous shocks (e.g. Allen and Wood, 2006; Padoa-Schioppa, 2003). Second, those that consider that financial distress can be endogenous and so consider that the essence of financial stability lies in the ability to manage the imbalance within the system (e.g. Schinasi, 2004) or how those imbalances can make the system vulnerable even in the face of relatively usual shocks (Borio and Drehman, 2009a).

Regarding the goals for macroprudential policy, Brunnermeier et al. (2009) suggest that it act to limit the financial systems tendency to underestimate risk in the downturn and overestimate it in the upturn. By leveling the measurement of risk through the cycle, regulation and policy may limit the magnitude of booms and busts. Bank of England (2009) shares this view and highlights that in avoiding such boom bust cycles, it will help the financial system provide its services to the economy. As a result, if the boom bust cycle is not related to the provision of financial services and the supply of credit, it would be beyond the scope of macroprudential policy. Landau (2009), however, asserts that in practical terms it would probably be appropriate for macroprudential policies to take into account the creation of bubbles.

Borio and Drehmann (2009a) consider that the main role of macroprudential policy is to limit the materialization of system-wide risk that can have a significant macroeconomic cost. One must understand the differences of macro- and the micro prudential regulation in order to understand the possible effects of the policies implemented (Crockett, 2000). Borio (2003) synthesized the differences between the goals and instruments of macro- and microprudential policy, as can be seen in table 1 below.

Table 1		
Macro- versus microprudential perspectives		
Macroprudential	Microprudential	
Proximate objective	limit financial system-wide distress	limit distress of individual institutions
Ultimate objective	avoid macroeconomic costs linked to financial instability	consumer (investor/depositor) protection
Characterization of Risk	“endogenous” (dependent on collective behavior)	“exogenous” (independent of individual agents’ behavior)
Correlations and common exposures across institutions	Important	Irrelevant
Calibration of prudential controls	in terms of system-wide risk; top-down	in terms of risks of individual institutions; bottom-up
Source: Borio (2003).		

Caruana (2010b) considered two aspects of systemic risk that macroprudential policy should address. First, the interlinkages amongst financial institutions, and, second, the procyclicality of the financial system as a whole. Perotti and Suarez (2009a) consider macroprudential policy should tackle individual bank strategies which cause systemic risk, a negative externality on the financial system, even if optimal at the individual bank level.

Hanson et al (2010) posit that macroprudential policy can complement microprudential policies, whose aim is to protect depositors by having banks internalize the losses they may incur in their assets. This behavior must be regulated because deposit guarantee schemes can lead to moral hazard. Such regulation will remain in use. Alternatively, macroprudential policy minimizes the social costs of a general decline in the provision of banking services that can be caused by the need to comply with minimum capital requirement ratios. The manifestation of this shrinkage of balance sheets can be found in credit crunches and fire-sales of assets.

### 5.1. Implementing macroprudential policy

The broadening of the scope of financial policy introduces the question of how it may be instrumented. This is in contrast to monetary policy, which, at least in advanced economies, the debate on the instruments to be used had been settled (at least until the global financial crisis). The interest rate was the primary instrument, and communication was an increasingly important complement (Blinder et al, 2008). Non-conventional tools (e.g. Bernanke and Reinhart, 2004; Gertler and Karadi, 2009; Motto et al, 2009; Curdia and Woodford, 2009; Lenza et al, 2010), are considered to be the realm of specific periods of time, in which the zero lower bound becomes binding.

The research into the role of macroprudential policy being at an earlier stage, the conclusions remain far from obtaining the depth and the level of consensus on basic questions that has been achieved in monetary policy. To foster the debate in this area, the ECB has launched an initiative to facilitate academic research on aspects that could improve macroprudential supervision within the EU (Constâncio, 2010). A range of possible macroprudential measures have been investigated without identifying a primary instrument nor a standard taxonomy of instruments.

One important distinction in the debate is between macroprudential tools – defined as prudential tools set up with a macro (in the sense of system-wide/systemic) perspective – and other macroeconomic tools that can support financial stability such as fiscal policy (see e.g. Blanchard et al, 2010; Borio, 2009). Caruana (2010) argues that regulation is only one part of the broad toolkit that should be used for macroprudential toolkit.

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Part of the macroprudential literature is based on the attempt by emerging economies to deal with large incoming capital flows and reduce the domestic consequences of such flows. Some of these policies include limiting foreign exchange positions and constraining the type of foreign assets and magnitude of those purchases. Borio and Shim (2007) show that the build-up of financial

imbalances was often accompanied by a growing share of net foreign-currency financing.

