Prudential Policy

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This paper studies the rationale behind prudential policies in the banking sector. The main components of these prudential policies are deposit insurance, solvency regulations, and emergency liquidity assistance by the central bank, acting as a lender of last resort. We discuss the institutional arrangements that are necessary to limit the frequency and extent of individual bank failures as well as those of systemic banking crises.

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I. Introduction

In almost every country in the world, public authorities intervene a lot in the functioning of the banking sector. The two main components of this public intervention are on the one hand the financial safety nets (composed essentially of deposit insurance systems and emergency liquidity assistance provided to commercial banks by the central bank) and on the other hand prudential regulation systems, consisting mainly of capital adequacy (and liquidity) requirements, and exit rules, which establish when supervisory authorities should close commercial banks.

In spite of these sophisticated prudential regulation systems, many countries (especially but not exclusively emerging countries) have recently experienced major banking crises. A good account of these crises can be found, for example, in Lindgren, Garcia, and Saal (1996). Some economists (e.g., Demirgüc-Kunt and Detragiache [1997]) have argued that financial safety net systems (particularly deposit insurance funds) were actually responsible for these crises, because they generate moral hazard in bankers' behavior.

Although the topic is still debated in the academic literature (for extended surveys, see Bhattacharya and Thakor [1993], Freixas and Rochet [1995], and Santos [2000]), a large consensus seems to have emerged on the rationale behind this public intervention in the functioning of the banking sector. It is now widely accepted that bank regulation and supervision have essentially two purposes:

- Protect small depositors, by limiting the frequency and cost of individual bank failures. This is often referred to as *micro-prudential* policy.[1]
- Protect the banking system as a whole, by limiting the frequency and cost of systemic banking crises. This is often referred to as *macro-prudential* policy.

Notice that, from the point of view of economic analysis, these two types of policies have very different justifications:

- Micro-prudential policy is justified by the (presumed)[2] inability of small depositors to control the use of their money by bankers. This is why most countries have organized deposit insurance funds (DIFs) that guarantee small deposits against the risk of bank failure. The role of bank supervisors is then to represent the interests of depositors (or rather of the DIF) *vis-à-vis* banks' managers and shareholders.[3,4]
- Macro-prudential policy is justified by the (partial) failure of the market to deal with aggregate risks, and by the public good component of financial stability. As with other public goods, the total (declared) willingness of individual banks (or more generally of investors) to pay for financial stability is less than the social value of this financial stability. This is because each individual (bank or investor) "free rides" on the willingness of others to pay for financial stability.

These differences imply in particular that, while micro-prudential policy (and supervision) can in principle be dealt with at a purely private level (i.e., that it amounts to a collective representation problem for depositors), macro-prudential policy has

1. See, for example, Borio (2003) or Crockett (2001) for a justification of this terminology.
2. The supporters of the "free banking school" challenge this view.
3. Contrarily to what is often asserted, the need for a micro-prudential regulation is not a consequence of any "*mispricing*" of deposit insurance (or other form of government subsidies) but simply of the *existence* of deposit insurance.
4. This is the "representation theory" of Dewatripont and Tirole (1994).

intrinsically a public good component. This being said, governments have traditionally controlled both dimensions of prudential policy, which may be the source of serious time-consistency problems[5] (this is because democratic governments cannot commit on long-run decisions that will be made by their successors) leading to political pressure on supervisors, regulatory forbearance, and mismanagement of banking crises.

Once the principles for (the two types of) bank regulation are established, it is important to determine how these principles can be put into practice and how banking regulation should be organized. I claim that there is a crucial need to reexamine this question in depth. Indeed, the traditional vision of bank regulation, in many countries, was extremely paternalistic. Roughly speaking, it was accepted that bank supervisors existed to tell banks what they had to do. Banks were protected from too much competition in exchange for "helping" governments in different occasions: bailing out insolvent institutions, lending at subsidized rates to certain sectors of the industry, and financing public deficits, not to mention (in certain countries) more extreme forms of support such as financing political campaigns or providing jobs for the friends and families of politicians.

This traditional view of banking regulation was abandoned in the 1990s under the pressures of international competition and increased sophistication of financial markets and instruments, as well as the growing realization in many countries of the intrinsic inability of governments to prevent or resolve banking crises in a prompt and efficient way. The two key phrases during this period were

- guaranteeing a "level playing field" for international competition (which essentially meant preventing governments from subsidizing domestic banks through implicit bailout commitments), and
- forcing supervisors to adopt "prompt corrective action" (PCA) measures when a bank started showing signs of financial distress.

The two main instruments developed for these purposes were the first Basel Accord, or Basel I (Basel Committee on Banking Supervision [1988]) in the G-10 countries and, in the United States, the Federal Deposit Insurance Corporation Improvement Act (FDICIA),[6] adopted in 1991. Even though these two reforms were basically successful (as illustrated by the substantial increase in banks' capital ratios in most developed countries since 1990),[7] the Basel Accord was heavily criticized for having provoked a "credit crunch"[8] and regulatory arbitrage,[9] while PCA was never implemented, or even seriously considered outside the United States. Besides, both reforms only concern micro-prudential regulation. As argued by Borio (2003), there is, however, an urgent need for a conceptualization and international harmonization of macro-prudential regulation systems.

5. A similar time-consistency problem used to exist for monetary policy, until independence was granted to the central banks of many countries.
6. The FDICIA of 1991 requires that each U.S. bank be placed in one of five categories based on its regulatory capital position and other criteria (CAMELS ratings). Undercapitalized banks are subject to increasing regulatory intervention as their capital ratios deteriorate. This prompt corrective action (PCA) doctrine is designed to limit supervisory forbearance. The consequences of FDICIA are assessed in Jones and King (1995) and Mishkin (1996).
7. See, for example, Furfine (2001) or Flannery and Rangan (2003).
8. On this, see, for example, Berger and Udell (1994), Bernanke and Lown (1991), Jackson *et al.* (1999), Peek and Rosengren (1995), and Thakor (1996).
9. See Jones (2000).

This paper builds a simple model of the banking industry where both micro and macro aspects of prudential policies can be integrated. This model, already used in Rochet (2004b), is an adaptation to the banking sector of the corporate finance model of Holmström and Tirole (1997, 1998).

My results suggest that the main cause behind the poor management of banking crises may not be the "safety net" *per se* as argued by many economists, but instead the lack of commitment power of banking authorities, which are typically subject to political pressure. I show that the use of private monitors (market discipline) is a very imperfect means of solving this commitment problem. Instead, I argue in favor of establishing independent and accountable banking supervisors, as has been done for monetary authorities. I also suggest a differential regulatory treatment of banks according to the costs and benefits of a potential bailout. In particular, I argue that independent banking authorities should make it clear from the start (in a credible fashion) that certain banks with an excessive exposure to macro shocks should be denied access to emergency liquidity assistance by the central bank. By contrast, banks that have access to the lender of last resort (LLR) facility either because they have a reasonable exposure to macro shocks or because they are too big to fail should face special regulatory treatment, with an increased capital ratio and deposit insurance premium (or liquidity requirements).

The rest of this paper proceeds as follows.

- In Section II, we survey the academic literature on the impact of safety nets and market discipline on banks' behavior.
- In Section III, we develop a simple model of moral hazard in banking (closely following Holmström and Tirole [1997]) that justifies the need for prudential regulation and/or market discipline.
- In Section IV, we extend this model by introducing macroeconomic shocks and determine the optimal closure rule for banks in a situation of crisis. We also identify the source of regulatory forbearance: the lack of commitment power by political authorities.
- Section V offers policy recommendations for reforming banking supervisory systems.
- Finally, Section VI concludes.

II. Survey of the Academic Literature

The ongoing reform of the Basel Accord[10] relies on three "pillars": capital adequacy requirements, supervisory review, and market discipline. Yet the articulation between these three instruments is far from clear. On the one hand, the recourse to market discipline is justified by common-sense arguments about the increasing complexity of banking activities, and the impossibility of banking supervisors' monitoring of these

10. Basel I, elaborated in July 1988 by the Basel Committee on Banking Supervision (BCBS), required internationally active banks from the G-10 countries to hold minimum total capital equal to 8 percent of risk-adjusted assets. It was later amended to cover market risks. It has been revised by the BCBS, which has released for comment several proposals of amendment, commonly referred to as Basel II (Basel Committee [1999, 2001, 2003]).

activities in detail. It is therefore legitimate to encourage monitoring of banks by professional investors and financial analysts as a complement to banking supervision. Similarly, a notion of gradualism in regulatory intervention is introduced (in the spirit of the reform of U.S. banking regulation, following the FDICIA of 1991). It is suggested that commercial banks should, under "normal circumstances," maintain economic capital significantly above the regulatory minimum and that supervisors could intervene if that is not the case. Yet, and somewhat contradictorily, while the proposed reform states very precisely the complex refinements of the risk weights to be used in the computation of this regulatory minimum, it remains silent on the other intervention thresholds. I briefly survey the academic literature on the impact of solvency regulations, market discipline, regulatory intervention, and the LLR.

A. Solvency Regulations

I will not discuss in detail the enormous literature on Basel I and its relation to the "credit crunch" (good discussions can be found in Thakor [1996], Jackson *et al.* [1999], and Santos [2000]). Briefly, it should be mentioned that most of the theoretical literature (e.g., Keeley and Furlong [1990], Kim and Santomero [1988], Koehn and Santomero [1980], Rochet [1992], and Thakor [1996]) has focused on the distortion of banks' asset allocations that could be generated by the wedge between market assessment of asset risks and its regulatory counterpart in Basel I.

1. Regulatory arbitrage

Following the implementation of Basel I, academic research has spent much effort trying to assess the consequences of minimum capital standards on banks' behavior. For example, Furlong and Keeley (1989) show that value-maximizing banks tend to reduce risk taking after a capital requirement is imposed. Using a mean variance framework, Kim and Santomero (1988) and Rochet (1992) show that improperly chosen risk weights induce banks to select inefficient portfolios, and to undertake regulatory arbitrage activities which might paradoxically result in increased risk taking. These activities are analyzed in detail in Jones (2000). Hellman, Murdock, and Stiglitz (2000) argue in favor of reintroducing interest rate ceilings on deposits as a complementary instrument to capital requirements in mitigating moral hazard. By introducing these ceilings, the regulator increases the franchise value of the banks (even if the ceilings are not currently binding), which relaxes the moral hazard constraint. Similar ideas are put forward in Caminal and Matutes (2002).

