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Prudential Policy

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Abstract

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.

Keywords: Banking Supervision; Prudential Regulation; Financial Stability
JEL classification: G18, G21

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1- 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 of prudential regulation systems, consisting mainly of capital adequacy (and liquidity) requirements, and exit rules, establishing 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 spectacular banking crises. A good account of these crises can be found for example in Lindgren et al. (1996). Some economists (for example 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' behaviour.

Although the topic is still debated in the academic literature (see Bhattacharya and Thakor (1993), Freixas and Rochet (1995) and Santos (2000) for extended surveys), 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 in the sequel) that guarantee small deposits against the risk of failure of their bank. 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]

[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).

- 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. Like for other public goods, the total (declared) willingness to pay of individual banks (or more generally of investors) for financial stability is less that 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 (it amounts to a collective representation problem for depositors), macro-prudential policy has 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 wonder how these principles can be put into application and how banking regulation should be organized. I claim that there is a crucial need to re-examine 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 were there 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, financing public deficits, not to mention (in certain countries) more extreme forms of support like financing political campaigns or providing good jobs to the friends and families of politicians.

This traditional view of banking regulation was abandoned in the 1990s under the pressures of international competition, increased sophistication of financial markets and instruments, and also with the revelation in many countries of the intrinsic weakness of governments for preventing and resolving banking crises in a prompt and efficient way. The two crucial mottos in this period were:

- guaranteeing a "level playing field" for international competition (which essentially meant preventing governments from subsidizing domestic banks through implicit bail out commitments) and
- forcing supervisors to adopt "Prompt Corrective Action" (PCA) measures when a bank starts showing signs of financial distress.

[5] A similar time consistency problem used to exist for monetary policy, until independence was granted to the central banks of many countries.

The two main instruments developed for these purposes where the first Basel Accord (BCBS 1988) in G-10 countries and, in the USA, the Federal Deposit Insurance Corporation Improvement Act (FDICIA)[6] adopted in 1991. Even though these two reforms were basically successful (as illustrated by the spectacular increase in banks capital ratios in most developed countries between 1990 and today),[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 USA. 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.

This article 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 (2004), 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, who 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, like has been done for monetary authorities. I also suggest a differential regulatory treatment of banks according to the costs and benefits of a potential bail-out. 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 the access to emergency liquidity assistance by the central bank. By contrast, banks that have access to the lender of last resort either because they have a reasonable exposure to macro-shocks or because they are too big too fail should face a special regulatory treatment, with increased capital ratio and deposit insurance premium (or liquidity requirements).

The plan of the rest of this article is the following:

- In Section 2, we survey the academic literature on the impact of safety nets and market discipline on banks' behavior.

[6] The FDIC Improvement Act of 1991 requires that each US 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).

- In Section 3, we develop a simple model of moral hazard in banking (closely inspired of Holmström and Tirole 1997) that justifies the need for prudential regulation and/or market discipline.
- In Section 4 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 authoritites.
- Section 5 offers policy recommendations for reforming banking supervisory systems.
- Finally, Section 6 concludes.

2- A 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 being clear. On the one hand, the recourse to market discipline is rightly justified by common sense arguments about the increasing complexity of banking activities, and the impossibility for banking supervisors to monitor in detail these activities. 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 US banking regulation, following the FDIC Improvement Act of 1991). It is suggested that commercial banks should, under "normal circumstances", maintain economic capital way above the regulatory minimum and that supervisors could intervene if this 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 Lender of Last Resort.

2.1- Solvency Regulations

I will not discuss in detail the enormous literature on the first Basel Accord and its relation with the "credit crunch" (good discussions can be found in Thakor (1996), Jackson et al. (1999), Santos (2000)). Let us briefly mention that most of the theoretical literature (e.g.,

[10] The Basel Accord, elaborated in July 1988 by the Basel Committee on Banking Supervision (BCBS) required internationally active banks from the G10 countries to hold a minimum total capital equal to 8% of risk-adjusted assets. It was later amended to cover market risks. It has been revised by the BCBS, who has released for comment several proposals of amendment, commonly referred to as Basel II (Basel Committee, 1999, 2001, 2003).

Furlong and Keeley (1990), Kim and Santomero (1988), Koehn and Santomero (1980), Rochet (1992), Thakor (1996)) has focused on the distortion of banks' assets allocation that could be generated by the wedge between market assessment of asset risks and its regulatory counterpart in Basel I.