Market-based regulations that try to discourage capital inflows (Mohanty and Scatigna, 2005; Ghosh et al., 2008; CGFS, 2009) and other tools aimed at controlling large capital inflows, some of which became increasingly popular in 2009-2010, are not considered within the scope of macroprudential regulation, but rather as tools that may have a prudential side effect (Ostry et al, 2010). While examples of such policies abound, many take the form of the tax on international debt described in Jeanne and Korinek (2010), which forces borrowers to internalize the costs of currency mismatches.

BIS (2008) provides a useful summary of macroprudential tools and instruments, their targets and their implementation.

One can classify macroprudential tools according to their aim. For instance, some tools are geared towards addressing risks that may arise over time, particularly linked to the procyclicality in the financial system. Others consider the distribution of risk within the financial system, that is, the cross-sectional dimension of macroprudential risk, focusing on the systemic contribution of an individual firm or its exposure to a system wide risk event. The procyclicality of risk is the key concern of the time series dimension (BIS, 2001; Borio et al., 2001; Danielsson et al., 2001; Borio and Zhu, 2008; Brunnermeier et al, 2009, Brunnermeier and Pedersen, 2009; Shin, 2009).

Saurina and Trucharte (2007) and Repullo et al. (2009) show that capital requirement ratios are procyclical. Shin (2010) discusses ways of mitigating this procyclicality, and considers that countercyclical capital requirements, together with forward-looking statistical provisioning schemes, can mitigate the harmful effects of excessive risk taking via securitization. Kashyap and Stein (2004) present a model where, if a social planner was to maintain credit during downturns and minimize the use of deposit insurance, then a time-varying capital requirement can be optimal. Hanson et al (2010) argue that such a regulation may not be strong enough in downturns, when markets may find that the capital accumulated in good times may not be enough to convince to lend to the bank. These demands in bad times should be taken as a benchmark for the capital required in good times. In practice, this will mean stronger capital requirements in good times.

The valuation of collateral and of loan-to-value ratios may also be a source of procyclicality, which can be addressed through maximum loan-to-value (LTV) ratios. Borio et al (2001) analyzes how this can be dealt with.

The second macroprudential instrument that deals with the procyclicality of banks is loan loss provisions, which has been identified as a way of limiting the impact of the downturn in weakening banks' balance sheets and so reduce the ensuing amplification of the financial cycle. Borio et al (2001) argue that the procyclicality of bank provision is amplified by accounting practices, tax constraints and methodological shortcomings. Fernandez de Lis et al (2000) discuss how forward-looking provisioning would limit the observed strong procyclicality of loan provisions. Jimenez and Saurina (2006) suggest that forward-looking loan loss provision should take into account the credit risk profile of banks' loan portfolios along the business cycle.

The third is haircut-setting and margining practices in securities financing and over-the-counter derivatives transactions. CGFS (2010a) highlights the system-wide impact of these practices during the financial crisis, and discusses policy options for reducing the procyclical effects of mark to market and haircut determination practices on financial markets. These include countercyclical variations in margins and haircuts, and higher and relatively stable through-the-cycle haircuts for securities financing transactions.

The cross-sectional dimension focuses on the distribution of risk in the financial system at a point in time. The idea is that linkages, common exposures, and herd behavior can introduce system wide risk that needs to be reckoned with. There is a rich literature on which analysis of the cross-sectional dimension can draw, such as studies of systemic aspects of risk management (see e.g. Hellwig, 1995) or theories of systemic risk (e.g. Acharya, 2009). Important elements within this perspective include market failures (e.g. Rabin, 1998; Calomiris, 2009) and propagation channels (e.g. Jensen, 1986; Calomiris and Khan, 1991; Caruana 2010).

Short-term debt in banks' liabilities has been identified as a major source of vulnerability (Brunnermeier, 2009; Gorton, 2009; Shin, 2009; Hanson et al, 2010). These are often modeled as idiosyncratic shocks that are amplified across the system, as banking networks reinforce the systemic nature of the amplifications. The key to the amplifications lies in the presence of interdependencies across banks, be it regarding assets and liabilities or through the payments and settlement systems. The accelerator of the spillovers is usually the difficulties in discerning in real time, solvent institutions from insolvent ones (e.g., Kiyotaki and Moore, 1997; Allen and Gale, 2000; Rochet and Tirole, 1996a, b; Freixas and Parigi, 1998; McAndrews and Roberds, 1995; Aghion et al, 1999). In fact, as Martin et al (2010) showed using an extended Diamond-Dybvig (1983) framework, financial institutions that are funded by short-term debt and hold financial assets can run with similar effects on solvency as traditional deposit runs. According to a model developed by Stein (2010), in the absence of regulation, money creation by banks can lead to financial system vulnerabilities, as banks will issue more debt than is socially desirable and so could lead to externalities that would make the banking system vulnerable to crises.

