Article:
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Executive summary

Externalities and macroprudential policy

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The recent financial crisis has led to a re-examination of policies applied for achieving macroeconomic and financial stability. Part of the debate involves the adoption of a macroprudential perspective on financial regulation, with the aim of mitigating boom-bust patterns and systemic risks in financial markets. The fundamental rationale for macroprudential policies, however, is not always clearly articulated. The contribution of this paper is to lay out the key sources of market failures that justify macroprudential regulation. It explains how externalities associated with the activity of financial intermediaries can lead to systemic risk, and require specific policies to mitigate such risk. The paper classifies externalities that lead to systemic risk and suggests that the correction of these externalities can be seen as intermediate targets for macroprudential policy, since policies that control externalities mitigate market failures that create systemic risk. This paper discusses how the main proposed macroprudential policy tools – capital requirements, liquidity requirements, restrictions on activities and taxes – address the identified externalities. This mapping may help policymakers select the most effective instruments for macroprudential policy.

Externalities and macroprudential policy[1]

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Abstract
As for any form of government intervention, macroprudential policy should be justified by market failures. This paper discusses three key externalities across financial institutions and from financial institutions to the real economy that rationalize the need for macroprudential policy: externalities related to strategic complementarities, fire sales and interconnectedness. We link each externality to recently proposed macroprudential policy tools, and argue that although various tools can correct the same externality, these tools are best seen as complements rather than substitutes.

1 We would like to thank Olivier Blanchard, Stijn Claessens, Giovanni Dell'Ariccia, Luc Laeven and Anton Korinek for useful comments and suggestions. All errors are our own. The views expressed in this paper are those of the authors and are in no way representative of the views of the IMF or the Federal Reserve System, their management, or any affiliated organizations. All remaining errors are the sole responsibility of the authors.

1. Introduction

The 2007–08 financial crisis and the ensuing "Great Recession" have led to a profound re-examination of macroeconomic policy, and financial regulation and oversight. At the heart of this re-examination is the realization that financial stability has a critical bearing on macroeconomic outcomes [Blanchard et al. (2010)]. The renewed focus on financial stability has sparked important financial regulation reforms. The new Basel III accord envisions more stringent capital regulation, as well as the introduction of new tools, such as liquidity requirements. Other reforms, affecting banks' activities, the shadow banking system, and changes in the institutional infrastructure, are under way in various jurisdictions.

Beyond traditional microprudential regulation, the crisis has led to a new focus on "macroprudential" policy, which aims to address systemic risk, i.e., "the risk of developments that threaten the stability of the financial system as a whole and consequently the broader economy" [Bernanke (2009)].[2] The proposed tools range from adaptations of standard micro-prudential measures, such as capital surcharges that are countercyclical or systemic risk-based, to taxes and restrictions on intermediaries' assets and liabilities [FSB (2011a, b), IMF (2011a), and Shin (2011)]. Many countries have announced the adoption of macroprudential policies, and some have already implemented versions of such policies with mixed evidence as to their effectiveness [see Crowe et al. (2011), IMF (2011b), Lim et al. (2011)].

The focus on macroprudential policy is motivated by the fact that microprudential regulation is necessary but not sufficient to deal with systemic risk. Microprudential regulation (such as Basel I and II capital accords) tends to view financial institutions in isolation and aims mainly to ensure that each is individually solvent. Yet solvency of individual institutions is not a sufficient condition for the stability of a system as a whole, for two main reasons. First, the focus on individual institutions neglects risks that are of systemic rather than individual nature, such as correlation risk [Acharya (2009)]. Second, certain aspects of microprudential regulation, while aimed at protecting individual institutions, may at times destabilize the system as a whole [Hanson et al. (2011)]. For example, microprudential capital requirements that become binding following a shock can turn individual deleveraging into a system-wide credit crunch. Given these limits, the purpose of macroprudential regulation is to focus on the financial system as a whole, with an ultimate objective of limiting systemic risk.