2. The credit crunch

The empirical literature (e.g., Bernanke and Lown [1991]; see also Thakor [1996], Jackson *et al.* [1999], and the references therein) has sought to relate these theoretical arguments to the large-scale (yet apparently transitory) substitution of commercial and industrial loans by investment in government securities among U.S. banks in the early 1990s, shortly after the implementation of Basel I and the FDICIA.[11,12]

Hancock, Laing, and Wilcox (1995) study the dynamic response to shocks in the capital of U.S. banks using a vector autoregressive framework. They show that the

11. Peek and Rosengren (1995) find that the increase in supervisory monitoring also had a significant impact on bank lending decisions, even after controlling for bank capital ratios.
12. Blum and Hellwig (1995) analyze the macroeconomic implications of bank capital regulation.

U.S. banks seem to adjust their capital ratios much faster than they adjust their loan portfolios. Furfine (2001) extends this line of research by building a structural dynamic model of banks' behavior, which is calibrated using data from a panel of large U.S. banks during the period 1990–97. He suggests that the credit crunch cannot be explained by demand effects, but rather by the rise in capital requirements and/or the increase in regulatory monitoring. He also uses his calibrated model to simulate the effects of Basel II and suggests that its implementation would not provoke a second credit crunch, given that average risk weights on quality commercial loans will decrease if Basel II is implemented.

3. Dynamic aspects

Blum (1999) is one of the first theoretical papers to analyze the consequences of more stringent capital requirements in a dynamic framework. He shows that more stringent capital requirements may paradoxically induce an increase in risk taking by banks that anticipate having difficulty meeting these capital requirements in the future.

Décamps, Rochet, and Roger (2004) and Rochet (2004a) analyze the articulation between the three pillars of Basel II in a dynamic model. They suggest that regulators should put more emphasis on implementation issues and institutional reforms, to reduce a certain imbalance between Pillar 1 of the accord (capital adequacy requirements) and the other two pillars (supervisory review and market discipline).

Merton (1977, 1978) is the first to use a diffusion model to study the behavior of commercial banks. He computes the fair pricing of deposit insurance in a context where supervisors can perform costly audits. Fries, Mella-Barral, and Perraudin (1997) extend Merton's framework by introducing a withdrawal risk on deposits. They study the impact of the regulatory policy of bank closures on the fair pricing of deposit insurance. The optimal closure rule must trade off between monitoring costs and the costs of bankruptcy. Under certain circumstances, the regulator may want to let the bank continue even when equity holders have decided to close it (the underinvestment result).

Following Leland (1994), Bhattacharya *et al.* (2002) derive closure rules that can be contingent on the level of risk chosen by the bank. Then they examine the complementarity between two policy instruments of bank regulators: the level of capital requirements and the intensity of supervision. In the same spirit, Dangl and Lehar (2001) mix random audits as in Bhattacharya *et al.* (2002) with risk shifting possibilities as in Leland (1998) to compare the efficiency of the first Basel Accord (1988) and value-at-risk (VaR) regulation. They show that VaR regulation is better, since it reduces the frequency of audits needed to prevent risk shifting by banks.

Calem and Rob (1996) design a dynamic (discrete-time) model of portfolio choice, and analyze the impact of capital-based premia when regulatory audits are perfect. They show that regulation may be counterproductive: a tightening in the capital requirement may lead to an increase in the risk of the portfolios chosen by banks, and similarly, capital-based premia may sometimes induce excessive risk taking by banks. However, this never happens when capital requirements are stringent enough.

Froot and Stein (1998) model the buffer role of bank capital in absorbing liquidity risks. They determine the capital structure that maximizes the bank's value when there are no audits or deposit insurance. Milne and Whalley (2001) develop a

model in which banks can issue subsidized deposits without limit to finance their liquidity needs. The social cost of these subsidies is limited by the threat of regulatory closure. Milne and Whalley (2001) study the relation between two regulatory instruments: the intensity of costly auditing and the level of capital requirements. They also allow for the possibility of banks' recapitalization. They show that banks' optimal strategy is to hold an additional amount of capital (above the regulatory minimum) used as a buffer against future solvency shocks. This buffer reduces the impact of solvency requirements.

Finally, Pagès and Santos (2001) analyze optimal banking regulations and supervisory policies according to whether or not banking authorities are also in charge of the deposit insurance fund. If this is the case, they show that supervisory authorities should inflict higher penalties on the banks that do not comply with solvency regulations, but should also reduce the frequency of regulatory audits.

B. Market Discipline versus Regulatory Intervention

Conceptually, market discipline can be used by banking authorities in two ways:

- *Direct* market discipline, which aims at inducing market investors to *influence*[13] the behavior of bank managers, and works as a *substitute* for prudential supervision.
- *Indirect* market discipline, which aims at inducing market investors to *monitor* the behavior of bank managers, and works as a *complement* to prudential supervision. The idea is that indirect market discipline provides new and objective information that can be used by supervisors to improve their control of problem banks, but also to implement PCA measures that limit forbearance.

The instruments for implementing market discipline are essentially of three types:

- *Imposing more transparency*, in other words, forcing bank managers to disclose publicly various types of information that can be used by market participants to better assess banks' management.
- *Changing the liability structure of banks*, for example, forcing bank managers to issue periodically subordinated debt.
- *Using market information* to improve the efficiency of supervision.

We now successively examine these three types of instruments.

1. Imposing more transparency

In a recent empirical study of disclosure in banking, Baumann and Nier (2003) find that more disclosure tends to be beneficial to banks: it decreases stock volatility, boosts market values, and increases the usefulness of accounting data. However, as argued by D'Avolio, Gildor, and Shleifer (2001), "market mechanisms . . . are unlikely themselves to solve the problems raised by misleading information . . . For the future of financial markets in the United States, disclosure [of accurate information] is likely to be critical for continued progress." In other words, financial markets will not by themselves generate enough information for investors to allocate their funds appropriately and efficiently, and in some cases will even tend to spread misleading information. This means that disclosure of accurate information must be imposed by regulators. A good example of such regulations is the disclosure requirements imposed

13. This distinction between influencing and monitoring is due to Bliss and Flannery (2001).

in the United States by the Securities and Exchange Commission (SEC) (and in other countries by the agencies regulating securities exchanges) for publicly traded companies. However, the banking sector is peculiar in two respects: banks' assets are traditionally viewed as "opaque,"[14] and banks are subject to regulation and supervision, which implies that bank supervisors are already in possession of detailed information on the banks' balance sheets. Thus, it may seem strange to require public disclosure of information already possessed by regulatory authorities: why cannot these authorities disclose the information themselves,[15] or even publish their regulatory ratings (BOPEC, CAMELS, and the like)? There are basically two reasons:

- First, as argued by Rochet and Vives (2004), too much disclosure may trigger bank runs and/or systemic banking crises. This happens in any situation where coordination failures may occur between many dispersed investors.
- Second, as explained below, the crucial benefit of market discipline is to limit the possibilities of regulatory forbearance by generating "objective" information that can be used to force supervisors to intervene before it is too late when a bank is in trouble. This would not be possible if the information were disclosed by the supervisors themselves.

In any case, there are intrinsic limits to transparency in banking: we must recall that the main economic role of banks is precisely to allocate funds to projects of small and medium-sized enterprises, which are "opaque" to outside investors. If these projects were transparent, commercial banks would not be needed in the first place.

2. Changing the liability structure of banks

The economic idea behind *direct market discipline* is that, by changing the liability structure of banks (e.g., forcing banks to issue uninsured debt of a certain maturity),[16] one can change the incentives of bank managers and shareholders. In particular, some proponents of the mandatory subdebt proposal claim that informed investors have the potential to "influence" bank managers. This idea has been discussed extensively in the academic literature on corporate finance: short-term debt can in theory be used to mitigate the debt overhang problem (Myers [1984]) and the free cash flow problem (Jensen [1986]). In the banking literature, Calomiris and Kahn (1991) and Carletti (1999) have shown how demandable debt could be used in theory to discipline bank managers. The subdebt proposal has been only analyzed formally in a very few articles: Levonian (2001) uses a Black-Scholes-Merton type of model (where the bank's return on assets and closure date are exogenous) to show that mandatory subdebt is typically not a good way to prevent bankers from taking too much risk.[17] Décamps, Rochet, and Roger (2004) and Rochet (2004a) modify this model by endogeneizing the bank's

14. Morgan (2002) provides indirect empirical evidence on this opacity by comparing the frequency of disagreements among bond rating agencies about the values of firms across sectors of activity. He shows that these disagreements are much more frequent, all else being equal, for banks and insurance companies than for other sectors of the economy.
15. One could also argue that the information of supervisors is "proprietary" information which could be used inappropriately by the bank's competitors if publicly disclosed. This is not an argument against regulatory disclosure, since regulators can select which pieces of information they disclose.
16. The "subordinated debt proposal" is discussed, for example, in Calomiris (1998, 1999), Evanoff (1993), Evanoff and Wall (2000), and Wall (1989).
17. The reason is that subdebt behaves like equity in the region close to liquidation (which is precisely the region where influencing managers becomes crucial), so subdebt holders have some incentives as shareholders to take too much risk.

return on assets and closure date. They find that under certain conditions (sufficiently long maturity of the debt, sufficient liquidity of the subdebt market, limited scope for asset substitution by the bank managers) mandating a periodic issuance of subordinated debt could allow regulators to reduce equity requirements (Tier 1). However, it would always increase total capital requirements (Tier 1 + Tier 2).

In any case, empirical evidence for direct market discipline is weak: Bliss and Flannery (2001) find very little support for equity or bond holders influencing U.S. bank holding companies.[18] It is true that studies of crisis periods, either in the recent crises in emerging countries (see Martinez Peria and Schmukler [2001] or Calomiris and Powell [2000]), during the Great Depression (see Calomiris and Mason [1997]), or the U.S. savings and loan (S&L) crisis (see Park and Peristiani [1998]) have found that in extreme circumstances depositors and other investors were able to distinguish between "good" banks and "bad" banks and "vote with their feet." There is no doubt indeed that depositors and private investors have the potential to provoke bank closures, and thus ultimately discipline bankers. But it is hard to see this as "influencing" banks' managers, and is not necessarily the best way to manage banking failures or systemic crises. This leads me to an important dichotomy within the tasks of regulatory-supervisory systems: one is to limit the *frequency* of bank failures, the other is to *manage* them in the most efficient way once they become unavoidable. I am not aware of any empirical evidence showing that depositors and private investors can directly influence bank managers before their bank becomes distressed (i.e., help supervisors in their first task). As for the second task (i.e., managing closures in the most efficient way) it seems reasonable to argue that supervisors should in fact aim at an orderly resolution of failures, in other words, exactly *prevent* depositors and private investors from interfering with the closure mechanism.

3. Using market information

The most convincing mechanism through which market discipline can help bank supervision is indirect: by *monitoring* banks, private investors can generate new, "objective" information on the financial situation of these banks. This information can then be used to complement the information already possessed by supervisors. There is a large academic literature on this question.[19] Most empirical studies of market discipline focus indeed on market monitoring, in other words, indirect market discipline. The main questions examined by this literature are: What is the informational content of prices and returns of the securities issued by banks? More precisely, is this information new with respect to what supervisors already know? Some authors also examine if bond yields and spreads are good predictors of bank risk.