2.1.1- Regulatory Arbitrage

Following the implementation of the first Basel Accord, academic research has spend a lot of effort in 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 et al. (2000) argue in favor of reintroducing interest rate ceilings on deposits as a complementary instrument to capital requirements for mitigating moral hazard. By introducing these ceilings, the regulator increases the franchise value of the banks (even if there are not currently binding) which relaxes the moral hazard constraint. Similar ideas are put forward in Caminal and Matutes (2002).

2.1.2- 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 tried to relate these theoretical arguments to the spectacular (yet apparently transitory) substitution of commercial and industrial loans by investment in government securities in US banks in the early 1990s, shortly after the implementation of the Basel Accord and FDICIA.[11,12]

Hancock et al. (1995) study the dynamic response to shocks in the capital of US banks using a Vector Auto Regressive framework. They show that US banks seem to adjust their capital ratios must faster than they adjust their loans portfolios. Furfine (2001) extends this line of research by building a structural dynamic model of banks behavior, which is calibrated on data from a panel of large US banks on the period 1990-97. He suggests that the credit crunch cannot be explained by demand effects but rather by the raise 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

[11] Peek and Rosengren (1995) find that the increase in supervisory monitoring had also 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.

crunch, given that average risk weights on good quality commercial loans will decrease if Basel II is implemented.

2.1.3- 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 the banks who anticipate having difficulty meeting these capital requirements in the future.

Décamps et al. (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, in order to reduce a certain imbalance between pillar 1 and the two other pillars.

Merton (1977, 1978) is the first to use a diffusion model for studying the behavior of commercial banks. He computes the fair pricing of deposit insurance in a context where supervisors can perform costly audits. Fries et al. (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 has to trade-off between monitoring costs and costs of bankruptcy. Under certain circumstances, the regulator may want to let the bank continue even when equity-holders have decided to close it (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) so as to compare the efficiency of Basel Accords (1988) and 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 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 nor deposit insurance. Milne and Whalley (2001) develop a model where banks can

issue subsidized deposits without limit in order to finance their liquidity needs. The social cost of these subsidies is limited by the threat of regulatory closure. Milne and Whalley study the articulation 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, Pagès and Santos show that supervisory authorities should inflict higher penalties on the banks who do not comply with solvency regulations, but should also reduce the frequency of regulatory audits.

2.2- Market Discipline vs Regulatory Intervention

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

- **Direct** market discipline, which aims at inducing market investors to **influence**[13] the behaviour 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, objective, information that can be used by supervisors for improving their control on 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**, i.e. forcing bank managers to disclose publicly various types of information that can be used by market participants for a better assessment of 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.

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

2.2.1- 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, increases market values and increases the usefulness of accounting data. However, as argued by D'Avolio et al. (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 occasions will even tend to propagate misleading information. This means that disclosure of accurate information has to be imposed by regulators. A good example of such regulations are the disclosure requirements imposed in the US by the SEC (and in other countries by the agencies regulating security 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 can't these authorities disclose the information themselves,[15] or even publish their regulatory ratings (BOPEC, CAMELS and the like)? There are basically two reasons for this:

- 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 we explain 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 was disclosed by the supervisors themselves.

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

[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 that 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.

2.2.2- Changing the Liability Structure of Banks

The economic idea behind **direct market discipline** is that, by changing the liability structure of banks (for example 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 possibility 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 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 et al. (2004) and Rochet (2004a) modify this model by endogeneizing the bank's 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 US 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 US Savings and Loans 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 possibility 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

[16] The "subordinated debt proposal" is discussed for example in Calomiris (1998), (1999), Evanoff (1993), Evanoff and Wall (2000), Gorton and Santomero (1999) 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 the some incentives as shareholders to take too much risk.

[18] A recent article by Covitz et al. (2003) partially challenges this view. However, Covitz et al. (2003) focus exclusively on funding decisions. More specifically they find that in the US, 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.

any piece of 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 ask). 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, i.e. exactly **preventing** depositors and private investors to interfere with the closure mechanism.

2.2.3- 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, i.e. 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 et al. (2000) and De Young et al. (2001). The main stylized facts are:

- 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 USA this is only true since explicit too-big-to fail policies were abandoned (that is after 1985-1986). This shows that market discipline can work only if regulatory forbearance is not anticipated by private investors.
- However as shown by Covitz et al. (2003) bond and subdebt yields can also reflect other things than bank risk. In particular, liquidity premia are likely to play an important role.

[19] See for example De Young et al. (2001) Evanoff and Wall (2001), (2002), (2003), Flannery (1998), Flannery and Sorescu (1996), Gropp et al. (2002), Hancock and Kwast (2001), Jagtiani et al. (2000), and Pettway and Sinkey (1980).