This paper aims to advance the debate on macroprudential policy by focusing on its economic rationale, i.e., the correction of market failures that give rise to systemic risk. To do so, we identify three types of externalities: (a) externalities related to strategic complementarities, which lead banks (and other financial institutions) to take excessive or correlated risks and build up vulnerabilities during the upswing of a financial cycle; (b) externalities related to fire sales, arising from a generalized sell-off of financial assets that causes a decline in asset prices and impairs the balance sheet of intermediaries, amplifying the contractionary phase of the financial cycle; (c) externalities related to interconnectedness, caused by the propagation of shocks from systemic institutions or through financial networks.

Correcting these externalities can be seen as intermediate targets for macroprudential policy, since policies that control externalities mitigate market failures that create systemic risk. This approach may help policymakers select the most effective instruments for macroprudential policy. By focusing on the economic rationale, our approach complements the traditional, descriptive classification of macroprudential policies based on the distinction between time-series and cross-sectional dimensions of systemic risk [Borio (2009), Bank of England (2011)].

While it would be desirable to derive from first principles the optimal response to the identified externalities, it is difficult to do so.[3] The narrower approach of this paper is to discuss how the main proposed macroprudential policy tools — variations of capital requirements, liquidity requirements, restrictions on activities, and taxes — may address the identified externalities.

We find that the three externalities identified in this paper may be corrected by various tools, but each tool has benefits and limitations. As a result, various tools addressing the same externality are best seen as complements. For example,

2 The term "macroprudential" was put into use by Crockett (2000) and Borio (2003). Galati and Moessner (2011) provide a review of the recent literature on macroprudential policy.

3 See Goodhart et al. (2012) for a recent attempt in this direction.

both capital requirements and limits on bank asset allocation can correct the externalities associated with strategic complementarity. However, capital requirements may become less effective in booms (when capital ratios increase due to buoyant asset prices), so more crude but direct quantity restrictions, such as debt-to-income (DTI) or loan-to-value (LTV) ratios, can supplement them. Similarly, capital and stable funding measures can be complements in addressing the risk of fire sales, since they focus on vulnerabilities on different sides of the balance sheet. And, capital surcharges can weaken the incentives of banks to become systemic and ensure that systemic institutions have a larger buffer to use in case of distress, while restrictions on the composition of bank assets (e.g., as envisioned by the Volcker rule) can limit their most risky exposures.

Despite these complementarities, one conclusion that emerges from this paper is that capital surcharges are likely to play an important role in any macroprudential framework. The reason is that relative to other policy tools, time-varying and systemic risk-based capital surcharges address any of the three identified externalities that lead to systemic risk. Moreover, they are closely linked to microprudential regulation and are already part of the Basel III accord.

In this paper, we also suggest that a key challenge for the design of macroprudential policy is to acquire more evidence on the effectiveness of alternative policy tools. While policymakers have so far relied mostly on "rule of thumb" considerations, it is necessary to gain evidence on the effectiveness of interventions in order to make the macroprudential policy design more precise.

Since the analysis in this paper is limited to ex-ante regulation of financial intermediaries, we abstract from other important challenges related to macroprudential policy. For example, we do not cover issues related to the supervision of financial intermediaries. We also take as given the imperfect mechanisms to resolve distressed financial institutions [Claessens et al. (2011)] and abstract from systemic risk implications of capital flows and monetary and fiscal policies [Ostry et al. (2011), De Nicolò et al. (2010), Mooij (2011)].

The structure of the paper is as follows. Section 2 reviews the rationale for microprudential and macroprudential regulation. Section 3 discusses the three externalities that lead to systemic risk. Section 4 links these externalities to macroprudential policy tools and discusses policy design challenges. Section 5 concludes.

2. Why is traditional microprudential policy not enough?

The prevailing economic rationale for microprudential regulation rests largely on a standard moral hazard argument. Shareholders of leveraged firms have incentives to engage in risky activities, since they reap the benefit of the upside, but in the event of failure creditors bear the cost. This classical risk-shifting problem is worse for banks because of public safety nets. Deposit insurance, intended to prevent bank runs and panics, worsens the incentives of depositors to monitor bank risk strategy. The expectation of government bailout, which may be necessary to limit the ex-post cost of financial distress, similarly reduces the monitoring incentives of uninsured creditors.

