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Macroprudential framework: key questions applied to the French case

Taryk Bennani, Morgan Després, Marine Dujardin, Thibaut Duprey and Anna Kelber
Banque de France
Financial Stability Directorate

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This paper presents the main features of macroprudential policy with a focus on the French case. We first recall the ultimate objective of this policy, which is to prevent and to mitigate systemic risk, i.e. the risk of "widespread disruptions to the provision of financial services that have serious consequences for the real economy" (CGFS, 2012). We put forward two goals to achieve this ultimate objective, namely (i) increasing the resilience of the financial sector and (ii) leaning against the financial cycle. Then, in the context of the ongoing reflections on the organisation of macroprudential policy at the national and European level, we analyse the macroprudential institutional framework recently adopted in France. We discuss the instruments available to macroprudential authorities in light of the two main goals of macroprudential policy. Drawing on theoretical considerations and past experience, we favour a macroprudential toolkit broadly consistent with the European CRD IV/CRR package. Finally, we emphasise the need for macroprudential authorities to be able to monitor and detect systemic risk. To this end, several indicators and their reliability are analysed.

Keywords: macroprudential policy, central bank, systemic risk, financial crisis.

JEL codes: E58, G28, G18, G01, C50.

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Glossary

ACPR Autorité de contrôle prudentiel et de résolution
AMF Autorité des marchés financiers
ANC Autorité des normes comptables
AUROC Area under the receiver operating characteristic curve
BAFIN Bundesanstalt für Finanzdienstleistungsaufsicht
BCBS Basel Committee on Banking Supervision
BIS Bank for International Settlements
BoE Bank of England
BSI Banking stability index
CCB Countercyclical capital buffer
CCP Central counterparty
CDS Credit default swap
CET1 Common equity Tier 1
CGFS Committee on the Global Financial System
CIMDO Consistent information multivariate density optimizing
CoVaR Conditional value-at-risk
CRD Capital Requirements Directive
CRR Capital Requirements Regulation
DiDe Distress dependence matrix
D-SIB Domestic systemically important bank
DSR Debt service ratio
DSTI Debt-service-to-income
DTI Debt-to-income
EBA European Banking Authority
ECB European Central Bank
EDF Expected default frequency
ESRB European Systemic Risk Board
EU European Union
FCA Financial Conduct Authority
FDIC Federal Deposit Insurance Corporation
Fed Federal Reserve
FMSA Bundesanstalt für Finanzmarktstabilisierung
FPC Financial Policy Committee
FPR False positive rate
FSA Financial Services Authority
FSB Financial Stability Board
FSOC Financial Stability Oversight Council
G20 Group of twenty
GAAP Generally accepted accounting principles
GDP Gross domestic product
G-SIB Global systemically important bank
G-SIFI Global systemically important financial institution
G-SII Global systemically important institution
HCSF Haut Conseil de stabilité financière
HQLA High quality liquid assets
IAIS International Association of Insurance Supervisors
ICB Independent Commission on Banking
IFRS International financial reporting standards
IMF International Monetary Fund
IOSCO International Organisation of Securities Commissions

IRB	Internal ratings-based approach
JPoD	Joint probability of distress
LCR	Liquidity coverage ratio
LGD	Loss given default
LTD	Loan-to-deposit
LTI	Loan-to-income
LTSF	Loan-to-stable-funding
LTV	Loan-to-value
MES	Marginal expected shortfall
MFI	Monetary Financial Institution
MMF	Money market fund
MPC	Monetary Policy Committee
NCOF	Net cash outflows
NSFR	Net stable funding ratio
OBS	Off-balance sheet
OLA	Orderly Liquidation Authority
O-SII	Other systemically important institution
OTC	Over-the-counter
PD	Probability of default
PRA	Prudential Regulation Authority
ROA	Return on assets
ROC	Receiver operating characteristic
ROE	Return on equity
RWA	Risk-weighted assets
SCAV	Standing Committee on Assessment of Vulnerabilities
SCR	Sectoral capital requirement
SFT	Securities financing transaction
SIB	Systemically important bank
SIFI	Systemically important financial institution
SII	Systemically important institution
SRB	Systemic risk buffer
SRISK	Systemic risk measure
SSM	Single Supervisory Mechanism
TPR	True positive rate
VAR	Value-at-risk

The financial crisis has highlighted the limits of supervision that mainly focuses on microprudential aspects and individual financial institutions without taking proper account of the soundness of the financial system as a whole.[1] The original microprudential view sees systemic risk as an aggregation of individual risks. However, in both the subprime crisis that started in the United States in 2007 and the euro area sovereign debt crisis that began in 2010, financial shocks were propagated by a number of key factors. These include contagion across the financial system and to the real economy, interdependence of different natures between institutions, market infrastructures and markets and the inability of financial institutions to factor in the general equilibrium effects of their individual decisions. The stakes are high: over the September 2008–December 2010 period, European Union (EU) Member States provided the financial sector with state aid amounting to more than 10% of EU gross domestic product (GDP), in order to restore financial stability and the normal functioning of financial markets (European Commission, 2011).

When the 2007-2009 financial crisis emerged, a policy focusing primarily on the stability of the financial system as a whole was missing. Financial intermediaries, markets and financial infrastructures that comprise the financial system were unable to withstand shocks without major failures and to continue extending credit to the real economy. To prevent crises of this sort in the future, there is now a consensus on the relevance and the specific nature of a macroprudential approach, which should be coupled with microprudential supervision. This macroprudential approach should aim at "limiting", in the sense of preventing and actually mitigating, "systemic risk, i.e. the risk of widespread disruptions to the provision of financial services that have serious consequences for the real economy" (Committee on the Global Financial System – CGFS, 2012). Yet, even though important steps have been taken in recent years, the debate regarding the definition, objectives, instruments and institutional framework of macroprudential policy is ongoing.

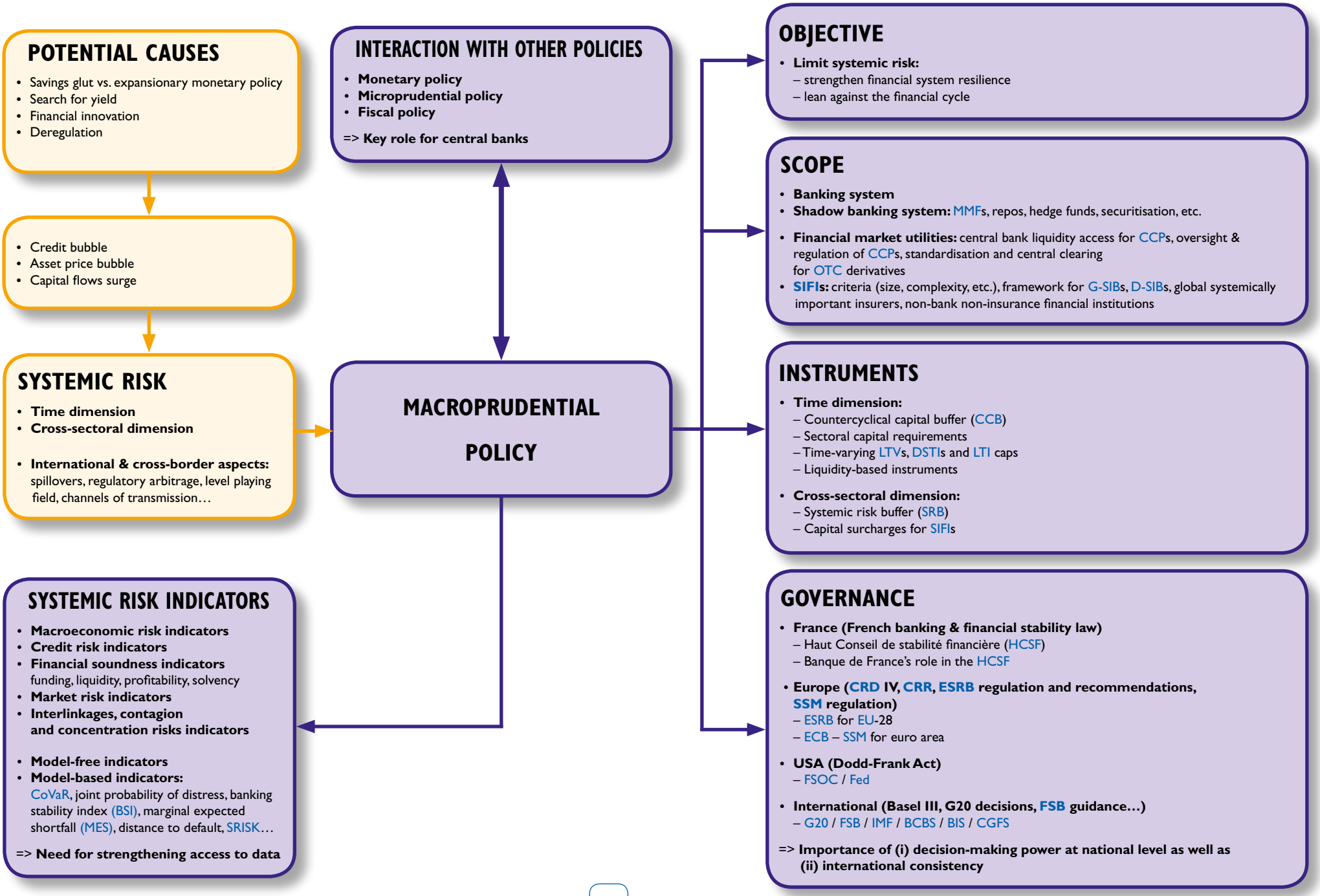
It is therefore a priority to define and implement a consistent framework for macroprudential policy, both at the national level through implementation of France's recent law on banking and financial stability, and at the European level with the European Central Bank (ECB)/Single Supervisory Mechanism (SSM) for the euro area, and the European Systemic Risk Board (ESRB) for the European Union. Against this background, we discuss key issues related to macroprudential instruments, authorities in charge of such instruments and the ability of these authorities to monitor systemic risk.

Resolution regimes that apply to systemically important financial institutions (SIFIs) are aimed at preventing systemic disruptions in times of stress and increasing the resilience of the financial sector. They strengthen market discipline and reduce incentives to take excessive risks, mitigating the need for macroprudential intervention (International Monetary Fund – IMF, 2013c). Effective and credible resolution regimes are complementary to macroprudential policy but are not macroprudential instruments *per se*. They are therefore not within the scope of this paper.

The paper is organised as follows: section 1 presents the objective and rationale for macroprudential policy; in section 2, we examine the institutional architecture currently implemented in France and Europe. In section 3, we present a range of macroprudential instruments, in the context of entry into force of the Capital Requirements directive (CRD) IV/Capital Requirements Regulation (CRR) package. Finally, in section 4, we discuss a set of indicators that can be followed by macroprudential authorities to detect the build-up of systemic risk with the aim of potentially activating macroprudential instruments.

1 See Brunnermeier et al. *(2009), pp. 11-21, for a detailed explanation of why microprudential regulation alone is an unsatisfactory basis for ensuring the stability of the system as a whole.*

Figure 1 Overview of the macroprudential policy framework



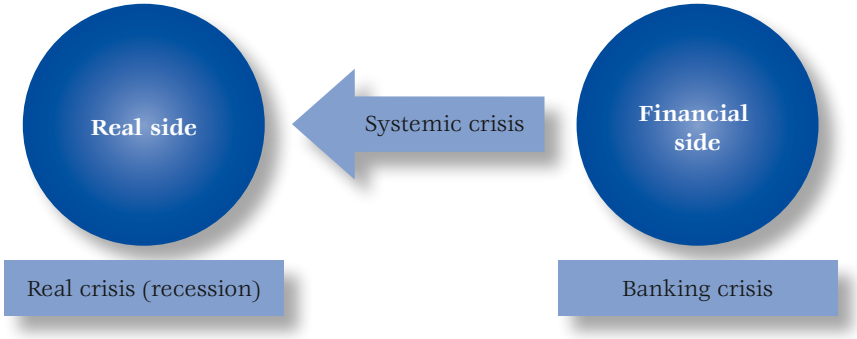
1| Objectives and rationale of macroprudential policy

Broadly, the ultimate objective of macroprudential policy is to limit the risks and costs associated with systemic financial crises (Galati and Moessner, 2013). Such crises are specific in the sense that financial intermediaries' solvency and/or liquidity is severely impaired, preventing them from properly fulfilling their intermediation function, namely channeling credit into the real economy. These restricted credit conditions spill over into the real economy and undermine economic activity. In this sense, systemic financial crises are distinct both from "normal" recessions (see Figure 2), which do not always involve serious credit constraints, and from "pure" banking crises, which do not affect the real economy (Laeven and Valencia, 2008).

While views have converged over the past two decades on the objective of monetary policy, a consensus on the definition and objectives of macroprudential policy has yet to emerge (Galati and Moessner, 2013). In line with the definition endorsed by the CGFS (2012), this paper assumes that the ultimate objective of macroprudential policy is "to limit systemic risk, i.e. the risk of widespread disruptions to the provision of financial services that have serious consequences for the real economy". This systemic risk may arise from "intrinsic procyclicality" created *inside* and *by* the financial system (see also 1|1).

The ultimate objective of macroprudential policy is difficult to quantify. Operational specifications in the form of intermediate objectives may help in this regard. In the following, we discuss two main goals of macroprudential policy, namely (i) increasing the resilience of the financial sector and (ii) leaning against the financial cycle (1|1). We also mention several intermediate objectives of macroprudential policy (1|2) and discuss its scope (1|3).

Figure 2 Systemic crisis



1|1 Increasing the resilience of the financial sector and leaning against the financial cycle

Two goals, related to the cross-sectional and time dimension of systemic risk,[2] can be put forward to achieve macroprudential policy's ultimate objective.

On the one hand, macroprudential policy can aim to enhance the resilience of the financial system, i.e. its ability to absorb financial or economic shocks without major repercussions. To achieve this, macroprudential policy particularly targets systemically important institutions, whose failure could jeopardise the whole financial system. It does not primarily set out to prevent all failures, or to ensure the financial soundness of

2 *Close interlinkages can make it hard to distinguish between the two dimensions.*

each individual institution, but to avoid failures which the financial system could not cope with.[3] In addition, as negative externalities can also arise across the financial system (Acharya *et al.*, 2009), macroprudential policy strives to limit collective defaults, which occur as a result of strong interlinkages or massive exposures to an aggregate risk, for instance when reliance on short-term wholesale funding becomes excessive and creates liquidity risk. This goal is related to the cross-sectional or structural dimension of systemic risk, which refers to the distribution of risks in the financial system at a given moment (IMF, 2011a).

On the other hand, macroprudential policy can aim to mitigate financial system procyclicality, i.e. the mechanism through which financial systems can amplify economic cycles and swings in the real economy (Borio *et al.*, 2001), either by encouraging boom cycles during which risks accumulate and are underestimated or, conversely, by exacerbating disruptions during bust cycles due to excessive risk aversion.[4] In recent decades, developments in the financial sector have indeed reinforced the momentum of underlying economic cycles, and in some cases have led to extreme swings in economic activity. This goal relates to the time dimension of systemic risk.

While information asymmetries between borrowers and lenders are considered essential driving factors of the business cycle (Bernanke *et al.*, 1999), additional aspects are presumably leading to the occasionally very large swings in economic activity that occur together with financial instability. A crucial aspect is that financial market participants do not appropriately react to changes in risk over time, due to difficulties in measuring the time dimension of risk and to the socially suboptimal risk-taking incentives of market participants (Minsky, 1982, 1992; Rajan, 2006). An important step to help mitigate undesired procyclicality in the financial system is to use regulatory instruments which act in a countercyclical way, encouraging the build-up of a protective cushion in good times that can be drawn down in bad times. By "leaning against the wind", instruments focusing on the time dimension of risk could reduce the amplitude of the financial cycle, thereby limiting the likelihood of financial distress in the first place.

1|2 Intermediate objectives of macroprudential policy

In practice, the implementation of macroprudential policy is likely to be facilitated by identifying a set of more delimited objectives which would provide the basis for selecting instruments and assessing policy efficiency. In this regard, those intermediate objectives would contribute to making macroprudential policy more accountable.

Following the ESRB recommendation on the intermediate objectives and instruments of macroprudential policy (ESRB, 2013), an indicative list[5] of intermediate objectives based on specific market failures could be the following:

- mitigate and prevent excessive credit growth and leverage;
- mitigate and prevent excessive maturity mismatch and market illiquidity;
- limit direct and indirect exposure concentration;
- limit the systemic impact of misaligned incentives.

3 *However, policies aiming at greater resilience at the individual bank level (microprudential policy) are likely to have a positive impact on the resilience of the whole system as well (BCBS, 2010d). Yet, if synergies do exist, the objectives of microprudential and macroprudential policies may also sometimes conflict with each other.*

4 *However, the aim of mitigating procyclicality is not to eliminate financial cycles. Rather, it seeks to prevent the excessive volatility and magnitude of such cycles. At the same time, it is important to bear in mind that not all procyclicality necessarily leads to real and significant damages. For instance, procyclicality in the real economy can benefit long term growth, since it is "one mechanism through which 'creative destruction' can take place in the productive system" (Landau, 2009).*

5 *Depending on developments in the financial system and systemic risks, this list may evolve.*

Regarding the first intermediate objective, excessive credit growth and leverage may include, for instance, a tendency to collectively underestimate risk during good times, due to short-term memory ("risk illusion"). The second intermediate objective is focused on excessive maturity mismatch and market illiquidity which can result from a loss of confidence or pessimistic expectations and may prompt fire sales, banks runs and market malfunction. The third intermediate objective targets direct and indirect exposure concentration which, if excessive (large exposures to the same risk or counterparty for instance), may in particular cause contagion and fire sales. The fourth intermediate objective is to address moral hazard issues which may for instance be reflected in "too-big-to-fail" features (ESRB, 2013).

1|3 Scope of macroprudential policy

By nature, macroprudential policy aims at safeguarding the whole financial system. Hence, to be effective, it should be able to encompass all entities making up the financial system, namely: financial markets, financial intermediaries such as banks, insurance companies or institutional investors, and financial infrastructures.

In this context, as stated by Hanson *et al.* (2010), regulators need to pay attention to all the channels through which the actions of financial institutions – including those currently unregulated – can cause damage. Kashyap *et al.* (2011) argue that a satisfactory regulatory toolkit needs to include more than two tools (Basel III mainly focuses on capital and liquidity at this stage) to address the three major sources of instability (defaults, credit crunches and fire-sales). If only a single capital tool and a single liquidity tool are available, then using them could create incentives to push activity into the shadow banking system. A possible step towards avoiding this outcome would be to impose comparable capital standards on a given type of credit exposure, no matter who is ultimately holding it. This could be done, for instance, through broad-based regulation of haircuts on asset-backed securities (Hanson *et al.*, 2010).[6] The authors argue that if these regulatory requirements are well-structured, they could help to harmonise regulation across organisational forms and thus reduce the incentives for moving lending activity to the shadow banking sector. At the same time, for assets that move to the shadow banking sector, haircut requirements on all investors, irrespective of their identity, could mitigate the adverse effects.

For all these reasons, it is essential for the scope of macroprudential policy to address systemic risks in the shadow banking system as well. In this vein, the Financial Stability Board (FSB, 2011a) emphasises that "enhancing supervision and regulation of the shadow banking system in areas where systemic risk and regulatory arbitrage concerns are inadequately addressed is important". In particular, the part of the shadow banking system that should be looked at more closely can be defined as "a system of credit intermediation that involves entities and activities outside the regular banking system, and raises (i) systemic risk concerns, in particular by maturity/liquidity transformation, leverage and flawed credit risk transfer, and/or (ii) regulatory arbitrage concerns". Regarding the development of possible regulatory measures for the shadow banking sector, FSB (2011a) mentions that "a single regulatory approach for all components of the shadow banking system is unlikely to be desirable". Concerning macroprudential measures, it is highlighted that "rather than focusing on certain entities or activities, policy measures can address systemic risk in the shadow banking system more broadly (e.g. regulatory measures for mitigating procyclicality or policies to strengthen market infrastructure to lower contagion risks)". In this regard, the FSB strategy to deal with fault lines in the shadow banking sector focuses on five areas: (i) mitigating the spillover effect between the regular banking system and the shadow banking system; (ii) reducing the susceptibility of money market funds to "runs"; (iii) improving transparency and aligning incentives in securitisation; (iv) dampening financial stability risks and procyclical incentives associated with securities financing transactions; and (v) assessing and mitigating systemic risks posed by other shadow banking entities and activities (FSB, 2013a). Above all, the approach to supervising shadow banking entities has to be integrated into the macroprudential regulatory frameworks currently under development in a number of countries (European Commission, 2012a).