[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 et al. (2000) obtain similar conclusions by testing causality relations between changes in supervisory ratings and in stock prices.

In any case, even if there seems to be a consensus that complementing the information set of banking supervisors by market information is useful, it seems difficult to justify, on the basis of existing evidence, mandating all banks to 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 bevery 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 data sets containing a vast majority of well capitalized banks. Remember that the problem at stake is the dynamic behaviour 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 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, like those of "zombie" Saving and Loans in the US 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 at stake?

In fact, the crucial aspect about 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 investors, depositors, managers, shareholders or employees of a bank in trouble) can check that supervisors have done their job, that is 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 has to be triggered by well specified market events.

[22] The argument that subordinated debt has the same profile as (uninsured) deposits and can thus be used to replace foregone 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 have problems, but like equity when the bank comes closer to the failure region.

2.2.4- 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 all banks to regularly issue of a certain type of subordinated debt would not generate a lot of 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 the new Basel accord, the Basel Committee should concentrate on this difficult issue, crucial to creating a level playing field for international banking.

There is also clearly a lot more to be done, both by academic and regulators, if one really wants to understand the interactions between banking supervision and market discipline. In particular, very little attention has been drawn[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 is then 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 sub-debt 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.

2.3- The Lender of Last Resort (LLR)

2.3.1- The Doctrine and the Facts

The concept of LLR was elaborated in the nineteenth 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 was clearly effective: traditional banking panics were eliminated with the LLR facility and deposit insurance by the end of the nineteenth century in Europe, after the crisis of the 1930s in the United States and, by now, also mostly in emerging economies, which have suffered numerous crises until today.[25] Modern liquidity crises associated with securitized money or capital markets have also required the intervention of the LLR. Indeed, the Federal Reserve 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 LTCM (in the latter case a "lifeboat" was arranged by the New York Fed). For example, in October 1987 the Federal Reserve supplied liquidity to banks through the discount window.[26]

2.3.2- 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 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.

2.3.3- The Modern View

Rochet and Vives (2004) provide a theoretical foundation for Bagehot's 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

[25] See Gorton (1988) for U.S. evidence and Lindgren, Garcia, ans Saal (1996) for evidence on other IMF member countries.

[26] See Folkerts-Landau and Garder (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 (2005) show that, in some cases, moral hazard can be reduced by the **presence** of LLR.

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 a too large proportion of wholesale deposits are not renewed. Freixas et al. (2004) formalize two common criticisms to 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 a LOLR but only during crisis periods, when market spreads are too high. In "normal" times liquidity provision by interbank markets is sufficient.

3- 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 2 dates $(t = 0,1)$ inspired of Holmström and Tirole[28] (1997), where banks are modeled as delegated monitors à la 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 Deposit Insurance Fund (DIF). We also neglect conflicts of interest inside the bank, i.e. 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 don't 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:

[28] Homström and Tirole 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 assets structure) roughly proportional to the size (assets 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.

- First we assume that $L > E$, which implies that some fraction of bank loans are 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 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.

[FIGURE 1 ABOUT HERE]

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 $R > \frac{B}{\Delta p}$.

Assumption 2: $p\left(R - \frac{B}{\Delta p}\right) < 1$

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

The optimal contract (L^*, D^*) maximizes expected social surplus under two constraints: The DIF has to 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:

[32] There may also be a private continuation value, associated to the banker's non transferable knowledge of borrowers (relationship banking as in Sharpe 1990, or Degryse and Van Cayseele, 2000). We don't 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:

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

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:*

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

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

$$S = p\left[RL - D\right]$$

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 $L \leq \frac{E}{k}$, shareholders will select the maximum possible volume of loans $L = \frac{E}{k}$. By choosing in turn the appropriate level for the capital ratio, i.e.

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

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 $\frac{E}{k}$. The difference between private and public arrangements only appears if macro shocks are introduced. This is what we do in Section 4.

4- 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 lot 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 US 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 et al. (2000)) has examined the possible mechanisms of contagion, i.e. 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, like recessions, asset markets crashes

and the like. We introduce these macro shocks by assuming, as in Holmström and Tirole[34] (1998), that at an interim date $(t = 1/2)$, each bank[35] suffers with some probability q from a liquidity shock: continuation can only occur if an additional amount of cash ρL is injected in the bank. We interpret this shock as resulting from a non diversifiable event, like 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 by the Figure 2.

[FIGURE 2 ABOUT HERE]

Confronted with the possibility of such macro-shocks, the regulators have now to 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 = ½ 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 view point and solve for the (ex ante) optimal contract without specifying the way in which it is implemented (this is done in the next section).

