The Conceptual Foundations of Macroprudential Policy

A Roadmap

Augusto de la Torre

Alain Ize

The World Bank
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Abstract

This paper explores post-Lehman macroprudential regulation by interacting two types of market failures (principal-agent and collective action) with two cognition modes (unconstrained and constrained) in the context of aggregate risk. Four paradigms with orthogonal policy justifications are identified. In the first *time consistency* paradigm, regulation offsets the moral hazard implications of efficient but time inconsistent post-crisis bailouts. In the second *dynamic alignment* paradigm, it protects unsophisticated market participants by maintaining principal-agent incentives continuously

aligned in the face of aggregate shocks. In the third *collective action* paradigm, regulation arises in response to the socially inefficient yet rational financial instability resulting from uninternalized externalities. The fourth *collective cognition* paradigm is grounded on the need to temper the mood swings that arise from bounded rationality or severe cognitive frictions in a rapidly changing, complex and uncertain world. These four rationales give rise to important tensions and trade-offs in the design of macroprudential policy.

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The Conceptual Foundations of Macroprudential Policy: A Roadmap

Augusto de la Torre and Alain Ize[⊕]

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[⊕] Augusto de la Torre (adelatorre@worldbank.org) and Alain Ize (alain.ize@gmail.com) work for the World Bank as, respectively, Chief Economist for Latin America and the Caribbean and Senior Consultant. The authors are grateful for comments from Tito Cordella, Anton Korinek, Carlos Montoro, Lev Ratnovski, Carlos Vegh and two anonymous reviewers. Magali Pinat provided excellent research assistance. The views and opinions in this article are the authors' and do not necessarily reflect those of the World Bank.

1. Introduction

While macroeconomic modeling with financial frictions—a research agenda most suitable to macroprudential policy development—has made impressive progress over the last fifteen years (to the point where, arguably, finance is no longer a “veil”), the gap between theory and policy remains large.¹ To help bridge this gap, we explore the conceptual foundations of macroprudential policy in light of the theoretical literature on financial frictions and from the perspective of four distinct paradigms (analytical lenses) that constitute a convenient, conceptually revealing organizing tool. The paradigms derive from a typology that interacts the two basic types of market failures that have traditionally motivated the need for financial regulation (principal-agent and collective action failures) with two cognition modes (unconstrained and constrained), all in an aggregate risk setting. In the first mode, agents do not face significant cognitive challenges because they are fully rational *and* the risk environment evolves slowly enough to limit learning frictions. In the second, agents are boundedly rational *or* are constrained by the learning frictions that arise in a rapidly evolving, uncertain risk environment. This approach gives rise to four distinct and largely orthogonal justifications for macroprudential policy. To better anchor this construct, we first review two alternative rationalizations of the pre-Lehman microprudential regulatory architecture that focus on idiosyncratic risk and treat aggregate risk as exogenous and invariant.

This paper is structured as follows. Section 2 reviews two possible rationalizations of pre-Lehman regulation, based on, respectively, bounded rationality and public moral hazard. Section 3 explores each of the four rationales for post-Lehman macroprudential oversight. Section 4 concludes by discussing the cross-paradigm policy tensions and trade-offs.

2. The pre-Lehman microprudential world

The pre-Lehman prudential regulatory architecture rested on two pillars, the first (*the ex-ante pillar*) aimed at encouraging sound financial intermediation and preventing bank failures through prudential regulation, the second (*the ex-post pillar*) at limiting the social costs of a financial crisis through a financial safety net (Figure 1). These two pillars were only weakly connected because the different rationales that underpinned them were never adequately reconciled. Such an uneasy construct largely reflects the course of pre-Lehman historic events, particularly in the U.S. The safety net (deposit insurance and lender of last resort) was introduced early on as a response to collective action problems as reflected in the bank runs of the 19th century and the Great Depression. The Basel I and II prudential constructs came about largely as a response to the principal-agent (reckless risk taking and fraud) problems of the S&Ls crisis. Such a conceptual fragility, born from haphazard responses to financial crises of very different natures, became all too obvious during the recent global crisis.

¹ See Brunnermeier, Eisenbach and Sannikov (2012) for a comprehensive survey on the macroeconomic impact of financial frictions. Bank of England (2009) and Galati and Moessner (2012) provide broad policy overviews. Hanson, Kashyap and Stein (2011) or De Nicolo, Favara and Ratnovski (2012) connect theory and policy. Kashyap, Tsomocos and Vardoulakis (2014a) propose a framework for macroprudential regulation based on the various functions that the financial system plays, rather than on a typology of risk settings as we do here. We believe the two approaches to be largely complementary.