Given the prominence of balance sheet mismatch in the literature, it is natural that the key instruments that have been designed minimize the risks associated to this mismatch. Some examples of such tools are the net stable funding ratio or a liquidity coverage ratio (BCBS, 2009), which have an element of procyclicality. One way to overcome procyclicality, proposed by Perotti and Suarez (2009a, b, 2010), is discouraging short term funding through liquidity risk charges. Brunnermeier et al (2009) propose that a capital surcharge be created that is proportional to the maturity mismatch of the financial institution.

The parallelism with monetary policy can also be found in the debate on whether there should be automatic, pre-specified rules or whether the supervisors must be afforded discretion and flexibility to enforce macroprudential regulation (Borio and Shim, 2007).

In the academic literature, and in particular since the observation that discretion can have a time inconsistency and as the historical experience built up, the evidence seemed to favor the existence of rules that would enhance



transparency and accountability, and would be superior in welfare terms than discretion-based decisions (Kydland and Prescott, 1977).

Rule-based macroprudential tools – e.g. automatic stabilizers – have, similarly, some interesting characteristics (Goodhart, 2004). Loan loss provisions, capital requirements/capital surcharges, or loan-to-value ratios can for example be designed in a rules-based way. One important built-in stabilizer are risk management practices that internalize the risk of the buildup of financial imbalances and their unwinding (Borio and Shim, 2007 or Sundaresan and Wang, 2010)

Mid way between discretion and full flexibility, one finds contingent instruments, which try to have the best of both worlds, and can be considered rule-based tools that are state-dependent. Hanson et al (2010) break up these instruments as those that are contingent reversible i.e. debt that is automatically converted into equity in times when a bank's capital buffer declines under a pre announced limit (Flannery, 2005; French et al, 2010; Pennacchi, 2010), and, on the other hand, capital insurance, which would take the form of a policy purchased by the bank which pays off if certain conditions of stress or capital shortfall for the bank take place (Kashyap, Rajan and Stein 2008).

While rule-based tools play an important role, in policy debates, other, more discretionary rules have also been highlighted. The reasoning behind this is that since the next crisis is likely to take a different form, the regulation may not be prepared to deal with it. As a result, discretion may play an important role. One such instrument is the ability to issue warnings in speeches or in official publications. However, the use of warnings is far from uncontroversial: in fact, there may not be enough of them, as regulators could fear adverse effect, by triggering self-fulfilling dynamics (Libertucci and Quagliariello, 2010). An alternative could be levies or quantitative adjustments to prudential tools, so as to tackle the new forms of systemic risk that may arise (Hilbers et al, 2005).

Another aspect of the debate has been on whether the regulation should be instrumented through prices or quantities. Perotti and Suarez (2010) provide a theoretical treatment of price vs. quantity based tools based on the model by Weitzman (1974), who shows that in the presence of externalities the two types of policy instruments can have different welfare outcomes. Price-based tools fix the marginal cost of compliance and lead to uncertain levels of compliance, while quantity-based tools fix the level of compliance but result in uncertain marginal costs.

Perotti and Suarez (2010) analyze quantity regulations such as net funding ratios as Pigovian taxes aimed at equating private and social liquidity. They show that the industry response to new regulation depends on the composition of bank characteristics. Hence, depending on bank heterogeneity, the socially efficient solution may be attained with Pigovian taxes, quantity regulations or a combination of both.

Among quantity restrictions, Hanson et al (2010) argue in favor of small increases in capital in absolute terms for trouble banks, instead of using the capital ratio, so as to avoid the incentive to shrink their balance sheets and lead to more procyclicality of regulation. According to Hanson et al (2010) this can be implemented through the introduction of a capital ratio requirements in terms of the maximum of current and lagged assets.

Some studies also distinguish the context in advanced and emerging market countries. McCauley (2009) argued that emerging market central banks have been regular practitioners of macroprudential policy, without calling it by this name. As an example, he cited the Reserve Bank of India's decision to raise the Basel I weights on mortgages and other household credit in 2005 (RBI, 2005). Borio and Shim (2007) and CGFS (2010b) provide an overview of emerging market economies' experience with macroprudential instruments. Agénor and Pereira da Silva (2009) examined the cyclical effects of capital requirements for banking sectors in developing countries, with a view to understanding the cyclical effects of Basel regulations in the prevention and/or amplification of the financial crisis Brunnermeier and Sannikov (2009), Tucker (2009) and Borio (2009), Peston (1959) Bullard et al (2009).

