



# **Regulation and Banking Stability: A Survey of Empirical Studies<sup>1</sup>**

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<sup>1</sup> I thank Rui Castro, René Garcia, three anonymous referees for helpful suggestions. This paper is based on Chapter 1 of my Ph.D thesis at Université de Montréal

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# Regulation and Banking Stability: A Survey of Empirical Studies\*

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## Abstract

This paper brings together and adds structure to the empirical literature on the link between banking regulation and banking system stability. In addition to clarifying the theoretical underpinnings for studying banking regulation, it points to several directions for future empirical research, necessary to fill the gaps in our understanding of the link between banking regulation and stability. The paper starts with a review of the literature on the design of banking regulation and its link with stability, followed by an assessment of the most common methodologies used in this literature. The paper then reviews the empirical literature of various banking regulations. This is followed by a proposal on the new directions for research of the link between banking regulation and banking system stability.

*Keywords:* Banking Stability, Banking Regulation.

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# 1 Introduction

Banking is one of the most regulated and monitored industries in the world. In fact, there exists no less than eight types of banking regulation.<sup>1</sup> Two main reasons have been pointed out to explain why this is the case. Firstly, is the perception of banks as fragile institutions that need the help of government to evolve in a sound and safe environment; and secondly, banking instability is costly to the entire economy as a result of the key role banks play in financial intermediation by providing liquidity insurance, monitoring services, and providing economic and financial information.

However, this has not always been the case (see, e.g., Allen and Herring (2001)). At the beginning, the banking industry was unregulated. It is only in the nineteenth century that governments and Central Banks started to worry about financial instability and one of their role increasingly came to be to eliminate crises. Moreover, the experience of bank panics during the Great Depression had a profound effect on bank regulation in the US and in almost all countries in the world. As a result banks became heavily regulated in every country. Furthermore, in some countries the government intervened directly in the financial system to allocate resources. Interest rates were strictly controlled and systemic risk was avoided. Financial stabilization became the main objective of banking regulation.

The costs of banking crises were perceived to be so high that they had to be avoided at all costs. Even though intensive regulations were able to eliminate systemic risk associated with banks in the post war period, over time it became increasingly less obvious that heavily regulated banking were optimal. This led to a worldwide wave of financial liberalization. Unfortunately, it also led to the return of financial crises. As a by-product it induced a new generation of regulations.

Since the re-introduction of financial liberalization in the 1980s, new types of regulation have emerged: the most important being the Basel Accords with its capital adequacy requirement and its supervision practices, the decline of the level of the reserve requirement, the adoption or the redesign of deposits insurance, and the emergence of banking examination and supervision in a great number of economies. This new regulatory framework has been praised for the international convergence of banks' risk management standards and for the improvement of these standards in many economies. Their design and implementation have been blamed for increasing several market failures in the banking industry and recently to be unable to avoid or at least to mitigate the effect of the ongoing subprime banking crisis. For example Brimmer (1992) argued that:

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<sup>1</sup>see, e.g., Mishkin (2000), Barth, Caprio, and Levine (2004), and Allen and Herring (2001)

*“Contrary to expectations,(...) the banking bill which became law in December 1991, will most likely undermine the stability and the efficiency of the banking system in coming years. In the mistaken belief that it was helping to enhance the “safety and soundness” of individual banks—and simultaneously protecting Federal insurance funds—Congress actually established an inflexible regulatory regime which will cut back on the scope of the financial activities in which banks can engage, increase the level and costs of capital requirements, make the money market less efficient, and involve regulators much more extensively in the internal affairs of banking institutions.”*

Existing banking regulations can be regrouped into three broad categories: regulatory measures affecting the bank’s balance sheet (e.g., capital adequacy requirements, reserve requirements, and asset holding restrictions), regulatory measures affecting the structure of the banking system (separation of banking and other financial industries like securities, insurance, or real estate (e.g., the Glass-Steagall act of 1933), and restrictions on competition), and regulatory measures for banks’ owners’ and managers’ behavior (risk-based deposit insurance premiums, disclosure requirements, bank chartering, and bank examination).

Despite the recent progress in the research on banking fragility and the growing public interest in banking regulation due to the ongoing subprime banking crisis, there is still no consensus on how best to design and implement banking regulation in this new context of free-banking. According to Santos (2001), this is the result of our lack of understanding of the mechanisms between banking regulation and market failure, and also the interaction of these regulations among them. It is also a consequence of our limited understanding of the implications of those regulations in a general equilibrium framework.

Notwithstanding of these limitations, the research already undertaken has produced some important results, specifically on the link between the type of banking regulation and banking system stability. This paper contributes to this literature by bringing together and adding structure to the contemporary theoretical and empirical literature.

The remainder of the paper is organized as follows. Section 2 presents a theoretical review of the link between regulation and banking stability. Section 3 reviews the design of banking regulations. Section 4 assesses the existing methodologies used in the empirical literature. Section 5 reviews the empirical literature of various types of banking regulation. Section 6 presents a proposal for new directions of research on the link between banking regulation and banking system stability, and concludes.

Before proceeding, we should mention several important topics closely related to banking regulation that our article does not deal with, as well as some of the references to these

topics. Specifically, our study does not deal with the link between regulation, banking profitability, and/or financial development (see, e.g., Bath, Caprio, and Levine (2004)). It also does not deal with the link between regulation and bank governance (see, e.g., Beck, Demirgüç-Kunt, and Levine (2006b)). The last preliminary point is on the selection of countries that we talk about. Most of the available empirical evidence comes from the United States and the group of ten member countries of the Basel committee. One reason for this is the fact that data are generally more easily available for these economies than for others, and another is that a great number of economic researchers is located in these countries.

## **2 Reviewing the Link Between Regulations and Banks' Stability**

We have argued that one of the key rationales for banking regulation is the prevention of banking crises. Hence, we start our paper with an effective review of the sources of banking instability, and the channels through which regulations can prevent it.

### **2.1 Sources of Banking Instability**

Let us start by making a difference between a numbers of definitions. We will refer to bank's failure as the failure of one bank, and banking crisis or systemic banking crisis as a failure of an important number of banks in a given banking system. Banking system fragility refers to the presence of banking crisis in the banking system.

To fully understand banking stability we need to understand how a banking crisis occurs. In the literature they are many definitions of banking crisis:

(1) According to Schwartz (1985), Miron (1986) and Wolfson (1986), a banking crisis is a demand for reserve money so intense that the demand could not be satisfied for all parties simultaneously in the short run. For these economists a banking crisis is mainly characterized by a liquidity crisis in the banking system.<sup>2</sup>

(2) According to Guttentag and Herring (1984) and Manikow (1986), a banking crisis is a condition in which borrowers who in other situations were able to borrow without difficulty become unable to borrow on any terms. Therefore, for these authors a banking crisis is only characterized by a credit crunch crisis.<sup>3</sup>

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<sup>2</sup>Let us remind that a liquidity crisis is a situation where the demand of liquidity is higher than the supply of liquidity by the bank.

<sup>3</sup>The Council of Economic Advisors (1991) defines a credit crunch as "a situation in which the supply of credit is restricted below the range usually identified with prevailing market interest rates and the profitability of investment projects".

(3) According to Fisher (1933), Flood and Garber (1981) and Minsky (1982), a banking crisis is a forced sale of assets because liability structures are out of line with market-determined asset values, causing further decline in asset values—the bursting of a price “bubble,”; in other world a banking crisis starts with a liquidity problem which lead to a solvency crisis.<sup>4</sup>

(4) Finally according to the Federal Reserve Bank of San Francisco (1985), a banking crisis is a sharp reduction in the value of banks’ assets, resulting in the apparent or real insolvency of many banks and accompanied by some bank collapses and possibly some runs.

This last definition is more compelling in the sense that it combines at least two main characterizations of bank’s failures given by the other authors i.e., nsolvency and liquidity problems and also it provides a sequence of events.

Our definition of banking crisis is more closed to this and it is the following. A banking crisis is a sharp reduction in the value of banks’ assets as well as banks’ deposits, resulting either from an apparent or real insolvency of many banks or from an apparent or real liquidity problem in many banks and accompanied by some bank collapses and a possibly credit crunch crisis.

To know the reasons of the occurence of banking crises, one needs to understand the sources of liquidity as well as insolvency problems, then how it can move from one banks to others. How it can generate banks collapse, banks panic and also credit crunch.

We will start by the sources and reasons for a banking crisis characterized by a liquidity problem. In the literature many reasons has been used to explain why this can be the case. Those reasons move from mismanagement of banks by managers to hysteria.

A bank run can be initiated by a sudden rush of withdrawals. This sudden rush can be generated by a coordination failure among the bank’s depositors as well as other type of failures. In fact, banks are characterized by balance sheets where banks’ liabilities (deposits) are generally short-term, while their assets are long-term and illiquid.

In the literature the following reasons have been given as the trigger of bank runs:

(1) An arbitrary shift in expectations generally called sunspot (see, e.g., Diamond and Dybvig (1983)).

(2) A shift in expectations due to the release of "bad news" (see, e.g., Morris and Shin (1998, 2000), Goldstein and Pauzner (2000), Chari and Jagannathan (1988)).

(3) A productivity shock can trigger a bank run (e.g., Diamond and Rajan (2001a, 2001b), and Chen (1999)).