However, given the wide scope of macroprudential policy, conflicts with other economic policies may arise.

6 *In the case of a consumer loan, if granted by a bank, it will be subject to a capital requirement. If, however, the loan is securitised by the bank and becomes part of a consumer asset-backed security whose tranches are distributed to investors, then regulation should require the holder of such a tranche to post and maintain a minimum haircut.*

1|4 Interactions and potential conflicts with other policies

1|4|1 With monetary policy

Monetary policy[7] and macroprudential policy should generally reinforce one another (Angelini *et al.*, 2011), especially when one of the two faces constraints (IMF, 2013a). Yet, the former policy does not guarantee the latter (and vice versa) and conflicts of objectives may arise, for example, in periods when monetary policy does not prevent asset price bubbles from arising. Nonetheless, using an estimated dynamic stochastic general equilibrium (DSGE) model with financial frictions, Beau *et al.* (2012) show that "episodes of conflicts should be rather limited, on average, over the business cycle".

Potential conflicts may be avoided by prioritising objectives, implementing clear governance procedures (such as a strict separation of decision-making bodies between monetary policy and macroprudential policy) and using specific instruments for each objective.[8]

1|4|2 With fiscal policy

Fiscal policy may have major consequences for financial stability. For instance, excessive deficits or public debt levels may greatly increase the vulnerability of the financial sector, as recalled in FSB (2011c). Conversely, macroprudential policy may result in a rise in capital requirements during a period of overly strong credit expansion (by the triggering countercyclical buffers). This, in turn, reduces both the supply of credit to the economy and ultimately, demand, which influences the government's economic policy.

For this reason, a clear and well-understood division of tasks is essential (FSB, 2011c): macroeconomic policy aims to correct economic imbalances, whereas macroprudential policy seeks to contain systemic risk. Some involvement of fiscal authorities in macroprudential policymaking is nonetheless desirable, with a view to facilitating discussions of the legislative changes needed to adapt regulation and establish new macroprudential tools (Nier *et al.*, 2011).

1|4|3 With microprudential policy

Close coordination between macro and microprudential supervision is of utmost importance. However, there may be potential conflicts of objectives between macro and microprudential policies. In particular, responses adapted to the individual level of a credit institution may have an adverse impact at the level of the system. For example, in response to a crisis, the institution may restrict lending and sell off assets. Microprudential regulations may encourage this type of behaviour, which most financial institutions end up adopting (Goodhart, 2011). Conversely, macroprudential regulations can prompt institutions to reduce the level of additional capital buffers in the event of a crisis, thus running counter to the supervisors' aim of having institutions maintain high capital levels (Bank for International Settlements – BIS, 2011; FSB, 2011c). Indeed, macroprudential policy is not merely the sum of microprudential considerations, as underscored by BIS (2011): contagion and interaction have a greater impact than individual banking cases on financial stability.

This case for conflicting issues between economic policies, combined with the wide scope of macroprudential policy, call for a clear institutional set-up. This is discussed in the next section, in light of the current implementation of macroprudential authorities in Europe and in France.

7 *See Beau* et al. *(2012) for a detailed discussion on the interaction between monetary and macroprudential policies.*

8 *According to the Tinbergen rule.*

2| The institutional set-up: governance issues

2 | 1 The macroprudential set-up, mandate and powers

Macroprudential policy must be organised on the basis of certain key aspects set out in a number of reference documents on this subject.[9]

First, in each jurisdiction, it is essential to identify a macroprudential authority with a clear mandate and objectives.

The macroprudential authority may be either a single institution or a board or council composed of several institutions with financial stability powers. In the latter case in particular, it is important to establish clear arrangements for coordination and cooperation between the institutions.

For the following reasons, an international consensus has emerged for central banks to play a leading role in the conduct of macroprudential policy,[10] provided the independence of their monetary policy function is not affected:[11]

- central banks have a comparative advantage thanks to their multiple areas of expertise, which include macroeconomics, financial institutions when central banks also play a microprudential supervisory role, analysis of interactions between financial markets and the real economy and oversight of financial infrastructures;

- they have the competencies required in the area of financial stability and are at the crossroads of monetary, microprudential and macroeconomic policies, making them suited to best exploit synergies and optimise information transmission, coordination and decision making in this area;

- their independence gives them a certain advantage in objectively assessing risks and formulating opinions and recommendations;

- they are lenders of last resort;

- they are generally in charge of payment systems.

The existence of an explicit mandate can remove ambiguities concerning the legitimacy of the macroprudential authority's actions by placing it in a clear legal framework. At the same time, the mandate is a certain safeguard against inaction bias. It should also give the authority adequate powers to correctly perform its tasks. For instance, the authority should be able to obtain all the necessary information (see 4|4), such as data relating to the supervision of banks, insurance companies and other financial institutions or concerning market infrastructures. Provided appropriate arrangements are in place to ensure respect for strict confidentiality criteria, this information may include individual data and/or data covered by professional secrecy rules. It is essential that the authority be able to apply macroprudential regulations to the appropriate scope within the financial sector with a view to preventing regulatory arbitrage and ensuring a level playing field.

9 *BIS (2011), IMF (2011a), ESRB (2011), FSB (2011c).*

10 *For example, the ESRB recommendation (ESRB, 2011) posits that central banks play a leading role in macroprudential policy. The central bank may either be the macroprudential authority itself, or play a leading role in the authority if it is a multi-agency board. An example is the support of the ECB in the key role played by Deutsche Bundesbank in the new institutional framework for macroprudential supervision in Germany (ECB, 2012). Nevertheless, a few countries have made different choices. For example, the macroprudential designated authority in Austria is the Financial Market Authority (FMA). Before executive regulations are issued, the FMA has to consult the Austrian central bank (OeNB) and the Ministry of Finance. A Financial Market Stability Committee has also been set up.*

11 *Safeguards for the independence of the monetary policy function would be for example separate decision-making structures for monetary and macroprudential policies, or separate accountability and communications structures (Ueda, Valencia, 2012).*

The abovementioned powers must be accompanied by rules ensuring accountability (e.g. auditions before the Parliament) and transparency. In order to avoid inaction bias, in addition to an explicit mandate, a macroprudential regime of "guided discretion" or "constrained discretion"[12] should be preferred to (i) a purely discretionary one (i.e. one based exclusively on the authority's judgement), or to (ii) a purely rule-based one, since there is no consensus at this stage either on the appropriate combination of macroprudential instruments or on which indicators provide an unequivocal sign that timely action is needed. Finally, the authority should also be independent, at least operationally (its budget and personnel for example), with respect both to the government and to private players in the financial sector.

A number of countries recently reviewed their institutional arrangements for financial stability to support the development of a macroprudential policy function. Table 1 provides a typology of various models based on five key dimensions.

Table 1 Stylised models for macroprudential policy

Features of the model	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
1. Degree of institutional integration of central bank and supervisory agencies	Full (at the central bank)	Partial	Partial	Partial	No	No	No	No
2. Ownership of macroprudential policy mandate	Central bank	Committee "related" to central bank	Independent committee	Central bank	Multiple agencies	Multiple agencies	Multiple agencies	Committee (multinational; regional)
3. Role of Treasury/ government	No	Passive	Active	No	Passive	Active	No	Passive (European Commission; Economic and Financial Committee)
4. Separation of policy decisions and control over instruments	No	In some areas	Yes	In some areas	No	No	No	Yes
5. Existence of separate body coordinating across policies	No	No	No	No	Yes	Yes	No	No
Examples of specific model countries/ regions	Ireland	United Kingdom	France Germany United States	Belgium	Australia	Canada	Switzerland	EU (ESRB)

Source: Nier et al.*, 2011.*
Update: Banque de France.

12 *See for example Goodhart (2011) or IMF (2013b).*

2|2 Need for coordination within the EU and at the international level

Macroprudential policy cannot be regarded as a purely domestic issue, due to the high degree of interconnectedness between financial systems and the risks of spillovers and regulatory arbitrage. Cooperation on macroprudential policies requires institutional mechanisms to promote a common understanding of threats to global financial stability and consistency in the implementation of macroprudential frameworks in individual countries.[13]

As far as global assessment of vulnerabilities is concerned, a number of monitoring exercises are conducted under the aegis of the FSB, Standing Committee on Assessment of Vulnerabilities (SCAV), as well as jointly with the IMF via the Early Warning Exercise. The IMF also conducts some bilateral and multilateral surveillance exercises. At the BIS, the CGFS is the forum where central bank governors exchange views on upcoming vulnerabilities and the identification of common risks and contagion channels across financial systems. In the European Union, the ESRB has also developed a risk dashboard that identifies and measures systemic risks through a set of qualitative and quantitative indicators. The dashboard is one of the inputs in the ESRB General Board discussions on risks and vulnerabilities in the EU financial system. The ECB, in its bi-annual *Financial Stability Review*, has also developed a matrix of "key risks" to financial stability.

Using macroprudential instruments on a national or regional basis is an appropriate way of tackling regional sources of systemic risk. However, as economies in the European Union are intertwined and interdependent, the macroprudential measures of one Member State (action as well as inaction) can impact on other Member States. These effects can be positive or negative. While allowing for the positive spillovers of macroprudential policy, the aim is to minimise its negative cross-border externalities. To identify possible externalities and suggest forms of coordination to mitigate them, the ESRB set up a working group to analyse these issues; the findings are summarised in ESRB (2012). With regard to bank activities, four main types of adverse spillovers were identified: (i) unintended effects on credit supply, (ii) capital shift, (iii) pressure for gold plating i.e. national bodies exceeding the terms of European Union directives when implementing them into national law, and (iv) increased systemic risk.[14]

The potential unintended effects on the supply of credit depend on the way capital requirements are imposed, for instance by entity or by exposures. Moreover, independently of whether entities or exposures are targeted, another scenario might come into play: even though country A has tighter policy, banks might not decrease credit supply there, instead repatriating capital from country B (a so-called capital shift), either through deleveraging in B or by reducing voluntary buffers in there (e.g. if B loosens policy). In a similar vein, a higher capital requirement uniformly imposed at the level of the entire global banking group might result in a substantial decrease of the group's credit exposure in "non-core" countries while maintaining exposures in key countries (IMF, 2013d).

Besides, higher requirements in one country might result in market pressure on banks in other countries to meet the same requirements. Potentially, that pressure could aggravate an economic downturn and hence increase systemic risk and/or lower credit supply by more than would have otherwise been the case. Inappropriate policy action in the form of too loose or too tight policy action – possibly induced by inaction – can create procyclicality, drive up systemic risk and ultimately lead to a bust, with negative effects for other countries. An upswing would be further fuelled by excessive lending supported by overly loose regulation, and the downswing would be aggravated by restrictive lending due to excessively tight regulation. The consequences of a financial crisis would spill over to other countries.

13 See Appendix B for additional information regarding macroprudential policy authorities in the Unites States, United Kingdom and Germany.

14 In addition to these four types of adverse spillovers, it has been argued that tighter restrictions on bank activities and higher minimum capital requirements in one country might lead to higher bank risk-taking abroad, as cross-border banks would have an incentive to lower their lending standards in the host country to compensate for the inability to take on risk in the home market.

To minimise negative cross-border spillovers, it could be useful to extend to other capital requirements the "reciprocity principle" which was originally developed for the countercyclical capital buffer (CCB) in the Basel III framework. Under this reciprocity principle, the CCB rate set in a jurisdiction applies to all credit exposures in its jurisdiction. The CCB rate of a banking group is then calculated as the weighted average of the CCB rates that apply in the jurisdictions where the bank's relevant credit exposures are located.

Finally, ex ante coordination of macroprudential policy decisions seems an appropriate way forward to tackle and prevent negative cross-border externalities.

2|3 The framework in Europe

Theoretically, it may seem difficult to assign macroprudential instruments to either national or European authorities since this depends on the externalities and shocks one seeks to counter. The authority charged with implementing macroprudential instruments should be determined by the nature and magnitude of asset price bubbles or the procyclical mechanisms or financial shocks. On the one hand, when shocks are of a cross-border type for example, they cannot be dealt with by a single national authority. On the other hand, given the divergence of national credit cycles and the essentially local or regional nature of several economic phenomena, such as real estate, a strong decisional role for national macroprudential authorities remains essential. Consequently, a pragmatic approach should be adopted if a potentially systemic financial shock occurs. The pre-assignment of macroprudential instruments to one or more authorities should ensure timely action as well as greater transparency in the roles played by the respective authorities. In this respect, it appears preferable to leave the task of implementing macroprudential instruments to the discretion of national authorities, provided prior notification is given to the European authorities in order to minimise the risks of regulatory arbitrage and cross-border effects.

The latter organisation broadly corresponds to the division of roles between the national macroprudential authorities and the European level (ECB, ESRB) set out in the EU legislation establishing the SSM,[15] the CRD IV/CRR package, which is gradually implemented from 1 January 2014 onwards,[16] and various ESRB legal documents.[17]

The ESRB issued in December 2011 a recommendation on the macroprudential mandate of national authorities (ESRB, 2011). This recommendation covers the objectives, tasks and instruments of macroprudential policy, the institutional arrangements, the transparency and accountability procedures as well as the conditions for independence from the industry and political bodies. As the ESRB does not have binding powers, jurisdictions which do not fully comply with the recommendation will be asked to explain the reasons for non-compliance under the "comply or explain" mechanism.

The EU regulation establishing the SSM provides for a specific allocation of tasks and responsibilities relating to macroprudential instruments between the European and the national level, "in accordance with the relevant provisions of [European] Union Law". Hence, the procedure described in the SSM regulation should be understood as applying to the macroprudential instruments provided in the CRD IV/CRR package (see 3|5.). Furthermore, in the CRD IV transposition process, each Member State is in charge of appointing either a national designated authority (i.e. the macroprudential designated authority) and/or a competent authority (i.e. the banking supervisor) for the purpose of implementing macroprudential instruments. In this vein, the procedure set out in the SSM regulation vests the national designated and/or competent authorities with the main responsibility for applying

15 *Council Regulation conferring specific tasks on the European Central Bank concerning policies relating to the prudential supervision of credit institutions of 12 September 2012, adopted by the European Parliament in September 2013 and by the Economic and Financial Affairs Council (ECOFIN) in October 2013.*

16 *Institutions are required to apply the new CRD IV/CRR rules from 1 January 2014, with full implementation on 1 January 2019.*

17 *Regulation (EU) No. 1092/2010 of the European Parliament and of the Council of 24 November 2010 on European Union macroprudential oversight of the financial system and establishing a European Systemic Risk Board.*
Recommendation of the ESRB of 22 December 2011 on the macroprudential mandate of national authorities.
Recommendation of the ESRB of 4 April 2013 on intermediate objectives and instruments of macroprudential policy.

macroprudential measures foreseen in the CRD IV/CRR package, although the national authorities are subject to a specific notification and coordination process vis-à-vis the ECB. The national authority has to notify its intention ten working days before taking its decision. The ECB has the possibility to object to this decision, in which case, it is expected to provide a written explanation within five working days. Such an objection does not bind the national designated and/or competent authority, but the authority should duly consider the ECB's reasons. If deemed necessary, the ECB, instead of the national designated and/or competent authority, may also apply higher requirements for capital buffers than applied by the national authorities and more stringent measures aimed at addressing systemic or macroprudential risks. The regulation also allows national authorities to propose that the ECB take a measure in order to address the specific situation of their country's financial system and economy.

Furthermore, to achieve consistent application across the European Union, CRD IV/CRR mandates the ESRB to develop a set of appropriate principles for the European Union economy and makes it responsible for monitoring their application.

Regarding the ECB macroprudential framework, precautions have been taken in order to ensure that ultimate decisions regarding macroprudential policy will be within the competence of the ECB Governing Council, while allowing the microprudential perspective to be properly taken into account. In the future, the respective roles of the ECB and the ESRB regarding macroprudential policy will have to be clarified to avoid overlaps.

Overall, the architecture designed under the European regulatory framework (both for the EU-28 and the euro area) corresponds to a balanced and operational division of roles. Nevertheless, particular attention should be paid to simplify a sometimes overly complex governance architecture and ensure prompt and operational macroprudential decision-making (see procedures described in Appendix A).

2|4 The framework in France

The macroprudential framework being implemented in France following the passage of the law on separation and regulation of banking activities has to be seen as part of the general European backdrop. That framework is documented notably in the ESRB recommendation on the macroprudential mandate of national authorities (ESRB, 2011) and in the implementation of the new Basel III agreement, transposed into European law by the CRD IV/CRR package.

The French law on separation and regulation of banking activities, passed in July 2013, appoints the High Council for Financial Stability (*Haut Conseil de stabilité financière* – HCSF)[18] as the national designated macroprudential authority. The HCSF, chaired by the Minister of Finance, will comprise the Governor of the Banque de France, the Vice-Chairman of the *Autorité de contrôle prudentiel et de résolution* (ACPR, the banking and insurance supervisor and resolution authority), the Chairman of the Financial Markets Authority (*Autorité des marchés financiers* – AMF, the securities regulator) and the Accounting Standards Authority (*Autorité des normes comptables* – ANC). In addition, three qualified experts are appointed respectively by the chairs of both legislative assemblies and the Minister of Finance for a five-year term. These experts, selected for their expertise in the monetary, financial or economic fields have to comply with strict rules aimed at preventing conflicts of interest. The HCSF is due to meet on a quarterly basis.

The HCSF will set macroprudential policy in France and be in charge of overseeing the financial system as a whole. More precisely, it is entrusted with a wide range of tasks and binding powers of intervention:

– ensuring smooth information exchange between members authorities;

– identifying and assessing systemic risks with due regard to the recommendations and advice of the competent European institutions;

18 The previous Council was known as COREFRIS (Conseil de régulation financière et du risque systémique).

– issuing any advice or recommendation to prevent systemic risk;

– upon a proposal from the Governor of the Banque de France, imposing stricter capital requirements on investment firms and credit institutions to prevent excessive credit growth or reduce risks of financial system destabilisation;

– upon a proposal from the Governor of the Banque de France, setting credit institutions' credit standards to prevent, in particular, undue increases in asset prices and excessive private debt levels;

– issuing advice to competent European institutions aiming at recommending adoption of specific measures to address domestic risks to financial stability (see 2|3);

– facilitating the cooperation of member authorities as regards the preparation of European and international financial regulations and issuing advice in that respect.

In carrying out its tasks, the HCSF will take into consideration financial stability objectives within the EU and work in cooperation with equivalent authorities in other EU Member States and with competent European institutions.

In France, the HCSF, as so-called "designated authority", will be in charge of the countercyclical buffer and the systemic risk buffer (see also part 3 and specifically 3|5). In addition, the HCSF will be in charge of Article 458 of the CRR which allows, under certain conditions, the tightening of requirements for own funds, large exposures, public disclosure, liquidity, risk weights for the property sector and intra financial sector exposures, with a macroprudential purpose (see part 3|5 for more details). Moreover, the HCSF is expected to have full responsibility to apply macroprudential tools currently not harmonised in European legislation, such as loan-to-value (LTV), debt-service-to-income (DSTI) and loan-to-income (LTI) ratios. As regards the ACPR, it will be in charge of the global systemically important institution (G-SII) and other systemically important institution (O-SII) buffers, and other measures such as Pillar 2 and Article 124 of the CRR.[19]

In accordance with the ESRB recommendation, the French law also reinforces the role of the Banque de France in the HCSF. First, the Banque de France has been given an explicit financial stability mandate,[20] not previously one of its official tasks. Furthermore, as mentioned above, key decisions by the HCSF such as setting stricter capital requirements or credit standards will be taken upon proposals by the Governor of the Banque de France in order to prevent, in particular, asset price run-ups and excessive private debt.

This newly adopted French macroprudential governance framework combining a multi-agency council with binding powers and a key role for the central bank appears to be largely in line with the guiding principles of the current consensus.

19 Ordonnance n° 2014-158 portant diverses dispositions d'adaptation de la législation au droit de l'Union européenne en matière financière, *20 February 2014*.