## 5.2. Measuring systemic risk

Models that deal with financial stability typically take three different approaches, as shown by Borio and Drehmann (2009a). Diamond and Dybvig, 1983, design models where exogenous shocks can lead to multiple equilibria, in line with the sunspot literature. A second class of models starts from a negative shock (Allen and Gale, 2004), which in itself is not necessarily systemic, but when coupled with a propagation mechanism (such as the balance sheet linkages of Rochet and Tirole, 1996b) leads to financial instability. Finally, Minsky (1982) and Kindleberger (1996) posit that financial instability arises from cyclical fluctuations.

Bandt and Hartmann (2000) and de Bandt et al. (2009), consider the perspective of systemic weakness. While there is no clear definition of the concept (See e.g. Hutchinson and McDill, 1999; Kaminsky and Reinhart, 1999; Bell and Pain, 2000; Demirguç-Kunt and Detragiache, 2005; Davis and Karim, 2008; Dell'Arricia et al., 2008; Von Hagen and Ho, 2007. Definitions of systemic risk often evolve around the idea present in De Bandt and Hartmann (2000), by which systemic risk materializes when institutions that had a healthy starting point and were resilient to the first round of stress are vulnerable to a second (or ulterior) rounds of stress (See Borio and Drehmann, 2009a).

Perotti and Suarez (2009b) interpret systemic risk as propagation risk, by which initial shocks end up affecting other institutions and can thus have an impact on the macroeconomy that is not the consequence of the initial shock.

The previous literature focuses on contagion as the mechanism that unearths financial instability. However, a line of literature focuses on how the interaction of financial decisions and the business cycle can lead to instability. The driver of this, according to Borio, 2003, is that in boom times the financial sector overextends, and contracts in recessions, thus amplifying the cycle. In this context, risk and financial instability is endogenous to the macroeconomy, and has a dynamic, self-correcting element to it.

Danielsson et al. (2009) consider as a starting point the divergence between perceived risk and actual risk. As a result, market participants may, in good times, underestimate the actual risk they are facing, and so, an equilibrium level of risk arises, which could be excessive from a social point of view.

A key ingredient of the systemic risk literature has been the efforts at quantifying financial instability. A first such approach was the use of balance sheet structures. This was particularly popular over the past decade, where much effort has been dedicated to the creation of indicators of financial distress (Carson and Ingves, 2003; Bordo et al, 2000). In terms of policy, the IMF upgraded its surveillance of the financial sector, creating a broad set of indicators that were meant to give an indication of the risks emanating from the financial sector (the Financial Soundness indicators; Moorhouse, 2004; IMF, 2008) – and market indicators, such as those that use equity and credit-default-swap (CDS) or other derivative instruments (Illing and Liu, 2006; Tarashev and Zhu, 2006, 2008). While these indicators are increasingly used, they have important limitations (e.g. Fell, 2007). Most balance sheet indicators – such as loan loss provisions or non-performing loans – are typically backward looking (Bongini et al, 2002). Ratings of individual institutions are in principle forward-looking but in practice tend to incorporate new information only with a lag. Moreover, they are micro in nature and thereby fail to highlight vulnerabilities at the level of the whole financial system.

One line of literature that has attempted to draw conclusions from underlying dynamics in the financial system is the literature on early warning indicators. These studies predict financial stress from a set of leading indicators, which (Aikeman, 2009) are typically associated with financial stress, the key shortcoming from a macroprudential perspective is that they provide limited information on the interaction between the real sector and the financial sector, and usually do not give a structural view on how risks arise and are transmitted so as to cause financial instability, thus limiting the information they provide to policymakers

One area that is particularly interesting of this literature is that which looks at the interactions between credit growth and the consequences for financial Price misalignments (Borgy et al, 2009; Borio and Lowe, 2002; Borio and Drehman, 2009b; Gerdesmeier et al, 2009; Alessi and Detken, 2009; Fornari and Lemke, 2009). Their theoretical underpinning relies on endogenous cycles, which suggest that loose risk controls lead to excessive credit which, once asset prices turn round, lead to disorder which can have important macroeconomic consequences. Another advantage of these models is that they tend to spot financial instability over a longer horizon than other early warning models (Borio and Drehmann, 2009<sup>a</sup>, Borio and Lowe, 2002).

In terms of the econometric literature, VARs provide a method that can help understand the drivers, propagation mechanism and consequences of financial distress (Drehmann et al, 2006; Misina and Tessier, 2008). While flexible and tractable, they are purely empirical and are often highly stylized (De Nicolo and Lucchetta, 2009). They are perhaps, most useful, in comparing the conclusions that arise from the literature with the empirical models that bring the data to the theory.