(4) A high level of unexpected non-performing loans in a bank. When this information

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<sup>4</sup>An insolvency problem is a situation where the value of assets are less than the value of the liabilities.

is known by the depositors, they rush to the bank to get back their deposits before the other depositors. If markets for liquidity are inefficient because of market power or information asymmetries, the bank is forced to sell its long-term assets below their fair value, (see, e.g., Allen and Gale (1998), Bernanke and Gertler (1989, 1990), Donaldson (1992), and Kiyotaki and Moore (1997) and Chari and Jagannathan (1988)).

But even if coordination failure and the other above failures can cause the failure of a bank, we need a linkage between banks in the form of information spillovers or credit exposures to turn a bank run into a systemic banking crisis, (see, e.g., Allen and Gale (2000a); Freixas, Parigi, and Rochet (2000)). i.e., the inter-bank lending structure can lead to contagion in the banking system and turn a bank failure into a systemic crisis.

Another characterization of banking crisis is the solvency crisis. A solvency crisis can be initiated by a high level of non-performing loans in a bank. This can be generated by liquidity problems in the context of asset price decline, (see, e.g., Allen and Gale (1998), Bernanke and Gertler (1989, 1990), Donaldson (1992), and Kiyotaki and Moore (1997) and Chari and Jagannathan (1988)). It can also be driven by a great depreciation or devaluation of the domestic currency; this has been the case for many emerging countries in Latin America and in East Asia crises (see, e.g., Sundararajan and Baliño (1991)). Finally a solvency crisis can also be generated by the losses in balance sheet as well as in off-balance sheet positions arising from movements in stock market prices. This risk has been proven important by the ongoing subprime banking crisis. In fact, many banks found themselves undercapitalized due to the drop of their share's price on the stock market, the value of their equity drop sharply and given that at least one third of their capital is in the form of equity, they were forced to find additional money to meet regulatory requirement. Also many banks hold securities of publicly trading companies, when the value of these securities drop, the bank realizes a loss.

The credit crunch is one of the characterizations of banking systemic crisis given by some authors. Under this type of crisis, banks refuse to lend to each others as well as to entrepreneurs and consumers. It is then not a failure of one bank but the failure of the entire banking system or at least an important share of the banking sector. There are still controversies about the credit crunch as a source or a consequence of banking crisis. For many authors credit crunch is a consequence of weakness in the banking sector. A credit crunch arises when actors in the financial market lost confidence on the quality of assets due for instance on the fact that their previous assessment was very optimistic and they have realized important losses. It may also be a consequence of new regulations.

## 2.2 Solution for Banking Failure: Market versus Government

Banking crises are very costly. The typical cost in term of GDP loses is more than 20 percent for developing countries (see, e.g. Caprio et al. (2003)). Banking crisis creates a lot of distress. Therefore, there is a huge need to find ways to reduce the likelihood of its appearance, to reduce its duration and to mitigate its devastating effect on the economy when it is ongoing.

There are many solutions that have been proposed, but the efficiency of these solutions is often a topic of controversy. One way to present this is to regroup the methods proposed, based on who is in charge of developing and implementing the solutions: The government (regulator) or the market. If there is no market failure there is no need of government intervention through regulation. In fact, it is plausible that regulations by hampering the well functioning of the financial markets are part of the causes of the banking crisis. If there is a market failure then there is a need for the government to adopt legislations to tackle it, but even in this case, is it necessary to the government to implement these legislations by itself?

The following market failures have been used by some to justify the need for banking regulations: (i) depositors are generally uninformed and are not enough sophisticated to monitor banks; (ii) the presence of asymmetry of the information between depositors and banks' owners and/or manager's; (iii) the presence of market power, (iv) the importance of externalities.

Since the failure of any bank is awful to its depositors which are generally uninformed and not enough sophisticated to monitor their bank (to see if they are good enough before investing in), see, e.g., Dewatripont and Tirole (1994)), the government should intervene upfront by putting in place laws which can reduce the likelihood of banking failures.<sup>5</sup> Another argument for intervention in order to maintain any bank in business is the asymmetry of information typically present in the banking system, even if depositors form a union, it will not be easy for them to obtain all the information that they need in order to make optimal decision as the bank may have superior information. One solution for this is to build regulations allowing for banks supervision and forcing banks to disclose all the necessary informations needed to make a complete assessment of the risk and the return of each type of asset.

But proponents of free-banking will argue that market can make this work better than the supervisors. For them market discipline can force banks to reveal all the information

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<sup>5</sup>Depositors are small enough and also their identities are not fully available; free-riding will be the dominant strategy for many of them. This rendered the possibility of depositors' unions unlikely.



needed. In fact, banks who will release more information will be able to attract more depositors, and therefore all banks would release the maximum amount of information in order to attract a great number of depositors. Thus the equilibrium in the free banking will be formed with banks that provide the optimal level of information needed by depositors to make their decision. The problem with this is that generally the banking sector in many countries even when the markets have been liberalized does not exhibit the feature of full competition. In fact, banks may tend to act as an oligopoly, they implicitly agree on the level of information they want to make available to the depositors, therefore market power can mitigate market discipline.

Another problem with the market discipline argument is that bank's managers are not the owner of the capital of banks; they are not also the owner of the deposits that they use to provide loans with. The structure of their remuneration allows them to take excessive amount of money at the end of the years in form of bonuses if the return of their investment is high. If the return is low or even negative they have no negative compensation on the gain that they have realized in the previous years (see, e.g., White (2008)). This gives to banks' managers an incentive to invest more in assets which yield very high short-run return but with a higher probability of default. In this environment the manager worried only about the return in the short-run without thinking about the return in the long-run since it will endure no cost or very little cost at that time.<sup>6</sup>

A question of interest here is: Why did owners of the banks have adopted this structure of compensation? In the case of US one can argue that CEOs and members of top-management form a small club of people, therefore they can implicitly agree on the term of their appointment given no choice to the owners.<sup>7</sup> However, it is not only the top-management who has this remuneration structure, traders and analysts have enjoy it too. This drives us to argue that owners provide this type of structure because they too want to make money quickly hoping to sell their share as soon as the bank is in trouble. Therefore, the fact of banks being publicly trade companies make them vulnerable to speculative investors who ask for higher return in order to invest in banks. Another reason for this owners' behaviour can be that they do not incur all the burden of a bankruptcy. In fact, in case of systemic banking crisis, they expect a bailout, based on the argument that governments don't want to see a credit crunch developed in the banking system. Owners always end up paying only a small share of their debt, there is then a truncation of the owners' return distribution curve given then a big incentive for owners to take too much risks.

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<sup>6</sup>John, Saunders, and Senbet (2000) have argued that there is an optimal top-management compensation structure which can drive banks to not take excessive risks.

<sup>7</sup>This is only a lose answer since owners can find managers out from the club.

In Basel II Accord, a great emphasis has been given to market discipline by asking banks to publicly disclose some key information. This is an implicit acceptance of the fact that the information will not be publicly disclosure without regulation, the regulator need to force banks to do so. In our view and in light of the ongoing subprime banking crisis, market discipline is not enough to insure stability in the banking sector. We then explore below regulations useful in stopping banking crisis. Let us then provide the best regulations for each type of banking crises.

### **2.3 Best Regulations by Type of Banking Crisis**

As seen above a banking crisis can be characterized by: (i) a liquidity problem, (ii) a solvency problem, and (iii) a credit crunch.

#### **2.3.1 Regulations for crises due to liquidity problems:**

A banks failure due to liquidity problem and materialized by a bank run can be prevented by many techniques. The first one is the establishment of complete explicit deposit insurance. In this case depositors know for sure that their money is safe, therefore even if their bank is experiencing a liquidity problem, depositors with no need of money in the short-run will no rush to ask for their deposits, this will be helpful for the bank as it can resolve its liquidity problem without liquidating a substantial part of it assets at a lost.

A second idea is the suspension of withdrawal by the bank, this allow the bank to find liquidity and to sell some of its asset at a better price without liquidating it at a silly price, the problem with this solution is that after the suspension's period, depositors will lose faith in the bank and therefore they will ask their money anyway. So even if the theoretical argument of Chari and Jagannathan (1988) shows that this is welfare improving, it will not succeed to stop a liquidity problem to turn into a bank run.

A third idea is the scrutiny of withdrawal to provide money only to those who need money; this is for sure a better solution than the suspension of withdrawal alone, but the point is that it is practically impossible to do this.

A suspension of withdrawal to allow banks to find liquidity and liquidate at a good price some of its assets couple with the scrutinizing of withdrawal will do a better job to stop a bank failure due to liquidity problem and stop a bank run. The problem with this last solution is it applicability.

Furthermore, Allen and Gale (1998) questioned the usefulness of the first arrives first serve contract between banks and depositors. If this is a good policy during normal time, it is questionable in crisis time. To avoid costly liquidation which is actually the most

important cost of banking crisis according to them, a different type of contract is required. They advocated during crisis time that banks can state that they will split the remaining resources to those asking for withdrawal. Therefore, it will be optimal for those without need of immediate withdrawal to not join the run and wait until the next period to obtain their promised cash. The problem with this argument is that no bank so far is providing such a contract. Another difficulty with this is to see if depositors will be willing to put their saving in banks under this type of contract. If one takes even their idea of agents not knowing if they are late consumers or not at the beginning of the process, a contract promising a fixed amount of payment at each period may prove dominant.