Flannery (1998) reviews most of the empirical literature on these questions. More recent contributions are Jagtiani, Kaufman, and Lemieux (1999) and De Young *et al.* (2001). The main stylized facts are as follows:

18. A recent article by Covitz, Hancock, and Kwast (2003) partially challenges this view. However, they focus exclusively on funding decisions. More specifically, they find that in the United States, riskier banks are less likely to issue subdebt. This does not necessarily imply that mandating subdebt issuance would prevent banks from taking too such risk.

19. See, for example, De Young *et al.* (2001), Evanoff and Wall (2001a, 2001b, 2003), Flannery (1998), Flannery and Sorescu (1996), Gropp, Vesala, and Vulpes (2002), Hancock and Kwast (2001), Jagtiani, Kaufman, and Lemieux (1999), and Pettway and Sinkey (1980).

- Bond yields and spreads contain information not contained in regulatory ratings, and vice versa. More precisely, bank closures can be predicted more accurately by using both market data and regulatory information than by using each of them separately.[20,21]
- Subdebt yields typically contain bank risk premiums. However, in the United States, this is only true since explicit too-big-to fail policies were abandoned (i.e., after 1985–86). This shows that market discipline can work only if regulatory forbearance is not anticipated by private investors.
- However, as shown by Covitz, Hancock, and Kwast (2003), bond and subdebt yields can also reflect other things than bank risk. In particular, liquidity premia are likely to play an important role.

In any case, even if there seems to be a consensus that complementing the information set of banking supervisors with market information is useful, it seems difficult to justify, on the basis of existing evidence, mandating that all banks issue subordinated debt for the sole purpose of generating additional information. Large banks and U.S. bank holding companies already issue publicly traded securities, and therefore this information is already available, while small banks would probably find it difficult to issue such securities on a regular basis and the market for them would probably not be very liquid.[22]

Also, there is a basic weakness in most empirical studies of indirect market discipline: for data availability reasons, they have essentially used cross-sectional datasets containing a vast majority of well-capitalized banks. Remember that the problem at stake is the dynamic behavior of undercapitalized banks. Thus, what we should be interested in is instead the informational content of subdebt yields for predicting banks' problems. That is, empirical studies should essentially focus on panel data and restrict their analysis to problem banks.

Finally, most of the academic literature (both theoretical and empirical) has focused on the asset substitution effect, exemplified by some spectacular cases, such as those of "zombie" S&Ls in the U.S. crisis of the 1980s. However, as convincingly argued by Bliss (2001), "poor investments are as problematic as excessively risky projects . . . Evidence suggests that poor investments are likely to be the major explanation for banks getting into trouble." Thus, there is a need for a more thorough investigation of the performance of weakly capitalized banks: is asset substitution the only problem, or is poor investment choice also a factor?

In fact, the crucial aspect in using market regulation to improve banking supervision is probably the possibility of limiting regulatory forbearance by triggering PCA, based on "objective" information. As soon as stakeholders of any sort (private

20. A similar point was made earlier by Pettway and Sinkey (1980). They showed that both accounting information and equity returns were useful to predict bank failures.
21. Berger, Davies, and Flannery (2000) obtain similar conclusions by testing causality relations between changes in supervisory ratings and in stock prices.
22. The argument that subordinated debt has the same profile as (uninsured) deposits and can thus be used to replace forgone market discipline (due to deposit insurance) is not convincing. Indeed, as pointed out by Levonian (2001), the profile of subdebt changes according to the region of scrutiny: it indeed behaves like deposits (or debt) in the region where the bank starts to have problems, but like equity when the bank comes closer to the failure region.

investors, depositors, managers, shareholders, or employees of a bank in trouble) can check that supervisors have done their job, that is, that they have reacted soon enough to "objective" information (provided by the market) on the bank's financial situation, the scope for regulatory forbearance will be extremely limited. Of course, the challenge is to design (*ex ante*) sufficiently clear rules (i.e., set up a clear agenda for the regulatory agency) specifying how regulatory action will be triggered by well-specified market events.

4. How to integrate market discipline and banking supervision

A few conclusions emerge from our short review:

- First, it seems that supervision and market discipline are more *complements* than *substitutes*: one cannot work efficiently without the other. Without credible closure policies implemented by supervisors, market discipline is ineffective. Conversely, without the objective data generated by prices and yields of banks bonds and equity, closure policy is likely to be plagued by ambiguity and forbearance.
- Second, *indirect* market discipline (private investors *monitoring* bank managers) seems to be more empirically relevant than *direct* market discipline (private investors *influencing* bank managers). Also, mandating that all banks regularly issue a certain type of subordinated debt would not generate much new information on large bank holding companies (because most of them already issue publicly traded securities), but would be very costly for smaller banks.[23]
- Third, more attention should be directed to the precise ways in which supervisory action can be gradually triggered by market signals. Instead of spending so much time and energy refining Pillar 1 of Basel II, the Basel Committee should concentrate on this difficult issue, crucial to creating a level playing field for international banking.

There is also clearly much more to be done, both by academics and regulators, if we really seek to understand the interactions between banking supervision and market discipline. In particular, very little attention has been paid[24] so far to macro-prudential regulation: how to prevent and manage systemic banking crises. It seems clear that market discipline is probably not a good instrument for improving macro-prudential regulation. Indeed, market signals often become erratic during crises, and the very justification of macro-prudential regulation is that markets do not deal efficiently with aggregate shocks of sufficient magnitude. Macro-prudential control lies, therefore, almost exclusively on the shoulders of bank supervisors, in coordination with the central bank and the Treasury. A difficult question then is how to organize the two dimensions (macro and micro) of prudential regulation in such a way that systemic crises are efficiently managed by governments and central banks, while individual bank closure decisions remain protected from political interference.

23. The only convincing argument for mandating regular issuance of a standardized form of subdebt is that it may improve liquidity of such a market, and therefore increase informational content of prices and yields.
24. Borio (2003) is one exception.

C. The Lender of Last Resort (LLR)

1. The doctrine and the facts

The concept of LLR was elaborated in the 19th century by Thornton (1802) and Bagehot (1873). The essential point of the classical doctrine associated with Bagehot asserts that the LLR role is to lend to "solvent but illiquid" banks under certain conditions. More precisely, the LLR should lend freely against good collateral, valued at pre-crisis levels, and at a penalty rate. These conditions can be found in Bagehot (1873) and are also presented, for instance, in Humphrey (1975) and Freixas *et al.* (1999).

This policy has clearly been effective: traditional banking panics were eliminated with the LLR facility and deposit insurance by the end of the 19th century in Europe, after the crisis of the 1930s in the United States and, more recently, in many emerging market economies, which had previously suffered numerous such crises.[25] Modern liquidity crises associated with securitized money or capital markets have also required the intervention of the LLR. Indeed, the Federal Reserve System intervened in the crises provoked by the failure of Penn Central in the U.S. commercial paper market in 1970, by the stock market crash of October 1987, and by Russia's default in 1997 and subsequent collapse of Long-Term Capital Management (in the last case, a "lifeboat" was arranged by the Federal Reserve Bank of New York). For example, in October 1987 the Fed supplied liquidity to banks through the discount window.[26]

2. The main criticisms

The LLR's function of providing emergency liquidity assistance has been criticized for provoking moral hazard on the banks' side.[27] Perhaps more importantly, Goodfriend and King (1988) (see also Bordo [1990], Kaufman [1991], and Schwartz [1992]) remark that Bagehot's (1873) doctrine was elaborated at a time when financial markets were underdeveloped. They argue that, whereas central bank intervention on aggregate liquidity (monetary policy) is still warranted, individual interventions (banking policy) are not anymore: with sophisticated interbank markets, banking policy has become redundant. Goodfriend and Lacker (1999) suggest that commercial banks could instead provide each other with multilateral credit lines, remunerated *ex ante* by commitment fees.

3. The modern view

Rochet and Vives (2004) provide a theoretical foundation for Bagehot's (1873) doctrine in a model that fits the modern context of sophisticated and presumably efficient financial markets. Their approach bridges a gap between the "panic" and "fundamental" views of crises by linking the probability of occurrence of a crisis to the fundamentals. They show that in the absence of intervention by the central bank, some solvent banks may be forced to liquidate if too large a proportion of wholesale deposits is not renewed. Freixas, Parigi, and Rochet (2004) formalize two common criticisms

25. See Gorton (1988) for U.S. evidence and Lindgren, Garcia, and Saal (1996) for evidence on other International Monetary Fund (IMF) member countries.
26. See Folkerts-Landau and Garber (1992). See also Freixas, Parigi, and Rochet (2004) for a modeling of the interactions between the discount window and the interbank market.
27. However, Cordella and Levy-Yeyati (2003) show that, in some cases, moral hazard can be reduced by the *presence* of LLR.

of the Bagehot doctrine of the LLR: that it may be difficult to distinguish between illiquid and insolvent banks (Goodhart [1995]) and that LLR policies may generate moral hazard. They find that when interbank markets are efficient, there is still a potential role for an LLR but only during crisis periods, when market spreads are too high. In "normal" times, liquidity provision by interbank markets is sufficient.

III. A Simple Model of Prudential Policy

In this section, we introduce the benchmark model of banking regulation, used also in Rochet (2004b) in the absence of macroeconomic shocks. We consider a static model with two dates ($t = 0, 1$) following Holmström and Tirole (1997),[28] where banks are modeled as delegated monitors in the manner of Diamond (1984). They collect a volume D of deposits from the public and invest them, together with their own funds E, in loans to private borrowers. The volume of loans granted by the bank is denoted by L. Since we focus on the role of banks as monitors of private borrowers, we take small depositors out of the picture by assuming that they are perfectly insured by a DIF. We also neglect conflicts of interest inside the bank, that is, between managers and shareholders. Thus, in the first version of the model there are only two protagonists:[29] the "banker" (who represents the collective interests of the bank's managers and shareholders) and the DIF (which subrogates the collective interests of retail depositors). The budget constraint of the bank at date 0 is thus

$$D + E = L + P,$$

where P is the deposit insurance premium charged by the DIF. The lending technology has a constant return to scale.[30] This return is binomial: R (per unit) in case of success and zero in case of failure. All agents are risk neutral and do not discount future payments (alternatively, the interest rate is normalized to zero). Banking supervision is modeled as a contract between the banker and the DIF.[31] This contract stipulates the volume of loans L and the volume D of deposits that the bank can collect, the level of equity E being taken as given. The specificities of banking are thus captured by three assumptions:

- First, we assume that $L > E$, which implies that some fraction of bank loans is financed by deposits.
- Second, we assume that the quality of loans is affected by an unobservable decision of the banker. He can either monitor the loans, in which case they have a "high" probability of repayment p, or "shirk," in which case the loans have a

28. Holmström and Tirole (1997) study the financing needs of nonfinancial firms. We adapt their model to study the financing needs of banks.
29. We later introduce the central bank and the Treasury.
30. Empirical evidence on the nature of returns to scale in the banking sector is mixed. Moreover, capital requirements are (for a given asset structure) roughly proportional to the size (asset volume) of the bank. Thus, assuming constant returns seems to be a reasonable approximation of reality.
31. In fact, the contract is signed between the banker and the regulator, who is supposed to represent the interests of the DIF.

probability of repayment of only $p - \Delta p$. Shirking provides the banker with a private benefit with monetary equivalent B (per unit of investment).