20 *According to Article 29 of the law: "The Banque de France shall safeguard, together with the HCSF, the stability of the financial system. It shall contribute to the implementation of decisions of this High Council".*

3| Macroprudential policy instruments

As in the case of the objective of macroprudential policy, a consensus on the appropriate macroprudential instruments is still missing. While a range of possible instruments has been investigated, neither a primary instrument nor a standard taxonomy of instruments has been identified (Galati and Moessner, 2013). The choice of specific macroprudential instruments has to be understood as being part of a broader process of risk identification and risk measurement which should provide useful information about the specific implementation of macroprudential instruments (cf. Figure 3).

There are several ways to categorise the different instruments (see Appendix C). One distinction is between instruments that have been explicitly developed to mitigate systemic risk (i.e. newly developed instruments for macroprudential purposes) and pre-existing instruments (microprudential ones for instance) that have been modified to address macroprudential purposes.[21] Another important distinction is between instruments addressing the time dimension and those addressing the cross-sectional dimension of systemic risk.[22] One can also distinguish between price-based instruments (such as the setting of capital and liquidity ratios or the taxing of financial transactions) and quantity-based measures (for example, the setting of loan-to-value caps or debt-to-income limits for mortgages).[23] Table 2 shows a number of macroprudential instruments classified according to the intermediate objectives they follow (adapted from ESRB, 2013).

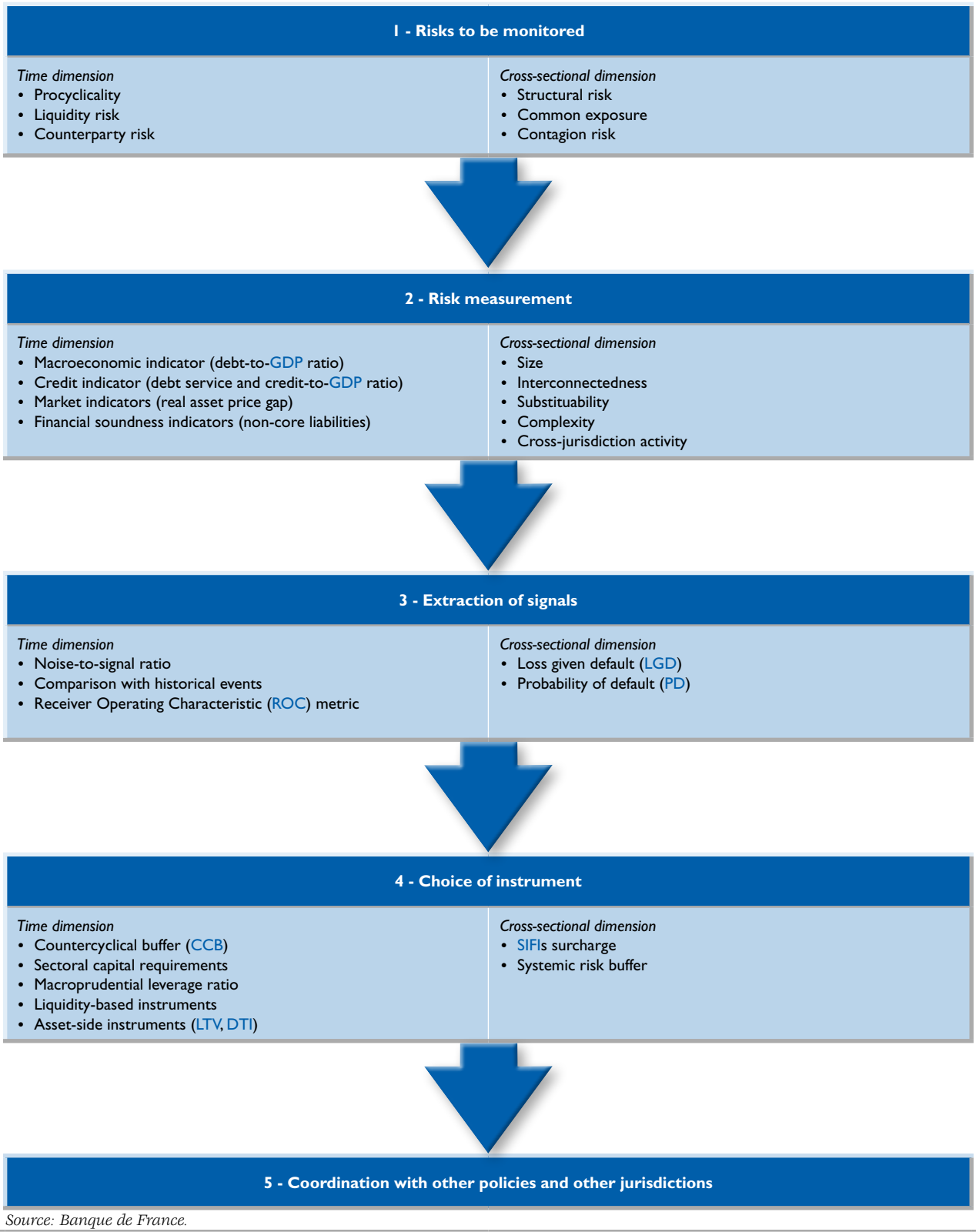
The report of the CGFS working group on operationalising the selection and application of macroprudential instruments (CGFS, 2012) differentiates between instruments addressing the time-dimension and those addressing the cross-sectional dimension of systemic risk, which is the distinction we follow here.

21 *On the discussion of how to adjust microprudential instruments to account for systemic risk, see for example IMF (2011a), pp. 23-24.*

22 *Systemic risk is characterised by both a cross-sectional and a time dimension (De Bandt* et al., *2010). According to Galati and Moessner (2013), other common distinctions are (i) rule-based versus discretionary instruments, (ii) instruments based on quantity restrictions versus those based on price restrictions.*

23 *Price-based measures are often considered to be less "distortionary" for financial institutions then quantity-based measures (Lim* et al., *2011).*

Figure 3 The macroprudential policy implementation process



Source: Banque de France.

Table 2 Intermediate objectives and indicative macroprudential instruments (adapted from ESRB, 2013)

Mitigate and prevent excessive credit growth and leverage
– Countercyclical capital buffer (CCB)
– Sectoral capital requirements (including intra-financial system)
– Macroprudential leverage ratio
– Loan-to-value requirements (LTV)
– Loan-to-income/debt (service)-to-income requirements (LTI)
Mitigate and prevent excessive maturity mismatch and market illiquidity
– Macroprudential adjustment to liquidity ratio (e.g. liquidity coverage ratio)
– Macroprudential restrictions on funding sources (e.g. net stable funding ratio)
– Macroprudential unweighted limit to less stable funding (e.g. loan-to-deposit ratio)
– Margin and haircut requirements
Limit direct and indirect exposure concentration
– Large exposure restrictions
– CCP clearing requirement
Limit the systemic impact of misaligned incentives
– SIFI capital surcharges
– Systemic risk buffer (SRB)

3|1 Criteria for selecting macroprudential instruments

The respective instruments to be included in the macroprudential toolkit should fulfil certain criteria, of which effectiveness and efficiency may be the most important (CGFS, 2012). Effectiveness amounts to achieving the policy objectives; efficiency means respecting them at the lowest cost for other policy areas.[24]

Implementation of a macroprudential instrument can be effective only (i) if there is a robust transmission mechanism to achieve the ultimate objective and (ii) if the underlying vulnerability can be assessed accurately. Macroprudential instruments should be rapidly implemented and the lag between their introduction and the time that some effects can be perceived should not be too long. Furthermore, arbitrage opportunities allowed for by macroprudential instruments should be limited and potential leakages minimised (Bank of England, 2011).

With regard to efficiency, a macroprudential instrument should not unnecessarily affect other policy objectives, be they monetary, fiscal or related to competition policy. Also, the level of uncertainty regarding (i) the use of macroprudential instruments at an inappropriate moment or (ii) the impact on other policy objectives in an unanticipated fashion should be low. In addition, coordination with other macroprudential instruments is important to avoid negative interaction effects, especially if they serve different intermediate objectives. Finally, the administrative burden of implementing a macroprudential instrument should be small.

3|2 Macroprudential instruments addressing the time dimension of systemic risk

Macroprudential instruments focusing on the time dimension of risk aim to reduce procyclicality in the financial system (Galati and Moessner, 2013). The following discussion focuses on several instruments identified as particularly promising or operational. In each case, the respective section attempts to provide a description of the respective macroprudential instrument, explain how its transmission mechanism is supposed to work,[25] and outline some advantages and drawbacks. In addition, Appendix C provides a brief implementation guide for each instrument.

24 *In comparison, IMF (2011a) considers the following features as desirable: (i) effectiveness in limiting the build-up of systemic risk and creating buffers to be used in periods of stress, (ii) limited opportunity for arbitrage (regulatory, cross-border), (iii) aimed at the roots, not the symptoms of systemic risk (notably by inducing private sector agents to internalise the systemic consequences of their decisions), and (iv) as least distortionary as possible to the financial system and the economy.*

25 *Details on the transmission mechanism of most macroprudential instrument described here can be found in CGFS (2012).*

3|2|1 Capital-based instruments

The countercyclical capital buffer

The countercyclical capital buffer (CCB) has been proposed by the Basel Committee on Banking Supervision (BCBS) as a time-varying capital requirement. It can be imposed on banks in addition to the minimum common equity requirement and the capital conservation buffer, depending on whether system-wide risks are considered to be increasing or decreasing. The CCB aims at ensuring "that the banking sector in aggregate has the capital on hand to help maintain the flow of credit in the economy without its solvency being questioned, when the broader financial system experiences stress after a period of excess credit growth" (BCBS, 2010b).

The CCB transmission mechanism would work in the following way. Raising capital requirements enhances the resilience of the banking system directly, since banks are able to cope with bigger losses before running into solvency problems. At the same time, resilience can be enhanced indirectly via the impact on the credit cycle and on market participants' expectations and behaviour. The CCB may also affect the credit cycle through banks' response to a capital shortfall by increasing lending spreads, decreasing dividends and bonuses, issuing new capital (which should have a negative impact on credit demand as a consequence of higher lending spreads) or, on the other hand, by reducing asset holdings, potentially leading to a reduction in credit supply or to a shift in the composition of assets towards exposures with lower risk weights (CGFS, 2012).

Thus, the CCB is a promising tool that could help curb the procyclical amplification of shocks through the banking system to the real economy. Activating the CCB may increase the resilience of the financial system to different kinds of economic shocks; releasing it may moderate credit crunch effects by alleviating pressure on banks to deleverage in bad times. The Basel III reciprocity principle should help to mitigate leakages by ensuring a level playing field between domestic and foreign banks that are active in more than one jurisdiction.[26] Ultimately, the CCB's efficiency as a macroprudential tool will depend on the handling of the conditioning variables, which will certainly prove unequally suited to different economic situations. In this regard, the judgement of the authority in charge of setting the CCB will be crucial, all the more so as the regime will not be exclusively rule-based.

Sectoral capital requirements

While aggregate system-wide capital buffers are calibrated to ensure that the banking system is able to face system-wide shocks, sectoral capital requirements (SCRs) concentrate on risky developments in a particular sector of the economy. These sectoral requirements can mainly take two forms: raising risk weights or imposing a capital surcharge, with regard to certain exposures.

Risk weights can be raised either by applying a multiplier or an add-on to banks' microprudential risk weights on the respective sector, such as commercial and residential real estate or corporate and intra-financial sectors, or by setting a lower bound (floor) for risk weights on particular sectoral exposures (for instance via a floor on the loss given default (LGD) parameter in the risk weights calculation). Both options, or a combination of the two, will automatically reduce banks' capital ratios, depending on their exposure to the sector in question. This general effect may however blur the line for market participants between what is driven by banks' risk-taking behaviour and what is the result of macroprudential tightening. Regarding sectoral capital requirements in the form of a capital surcharge, the mechanism functions similarly to the CCB, but the capital add-on depends on the exposure to the sector in question. As with the CCB, the exact level of the sectoral capital requirement would be based on conditioning variables such as a sectoral credit-to-GDP gap.

Sectoral capital requirements are intended to increase banks' resilience to risky developments in a particular sector and may dampen sectoral credit growth. Their main advantage is that they are likely to be more

26 *With the reciprocity principle, internationally active banks that have exposures in several countries will be subject to a CCB rate as a weighted average of the CCB rates in all countries where they have exposures (see also 2|2.).*

efficient than aggregate capital requirements, such as the CCB, when the underlying boom is contained within a particular sector. In fact, they are expected to have a "nipping in the bud" effect and to constrain only those banks that are exposed to the risk. In response to higher sectoral capital requirements, banks may be incentivised to reduce lending to the specified sector, as the relative marginal cost of such lending rises. This effect may be magnified by investor pressure: banks may find it difficult to raise external equity in order to fund lending that has been singled out by the macroprudential authority as particularly risky. However, sectoral capital requirements might also contribute to shifting risky developments to other parts of the financial system, the so-called "waterbed effect".

The leverage ratio

The leverage ratio is defined as the ratio of bank's capital to total non-risk-adjusted exposure. This tool was originally developed as a microprudential instrument but it might also be used as a macroprudential instrument to target systemic risk.

A minimum non-risk based leverage ratio of 3% was introduced by the Basel III framework (BCBS, 2010d and BCBS, 2014) as a microprudential instrument with the objective to serve as a backstop and supplement to risk-based requirements, since the latter rely on models which may miscalibrate or understate risks. The Basel III leverage ratio is not a macroprudential instrument *per se*. It could nonetheless be adjusted to serve macroprudential purposes. The leverage ratio could be used to cap banks' overall leverage throughout the cycle, thereby limiting procyclicality, and to increase their resilience by limiting their ability to leverage their capital, especially during the upward phase of the cycle. To this end, the ESRB specifies that it "could be applied to all banks as an add-on and possibly also in a time-varying manner" (ESRB, 2013). It could also focus on systemically important banks.

Attention needs to be paid to the simplicity of the leverage ratio which may also be a drawback. Since the ratio does not take risk weights into account, it can disadvantage banks' business models based on safe assets and give incentives for banks to favour riskier assets with higher yields in order to maximise their returns. As highlighted by Cecchetti (2012), "banks have an incentive [...] to take on too much risk for a given amount of leverage. It is for this reason that regulation must remain risk-sensitive". In addition, the leverage ratio is often used as an indicator of the build-up of systemic risks in the financial system. However, following Goodhart's law,[27] it could lose its ability to provide information if used as a prudential tool. Moreover, the potentially destabilising nature of leverage targeting has been shown by Adrian and Shin (2010).

3|2|2 Liquidity-based instruments

The liquidity coverage ratio

The crisis has highlighted the potential role of liquidity tools in reducing vulnerabilities coming from wholesale and short-term funding. Some countries, among them France, already have a microprudential liquidity instrument in place. Under the French liquidity ratio, introduced in 1988 and reviewed in 2009, banks are required to maintain liquidity inflows at least equal to liquidity outflows[28] at all times, and especially in periods of stress.

The liquidity coverage ratio (LCR), proposed by the BCBS as part of the Basel III framework, will be phased in from 2015 onwards (and, in the case of France, gradually replace the French liquidity ratio). The LCR is defined as the value of the stock of high-quality liquid assets (HQLA) in stressed conditions divided by the total net cash outflows over the 30 calendar days of the stress scenario. The stock of HQLA should be at least equal to total net cash outflows. Banks are required to have an LCR of 100% or more in normal times and

27 *Charles Goodhart's law can be formulated as: "When a measure becomes a target, it ceases to be a good measure".*

28 *Liquid assets, the numerator of the ratio, encompass reserves that can first be mobilised to face unexpected liquidity needs.*

are allowed to draw down liquidity buffers in times of stress.[29] Its purpose is to prevent a bank from being unable to satisfy withdrawal requests and margin calls requiring liquid collateral during a period of stress.[30]

How could liquidity requirements become macroprudential? To be used as a "genuine" macroprudential instrument, a liquidity requirement would take the form of a time-varying buffer (add-on) over and above the microprudential liquidity minimum requirement (ESRB, 2013) to be activated in periods of excessive market liquidity or maturity and liquidity transformation and to be loosened or released when imbalances narrow. Its aim would be to strengthen collective resilience against systemic liquidity shocks whereas the microprudential liquidity requirements would continually ensure the resilience of individual banks. However, the exact features of these macroprudential liquidity tools are in a very early stage of development, since even microprudential liquidity regulation itself is still being developed.

As the amount of practical experience with the implementation of liquidity based instruments is limited, the transmission mechanism is largely unknown for the moment. The increase in liquidity requirements should directly enhance the banking system's resilience by allowing banks to sell assets whose prices remain stable or to be less reliant on volatile short-term funding. The higher requirements can also enhance banks' resilience indirectly via the impact on the credit cycle or market expectations. With regard to the effect on the credit cycle, banks could respond to a rise in liquidity requirements by replacing short-term with long-term funding, or by replacing illiquid with liquid assets (see CGFS, 2012). In these cases, banks would probably increase lending spreads instead of accepting lower profits, which could spur a decrease in the overall volume of credit in the economy, as banks pass the costs of complying with a higher liquidity requirement through to borrowers.

Possible drawbacks of liquidity requirements include a potentially negative interaction with monetary policy. On the one hand, banks may have incentives to use central bank operations to arbitrage liquidity requirements and not only to fulfil reserve requirements when central bank funding is considered to be a more stable funding source than interbank loans.[31] On the other hand, there could be a negative impact on the implementation and effectiveness of monetary policy since liquidity buffers might induce a higher interest rate in the liquidity-providing auctions of the central bank, thus making it harder for central banks to steer interest rates according to their monetary objectives. Liquidity requirements also hold the risk of increased concentration, since banks may invest more and more in similar liquid assets (for example sovereign bonds). It is also worth mentioning that liquidity requirements may lead to an increase in banks' demand for customer deposits since the latter are included in the definition of stable funding. The resulting price competition ("deposit war") may lead to a decrease in banks' profitability and an increase in deposits' volatility.

Limits on the loan-to-deposit ratio

The LCR and also the net stable funding ratio (NSFR),[32] as defined in the Basel III framework, are examples of weighted liquidity ratios. Unweighted liquidity ratios such as the loan-to-deposit ratio (LTD) might also help to increase the resilience of the banking system, especially when used as a macroprudential instrument.[33]

The LTD ratio is defined as the outstanding amount of loans divided by the amount of deposits and is thus a measure of a bank's structural liquidity position, similarly to the core funding ratio (applied by the central bank of New Zealand).[34] Customer deposits are sluggish, insensitive to risks (partly because they are insured),

29 *This flexibility introduces a macroprudential dimension in the otherwise microprudential instrument.*

30 *According to BCBS (2010c), the LCR should ensure "that a bank maintains an adequate level of unencumbered, high-quality liquid assets that can be converted into cash to meet its liquidity needs for a 30 calendar day time horizon under a significantly severe liquidity stress scenario specified by supervisors."*

31 *This is the case for the LCR.*

32 *The net stable funding ratio (NSFR) aims at promoting more medium and long-term funding of banks' assets (BCBS, 2010c). Due to be put in place from 2018, it establishes a minimum acceptable amount of stable funding, based on the liquidity characteristics of an institution's assets over a one-year horizon. The NSFR is defined as the available amount of stable funding divided by the required amount of stable funding and must be greater than 100%. The definition of stable funding encompasses equity and liability financing supposed to be reliable sources of funds over a one-year time horizon under extended stress conditions.*

33 *See ESRB (2013): the LTD ratio may "follow the cycle, making a related requirement restrictive in booms and non-restrictive in downturns".*

34 *In New Zealand, the core funding ratio measures total retail funding and wholesale funding maturing over one year as a proportion of total assets. Its aim is to make sure that locally incorporated banks have a minimum level of "stable" or core funding. Initially set at 65%, its level was raised to 70% mid-2011 and to 75% in January 2013.*

and provide a relatively stable source of long-term funding (Huang and Ratnovski, 2008). If the loan volume grows at a higher rate than the deposit base, a bank can decide to fill this gap with wholesale funds from investors. The LTD ratio thus captures the extent to which a bank relies on a rather unstable sort of funding and therefore provides information on potential vulnerabilities in the banking system.

Introducing a limit for the LTD ratio can be considered to directly increase banks' resilience, to smooth the cycle and to contain lending growth, since it reduces their reliance on volatile wholesale funding and hence their sensitivity to changes in market sentiment.[35] During a downturn, however, a fixed LTD cap could have a procyclical effect. In this respect, adding a time-varying component or influencing the LTD ratio in a more flexible manner, for instance between an upper and a lower bound (see Van den End, 2013), would permit a finer calibration.