### **2.3.2 Regulations for crises due to solvency problems:**

Another important source or reason of banking failure is the insolvency i.e., when the value of assets are less than the value of the liabilities. If this has already occurred, the government can bailout the bank or the bank can merge with a healthy bank in order to avoid bankruptcy. The most important aspect of regulation is to prevent this insolvency crisis to happen even for one bank. Regulations that serve this purpose are based on the idea of increasing the proportion of safe assets in each bank and also on the idea of portfolio diversification. In fact, using the idea behind the CAPM i.e. “do not put all your eggs in the same basket”, portfolio diversification allows banks to eliminate non-systematic risk and can allow them to reduce their exposure to risks. But this portfolio diversification is not effective under aggregate risk. Therefore in this case the bailout may end up being the only ex-post solution. Bailout has been widely criticized for the moral hazard it introduces in the banking industry. If bank’s owners know even implicitly that they will obtain bailout they will have less incentive to reduce their risk exposure in the future. Generally, bank used efficiently portfolio diversification techniques without the need of a regulator or any form of supervision.

Besides the diversification, the other important technique used in order to protect against solvency problem is the risk-based capital adequacy requirement. If banks are forced to maintain in form of equity, real estate, reserves, cash and other immobilizations, a given fraction of risky assets they hold, this will reduce their incentive to take risks, because in case of a failure and if the regulator is quick enough to detect the crisis at the beginning, the equity share may be large enough to pay for the losses, and allow the regulator to pay depositors without asking the taxpayer to pay for it.

### 2.3.3 Regulations to mitigate the a negative externality of banking crises:

More importantly, the failure of a bank can have a negative externality for many businesses and economic actors. This externality can be contagion through the inter-bank lending structure; it can be bank panic as other investors may find the banking sector not secure enough and may want to pull out from it. So even if a failure of a bank may be seen by some economists as the failure of a usual business (therefore no need for government intervention), this negative externality provides a rationale for government intervention when the bank is big enough to generate a sufficient negative externality that can pose a threat to the entire banking system stability.

The banking crisis contagion through inter-bank lending channel is very important, if a major bank collapse, it exposes sound banks dealing with him to a non-performing loans problem. If this is followed by a collapse or a merge for survival of another important bank, it sends the message in the banking sector that many banks are unhealthy. This can drive banks to refuse loans to each other, breaking the remaining inter-bank lending structure and this can lead to a credit crunch as this had been the case with the ongoing subprime banking crisis. In this situation contrary to Allen and Gale (2000a) where a complete inter-bank lending structure is the best solution to stop contagion, inter-bank lending disappears in this case.

What type of regulations can prevent such a disaster to happen or what type of market structure can stop this type of contagion mechanism to be in place?

First, let us look at ex-ante solutions for this type of contagion. Allen and Gale (2000a) state that if the inter-bank lending structure is complete, there is no possibility of contagion, also if there is no inter-bank lending structure there is no possibility of contagion. Therefore, ex-ante one has two market structures which can solve this market failure. The first structure is the best since it allows the existence of the inter-bank market it therefore improves the completeness of financial market.

Is there any need to regulate the inter-bank lending ex-post? Ex-post when one or more banks have failed the optimal market structure seems to be the absence of inter-bank lending market, the asymmetry of information between banks can explain why this is the case. The regulation is then needed here to insure the existence of the inter-bank lending market even in case of crisis. Government can guarantee the credit made by banks to each other over that period to help the banking sector to get out of the freeze of the inter-bank lending and also of the credit crunch.

With the observation that the collapse of some banks can trigger a freeze of the inter-bank lending market (due to the asymmetry of information available in this market), there is

a room for regulation even ex-ante in this market. The regulator can enforce legislations which force more transparency among banks, should disclose enough information about their risk structure and their profitability this will improve the decision making process of banks in choosing the best weight structure of their interbank lending.

Another externality is bank panic, when a big bank is allowed to fail, this send a message to depositors that the banking sector is in a difficult situation because if even a big bank fail therefore small ones with less expertise and less possibility of portfolio diversification may fail too. It follows that depositors of safe banks can panic and start to withdraw their deposits. Banks' panic has the ability to make even safe banks to fail. In order to stop this possibility, complete explicit deposit insurance is needed, since it removes the incentive of run and panics in the mind of other depositors and makes them not to join the run taking place in the banks.

To end this subsection, it is important to say that deposit insurance is widely criticized as been an important source of moral hazard behaviour in the banking industry (see e.g. Demirgüç-Kunt and Detragiache (2002)). In fact, it removes the incentive to depositors to monitor banks and drive them to focus only on the expected return. They then put their deposits only into banks providing them the highest deposit interest rate. This drives banks' owners and managers to get involve in very risky activities.<sup>8</sup>

### 3 Review of the Design of Banking Regulation

Allen and Herring (2001) provides an explicit and comprehensive list of banking regulations. Given that there are many objectives for these regulations, not all of these regulations have as objective the stability of the banking sector. From this list, the following types of regulation have been set in order to improve the stability of the banking system: (i) the asset restrictions; (ii) the capital adequacy requirement; (iii) the deposit insurance, (iv) the fit and proper entry tests; (v) the interest rate ceilings on deposits, (vi) the liquidity requirement; (vii) the reserve requirements; (viii) the restrictions on services and product lines. Mishkin (2000) and Barth, Caprio, and Levine (2004) have also provided lists of banking regulation.<sup>9</sup> <sup>10</sup> Although these studies do not report the same regulations, they

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<sup>8</sup>Lai (2006) provided a good survey of reasons behind banking fragility.

<sup>9</sup>From Barth, Caprio, and Levine (2004) these regulations are: (i) entry into banking, (ii) ownership, (iii) capital, (iv) activities, (v) external auditing requirements, (vi) internal managements/organizational requirements, (vii) liquidity and diversification requirements, (viii) the deposit requirements, (ix) the accounting /information disclosure requirements, (x) the discipline/problem institutions/exit, and (xi) supervision

<sup>10</sup>The basic regulatory measures pointed out by Mishkin (2000) are: (i) restrictions on asset holdings and activities, (ii) separation of the banking and other financial industries like securities, insurance, or real estate, (iii) restrictions on competition, (iv) capital requirements, (v) risk-based deposit insurance premiums, (vi) disclosure requirements, (vii) bank chartering, and (viii) bank examination.

do report many in common.

Since the publication of these papers there has been many developments on the regulation front. The adoption of the Basel II Accord and the ongoing subprime crisis, have bring some debates about the type of banking regulation needed for banking stability. Given the increasing globalization in banking and financial industries which make the banking sector to be vulnerable from risks developed in the financial market of other countries (e.g., the subprime crisis), many economists and practitioners of banking regulation have advocated the adoption of regulations which will take the specificity of the Islamic banks, take into account risks taken by investment banks (which was not regulated in the US on the premise that their failure would have been unable to create a systemic crisis in the financial sector), and take into account risks created by hedge funds. A book by Davies and Green (2008) provides some guidelines for the global financial regulation. Nevertheless, the existing literature can be analyzed around three groups based on their target.

### **3.1 Regulations Affecting Bank's Balance Sheet**

Among the regulatory measures presented in this literature, three measures aims at affecting the bank's balance sheet: restrictions on asset holdings, capital adequacy requirements, and reserve and/or liquidity requirements.

a) Restrictions on asset holdings aim at reducing the proportion of some type of risky assets in the portfolios of banks. It is then a constraint on the asset side of the bank's balance sheet. Its theoretical justification is based on the presence of information asymmetries between depositors and the bank manager, which can lead the manager to take too much risk without being disciplined by the withdrawal of deposits. It is a regulation, which has been adopted by many countries around the world. However, findings of Barth, Caprio, and Levine (2004) show that the level of restriction is higher in lower-income countries than in higher-income countries.

b) Capital adequacy requirements ask bank managers and/or owners to keep, in the form of equities, fiat money, and other form of immobilization, a given proportion of the amount of the risky loans that they have made. This has a direct effect on the composition of the liability side of a bank's balance sheet. More importantly, it aims at providing incentives for banks to hold less risky portfolios. In fact, this regulation can reduce their incentive to provide too many risky loans since in the case of a failure they may lose all their equities.

There are many types of capital adequacy requirement; their design has also evolved over time. According to Mishkin (2000) bank capital requirements typically take three forms: (i) the first type is based on the so-called leverage ratio, which is the amount of capital

divided by the bank's total assets; (ii) the Basel I Accord type where assets and off-balance sheet activities are allocated into four categories, each with a different weight to reflect the degree of credit risk; (iii) the third type is the capital requirement based on the level of market risk taken by banks.

Given the importance of the capital adequacy requirement in the regulatory framework of almost every country in the world today, we found useful to present some insight about the design of the capital adequacy requirement as stated by the Basel II Accord. The risk-weighted capital adequacy requirement is based on the concept of the capital ratio where the numerator represents the amount of capital a bank has available and the denominator is a measure of risks faced by the bank and is referred to as risk-weighted assets. The resulting capital ratio may be no less than eight percent. The assessment of the risk-weighted assets taken by a bank depends heavily on the technique used to measure it. The Basel II Accord specifies the technique that should be used to assess each type of risks: credit risk, market risk, and operational risk.

In light of the ongoing subprime banking crisis the latent debate on the right type of regulation for ensuring stability has emerged with two main views of the need of capital regulation.

(i) Firstly, the Basel Accords approach is the right approach and that regulators should continue to improve it; see, e.g., Davies and Green (2008), Barth, Caprio and Levine (2006).

(ii) Secondly, Basel II bank capital regulation is not useful; it increases complexity and fails to improve its accuracy. It therefore leads to susceptibility of manipulations of the rules by banks and forbearance of enforcement by regulators. Only the market can assess risks properly, which is why information needs to be harnessed by the regulators from the market.