[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 non-financial 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.

[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* = ½ is zero.

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:

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

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,
- 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* = ½.

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 $x(\cdot)$ and $L(\cdot)$ 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* $\rho \le \rho^* = \dfrac{1}{1-q}$ *(small exposure to macro shocks) are rescued in case of a crisis, but they are subject to a higher capital ratio*

[38] This generalizes the constant *v* introduced in Section 3 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 $t = 1/2$.

(than in the absence of macro shocks). This capital ratio increases with their exposure ρ to macro-shocks:

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

- *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:*

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

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 Lender of Last Resort facility and which don't. Proposition 2 then makes two points:

- This distinction[39] should be make explicit ex-ante by banking authorities, based on assessments for the (ex-ante) social costs and benefits of a potential bail-out in case of a crisis.
- Banks that are eligible to the Lender of Last Resort facility should face a special regulatory treatment, with increased capital ratio and deposit insurance premium (or liquidity requirement).

Proof of Proposition 2: Given that there is a separate budget constraint for each ρ (condition (4)), we can solve for $L(\rho)$ and maximize w.r.t. 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:

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

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

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

For a given ρ, this expression is monotonic in *x*: increasing if $\rho < \frac{1}{1-q}$, decreasing if $\rho > \frac{1}{1-q}$. Thus the optimal regulatory contract involves:

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

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

Proposition 2 adopts a normative view-point, i.e. it characterizes the optimal closure rule for banks in the presence of macroeconomic shocks. We now adopt a positive view-point 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 hand.

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* $\rho \le \rho_0 = p\left(R-\frac{B}{\Delta p}\right) < \rho^*$.

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 CDs). The maximum amount of cash that can be raised in the way is equal to the collateral value of the bank's assets, i.e. the maximal expected payment that can be obtained from bankers while preserving incentive compatibility, i.e.:

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

Assumption A2 states that $\rho_0 < 1$, which implies that $\rho_0 < \rho^* = \frac{1}{1-q}$. 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 a Lender of Last Resort: 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 $\rho^* = \frac{1}{1-q}$ 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 let also all the banks such that $\rho \in]\rho^*, \rho_1[$ continue. Not only this implies 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 imposing on these banks a flat capital ratio:*[40]

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

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

Proof of Proposition 4: 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 $\left(R - \frac{B}{\Delta p}\right)L = D$ in case of success. From the DIF point of view the cost of deposit insurance becomes:

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

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

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 $\rho > \rho_0 = p\left(R - \frac{B}{\Delta p}\right)$. Thus there is overinvestment. Finally, notice that from an ex-ante view point, 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 its lack of commitment power by an increase of capital ratios. ■

We see this as the fundamental problem faced by prudential supervision: public intervention is needed[41] in order 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 (SBC) phenomenon.[42]

This problem is summarized by the diagram Figure 3.

[FIGURE 3 ABOUT HERE]

We discuss in Section 5 a possible organization of banking supervision that could solve this problem.

5- Policy Recommendations for Prudential Policy

This section offers some reflections on the ways in which the optimal contract characterized in Section 4 can be implemented by an adequate design of the supervisory-regulatory system. As we saw in Section 4, two crucial elements are needed:

[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 that underlies the SBC in Dewatripont and Maskin (1995) is different.

- Intervention of the central bank as a lender of last resort for providing 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 point of view) but bailing them out 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, like has been done for monetary policy. To ensure accountability of the central bank in its functions of a lender of last resort, a precise agenda has to 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 a lender of last resort) would be backed by the DIF. In other words, those loans would be insured by the DIF: the central bank would be completely protected against credit risk and no tax payer 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 bail-out in case of a systemic shock. This assessment determines the treatment of the bank by regulators.*
- *Banks for which ex-ante social benefits of bail-out 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 bail out costs exceeds social benefits are not backed by the DIF: they don't receive liquidity assistance by the Central Bank.*
- *The lender of last resort 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 can be summarized by the diagram Figure 4.

[FIGURE 4 ABOUT HERE]

6- 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, who are likely to exert pressure for bailing out insolvent banks and delay crisis resolution.

The remedy to political pressure on banks' supervisors is probably not to substitute supervision by market discipline. This is because market discipline can only be effective if 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, like has been done for monetary policy. However, this independence is probably more difficult to implement, given the difficulty to define explicit, quantitative, objectives for lender of last resort interventions. Another difficulty is the need to coordinate lender of last resort 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, who then would face a special regulatory treatment. Finally, central bank loans should be senior to wholesale deposits, in order to protect taxpayers' money and also to provide adequate incentives to banks' supervisors.