(a) Bounded rationality and consumer protection

A first way to rationalize the pre-Lehman regulatory construct is by introducing bounded rationality (*naïveté*). Contrary to what is often believed, information asymmetry or enforcement frictions alone do not suffice to warrant microprudential regulation if all players are rational and the world in which they interact does not mutate too rapidly. However, if some players are less sophisticated (*naïve*), prudential regulation is justified to protect such players from being abused by the more sophisticated.

The gist of the argument is nicely captured in Akerlof's (1970) seminal article on the "market for lemons," which demonstrates that, if information is asymmetric *but* all players are equally and fully rational, investors will not trade in equilibrium at any price knowing that borrowers with "lemon" projects or bankers with "lemon" financial services have incentives to use their own superior information in order to take advantage of their clients. To activate trading, the seller of potential "lemons" must overcome the information asymmetry barrier. This sort of incentives is precisely what gives rise to the financial services industry. Banks, for example, specialize in screening, monitoring, and other forms of disciplining protocols and technologies that help investors and borrowers cope with information asymmetry or collateral constraints and thus align principal-agent incentives. In this rational, stable world, regulators have no enduring information or enforcement advantage over the private sector. Hence, they cannot improve the equilibrium via prudential policy. However, the state can help relax contracting constraints via market-enhancing regulation, such as disclosure and accounting standards, corporate governance regulation, and a suitable legal and regulatory framework for credit bureaus, accountants, auditors, rating agencies and the like.

Things change radically, however, once the presence of boundedly-rational participants in the marketplace is explicitly recognized. These participants have difficulties not so much in *gathering* information but mainly in *processing* (hence understanding) information. As noted by Akerlof and Shiller (2013) in their recent work on "phishing for phools," once *naïveté* is recognized, the rational world of Akerlof's (1970) market for lemons suddenly metamorphoses into a world filled with manipulation and abuse, where the sophisticated have incentives to prey on the emotional and intellectual weaknesses (biases) of the unsophisticated. Under these circumstances, the availability of free information fails to eliminate the abuse because the unsophisticated cannot process information adequately. Instead, the *naïve* are exposed to what welfare theory defines as "externalities"—i.e., they may take decisions that are not in their long-run best interest.

The state has therefore an important prudential role to play not just because it is presumably more sophisticated than the unsophisticated (albeit not more so than the sophisticated) but also because it has a natural advantage in providing public goods. The state can "represent" the unsophisticated by imposing incentive-aligning prudential regulation that mimics what the more sophisticated investors would require from their financial services providers, especially in terms of collateral (capital). In addition, to protect the unsophisticated from regulatory policy failures and thus further entice them to participate in the banking world, the state can provide a deposit insurance limited to small deposits and, hence, focused on the unsophisticated.

This rationale for prudential regulation is broadly in line with that proposed by Dewatripont and Tirole (1994). It also conforms with Greenspan's vision of a neat separation between the regulated commercial banking world of the small, unsophisticated investors and the unregulated capital markets and shadow-banking world of the sophisticated investors. The latter can fend for themselves outside the protected commercial banking world and discipline each other without any need for prudential rules imposed from the outside. The resulting architecture calls therefore for a perimeter of prudential regulation that is narrowly and strictly drawn around commercial banking, where the unsophisticated live, and that delimits the reach of prudential regulation as well as the financial intermediaries that have access to the deposit insurance (Figure 1). To the extent that the unsophisticated do not exit the regulatory perimeter—as this rationale would tend to argue—there is no justification to incur the regulatory and efficiency costs of extending such perimeter beyond deposit-taking financial intermediaries.

(b) The financial safety net and public moral hazard

Letting go of the rationality assumption was not popular, however. For economists, it meant doing away with the cornerstone of traditional microeconomics and drifting into the unnervingly imprecise world of behavioral economics. For regulators, it meant accepting the premise that somehow they knew better than the depositors they represented. This implied accepting a role and responsibility that regulators generally did not feel comfortable with. Perhaps for these reasons, bounded rationality was never universally viewed as being at the core of prudential regulation. Instead, some financial market participants (typically small depositors) were simply described as “uninformed,” without digging into the causes, nor implications, of such information failures. The focus was thus on information asymmetries (and other principal-agent frictions) rather than on bounded rationality. But how can one justify the pre-Lehman regulatory architecture while still adhering to rationality?