Also, there is a debate about optimal capital ratio for countries. According to Morrison and White (2005), regulators with lack of reputation will be well served by strict rule setting capital requirement at a higher level, but those with higher reputation can have more discretion to set the capital requirement at a low level and modify it, given their knowledge of the recent development in the banking industry that they have the charge to supervise.

Finally, Barth, Caprio, and Levine (2004) found that the stringency of capital requirements is lower for lower-income countries than for higher-income countries. The overall capital stringency is lower in developing countries than in developed countries.

c) Reserve and/or liquidity requirements are a form of regulation which forces banks to maintain, in the form of reserves, a given proportion of their deposits in an account

of the Central Bank, and/or to maintain, in the form of liquidity, a given proportion of deposits in their account. This type of regulation affects the composition of the asset size of the bank's balance sheet. This regulation can mitigate the incentive of a bank's owner and manager to get involved in too risky activities. Besides, the reserve requirement is probably one of the most ancient types of banking regulation. It has been viewed as a form of taxation on banks by governments, since generally these required reserves do not bear interest. Many US economists have argued that a reserve requirement was needed in the US because of the existence of a deposit insurance run by the government. But this is no longer the view of a lot of Central Bank economists in developed economies. In fact, in the 1990s some countries like Australia, Canada and New Zealand have abandoned the use of this required reserves and even countries which have not removed it, have reduced it substantially and more frequently. Meanwhile, in developing countries the reserve and/or liquidity requirement is still used. Some countries have significantly reduced their reserve requirement and increased the liquidity requirement. More than four-fifth of the countries still maintains a reserve requirement and about one-eighth of the countries has a liquidity requirement.

### **3.2 Regulations Affecting the Banking Sector Structure**

Some regulations have an important impact on the structure of the banking system in a given country. From the previous example of regulations the following can have a significant influence on bank structure: regulations separating banking and non-banking business, and restrictions on entry in the banking industry.

a) Regulations separating banking and non-banking business: some governments restrict banks from involvement in commercial activities, which are considered to be outside the core banking business and, therefore, may be more risky. In the United States there was an even more restrictive policy, which was under application during the period 1933-2003: the Glass-Steagall Act of 1933.<sup>11</sup>

We observed from the Barth, Caprio, and Levine (2004) survey that almost every country (except New-Zealand) has at least a restriction on banks' involvement in activities such as: securities, insurance, real estate, and a bank owning non-financial firms. We also found that restrictions imposed on bank activities are greater for lower-income countries than higher-income countries; and that government ownership of banks increases in countries, on average, as one moves from the higher-income level to the lower-income level.

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<sup>11</sup>The Glass-Steagall Act of 1933 forces banks to be separated from other financial industries such as securities, insurance or real estate.



b) Regulation on entry into the banking industry: there are many types of restrictions to the entry into the industry. It ranges from the minimum amount of capital that the owner should provide to the regulatory agencies, to the restriction of foreigners to own or invest in banks. If the goal of the minimum amount of capital needed to enter into the banking sector is mainly to limit competition, the goal of restricting foreign funds is three-fold: to limit competition, to reduce the exposure to capital flight, and to reduce the exchange-rate risk. This type of regulation can affect the banking sector stability mainly through its effect on competition in the banking industry. Unfortunately, the theoretical literature so far does not agree on the link between competition and stability. One view is that when banks can earn monopoly rents, they become relatively conservative. Their banking charter is valuable and, thus, they shun the risk of bankruptcy, because bankruptcy would cause the loss of a valuable charter. Boyd and De Nicolo (2005) provide a different view. They argue that the previous view holds only when one focus only on deposit market competition. But if one takes into account the competition on the asset side, the implication is different. They show that there is a risk-incentive mechanism that operates in exactly the opposite direction, causing banks to become more risky as their markets become more concentrated.

From Barth, Caprio, and Levine (2004) almost every country has set a minimum amount of capital that is needed in order to obtain a licence (or a charter for banking activities). Although the entry of foreign funds was prohibited for acquisition, subsidiary, and creation of a branch during the 1980s, according to Barth, Caprio, and Levine (2004) almost no banking system is now restricting foreign funds to invest in banking. Meanwhile, they found that the percentage of entry applications denied is greater for low-income countries than for high-income countries; and that developing countries place more limitations on foreign bank ownership of domestic banks and foreign bank entry through branching than developed countries.

### **3.3 Regulations Affecting the Managers' and/or Owners' Behavior**

Since the theoretical literature has pointed out many market failures which can lead managers to take too much risk or to take improper actions without being disciplined by a free well-functioning financial market, many regulations have been designed to deal with this issue: the risk-based deposit insurance, disclosure requirements, bank chartering, and bank examination.

a) Deposit insurance was first introduced in the US after the Great Depression and has since been adopted by many countries. In their survey of 2001 Barth, Caprio, and Levine observed that at least 77 countries were applying it; while Demirgüç-Kunt, Kane,

and Laeven (2006) found that 87 countries were applying it by the end of 2003. It aims at reducing the likelihood of bank runs and panics in the banking system. Theoretical models (e.g., Diamond and Dybvig (1983)) show that complete deposit insurance will successfully prevent and stop the possibility of bank runs and panics. However, complete insurance is likely to introduce moral hazard into the banking system and therefore increase its fragility. In fact, complete insurance removed any incentive for depositors to be worried about the risk taken by banks; as a result they focus only on the deposit interest rate. In case of competition, banks will increase their deposit rate in order to attract more depositors. In order to keep their profit, they will increase the lending rate which will increase ceteris-paribus their proportion of non-performing loans and therefore the risk of insolvency. That is why a new type of deposit insurance has emerged, namely risk-based deposit insurance premiums. If the deposit insurance premium, provided by the government, is priced appropriately to reflect the amount of risk taken by a bank, it will solve the moral hazard issue.<sup>12</sup>

Barth, Caprio, and Levine (2004) found that developing countries are almost three times as likely as developed countries not to have an explicit deposit insurance scheme.

b) Disclosure requirements aim at mitigating the asymmetry of information available in the banking industry. Generally, regulators require that banks adhere to certain standard accounting principles and disclose a wide range of information that helps the market to assess the quality of a bank's portfolio and the degree of the bank's exposure to risk. This type of regulation is widely used by high-income countries and less by developing countries. For example, Barth, Caprio, and Levine (2004) point out that the percentage of banks rated by international credit rating agencies is seven times greater for high-income countries as compared to low-income countries.

c) Bank chartering aims at preventing dishonest people and overly ambitious entrepreneurs from engaging in highly speculative activities. In fact, chartering proposals for new banks are screened to prevent dishonest and speculative people from controlling banks. Almost every country has this type of regulation.

d) Bank examination, or supervision, or monitoring helps to limit moral hazard incentives for excessive risk taking. Since it is not enough to have regulations which encourage less risk taking, banks must be monitored to see if they are complying with these regulations. This type of regulation improves the quality of the financial information given to the public by bank owners and managers and can also serve to enforce the existing regulations. Barth, Caprio, and Levine (2004) found that the degree of private monitoring increases

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<sup>12</sup>Risk-based deposit insurance premiums are theoretically appealing but in practice they have not worked very well mainly because it is hard to accurately determine the amount of risk a bank is actually taking.

as one compares lower-income countries to higher-income countries and that the tenure of supervisors is less in developing countries than in developed countries.

## 4 Review of Empirical Methodologies

The empirical analysis of the link between regulation and stability of the banking system had so far taken two main directions. The first direction is to compute, using a measure of risk assessment, the risk taken by banks during a period under which a given type of regulation was under implementation and to see if the dynamic of the risk is associated with the given regulation. We will refer to this method as the implicit-fragility method. This method is generally applied on bank-level data in a given economy or on bank-level data of a group of economies. The second direction is to talk about banking fragility in a given economy. The fragility measure here takes the form of a dummy variable which takes the value 1 if a banking system is assumed to be in a systemic banking crisis situation during a given year, and 0 if not. Under this method cross-country data and discrete regression model are widely employed.

Of course this is not the only dimension in which one can classify these studies; but this classification is appealing because it allows a dichotomic analysis of empirical studies based on the empirical methodology.

### 4.1 Implicit-Fragility Method

There is at least three classes of econometric models which use the implicit measure of fragility to assess the impact of regulation on banking stability. These classes are: the simultaneous equation model, which is generally used to study the impact of capital adequacy requirement on bank's risk, the discrete regression model which is mainly used in studies using the rate recorded by credit rating agencies, and the survival and hazard models used to model the probability of a bank's failure.