For this reason, and given the crucial role that debt plays in the capital structure of banks, capital requirements have been a central feature of microprudential regulation. Equity increases the shareholders' "skin in the game," forcing them to bear a greater share of the cost of the bank's risk-taking choices.[4]

The recent financial crisis has shown, however, that solving the moral hazard problem at each individual institution is not a sufficient condition to ensure the stability of the financial system as a whole. One lesson of the crisis is that interconnectedness among banks and other financial institutions can generate externalities with adverse effects on the real economy. A common source of such externality is contagion, the possibility of one distressed bank affecting the stability of others. But the links can be more subtle and involve, for example, pecuniary externalities through asset prices (asset liquidations that result in price declines impairing the balance sheets of other institutions) or strategic interactions among banks that lead them to take correlated risks ex-ante. Indeed, the crisis has brought to the fore the idea that the risk in a

4 A complementary view of prudential regulation and capital requirements is that because small and inexperienced depositors are unable to monitor banks' manager behavior, regulation is needed to guarantee that banks act in the interest of depositors [Dewatripont and Tirole (1994)].

financial system is not simply the aggregation of individual risks, but is mostly endogenous risk, resulting from the collective behavior of financial institutions.[5]

Another lesson of the crisis is that microprudential regulation is not always suited to address risks that are systemic in nature. In fact, ensuring the stability of each institution individually can at times destabilize the system as a whole. For example, capital ratios set independently of the business cycle may be a source of systemic risk. Since it is costly to raise new capital in downturns, banks hit by a negative shock may prefer to delever. In aggregate, this collective behavior may cause a credit crunch and a generalized drop in asset prices, exacerbating the initial negative shock.

In the presence of such externalities, microprudential regulation needs to be supplemented with tools that aim to safeguard the financial system as a whole. It is common to refer to such tools as macroprudential policies, although there is no general agreement on their definition and objectives. The standard view is that macroprudential policies address the time and cross-sectional dimensions of systemic risk in the financial system. This classification implies that the objective of macroprudential policies is to smooth financial and credit cycles, in order to prevent systemic crises and provide cushion against their adverse effects.

In this paper, we take the view based on the "first principles" that regulation needs to be justified by market failures. This approach clarifies that macroprudential policies are justified by the need to correct market failures, and not simply because the financial system is "fragile." This provides a justification for regulation, and a framework to analyze the economics behind recent policy proposals.

3. What are the externalities — market failures that justify macroprudential policy?

We start our discussion by identifying market failures that may require a response in the form of macroprudential policy. The recent financial crisis and the debate it spurred in the literature highlight three main sources of such market failures: externalities related to strategic complementarities, fire sales and interconnectedness.[6] Externalities operate between financial institutions, and therefore cannot be fully addressed by microprudential policy that views institutions in isolation. In principle, there may be other market failures that require a macroprudential policy response; the scope of our discussion is confined to these three externalities, reflecting the current state of knowledge.[7]

3.1 Externalities related to strategic complementarities

Historical experience suggests that financial intermediaries tend to assume exposure to common credit and liquidity risk in an upswing of a business cycle, which amplifies credit and liquidity cycles and generates asset price volatility.

Banks and other financial intermediaries choose to correlate their risks because of strategic complementarities, meaning that the payoff from a certain strategy increases with the number of other agents undertaking the same strategy. Some complementarities are driven by the simple market interactions of rational agents, whereas others stem from the optimal ex-ante response of agents to ex-post government intervention in the event of a financial crisis. We refer to the effects of these strategic complementarities as externalities.

One source of strategic complementarity is related to increased competition in boom times, which can affect economy-wide credit standards. In the presence of imperfect information, banks' incentives to assess borrower risk depend on their strategic interaction. In booms, banks have fewer incentives to screen potential borrowers due to lower rents prompted by fiercer competition. As a result, they reduce screening intensity and increase lending. This causes a worsening of the pool of borrowers, which is reversed through lower credit origination and milder competitive pressures once the contractionary phase sets in [Ruckes (2004), Dell'Ariccia and Marquez (2004), Gorton and He (2008)].

A second strategic complementarity is caused by reputational

5 Brunnermeier et al. (2009) frame the distinction between microprudential and macroprudential regulations as a "fallacy of composition": safeguarding the components of the financial system is not a sufficient condition to safeguard the system.

6 Externalities have welfare effects in the presence of asymmetric information or market incompleteness [Greenwald and Stiglitz (1986)]. The papers reviewed in this section identify externalities in the financial system in the presence of such market frictions.