One way of doing so was to base prudential regulation on the existence of public moral hazard. Prudential regulation aimed at offsetting the incentives to take excessive risk fueled by the existence of an ex post pillar, i.e., a financial safety net, conformed by a deposit insurance and a lender of last resort. The attention thus shifted to justifying the safety net itself through positing the existence of Diamond-Dybvig (1983) type collective action failures in a perfectly rational world. Because rational depositors could not internalize the benefits of acting in a coordinated way, socially inefficient and self-fulfilling bank runs could occur. A financial safety net was therefore needed to prevent rational coordination failures, or limit their social costs if they did occur. However, the financial safety net could also undermine market discipline and promote public moral hazard by inducing market participants to take excessive risk while shifting risks and costs to the state. An ex-ante prudential regulation largely based on capital and liquidity requirements would consequently be required to offset such public moral hazard. By construction, this rationale also called for a perimeter of prudential regulation strictly circumscribed to deposit-taking financial intermediation, hence coterminous with eligibility of access to the financial safety net. In effect, a mantra that characterized the pre-Lehman times was that “prudential regulation should extend no further than the reach of the deposit insurance.”

While consistent with full rationality, this alternative justification for pre-Lehman microprudential regulation was not universally accepted among economists either. Many thought

that bank runs typically reflected weak fundamentals rather than coordination failures. From this perspective, runs were a desirable manifestation of market discipline, a cleansing mechanism.² Thus, a case was made by some for “free banking” (i.e., prudentially unregulated banking)³ and the financial safety net was often viewed as an unwarranted source of public moral hazard. Indeed, many economists shared Allen and Gale’s (2007) view that “one bad policy (a deposit insurance) does not justify another (capital requirements)”.⁴

(c) The weaknesses of the pre-Lehman regulatory construct

The fuzziness resulting from the coexistence of these two alternative justifications of the pre-Lehman regulatory architecture was never satisfactorily resolved. Hence, such architecture was not always internally consistent. On the one hand, the limited deposit insurance hardly discouraged bank runs in a world of collective action failures where the largest uninsured depositors are most likely to run first. On the other hand, the collective action failures that largely motivated the ex post safety net were typically ignored. In particular, if self-fulfilling runs by uncoordinated yet rational investors were a problem, why circumscribe the lender of last resort facilities only to deposit taking institutions? And if the anticipation of bailouts motivated prudential oversight, why not extend prudential oversight to all systemically important intermediaries and not just commercial banks?

These puzzles and inconsistencies in turn largely reflected the fact that the pre-Lehman prudential regulation was built on purely idiosyncratic risk. Although it recognized that financial intermediaries could be exposed to correlated risk and aggregate shocks, these were considered to be a limited, exogenous and invariant component of the risk environment. The endogeneity resulting from the constant interplay of financial dynamics with aggregate risk were simply not an explicit part of the Basel I and II regulatory architecture. Instead, the perception of systemic risk was limited for the most part to domino-type effects through which the collapse of one financial institution could trigger the collapse of others. In turn, this induced a fallacy of composition according to which ensuring the solvency of each institution on its own was believed to suffice to ensure the soundness of the system as a whole. Indeed, the dominating presence of aggregate, endogenous risk constitutes the unavoidable point of departure for the world of post-Lehman macroprudential oversight, a new world to which we now turn.

3. The post-Lehman macroprudential world

In this section we interact cognition modes (unconstrained and constrained) with market failures (pure agency or a mix of agency and collective action failures) in a world of aggregate risk. This yields a four-way typology of paradigms (analytical lenses) that gives rise to the four largely orthogonal justifications for macroprudential oversight shown in Table 1. The complications under each paradigm cumulate as we move down and to the right in the cells of the table.

² See Diamond and Rajan (2000).

³ See Calomiris and Kahn (1991).

⁴ However, Allen et al. (2015) find the combination of regulated capital and insured bank deposits to be welfare superior under some conditions.

The upper two cells depict rational paradigms where complexity and uncertainty are not as high as to severely limit learning and interpretation capacity. The upper-left cell represents the “time consistency” paradigm, where the interaction of agency frictions and aggregate risk suffices to justify macroprudential regulation, even if all externalities are assumed to be internalized. Macroprudential policy in this case aims at mitigating the public moral hazard caused by a time inconsistency problem, namely, the state’s inability to credibly commit not to intervene in the event of a crisis. The upper-right cell represents the “collective action” paradigm. It focuses on the wedge between social and private interests, where the need to induce the internalization of externalities provides the classic and most widely recognized justification for macroprudential policy.