Finally, macro stress testing provides a forward looking methodology for understanding the effect of macro shocks on the financial system. Of course, a limitation of these models is that they tend to rely on the existing knowledge of the macro and financial linkages, which is limited. Secondly, they tend to focus on large shocks, and usually do not consider the amplification of small initial shocks which can end up having systemic consequences. As result, they may not be particularly helpful to identify elusive connections between macroeconomic

and financial variables. (Borio and Drehmann, 2009a). Alfaro and Drehmann (2009) emphasize that macroeconomic weakness was not at the heart of previous crises. As a result, traditional macro stress testing may be of limited use to predict future crisis.

A main line of research involves understanding whether an individual firm can have systemic consequences. Allen and Babus (2008)

A key contribution, in the wake of the crisis, was the CoVaR by Adrian and Brunnermeier (2009), which measures the value at risk (VaR) of the financial system conditional on the financial market being under distress. They define an individual financial institution's marginal contribution to systemic risk as the difference between CoVaR and the financial system VaR.

From this starting point, one can analyze what makes a firm become systemic, which is crucial from a supervisory point of view. They find that leverage, size, and maturity mismatch are the key drivers of a high covar. Covar must be thought of for an individual firm, as it is not additive across firms (Tarashev et al, 2010).

Buiter (2009a) notes that Covar (which can be calculated through quantile regressions) do not necessarily measure causation, but rather correlation. Also, the CoVaR does not consider that the Var may behave very differently in crisis times. Secondly, and crucially, the coVar does not consider indirect effects, as it does not build the network of possible effects.

Segoviano and Goodhart's (2009) define systemic impact as the probability of having at least one extra bank failure given a particular bank fails, thus using conditional probabilities.

Zhou (2010) proposed a "systemic importance index", aka the number of bank failures caused by the failure of one particular bank.

Zhu (2009) constructs market-based systemic risk indicators, defined as the insurance premium for a hypothetical protection on liability losses when the financial system as a whole is in distress.

Zhu et al. (2009b) posit a rule to allocate systemic risk contributions, the losses from a particular bank conditional on the banking system being in distress. It has the same additive property (i.e. systemic risk contribution of individual banks add up to the system's risk) and incorporate size weight information and LGD information in the simulation.

Gauthier et al. (2010) use data on individual banks' loan books, risk exposures, and on interbank linkages including OTC derivatives for the Canadian banking system to compare alternative mechanisms for allocating the overall risk of a banking system to its member banks. They explicitly take into account that overall risk as well as each bank's risk contribution change once bank capital requirements change. Gauthier et al. (2010) consider five different ways to compute contributions to systemic risk, namely component VaR, incremental VaR, two kinds of Shapley values, and CoVaRs. They find that all five risk allocation mechanisms give similar results in terms of improving financial stability due to macroprudential capital buffers based on them that are quite different from the ones proposed at the BCBS.

One literature strand on the interconnectedness of financial systems models them as complex systems (Hommes 2006, 2008, 2009; Hommes and Wagener, 2009; LeBaron and Tesfatsion, 2008).

Generally, the interconnections arise from exposures in the interbank market. These exposures can be modeled by estimating the actual network structure of the financial system Lelyveld and Liedorp (2006), which can then help understand the contagion risks. A typical result of this literature is that systemic risk only arises if the largest banks fail. Gai and Kapadia (2008) and Nier et al. (2008) construct artificial homogeneous networks of banks to test the results mentioned above. They find that connectivity has two opposing effects on contagion risk: on one hand, by favoring diversification, it helps reduce the probability of failure. However, the interconnections amongst firms facilitate the propagation of risk once failure affects one of the firms in the network.

Relatedly, one can identify a measure of systemic risk and then calculate the contributions of individual institutions to it (Tarashev et al, 2009a, 2009b). Policy should be directed at the firms and the connections that lead to the systemic risk (Huang et al, 2009).

Acharya et al. (2009) calculate the contribution of each individual financial institution to the social cost of a systemic failure, which is considered proportional to its size and to the percentage loss or negative return it suffers when the market is below this threshold. They propose a levy on banks depending on the average of this contribution (its Marginal Expected Shortfall, MES) multiplied by its weight in the economy.

### 5.3. Financial stress and macroeconomic stability

The popularity of DSGE models in policymaking (Sbordone et al., 2010) made central banks vulnerable to three criticism. First, their unsatisfactory modeling of financial frictions (Bean, 2009). The model the BoE uses as an input to its MPC is an example of this (Harrison et al., 2005). Second, DSGE models generally analyze the transition towards a steady state, so are not able to model the dynamics that generate financial booms and busts (see Buiter, 2009b; Bank of England, 2009 and Tovar, 2008).