7 Allen and Carletti (2011), Bank of England (2011), or Schoenmaker and Wierts (2011) provide alternative classifications of the same market failures.

concerns and the incentives structure facing bank managers. When bank managers care about the market perception of their abilities, their credit policies are influenced by those of other banks [Rajan (1994)]. Benchmarking creates externalities across banks because a bank reporting poor performance due to losses will be evaluated more leniently by the market if many other banks suffer loan losses at the same time. Banks, therefore, have incentives to hide losses or maintain risky lending until the buildup of bad loans forces them to "coordinate" a strategy of loss recognition and credit contraction.

The prospect of a government bailout in the event of financial distress can also lead banks to engage in correlated asset choice ex-ante. Anticipating that simultaneous bank failures trigger a bailout (to prevent a financial meltdown), banks may find it optimal to correlate risk to maximize the probability that any failure is a joint failure [Farhi and Tirole (2011), Acharya and Yorulmazer (2007)]. As firms mimic each others' strategy, vulnerabilities in the financial system increase.

Complementarities can affect banks' asset choices, or manifest themselves in the form of excess maturity or exchange rate mismatches [Ratnovski (2009), Allen and Carletti (2011)]. The upshot of these mechanisms is that the quality of banks' and other investors' portfolios worsens in a boom, and banks become exposed to the same types of risk, creating vulnerabilities that lead to or deepen the downside of the financial cycle.

3.2 Externalities related to fire sales

Fire sales typically arise in downturns, amplifying financial distress through a pecuniary externality. A fire sale occurs when a financial institution is forced to liquidate an asset at a time when potential buyers are also troubled. Given limited potential buyers, the asset is sold at price below its fundamental value, causing losses to the seller [Shleifer and Vishny (1992), Allen and Gale (1994)]. Not only does this asset fetch a lower price, but also similar assets held by other banks may decline in value. This reduces the capital ratios of these banks and their ability to post assets as collateral, forcing them to liquidate underpriced assets. The new round of selling triggers further losses, new selling, etc. A fire sale can bring multiple banks to financial distress, and through this trigger a credit crunch with adverse real consequences.[8]

The forced sale condition is an obvious possibility for banks because one of their main functions is to issue liquid liabilities to fund investments in illiquid assets. This maturity transformation exposes banks to the risk of having to liquidate investments prematurely in case of a sudden withdrawal of funding. Although government guarantees, such as deposit insurance and liquidity facilities (discount window), reduce the likelihood of fire sales, their effectiveness is limited when banks also rely on wholesale funding or when other important players in the intermediation process, such as broker-dealers and "shadow banks," do not (formally) benefit from such government guarantees and liquidity support.[9]

Although the externalities associated with fire sales manifest themselves in a downturn, the imbalances that sow the risk of fire sales are often built up in booms. The reason is that atomistic agents take prices as given, but in aggregate the equilibrium price depends on their joint behavior. As a result, private agents may overborrow, leading to excessive leverage and inflated asset prices, because they do not internalize the costs that a generalized fire sale may have on the ex-post borrowing capacity of other agents [Caballero and Krishnamurthy (2003), Lorenzoni (2008), Korinek (2011) and Stein (2012)].

3.3 Externalities related to interconnectedness

Banks operate in an interconnected system. As a result, distress or failure of a bank can affect other institutions. Spillovers can arise because of asset price movements [as discussed in the previous section, see also Nier et al. (2007)], bilateral interbank market exposures [Allen and Gale (2000), Diamond and Rajan (2005)], or feedback from the real economy [Bebchuk and Goldstein (2011)].

Banks can reduce but not entirely eliminate contagion risk for two reasons. First, the shape of interconnectedness in

8 There are two additional channels through which fire sales can undermine investment. First, if the price dislocation is extreme, with asset prices dropping extensively, banks may find it convenient to use spare financial capacity to buy the extreme underpriced assets instead of lending to firms [Shleifer and Vishny (2010)]. Second, the prospect of an ex-post fire sale may lead banks to take precautionary measures and hold ex-ante liquid assets instead of lending [Diamond and Rajan (2012)].