However, it is important to underline that LTD ratios are subject to the same reservations as the leverage ratio, since they do not take risk weights into account.

3|2|3 Asset-side instruments

Loan-to-value (LTV), loan-to-income (LTI) and debt-service-to-income (DSTI) caps are asset-side tools from the perspective of banks. They address interactions between the balance sheets of financial institutions and the household sector, i.e. strong credit growth on the asset side of banks, increases in debt on the liability side of households' balance sheets. Financial institutions and households are all vulnerable to shocks in asset prices, interest rates and changes in income.

Loan-to-value caps

LTV caps set a quantitative limit on the amount of credit that can be borrowed for a given value of a property. The LTV ratio is defined as the value of the loan divided by the value of the underlying collateral, and expressed in percentage terms. The LTV cap can be set as either a static and/or a time-varying limit. In the first case, the LTV cap is set proportionally to housing prices; in the second case, it is adjusted in line with the credit and economic cycles, in order to limit procyclicality: the LTV cap is tightened during good times and relaxed during busts. In theory, the cap could apply to both the stock and the flow of loans; but in practice, it typically targets the flow of new loans. Also in practice, the tool often applies to residential mortgages, since the commercial real estate market may appear too heterogeneous.

The impact of an LTV cap is twofold. First, it *de facto* limits the quantity of credit by restricting the ability of borrowers – or groups of borrowers – to be granted mortgage loans. Credit restrictions may contribute to curbing effective demand for housing and thus mitigating house price appreciation. Second, an LTV cap enhances the resilience of the banking system, by limiting borrowers' leverage and thereby reducing banks' loss (LGD) in case of borrowers' default (CGFS, 2012). In addition, restrictions on LTV may reduce the probability that a household will enter into negative equity following a negative shock. Consequently, defaults are also less likely to occur, thus decreasing the probability of default (PD).

In practice, LTV caps are generally calibrated on actual LTV ratios. One problem is that sufficiently long and harmonised data series are not always available. Moreover, once LTV ratios are capped, they might lose some of their information content as indicators of housing market tensions, since "too high" LTV ratios are no longer allowed. Hence, other indicators may need to be checked. Alternatives include house prices, house-price-to-income ratios and banks' exposures to the housing market.

35 *Regarding the numerator of the ratio, i.e. the amount of loans, the impact of imposing a LTD ratio limit is less clear. While a sluggish deposit base may force a bank to reduce the outstanding amount of loans in order to fulfil the LTD ratio requirements, it may increase a bank's incentives to grant riskier loans in order to compensate for the loss in profitability due to the lower loan volume/more expensive deposit funding. However, this may also be the case for capital-based macroprudential instruments.*

Loan-to-income and debt-service-to-income ratio caps

Compared to the LTV ratio cap described in the previous section, the LTI and DSTI ratio caps set loan constraints relative to the income of borrowers. The LTI ratio is calculated as the value of the loan or of a set of loans divided by the disposable income of the borrower, whereas the DSTI ratio is defined as the debt servicing requirements relative to the disposable income of the borrower.

The transmission mechanisms for the LTI/DSTI are broadly the same as for the LTV. LTI/DSTI caps impact more directly the borrowers' probability of default, since they target their leverage by setting a constraint relative to their income.

LTV and LTI/DSTI caps are often seen as complementary instruments, as caps on LTV can in certain cases be more effective if combined with an LTI/DSTI limit. For instance, since income is more stable than housing prices, LTI/DSTI caps may become more binding than LTV caps in times of rising housing prices. For that reason, LTI/DSTI caps probably do not need adjusting over the credit cycle.

3|3 Instruments addressing the cross-sectional dimension of systemic risk

Instruments addressing the cross-sectional dimension of systemic risk aim at mitigating structural vulnerabilities in the financial system that arise from risk concentration, complexity and interconnectedness between financial institutions. One of their targets is to limit spillover on other financial institutions and also on the wider economy that may result from the distress of a systemically important financial institution. These instruments also aim to reduce the similarities between banks and dampen their risk-taking behaviour, which leaves the system as a whole vulnerable to common shocks to the economy.

3|3|1 Structural measures

Structural measures may be implemented to limit risk concentration, complexity and interconnectedness in the financial sector, as a complement to price-based measures which "may not go far enough" in some areas (European Commission, 2012b). They can take the form of legal restrictions on risky speculative activities.

Several banking reforms are currently underway in major industrialised countries to curb banks' incentives and ability to undertake risky business.

The Volcker Rule in the United States (section 619 of the Dodd-Frank Act of July 2010), which becomes effective in April 2014,[36] prohibits banking entities from engaging in proprietary trading activities and investing in hedge funds and private equity funds.[37]

At the EU level, the High-level Expert Group on reforming the structure of the EU banking sector, chaired by Erkki Liikanen, presented its report in October 2012. The report favoured ring-fencing a fraction of trading activities in a legally separated entity ("trading entity"). On 29 January 2014, the European Commission adopted a proposal for a regulation on structural measures aiming at improving the resilience of EU credit institutions. A ban on proprietary trading as well as a potential separation of other risky trading activities would be imposed on global systemically important banks (G-SIBs) and on banks with significant trading activities.

In 2013, Germany and France were among the first European countries to adopt structural reforms for their respective banking sectors to address concerns related to the largest and most complex banks. The French law on the separation and regulation of banking activities, adopted in July 2013, and the German bank-separation

36 *However, full compliance with the rule is not required until July 2015.*

37 *There are a number of exemptions: transactions in certain instruments (including US government bonds), market making, underwriting, and risk-mitigating hedging activities,* de minimis *investments in hedge funds and private equity funds (less than 3% of the banking entity's Tier 1 capital and less than 3% of the total ownership interest in the fund).*

law, promulgated in August 2013, require banks to ring-fence purely speculative trading activities in separate legal entities. Belgium is also in the process of adopting a national structural reform.

In the United Kingdom, the report of the Independent Commission on Banking (ICB) of September 2011, headed by John Vickers, proposed that banks ring-fence retail activities in separate legal entities. The Financial Services (Banking Reform) Act, inspired by the Vickers' report, received Royal Assent in December 2013. Secondary legislation is forthcoming and the framework is scheduled to enter into force by the start of 2019.

The potential cross-border implications of such structural measures, including regulatory arbitrage, additional burden on consolidated supervision and cross-border resolution, are considerable and have to be considered closely (Viñals *et al.*, 2013).

3|3|2 Capital surcharges for systemically important financial institutions

Systemically important financial institutions (SIFIs) are financial institutions whose distress or failure would trigger contagious defaults and significantly disrupt the financial system and the real economy. Additional capital surcharges are thus intended to reduce the likelihood and severity of such a risk by increasing the going-concern loss absorbency of SIFIs. In this respect they also contribute to addressing the "too-big-to-fail" issue by limiting the expectations of a taxpayer's bail-out. These capital surcharges are macroprudential instruments in the sense that they apply only to institutions of systemic importance and are specifically meant to lessen systemic risk in the entire financial system.

The BCBS and the FSB have set up a framework to address the risks posed by G-SIBs (BCBS, 2011). The policy tools include capital surcharges that exceed the Basel III minimum standards and are calculated in line with the bank's degree of global systemic importance (see 4|2|1 for details). These capital surcharges, which currently range from 1% to 2.5% of risk-weighted assets (plus an empty bucket with a 3.5% requirement) depending on the global systemic importance of the bank, have to be met with the highest quality component of capital, common equity, as of January 2016 for banks identified in November 2014 as G-SIBs.[38]

The G-SIB framework and the additional loss absorbency requirement have been extended by the BCBS and the FSB to domestic systemically important banks (D-SIBs) (BCBS, 2012). Contrary to the G-SIB framework which imposes common rules and quantitative methodologies, the D-SIB framework simply sets up broad guidelines. National authorities have greater room for manœuver; they have to draw up national methodologies for identifying D-SIBs in their jurisdiction and calibrating the surcharge.

Also, by analogy with the G-SIBs methodology, a methodology for global systemically important insurers was published in July 2013 by the International Association of Insurance Supervisors (IAIS).

Finally, the FSB, in consultation with the International Organisation of Securities Commissions (IOSCO), is working on a proposed assessment methodology for identifying systemically important non-bank non-insurance financial institutions.

3|3|3 Systemic risk buffer

A specific buffer for systemic risk will be available in the EU in order to strengthen the resilience of the banking system, or its components, to potential shocks stemming from structural systemic risk. The buffer would strengthen resilience and solvency by increasing loss-absorption capacity. Potential reasons for applying it would be structural vulnerabilities such as changes in legislation or accounting standards, cyclical spillovers from the real economy, the size of the financial system relative to GDP, or complexity due to financial

38 *For the G-SIB list of November 2013, see FSB (2013b).*

innovation (see ESRB, 2013). However, uneven application of the buffer would harm the cross-border level playing field (ESRB, 2013). In this respect, coordination across borders will be essential, particularly since the systemic risk buffer (SRB) will most likely be used and calibrated on a case-by-case basis (see also 3|5).

3|4 Country experiences with macroprudential instruments[39]

Country experience with macroprudential instruments is rather rare or discontinuous. Isolating the effect of macroprudential instruments is difficult, since they have often been combined with other measures such as monetary policy or have taken the form of supplements to instruments already in use for microprudential or liquidity management purposes. Authorities that have used them often explain that they were efficient in defending the financial system from the consequences of downturns, but contributed to a lesser extent to moderating the financial cycle (CGFS, 2010).[40]

Instruments aiming at limiting excessive credit growth in specific sectors included LTV, LTI/DSTI caps and sectoral capital requirements. They were mainly used in Asia: Hong Kong is a case in point of the intensive use of LTV caps since 1991; Korea introduced LTV caps in 2002 followed by DSTI limits in 2005 and used them in a time-varying manner to tackle housing cycles. LTV/LTI/DTSI caps were also used, often intermittently, in Bulgaria, China, Colombia, Croatia, India, Malaysia, Norway, Singapore, Sweden, Thailand, Turkey, and Romania for instance (Borio and Shim, 2007; IMF, 2011b; Lim *et al.*, 2011). Sectoral capital requirements mainly took the form of adjustments to risk weights. This instrument was used in countries such as Bulgaria, Estonia, India, Ireland, Norway, Portugal, Spain, Thailand, and Australia. The existing literature tentatively supports the view that LTV/LTI/DSTI ratios and sectoral capital requirements are effective in taming housing booms, even though it is sometimes difficult to isolate the impact of these instruments. In particular, the LTV policy in Hong Kong is deemed to have helped domestic banks to cope with the 40% drop in housing prices during the Asian financial crisis between September 1997 and September 1998 (Craig and Hua, 2001; Wong, Fong, Li and Choi, 2011). More generally, Crowe *et al.* (2011) report that a 10 percentage points tightening in the LTV ratio leads to a decline in house price in a range of 8 to 13 percentage points.

There is also some experience with reserve requirements, which can be considered as a macroprudential instrument to the extent that they limit liquidity risk (BIS, 2010). Reserve requirements have been used especially in emerging market economies as an alternative way to tighten domestic credit conditions arising from volatile cross-border capital flows, since higher interest rates would attract even more foreign capital and appreciate the currency (Montoro and Moreno, 2011). The central bank of Turkey, for example, uses reserve requirements and reserve remuneration explicitly as a macroprudential tool. Brazil, Croatia, Columbia, Peru, and Russia also adjust reserve requirements with a similar purpose (Lim *et al.*, 2011). In this respect, according to Glocker and Towbin (2012), increases both in interest rates and in reserve requirements result in a contraction in domestic credit, but tend to have a different impact on other macroeconomic variables. Robitaille (2011) finds that Brazilian reserve requirements did not serve the liquidity provision goal effectively. A number of countries have also imposed reserve requirements on foreign currency funding of financial institutions.

Dynamic provisioning was introduced in Spain in 2000 (revised in 2004) to target the increase in credit risk in financial institution balance sheets. This instrument had both a microprudential purpose, due to its application to individual institutions, and a macroprudential role, owing to its intended countercyclical impact (Saurina, 2009): banks are required to set aside provisions during phases of rapid credit expansion, in anticipation of the impairments that will arise when credit retrenchment appears. Dynamic provisioning appears to have contributed to limiting the risk of banks under-provisioning during the boom phase, but its effectiveness in moderating the financial cycle is not well established (CGFS, 2010).

39 *This section may not be exhaustive.*

40 *For an overview on the use of macroprudential instruments in specific countries, see Borio and Shim (2007), p. 16 and Lim* et al. *(2011), p. 16.*

In the aftermath of the global financial crisis, experience with macroprudential instruments may become more frequent. Switzerland has already introduced and activated a countercyclical capital buffer,[41] before its EU neighbors were able to do so (with the application of CRD IV). Another example is Sweden which increased the minimum risk weights for mortgages in 2013 in order to prevent risks in its banking system.

3|5 The French/European toolkit of macroprudential instruments in the CRD IV/CRR framework

Ex ante selection of a range of macroprudential tools is necessary to enable preventive macroprudential policy (Goodhart and Perotti, 2013). This paper favours the setting up of a critical number of instruments. They should neither be too few, in order to address each objective of macroprudential policy discussed above and minimise the deficiencies of individual tools, nor too many, to avoid the costs associated with the calibration and application of the instruments and the potential unintended consequences arising from their interconnection. We also favour a combination of capital rules and other regulations such as asset-side instruments, since capital alone is unlikely to build a sufficient macroprudential framework (Goodhart *et al*. 2012).

Maintaining flexibility when selecting and handling the instruments is necessary: a one-size-fits-all approach should be avoided (Lim *et al.*, 2011) because manifestations of systemic risk vary among countries. Knowledge about the effectiveness and efficiency of macroprudential instruments will certainly improve with future practical experience. Nonetheless, based on past experience and theoretical considerations, we consider the EU CRD IV/CRR package well balanced in that sense. The package introduces a set of instruments representing a mix between rule-based and more flexible instruments, in order to provide for regulatory certainty and prevent political economy pressures.

The countercyclical capital buffer introduced by Articles 130 and 135-140 CRD IV will be calculated and applied at the level of individual institutions, since the Basel III reciprocity principle will be mandatory at EU level for buffer rates of up to 2.5% (see 3|2|1 and 2|2). However, recognition by the national designated authority of buffer rates in excess of 2.5% in EU Member States and of buffer rates in third countries will be voluntary. Eventually, for exposures in a third country, national authorities will be able to require domestic institutions to apply a CCB rate higher than the rate set by the third country, if such action is considered necessary to protect these institutions against excessive credit growth in that country.

The systemic risk buffer introduced by Articles 133 and 134 CRD IV is meant to address long-term, non-cyclical systemic or macroprudential risk at a national level that would have potentially serious negative consequences for the national financial system and the real economy. This risk cannot be mitigated effectively by the other measures in the CRD IV/CRR framework (except Article 458 CRR) and the imposition of the systemic risk buffer should not have disproportionate adverse effects on the financial system of other Member States or of the EU as a whole. The main advantage of the SRB is its flexible application. This flexibility concerns the possibility of setting up the buffer or not, as well as its amount (at least 1%) and the institutions concerned (all institutions covered by CRD IV, one or more subsets of institutions, exposures located in the domestic market, in other Member States or in third countries). However, certain procedures will need to be followed at the European level, depending on the amount of the buffer (for buffer rates of up to 3%, notification will be sufficient, whereas procedures will become more complex if the rates are higher) and the location of the exposures (see Appendix A). National authorities can recognise the buffer rates set in other Member States, similarly to the CCB, in which case domestic institutions will apply the "foreign" buffer rates for their "foreign" exposures.

Buffers for global systemically important institutions (G-SIIs) and other systemically important institutions (O-SIIs) are introduced by Articles 131 and 132 CRD IV. From 2016, G-SIIs will be assigned, on a consolidated

41 *The Swiss countercyclical buffer can be implemented on a broad basis or with a sector-specific scope. Its first application in February 2013 is targeted at mortgage loans financing residential property located in Switzerland, at a level of 1% of associated risk-weighted positions.*

basis, an additional buffer of 1% to 3.5%, and O-SIIs will be subject to an additional buffer of up to 2%. Institutions subject to both G-SII and O-SII buffers will be asked to apply only the higher of the two.

In addition to these new, explicitly macroprudential tools, other provisions of the CRD IV/CRR package allow several existing instruments to be applied for macroprudential purposes.

Article 458 CRR allows national authorities, under certain conditions,[42] to impose stricter national requirements to address macroprudential or systemic risks at the national level, by tightening the requirements for own funds, large exposures, public disclosure, liquidity, risk weights for the property sector, or intra financial sector exposures.

Concerning exposures secured by mortgages on immovable property, competent authorities may set higher risk weights of up to 150% or stricter criteria for assessing the mortgage lending value, on the basis of financial stability considerations (Article 124 CRR).

Article 164 CRR allows the competent authority to require banks using an internal ratings-based approach (IRB) to apply a higher exposure-weighted LGD floor for retail exposures secured by residential or commercial property than is usually allowed under the CRR, on the basis of financial stability considerations.

In addition, some of the measures of the supervisory review process under Pillar 2[43] can aim at financial stability and take on a macroprudential dimension (see e.g. Article 103 CRD IV).

We consider the LTD ratio and the leverage ratio as useful backstops to risk-based instruments but we do not include them in our initial macroprudential toolkit because their macroprudential features are not yet properly designed.

Overall, our initial macroprudential toolkit would include the macroprudential instruments of the CRD IV/CRR package as well as asset-side instruments not harmonised under CRD IV/CRR, such as caps on LTV, DSTI and LTI ratios.

42 *The measures should be imposed in response to "changes in the intensity of macroprudential or systemic risk in the financial system with the potential to have serious negative consequences to the financial system and the real economy in a specific Member State and which that authority considers would better be addressed by means of stricter national measures" (Article 458 2. CRR). National authorities may only use these instruments if they can justify that they are necessary and effective to address systemic risks, and that these risks cannot be adequately addressed by a specified list of other instruments. Any Member State imposing such measures has to inform the European Parliament, the European Commission, the Council, the ESRB and the European Banking Authority and submit justification. Following a proposal by the Commission, the Council can reject the measure by a qualified majority under certain conditions.*

43 *Pillar 2 has been developed in the Basel II supervision framework as a complement to Pillar 1. It aims at enhancing risk management of banks and at addressing risks that are not (or insufficiently) covered by Pillar 1, by providing supervisors with a broad set of flexible tools.*

Table 3 Main available instruments in CRD IV/CRR

Legal text	Article	Instrument	Responsible authority	Buffer (as a % of CET1)	Enforcement date	Revision frequency
CRD IV	130 and 135 to 140	Countercyclical buffer (CCB)	Designated authority *In France: HCSF*	0% to 2.5% with compulsory reciprocity (voluntary reciprocity if > 2.5%)[a]	From January 2016	Every quarter
	131	G-SII surcharge and bucket allocation	Designated or competent authority *In France: ACPR*	1% to 3.5%	From January 2016	Every year (depending on G-SII identification)
	131	O-SII surcharge	Designated or competent authority *In France: ACPR*	Up to 2%	From January 2016	Every year
	133 and 134	Systemic risk buffer (SRB)	Designated or competent authority *In France: HCSF*	At least 1%; specific procedures above 3%	From January 2014	At least every 2 years
				At least 1%; specific procedures above 3% and above 5%	From January 2015	
	129	Exemptions from the capital conservation buffer	Designated or competent authority *In France: ACPR*	2.5%	From January 2016	Stable
	103	Pillar 2	Competent authority *In France: ACPR*		From January 2014	Ad hoc
CRR	458	"Flexibility package": possibility to impose stricter requirements at the national level regarding own funds, large exposures, public disclosure, liquidity, risk weights for the property sector, or intra financial sector exposures	Designated or competent authority *In France: HCSF*		From January 2014	Ad hoc
	124	Higher risk weights or stricter criteria on exposures secured by mortgages on immovable property	Competent authority *In France: ACPR*		From January 2014	Ad hoc
	164	Higher exposure-weighted LGD floor for retail exposures secured by residential or commercial property	Competent authority *In France: ACPR*		From January 2014	Ad hoc

a) The capital conservation buffer and the countercyclical buffer will be phased in from 2016. The full rate will be applicable from 2019 onwards.

4| How to assess systemic risk?