- The social value of the bank exceeds the present value of its investments: we assume that, from the point of view of the economy[32] as a whole, the bank has an additional continuation value of $v \geq 0$ per unit of assets, which corresponds, for example, to public good aspects of the bank's activity such as the bank's role in the payments system[33] (Solow [1982]).

The time line of the model is summarized in Figure 1.

At this stage, we need two assumptions on the parameters of our model:

Assumption 1: $(p - \Delta p)R + B + v < 1 < pR + v$.

Assumption 1 means that loans have a positive social value only when they are monitored. This assumption implies in particular that $R > B/\Delta p$.

Assumption 2: $p(R - B/\Delta p) < 1$.

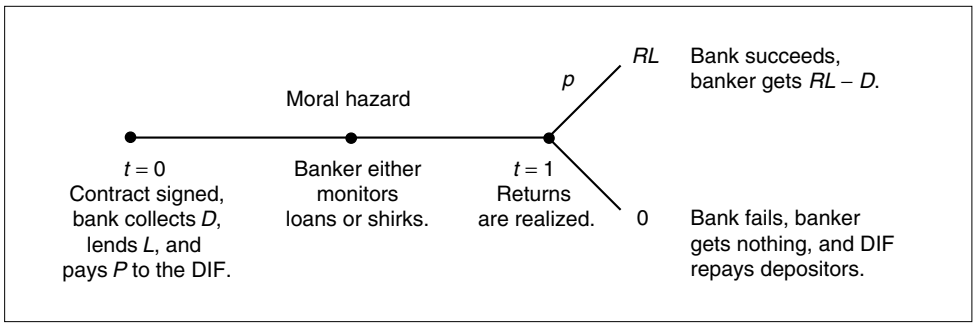
As explained below, Assumption 2 implies that banks need capital. If it were not satisfied, banks could be 100 percent externally financed.

The optimal contract (L^*, D^*) maximizes expected social surplus under two constraints: the DIF must break even and the banker must be given incentives to monitor the loans. Denoting by P the premium paid by the bank to the DIF, and using the budget constraint of the bank at date 0, we see that the DIF breaks even if and only if

$$P = D + E - L \geq (1 - p)D,$$

or

Figure 1 Time Line of the Model



32. There may also be a private continuation value, associated with the banker's nontransferable knowledge of borrowers (relationship banking as in Sharpe [1990], or Degryse and Van Cayseele [2000]). We do not discuss this aspect.
33. This feature is not crucial: our results also hold when $v = 0$. However, in the next section it allows us to discuss the basic trade-off confronted by banking authorities during crises: rescuing insolvent banks and losing credibility, or closing them and creating social disruption.

$$L \leq pD + E. \qquad (1)$$

Similarly, the incentive compatibility constraint is

$$p(RL - D) \geq (p - \Delta p)(RL - D) + BL,$$

which can be rewritten as

$$D \leq \left(R - \frac{B}{\Delta p}\right)L. \qquad (2)$$

The optimal contract (L, D) is thus a solution of

$$\begin{cases} \max L[pR + v - 1], \\ L \leq pD + E, \qquad (1) \\ D \leq \left(R - \frac{B}{\Delta p}\right)L. \qquad (2) \end{cases}$$

It is characterized as follows:

Proposition 1: *In the absence of macroeconomic shocks, the optimal organization of the banking sector can be implemented by a combination of two instruments:*

- *A deposit insurance system financed by (fair) risk-based premiums:*

$$P = (1 - p)D.$$

- *A capital adequacy requirement limiting banks' lending to a certain multiple of their equity:*

$$L \leq \frac{E}{k}, \quad \text{where } k = p\frac{B}{\Delta p} - (pR - 1) > 0.$$

Proof: The optimal organization of the banking sector is obtained by solving the above program. The solution is obtained by saturating the two constraints. In particular,

$$D^* = \left(R - \frac{B}{\Delta p}\right)L^*.$$

Plugging this into the other constraint, we obtain

$$L^*\left[1 - p\left(R - \frac{B}{\Delta p}\right)\right] = E.$$

These two conditions characterize the optimal contract (D^*, L^*).

We now show that this contract can be implemented by actuarial deposit insurance premiums and a capital requirement, $E/L \geq k$. Indeed shareholders' value equals

$$S = p[RL - D],$$

where $L = D + E - P = pD + E$ (since deposit insurance is actuarially priced).

Therefore, shareholders' value can also be written as

$$S = (pR - 1)L + E,$$

which is increasing in L. Thus, if the bank is subject to a capital requirement, $L \leq E/k$, shareholders will select the maximum possible volume of loans, $L = E/k$. By choosing in turn the appropriate level for the capital ratio, that is,

$$k = p\frac{B}{\Delta p} - (pR - 1),$$

the bank regulator will implement the optimal allocation (D^*, L^*). ■

Notice that this optimal allocation can also be implemented by a private arrangement between the DIF and the banker: the DIF offers a deposit insurance contract with a fair premium P and stipulates that the bank's assets L should not exceed E/k. The difference between private and public arrangements only appears if macro shocks are introduced. This is what we do in Section IV.

IV. How to Deal with Macroeconomic Shocks?

Protection of depositors is not the only preoccupation of bank supervisors: they also care about what may lead to the instability of the financial system as a whole (systemic risk). The theoretical literature has insisted a great deal on a first cause of instability, namely, bank runs, provoked by a sudden loss of confidence of depositors in the banks' safety. These bank runs were, for example, very common in the United States prior to the creation of the Fed. However, since the implementation of deposit insurance systems in most countries, such bank runs have become much less frequent, and banking authorities are now more concerned about systemic risk. One strand of the literature (e.g., Rochet and Tirole [1996] or Freixas, Parigi, and Rochet [2000]) has examined the possible mechanisms of contagion, that is, propagation of one bank failure to other banks. We focus here on another source of systemic risk, namely *systematic* risk, generated by a common exposure of banks to macroeconomic shocks, such as recessions, asset market crashes, and the like. We introduce these macro shocks by assuming, as in Holmström and Tirole (1998),[34] that at an interim date ($t = 1/2$), each bank[35] suffers with some probability q from a

34. In Holmström and Tirole (1998), the cause of the liquidity shock can be microeconomic (i.e., diversifiable) or macroeconomic. We focus here on the second case.

35. Holmström and Tirole (1998) do not consider banks but instead nonfinancial firms. Moreover, they take ρ to be a random variable, but assume that it is identically distributed across firms. We assume instead that ρ is deterministic, but varies across banks.

liquidity shock: continuation can only occur if an additional amount of cash ρL is injected into the bank. We interpret this shock as resulting from a nondiversifiable event, such as a recession: the projects financed by the bank need a further injection of cash, otherwise they lose all value. We assume that the probability q is sufficiently small for bank lending to remain profitable even if the risk of recession is taken into account. Specifically:

Assumption 3: $(1 - q)pR > 1$.

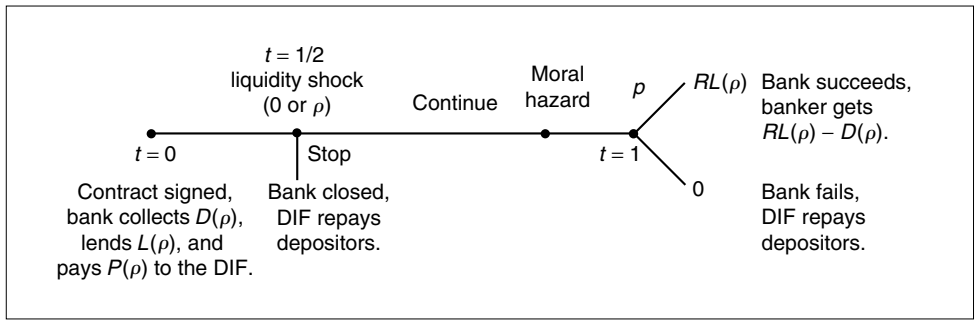
Notice that all banks are hit simultaneously but ρ differs across banks. This parameter ρ is known *ex ante* by the supervisor: it measures the bank's exposure to macro shocks. The new time line is indicated in Figure 2.

Confronted with the possibility of such macro shocks, the regulators must now consider the situation of the banking system as a whole. We assume that there is a continuum of banks, which for simplicity only differ through their exposure[36] ρ to macro shocks. ρ is distributed according to a continuous distribution with continuous distribution function F. $F(\hat{\rho})$ can thus be interpreted as the proportion of banks such that $\rho \leq \hat{\rho}$.

Since ρ, the macro exposure of each bank, is known *ex ante* by the supervisors, the optimal regulation contract can be conditioned on it. Moreover, the supervisors may decide to close a bank at $t = 1/2$ in case of a recession, again conditionally on ρ. We denote by $x(\rho) \in [0, 1]$ the probability that the bank is allowed to continue in case of recession. If a bank is closed, its assets are liquidated[37] and its depositors are compensated by the DIF. A regulation contract is described by a continuation probability $x(\rho)$, a volume of loans $L(\rho)$, and a volume of deposits $D(\rho)$. For the moment, we adopt a normative perspective and solve for the (*ex ante*) optimal contract without specifying the way in which it is implemented (this is done in the next section).

Since moral hazard takes place after the liquidity shock, it is easy to see that the optimal volume of deposits still corresponds to the maximal payment that can be obtained from bankers while preserving incentive compatibility, namely:

Figure 2 Time Line in the Presence of Macro Shocks



36. This exposure results in fact from policy decisions by banks, and therefore should be endogenized. We leave this for further research. In this paper, the distribution of ρ is taken as exogenous.
37. For simplicity, we assume that the liquidation value of the bank's asset at $t = 1/2$ is zero.

$$D(\rho) = \left(R - \frac{B}{\Delta p}\right) L(\rho). \tag{3}$$

We rule out cross-subsidies between banks or between the banking sector and the government. Thus, taking into account the expected cost of liquidity injections, the budget constraint of the bank at date 0 can then be written

$$L(\rho)\left[1 - \{1 - q + qx(\rho)\}p\left(R - \frac{B}{\Delta p}\right) + q\rho x(\rho)\right] = E. \tag{4}$$

This budget constraint takes into account the unconditional probability of continuation of the bank at $t = 1/2$ (that is, $1 - q + qx(\rho)$) and the liquidity injection needed in case of a recession (that is, $\rho x(\rho)$).