9 Institutions that make up the shadow banking system are money market mutual funds, repo-financed dealer firms, and securities lenders. Shadow banks commonly obtain short-term funding in wholesale markets and invest these funds in longer-term financial assets, performing maturity transformation that is similar to that of banks [see, e.g., Gorton and Metrick (2011), Pozsar et al. (2010)].

the financial system is beyond the individual bank's control.[10] Second, interconnectedness may arise naturally as a result of mutual hedging and diversification motives [Wagner (2011), Allen et al. (2012)]. Banks may become overly interconnected when they do not internalize the implications of their own interconnectedness on systemic risk, or behaviorally "neglect" the possibility of rare but large shocks [Acemoglu et al. (2012), Gennaioli et al. (2011)]. The growing financial networks literature [Allen and Gale (2000), Allen and Babus (2009), Gai et al. (2011)] suggests that high interconnectedness mitigates the impact of small shocks by spreading them, but amplifies large shocks since they can reach more counterparties. Externalities stemming from interconnectedness are particularly strong for systemically important financial institutions (SIFIs). Unlike smaller institutions, distressed SIFIs cannot be easily wound down, since they are complex, operate internationally and play a role as backbones of the financial infrastructure.

Historically, most interventions in SIFIs were de facto bailouts, which have protected their shareholders and creditors from the full scale of distress-related losses. The anticipation of bailouts has the adverse effect of increasing risk-taking incentives. It also reduces market discipline and effectively subsidizes SIFIs, especially the riskiest ones [O'Hara and Shaw (1990), Flannery (2009), Ueda and Weder di Mauro (2011)]. In addition, the near-certain government support to distressed SIFIs introduces a race among financial institutions to become systemically important, as this implies a lower cost of funding in normal times and a better protection against losses when in distress.

While historically "systemic importance" has been associated with institutions' size, recent events suggest a more complex picture. The interconnectedness of a SIFI is also determined by its interbank market linkages, and its effects are amplified by high leverage [Drehmann and Tarashev (2011a)]. Interconnectedness may also be present in non-banks (e.g., hedge funds or money market mutual funds), or institutions that support market infrastructure, such as central clearing counterparties.

10 For example, a bank has no control over other interbank exposures of its counterparties [Acemoglu et al. (2012)].

4. How to link theoretical market failures to practical policy tools?

The ultimate goal of macroprudential policy is to reduce "systemic risk", i.e., risks that threaten the stability of the financial system as a whole, and can adversely impact the real economy. This broad definition of systemic risk is not, however, well suited for the formulation of macroprudential policy. The reason is that it does not highlight the sources of systemic risk – market failures.

The approach taken in this paper allows us to treat the correction of externalities as the intermediate target for macroprudential policy. Policies that control externalities correct market failures that create systemic risk. This approach gives more structure to the definition of systemic risk, and introduces economic rationale into the discussion of macroprudential policy.

It would be ideal to derive from first principles optimal policies that correct the externalities. Unfortunately, a comprehensive theoretical treatment is difficult. At least since Weitzman (1974), it has become clear that the optimal policy rests on assumptions regarding the set of instruments and information available to the regulator [Kaplow and Shavell (2002)]. Heterogeneity of agents and their capacity to engage in moral hazard also play a role [Perotti and Suarez (2011)]. For the financial sector, all four dimensions are complex. Information is often asymmetric, and its production requires effort by the regulator and market participants [Flannery (1998)]. Instruments include not only taxes and (various) quantity restrictions, but also hybrids: capital and liquidity requirements combine the properties of price (in liquid markets) and quantity tools (in illiquid markets) and provide buffers to offset losses in financial distress. Agents have different comparative advantages, including in their capacity to assess, monitor, diversify and bear risks [Boot (2000)]. And finally, there is significant scope for regulatory arbitrage, ability to conceal risks, and moral hazard more generally. Incorporating all these elements into a single framework in a meaningful way is likely impossible. Analytical treatment has to be selective, looking at specific contexts and trade-offs.