The ability to identify and measure systemic risk is key for successfully implementing macroprudential instruments. Indeed, imprecise timing of macroprudential instrument application can result in overshooting or undershooting of macroprudential objectives. Therefore, apart from the costs of a financial crisis and the costs of macroprudential regulation, the precision with which systemic risk is measured has a crucial impact on the total expected welfare costs that policymakers face (CGFS, 2012; Drehmann, 2012).

In response, macroprudential authorities take part in developing new methods to better monitor and assess the individual exposures and contributions to systemic risks as well as spillovers and interconnection during the three phases of a systemic crisis, namely risk build-up, materialisation of vulnerability and amplification of the initial shock.

As discussed above, systemic risk is characterised by both a cross-sectional and a time dimension. On the one hand, the cross-sectional dimension captures how risks are distributed and correlated across financial institutions at a given point in time, due to direct and indirect linkages. On the other hand, the time dimension captures the evolution of systemic risk over time due to changes in the default cycle and in financial market conditions, and to the potential build-up of financial imbalances such as asset and credit market bubbles.

But although real-time scrutiny makes it possible to evaluate existing weaknesses in both the time and cross-sectional dimensions, ex ante warnings are also needed to shed light on potential threats to financial stability which may materialise in the future. Therefore particular attention is now paid to identifying forward-looking indicators that could help macroprudential authorities better anticipate the build-up of risks to the system and implement appropriate regulatory responses before they materialise.

However, as pointed out by Danielsson *et al*. (2012), policy makers have to be aware that the models currently available still need to be improved and that persistent data gaps limit precision when estimating the actual risk. Thus, a broad set of indicators should be used not only to capture the different dimensions of systemic risk (there is no "one-size-fits-all" measure), but also to avoid being distracted by false alarms.

The remainder of this section outlines the methods currently used to measure each dimension of systemic risk as well as the recent effort to design early warning indicators.

Table 4 Examples of systemic risk indicators[a)]

Category	Time dimension indicator	Cross-sectional dimension indicator
Macroeconomic risk	Real GDP growth	Foreign exchange (currency mismatch)
	Current account balance-to-GDP ratio	
	Unemployment rate	
	General government debt-to-GDP ratio	
	General government deficit-to-GDP ratio	
Credit risk	Credit-to-GDP gap (Drehmann *et al.*, 2010; Drehmann *et al.*, 2011)	*Overall asset quality* (haircut, losses, non-performing loans, VaR, lending spreads)
	Debt service ratio (Drehmann *et al.*, 2012, 2013)	*Government* (loans to governments, CDS spreads, debt-to-GDP, ratings)
	Aggregate real credit growth	*Real estate* (mortgage credit growth, price-to-rent ratios, down payments, residential property or commercial real estate prices)
	Banks' charge-off rates	
	Ratio of non-performing to total loans	
	Aggregate gross losses of banks	*Households* (indebtedness ratio, interest repayments over disposable income)
	Credit conditions (Bank Lending Surveys)	
Market risk	Real asset price gaps (Borio and Drehmann, 2009)	Global risk aversion indicator (risk appetite survey, VSTOXX)
	Price-to-book ratios	(Market) Liquidity index
	Global risk aversion indicators/volatilities	
Financial soundness	Ratio of non-core liabilities over deposits (Hahm *et al.*, 2012)	*Liquidity* (loan-to-deposit ratios, liquid assets to total assets, LCR, NSFR)
		Funding (credit and CDS spreads, bid-ask spreads, ratings, central bank funding)
		Profitability (ROA, ROE, lending standards, margins)
		Solvency (Tier 1 ratio, Z-score, distance-to-default)
Interlinkages, contagion and concentration risks		MES (Acharya *et al.*, 2010)
		SRISK (Acharya *et al.*, 2012)
		CoVaR (Adrian and Brunnermeier, 2008)
		BSI (Segoviano and Goodhart, 2008)
		JPoD (Segoviano and Goodhart, 2008)
		DiDe (Segoviano and Goodhart, 2008)
		Network analysis (static and dynamic)
		Interbank (net position, reserves, spreads)
		Top 5 MFIs' market share
		MFIs' exposure to domestic government sector over total credit
		Banking sector size over domestic GDP
		Share of G-SIFIs' assets over financial systems total assets

a) see appendices for more details.
Source: Banque de France.

4|1 Measuring the state of the cycle (time dimension of risk)

Measuring the time dimension of risk is fundamentally difficult. For an individual institution, this requires not only assessing how the riskiness of each individual borrower changes, but also how the cross-correlations evolve over time, either due to increased exposure to a common risk factor, or to greater interconnectedness between institutions.

In addition, measuring the build-up of risk involves identifying the sources of procyclicality in the financial system, i.e. the channels through which financial institutions expand their risk-taking activities as the economy booms. This is particularly challenging as risk tends to be undervalued during good times, encouraging financial institutions to increase their leverage and risk-taking. This procyclicality is at the heart of Minsky's (1992) Financial Instability Hypothesis.[44] But this build-up of risk cannot be captured adequately by so-called price-based measures, which rely on market data, since optimistic beliefs can bias them downwards. For instance, Adam and Marcet (2011) show that investors' expectations of asset returns in the United States were highest at the peak of the internet boom period in early 2000.

4|1|1 Candidate measures of risk build-up

An ideal time-varying risk measure would be an indicator that is able to forecast early on the expansion and contraction phases of the cycle. Two types of measures may be used to this end. The first possibility is price-based measures. However, their predictive power is limited: the "market efficiency hypothesis", whereby prices convey all necessary information, may not hold. The failure of markets to internalise the cost and probability of the 2007-2009 systemic crisis is a case in point. The second possibility is macroeconomic aggregates and balance sheet variables, which are more promising for the purpose of measuring the state of the cycle because they capture long-run trends in quantities without relying on agents' possibly misguided beliefs (see Table 4).

Examples of price-based measures include economic variables such as asset prices, measures of banks' risk-taking and measures capturing banks' funding costs. Borio and Drehmann (2009) find that real asset price gaps, especially property price gaps, proved useful in predicting banking crises; at the same time they stress that indicators focusing exclusively on stock market prices would have failed to signal the build-up of risk as it was not correctly priced. In fact, most of the measures capturing banks' risk-taking that have been used in the literature, such as the expected default frequency (EDF), idiosyncratic bank volatility, the so-called Z-score,[45] or banks' Value-at-Risk (VaR), work reasonably well for assessing risks in the cross sectional dimension but not in the time dimension (Dufrénot *et al.*, 2012). Likewise, measures capturing banks' funding costs, such as banks' bond or credit default swap spreads, were not able to predict banking sector vulnerabilities prior to the financial crisis of 2007-2009 (Andersson and Vanini, 2010; Goodhart and Tsomocos, 2011).

Alternatively, balance sheet-based measures and macroeconomic indicators perform better when signalling the build-up of vulnerabilities. At the bank level, a financial ratio such as the ratio of non-core bank liabilities to the traditional deposit base, i.e. reliance on short term debt, was shown to be a signal of financial vulnerability in the run-up to the crisis (Hahm *et al.*, 2012). Duprey and Lé (2014) suggest that an estimation of banks' capital constraint combining different financial soundness ratios correlates with future variations in aggregate lending. At the economy-wide level, aggregate gross losses of banks and aggregate macroeconomic conditions tend to effectively signal the state of the financial cycle. Aggregate gross losses can be proxied, for instance, by the ratio of non-performing to total loans or banks' charge-off rates.[46] Aggregate macroeconomic conditions include measures of aggregate output and credit, such as real GDP growth, aggregate real credit growth and the credit-to-GDP ratio. In addition, an indicator recently proposed by Drehmann *et al.*

44 Minsky argues that financial crises are endogenous to the financial system: periods of prolonged economic prosperity encourage market participants to become reckless, and this excess optimism fuels financial bubbles which undermine financial stability.

45 The Z-score equals the return on assets plus the capital-asset ratio divided by the standard deviation of asset returns.

46 In addition, a measure of credit conditions can provide complementary information in case losses fail to perform their signalling role effectively. One drawback with credit conditions is that they are based on survey data and could therefore be manipulated.

(2012, 2013) is the debt service ratio (DSR) which measures interest payments and debt repayments over income. As such, borrowers' repayment ability is a proxy for the indebtedness of the private sector which was shown to be a good predictor of systemic crises in a long-term perspective (Jordà *et al.*, 2013).

4|1|2 The credit-to-GDP gap and other possible conditioning variables for the setting of the countercyclical capital buffer

As outlined above, an important aspect of implementing the CCB is to choose appropriate conditioning variables which could guide the build-up and the release of the buffer. The BCBS (2010b) and CRD IV recommend using credit-to-GDP gaps to assess the position in the cycle and guide the build-up of the buffer. Under Article 135 CRD IV, the ESRB has the possibility, by way of a recommendation, to give further guidance to designated authorities on setting CCB rates.[47]

In fact, the credit-to-GDP gap is particularly relevant for calibrating the CCB as it signals the build-up of risk sufficiently early, prior to financial crises (see, e.g., Drehmann *et al.*, 2010; Drehmann *et al.*, 2011). However, it may not be always a robust leading indicator of costly price booms or banking crises (Borgy *et al.*, 2013). When applied to the CCB, Repullo and Saurina (2011) argue that the credit-to-GDP gap ratio could exacerbate the inherent procyclicality of the risk-sensitive bank capital regulation. In addition, as the credit-to-GDP gap ratio corresponds to the deviation from a filtered trend, its real-time use depends mostly on the reliability of the end-of-sample estimates of credit and GDP. Some authors argue that subsequent revisions of macroeconomic statistics could be as large as the gap itself (Edge and Meisenzahl, 2011), which can raise concerns about the robustness of the credit-to-GDP gap if used as the sole indicator for CCB implementation.

In the meantime, the BCBS (2010b) and CRD IV (Article 136) also highlight the importance of national specificities in the choice of the buffer guide and permit consideration of other variables that are "relevant for addressing cyclical systemic risk". It is thus necessary to investigate various buffer guides in the French case.

The main conclusions of early internal Banque de France investigations of the relative performance of the different conditioning variables for the CCB suggest that various specifications of the credit-to-GDP gap as well as real credit growth variables perform well in signalling a boom early on. Other indicators such as measures of property prices, of private sector debt sustainability or of bank balance sheets could also usefully complement the credit-to-GDP gap. As for the release phase, measures of stress in bank funding markets and financial market variables seem to perform well. At the same time, there will be room for judgement, in line with the principle of "guided discretion".[48]

Overall, counterfactual scenarios of CCB implementation in France show that, had it been activated early enough, it would have had a beneficial effect for the resilience of the financial system during the current crisis. The result would have been a timely build-up of large buffers that could have been used during the downturn. However, one substantial caveat of this analysis is that it does not take into account general equilibrium effects and thus cannot estimate the impact of the CCB on credit dynamics.

4|2 Measuring the systemic risk of financial institutions (cross-sectional dimension of risk)

The 2007-2009 financial crisis revealed that limiting the likelihood of failure of individual financial institutions, i.e. microprudential regulation, was not sufficient to avoid a systemic financial crisis, which led to severe adverse consequences for the real economy. As pointed out by Crockett (2000), when thinking of the financial system as

47 *A recommendation is expected to be published in 2014.*

48 *The CRD IV establishes the principle of "guided discretion" for the countercyclical capital buffer, meaning that authorities responsible for setting the buffer rate combine rules-based and discretionary elements when deciding on the appropriate buffer rate and do not only rely on a purely mechanical relationship.*

a portfolio of securities, the macroprudential perspective would focus on the overall performance of the portfolio, while the microprudential view would give equal and separate weight to the performance of each of its constituent securities.

Taking the macroprudential perspective, it becomes clear that the solvency of a bank whose assets account for a large fraction of the financial sector is much more important than the solvency of a small bank. Moreover, while an individual institution might reasonably perceive the state of the economy as given when taking a decision, this factor becomes an endogenous variable when considering the system as a whole, such that a feedback loop exists between individual and collective resilience (Borio *et al.*, 2001). Therefore, additional criteria have to be taken into account in order to appropriately measure the systemic risk contribution of an individual financial institution and thus effectively implement bank-specific macroprudential instruments.

4|2|1 Identifying systemically important banks

In its effort to identify G-SIBs, the BCBS (2011, 2013b) has developed an indicator-based approach to assess the systemic risk of banks. This approach focuses on the financial and economic consequences of the default of an institution rather than on the likelihood of such a default. The balance-sheet indicators are supposed to reflect the different aspects of what makes a bank critical for the stability of the financial system. Each bank is assigned a score that summarises five different sets of indicators of its systemic importance: (i) the size of the bank, (ii) its interconnectedness, (iii) the lack of substitutes able to provide similar services, (iv) its global (cross-jurisdictional) activity and (v) its complexity. Table 5 shows the different indicators and the respective weights.

Table 5 Indicator-based approach to measuring banks' systemic risk (BCBS, 2013b)

Category (and weighting)	Individual indicator	Indicator weighting
Cross-jurisdictional activity (20%)	Cross-jurisdictional claims	10%
	Cross-jurisdictional liabilities	10%
Size (20%)	Total exposures as defined for use in the Basel III leverage ratio	20%
Interconnectedness (20%)	Intra-financial system assets	6.67%
	Intra-financial system liabilities	6.67%
	Securities outstanding	6.67%
Substitutability/financial institution infrastructure (20%)	Assets under custody	6.67%
	Payments activity	6.67%
	Underwritten transactions in debt and equity markets	6.67%
Complexity (20%)	Notional amounts of over-the-counter (OTC) derivatives	6.67%
	Level 3 assets	6.67%
	Trading and available-for-sale securities	6.67%

4|2|2 Monitoring systemic risk contributions from banks and sectors

As part of its effort to quantify and monitor the contribution of each financial institution to systemic risk, the Banque de France includes in its regular risk assessment exercises simple economic and financial ratios but also more elaborate model-based tools. Monitoring a broad and flexible set of indicators makes it possible to draw a comprehensive picture of the current and potential future state of the cycle (see Table 4).

Macroeconomic aggregates, credit risk variables, financial soundness ratios as well as some measures of concentration risks provide added value to macroprudential authorities as easy-to-interpret instantaneous snapshots of the current state of the financial system. As shown by Drehmann, Borio et Tsatsaronis (2011),

Dufrénot *et al.* (2012) and IMF (2011c), their comparative advantage lies in their use as a "thermometer" for monitoring the level of imminent stress in the financial system. However, they are not necessarily good predictors ("barometer") of the future evolution of systemic risk. A downside of this type of indicators is that they are in general not updated frequently and are thus not available in real time. Furthermore, they do not account either for probabilities of default or for correlation structures.

As a complement to those economic and financial aggregates, several model-based indicators have been developed to provide a real-time assessment of the sources and the intensity of systemic risk (see Table 6 and Appendix E for a detailed explanation). Based on either publicly available data (market information or balance sheet statements) or regulatory data (credit default swap – CDS – counterparties or interbank payment data), these indicators are computed to identify financial institutions of systemic importance and quantify their impact on the resilience of the system. To this end, they combine (i) a measure of individual risk as well as (ii) a proxy of the interconnection between entities in order to assess systemic risk externalities across institutions.

The set of measures currently monitored by the Banque de France primarily uses the market capitalisation (marginal expected shortfall – MES – indicator) and CDS spreads (joint probability of distress – JPoD, banking stability index – BSI – and distress dependence matrix – DiDe – indicator) of individual banks. The use of cross-correlation of market capitalisations gives an idea of the co-movement of banks' risk after a common shock; CDS spreads on senior debt provide a proxy for exposures and individual default probabilities. Then systemic risk is assessed either by looking at the impact of extreme shocks using an estimation of tail dependencies (MES) or by computing all bilateral conditional probabilities of default using a copula (JPOD and BSI). These model-based real-time indicators are useful as they can be computed more frequently than most of the economic and financial ratios and encompass all the information available to market participants when making a decision. They also capture the feedback effects from fire sales and "informational" contagion (Nier *et al.*, 2007), which are accounted for via the asset price channel, although this comes at the cost of more reliance on possibly biased market prices (Berg, 2010). However, their inability to capture long-term trends calls for the integration in the set of indicators of measures that include (i) slow-moving balance sheet data (distance-to-default, systemic risk measure – SRISK – and conditional value-at-risk – CoVaR) and (ii) macro-economic variables (CoVaR). The SRISK indicator, for instance, is akin to a macro stress test based on a scenario of market expectations about the cost and likelihood of extreme risk at a specified horizon.

Table 6 Model-based indicators of systemic risks subject to monitoring[a)]

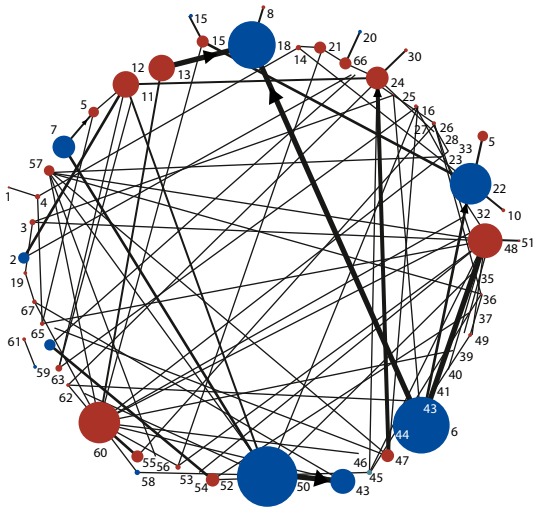
Aspects of systemic risk	Indicators	Category
Individual risk	Distance-to-default	Financial soundness
Exposition to aggregate systemic risk	MES (Acharya *et al.*, 2010) SRISK (Acharya *et al.*, 2012)	Interlinkages and contagion risk
Contribution of each institution to aggregate systemic risk	CoVaR (Adrian and Brunnermeier, 2008)	Interlinkages and contagion risk
Contagion from one individual institution to another	BSI (Segoviano and Goodhart, 2008) JPoD (Segoviano and Goodhart, 2008) DiDe (Segoviano and Goodhart, 2008) Network analysis (static and dynamic)	Interlinkages and contagion risk

a) See appendices for more details.

Network analysis provides another tool to monitor systemic risk. In particular, networks represent an ideal framework to analyse systemic risk arising from contagion, i.e. from spillovers due to direct or indirect links between financial institutions. Two complementary approaches are static and dynamic networks analysis. The study of static networks (or topology) portrays complex financial systems as a set of nodes

connected by links, identifies their key structural features, and tracks the evolution of the network over time to assess its robustness. Dynamic network analysis relies upon stress scenarios applied to the balance sheets of individual institutions and explores the propagation channels and cascade effects within the (actual or simulated) networks.

Figure 4 Example of a network graph



Note: Visualisation of the largest links in e-MID on 3 January 2007 (Gabrieli, 2012). Only links transferring an amount of at least EUR 50 million are included. These are 92 links and transferred 83% of the total market turnover on 3 January 2007. Legend: blue circles represent the 20 largest banks; red circles are the medium and small banks; green circles (for which only a label-number is visible in the picture) are the 50 smallest banks in the system. The size of a circle is determined by the (borrowing and lending) strength of the bank.
Source: Banque de France.

Most of the network analyses carried out at the Banque de France focus on interbank funding and liquidity (Abbassi *et al.*, 2013 ; Fourel *et al.*, 2013), bilateral contracts such as credit default swaps (Clerc *et al.*, 2013) or endogenous network formation (Vuillemey and Breton, 2013). Nevertheless, the network literature in the field of finance is still relatively recent. Only a few theoretical models try to provide the microfoundations for network formation by looking at the behaviour of each type of market participant. Moreover, network analysis tends to focus on specific market segments due to data availability, whereas a proper assessment of spillover effects and feedback loops would require a comprehensive view of direct and indirect contagion.

4|3 Towards the development of early warning/forward-looking indicators

Macroprudential authorities favour simple techniques when guidance is required on the timing of macroprudential instruments, since alternatives are neither sufficiently reliable nor sufficiently easy to pin down. Indeed, while measures of the cross-sectional dimension perform reasonably well, it is harder to come up with forward-looking indicators able to measure risk build-up when expectations are still excessively optimistic.

Thus, there is a vast scope for additional research aimed at:

- developing early warning signals which could trigger deeper and more formal analysis, hence the need to monitor a sufficiently broad set of indicators;

- improving the forecasting ability of systemic risk measures, for instance by combining micro and macro variables in order to design stress scenarios conditional on macroeconomic forecasts;

- obtaining reliable indicators that could be used to activate macroprudential instruments sufficiently ahead of a crisis.