The two bottom cells depict paradigms that incorporate cognitive limitations. These can arise either from bounded rationality (e.g., naïveté and other behavioral finance-type cognitive biases) or high levels of uncertainty and complexity in a rapidly changing environment that result in severe learning and interpretation difficulties, possibly leading to a persistent heterogeneity in beliefs. In the lower-left cell lives the “dynamic alignment” paradigm, where information *processing* (rather than merely information *gathering*) problems (naïveté) are added to the mix, while keeping the assumption that all externalities are internalized. In this case, the prudential regulator’s main commitment is to represent unsophisticated players efficiently over time, by adjusting or recalibrating prudential norms in response to aggregate shocks so as to maintain principal-agent incentives properly aligned. The lower-right cell represents the most complex, “collective cognition” paradigm where all the key sources of market failure (principal-agent and collective action frictions as well as cognitive limitations) coexist and interact with aggregate risk. In this paradigm, macroprudential policy has a distinct additional duty, namely to mitigate the negative externalities associated with collective mood swings induced by constrained cognition.

In the rest of this section, we discuss each of the four paradigms in some detail.

(a) *Time consistency*

Aggregate shocks boost financial volatility because their interaction with principal-agent (information asymmetry and enforcement) frictions in a world of limited liability and incomplete markets can give rise to persistent, non-linear amplification effects that may end up in painful crises.⁵ For example, a positive aggregate shock (e.g., a financial innovation such as securitization) can significantly relax collateral constraints, thereby amplifying a leveraged credit expansion, while a negative aggregate shock (e.g., some quirky macroeconomic turn of events) can so destroy financial intermediaries’ net worth and tighten collateral constraints as to magnify persistence effects and downward spirals marked by massive fire sales and deleveraging.

Given incomplete markets, such dynamics unavoidably give rise to welfare-relevant pecuniary externalities that can magnify instability and increase the frequency or severity of

⁵ See Bernanke and Gertler (1987); Kiyotaki and Moore (1997); Adrian and Shin (2009); Brunnermeier and Pedersen (2009); and He and Krishnamurthy (2012).

crises.⁶ In this paradigm, however, we assume that all externalities, including pecuniary, are internalized. This assumption admittedly leads to a rather abstract setting that may at first sight appear to be too narrow and unrealistic.⁷ Yet, it helps make the case for macroprudential policy based not on uninternalized externalities but on time inconsistency.

This argument has two legs. First, socially efficient systemic financial instability and crises can occur even if all externalities are fully internalized.⁸ This claim flows from the simple fact that part of the observed volatility in financial markets can correspond to extreme, exogenous, low probability-high cost, tail risk events (akin to 100 hundred-year floods), against which full protection (via, say, capital and liquidity buffers) is neither privately nor socially sensible. That is, a rational and benevolent central planner would not require financial intermediaries to build prudential buffers high enough to prevent these extreme events. Should the planner do so, the social costs are likely to outweigh the social benefits.

The second leg of the argument is that, by linking pre-crises behaviors with post-crises state interventions, time inconsistency constitutes an important motive on its own right for macroprudential regulation. Even in a world where externalities are internalized, the state has clear comparative advantages over markets in speeding up a post-crisis recovery persistently hampered by principal-agent frictions. In particular, the state's taxation capacity allows it to provide public goods (Bianchi, 2013), issue risk free debt (Holmstrom and Tirole, 1998), and spread risk more finely, including across generations (Arrow and Lind, 1970). By being a "borrower of last resort" (Calvo, 2002), the state can cover the agency frictions-induced aggregate liquidity shortages via lender-of-last-resort operations (LOLR), as well as redistribute assets from the rest of the economy to credit-constrained financial intermediaries and inject capital where needed to facilitate re-intermediation via risk-absorption-of-last-resort operations (RALR).

Yet, when anticipated, such post-crises interventions can amount to put options provided by the state free of charge to market players. These options induce market players to take more risk and hold less liquidity than would be socially desirable (Farhi and Tirole, 2011), while expecting to transfer risk and costs to the state in the event of a crisis. This in turn increases the likelihood of a crisis and the concomitant use of post-crises interventions that are ex post optimal (given the crisis) but ex ante undesirable.⁹

The potential optimality of post-crises interventions introduces public moral hazard (an ex ante wedge between the interests of market players and those of taxpayers) and creates a clear time inconsistency conundrum. A state that could credibly commit not to bail out insolvent institutions, no matter how painful the crisis, could go for free banking and limit its policy focus to relaxing through institutional and legal reforms the constraints that hinder market functioning. However, because ex post interventions are likely to have first order social benefits (they relax binding agency constraints), the government may not be able to credibly commit not to intervene in the

⁶ See Stiglitz (1982).

⁷ Alternatively, one could assume an externalities-free world of complete contingent markets, as in Alvarez and Jermann (2000).