Social surplus W is the sum of two terms:

- the expected net surplus generated by bank lending, and
- the social value of the banking system as a whole, captured by a function[38] V of the total assets $\bar{L}$ of the banks at the interim date $t = 1/2$.

Therefore

$$W = \int_0^{+\infty} \{(1-q)pR + qx(\rho)(pR - \rho) - 1\} L(\rho) dF + V(\bar{L}), \tag{5}$$

where

$$\bar{L} = \int_0^{+\infty} L(\rho)\{1 - q + qx(\rho)\} dF. \tag{6}$$

The optimal regulatory contract is obtained by choosing $x(\bullet)$ and $L(\bullet)$ that maximize W under the budget constraint (4) of each bank.

Proposition 2: *In the presence of macroeconomic shocks, the optimal regulatory contract is characterized by a separation of banks into two categories:*

- *The banks such that $\rho \leq \rho^* = 1/(1-q)$ (small exposure to macro shocks) are rescued in case of a crisis, but are subject to a higher capital ratio (than in the absence of macro shocks). This capital ratio increases with their exposure ρ to macro shocks:*

$$k_1(\rho) = \frac{E}{L(\rho)} = 1 - p\left(R - \frac{B}{\Delta p}\right) + q\rho. \tag{7}$$

- *The banks such that $\rho > \rho^*$ (large exposure to macro shocks) are closed in case of a crisis and are subject to a flat capital ratio:*

$$k_0 = \frac{E}{L(\rho)} = 1 - (1-q)p\left(R - \frac{B}{\Delta p}\right). \tag{8}$$

38. This generalizes the constant v introduced in Section III in the case of a single bank. In what follows, v is replaced by $V'(\bar{L})$, the marginal value of letting any given bank continue at $t = 1/2$.

The interpretation of our notion of exposure to macro shocks should be wide. Indeed, our model assumes for simplicity that banks are identical in all other respects. If, more realistically, we also introduce differences in sizes of loans or positions in the interbank markets, the important distinction arising from Proposition 2 concerns which banks have access to the LLR facility and which do not. Proposition 2 then makes two points:

- This distinction[39] should be made explicitly *ex ante* by banking authorities, based on assessments for the (*ex ante*) social costs and benefits of a potential bailout in case of a crisis.
- Banks that are eligible for the LLR facility should face special regulatory treatment, with an increased capital ratio and deposit insurance premium (or liquidity requirement).

Proof: Given that there is a separate budget constraint for each ρ (condition [4]), we can solve for $L(\rho)$ and maximize with respect to x the following quantity:

$$U(x, \rho) = \frac{(1-q+qx)(pR+V'(\bar{L})) - qx\rho - 1}{1-(1-q+qx)p\left(R-\frac{B}{\Delta p}\right)+qx\rho}$$

(E has been omitted, because it only appears multiplicatively and therefore does not influence the optimal value of $x(\rho)$). The expression of U can be simplified as follows:

$$U(x,p) = -1 + \frac{(1-q+qx)\left(V'(\bar{L})+\frac{pB}{\Delta p}\right)}{1+qx\rho-(1-q+qx)p\left(R-\frac{B}{\Delta p}\right)}$$

$$= -1 + \frac{V'(\bar{L})+\frac{pB}{\Delta p}}{\frac{1+qx\rho}{1-q+qx}-p\left(R-\frac{B}{\Delta p}\right)}.$$

For a given ρ, this expression is monotonic in x: increasing if $\rho < 1/(1-q)$, and decreasing if $\rho > 1/(1-q)$. Thus, the optimal regulatory contract involves

$$\begin{cases} x(\rho) = 1 & \text{if } \rho \le \dfrac{1}{1-q} \equiv \rho^*, \\ = 0 & \text{if } \rho > \rho^*. \end{cases}$$

39. However, eligibility for the LLR facility should not be taken for granted and could evolve over time as a function of regulatory assessments.

The corresponding capital ratios are deduced from constraint (4):

$$k(\rho) \equiv \frac{E}{L(\rho)} = 1 - \{1 - q + qx(\rho)\}p\left(R - \frac{B}{\Delta p}\right) + q\rho x(\rho),$$

by replacing $x(\rho)$ with its optimal value found above. ■

Proposition 2 adopts a normative perspective, in other words, it characterizes the optimal closure rule for banks in the presence of macroeconomic shocks. We now adopt a positive perspective and compare the optimal closure rule with the effective closure rules implied by two institutional arrangements: pure private contracting between the banks and the DIF on the one hand, and pure public supervision on the other.

Proposition 3: *A purely private organization of the banking sector leads to too many closures in the event of a recession; indeed, a bank is closed whenever* $\rho \leq \rho_0 = p(R - B/\Delta p) < \rho^*$.

Proof: In the absence of a public intervention, the only way in which a bank can obtain liquidity at the interim date $t = 1/2$ is by borrowing from other banks (or issuing new certificates of deposit). The maximum amount of cash that can be raised in that way is equal to the collateral value of the bank's assets, in other words, the maximal expected payment that can be obtained from bankers while preserving incentive compatibility, that is,

$$\rho_0 L \equiv p\left(R - \frac{B}{\Delta p}\right)L.$$

Assumption 2 states that $\rho_0 < 1$, which implies that $\rho_0 < \rho^* = 1/(1-q)$. Therefore, all the banks with an intermediate exposure to macro shocks ($\rho \in]\rho_0, \rho^*[$) should be allowed to continue, but would be closed in the absence of a public intervention. ■

Proposition 3 shows the need for the central bank acting as an LLR: by providing liquidity assistance to the banks characterized by $\rho \in]\rho_0, \rho^*[$, the central bank improves upon the purely private organization discussed in Proposition 3. However, there is also a problem with public intervention. Indeed, once a bank has granted a certain volume of loans, its social continuation value is positive as long as $\rho < pR + V'(\bar{L}) \equiv \rho_1$, which is larger than $\rho^* = 1/(1-q)$ by Assumption 3. If the bank authorities are subject to political pressure, it will be impossible for them to limit liquidity assistance to the banks such that $\rho \leq \rho^*$, since it is *ex post* optimal to also let all the banks characterized by $\rho \in]\rho^*, \rho_1[$ continue. Not only does this imply too few closures (regulatory forbearance), but also overinvestment at $t = 0$, since bankers anticipate this forbearance. This is explained in the next proposition.

Proposition 4: *Prudential regulation by a public authority leads to forbearance: all banks such that* $\rho \leq \rho_1$ *receive liquidity support in case of a recession. In this case, the only thing regulatory authorities can do is impose on these banks a flat capital ratio:*[40]

40. Banks such that $\rho < \rho_0$ are subject to the same capital ratio as in Proposition 2.

$$k_0 = 1 - (1-q)p\left(R - \frac{B}{\Delta p}\right).$$

Compared with the optimal contract characterized in Proposition 2, we see that this leads to overinvestment by these banks, which thus exploit this anticipated regulatory forbearance.

Proof: We have already seen that it is *ex post* optimal for the government to provide liquidity assistance to all banks such that $\rho \leq \rho_1 = pR + V'(\bar{L})$ (positive social continuation value). When $\rho < \rho_0$ (solvent banks), this liquidity support is fully collateralized and the central bank does not lose any money. However, when $\rho \in]\rho_0, \rho_1]$, the central bank loses $(\rho - \rho_0)L$ in expectation, but seizes maximum income $(R - B/\Delta p)L = D$ in case of success. From the DIF point of view, the cost of deposit insurance becomes

$$P = [(1-q)(1-p) + q]D.$$

The associated capital ratio is

$$k_0 = \frac{E}{L} = 1 + \frac{P-D}{L} = 1 - (1-q)p\left(R - \frac{B}{\Delta p}\right).$$

It is smaller than the efficient capital ratio characterized in Proposition 2:

$$k_0 < k_1(\rho) = 1 - p\left(R - \frac{B}{\Delta p}\right) + q\rho.$$

This is because $\rho > \rho_0 = p(R - B/\Delta p)$. Thus, there is overinvestment. Finally, notice that from an *ex ante* perspective, the marginal social value of loans made by a bank such that $\rho \in]\rho_0, \rho_1]$ is equal to $(\rho_1 - \rho)$, which is non-negative. This means that it would be inefficient *ex ante* to restrict further the volume of credit granted by such banks. Thus, the government cannot compensate for its lack of commitment power with an increase in capital ratios. ■

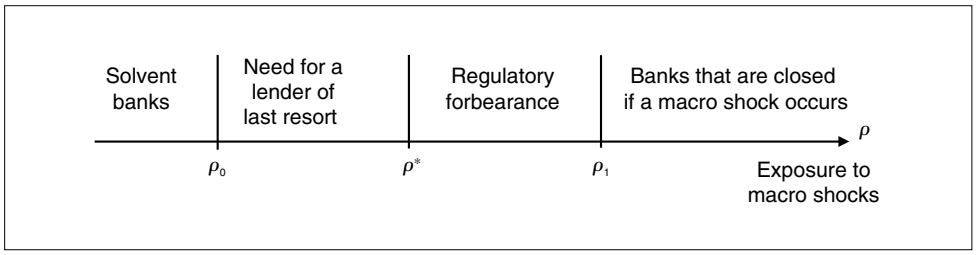
We see this as the fundamental problem faced by prudential supervision: public intervention is needed[41] to avoid too many bank closures, but since governments are subject to commitment problems, public supervision alone leads to too few bank closures and overinvestment. By analogy with Dewatripont and Maskin (1995), we call this a soft budget constraint phenomenon.[42]

This problem is summarized in Figure 3.

We discuss in Section V a possible organization of banking supervision that could solve this problem.

41. Holmström and Tirole (1998) show that, when ρ corresponds to a diversifiable shock, private arrangements between firms and banks (namely, private lines of credit) can be enough to implement the (second-best) optimum. However, when there are macro shocks, public provision of liquidity is needed.
42. Notice, however, that the mechanism which underlies the soft budget constraint in Dewatripont and Maskin (1995) is different.

Figure 3 The Fundamental Problem Faced by Prudential Supervision



V. Policy Recommendations for Prudential Policy

This section offers some reflections on the ways in which the optimal contract characterized in Section IV can be implemented by an adequate design of the supervisory-regulatory system. As we saw in Section IV, two crucial elements are needed:

- Intervention of the central bank as an LLR to provide liquidity assistance, in case of a recession, to a subset of banks that satisfy certain criteria (in our model, this reduces to $\rho \leq \rho^*$).
- Preventing extension of this liquidity assistance to the banks characterized by $\rho^* < \rho \leq \rho_1$, for which *ex post* continuation value is positive (from a social perspective) but for which a bailout would be welfare decreasing from an *ex ante* perspective.