For this reason, we have decided to adopt a more "practical" approach. We consider the existing set of macroprudential policy proposals [see Bank of England (2011) and Lim et al. (2011) for overviews] and assess their advantages and disadvantages

Externalities due to	Can be addressed by			
	Capital requirements (surcharges)	Liquidity requirements	Restrictions on activities, assets or liabilities	Taxation
Strategic complementarities	X		X	
Fire sales	X	X		X
Contagion	X		X	X

Table 1: Externalities and macroprudential policies

in correcting the three externalities discussed in Section 3. Specifically, we map the externalities discussed in the previous section with the following key macroprudential policy proposals: enhanced capital requirements, liquidity regulation, restrictions on bank activities and asset allocation, and taxation.[11] Table 1 provides a simplified representation of this mapping.

Most of the instruments considered in this table (e.g., capital or liquidity requirements, and restriction on assets and liabilities) are akin to tools already used in traditional microprudential regulation. What gives these instruments a macroprudential flavor is that they are not imposed to resolve agency conflicts within a bank, but rather to correct externalities that arise in between banks. Consequently, these measures do not depend on bank characteristics taken in isolation (as for microprudential regulation), but are contingent on the aggregate behavior of all banks (e.g., the lending cycle) or the position of a bank within the financial system (e.g., systemic importance).[12]

In what follows, we explain how the instruments outlined in Table 1 can correct the three externalities. Although these instruments may be seen as substitutes, they often entail different advantages and limitations, and become complements in addressing the same externality.

4.1 Correcting externalities related to strategic complementarities

Of the policies considered in Table 1, two address the externalities related to strategic complementarities: capital requirements and restrictions on bank asset allocation. Both tools limit banks' expected gains from choosing correlated lending strategies: capital requirements induce banks to internalize more of the cost of engaging in risky lending; restrictions on asset allocation prevent banks from taking large exposures. These tools can thus limit asset growth in the upturn of the credit cycle so as to reduce the cost associated with adjustments in downturns.

Time-varying capital requirements, in the form of a capital surcharge linked to aggregate credit growth, are part of the new Basel III accord [Basel Committee (2011)]. Basel III also allows for adjusting risk weights in order to control exposures to specific assets, such as real estate loans. The time-varying feature of this surcharge is new relative to standard microprudential regulation, and is meant to mitigate risk-taking during credit expansions.[13]

Several countries have also imposed restrictions on bank assets through caps to loan-to-value (LTV) or debt-to-income (DTI) ratios. These restrictions affect directly the asset side of a banks' balance sheet and are meant to limit the fall in banks' lending standards in booms. While similar quantity restrictions historically were widely used as part of macro-stabilization policies to control credit flows, limits to LTV and DTI ratios have a macroprudential purpose because they are designed to bind in expansions.

Although capital and restrictions on assets can independently mitigate externalities associated with strategic complementarity,

11 Dynamic provisioning and leverage ratios – two commonly discussed macroprudential tools – may be considered as capital-based instruments. In our analysis, we omit the discussion of macroprudential policy tools that target market functioning and infrastructure, e.g., through-the-cycle margining, central clearing counterparties and disclosure of risk.

12 The design of macroprudential policy may conflict with microprudential objectives. For example, macroprudential capital requirements are high in booms (to limit the accumulation of imbalances) and low in recessions (to avoid fire sales and deleveraging). In contrast, optimal microprudential capital requirements are low in booms (when the volume of defaults is low) and high in recessions (when banks need more equity to absorb an increase in defaults). In downturns, pursuing solely a macroprudential objective may lead to instability of individual banks, while a focus only on microprudential objective may lead to a deleveraging spiral at the system level.

13 The economic effects of procyclical capital can also be replicated using dynamic provisioning, cf. Saurina (2009).

they have different drawbacks. Capital requirements are useful for incentives and as a buffer, but can become less effective in booms, when capital ratios increase due to high profitability and buoyant asset prices [Shin (2011)]. For this reason, quantity restrictions, such as DTI and LTV ratios, can complement capital requirements by imposing direct constraints on asset allocation. They can also target specific risky borrowers and asset classes that raise macroprudential concerns.[14]

4.2 Correcting externalities related to fire sales

The externalities associated with fire sales arise because banks fail to internalize the consequences of not taking precautionary measures in normal times, and thus need to adjust by shedding assets ex-post in the event of a negative aggregate shock. Time-varying capital requirements that are higher in upturns alleviate this externality, by mitigating the incentives for risk-taking in booms. They also provide a buffer that offsets losses and reduces the risk of selling assets at fire sale prices in downturns.[15]

But, fire sales can also be triggered by disruptions to bank funding markets. As witnessed during the recent financial crisis, bad news about asset values can trigger run-like reactions of creditors that stop rolling over short-term funding, forcing banks to shrink balance sheets. Accordingly, Basel III proposals to impose liquidity and stable funding requirements can be thought of as tools to limit the risk of fire sales stemming from bank reliance on short-term debt. A related way to limit the use of short-term debt is to rely on taxes calibrated to the cost difference between long- and short-term funding [Huang and Ratnovski (2011), IMF (2010a), Perotti and Suarez (2011)].