One critical issue for macroprudential authorities when using systemic risk measures in practice, for instance as empirical guides for calibrating macroprudential instruments, is the ability to assess the informational content of the indicator and identify its forward-looking properties. Ideally, when choosing a macroprudential instrument to tame the build-up of risk, a macroprudential authority would want to minimise the costs associated with the implementation of the instrument, taking into account the uncertainty about the current state of the financial cycle. One step forward in order to compare the robustness of different indicators is to use a model that includes the preferences of the macroprudential authority for either signalling too few crises or launching too many false alarms.

More precisely, this signalling approach makes it necessary to set a threshold, based on historical data, beyond which there is a significant chance of facing systemic risk build-up. Then an easy-to-use criterion to test the relevance of the signal would be the noise-to-signal ratio (NTS), which compares the informational content of a signal to its background noise. Even so, the NTS does not provide confidence intervals when the same procedure is performed across competing indicators. Alternatively, one can weigh the preference for failing to signal some systemic events against the preference for having too many false alarms. But as the preferences of the authorities are unknown, it would be preferable to evaluate the signal given by the indicator over the full range of the regulator's possible preferences. Drehmann and Juselius (2013) recently proposed the use of a mapping procedure, called Receiver Operating Characteristic (ROC) curve, to plot the noise ratio against the signal ratio for all possible thresholds (see Appendix F for more details on the methodology).

The preliminary results of this nascent literature are that (i) the credit-to-GDP gap (CGFS, 2012), (ii) the DSR (Drehmann and Juselius, 2012) as well as (iii) the non-core liabilities ratio (Hahm *et al.*, 2012) seem to be promising forward-looking measures of systemic stress.

4|4 Practical issues: access to data and data sharing

Access to bank-level information is crucial for macroprudential policy in order to provide timely alerts to the relevant authorities, because banking system aggregates may mask significant vulnerabilities at the more granular level. Such information also provides insight on the financial network and interconnectedness between institutions, sectors and markets. In addition, the crisis has shown that individual G-SIBs can have a considerable impact on global financial stability.

In this respect, the FSB approved implementation of the initial phase of the "Data Gaps Initiative" in May 2012. The objective is to consistently pool and share information on bilateral credit counterparty exposures ("Individual to Individual or I-I data") as well as countries and sectors credit exposures ("Individual to Aggregate or I-A data") of major G-SIBs among their home supervisors, through an international data hub hosted at the BIS. It is currently envisaged that central banks would be given direct access to hub reports as of 2014. Other macroprudential authorities would have an indirect access only.

Conclusion

Against the backdrop of the recent evolution of legal, institutional and operational frameworks in Europe, this paper sheds a particular light on the French case. The macroprudential framework recently adopted in France, which combines (i) a multi-agency council with binding powers, namely the HCSF, and (ii) a key role for the Banque de France, is largely in line with the guiding principles on macroprudential governance. As regards the French macroprudential toolkit, it is consistent with the European CRD IV/CRR package and encompasses also asset-side instruments such as caps on LTV, DSTI and LTI ratios. Moreover, the institutional architecture designed under the European regulatory framework corresponds to a balanced division of roles. It provides an appropriate combination of (i) discretion and rules – i.e. a regime of "guided discretion" – when selecting and handling the instruments and (ii) national flexibility and international coordination to tailor the policy to national specificities while taming potential negative cross-border spillovers.

However, macroprudential policy is still in its early days. The complexity of the activation procedures for macroprudential instruments within the European framework is one of the main challenges ahead. The national and European macroprudential frameworks will be tested in the coming months and years on their ability to effectively implement macroprudential measures in a timely manner, and deliver tangible results. Improvements, be it in terms of impacts, indicators or operational processes, will probably be made as macroprudential knowledge grows.

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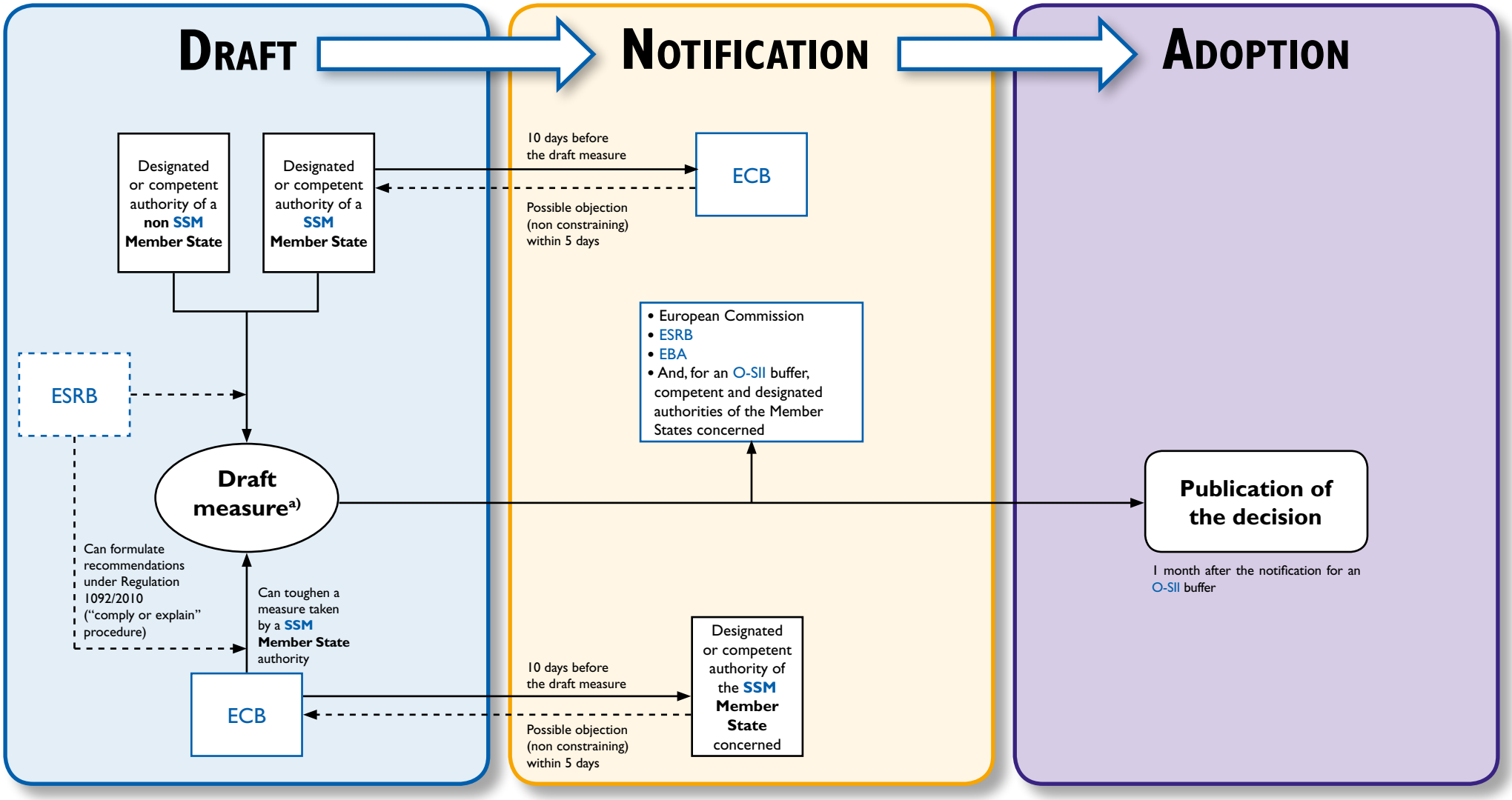
Appendix A

Current activation procedures of macroprudential instruments in the European framework[1]

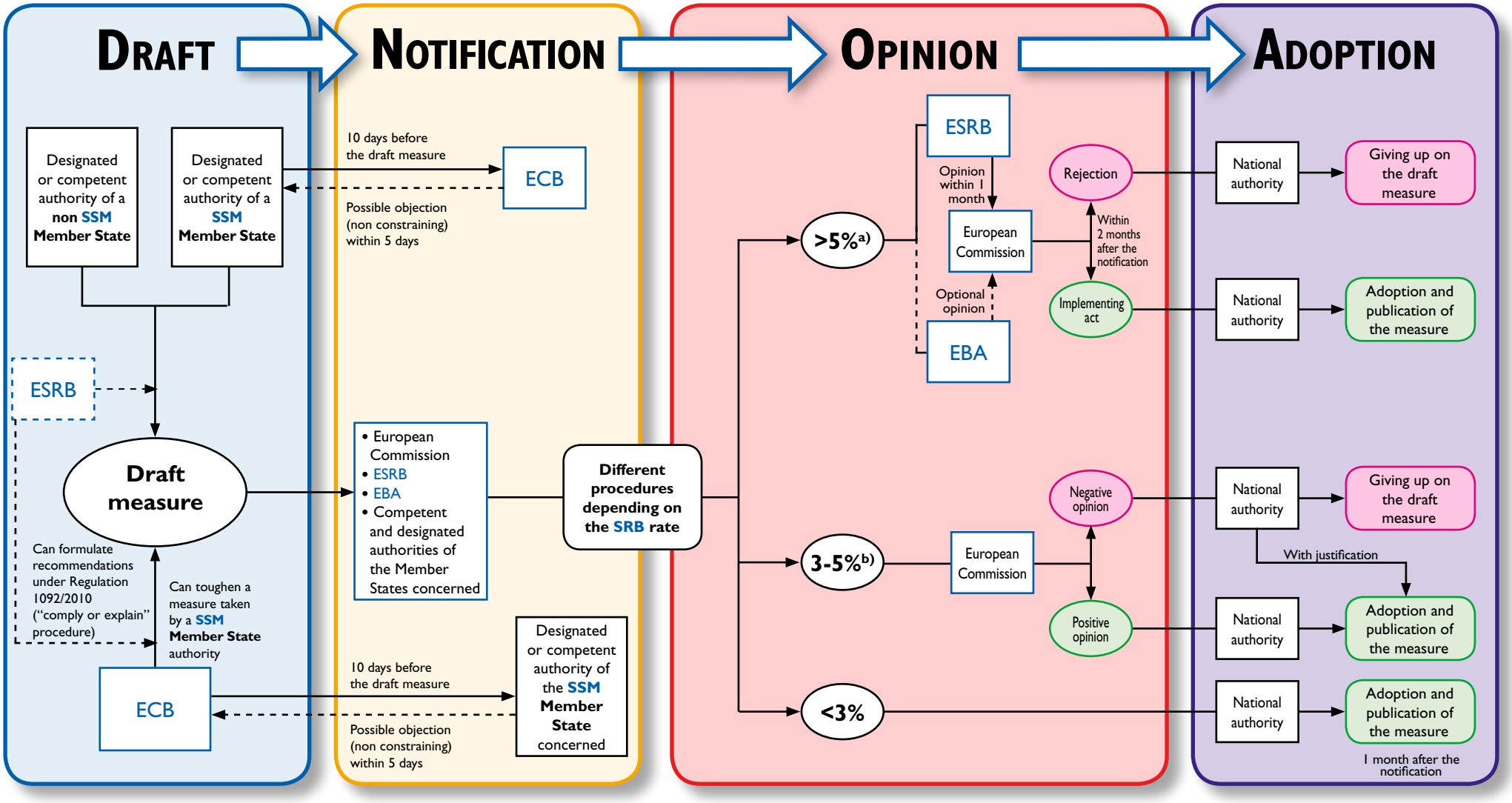
1 *The introduction of the SSM will probably lead to a review of the role of the ESRB.*

Global systemically important institutions (G-SIIs) and other systemically important institutions (O-SIIs) - Article 131 CRD IV



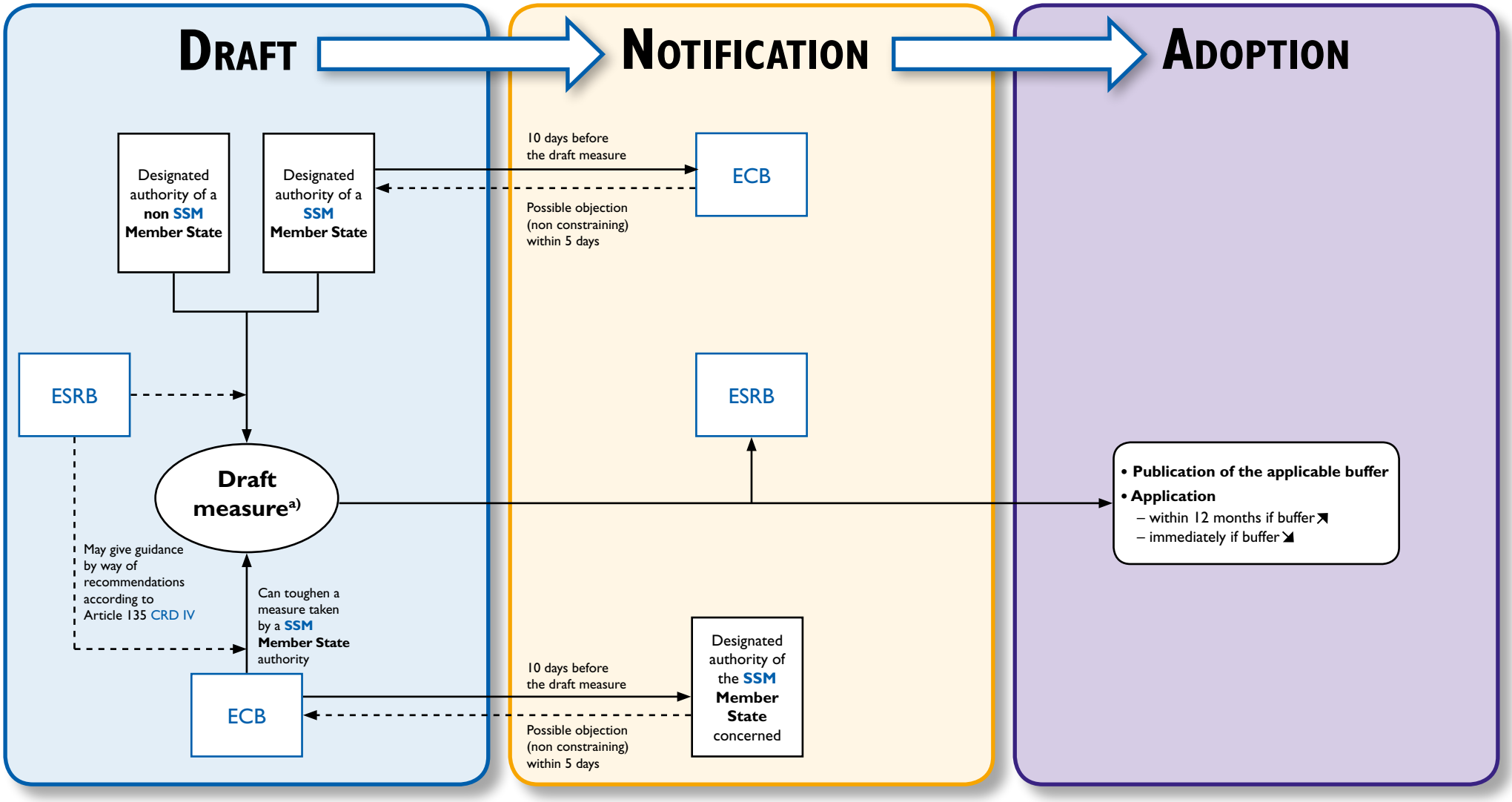
a) Identification of G-SIIs and O-SIIs; allocation of G-SIIs into subcategories associated with a capital buffer (1-3.5%); setting or resetting of an O-SII buffer (0-2%). Note that for the annual review, the G-SII or O-SII concerned has also to be notified.
Source: Banque de France.

Systemic risk buffer - Article 133 CRD IV



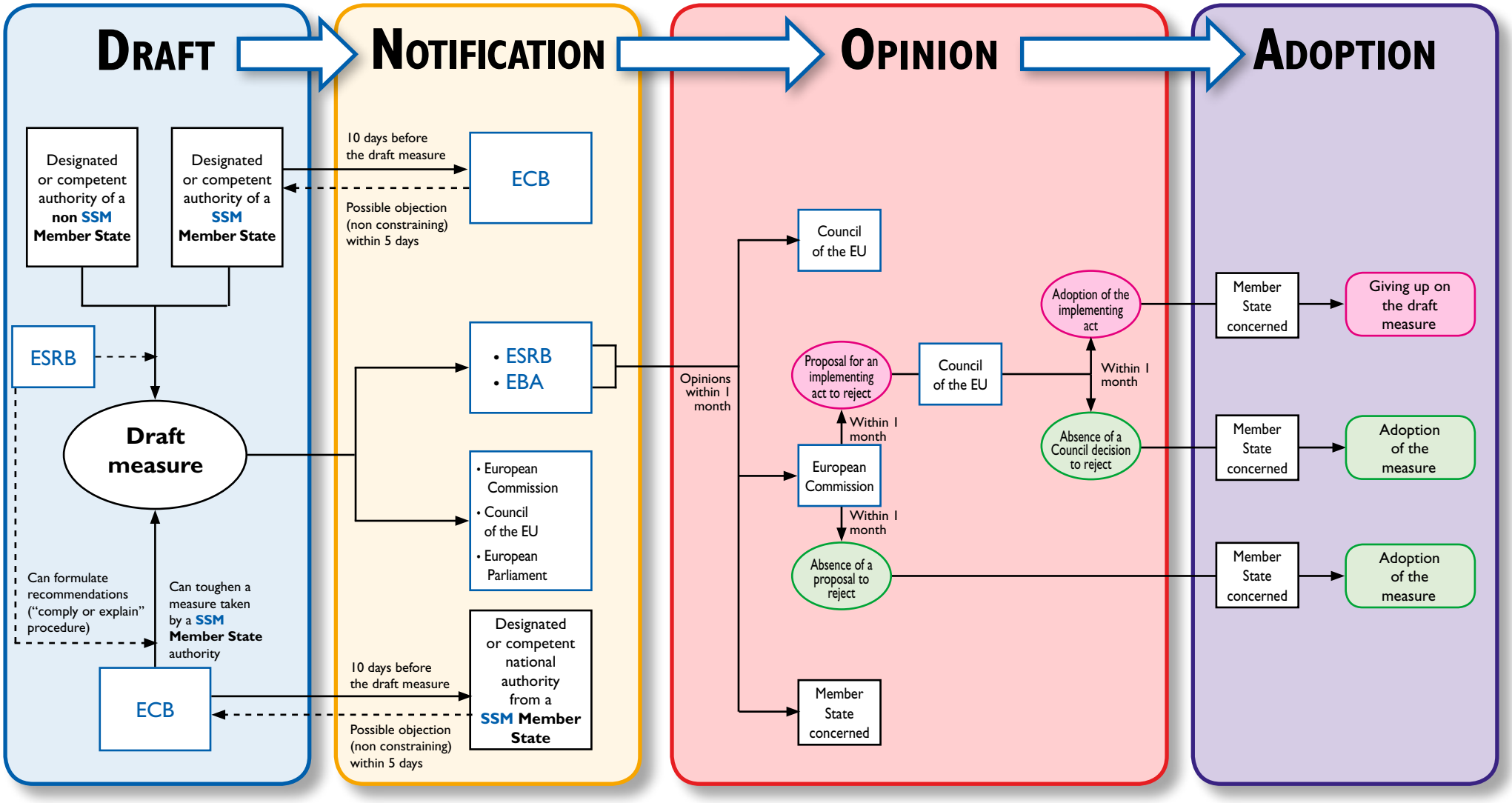
a) Before 1 January 2015, this procedure applies to all SRB rates above 3%.
b) This case is relevant only after 1 January 2015.
Source: Banque de France.

Countercyclical buffer - Article 136 CRD IV



a) Quarterly setting of the countercyclical buffer. Note: Procedure of recognition by the other Member States (reciprocity principle) of the buffer set up by the national authority in its juridiction J (for the institutions situated in J and authorised in another Member State): automatic when the buffer ≤ 2.5 %, volontary when the buffer > 2.5 %.
Source: Banque de France.