We claim that these two elements can only be reconciled if the central bank is made independent from political authorities, as has been done for monetary policy. To ensure accountability of the central bank in its functions as an LLR, a precise agenda must be defined *ex ante*, namely, providing liquidity assistance to a subset of banks that would be backed by the supervisors (or the DIF). To ensure that the DIF selects properly the banks that can be assisted, we require that the liquidity loans granted by the central bank (acting as an LLR) be backed by the DIF. In other words, such loans would be insured by the DIF: the central bank would be completely protected against credit risk, and no taxpayer money would be involved. The next proposition summarizes the proposed organization of the regulatory system.

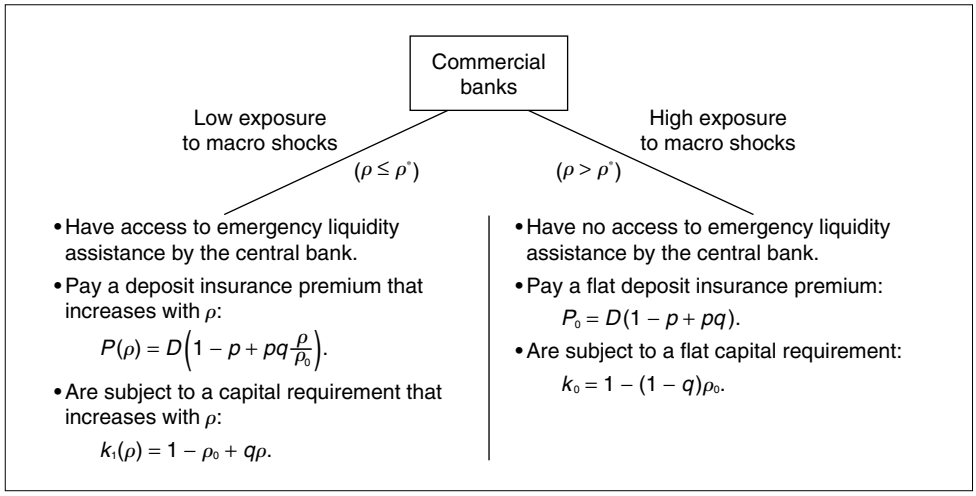
Proposition 5: *The optimal contract (characterized in Proposition 2) can be implemented by the following organization of the regulatory system:*

- *For each commercial bank, the supervisory authorities evaluate the* ex ante *social costs and benefits of bailout in case of a systemic shock. This assessment determines the treatment of the bank by regulators.*
- *Banks for which* ex ante *social benefits of bailout exceed costs are backed by the DIF and, in case of a macro shock, receive liquidity assistance by the central bank. They face a higher capital adequacy requirement and an adjusted deposit insurance premium.*
- *Banks for which bailout costs exceeds social benefits are not backed by the DIF: they do not receive liquidity assistance by the central bank.*

- *The LLR activities of the central bank are made independent from political powers: the central bank exclusively provides liquidity assistance to the banks that are backed by supervisory authorities. Central bank loans are fully insured by the DIF.*

This organization is summarized in Figure 4.

Figure 4 Optimal Management of Systemic Crises



VI. Conclusion

The main reason behind the frequency and magnitude of recent banking crises might not be deposit insurance, bad regulation, or incompetence of supervisors. It might be essentially the commitment problem of political authorities, which are likely to exert pressure to bail out insolvent banks and delay crisis resolution.

The remedy to political pressure exerted on banks' supervisors is probably not to substitute supervision by market discipline. This is because market discipline can only be effective if the absence of government intervention is anticipated. Market discipline and central supervision are more complements than substitutes. In fact, the way to restore credibility of banks' closure policy is to ensure independence and accountability of bank supervisors, as has been done for monetary policy. However, this independence is probably more difficult to implement, given the difficulty to define explicit, quantitative objectives for LLR interventions. Another difficulty is the need to coordinate LLR interventions between the central bank, supervisory authorities, and the Treasury without reintroducing disguised forbearance.

The other key reform is to find a way to restrict liquidity assistance by the central bank to a subset of banks that are backed by the independent supervisors. Supervisors should be in charge of selecting these banks, which then would face special regulatory treatment. Finally, central bank loans should be senior to wholesale deposits, to protect taxpayers' money and provide adequate incentives to banks' supervisors.

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Comment

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I. Introduction

Over the past 30 years, banking crises have become more common.[44] And the evidence of how costly they can be has been mounting. In one study by some of my colleagues,[45] it was estimated that output losses during banking crises are on average around 15 to 20 percent of annual GDP. Crises have occurred in both developed and emerging market economies. It is not surprising, then, that central banks and other public authorities have been focusing more attention on how to maintain financial stability and the question, "how should macro-prudential policy be designed?" My interest lies in this *macro*-prudential element of prudential policy, given my own institution's remit to safeguard "the overall stability of the U.K. financial system as a whole."[46]

The problem is that financial stability authorities have not had at their disposal an analytical framework as developed as that available to their colleagues in the monetary policy arena. There is no consensus definition of financial stability. And it has been difficult to establish precisely why banking crises have taken place and precisely why they have imposed heavy output costs. So I very much welcome Jean-Charles Rochet's paper, both for demonstrating that there has been considerable progress in analyzing prudential policy questions and for carrying the analysis further.

In my brief remarks, I would like first to comment on some of the conclusions that Rochet draws from his review of the literature on prudential policy. Then I would like to say something about the model that he develops. Finally, I want to mention some of the challenges to financial stability authorities suggested to me by his stimulating paper.

II. Rochet's Survey of the Academic Literature

In his survey of the literature, the author outlines the twofold rationale for prudential policy: first, the micro-prudential challenge (how to address the principal-agent problem facing depositors in their relations with banks); second, the macro-prudential challenge (how to promote the public good of financial stability, which banks and investors will tend to under-supply).

This is a dichotomy that makes sense and has proved useful in assigning responsibilities to public authorities. But it is important to note that some of the economic characteristics which give rise to a case for public policy intervention have both

43. These remarks are made in a personal capacity and do not reflect the official view of the Bank of England.
44. See Bordo *et al.* (2001) and Crockett (2003).
45. See Hoggarth, Reis, and Saporta (2001).
46. HM Treasury, Bank of England, and Financial Services Authority (1998).

micro- and macro-prudential consequences. Three examples are asymmetric and incomplete information, problems with contracts and pre-commitment, and network externalities. All can give rise to spillover effects sufficient to merit interest from a macro-prudential angle.

Some of the problems often discussed in a micro-prudential context can have wide-ranging consequences. Examples include contagion following a bank run, a failure of a large complex financial institution, or interruption of vital financial infrastructure services. In many of these cases, it is desirable to model the general equilibrium aspects and spillovers to the economy at large.[47] But at the root of the analysis should be the identification and modeling of the key market imperfections—this is necessary whether one is developing micro- or macro-prudential policy instruments.

Rochet reviews the extensive literature on solvency regulation. He notes how in principle it could induce inefficiency and distort risk management as well as discipline bank managers. But my reading of his paper leads to the conclusion that the empirical impact of capital adequacy requirements is still uncertain, suggesting a need for caution in implementing changes.

The paper does not address the regulation of bank liquidity at any great length, but research both by the author[48] and by Plantin, Sapra, and Shin (2005), presented by Hyun Song Shin in the next session of this conference, suggests that there are difficult issues for financial stability authorities here. Given the increasing interest in revisiting the regulation of banks' liquidity management, it is important for the authorities to engage with these issues. But Rochet reminds us that solvency and liquidity regulation do not exhaust the list of prudential policy instruments. One also needs to consider the intensity of supervisory monitoring—supervisory review—and the promotion of information disclosure and market discipline.

The studies cited show that there is interesting work going on concerning supervisory strategies—where to focus monitoring, how much to undertake—but also plenty of scope for further modeling of supervisory agencies' behavior, objectives, and constraints, to relate them to the range of market imperfections they have implicitly been set up to address.

Turning next to market discipline, Rochet expresses some skepticism about how much it can achieve. He is doubtful that it can, in theory or practice, solve the principal-agent problem confronting depositors or indeed shareholders; he reminds us that, in some circumstances, information disclosure can lead to market movements that trigger a rush for the exit by depositors; and he argues that market discipline is irrelevant as far as the macro-prudential objective of policymakers is concerned.

I am a little less skeptical about the possible benefits of information disclosure and market discipline. As Rochet notes, it can exercise discipline on regulators—just as a public commitment to an inflation target, defined in terms of a specific statistical measure, can impose discipline on monetary policymakers. Market prices can disseminate information disclosed by banks, increasing the information set available to all. And

47. As Rochet observes, there has not been a great deal of work in this area. But see, for example, Haldane *et al.* (2004) and Goodhart, Sunirand, and Tsomocos (2004, 2006).
48. See Rochet (2005).

empirical work by my colleague Erlend Nier suggests that banks are less likely to suffer distress, the more they disclose.[49] The advantages appear to outweigh the disadvantages.

I would argue that this *is* relevant for the macro-prudential objective. Promoting disclosure to the market helps to address problems of imperfect information, improving *ex ante* incentives, and reducing contagion risk in the event of financial distress. But I would agree with Rochet that disclosure and market discipline do not provide a panacea. If externalities or other market imperfections remain, more information may simply make them more problematic in some circumstances. As editor of the Bank of England's *Financial Stability Review*, I am very conscious of the possible danger of triggering, by disseminating information and analysis, the very problems we are seeking to avoid. Unless financial stability authorities have means with which to address the underlying externalities, public information disclosure is not necessarily optimal; transparency is not as straightforward for them as it is for monetary policy authorities. Hyun Song Shin and my colleague Prasanna Gai have written about this conundrum.[50]

Finally, in Rochet's literature review, he considers the doctrine of lender of last resort (LLR). Is Bagehot out of date? Rochet's own work suggests not—there is still a role in periods of systemic stress for central bank emergency liquidity assistance. He notes the scope for private liquidity insurance arrangements in "normal" times, but we have seen some episodes in the past few years when banks became reluctant to roll over lines of credit in the face of uncertainty about the creditworthiness of individual lenders or about general liquidity conditions. So it seems to me that the empirical evidence backs up Rochet's defense of Bagehot.

The model that Rochet has presented at this conference suggests that, in some circumstances, the authorities will be inclined to support too many banks and that there will be overinvestment by banks in projects. It is interesting that banking crises associated with more LLR activity have actually tended to be more serious and lengthy.[51] This offers some support for Rochet's thesis. But it is very difficult empirically to sort out cause and effect here. It is not at all easy to assess the size of the shock leading to each banking crisis. So in practice, the degree of LLR activity may reflect the seriousness of the initial shocks.

The other point I wish to mention here is that there is some empirical evidence[52] that explicit and implicit government guarantees may reduce the beneficial impact of disclosure and market discipline—another form of the moral hazard which Rochet mentions.