These limitations have been tried to overcome in different ways. First, augmenting DSGE with financial frictions (Curdia and Woodford, 2009; Christiano et al., 2008, Christiano et al., 2010, Gerali et al., 2009; Dellas et al., 2010.), The origin of this literature can be found in the financial accelerator of Bernanke et al. (1999). Some papers explicitly use these models to examine the interaction between monetary policy and the macroeconomy during the crisis. Del Negro et al. (2010) for example introduce a model with credit frictions of the form suggested by Kiyotaki and Moore (2008), as well as nominal wage and price frictions to show that the non-standard monetary policies followed by the Federal Reserve during the crisis prevented a repeat of the Great Depression in 2008-09. The standard references are Bernanke and Gertler (2001), Goodfriend (2002), and, for an overview of the arguments, Giavazzi and Mishkin (2006).

Kannan, Rabanal and Scott (2009) show that the reaction by monetary authorities to the financial accelerator that drive credit growth and asset prices can deliver financial and macroeconomic stability. In addition, a macroprudential instrument

designed specifically to dampen credit market cycles would be useful. In their model, policy responses must be flexible, if not, they run the risk of lowering stability. Vlieghe (2010) suggests that monetary policy take into account the fact that credit frictions may lead to an inefficient allocation of resources.

This set of models usually examines the financial sector from the point of view of its ability to allocate resources to the right borrowers. The interactions amongst lenders (or intermediaries) as a source of financial instability is largely absent from these models.

The second strand investigates frictions related to *financial intermediaries*, and studies the role of bank capital in the monetary transmission mechanism. Goodfriend and McCallum (2007) study the different financial markets, and so depart of the one interest rate hypothesis. By thus modeling the financial sector, they find that actual resource allocation and so optimal policy responses can deviate from the standard conclusions of the regular DSGE.

Other includes Cohen-Cole and Martinez Garcia (2008) and Gertler and Karadi (2009), who introduce balance sheet constraints of financial firms in a DSGE, and make use of Kiyotaki and Moore (2008)'s modeling of liquidity risk. However, Gertler and Kiyotaki (2009) is an RBC model without frictions, and so not a useful framework to study the effect of monetary policy, although it is valid for the analysis of credit policies. Jeanne and Korinek (2010) show that as borrowers do not internalize their contribution to aggregate volatility and as a result take on excessive leverage, thereby leading to boom-bust cycles. To reign in excessive leverage, Jeanne and Korinek (2010) propose a Pigouvian tax on borrowing that induces agents to internalize their externalities they generate.

A set of papers has looked at the interaction between capital regulation and macroeconomic performance. Covas and Fujita (2009) calculate the effect of capital requirement ratios on the business cycle, in a banking model that mirrors Holmstrom and Tirole (1998). They find that Basel II capital requirements are procyclical and so increase output volatility. Zhu (2008) finds that a risk-sensitive capital standard leads to much higher capital requirements for small and riskier banks, and much lower requirements for large and less risky banks.

Repullo and Suarez (2009) show that countercyclical capital buffers would reduce the incidence of credit rationing over the business cycle without compromising the long-run solvency targets implied in the original regulation. N'Diaye (2009) finds that binding countercyclical prudential regulations can help reduce output fluctuations and allow monetary authorities to achieve the same outcomes.

Meh and Moran (2008) construct a DSGE model in which the balance sheet of banks affects the propagation of shocks. They find that economies whose banking sectors remain well-capitalized experience smaller reductions in bank lending and less pronounced downturns. Bank capital thus increases an economy's ability to absorb shocks and therefore affects the conduct of monetary policy.

Macroeconomic Assessment Group (2010) mainly consider macroeconomic models without a financial sector: the effect of stronger capital and liquidity requirements is mainly assessed by first modeling their effect on credit spreads, economy-wide lending volumes and lending standards, and then modeling the effect of these on macroeconomic outcomes using standard semi-structural

macroeconometric models or DSGE models without a banking sector; but some DSGE models in which financial intermediaries and their balance sheets are modeled explicitly were also employed in the study. In Basel Committee on Banking Supervision (2010) the effect of a macroprudential overlay in the form of countercyclical capital buffers proposed under Basel III has not yet been analyzed.

Angeloni and Faia (2009) find that tighter monetary policy reduces bank leverage and risk, while a productivity or asset price boom increases it. They document that procyclical capital ratios are highly destabilizing. The best outcome is through mildly anticyclical capital ratios with monetary policy taking into consideration leverage and asset prices.