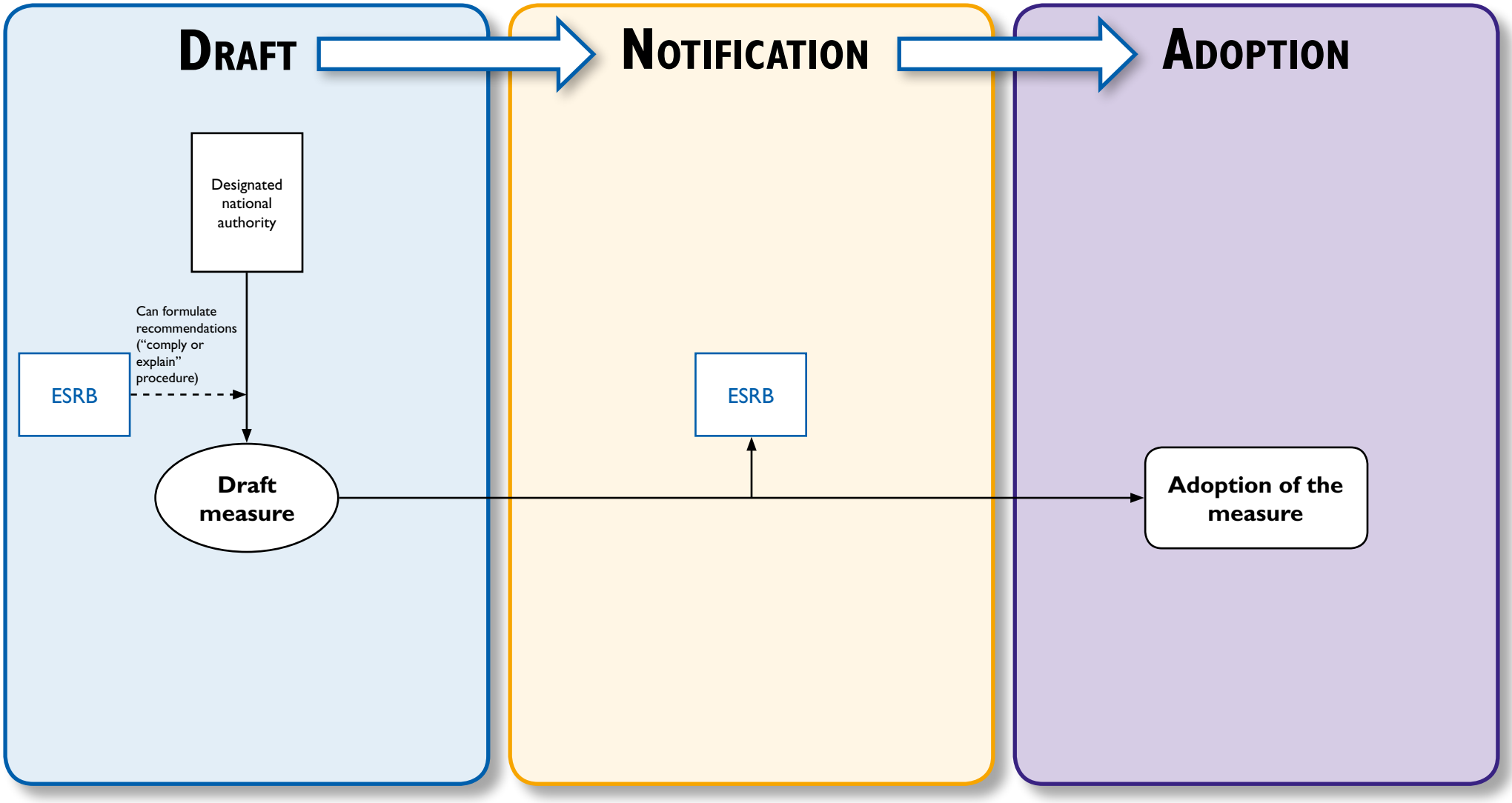
Macroprudential tools listed in the CRR (Article 458)[a)]



a) Including in particular: strengthening of the own funds requirements, of the capital conservation buffer, large exposures requirements, public disclosure requirements, liquidity requirements, risk weights for real estate, intra financial sector exposures.

Source: Banque de France.

Instruments not harmonised under CRR and CRD IV: loan-to-value (LTV) / loan-to-income (LTI) / debt-service-to-income (DSTI) ratios



Source: Banque de France.

Appendix B

International developments and comparison

1| United States

The 2010 Dodd-Frank Act established the Financial Stability Oversight Council (FSOC), a multi-agency council in charge of financial stability and monitoring systemic risks. Chaired by the Secretary of the Treasury, the FSOC is composed of representatives of different regulatory agencies, including the Federal Reserve (Fed). Although the FSOC itself does not have binding powers, it may formulate public "comply or explain" recommendations and request in certain cases that its constituting bodies take the required measures to maintain financial stability. The FSOC is responsible for designating non-bank systemically important financial institutions and market infrastructures.

The Fed is charged with supervising all bank holding companies and their subsidiaries, as well as systemic non-bank financial companies designated by the FSOC, and State Member banks.[1] The Fed must develop enhanced prudential standards for all bank holding companies with total consolidated assets of USD 50 billion or more, and also non-bank financial companies designated as systemic by the FSOC. These enhanced prudential standards include increased capital requirements and limits on the leverage ratio, enhanced liquidity requirements, limits on the concentration of funding, a requirement to carry out stress tests, a requirement to submit resolution plans or "living wills", and the creation of an Orderly Liquidation Authority (OLA) enabling the Federal Deposit Insurance Corporation (FDIC) to take control of a financial institution whose failure would cause a systemic risk.

2| United Kingdom

The system prevailing before the financial crisis was extensively reformed and the Bank of England (BoE) is now at the core of the financial sector's supervision. The microprudential supervision powers of the Financial Services Authority (FSA) were transferred to an operationally independent entity, the Prudential Regulation Authority (PRA), under the aegis of the BoE. The PRA will be responsible for supervising all important bank and non-bank financial institutions. In parallel, the Financial Conduct Authority (FCA) will be the financial market regulator.

Within the Bank of England, in addition to the current Monetary Policy Committee (MPC), the recently established Financial Policy Committee (FPC) is responsible for financial stability and macroprudential policy; it is also responsible for coordinating macro – and microprudential functions. Chaired by the Governor of the BoE, the FPC comprises 12 members, including six from the BoE and a (non-voting) member from the Treasury.

The Bank of England's financial stability objective, introduced by the Banking Act of 2009, is reaffirmed but has been amended to highlight the need for coordination between the central bank and the other relevant authorities.

1 *State-chartered banks belonging to the Federal Reserve.*

3| Germany

The Act on the strengthening of German financial supervision, which entered into force on 1 January 2013, aims at strengthening the institutional arrangements through which micro- and macroprudential supervision are conducted. The Act creates a Financial Stability Commission (*Ausschuss für Finanzstabilität*), chaired by the Minister of Finance and composed of representatives of the Bundesbank, the Ministry of Finance, the Financial Supervisory Authority (BaFin) and the Financial Market Stabilization Agency (FMSA). The Financial Stability Commission is in charge of (i) discussing issues key to financial stability, (ii) coordinating the cooperation between the institutions in charge of financial stability and of deliberating on national responses to warnings and recommendations from the ESRB, (iii) advising on the handling of ESRB warnings and recommendations ESRB, (iv) reporting to the Bundestag and (v) issuing and publishing warnings and recommendations regarding risks which might impair financial stability as well as measures to be taken in response to them.

The role of the Bundesbank in the area of financial stability and macroprudential policy is enhanced via an explicit mandate that includes identification of systemic risks, provision of analytical support to the FSC, and suggestion of warnings and recommendations to be issued by the FSC. In order to guarantee the independence of the Bundesbank, proposals on warnings and recommendations have to be based on economic necessities and not on political considerations. The Act also foresees the comprehensive exchange of information between the Bundesbank and the BaFin for the purposes of performing their respective functions in the field of financial stability.

Appendix C

Simplified implementation guide/overview on selected instruments

NB: When the macroprudential dimension of the instruments listed hereafter is not properly designed yet, we refer only to the microprudential definition.
The examples referred to for each type of instrument are not meant to be a comprehensive list of past experiences. For a more extensive overview of the implementation of macroprudential instruments, see for example Lim et al. *(2011).*

Table 1 Classification of macroprudential (MaP) instruments

Classification	Categories	CCB	Sectoral capital requirements	MaP leverage ratio	MaP add-on to LCR	MaP LTD	MaP LTV	MaP LTI	MaP DSTI	Capital surcharge on SIFIs	Systemic risk buffer
Type of instrument	Capital-based	x	x	x						x	x
	Liquidity-based				x	x					
	Asset-side						x	x	x		
Main dimension	Cross-sectional									x	x
	Time	x	x	x	x	x	x	x	x		
Scope of implementation	Broad-based	x		x	x	x					x
	Targeted		x				x	x	x	x	x
Main transmission channel	Price-based	x	x	x	x	x				x	x
	Quantity-based						x	x	x		
Regulatory origin	Recalibrated tool			x	x	x	x	x	x		
	Purely macroprudential	x	x							x	x

Table 2 Countercyclical capital buffer (CCB)

Type of risk	Capital-related (procyclicality).
Aim of the instrument	The CCB increases the resilience of the banking system during periods of excessive credit growth, in order to allow banks to maintain the flow of credit in the economy without risks for their solvency during periods of financial stress (primary aim). In addition, during a boom phase, the CCB could help to lean against the build-up phase of the financial cycle (positive side effect).
Computation	The computation is based on a conditioning variable (here the credit-to-GDP gap), which coincides ideally with the expansionary and contractionary phases of the financial cycle: *Step 1: compute the credit-to-GDP ratio at time t:* $$RATIO_t = \frac{CREDIT_t}{GDP_t} \cdot 100\%$$ where $CREDIT_t$ is a broad measure of credit to the private non-financial sector and GDP_t is the gross domestic product. Both measures are in nominal terms at a quarterly frequency. *Step 2: compute the gap between the credit-to-GDP ratio and its long-term trend:* $$GAP_t = RATIO_t - TREND_t$$ where $TREND_t$ is the long-term trend of the credit-to-GDP ratio computed using a one-sided Hodrick-Prescott filter with a high smoothing parameter (e.g. in BCBS, 2010b, this lambda parameter is set to 400,000). Only information available at each point in time should be used when computing the trend. *Step 3: transform the credit-to-GDP gap into the buffer add-on:* $$CCB_t = \begin{cases} 0 & \text{if } GAP_t < L \\ 2.5 \cdot \frac{(GAP_t - L)}{H - L} & \text{if } L < GAP_t < H \\ 2.5 & \text{if } GAP_t > H \end{cases}$$ When the credit-to-GDP gap is below a certain threshold (L), the buffer add-on is zero. It increases linearly with the credit-to-GDP gap, calibrated in steps of 0.25 percentage points or multiples of 0.25 percentage points (CRD IV, Article 136), until the buffer reaches its maximum level when the gap exceeds an upper threshold (H). The lower and upper thresholds L and H are key in determining the timing and the speed of the adjustment of the buffer add-on to underlying conditions. Analysis by the BCBS has found that an adjustment factor based on L=2 and H=10 provides a robust specification based on historical banking crises (BCBS, 2010b). The buffer add-on is expressed in percent of risk-weighted assets (RWA).
Implementation example	Brazil: used a formula to smooth capital requirements for interest rate risk in times of volatility. China (2010): introduced a countercyclical capital requirement similar to the one implemented by Basel III to curb credit growth and housing price inflation.
More information	BCBS (2010b).

Table 3 Sectoral capital requirements

Type of risk	Capital-related (procyclicality and risk concentration).
Aim of the instrument	Avoid the concentration of lending to sectors featuring systemic risks build-up.
Computation	Sectoral capital requirements can take mainly two forms, either higher risk weights on specific exposures (such as commercial or residential real estate loans) or capital surcharges calibrated in accordance with the bank's exposure to the specific sector (similar to a sectoral CCB).
Implementation example	Australia (2004): to prevent the development of the so-called "low-doc" mortgages, the Australian Prudential Regulation Authority tightened risk weights on this specific segment. India (2005, 2006): countercyclical risk weights' adjustments were implemented for the commercial real estate sector which experienced a credit boom, potentially creating an asset bubble.

Table 4 Leverage ratio

Type of risk	Capital-related (procyclicality and risk measurement errors).
Aim of the instrument	It provides a cap as to the extent the bank can leverage on a unit of capital which contributes to limiting the amplitude of the financial cycle, especially by mitigating the risk of a destabilising deleveraging process. As it does not rely on risk weights, it is free from risk modeling errors and does not depend on the risk categories which vary over-time.
Computation	$$Leverage\ ratio = \frac{Tier\ 1\ capital}{Total\ exposure} > 3\%$$ This formula reflects the Basel III leverage ratio definition set out in BCBS, 2014. The bank's total exposure measure is the sum of the following exposures: (a) on-balance sheet exposures; (b) derivative exposures; (c) securities financing transaction (SFT) exposures; (d) off-balance sheet (OBS) items. The specific treatments for these four main exposure types are defined in BCBS, 2014.
Implementation example	USA (1991): a simple leverage ratio (excluding in particular off-balance sheet items) ranged from 3 to 4% and could be adjusted if required by the regulator. After 2004, this ratio was allowed to be lower for investment banks, so that leverage significantly expanded for those institutions compared to commercial banks.
More information	BCBS (2010d), BCBS (2014).

Table 5 Liquidity coverage ratio (LCR)

Type of risk	Liquidity-related (liquidity and default risk).
Aim of the instrument	Ensure that a bank maintains an adequate level of unencumbered high quality liquid assets (HQLA) to meet its liquidity needs over 30 days in case of severe stress; this is meant to give enough time for the bank or the authority in charge to take the appropriate corrective actions.
Computation	*Step 1: the stressed "net cash outflow scenario" is defined as:* (a) the run-off of a proportion of retail deposits; (b) partial loss of unsecured wholesale funding capacity; (c) partial loss of certain secured, short-term financing; (d) outflows arising from a credit rating downgrade; (e) liquidity needs/haircuts due to increased market volatilities; (f) unscheduled draws on committed but unused credit lines; (g) potential liquidity needs to mitigate reputational risk. *Step 2: compute the net cash outflows (NCOF)* $NCOF = outflows - min\{inflows;\ 75\% \cdot outflows\}$ Following the "net cash outflow scenario", cash outflows are subject to prescribed "runoff" rates while cash inflows are subject to prescribed "inflow factors". Net cash outflows are defined as the total expected cash outflows minus total expected cash inflows during the 30 calendar days stress period. *Step 3: compute the stock of HQLA* $HQLA = Level\ 1 + Level\ 2A + Level\ 2B - max\{Adjusted\ Level\ 2A + Adjusted\ Level\ 2B - 2/3 \cdot Adjusted\ Level\ 1;\ Adjusted\ Level\ 2B - 15/85 \cdot (Adjusted\ Level\ 1 + Adjusted\ Level\ 2A);\ 0\}$ "Level 1" assets: cash, central bank reserves, and certain marketable securities backed by sovereigns and central banks, among others; "Level 2" assets (≤40% HQLA): comprised of Level 2A and Level 2B assets. Level 2A assets include certain government securities, covered bonds and corporate debt securities. Level 2B assets include lower rated corporate bonds, residential mortgage backed securities and equities that meet certain conditions. Level 2B assets may not account for more than 15% of a bank's total stock of HQLA. The specific treatments for Adjusted Level 1, Level 2A and Level 2B assets are defined in BCBS, 2013a. *Step 4: the LCR ratio is defined as:* $LCR = \frac{HQLA}{NCOF} \geq 100\%$
Implementation example	New Zealand (2009): ratio consistent with Basel III to increase banks' liquidity and reduce reliance on short-term offshore funding.
More information	BCBS (2010c, 2013a).

Table 6 Loan-to-deposit (LTD) ratio limit

Type of risk	Liquidity-related (mismatch between liquidity in assets vs. liabilities).
Aim of the instrument	When loans are extended beyond the deposit base, the residual funding gap is bridged by short-term funds levied on the financial markets. Thus, the LTD aims at reducing the funding gap in order to decrease the dependence on volatile wholesale funding and to favor more stable retail funding, i.e. deposits from households and non-financial companies.
Computation	$LTD = \frac{Loans}{Deposits} < \alpha\%$ The definition of loans and deposits used for this instrument should be as encompassing as possible, in order to avoid regulatory arbitrage (including at the cross-border level).
Implementation example	China: the LTD has been adjusted several times, currently set at 75% to reduce bank exposure to short-term funding and leverage risks. Korea (2011): LTD limit set at 100% to regulate the housing market due to its importance both on consumer confidence and overall macroeconomic conditions. USA (2012): set a lower bound to banks' statewide LTD ratios to prevent banks from collecting deposits in another state, while not investing these funds locally.
More information	Van den End (2013). On the case of the USA, see Federal Reserve Board (2012), "Banking Agencies Issue Host State Loan-to-Deposit Ratios", Press release, 29 June.

Table 7 Loan-to-value (LTV) ratio cap

Type of risk	Asset-related (procyclicality and exposure to default risk).
Aim of the instrument	Increase the resilience of banks and borrowers against losses by imposing a cap on the value of the loan relative to the value of the collateral, thereby reducing banks' losses in case of borrowers' default and possibly also lowering borrowers' probability of default. Dampen the credit cycle by restricting the quantity of credit.
Computation	$LTV = \frac{Loan\ amount}{Collateral\ value} < \alpha\%$
Implementation example	Hong Kong (1990s): LTV cap of 70% adopted in 1991. The LTV policy helped domestic banks to cope with the 40% drop in housing prices during the Asian financial crisis between September 1997 and September 1998. Korea (2000s): use of time-varying LTV caps from 2002 which contributed to limiting house price appreciation.
More information	For a study of the case of Hong Kong, see for instance Craig and Hua (2001) and Wong, Fong, Li and Choi (2011). For a study of the case of Korea, see for instance Igan and Kang (2011).

Table 8 Loan-to-income (LTI) ratio cap

Type of risk	Asset-related (procyclicality and exposure to default risk).
Aim of the instrument	Increase the resilience of banks and borrowers against losses by imposing a cap on the value of the loan relative to the income of the borrower, thereby reducing its leverage and probability of default. Dampen the credit cycle by restricting the quantity of credit.
Computation	$LTI = \frac{Loan\ amount}{Disposable\ income} < \alpha\%$ where the loan amount refers to the loan or a set of loans. When understood as total debt, it is generally referred to as the debt-to-income (DTI) ratio. Usually, the disposable income is calculated on a yearly basis.

Table 9 Debt-service-to-income ratio cap (DSTI)

Type of risk	Asset-related (procyclicality and exposure to default risk).
Aim of the instrument	Increase the resilience of banks and borrowers against losses by imposing a cap on the debt servicing costs relative to the income of the borrower, thereby reducing its leverage and probability of default. Dampen the credit cycle by restricting the quantity of credit.
Computation	$DSTI = \frac{Debt\ servicing}{Disposable\ income} < \alpha\%$ Usually, the disposable income is calculated on a monthly or yearly basis.
Implementation example	Korea (2000s): DSTI ratio introduced in 2005.
More information	For a study of the case of Korea, see for instance Igan and Kang (2011) and Kim and Lim (2013).

Table 10 Capital surcharge for systemically important financial institutions[a)]

Type of risk	Capital-related (risk concentration).
Aim of the instrument	Reduce the likelihood and severity of contagious defaults, and subsequent losses for the economy, that might stem from the failure of a SIFI. This aim is achieved by increasing SIFIs' loss absorbency capacity through a capital surcharge (buffer). As a by-product, SIFI surcharges would help offset any funding advantage derived from the perceived status of SIFIs as "too-big-to-fail" (moral hazard).
Computation	*Step 1: identify SIFIs* – The framework for the identification of G-SIBs has been set out in BCBS (2011) and updated in BCBS (2013b) (see part 4|2|1). It uses an indicator-based approach which comprises five categories with an equal weight of 20%: • size; • interconnectedness; • substitutability; • cross-jurisdictional activity; • complexity. Each category is subdivided into one or several indicators k, with each indicator equally weighted within its category (indicator weight w_k) (see Table 5). The total score S_i of a bank i is equal to the weighted sum of the amount for each indicator for bank i relative to the aggregate amount for this indicator summed across all banks in the sample ($n \in \{1,\ldots,N\}$). It is multiplied by 10,000 to be expressed in basis points: $$S_i = 10000 \cdot \left(\sum_{k=1}^{K} w_k \cdot \frac{indicator\ amount_{k,i}}{\sum_{n=1}^{N} indicator\ amount_{k,n}} \right)$$ – BCBS (2012) develops a set of principles on the assessment methodology and the higher loss absorbency requirement for D-SIBs. An assessment methodology for D-SIBs is to be established by each national authority. *Step 2: impose additional surcharges on SIFIs* – G-SIBs are allocated into 5 buckets depending on their score. Each bucket corresponds to an additional CET1 capital requirement ranging from 1% to 3.5% of RWA. Buckets increase in gradients of 0.5%. The highest bucket (currently at 3.5% additional CET1) was meant to be initially empty so as to discourage banks from becoming more systemically important. – Each national jurisdiction calibrates the appropriate capital surcharges for D-SIBs.
More information	BCBS (2011; 2012; 2013b).

a) The BCBS uses the wording "global" and "domestic systemically important banks" (G-SIBs and D-SIBs), whereas CRD IV uses "global" and "other systemically important institutions" (G-SIIs and O-SIIs), hence also investment firms. Work is underway at the BCBS level to extend the framework to other institutions.