III. Rochet's Model for Prudential Policy

Rochet then goes on to lay out a simple model for prudential policy, introducing, first, the principal-agent problem facing a deposit insurance fund (DIF); then, a

49. See Nier (2004).
50. See Gai and Shin (2003).
51. See Hoggarth, Reidhill, and Sinclair (2004).
52. See Baumann and Nier (2003).

systematic shock to banks that gives rise to a potential time-inconsistency problem for the policymaker.

Rochet derives a solution in which the capital adequacy ratio agreed by contract is a positive function of the benefit to managers of shirking and a negative function of the return to a successful project and of the probability of a loan repayment. Rochet shows that the optimal allocation of loans and deposits, taking the level of equity as given, can be implemented by a private arrangement between the DIF and banks.

Two aspects of this setup concern me. First, the assumption of risk neutrality. In practice, public authorities are likely to be concerned about the consequences of bad outcomes in cases where the law of large numbers does not apply; the social costs of extreme outcomes may be very high. Second, is there not a possible role for a subsidy if the externality from increasing the size of the banking system is positive? In other words, should not the DIF's budget constraint be loosened? The model focuses more on the principal-agent problem than on this externality, which may be just as relevant from the macro-prudential point of view.

Rochet then goes on to consider the implications of a common exposure of banks to macro shocks in this model. There is some probability of a systematic liquidity shock; if it crystallizes, some banks need a bigger cash injection than others if they are to survive and find whether the projects in which they invested pay off. If I understand the model correctly, this shock entails a real deadweight cost that does not reflect an information or coordination problem that could be addressed directly by a policymaker, thus eliminating the costs. Deadweight costs would still have to be paid in the first-best solution to the problem; the structure of incentives determines by whom. Another important aspect of the so-called macro shock is that it is not related to project returns or the continuation value of the bank—which seems odd to me if we are to think of this shock as reflecting macroeconomic developments.

Rochet then derives ranges for the exposure of a bank to this macro shock; these determine what ought to happen to banks in the optimal solution. The key results are, first, there is a need for an LLR; and second, there is a zone for the exposure parameter where, *ex post*, the regulator will be tempted to exercise forbearance but, in the optimal solution, should not. A private arrangement would not work, because some banks would not have enough collateral to be able to borrow enough from other banks; potential lenders realize that these banks would shirk if they knew they had to pay back the loans. But a public arrangement where the regulator could not stick to *ex ante* rules would result in too many banks being rescued. Knowing that, banks would overinvest in projects, and the costs to the authorities of a macro shock would increase.

The solution, Rochet suggests, is that banks with a large exposure to macro shocks should not get support from the DIF or liquidity assistance from the central bank; the fund should fully insure the central bank; and capital requirements and deposit insurance premiums should be set according to a sliding scale (with more exposed banks paying more) to rule out moral hazard. So insured banks would bear the expected cost of the macro shocks. High-risk banks pay a deposit insurance premium but do not get insurance against the "macro liquidity" shock.

I have some questions about this setup. First, again, is the budget constraint specified correctly to reach the social optimum, given that there is a positive externality associated with loans? Why does the public good element of loans not play a larger role? Second, is the characterization of a macro liquidity shock that is unrelated to a bank's continuation value and has nothing to do with the information structure of the model sufficiently representative of the real-world nature of systematic shocks? Third, how easy would it be for the DIF to identify *ex ante* the parameter of interest, the degree of exposure of a bank to the systematic liquidity shock? Is it not likely to change, depending on the specific source of the shock to the macroeconomy? Just to illustrate how tricky this can be, I looked at beta coefficients—as one crude measure of sensitivity to macro developments—for daily total equity returns for some British banks year by year to see how stable their rank ordering was. Not surprisingly, the betas changed over time, as illustrated in Figure 1.

So did the rank ordering, as illustrated in Figure 2. The change in HSBC's position from "most sensitive" in 2001 to "less sensitive" in 2002 is striking.

So I have some doubts about the practicality of the Rochet proposal. And I am not sure that the refusal to bail out big banks which failed would necessarily hold simply because the DIF could not afford it and had said in advance that it would not bail them out. Nevertheless, the proposal does suggest that further thought about variable capital adequacy ratios and deposit insurance premiums would be worthwhile.

Figure 1 Stability of Estimated Market Betas: HSBC

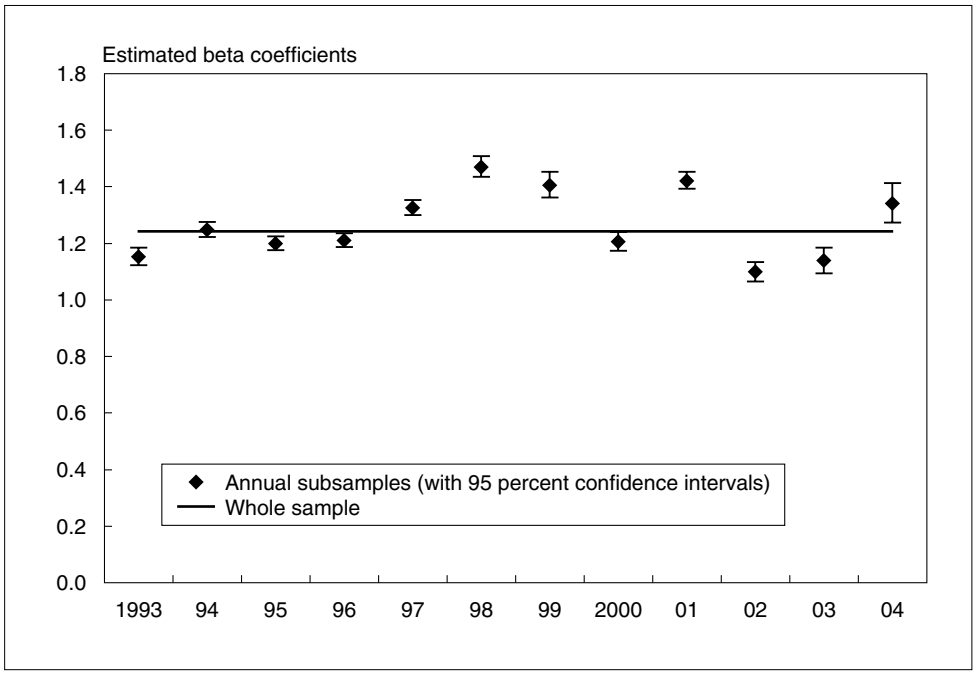
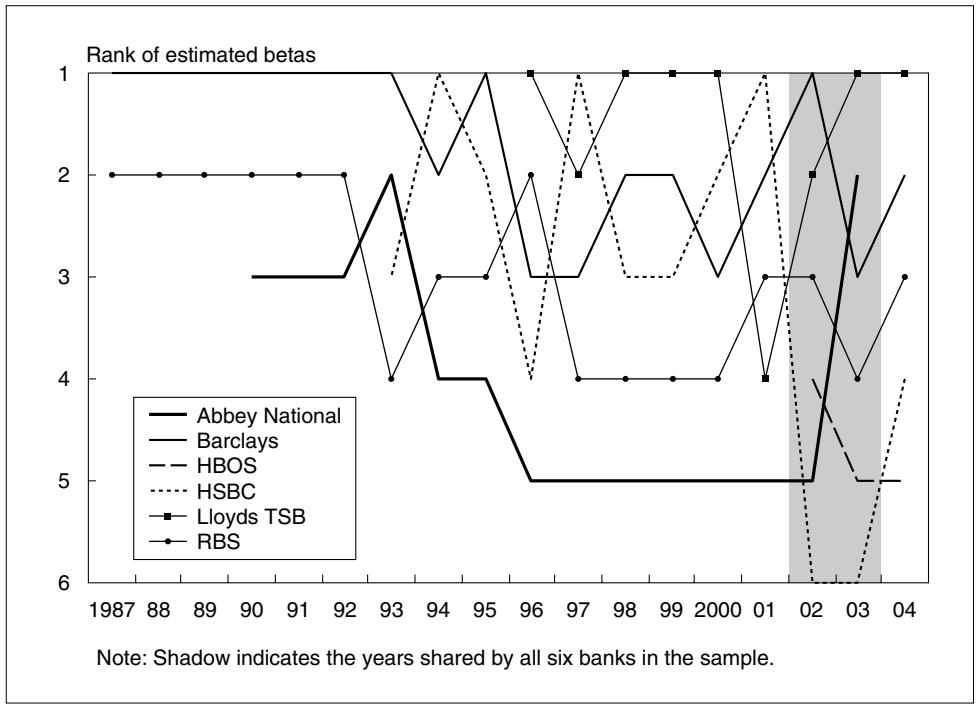


Figure 2 Ranking of Estimated Betas of Six British Banks



Note: Shadow indicates the years shared by all six banks in the sample.

IV. Conclusion

To sum up, Rochet is in favor of establishing independent and accountable banking supervisors. I think it would be well worth exploring further the parallels with the literature on the independent central bank and monetary policy.[53] In particular, what incentives do financial stability authorities actually face, and can they be improved? To answer that needs greater clarity about what market failures or externalities are being addressed.

Rochet's paper is a step in the right direction. I would also like to see more explicit modeling of multiple instruments and objectives in the macro-prudential arena. That could perhaps advance the debates on issues such as asset price bubbles and procyclical credit conditions. But let us not rush to experiment in the real world: we have the natural experiment of Basel II to analyze first!

53. Under U.K. arrangements, for example, the central bank's LLR function is likely to be exercised only with the agreement of the finance ministry. If there is any uncertainty about whether banks are insolvent or illiquid, the question about the terms under which finance ministry support is available is likely to arise. So the question of central bank independence, as with the question of transparency, is rather more difficult in the macro-prudential policy area than in the monetary policy area. See the discussion in Buiter (2005).

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Comment

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First of all, I would like to thank the Bank of Japan and the conference organizers for inviting me to this very interesting conference. It is an honor to be here and to comment on Jean-Charles Rochet's paper.

I find this paper to be a valuable and very interesting one. The paper has two parts. The first part offers a quite comprehensive review of the literature on capital adequacy and market discipline and the lender of last resort (LLR) policy. The second part presents a model of banking regulation. The basic model justifies a deposit insurance system and a capital adequacy requirement for the optimal organization of the banking sector. By including macroeconomic shocks, the model is extended to show that prudential regulation by a public authority leads to regulatory forbearance. But its absence results in too many closures in a recession, for example. The paper ends by suggesting a regulatory system.

As my comments are mainly concerned with the policy implications of the model, I will repeat the main points of the recommended regulatory system as follows. First, the supervisory authorities evaluate each bank's exposure to macroeconomic shocks. Second, banks with a small exposure are backed by a deposit insurance fund (DIF) and have access to the LLR facilities in the event of a macroeconomic shock. These banks face a capital adequacy requirement and a deposit insurance premium that increases with the size of exposure. And banks with large exposure to macroeconomic shocks do not have access to the deposit insurance and the LLR facilities and are subject to a higher capital ratio. Finally, the LLR activities of the central bank are independent from political interference.