Capital and funding measures can be seen as complements, since they affect fire sale risks on different sides of the balance sheet. Less obvious is the optimal choice between liquidity requirements and the taxation of unstable funding. Basel III gives preference to liquidity requirements. But, there are sound arguments for taxing bank funding risk. Taxes can be easily calibrated to reflect the price difference between stable and unstable funding, and offer more flexibility during stress periods, when banks have to "eat into" minimal liquidity or accept less stable funding.

4.3 Correcting externalities related to interconnectedness

The incentives of banks to become systemically important and to take excessive risk can be addressed through effective resolution mechanisms. However, resolution procedures remain imperfect nationally and especially for systematically important cross-border banks [Claessens et al. (2010)]. Accordingly, an ex-ante regulatory response that aims to reduce the probability of SIFIs' distress is necessary. Three of the regulatory tools reported in Table 1 can achieve this objective: capital surcharges, restrictions on asset composition and taxation.

Capital surcharges linked to a measure of systemic importance [BIS (2011)] aim to reduce incentives to become systemically important, as they increase the cost of funding.[16] They also generate additional buffer that a SIFI can use in case of distress. A downside of using capital surcharges as a tool for dealing with the systemic risk created by SIFIs is that they are hard to calibrate because it is difficult to map surcharges to SIFI contributions to systemic risk.[17] In addition, by making the list of SIFIs public, the surcharges can weaken creditor discipline, exacerbating the SIFI problem.

Complementary tools are restrictions on the composition of bank assets — as envisioned by the Volcker rule to limit proprietary trading or the recommendations of the U.K. Independent Commission on Banking (so-called Vickers Commission) to severe links between retail and investment banking operations. These tools are intended to limit the implicit subsidy of SIFI funding, and to provide a firewall protecting systemically important bank operations from risky activities. The key challenge in implementing restrictions on activities is that the optimal scale and scope of a bank is difficult to determine. Hence, restrictions on activities target only the most evident sources of risk, and can, at best, complement capital requirements. A "softer" form of

14 Some tax-based measures, such as the reduction of tax shield on corporate debt and mortgages and progressive income taxes, can also reduce banks' incentives to take excessive leverage and risk concentration [Blanchard (2009), IMF (2010a), Landier and Plantin (2011)]. While useful to reduce such risks, these tax instruments do not correct directly the source of the externality due to strategic complementarity, i.e., banks' incentives to benchmark or to reduce lending standards (see Section 3.1).

15 For non-bank financial institutions engaged in market-based activities, macroprudential regulations can take the form of procyclical margin requirements [see, e.g., Geanakoplos (2009), Gorton (2009), Gorton and Metrick (2010)].

16 This effect can be offset when a designation of an institution as systemically important lowers the required return on its debt and equity.

17 See IMF (2010b) for a discussion of the calibration of systemic risk-based capital surcharges.

restrictions on activities is "living wills" — a document describing bank dissolution and resolution procedures.

The academic debate has also suggested that systemic risk can be addressed through Pigouvian taxes. Such taxes, based on a measure of systemic risk externalities, can force a SIFI to internalize the systemic risk it creates. While theoretically appealing, the implementation of Pigouvian is complicated because it is difficult to measure with sufficient precision the systemic risk contributions of financial institutions [IMF (2010a), Kocherlakota (2010); see also Section 4.5].

4.4 The central role of capital-based tools

The discussion so far suggests that the instruments highlighted in Table 1— capital requirements, liquidity requirements, restrictions on bank activities, and taxes — have distinct properties, and tend to be complementary for addressing the same externality. Accordingly, no single instrument is a priori a "silver bullet" in correcting externalities. A combination of instruments may seem, instead, more appropriate.