Table 11 Systemic risk buffer (SRB)

Type of risk	Capital-related (structural risks).
Aim of the instrument	Strengthen the resilience of the financial sector, or its components, to potential shocks stemming from structural systemic risk of long term, non-cyclical nature, encompassing changes in legislation or accounting standards, the relative size of the financial system compared to GDP, or financial innovation increasing the complexity of the financial system.
Computation	A SRB of CET1 capital of at least 1% of RWA can be applied to the whole banking sector or a subset of institutions facing similar structural systemic risks. Its implementation should not harm the cross-border level playing field and should be coordinated across jurisdictions (ESRB, 2013).
More information	BCBS (2010b) and ESRB (2013).

Appendix D

A short guide to systemic risk measurement

A short guide to systemic risk measurement

Which type of risk-dimension to measure?	– Cross-sectional versus time dimension. – Exposure to common factors/contribution to aggregate systemic risk/ contagion from one institution to another. – Now-casting versus forecasting. ➜ *No one-size-captures-all indicator.*
Which "system" or "portfolio" to choose?	– **Scope of financial institutions**: include non-banks with potential systemic impact? (hedge funds, broker-dealers, insurance companies, clearing houses). – **Geographical coverage**: pick the countries with the largest relevant exposures, e.g. by using aggregate data from the BIS or the EBA. ➜ *Issue: comparability of results based on different samples.*
Which type of data to use?	– **Trading book**: high frequency, long series but sometimes subject to optimistic beliefs (noisy signals); useful for now-casting. – **Banking book**: low frequency, shorter time span but captures more slow-moving phenomena; useful for risk build-up. – **Macroeconomic data:** quarterly frequency; useful for forecasting and macro-stress-testing. – **Regulatory data**: high degree of granularity; useful for bilateral exposures and network analyses. ➜ *Issue: data comparability (accounting at bank level,[a]) national statistics) and unequal coverage in terms of frequency.*
Which building blocks?	– **Balance sheet-based**: *pros*: simple to compute, easy to interpret; *cons:* aggregated or netted data could hide interesting features for systemic risk. – **Model-based**: *pros*: captures interconnection between individual institutions, provides theoretical foundations of the underlying source of risk; *cons*: relies on structural assumptions which are sometimes difficult to test empirically. Standard model input (LGD, versus conditional PD): – co-movement of series (variance modeling or decomposition); – point estimates of the variable of interest (market loss, probability of default, etc.); – tail measures of the interdependence: parametric tail distribution, copula, quantile regressions. ➜ *Issue: correlation, co-movement or conditional probabilities do not mean causality; e.g. a lower conditional probability can reflect an increase in the transmission of the risk if it is associated with a lower probability of occurrence of the conditioning event (denominator).*
How to cross-check results?	– **For cross-sectional analysis**: compare with the ranking of G-SIBs by the FSB. ➜ *Issues: difficult to compare with existing metrics as measures do not all focus on the same portfolio, the same source of risk, etc. In addition, there are usually no confidence bands when a ranking is provided. Thus the focus should be more on identifying the set of vulnerable banks, rather than on isolating the most systemic bank at each date.* – **For time dimension**: internal validity by comparing peeks to known systemic risk events and weighting the relative importance for the authority between type 1 and type 2 errors (see Appendix F). ➜ *Issues: one would want to single out the excessive procyclicality, but this requires having an idea about what the optimal cycle would be. Also one needs a benchmark of what systemic crises are. Either expert-selected systemic stress events (systemic banking crisis database, IMF 2012; used by the CGFS when working on CCB, 2012) or model-selected systemic stress events (systemic risk index, Lo Duca and Peltonen, 2013).*
How to allocate systemic risks to each institution?	– Either the Euler allocation (Tasche, 2008) or the Shapley value approach (Tarashev *et al.*, 2009; Drehmann and Tsatsaronis, 2011; Cao, 2013). – Ensures the measure satisfies the additivity axiom, i.e. the sum of individual contributions to systemic risk is indeed equal to the aggregate systemic risk measure. ➜ *Issue: the allocation step can be separated from the measurement itself provided the aggregate measure of systemic risk is computed on a portfolio of individual institutions.*

a) Example of US GAAP versus IFRS in the netting of derivatives (end 2012): quasi-leverage (liabilities over capitalisation) of 34 and 54 for respectively BNP Paribas and Société Générale (IFRS accounting standards) versus 14 and 18 respectively for CitiGroup and Morgan Stanley (US GAAP standards). Thus using non-weighted capital ratios across jurisdictions requires a correction.

Appendix E

Examples of model-based systemic risk indicators

The marginal expected shortfall (MES)

Focus	Description
Type of risk	Exposure to system-wide stress.
Risk channel	Individual risk-taking, interconnectedness.
Interpretation	Expected marginal equity loss experienced by an investor in a financial firm conditional on substantial market stress.
Formula	$MES_{i,t} = E_t(r_{i,t+1} \mid r_{m,t+1} \leq q\%)$ $MES_{i,t}$ is the marginal expected shortfall experienced by financial firm i as of date t if the market return becomes less than $q\%$; r_i denotes firm i's returns, and r_m market index returns.
Systemic stress definition	Daily (weekly) market decline beyond 2% (4%).
Data requirements	– Individual stock returns. – Market index returns.
Building blocs	– Volatility of returns (of individual firms and of the market index). – Correlation between individual firms' and market index returns. – Conditional expected tail.
Time horizon	Daily or weekly.
Properties	Measure closest to the standard set of axioms of what an ideal risk measure should be.
Reference	Acharya *et al.* (2010), Brownlees and Engle (2010).

The systemic risk measure (SRISK)

Focus	Description
Type of risk	Exposure to system-wide stress.
Risk channel	Individual risk-taking, size effect, interconnectedness.
Interpretation	Recapitalisation required (in EUR million) in order to meet a minimum regulatory constraint of unweighted capital of k%. Taking the asset side of the balance sheet as given, SRISK compares the regulatory capital requirements against the expected equity loss (in EUR million) experienced by a bank conditional on substantial market stress.
Formula	$SRISK_{i,t,T} = \max\{E_{t-1}[(k \cdot (D_{i,t} + K_{i,t}) - K_{i,t} \mid crisis)], 0\}$ $= \max\{E_{t-1}[(k \cdot D_{i,t} - (1-k) \cdot K_{i,t} \cdot LRMES_{i,t,T})], 0\}$ $SRISK_{i,t,T}$ is the SRISK of bank i as of date t for a systemic stress at the horizon T; k denotes the regulatory non-risk-weighted capital ratio; D_i and K_i denote, respectively, the total liabilities and the market capitalisation of bank i; $LRMES_{i,t,T}$ denotes the long-run MES over a time horizon T.
Systemic stress definition	Loss of market capitalisation beyond 40% within a 6 months horizon.
Data requirements	– Market capitalisation of individual banks. – Total assets of individual banks.
Building blocs	Risk measure for each individual bank: marginal expected equity loss (MES, see indicator above) simulated over 6 months to obtain the long-run MES (LRMES).
Time horizon	Daily.
Properties	Akin to a stress-test measure on the capital position of the bank. Related to the leverage ratio regulation which is meant to become effective in 2018.
Reference	Acharya *et al.* (2012).

The conditional value-at-risk (CoVaR)

Focus	Description
Type of risk	Contribution of one institution to system-wide stress.
Risk channel	Spillover (unidentified channels) between banks and the system.
Interpretation	The CoVaR measures the expected market loss in the $q\%$ worst cases scenario (VaR) of the whole financial sector conditional on institution i being in distress. Institution i's contribution to systemic risk is measured as the difference between the VaR of the system conditional on the distress of institution i and the VaR of the financial system conditional on the median state of the institution i.
Formula	Definition of the CoVaR as the VaR of the market return m conditional on the institution i being at its VaR: $Pr(r_{m,t} \leq -CoVaR_q^{m\|i} \| r_{i,t} = -VaR_q^i) = q$ Measure of i's contribution to the CoVaR of the market m: $\Delta CoVaR_q^{m\|i} = CoVaR_q^{m\|x^{i=VaR_q^i}} - CoVaR_q^{m\|x^{i=Median^i}}$ where $r_{m,t}$ corresponds to the market index returns and $r_{i,t}$ is the individual bank's return; q is the quantile of interest. Recall that the VaR is the value associated with the probability to be in the $q\%$ tail of the stock returns' distribution.
Systemic stress definition	The conditioning event corresponds to the institution i being at its VaR level.
Data requirements	– Market capitalisation of individual banks. – Macroeconomic aggregates: proxy for risk profile and risk appetite; interest rates and spreads; stock index.
Building blocs	Quantile regression of returns conditional on a set of state variables.
Time horizon	Weekly.
Properties	For extensions to multiple conditioning and applications to the design of macroprudential instruments, see Cao (2013).
Reference	Adrian and Brunnermeier (2008).

Banking stability measures: joint probability of distress (JPoD), banking stability index (BSI) and distress dependence (DiDe)

Focus	Description
Type of risk	Spillover from one institution to another.
Risk channel	Interconnections, inter-linkages, cascade effect.
Interpretation	This set of measures relies on a flexible modeling of all the interactions (co-movements) between different institutions at any point of the individual distribution (including tail situations). – The joint probability of distress (JPoD) measures the probability of all institutions experiencing large losses at the same time. – The banking stability index (BSI) measures the expected number of institutions being in distress if at least one of them is in distress. – The distress dependence matrix (DiDe) refers to the set of all bilateral probabilities of default conditional on another institution falling in distress, for each pair of banks in the portfolio.
Formula	For a system of n banks $i \in \{1,2,\ldots,n\}$: $\text{JPoD} = \int_{-\infty}^{d^1} \int_{-\infty}^{d^2} \ldots \int_{-\infty}^{d^n} p(r_{1,t}, r_{2,t}, \ldots, r_{n,t})\, dr_{1,t}\, dr_{2,t} \ldots dr_{n,t}$ $\text{BSI} = \frac{Pr(r_{1,t} \le d^1) + Pr(r_{2,t} \le d^2) + \ldots + Pr(r_{n,t} \le d^n)}{1 - Pr(r_{1,t} > d^1, r_{2,t}) > d^2, \ldots, r_{n,t} > d^n)}$ $\text{DiDe} = \left\{ \frac{Pr(r_{i,t} < d^i, r_{j,t} < d^j)}{Pr(r_{j,t} < d^j)} \right\}_{i,j \in \{1,2,\ldots,n\}}$ where $r_{i,t}$ is the return of the bank i and d^i stands for the individual default threshold; $p(r_{1,t}, r_{2,t}, \ldots, r_{n,t})$ is the multivariate density of the return of all banks n.
Data requirements	– Spreads on CDS of individual institutions. – Market capitalisation of individual institutions.
Building blocs	– Default probabilities of individual institutions recovered from CDS after applying a haircut. – Correlation of returns to get the co-movement of all series. – Non-parametric and non-linear copula (CIMDO) to recover the multivariate density.
Time horizon	Daily.
Properties	– The computation of bilateral default probabilities does not require data on the actual exposures and thus circumvents data availability issues. – Sovereigns can be easily included using CDS on sovereign debt and stock indices, in order to examine the spillover due to sovereign debt crises on each individual institution. – Once the multivariate density is recovered and the matrices of all bilateral exposures obtained, financial stress tests can be conducted with different scenarios.
Reference	Segoviano and Goodhart (2009).

Appendix F

Comparing the ability of indicators to predict the build-up of systemic risks

The signal extraction method (Kaminsky and Reinhart, 1999) is used to assess the early warning abilities of different candidate indicators (e.g. for costly asset price cycles: Borgy *et al.*, 2009; Alessi and Detken, 2011; for banking crisis signals: Drehmann, 2011). The aim is to distinguish indicators according to their ability to signal effective risk build-up and avoid noise, i.e. instances when systemic risk builds up without being detected (type 1 error) or when the measure indicates systemic risk without it being present (type 2 error). CGFS (2012) uses this method to compare the ability of different indicators to signal the build-up of a crisis and calibrate the release phase of the CCB. The steps are as follows:

1 – *Define the event whose occurrence is to be predicted:* systemic crises can be identified either via a qualitative assessment (CGFS, 2012) or a quantitative method based for instance on financial variables (Lo Duca and Peltonen, 2013);

2 – *Build the signal based on the indicator to be tested:* for each period and country, the signal S of a systemic crisis takes the value 1 if the indicator y is above some critical threshold k to be defined;

$$S(y) = \left\{ \begin{array}{l} 1 \text{ if } y > k \\ 0 \text{ if } y < k \end{array} \right\}$$

3 – *Get the empirical frequencies of signals' informational content:* compare the signal to the subsequent occurrence (or not) of the event, with different time lags, which allows to compute the type 1 (T1) and type 2 (T2) errors (see Table A below);

Table A Signal extraction quality

	Systemic crisis in t+1	**No systemic crisis in t+1**
Signal in t (S=1)	Pr(Signal=1|Crisis=1)	Type 2 error (T2) = Pr(Signal=1|Crisis=0)
No signal in t (S=0)	Type 1 error (T1) = Pr(Signal=0|Crisis=1)	Pr(Signal=0|Crisis=0)

4 – *Define a criterion to compare the ability of indicators to predict the event:* ideally, when implementing a macroprudential instrument to tame the build-up of risk, the macroprudential authority would want to minimise the costs associated with the implementation of the instrument, taking into account the uncertainty about the actual state of the financial cycle. As stated in CGFS (2012), the tradeoff is both between the cost of the crisis (CostCrisis) and the cost of regulation (CostReg), i.e. the effectiveness α of the instrument in reducing the cost of the crisis (see Table B), and between a timely implementation and a false alarm signal, i.e. the noise of the signal about the state of the financial cycle (see Table A). Thus the macroprudential authority's problem can be described as follows:

$$Min \ \mathrm{E}(cost)$$

$$\begin{aligned} \mathrm{E}(Cost) \ = \ & \Pr(Crisis = 1) \cdot \Pr(S = 1 | Crisis = 1) \cdot ((1 - \alpha) CostCrisis \ + \ CostReg) \\ + \ & \Pr(Crisis = 1) \cdot \Pr(S = 0 | Crisis = 1) \cdot \ CostCrisis \\ + \ & \Pr(Crisis = 0) \cdot \Pr(S = 1 | Crisis = 0) \cdot CostReg \end{aligned}$$

Table B Benefits and costs of using macroprudential instruments (from CGFS, 2012)

	Systemic crisis in t+1	No systemic crisis in t+1
Use macroprudential instruments	(1- α).CostCrisis + CostReg	CostReg
No macroprudential instruments	CostCrisis	0

Nevertheless, the cost of a crisis as well as the cost of a regulation may be difficult to assess (see Macroeconomic Assessment Group – MAG, 2010 and Long-term économic impact – LEI, 2010). Thus an easier criterion would be used in practice. Three main solutions are put forward:

(i) The noise-to-signal ratio (NTS) compares the informational content of a signal to its background noise, but does not provide confidence intervals when ranking indicators. It corresponds to the ratio of the false alarm rate (false positive rate – FPR) to the rate of correctly predicted crises (true positive rate – TPR).

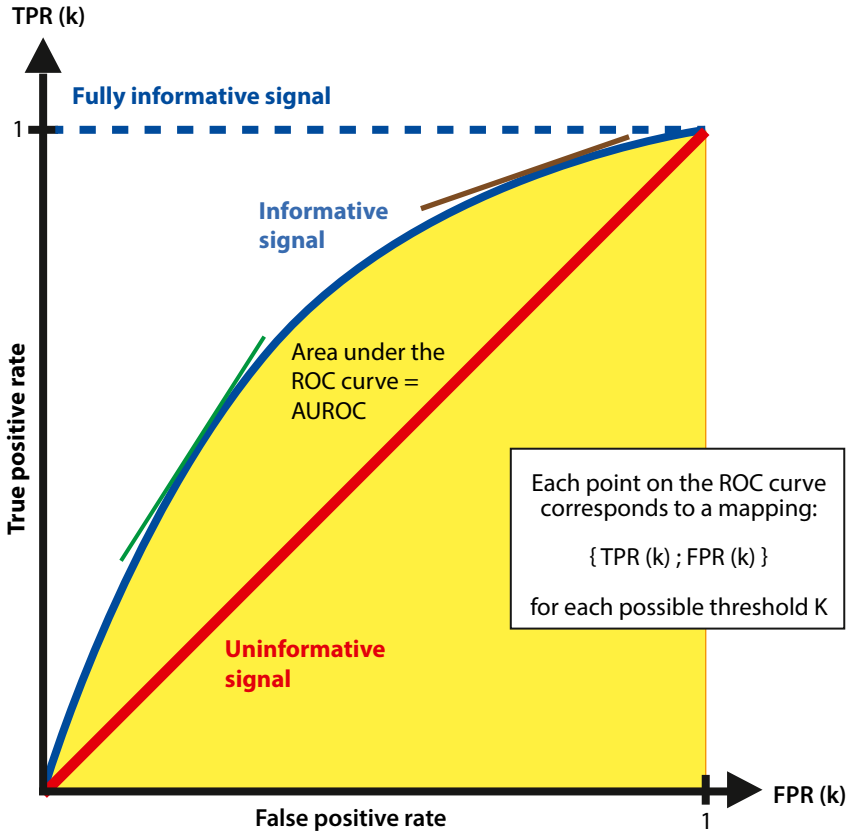
$$NTS = \frac{\Pr(Signal = 1|Crisis = 0)}{\Pr(Signal = 1|Crisis = 0) + \Pr(Signal = 0|Crisis = 0)} \Big/ \frac{\Pr(Signal = 1|Crisis = 1)}{\Pr(Signal = 1|Crisis = 1) + \Pr(Signal = 0|Crisis = 1)} = \frac{\textit{false positive rate}}{\textit{true positive rate}}$$

(ii) An alternative is to take into account the preferences of the macroprudential authority and define a loss function L with a parameter θ for the preference for failing to signal some events (T1) versus having too many false alarms (T2).

$$L = \theta \cdot \Pr(Signal = 0|Crisis = 1) + (1 - \theta) \cdot \Pr(Signal = 1|Crisis = 0)$$

(iii) But as the authority's preference is unknown – the true θ is unknown – one would need to evaluate the signal given by the indicator over the full range of possible utility functions (Drehmann and Juselius, 2013). This requires using a mapping called the "receiver operating characteristic" (ROC) curve as a metric for assessing and comparing the classification of early warning indicators. In addition, this method provides confidence bands to rank indicators. More precisely, the ROC methodology computes the relationship between the rate of correctly predicted crises and the rate of false alarms over all the possible cut-off levels k of the early warning indicator (see Figure A). Then the threshold that produces the desired ratio of true signals versus false alarms can be selected. Thus, each tangent curve (green or brown) would be associated with a specific regulator preference. Here, the green line would be associated with more aversion to false alarms, while the brown line would correspond to a preference for not missing crises. But instead of choosing one preference, this method also makes it possible to investigate the performance of the indicator over a wider range of plausible preferences by computing the area under the ROC curve (AUROC), possibly over one part of the graph. When the ROC curve is above the 45° line (equivalently the AUROC is above 0.5), the indicator has a predictive power for a range of thresholds k. When the AUROC gets closer to 1, then the signal tends to be fully informative and there exists a threshold k where the rate of false positives is close to 0 while the rate of true positives is close to 1.

Figure A The ROC methodology



Source: Banque de France, adapted from Drehmann and Juselius, 2013.