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Figure 1: The time line of the model.

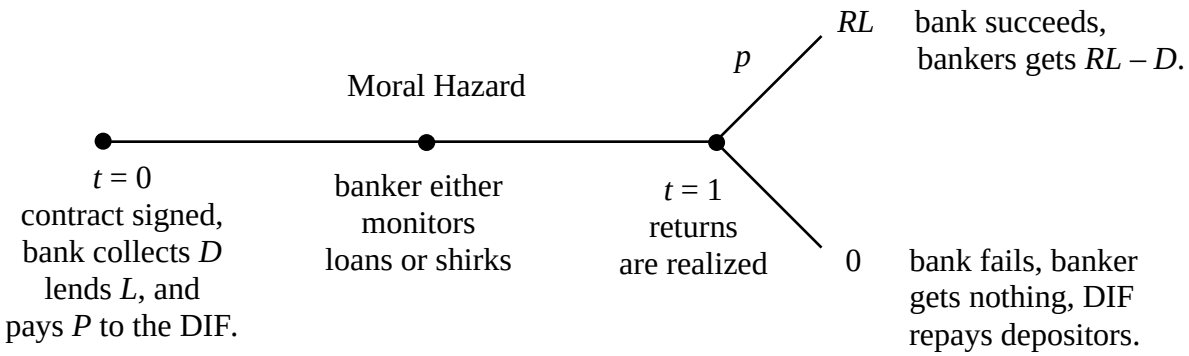


Figure 2: The time line in the presence of macro-shocks.

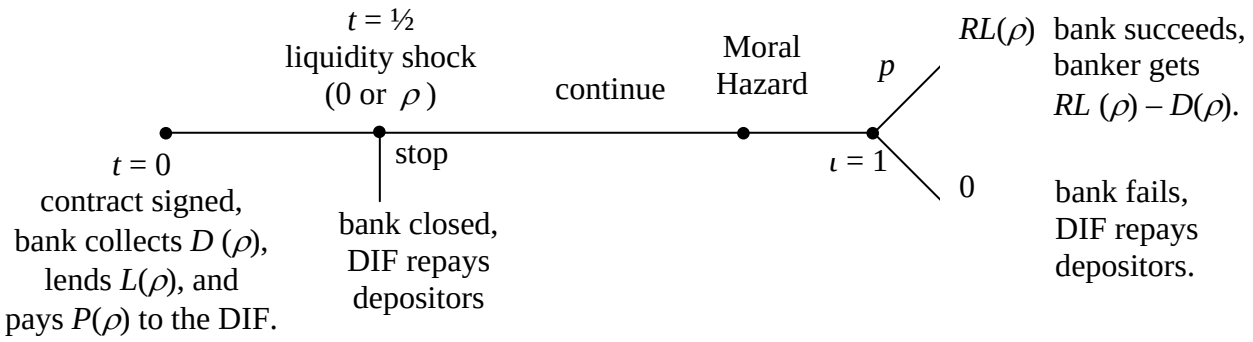
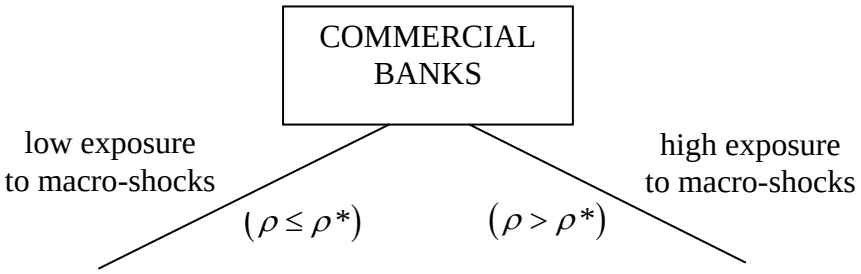


Figure 3: The fundamental problem faced by prudential supervision.

Figure 4: The optimal management of systemic crises.



- Have access to Emergency Liquidity Assistance by the Central Bank.
- Pay a deposit insurance premium that increases with ρ:

$$P(\rho) = D\left(1 - p + pq\frac{\rho}{\rho_0}\right).$$

- Are subject to a capital requirement that increases with ρ:

$$k_1(\rho) = 1 - \rho_0 + q\rho\,.$$

Have no access to Emergency Liquidity Assitance by the Central Bank.

- Pay a flat deposit insurance

$$P_0 = D(1 - p + pq)\,.$$

- Are subject to a flat capital requirement

$$k_0 = 1 - (1 - q)\rho_0\,.$$