Nevertheless, it appears that capital requirements are likely to play a key role in any macroprudential framework. As discussed above, tools based on time-varying and systemic risk-based capital surcharges can play a role in addressing any of the three externalities leading to systemic risk. Moreover, capital-based tools are closely linked to microprudential regulation and are part of the Basel III accord.

This means that banks — especially the systemic ones, and more so during booms — may have to maintain significantly higher capital buffers than presently. But what are the costs of higher capital requirements? The prevailing view in the literature is that, in the long run, the impact of higher bank capital on the cost of loans is likely to be small [Kashyap et al. (2010), Admati et al. (2010), Herring (2011), Mehran and Thakor (2011)]. The transition to higher capital may, however, be costly. Such costs may be lower if higher capital requirements are introduced gradually, allowing banks to use retained earnings and to time the market for any new equity issuance.[18]

4.5 Externalities and systemic risk measurement

Systemic risk is a multifaceted phenomenon. As such, there is a variety of metrics that either signal the gradual buildup of imbalances or flag the concentration of risk within the system [Borio and Drehmann (2009), Bisias et al. (2012)].

Each of these metrics captures some of the contributions of the externalities considered in this paper to systemic risk. For example, deviations from trend (gaps) in the credit-to-GDP ratio, property prices, risk premia or leverage can be used to identify externalities related to strategic complementarities or imbalances that can lead to fire sales in downturns [Drehmann et al. (2011), IMF (2011b), Dell'Ariccia et al. (2012)]. Measures of systemic risk contribution, such as CoVaR [Adrian and Brunnermeier (2010)] and systemic shortfall [Acharya et al. (2010), Drehmann and Tarashev (2011b)] can proxy externalities related to interconnectedness. The degree of interconnectedness can also be captured by stress-tests [Brunnermeier et al. (2010), Duffie (2011)] and forward-looking risk indicators [Capuano (2008), Gray and Jobst (2011)].

Although useful to highlight vulnerabilities, these metrics are not sufficient to formulate a policy response. For example, high mortgage credit growth may be caused by a deterioration of lending standards or signal risk concentration. Accordingly, the optimal tools to address the two underlying problems might be different.

Another major challenge is the calibration of macroprudential policy instruments. There is recent evidence that some tools are useful in reducing systemic vulnerabilities, but too little is known quantitatively.[19] For now, policymakers have based macroprudential policy on "rule of thumb" considerations. Yet, to make the policy design more precise, it is necessary to gain more evidence on the effectiveness of macroprudential policy tools. For example, how high should capital surcharges be? What is the optimal level of LTV ratio? Further, fundamental and applied research on the optimal choice and calibration of macroprudential policy tools is required to justify policy intervention and avoid regulatory discretion.

18 Flannery (2009) and French et al. (2010) argue that the tax shield costs of higher equity can also be offset using convertible instruments, such as contingent capital.

19 Crowe et al. (2011), Lin et al. (2011) and Dell'Ariccia et al. (2012) evaluate the effectiveness of some macroprudential policy tools.

5. Conclusions

In this paper, we have argued that the first step in the economic analysis of macroprudential policy is the identification of market failures that contribute to systemic risk. Externalities are an important source of such market failures, and macroprudential policy should be thought of as a policy that attempts to correct these externalities.

Building on the discussion in the academic literature, we have identified three externalities that lead to systemic risk: externalities due to strategic complementarities, fire sales and interconnectedness. Externalities due to strategic complementarities contribute to the accumulation of vulnerabilities during the expansion of the financial cycle. Externalities due to fire sales and interconnectedness exacerbate negative shocks.

While it is desirable to derive from first principles an optimal policy that corrects these externalities, it is difficult to do so. In this paper, we have adopted a "practical" approach of considering how externalities can be corrected by the currently proposed macroprudential policy tools: capital requirements, liquidity requirements, restrictions on bank activities, and taxation. We have argued that some of these policies can complement each other in correcting the same externality, and reached the conclusion that capital requirements are likely to play an important role in any macroprudential framework.

We have also argued that although externalities can be proxied through a variety of risk measurements, the accumulation of evidence on the effectiveness of alternative policy tools remains the most pressing concern for the design of macroprudential policy.

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