⁸ See for example Bianchi (2011) for a calibrated, model-based exercise that reaches this conclusion.

⁹ More generally, bail outs may be desirable both ex ante and ex post, yet less so ex ante than ex post (Bianchi, 2013).

event of a crisis (Jeanne and Korinek, 2012). Therefore, some combination of ex post interventions and ex ante macroprudential policies aimed at curbing the public moral hazard associated with the expectation of ex post interventions is generally called for (Bianchi, 2013).

This justifies a first variant of macroprudential policy, which we label *time consistency macroprudential*. This policy needs to act on two fronts. First, it must improve the efficiency of post-crisis interventions and reduce their bail-out component. In particular, the state can enhance the failure resolution framework so that failing intermediaries are unwound quickly and with minimal adverse spillovers, private capital is brought into (or reshuffled among) financial intermediaries, and disciplining haircuts are applied as needed to shareholders and large creditors. Second, the LOLR and RALR facilities must be priced ex ante in a way that discourages public moral hazard—including through systemic liquidity requirements that limit the scope for free riding (Farhi and Tirole, 2011) or ceilings on leverage that reduce the benefits of bailouts (Chari and Kehoe, 2013).

(b) Dynamic alignment

While still assuming away uninternalized externalities, we now add boundedly rational (naïve) players. Naïveté, in combination with aggregate shocks and principal-agent frictions, can transform the abuse of individual investors or borrowers into systemic risk buildup. On the one hand, naïveté boosts the scope for the abuse and manipulation of unsophisticated financial market participants by shrewd financial brokers or intermediaries, as amply demonstrated during the sub-prime crisis. On the other hand, because aggregate shocks hit financial intermediaries across the board, individual intermediaries focused on preying on the emotional or cognitive weaknesses of their clients can end up following similar dynamics that, in the absence of a proper regulatory response, may lead them all to fail at the same time.¹⁰

However, the responsibility for such socially inefficient systemic instability has to be assigned not to market imperfections *per se* but rather to the regulator's failure to adjust prudential regulation on behalf of the unsophisticated on a timely basis so as to keep principal-agent incentives continuously aligned. Consider the following three illustrations. First, the regulator may fail to raise prudential requirements on banks in response to a credit boom fueled by a financial innovation. By widening the upside relative to the downside, such a positive aggregate shock can create conditions where banks may have *too much to gain* in taking imprudent risks with someone else's (mainly unsophisticated) money. Second, the regulator may grant regulatory forbearance after an adverse aggregate shock that destroys much of the banks' capital. This may result in banks having *nothing to lose* and, hence, becoming all too willing to gamble for resurrection. Third, an economic downturn can seriously weaken debtors' capacity to pay but the regulator may not permit capital requirements to decline temporarily (hence allowing buffers to have a true buffering function). This may create a situation where banks have *too much to lose* given the adverse implications of failing to meet their prudential requirements. Thus, a credit crunch can emerge, with banks reducing credit exposure and foreclosing on loans too aggressively.

¹⁰ See Gavin and Hausmann (1996) and Borio (2003) for early discussions of the role of macroeconomic factors in banking crises.

Thus, once the regulator has made the choice of representing the unsophisticated in a world of purely idiosyncratic risk, she becomes automatically responsible for continuing to assume this responsibility effectively and proactively in a world of aggregate risk. Herein is the core rationale for a second variant of macroprudential policy, which we label *dynamic alignment macroprudential*. To maintain principal-agent incentives continuously aligned, the regulator must calibrate and recalibrate prudential oversight as needed in response to cyclical fluctuations or aggregate shocks. While the regulator continues to focus on principal-agent incentives and individual financial intermediaries rather than on systemic interactions, this policy can legitimately be defined as macroprudential because it must respond to an aggregate volatility that can eventually undermine the soundness of the system as a whole.¹¹

The associated policy toolkit would naturally include a mix of rules-based countercyclical (or through-the-cycle) capital or provisioning requirements and state-contingent, discretionary oversight (regulatory activism). As prudential policy acquires a macroeconomic dimension that may be partly subject to discretion, this mix needs to be coordinated with monetary policy.¹² Given that the emphasis is on aligning principal-agent incentives, it also needs to be supported by mark-to-market accounting, forward-looking provisioning requirements, and longer-term oriented compensation systems for asset and bank managers. It may also include time-contingent, cycle-oriented macro-prudential tools such as a countercyclical capital buffer, contingent capital, and mandatory capital insurance. Such a broad regulatory agenda is indeed at the core of Basel III.¹³

This macro-prudential policy variant may need to be accompanied by micro-prudentially oriented policies focused on addressing cognitive biases by ensuring that unsophisticated investors and borrowers are confronted with safe and fair financial products. Indeed, as became apparent in the sub-prime debacle, the accumulation of wrong-headed consumer decisions may result in a rapid build-up of systemic risk that cannot be contained through traditional prudential or consumer protection norms. However, because they venture into largely unexplored territories of consumer behavior, such regulations are difficult to design. At the same time, because they expand the role of the supervisor to one akin to that of a big brother, they raise tricky public governance issues.