#### 4.1.1 Simultaneous Equation Model

The simultaneous equation model was first used by Shrieves and Dahl (1992) to analyze adjustments in capital ratio and risk following the imposition of capital adequacy requirement in the US banking system.<sup>13</sup> The key ingredient of this model is that observed changes in bank capital ratios and portfolio risk levels can be decomposed into two components,

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<sup>13</sup>It has since then been used by a great number of authors e.g., Jacques and Nigro (1997), Rime (2001), and Nachane et al. (2000).

a discretionary adjustment, and a change caused by an exogenously determined random shock, such that

$$\begin{cases} \Delta CAP_{jt} &= \Delta^d CAP_{jt} + E_{jt} \\ \Delta RISK_{jt} &= \Delta^d RISK_{jt} + U_{jt} \end{cases}$$

where  $\Delta CAP_{jt}$  and  $\Delta RISK_{jt}$  are observed changes in capital ratios and risk levels for bank  $j$  in period  $t$ ,  $\Delta^d CAP$  and  $\Delta^d RISK$  represent discretionary adjustments in capital ratios and risk levels, and  $E$  and  $U$  are exogenous shocks. Recognizing that banks may not be able to adjust their desired capital ratios and risk levels instantaneously, the discretionary changes in capital and risk are modeled using a partial adjustment framework.

$$\begin{cases} \Delta CAP_{jt} &= \mu(CAP_{jt}^* - CAP_{j,t-1}) + E_{jt} \\ \Delta RISK_{jt} &= \beta(RISK_{jt}^* - RISK_{j,t-1}) + U_{jt} \end{cases}$$

Thus, observed changes in bank capital ratios and portfolio risk in period  $t$  are functions of the target capital ratio  $CAP_{jt}^*$  and target risk level  $RISK_{jt}^*$ , the lagged capital ratio  $CAP_{t-1}$  and risk levels  $RISK_{t-1}$  and any random shocks.

The target capital ratio level is not observable, but is assumed to depend upon some set of observable variables, including the changes in portfolio risk ( $\Delta RISK_{jt}$ ), while the exogenous shock that could affect bank capital ratios is the regulatory pressure. Also, the target risk level is not observable, but is assumed to depend on a set of observable variables including the changes in portfolio risk ( $\Delta CAP_{jt}$ ), while the exogenous shock that could affect bank capital ratios is the regulatory pressure. This assumption helps to recognize the possible simultaneous relationship between capital and risk.<sup>14</sup>

To complete the empirical estimation of the simultaneous equation system one must provide a measure of the bank capital and a measure of the portfolio risk of banks. In the literature, portfolio risk is measured in two ways: using the ratio of total risk weighted assets to total assets, and using the gross non-performing loans as percentage of total assets (see, e.g., Avery and Berger (1991), Berger, Herring, and Szego (1995), and Shrieves and Dahl (1992)). The literature also uses two definitions of a bank's capital ratio: the ratio of capital to total assets (see, e.g., Shrieves and Dahl (1992), and the ratio of capital to risk-weighted assets (see, e.g., Jacques and Nigro (1997), Aggarwal and Jacques (1998) and Ediz, Michael and Perraudin (1998)).

In this literature also, the regulatory pressure is a cornerstone of the hypotheses involving minimum capital standards; hence, it should be captured. Generally, the regulation pressure ( $REG$ ) is a binary variable.

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<sup>14</sup>Shrieves and Dahl (1992) argued that a positive relationship between changes in capital and risk may signify, among other possibilities, the unintended impact of minimum regulatory capital requirements or even managerial risk aversion. Jacques and Nigro (1997) argued that a negative relationship may result because of methodological flaws in the capital standards.

Let us denote by *OTHERS* the other variables affecting the banking capital and the bank's risk. The model can be broadly set as

$$\begin{cases} \Delta CAP_{jt} &= \mu_0 + \mu_1 REG_{jt} + \mu_2 OTHERS_{jt} + \mu_3 \Delta RISK_{jt} + \mu_4 CAP_{jt-1} + u_{jt} \\ \Delta RISK_{jt} &= \beta_0 + \beta_1 REG_{jt} + \beta_2 OTHERS_{jt} + \beta_3 \Delta CAP_{jt} + \beta_4 RISK_{jt-1} + v_{jt} \end{cases}$$

where  $u_{jt}$  and  $v_{jt}$  are error terms. This model is generally estimated using a two or a three-stage least-square procedure. Authors using the three-stage method argue that it allows them to take into account the simultaneity of banks' adjustments in capital and risk and to get estimates that are asymptotically more efficient than under the two-stage technique.

#### 4.1.2 Methodology with the Credit Rating

Some authors working on bank level data use the rate of commercial banks provided by the international rating risk agencies as their measure of risk. Typically these agencies rate banks' financial strength on a *N-point* scale, ranging from *E* to *A+*. Since these rates form a limited dependent variable, the appropriate econometric model used to assess the impact of regulation on the banking system stability here is an ordered probit or logit. Specifically, the regression equation estimated is:

$$RAT_{ij} = \beta_0 + \beta_1 REG_j + \beta_2 BKC_{ij} + \beta_3 INS_j + \beta_4 MEV_j + u_{ij}$$

where the subscript  $i$  denotes the country and the subscript  $j$  denotes the bank; with *RAT* for rating, *REG* for regulation, *BKC* for banking characteristics, *INS* for institutions, *MEV* for macroeconomic variables.<sup>15</sup>

#### 4.1.3 Survival Model

Some authors use the probability of bank failure as their measure of fragility. They then study the impact of regulation on this probability of failure. In the literature survival econometric model of Kaplan-Meier is generally used.<sup>16</sup>

## 4.2 Explicit-Fragility Method

So far in the literature, there are two econometric methodologies used to study the link between banking regulation and banking instability when the dependent variable is the explicit dummy variable of banking crisis. The most frequent one is the Demirgüç-Kunt and Detragiache (1998), hereafter *DKD98* method, which consists of using a discrete regression model in the context of panel data. More precisely, *DKD98* built a model similar to this:

<sup>15</sup>See Demirgüç-Kunt, Detragiache, and Tressel (2006) for more details.

<sup>16</sup>See, e.g., Erlend and Baumann (2006), and Sheldon (2006) for more details

Let  $P_{it}^*$  denotes an unobservable variable representing the probability that the banking system of country  $i$  suffers a systemic crisis at time  $t$ , and  $P_{it}$  - a dummy variable which takes the value 1 when country  $i$  suffers a systemic banking crisis at time  $t$  and 0 otherwise. The probability of a systemic banking crisis is modelled as follows:

$$\begin{cases} P_{it} = 1 & \text{if } P_{it}^* > C \\ P_{it} = 0 & \text{if } P_{it}^* \leq C \end{cases}$$

with

$$P_{it}^* = \beta' X_{it} + \varepsilon_{it}$$

and where  $X_{it}$  represents the matrix of all exogenous variables;  $i$  the country index;  $t$  the time index, and  $C$  a threshold value of the banking crisis probability.

The impact of each regulation on the banking system stability can be assessed by augmenting the above benchmark model of banking crises with variables capturing some characteristics of the banking regulation. Let us denote by  $L_{it}$  the matrix of variables representing the regulatory measures in country  $i$  at time  $t$ . The reduced form equation can be given by

$$P_{it}^* = \beta' X_{it} + \theta' L_{it} + \varepsilon_{it}.$$

If  $\theta$  is significant and negative, then regulation reduces the probability of the banking system to be in a systemic crisis.

This model is estimated using the logit regression model in the context of panel data. The sign of the estimated coefficients for each exogenous variable shows how an increase of that explanatory variable increases or decreases the probability of a crisis. However, as it is well known for a binary model, the estimated coefficients cannot represent the magnitude of the effect of a marginal change in the exogenous variable on the likelihood of a banking crisis. Each coefficient instead reflects the effect of a change in a given explanatory variable on  $\ln(P_{it}/(1 - P_{it}))$ , so that the magnitude of the effect on the probability of a crisis depends on the slope of the cumulative distribution function at  $\beta' X_{it} + \theta' L_{it}$ : it follows that the magnitude of the change in the probability of a banking crisis depends on the initial values of all the exogenous variables and their coefficients. Hence, after the estimation of the logit model, the following step is to compute the marginal coefficient estimates which are evaluated at the sample mean. These estimates represent the magnitude of the link between each exogenous variable and the probability of a systemic banking crisis evaluated at the sample mean.

The literature tends to use the logit instead of the panel-logit to estimate this model because the former is always convergent and the latter may not be.

The second method consists of using the discrete regression model but in the context of cross-section data. More precisely, Barth, Caprio, and Levine (2004) use the cross-section data over a five-year period time. Their dependent variable, which is the dummy variable for a crisis, is defined as follows: if a country has suffered a systemic banking crisis during the five-year period, the dummy variable takes on the value 1; if not it is 0. The regulatory variables are taken from a survey, and the macroeconomic control variables are the average of this variable over the five-year period. They then use a simple logit model to assess the impact of each regulatory measure on the banking instability.

## 5 Review of Empirical Studies

We will carry out our empirical review with respect to the above classification. Let us first start with the implicit-fragility method.

### 5.1 Empirical Studies Using the Implicit-Risk Method

A great number of theoretical as well as empirical studies have been carried out on the impact of the capital adequacy requirement on the banking stability or the risk-taking behavior of bank managers in developed economies over the last decade. A lot of research has been done on the US banking system. Generally, these works use individual bank-level data and compute a measure of risk taken by each bank. Let us first present the work already done for the US banking system before presenting the work for other economies.

#### 5.1.1 Capital Standard and Stability

**In the US Banking System.** The capital standard was first introduced in the US banking system in 1981.<sup>17</sup> Even before the introduction of the Basel I Accord on capital requirement, many theoretical studies have been carried out on this regulation regarding the risk-taking behavior of bank owners and managers. The most important studies were Koehn and Santomero (1980), and Kim and Santomero (1988). The message of this theoretical work was that capital standard may not be effective if not risk-related. Since then a lot of economists have carried out empirical studies on the US banking system to test this theoretical conclusion.