Angelini et al. (2010) develop a DSGE model, calibrated to the euro area and investigate whether a countercyclical capital requirements policy can usefully interact with monetary policy in achieving an inward shift of the output-inflation volatility trade-off. Policymakers' active management of capital requirements would improve the stabilization of economic activity.

Goodhart et al. (2005, 2006) De Walque et al. (2008, 2009) and Uhlig (2009) can also be considered attempts to include the banking sector in a macroeconomic model. Similarly, de Walque and Pierrard (2009) embed that same model into a DSGE model and examine the implications for monetary policy. They find that Taylor rules directly targeting some banking variables may perform better than standard Taylor rules targeting output.

Brunnermeier and Sannikov (2009) introduce the interactions between macroeconomic factors and the financial system in a model that does not necessarily evolve around a steady state. In this mode, the financial sector does not internalize all the costs it generates, and so some aspects, particularly in the presence of securitization, can lead to excessive risk taking. In general, the main conclusion is that the financial sector can achieve inefficient outcomes.

Related work examines the impact of monetary policy and funding liquidity on credit supply. Brunnermeier and Pedersen (2009) point to the important role of liquidity, and how liquidity is correlated with market performance. As a result, it can suddenly disappear, leading to liquidity crises. Adrian and Shin (2008) point to the health of bank balance sheets as a key transmission mechanism of the macroeconomic outcome of monetary policy. In this vein, according to Adrian and Shin (2009), interest rates can affect bank valuations and creditworthiness, and so, risk taking. Geanakoplos (2010) introduces leverage in a DSGE framework. Freixas (2009), Freixas and Jorge (2008), and Ongena and Popov (2009) also analyze the interactions between funding conditions, bank health and the macroeconomy.

Borio and Zhu (2008) analyze the role of bank capital in the transmission of monetary policy, in particular through banks' decisions of risk-taking. In particular, monetary policy affects banks' perceptions of risk tolerance, and so the exposure to risk they are willing to hold in their portfolios. This in turns determines the funding and debt they use. They consider three avenues by which monetary policy affects risk: through its effect on valuations, search for yield and central banks perceived reaction function: more aggressive when stress emerges than

when risk starts to build up (see Diamond and Rajan, 2009; Farhi and Tirole, 2010).

Dubecq et al. (2009), similarly, consider that risk taking is inversely proportional to the level of interest rate, which may in turn bias participants' perception of risk. Disyatat (2010) considers that balance sheet strength and risk taking can affect the mechanics of the bank lending channel.

There have also been important contributions to the debate from a more empirical perspective. Adrian and Shin (2009) find, empirically, that the size of balance sheets depends on short term interest rates. Maddaloni et al. (2008), Ioannidou et al. (2008) and Jimenez et al. (2009) find that lower interest rates leads banks to increase risk, via lower standards in credit origination. This effect can be deepened by innovation (Rajan, 2005) and by a long period of expansionary monetary policy (Altunbas et al., 2009; Gambacorta, 2009).

The empirical literature has analyzed monetary policy's role in the creation of bubbles. Some, like Taylor (2009), find that lower than optimal rates played a role in the formation of the housing bubble before the global financial crisis. However, others, including Dokko et al. (2009), do not find a central role for monetary policy in the formation of the housing bubble in those years.

Cecchetti et al. (2000) argue that monetary authorities should deflate asset bubbles Bean (2003, 2004, 2007, 2009) and Detken and Smets (2004) argue that bubbles and financial stability should be part of a central bank's reaction function, but not necessarily be a formal target of monetary policy.

#### 5.4. Measuring effectiveness

The literature on the impact of macroprudential policies is at a relatively early stage (see Turner, 2010).

Some have studied the case of pre-crisis in Spain, as in Borio and Shim (2007), with particular emphasis on the role of dynamic provisioning. Empirical studies find it had a small impact on credit, although it may have helped build up buffers in the upturn (Caruana, 2005, Saurina, 2009a). Saurina (2009b) finds that dynamic provisions provided a backstop and a larger first line of defense for financial firms. Jimenez and Saurina (2006) find that credit standards change throughout the cycle, which become more lenient in good times and stricter in the downturn. Such behavior may be curtailed by cyclical loan provision scheme that considers banks' risk appetite as an input. Fillat and Montoriol-Garriga (2010) find that had a dynamic provisioning system been in place, the need to use by TARP funds by firms would have been much smaller.

Keys et al. (2009) find that lending standards were significantly determined by the law in mortgage brokering. Nadauld and Sherlund (2009) also find that capital requirements can reduce the size of bubble-formation. Their analysis focuses on the effect of a change in the law in 2004, which reduced some elements of capital requirements, which they find played a role in the granting of low quality loans which eventually defaulted.