(c) Collective action

This paradigm keeps principal-agent frictions while maintaining the assumption of full rationality and complicates the setting by allowing uninternalized externalities to take center stage. Uninternalized externalities dramatically boost amplification effects (via fire sales, deleveraging, margin calls, etc.) and cause the invisible hand to fail, as rational market participants do not take into account the systemic consequences of their individual actions. Thus, financial fluctuations can become socially excessive, reflecting a basic collective action-driven market failure. At the same time, the social costs of crises, which now include the adverse effects of uninternalized

¹¹ Defining the dynamic alignment policy as macroprudential is at variance with the definition used by other authors (e.g., Claessens, Gosh and Mihet, 2014), who treat as microprudential any regulation focused on individual institutions.

¹² See Borio and Zhu (2008), Repullo and Suarez (2012), and Dell’Ariccia, Laeven and Marquez (2013), among many others.

¹³ The incorporation of dynamic, aggregate risk in prudential thinking is also consistent with Dewatripont and Tirole (2014), who extend the earlier static framework of Dewatripont and Tirole (1994).

externalities (e.g., the destructive ripple effects of bank and payment system failures), strengthen the grounds for post-crisis LOLR and RALR policy interventions.

We identify three basic types of negative uninternalized (non-informational) externalities:¹⁴

- a. *Pecuniary externalities*—the adverse impact on others (“I do, you pay”) via prices of fire sales and credit crunches during busts that are not internalized during booms.¹⁵
- b. *Behavioral externalities*—coordination failures and herding effects (“I do, you follow”) resulting in self-fulfilling attacks, whereby everybody runs to precipitate the collapse, or Chuck Prince-type effects, whereby everybody stays to feed the bubble.¹⁶
- c. *Interconnectedness externalities*—buildup of vulnerabilities in the network of financial contracting (“I go under, you go under”) as players do not internalize the socially excessive costs of eventual network failures (disconnection of vital flows, chain reactions, financial gridlock, destruction of information, etc.).¹⁷

Uninternalized externalities expose various fallacies of composition—proving wrong the beliefs that, say, the financial system as a whole is no more than the sum of its components; or that every individual institution can draw at the same time on a collectively supplied source of liquidity; or that the sum of individual insurance always makes the system stronger. Uninternalized externalities also erode the viability of a narrowly and sharply drawn perimeter for prudential oversight. As prudential regulation within the perimeter may induce at least a partial internalization of externalities, a wedge in risk-adjusted returns between the regulated and unregulated spheres may arise. By spurring the expansion of “shadow banking” and encouraging even the unsophisticated investors to abandon in droves the safe shores of the regulated world, this wedge can undermine consumer protection at its very core (de la Torre and Ize, 2010).

In this paradigm, public moral hazard can further intensify and become ever more treacherous as financial systems develop. Thus, the negative externalities associated with bank failures can significantly increase in deeper and more complex financial systems, boosting the *social benefits* of bailing out insolvent institutions in the event of a crisis. In addition, herding effects can intensify, raising the odds that the state will conduct such bailouts or be induced to follow a post-crisis accommodative monetary policy. As a result, banks may have greater incentives to correlate their investment choices (Farhi and Tirole, 2011) and become “too many to fail” or to grow to become “too big to fail.” Moreover, the deepening of finance quickened by information technology naturally raises the incentives for players to free ride on the liquidity and information provided by denser markets. This strengthens investors’ bias in favor of liquid assets and reliance on “timely exit” rather than “monitoring” (Huang and Ratnovski, 2011).

¹⁴ Informational externalities, which typically reflect cognition limitations, are discussed in section 3.d below.

¹⁵ Pecuniary externalities acquire a significant welfare impact when trading constraints introduce a wedge in marginal utilities between constrained and unconstrained players (Jeanne and Korinek, 2010).

¹⁶ On bank runs see Diamond and Dybvig (1983). Other forms of runs are analyzed in Morris and Shin (2003). Herding dynamics are discussed by Rajan (2005).