The first empirical work for the US banking system is the paper of Furlong (1988). He used the data of 98 large US bank holding companies from 1975 to 1986. He defined the risk taken by banks as the volatility of underlying asset values. He computed this by

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<sup>17</sup>This was even before the introduction of the Basel I accord which was adopted by the G10 countries in 1988.

inverting the call option pricing formula, and found that asset risk measured in this way doubled during the period 1981-86 in the part of his sample in which banks were under capital requirements, compared with the earlier period. However, banks which were well-capitalized in 1981 before the introduction of capital requirement experienced the same rise in volatility as those which were not. He then argued that these findings do not support the view that an increase in capital adequacy requirement leads banks to increase their risky-assets.

As noted by Jackson et al. (1999), his interpretation is true only if one assumes that the level of bank capital in 1981 was representing the desired or the equilibrium capital level. In this case Furlong's findings would be inconsistent with the Kim and Santomero's theoretical findings since well-capitalised banks would not have been subjected to any additional constraint. But, it is possible that, through the effects of capital requirements on market discipline, the introduction of fixed capital standards led to an increase in target capital rates for both highly capitalised and weakly capitalised banks. In this event, Furlong's findings might be seen as consistent with Kim and Santomero's findings.

This work has been criticized for not controlling for many variables which could have affected risk-taking behavior during that sample period. Also, it hasn't taken into account the endogeneity of capital ratio and risk. This has motivated the emergence of a new set of studies. Shrieves and Dahl (1992) built a simultaneous equation model to take into account the fact that changes in both capital and risk have endogenous as well as exogenous components, and to focus on the determination of discretionary changes in risk which are induced by either endogenous or exogenous changes in capital. They then investigated the relationship between changes in risk and capital in a large sample of US banks over the period 1983-1987, and found a positive association between changes in risk and capital.<sup>18</sup> In fact, their results established that risk exposure and capital levels are simultaneously related, and that the majority of banks mitigate the effects of increases in capital levels by increasing asset risk posture, and vice versa. They argued that the fact that these relationships were present even in banks which were in excess of the minimum regulatory requirements for capital adequacy, supports the conclusion that a positive association between risk and capital in such banks is not strictly the result of regulatory influence, but rather reflects the view that risk-taking behavior tends to be constrained by bank owners' and/or managers' private incentives. Their findings suggest then that capital standard tends to increase the risk in the US banking system.

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<sup>18</sup>Where risk is measured using the gross non-performing loans as percentage of total assets, and bank's capital ratio is the ratio of capital to total assets.



We can then conclude that taking into account the endogenous part of an increase in capital and risk can make a huge difference to the results and that the first capital regulation applied on US bank over the period 1980-1988 end up increasing the risk taken behavior in the banking industry.

Jacques and Nigro used the same empirical methodology to test the effectivity of capital regulation as implementing under Basel I. They obtained a different result. In fact, Jacques and Nigro (1997) studied the impact of risk-based capital standards on capital ratio and risk in the US banks under the period 1990-91 and found that changes in the capital ratio and risk are negatively related, i.e., an increase in the level of capital reduces the risk taken by US banks. This result is confirmed by Haubrich and Watchel (1993) who argued that the implementation of the Basel I risk standards caused poorly-capitalised banks to reconfigure their portfolios away from high-risk and towards low-risk assets, but it runs contrary to Hancock and Wilcox (1992) who found out that, banks that had less capital than required by the risk-based standards, shifted their portfolios towards high-risk assets. The implicit-fragility method failed then to close the debate about the effectivity of capital standard as applied under the Basel I Accord for banking stability in the US banking system. To end this subsection, let us review the Dahl and Spivey (1995) paper which provides an indirect way of assessing the importance of capital standard on banking stability. They used US bank data over the period 1980-88 to assess the likelihood and timing of bank recovery from undercapitalization. They noted that there appears to be only a limited capacity for banks to change positions of undercapitalization by growth limitations or dividend restrictions, and that the impact of profitability on recovery is greater the longer a bank remains undercapitalized. Hence, the design of the capital requirement has important implications not only for optimal capital levels, but also for the level of risk and the safety and soundness of the banking system as a whole.

**In Other Countries' Banking Systems** Outside of the US, studies on the impact of capital adequacy requirement on banking stability using the implicit-risk method are scarce. So far, we have found two studies on the Switzerland banking system (Rime (2001), and Sheldon (2001)), a study on the group of ten member countries of the Basel committee (Sheldon (1996)) and a study on the Indian banking system (Nachane et al. (2000)).

Using a modified version of the Shrieves and Dahl (1992), Rime (2001) built a simultaneous equations model to analyze adjustments in capital and risk in Swiss banks and found that regulatory pressure to implement capital adequacy requirement induced banks to increase their capital ratio but did not affect the level of risk. In his study, risk is measured by

the ratio of risk-weighted earnings to total assets. He argued that his findings indicate that for Swiss banks, an increase in available capital through retained earnings or equity issues is less costly than a downward adjustment in the risk of the portfolio, and that a rationale for this can be the absence of a developed market for asset-backed securities in Switzerland. However, this runs contrary to the result found by Sheldon (2001) on banks that operated in Switzerland during the period 1987-99. He estimated the impact of the capital standard on the probability of banks' failure and found that over this period the capital adequacy requirement succeeded in increasing the banks' safety, although it decreased the profitability of banks, and finally that the level of adequacy requirement was too high from a welfare point of view. The difference in results can be due to sample periods and the methodology used.

Nachane et al. (2000) provided an empirical assessment of the impact of capital adequacy requirement on the risk-taking behavior of India's commercial banks. Their study examined 27 Indian public sector banks using year-end data for 1998. Their measures of risk were: the ratio of risk-weighted assets to total assets and the ratio of gross non-performing loans to total assets. They found that banks adjusted their capital ratios significantly, but their risk positions adjusted relatively slowly to the respective target levels. They argued that this suggests that changes in capital and risk are negatively related.

Sheldon (1996) performed an analysis of the equity and asset volatilities of 219 banks from the group of ten member countries of the Basel committee over the period 1987 to 1994. He found that bank asset volatility in the US banks rose and that this was the case both for banks which increased their capital ratios and for those which did not. In Japan, asset volatility fell, although most banks raised their capital ratios. He concluded that he found little evidence that the implementation of the Basel guidelines had a risk-increasing impact on bank portfolios.

### **5.1.2 Other Regulations and Banking Stability**

In the literature of implicit-fragility some studies have been done on deposit insurance, entry restriction, and a broad notion of regulation.

**Deposit Insurance** We have found one study on the Japanese government safety-net and its links with stability. It is the paper of Horiuchi (1999) which examines how the Japanese government safety-net mechanism generated fragility in the banking system during the 1990s. He found that even though the Japanese safety net protected depositors from losses associated with bank failures, it did not implement prudential regulations to prevent moral

hazard associated with it. The later translated into the systemic banking crisis that Japan experienced during that period. This study therefore associated deposit insurance with banking crises in Japan.

Cull, Senbet and Sorge (2005) found a similar result using the volatility of credit to the private sector as the proxy for risk in a cross-country analysis. More precisely, they found that the decision to introduce deposit insurance increases the volatility of credit to the private sector in countries with weak institutions. Demirgüç-Kunt and Huizinga (2004) also found a similar result about the association of deposit insurance with banking fragility. They used bank-level data to study the effect of deposit insurance on market discipline of banks. They focused on the disciplinary role of interest rates and deposit growth and found that market discipline is stronger in countries with better institutions, but that the presence of generously designed deposit insurance is able to reduce its effect significantly, leading to banking system fragility. Nier and Baumann (2006) found the same result using bank-based data that *“government safety nets result in lower capital buffers and that stronger market discipline resulting from uninsured liabilities and disclosure results in larger capital buffers, all else equal,”*. In other words, the deposit insurance is less important for banking stability than market-discipline.<sup>19</sup>

**Entry Restriction** Many studies have investigated the link between entry restriction and an implicit measure of banking fragility using US banking data. Keeley (1990) presented evidence that the relaxation of state branching restrictions in the 1980s increased competition and induced large US bank holding companies to increase their risk profiles, as proxied by estimates of market capital-to-asset ratio. But Jayaratne and Strahan (1998) used a substantially larger sample of US bank and found that deregulation was followed by sharp reduction in loan losses, contrasting Keeley’s result. Also Dick (2006) used charged-off losses and loan loss provisions as implicit measures of fragility and found evidence of a positive link between the Riegle-Neal branching deregulation in the 1990s and the banking system fragility.

Also, viewing bank concentration as a symptom of regulatory restriction, Evrensel (2007) applied non-parametric and parametric methods of survival analysis to study the impact of bank concentration on banking crises. The empirical results suggest that concentration in the banking sector increases the survival time. In other words, it reduces the probability

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<sup>19</sup>This result about a positive association of deposit insurance and banking instability was found as a byproduct of their research on market discipline. Nier and Baumann (2006) found, using a cross-country panel data set consisting of observations on 729 individual banks from 32 countries over the years 1993 to 2003, that competition leads to greater risk.

of bank failure. Another result is that the *G10* and *non – G10* countries constitute two distinct groups of countries, where the *non – G10* countries have a higher incidence of bank crises.<sup>20</sup> The parametric survival time regressions confirmed the possibility that the effects of the covariates on bank crises may have different dynamics in the *G10* and *non – G10* countries. The study states that the different dynamics associated with banking crises in developed and developing countries seem to be related to the absence of competitive forces in the economic and political environment.

In the same order of idea Boyd and Runkle (1993) and De Nicolo (2000) related indicators of bank failure probability to bank size. They argue that the size variable is likely to be correlated with market power viewed as an implicit measure of entry restriction. Boyd and Runkle (1993) found no significant link between bank size and bank failure probabilities. Meanwhile, De Nicolo (2000) found a positive and significant relationship between bank size and failure probabilities for the US, Japan, and many European countries.