In my view, the model makes a useful contribution to the theoretical literature on banking regulation. It provides a simple and yet insightful formalization of key elements of banking regulation, including deposit insurance, emergency liquidity support by the central bank, and capital requirements. The model is a static one. In my view, it would be more interesting and the results or policy recommendations would be more realistic if a multiperiod dynamic model were employed. In particular, as mentioned by the author, the ratio of a bank's macroeconomic exposure, a key parameter in the model, could be endogenized in a dynamic framework. Moreover, the assumption of full insurance of deposits by the DIF may not be realistic. I would like to hear the author's comments on whether and how the result would be affected by a relaxation of some of these restrictions.

However, my comments are mainly related to the policy implications of the framework based, in part, on Hong Kong's experience. Hong Kong has experienced some major macroeconomic shocks in the past decade, including the Asian financial crisis and the bursting of the property bubble in 1997–98. In addition, Hong Kong has a fixed exchange rate, with a link to the U.S. dollar. Therefore, we do not have an independent monetary policy that could be used to guard against fluctuations in macroeconomic conditions. So prudential regulation is an important part of our regulatory framework for ensuring financial and monetary stability.

I would like to make the following points about the policy recommendations. First, I am sympathetic to the point made by Alex Bowen about the practicality of assessing macroeconomic shocks. There are many types of macroeconomic shocks with different probabilities, and they change over time. Thus, there is an issue of how to define macroeconomic shocks and assess their developments over time. In particular, there is a risk of underestimating or overestimating the probability of certain macroeconomic scenarios. The assessed overall exposure of a bank to macro shocks *ex ante* may turn out to be substantially different *ex post*.

Take Hong Kong's case as an example. Defining banks' exposure to changes, say, in interest rates and asset prices, is not an easy job. About half of Hong Kong banks' lending is related to the property market, including both mortgage lending and lending to property developers. From the peak of 1997 to the trough of 2003, property prices in Hong Kong declined by more than 70 percent. Considering that Hong Kong has a fixed exchange rate and therefore we do not have an independent monetary policy, one would expect that such a sharp decline in property prices would have a large impact on the banking system. Indeed, banks' profitability was affected,

but there was no crisis and in fact most banks continued to record profits throughout this period despite the sharp decline in property prices and recession in 1998. Indeed, our analysis suggests that banks with relatively large exposure to the property market suffered less from the recession and bursting of the property bubble because, despite the decline in property prices, mortgage lending remained relatively safe for banks compared to other lending.

Thus, considering the difficulties in assessing exposure to macroeconomic shocks, controversies would arise if this assessed exposure were used to determine capital requirements and access to the emergency liquidity support by the central bank or the monetary authority. A particular problem would be how to determine the threshold at which to divide banks into two groups. Traditionally, it is argued that the LLR should lend to solvent but illiquid banks. But because it is difficult to distinguish between illiquid and insolvent banks, the LLR policies may generate problems of moral hazard. In this framework, the same concern arises, because it is difficult to define the exposure and determine the threshold above which no emergency liquidity support would be provided.

My second comment on policy implications relates to the coordination between the supervisory authority and the central bank. In the case of a bank that had been assessed to have shifted from a "low" exposure to "high" exposure, the cutoff of access to the LLR and deposit insurance would be a major shock and would risk triggering a depositor run on the bank. Because of this, there might be a tendency on the part of the supervisory authority to underestimate macroeconomic exposure or to set a very high threshold. This would raise a question about the effectiveness of the system in practice.

Related to this, I would like to offer some comments on the effective way to regulate or limit banks' exposure to macroeconomic shocks. Again, take Hong Kong as an example. I mentioned earlier the seemingly surprising resilience of Hong Kong banks to the sharp decline in property prices. There are a number of explanations for this. In my view, given the absence of independent monetary policy, prudential regulation has played an important role in guarding against asset price bubbles and their impact on the banking system. In the early 1990s, because of concern about the banks' exposure to the property market, the Hong Kong Monetary Authority (HKMA) introduced a prudential regulation that required banks to observe a 70 percent loan to value ratio. For the luxury end of the market, the maximum loan to value ratio was set at 60 percent. In 1994, the HKMA issued a guideline that required banks' aggregate exposure to the property market not to exceed 40 percent of the total loan portfolio. These regulations—particularly the cap on the loan to value ratio—limited the banks' vulnerability to the property price decline in the subsequent period.

My third comment is related to capital injection to banks by the central bank or a government, which is another form of support from the public sector to the banking system in addition to the liquidity assistance. Some banks, even though they have a large exposure to macroeconomic shocks and thus should be denied access to the LLR in this framework, may be too big to fail. Their collapse would pose risks to the stability of the banking system as a whole. In such a case, capital injection by the

government may be required if a shock threatens the stability of the system. Thus, it is not clear that denying access to the LLR would resolve the problem of moral hazard. Indeed, moral hazard is of more concern in relation to capital injection than to liquidity support. In principle, if the two can be separated, moral hazard created by liquidity assistance would be limited to possible mismanagement of liquidity risk. Capital support may raise the expectation that the bank is insured against mismanagement of virtually all types of risks.

My last comment relates to the form of liquidity support by the central bank to banks to deal with macroeconomic shocks. For some major macro shocks, the effective way for the central bank to provide liquidity support may be to do so to the markets rather than to individual banks. Again, take Hong Kong's case as an example. In the wake of the Asian financial crisis, outflows of capital from Hong Kong reflecting speculation about a devaluation of the Hong Kong dollar led to sharp rises in Hong Kong dollar interest rates and a fall in asset prices, particularly stock prices. And there were indeed so-called double plays in the market to take advantage of the currency board system. Therefore, the government took the decisive action in 1998 of intervening in the stock market. That is, the HKMA intervened by buying Hong Kong stocks to counter short selling by speculators. This kind of intervention, in my view, can be regarded as liquidity support to the market, and it turned out to be quite a successful operation.

In summary, the author's paper makes a useful contribution to the theoretical literature. However, to turn this into policy recommendations, as Section V of the paper attempts to do, would require a richer structure and a consideration of other aspects of banking regulation.

General Discussion

As a rejoinder to the discussants, Jean-Charles Rochet stressed that his model was a first attempt to deal with the macro-prudential issue and admitted that many additional aspects had to be introduced before it could be useful for policy purposes. In particular, he deliberately chose to rule out any public subsidies and risk premiums as a cost of liquidity during crises. Regarding the realism of his policy implications, Rochet stated that what he had in view was the situation where the authority constantly negotiated with a large and complex banking organization and imposed different capital requirements or different policy insurance premiums according to different exposures, which would vary over time. He claimed that the authority could implement the intervention gradually rather than brutally. Rochet insisted that he was not a skeptic about the benefits of market discipline, but he had the feeling that it might work in the wrong direction and that it should be complemented by public supervision when there was a crisis. Finally, Rochet noted that the "too-big-to-fail" issues were better managed *ex ante* than *ex post*.

In the general discussion, Jean-Philippe Cotis (Organisation for Economic Co-operation and Development) questioned the meaning of "exposure to macro shocks." Erdem Başçi (Central Bank of the Republic of Turkey) proposed that a ratio

of short-term assets to short-term liabilities be used as a measure of exposure to macro liquidity shocks. Reuven Glick (Federal Reserve Bank of San Francisco) insisted that solvency shocks should be distinguished from the liquidity shocks on which Rochet's model focused. Rochet responded that the distinction in his model was between diversifiable risk and nondiversifiable risk, or between idiosyncratic shocks and common shocks. Rochet remarked that he had assumed that liquidity shocks were common shocks simply to illustrate the specific role of the central bank in providing emergency liquidity assistance and not to distinguish them from solvency shocks.

George Pickering (Bank of Canada) expressed doubts about the necessity and feasibility of defining all the outcomes of a wide range of shocks that might hit the banking sector before any crisis. Shigenori Shiratsuka (Bank of Japan) also expressed doubts about the feasibility of *ex ante* separation of banks based on their exposure to macro shocks and suggested the possibility of an incentive-compatible self-selection mechanism, which induces individual banks to announce their exposure in advance. Rochet agreed with suggestions on using possible incentive mechanisms and stated that their introduction would depend on discussions between the banks and the financial supervisory authority, as had occurred for the Basel II framework.

Regarding the role of the central bank, Ulrich Kohli (Swiss National Bank) claimed that it was a political decision to bail out an insolvent bank and therefore central banks should stay out of that. Alex Bowen (Bank of England) pointed out that many central banks would not save securities firms that encountered troubles because they had very liquid assets and liabilities, which could support Rochet's model. Hiroshi Fujiki (Bank of Japan) remarked on a similarity between Rochet's model and Scott Freeman's models on payment systems, which highlighted the role of the central bank in a context with aggregate shocks.[54] Fujiki suggested an extension of Rochet's model to the case where there were two regulators in two economies and their shocks might be correlated with each other.

Based on Wensheng Peng's discussion, Francesco Giavazzi (Università Bocconi) pointed out that all banks hit by a macro liquidity shock in an open economy could have credit lines with foreign banks so that the liquidity problem could be solved without resorting to a lender of last resort function. Eli M. Remolona (Bank for International Settlements) pointed out the problem of procyclicality in the bailout policy suggested by Rochet—that is, if banks exposed to macro shocks tend to fail during a recession, refusing to bail them out might make things worse.

Eiji Hirano (Bank of Japan) pointed out that there should be a huge political disincentive for politicians to get involved in financial matters and a strong incentive for supervisors to delay actual and decisive solutions of financial difficulties even if they were independent of political pressure. Pickering pointed out that bankers seemed to be incompetent in some areas owing to financial-sector liberalization and there seemed to be accounting sleight-of-hand at an earlier stage of recent financial crises. Rochet responded that there would be a time-consistency problem even in a

54. See, for example, Bruce Champ and Scott Freeman, *Modeling Monetary Economies*, Cambridge: Cambridge University Press, 2001, Chapter 11.

democratic country with full transparency and even if the incompetence of bankers or supervisors were removed.

Kohli explained that Switzerland has no deposit insurance scheme for its banking sector, consisting of hundreds of small banks and two very large banks. Kohli insisted on "constructive clarity" in prudential policy: the bank must be solvent be systemically relevant, and be lent against good collateral. Wolfgang W. Fritsch (Deutsche Bundesbank) remarked that the policy of "constructive ambiguity" pursued by German supervisors did not appear to differ materially from the strategy adopted in Switzerland. Rochet responded that he was in favor of "constructive clarity" rather than "constructive ambiguity" but understood the need for flexibility in the sense that, in practice, the optimal threshold level of exposure to macro shocks in his model could not be set once and for all.