¹⁷ See Adrian and Shin (2009); or Cifuentes, Ferrucci and Shin (2005).

All of this sets the grounds for a third distinct type of macroprudential policy, which we label *collective action macroprudential*. It aims at correcting the failure of market discipline precisely where the state has a comparative advantage over the market, that is, in dealing with collective action problems by internalizing externalities, appropriately pricing the financial safety net and focusing on the system rather than its parts.

The macroprudential policy toolkit is, however, not independent of the type of externality. Pigouvian taxes (aimed at, say, penalizing credit expansion based on non-core short-term funding) and/or quantitative regulations, such as higher capital requirements or systemically oriented liquidity requirements that penalize short-term wholesale funding, appear most suitable to deal with pecuniary externalities (Perotti and Suarez, 2011).¹⁸ Crowd control-type measures, such as circuit breakers that suspend securities markets trading in extreme circumstances or systemic liquidity requirements are arguably salient candidates to address behavioral externalities. Since the potential vulnerabilities of financial contracting networks are significantly associated with systemically important financial institutions (SIFIs) and too-big-to-fail and too-interconnected-to-fail effects, interconnectedness externalities naturally point towards macroprudential policies that focus on financial structure—e.g., limits on the size and systemic footprint of financial intermediaries, functional segmentation (e.g., Volcker rule-type proposals that separate investment and commercial banking), and incentives to foster diversity (of actors, intermediaries, portfolio compositions) in the financial ecosystem.

(d) Collective cognition

Finally, add cognition constraints to a world that is already complicated by principal-agent frictions, collective action failures, and aggregate risk. These constraints can arise either from bounded rationality—for example cognitive biases—or from such rapid changes in a complex and uncertain environment that even rational information processing faces severe problems of interpretation, possibly leading to a persistent heterogeneity in beliefs. Even in a static context, cognitive constraints can give rise to informational externalities that lead to the underproduction and perverse spillovers of information, thus producing inefficient and/or fragile equilibria.¹⁹ In the context of business cycle dynamics and aggregate shocks, on which this section focuses, such constraints have amplified consequences—they can trigger deep and prolonged mood swings that can culminate in acute financial crises.

Consider first the case of rational information processing in rapidly evolving and uncertain environments. Market players under those circumstances are compelled to draw systematic Bayesian inference under limited information. This can give rise to learning externalities whereby the unwarranted optimism resulting from a sequence of favorable outcomes creates a wedge between private and public optimal risk taking that feeds mood swings (Bianchi et al., 2013; Bhattacharya et al., 2015). Thus, bouts of exaggerated optimism and exuberance can be followed by panic-driven downward spirals.

¹⁸ Optimal Pigouvian taxation should reflect the fact that agents' welfare will generally be affected differently (Biljanovska, 2015), possibly calling for different tools to be used depending on the Pareto weights assigned to different agents (Kashyap et al., 2014b).

¹⁹ See Chari and Kehoe (2000).

Similarly, in the case of cognition biases, boundedly rational momentum traders (noise traders) would engage in financial contracting alongside rational arbitrageurs, and this mix can also lead to mood swings. To be sure, the non-rational behavior of momentum traders should in principle promote trading and arbitrage (Geanakoplos, 1992). However, rational arbitrageurs may not be able to dominate market outcomes because collateral and information asymmetry constraints may limit their capacity to borrow and thus engineer a successful leveraged attack (Shleifer and Vishny, 1997); or because they cannot coordinate due to lack of common knowledge (Abreu and Brunnermeier, 2003).²⁰ Thus, the less rational “noise traders” may end up dominating the markets through the momentum they impose on prices. By pushing prices away from fundamentals, they impose a negative perceptual externality on everyone else, thereby adversely affecting social welfare (De Long et al, 1990).

Equilibria are in both cases constrained inefficient and justify a fourth distinct role for macroprudential policy, which we label *collective cognition macroprudential*. If market players are rational but face a highly uncertain, complex and rapidly changing environment, regulators do not have a cognitive (interpretative) advantage over the market to identify unwarranted optimism. But regulators can internalize the adverse systemic effects of individual market players’ decisions by, for example, raising the cost of default through higher capital requirements (Bhattacharya et al., 2015). Evolving expectations should also typically call for state-contingent tools, as for example in Geanakoplos (2010), who argues for time-varying haircuts. If some players are boundedly rational momentum traders that coexist with rational arbitrageurs, regulators have a similar role to play, not because they are smarter but because they can solve collective action problems where rational arbitrageurs cannot. As shown by Farhi and Gabaix (2015), dealing with bounded rationality may include for example a modified optimal Pigouvian tax rule (one dollar of externality should be taxed by more than a dollar if people are inattentive to the tax) and a stronger role for quantity regulation (heterogeneity in attention favors quantity regulation over price regulation).