We can then conclude as Boyd and De Nicolo (2005) that this empirical literature has produced mixed findings.

**Broad Notion of Regulation** Some studies used a broad notion of regulation. They defined an index of banking regulation as a weighted average of many types of regulation. For example, Gonzalez (2005) provide a channel through which banking regulation affects banking stability: charter value. The study used a panel database of 251 banks in 36 countries to analyze the impact of bank regulations on bank charter value and risk-taking. He found, after controlling for the presence of deposit insurance and for the quality of a country’s contracting environment, that regulatory restrictions increase banks’ risk-taking incentives by reducing their charter value. More precisely, banks in countries with stricter regulation have a lower charter value, which increases their incentives to follow risky policies. In other words, there is a negative relationship between regulatory restrictions and the stability of banking systems. He also found that the deposit insurance can have a positive effect on stability if it is exogenous, but if it is endogenous, it is not relevant for stabilization purposes. Gonzalez used non-performing loans to total loans and bank stock price volatility as the measure of risk in banks.

Demirgüç-Kunt, Detragiache, and Tressel (2006) studied whether compliance with the Basel Core Principles for effective banking supervision (*BCP*) improves bank soundness. They argued that *BCP* compliance assessments provide a unique source of information

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<sup>20</sup>The G10 refers to the group of eleven countries member of the Basel Committee on Banking Supervision. More precisely, Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom and the United States.

about the quality of bank supervision and regulation around the world. They found a significant and positive relationship between bank soundness (measured with Moody's financial strength ratings) and compliance with principles related to information provision. Specifically, they found that countries, which require banks to report their financial data regularly and accurately to regulators and market participants, have sounder banks. They found similar results when the soundness was measured through  $z$  - scores yields. They interpreted their findings as evidence that transparency makes supervisory processes effective, strengthening market discipline, and that it is the most important element of the core principles.

A bemoal for this study is the fact that Moody's financial strength ratings like any risk rating may not be the relevant measure of fragility. This fact has been brought in light by the ongoing subprime crisis.

### 5.1.3 Remarks on the Implicit-Fragility Literature

The general result found in the implicit-fragility literature about the relationship between capital standard and stability is that: (i) bank capital regulation as implemented before the Basel I Accord was inappropriate for stabilization purposes because it was not risk-related; (ii) bank capital regulation as implemented during Basel I Accord has not shown convincingly that it has any effect in fighting risk-taking in the banking sector. This has motivated regulators to introduce the Basel II capital standard. So far no empirical assessment of the impact of the Basel II Accord on risk-taking in banking have been found in the literature. It will take some time to be able to carry out a good study on this new accord. This time may even be longer than usual, since the introduction of Basel II in the US has been coupled with a banking crisis.<sup>21</sup> A key issue one should take into account should be the endogenous part of the level of the capital ratio.

Apart from the capital standard, other types of regulation have not been scrutinized by many authors. Their findings however show that regulation directly affecting the bank manager's and/or owner's behavior (excluding full deposit insurance) seems effective for stabilization purpose. However, one cannot conclude strongly whether the empirical findings presented in this section are robust, since we have only a few studies. Therefore, these regulations need additional empirical scrutiny.

However, the implicit-fragility method will always bring controversy as some would argue that the measure of the risk which is taken into account may not be the one which matters

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<sup>21</sup>This crisis caused by the subprime loans for housing cannot be accounted for as a consequence of Basel II; more reasonably, it can be viewed as an evidence of the weakness of the Basel I Accord on capital standard.

for stability.

## 5.2 Explicit-Fragility Method

A recent and growing literature of the empirical studies on banking regulation and stability using an explicit measure of banking instability departs from the work of *DKD98*. These studies use cross-country data on banking regulation and banking crises to assess, using a discrete variable regression model such as the logit or the probit model, if a given regulatory measure has successfully contained or reduced the probability of the occurrence of a banking crisis in a given set of economies. Some studies use all countries with available data, while others focus on a group of countries such as developing countries, developed countries, etc.

Generally, these studies are motivated by the conflicting theoretical results of the effect of regulation on the banking system stability. However, the most important reason for the increase in empirical research on regulation and stability seems to be the availability of data. Since 1998, a group of researchers at the World Bank : Barth, Caprio, Levine, and others have developed a comprehensive survey of the banking regulation practices around the world. From the first survey in 1998 – 1999 to the third survey in 2007, the number of countries covered has increased significantly from 100 to almost every country in the world. The number of questions and types of regulation practices covered by these surveys have also increased over this period. They have also assembled a database on banking crises episodes.

Many studies have used these datasets to answer different types of questions, ranging from the effect of entry restriction on banking stability, to the effect of deposit insurance, capital adequacy requirement, and a broad range of criteria in banking regulation.

### 5.2.1 Banking Liberalization

A key question which has earned empirical scrutiny is whether banking liberalization is likely to increase the banking system fragility. Many proxies of banking liberalization are used in this literature. The most common are the removal of entry restriction, and the removal of interest rate ceiling.

Using the removal of entry restriction as the proxy of banking liberalization, Beck, Demirgüç-Kunt, and Levine (2006a) used data from 69 countries over the period 1980 – 1997. They applied the *DKD98* discrete regression model, they controlled for banking concentration, and they found that tighter entry restrictions and more severe regulatory restrictions on bank activities increase bank fragility. A higher fraction of entry applications denied which is their proxy for tighter entry regulations, leads to higher levels of fragility

in the banking system. They argue that their result is consistent with the argument that restricted entry reduces the efficiency of the banking system, also making it more vulnerable to external shocks. Besides, Barth, Caprio, and Levine (2004) found that the likelihood of systemic banking crisis is positively associated with greater limitations on foreign bank entry; and they found no evidence of positive association between domestic entry restrictions and banking stability. Their methodologies are quite different in the sense that they first use panel data and control for concentration, the second one use only cross-country average data. The difference in the results may also be due to the fact that in the first study, it is the fraction of banks being refused the entry instead of a dummy variable taken the value 1 if there is a legislation allowing free entry and 0 if not. Both studies are relevant, the first is more compelling since it uses panel data which allow for more dynamic but it falls short on making a distinction between domestic entry restriction and foreign bank entry restriction which is certainly important.

But before all these studies, Demirguc-Kunt and Detragiache (1998) used removal of interest rate ceiling as the proxy of banking liberalization and provided the first empirical assessment of the link between banking liberalization and financial fragility using a dummy variable of banking crises. Their study used a panel data of 53 countries over the period 1980–1995. They found that banking crises were more likely to occur in countries with more liberalized financial systems. They pointed out that the financial liberalization’s impact on a fragile banking sector is weaker in countries with strong institutions—especially where there is respect for the rule of law, a low level of corruption, and good contract enforcement. They also found that even in the presence of macroeconomic stabilization, less entry restriction is likely to be linked with the occurrence of banking crises in countries where institutions to ensure legal behaviour, contract enforcement, and effective prudential regulation and supervision are not fully developed.

Noy (2004) found almost the same result when studying the effect of liberalization on banking stability using data from non-*OECD* countries. He examined the hypothesis that insufficient prudential supervision of the banking sector after the removal of interest rate ceiling results in excessive risk-taking by financial intermediaries and a subsequent crisis. The paper used a panel-probit model of the occurrence of banking crises controlling for macro-economic, institutional and political variables to test this hypothesis. It found that banking liberalization is positively link to the occurrence of banking crisis. The result is less robust when he controls for corruption and also when he restricts his analysis only on emergent market economies.

Therefore, depending on the proxy of banking liberalization variable, liberalization can

increase fragility or can improve the stability. More precisely, empirical studies link entry restrictions to fragility and interest rate ceiling to stability.

### 5.2.2 Capital Standard

So far we have found in the literature only one study on the impact of capital standard on banking stability using the explicit-fragility method. Barth, Caprio, and Levine (2004) found a significant negative relationship between higher ratio of capital requirement and non-performing loans. However, when they used the explicit dummy variable for banking crises, they found some specifications in which capital requirement entered with a negative and significant coefficient. They interpreted this result as evidence that the relationship between capital adequacy requirement and banking stability is not very robust.

### 5.2.3 Deposit Insurance

Before the important empirical research of Demirgüç-Kunt and Detragiache (2002), hereafter *DKD02*, there was a large body of theoretical literature on deposit insurance and its association to fragility. However, there was a large divergence in the results of these studies too. *DKD02* used cross-country panel data on 61 countries over the period 1980-1997 and found that explicit deposit insurance tends to increase the likelihood of banking crises, the more so where bank interest rates are deregulated and the institutional environment is weak. They also found that the negative effect of deposit insurance on banks' stability is stronger the more extensive is the coverage offered to depositors, where the scheme is funded, and where it is run by the government. Barth, Caprio, and Levine (2004) found a positive association between the generosity of the deposit insurance scheme and the bank fragility. Their relationship was robust to alterations in the control variables. This was consistent with the view that deposit insurance not only substantially aggravates moral hazard but also produces deleterious effects on banking stability.

However this result has not been found to be robust by Arteta and Eichengreen (2006). In fact, they assessed the link between banking fragility and deposit insurance using a sample of 75 emerging market economies over the period 1975 – 1997 and found no significant effect of deposit insurance on the probability of the banking system to be in a systemic crisis episode. They argued that what led to this difference was that they had more data on deposit insurance on emerging market than *DKD02*. However, there are two main reasons for this difference: (i) Arteta and Eichengreen do not consider the design of the deposit insurance, which was proved by *DKD02* to be relevant; (ii) they also do not take into account the endogeneity problem between the likelihood of banking crisis and the adoption



of deposit insurance. Therefore, the *DKD02* is more compelling.