Part of the effort of the literature has focused on the data needed for an effective macroprudential supervision. In this context, some authors have argued for the



creation of an agency that collects more data from banks so as to have a fuller picture of their exposures to other institutions and to market events, like a rise in correlations (Lo, 2009; Sibert, 2010). From Sibert's (2010) point of view, while this data would be useful, the difficulty in understanding the driver of systemic risk would make them of limited use. The data are a starting point from which network effects and connectedness could be derived. One way of possibly overcoming this aspect (at least partially) would be through a timely collection of a wide array of data which would help researchers understand the risk building up in the system, as proposed by Brunnermeier et al. (2010), although it would still require a deeper understanding of the emergence of systemic risk.

Using data on individual banks' loan books, risk exposures, and on interbank linkages including OTC derivatives for the Canadian banking system, as mentioned above, Gauthier et al. (2010) take data on Canadian banks, and their exposures with other banks, as well as risk and loan books, and empirically calculate that a macroprudential capital buffer could reduce the probability of systemic stress by about 25%.

One controversial issue is the coordination of macroprudential policy across countries. This is particularly difficult in macroprudential policy (as in monetary policy) because leverage is usually not synchronized and regulatory arbitrage can undermine the effectiveness of the instruments used

Foreign currency exposures, at the heart of the wave of macroprudential policies that started in emerging economies in 2009 has also been the subject of much debate. Allen and Moessner (2010) show the foreign currency swaps put in place by the major central banks in the wake of the crisis played an essential role in saving several banking systems from severe distress. However, it remains to be seen whether central banks will be willing to accept such degree of foreign currency liquidity risk in the future, in an event of a lower magnitude.

Korinek (2010) uses the case of Indonesia to analyze the welfare implications of capital flows and risk taking. He finds that optimal taxes, which would target more volatile sources of funding could raise wellbeing significantly.

Bianchi (2009) uses a DSGE with credit frictions, calibrated to some features of emerging markets finds that an ex ante reduction in foreign currency debt can reduce the pressure on emerging economies, by reducing leverage and so the magnitude of the downturn when financing conditions worsen. In contrast, Benigno et al. (2010) do not find a clear preference for crisis prevention over intervention once the crisis starts.

### 5.3. Coordination with monetary policy and governance

The consensus was traditionally that monetary policy should be geared towards price stability over the medium term. There were, however, some exceptions, that considered the need to use monetary policy to Foster financial stability (e.g. Kent and Lowe, 1997; Borio and White, 2004; Filardo, 2004).

However, the crisis introduced the idea that financial stability be part of a central bank's reaction function, as noted by Trichet (2009), and Bernanke (2010).

Loisely et al. (2009) propose a model in which asset bubbles are possible because of her behavior in investment. Monetary policy, by introducing a cost to entrepreneurs who create new investment opportunities, can reduce those risks taken by banks. The model calibrates when this limitations may be beneficial from a social perspective.

Agur and Demertzis (2009) consider a central bank that tries to preserve financial stability. In downturns, the central bank has more of an incentive to cut rates so as to reduce the probability of default of risk, illiquid projects. However, on average, though the cycle, interest rates will be higher, so as to avoid excessive risk taking during boom times. Borio and Drehmann (2009a) consider monetary policy can complement, and complete, macroprudential policy and prevent financial imbalances from arising or limiting their scope.

The key is then the coordination of monetary and macroprudential policy. Some authors suggest it is analogous to the coordination between fiscal and monetary policy, which is modeled as a game in Lambertini and Rovelli (2003).

Cecchetti (2009) shows that monetary policy and capital requirements are substitutes. Bean et al. (2010) study the issue in a New-Keynesian DSGE taken from Gertler and Karadi (2009). As macroprudential tool they suppose regulators can directly affect the amount of capital that banks hold. As capital and leverage determine risk and lending, macroprudential policy can help monetary policy lean less against the wind and so have lower macroeconomic consequences. Macroprudential policy can be particularly useful if a country losses the ability to set rates (for instance because it enters a monetary union), as was the case of Spain upon entering EMU (Fernández and García Herrero, 2009).

## **6. Conclusions – topics for further research**

The recent financial crises has shed light on the importance on the interactions between fiscal stability, financial sector and the policies related. The intellectual apparatus used to deal with these issues remains, in spite of the fruitful and vast work of recent years, in a relatively early stage. In order to improve it, work remains to be done on different areas: 1) the improved understanding of the role of indicators to assess systemic risk and the determinants of connectedness of financial institutions and the sovereign; 2) the channels through which central bank policy and communication can lead to financial stability, by stabilizing financial markets and the interaction of the safeguarding of financial stability ad guaranteeing that the goals of monetary policy are met.

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