More generally, macroprudential policy in a world marked by cognitive constraints-induced mood swings should probably be formulated in a second-best world where the objective is no longer to correct and align incentives, but instead to guide markets away from ultimately unsustainable trajectories. The policy toolkit may involve a “kitchen sink” approach that relies largely on discretionary and rough, can-do instruments. To maintain financial activity within a reasonably safe path that does not contribute to feed the frenzy, the state may use judgment-based macro-prudential regulations such as increases in reserve requirements or calibrations to the mandated ceilings on debt-to-income or loan-to-value ratios. As in the case of dynamic alignment policies, controls on financial innovation may also be needed to limit adverse collective cognition spillovers.

4. Policy implications

Defining a sufficiently nuanced macroprudential policy response requires an understanding of the relative contribution of key drivers in each of the above four paradigms. This is complicated

²⁰ Mood swings can be exacerbated by irreducible, Knightian uncertainty (Caballero and Kurlat, 2009).

by identification problems, cross-paradigm tensions and tradeoffs, and the state-dependency of the relative dominance of alternative paradigms.

A first identification challenge stems from the fact that some forms of substantial financial volatility may well be constrained efficient, hence not warranting any macroprudential policy intervention. A second identification problem originates in the fact that observationally identical patterns of financial volatility may reflect different underlying market or policy frictions and failures (moral hazard, externalities, mood swings), hence requiring different policy responses. These identification problems need to be addressed through additional research focused on the interface and interactions between the paradigms.

Cross-paradigm policy tensions and tradeoffs add another layer of complexity. Macroprudential regulations aimed at addressing problems originating under one paradigm may aggravate problems under another paradigm, possibly requiring offsetting policies. For example, a prudential norm that taxes short-term wholesale funding to help address potential runs and other collective action failures may weaken market discipline by exacerbating principal-agent failures, if not accompanied by higher capital requirements (Cordella and Pienknagura, 2013). Similarly, by enhancing monitoring, mark-to-market requirements can help market players cope with principal-agent frictions but such requirements can also magnify contagious runs or spur irrational mood swings (Plantin, Sapra and Shin, 2008).

Macroprudential policy design is made even more difficult by the fact that the relevance of the various frictions and failures is likely to vary across time and place (i.e., be *dynamic and state-dependent*). For example, enforcement frictions are likely to acquire more relevance during downturns when collateral values drop and collateral constraints become more binding. Similarly, information asymmetry frictions and mood swing problems become more central during periods of rapid financial innovation or during downturns (when uncertainty peaks). Analogously, collective action frictions are likely to be more relevant when a rapid coordinated response is called for, typically during the build-up to a crisis or right at the onset.

As a silver bullet solution does not exist, the difficult task for the macroprudential regulator is to strike a reasonable balance. In this quest, a first approach could be to assemble an “all-terrain” regulatory framework, as is arguably the current trend in the world. However, this may lead to policy inconsistencies and end up being too inflexible to deal with large and rapid changes in the risk environment. The alternative could be to develop a state-contingent framework that emphasizes in normal times principal-agent frictions and market discipline but shifts its focus in exceptional times to systemic risk and collective action and cognition frictions. However, the normal-times oversight should be effective enough to detect fault lines before it is too late, and the regulator sufficiently agile to switch to exceptional-times oversight when warranted.

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Figure 1. Schematic Depiction of the Pre-Lehman Regulatory Architecture

Table 1: Macroprudential Policy Map

	Agency Failures	Agency + Collective Action Failures
Unconstrained Cognition	<p><i>Paradigm:</i> Time Consistency</p> <p><i>Wedge:</i> Private Sector - Public Sector</p> <p><i>Policy aim:</i> Correct incentive distortions due to expectation of post-crisis bailouts</p>	<p><i>Paradigm:</i> Collective Action</p> <p><i>Wedge:</i> Individual - Society</p> <p><i>Policy aim:</i> Induce the internalization of pre- or post-crisis externalities</p>
Constrained Cognition	<p><i>Paradigm:</i> Dynamic Alignment</p> <p><i>Wedge:</i> Sophisticated - Unsophisticated</p> <p><i>Policy aim:</i> Align principal-agent incentives on behalf of the unsophisticated</p>	<p><i>Paradigm:</i> Collective Cognition</p> <p><i>Wedge:</i> Collective Perception - Reality</p> <p><i>Policy aim:</i> Temper mood swings</p>