In our view there are still room for improvement in this literature. It is argued that deposit insurance increases banks fragility through its effect on moral hazard. On way of testing this is to see if the adoption of deposit insurance increases the likelihood of insolvency problem in the banking industry. This idea is close to the one developed by Cull, Senbet and Sorge (2005).

#### **5.2.4 Overall Banking Regulation**

Using the above databases some studies such as: Barth, Caprio, and Levine (2000, 2004, 2006), and Barth, Gan, and Nolle (2004) have assessed the stabilization effect of existing banking regulations.

In a book entitled "Rethinking Banking Regulation: Till Angels Govern" based on the World Bank survey, Barth, Caprio, and Levine (2006) assessed the importance of each type of regulatory policy on the stabilization of the banking system. They provided empirical results for a range of regulations. They found that regulation is not effective for stability, and for a long range of criteria. They argued for paying closer attention to the foundations of the financial sector, and that without good information and adequate incentives, market participants will not be able to effectively monitor banks. These findings are the summary of findings already done in one of their previous works: Barth, Caprio, and Levine (2004). In this work they used their database on bank regulation and supervision covering 107 countries to assess the relationship between specific regulatory and supervisory practices and banking-sector development, efficiency, and fragility. More precisely, they examined the effect on banking stability of regulations such as: restrictions on bank activities; entry restriction; capital adequacy requirement; deposit insurance system design features; supervisory power, independence, and resources; loan classification stringency, provisioning standards, and diversification guidelines; regulations fostering information disclosure and private-sector monitoring of banks; and government ownership. They found that regulatory measures that rely excessively on direct government restriction on bank activities is not good for stability and can even create fragility. More precisely, they found that the relationship between capital adequacy requirement and banking stability is not robust. They also found that regulatory policies that rely on guidelines that force accurate information disclosure, empower private-sector corporate control of banks, and foster incentives for private agents to exert corporate control, worked best to promote stability.

They argued that their findings do not mean that regulations which have not been proven effective have no role in strengthening the banking sector. Rather, their interpretation is

that it suggested a supporting role for regulation, one in which the regulators' job is to verify that the information being disclosed by banks is accurate, and to penalize banks that disclose false, misleading or inadequate information.

Furthermore, Shimpalee and Breuer (2006) found, using cross-section data on twin banking crises and controlling for institutional factors, mixed evidence that deposit insurance, the removal of capital controls, a lack of central bank independence, and financial liberalization increase the chance of banking crises.<sup>22</sup> Using cross-country data on bank ownership, regulation and supervision, Barth, Caprio, and Levine (2000) investigated the link between bank ownership and regulation on banking fragility. They found that the tighter the restrictions placed on this activity (a bank is not permitted to do securities, insurance and real estate activities), the greater the likelihood of a banking crisis. The likelihood of a banking crisis is also greater, on average, the tighter the restrictions placed on bank ownership of non-financial firms. They also found that restricting the mixing of banking and commerce is associated with greater financial fragility. Whereas restricting non-financial firms from owning commercial banks is not associated with financial fragility, restricting banks from owning non-financial firms is positively associated with bank instability. Finally, countries that restrict banks from owning non-financial firms have a robustly higher probability of suffering a major banking crisis.

It follows from the empirical studies, using explicit measures of banking crises, that regulations affecting the bank's balance sheet or the banking sector structure are generally at least not effective for stabilization purposes, and can even increase the fragility of the banking system. Conversely, regulations affecting the bank managers' and/or owners' behavior are effective. The importance of taking the institutional factors into account has emerged as these factors are often linked with instability.

## 6 Summary and New Directions for Research

The empirical literature on banking regulation has so far tried to solve the theoretically conflicting results on banking regulations and banking stability. It has taken two main directions in respect of the stability measure which is used in the study. The so called implicit-fragility method uses an implicit measure of fragility such as: the ratio of non-performing loan on the total asset, bank stock price volatility, and the ratio of risk-weighted assets to total assets; while the explicit-fragility method uses the occurrence of a systemic banking crisis in a given economy as the measure of instability.

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<sup>22</sup>Their dataset consists of over 30 countries covering 13 institutional factors for the period 1984-2002.

These two methods differ also in terms of econometric techniques that they use for their estimations. The implicit-fragility method relies mainly on simultaneous equation models, and on the survival and/or hazard models; while the explicit-fragility method relies on the discrete regression model such as logit or probit in the context of panel data.

So far, many studies have been done on the US banking system but only few on other banking systems. Most importantly, many works focus on a given type of regulation, generally on the capital adequacy requirement, deposit insurance, entry restriction, and supervision practices in the banking sector.

Although these empirical studies have succeeded to provide clear answer to some type of regulation such as the non risk-related capital regulation and removal of interest rate ceiling, they have failed to provide a convincing result about the impact of many types of regulation on banking stability. These conflicting results are mostly due to the methodologies used. In fact, even for studies using the implicit-fragility technique, the results on banking regulation and instability vary from studies using simultaneous equation models to those using hazard or survival models. They vary also in the function of the control variables used to account for the characteristics of the banking system, and finally on the sample periods or sample countries. The difference between the simultaneous equations model and the others is that the former takes into account the endogeneity effect of some type of regulations.

More precisely, for capital regulation, the theoretical literature on these regulations provides conflicting prediction. It was proven by Koehn and Santomero (1980) and after by Kim and Santomero (1988) that non-risk-related capital adequacy requirement was not effective in reducing risk in the banking industry. Empirical studies using data from US banking industry have proven this. It has then driven practitioners to introduce a risk-related capital adequacy regulation, the so-called Basel I Accord. But capital regulation under Basel I has also been criticized, e.g., Blum (1999) which shows that banks' managers can successfully increase their risk by using the most risky asset in each category. With the ongoing subprime banking crisis, issues have come up about the effectiveness of risk rating of assets by agencies (conflict of interest, inadequate model), making the credit-risk assessment difficult to believe in. With the best of our knowledge no comprehensive empirical work has been done on this regulation. To see if banks actually shift their assets in different risk categories toward the most risky asset, a precise study need to be done in this direction, and since the Basel I Accord is no longer in use a complete comprehensive assessment of this over the period 1988- 2006 will help to see exactly what went wrong with it.

The Basel II Accord introduced progressively over the period 2005-2007 is still at its earlier stage, nevertheless it has been criticized by many. In light of the development of the

ongoing subprime banking crisis, its complexity is said to make it difficult for regulators to monitor. Some criticize the importance it provides to internal assessment of risk on the ground that banks' managers may have incentive to build less accurate risk assessment models. The fact that rating agencies assessment of assets is very important in this regulation has also been criticized. But as it stands now, any empirical assessment of Basel II would be inappropriate, because its introduction coincided with this worldwide financial crisis (the subprime banking crisis) and which is most likely to be link to the weakness of the Basel I Accord.

The new direction for theoretical as well as empirical research for this regulation is to reassess the importance of the market risk component of the Basel II Accord. In fact, market risk has gained greater importance in the vulnerability of the banking system around the world. The ongoing subprime crisis has proven: (i) on one hand that market risk can effect hedge funds and investment banks in such a way that it can generate a systemic banking crisis characterized by a credit crunch; thus studies should look how the implementation of capital regulation on investment banks can yield in term of risk taken behavior in the investment banks industry and what will that implies for the stability of the commercial banking industry, (ii) on the other hand it has created a debate about the usefulness of maintaining the same level of capital requirement once the crisis is already there (see, e.g., Tcahana Tchana (2008), and also the relevance of mark-to-market accounting standard for bank assets during crisis time (see, e.g., Allen and Carletti (2008)).

The link between reserve requirement as well as liquidity requirement on banking stability has earned few empirical studies recently. The main reason is that it is no longer used for stabilization purposes in developed economy, and in developing countries, reserve requirement is now replaced by liquidity requirement. There is then a need to assess the effect of this liquidity requirement on banking stability in developing countries.

The empirical studies on the link between regulation affecting the banking sector structure and stability has fortunately presented less conflicting results. Studies using and explicit measure of fragility show that entry and activities restriction have no positive effect on banking stability and that they can actually increase the fragility of the banking system. But study using implicit measure of fragility present mixed results on US banking system. This is certainly due to the fact that those studies used different type of measure and therefore are less comparable. The most convincing implicit measure which is the probability of failure tends to confirm the result obtained with the explicit measure of fragility. Some studies have found a prominent role for foreign bank restriction on stability. More studies need to be done in order to see why the impact of foreign banks entry restriction seems

more important than the one of domestic banks.

For studies on regulation affecting managers' and banks owners' behavior; empirical studies have focused mainly on deposit insurance. The best studies on the link between deposit insurance and banking stability agree on the fact that it is source of moral hazard and that it is a most likely to increase the fragility of the banking system. The new direction for research will be to test the impact of deposit insurance presence on the solvency crisis in banking.

With the ongoing debate about the importance of the regulation of manager's compensation structure in the subprime banking crisis, there is a need of an empirical assessment of the link between management compensation and banking stability.

Overall is it important for practitioners and researchers to come together and define a comprehensive measure of fragility in the banking system in light with the ongoing banking crisis, this will help to improve the vocabulary about banking stability and reduce the proportion of conflicting results found in this empirical literature.

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