The Basle Accord: a review and a simple model

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Abstract

This work describes the prudential regulation of banks based on the Basle Accord signed in July 1988. In addition, it details a simple model of the banking firm. The Basle Accord was developed on the assumption that solvency of the financial market can maintain public confidence and prevent bank crises. The role played by the United States during the 1980s was an important push towards a unified international prudential regulation. Suffering a bank crisis, the U.S.A. led, with the U.K., the proceedings to support the Accord. The main rule resulting from the Accord was the capital adequacy based on a weighted risk ratio. Capital adequacy entails that each bank has to maintain a certain level of capital proportional to its assets' risk. The model detailed shows the impossibility of creating an incentive scheme supported by bonuses or benefits. The external menace, supervisory authority, can provide the incentives to sustain a good management performance. Moreover, the model indicates that the Basle rule is more appropriate to maintaining a strict bank regulation.

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I - Introduction

The financial system is largely studied by economic theory. On this subject, macroeconomic theory focuses, mostly, on monetary policy and its real effects on real activity[1]. The microeconomists were captivated by the strong regulation involved in the system.

The need for a special regulation in this market is based on two perspectives. First, the financial system (including banks, mutual funds, insurance companies, pension funds, etc.) are extremely important to the economic activity of non-financial industries. They are a connection between the people who want to borrow and the others who need credit. A strong financial market is the foundation for a growth economy. The second perspective is the opposite interpretation of the first one. Difficulties in the financial market can spread into a growth economy; therefore, the solvency of this market becomes a significant issue. The maintenance of a sound banking system is the theme of this work, the focus being on the prudential bank regulation based on the Basle Accord.

In order to represent the importance of a solvent banking system, Table 1 shows several cases of bank crises and their related costs. The cases of Spain and Finland are nationally important, but, lately, the most famous case is the Mexico crisis that started in 1995. The Mexico crisis spread over Latin America, especially Venezuela, with repercussions in the United States.

[1] See Blanchard and Fisher (1989).

Table 1- Cases of bank crises and their costs

Country	Year	Estimated losses or resolution costs as % of GDP
Spain	1977-85	17
Finland	1991-93	8
Sweden	1991	6
Norway	1987-89	4
U.S. S&L Crisis	1984-91	3
Venezuela	1995-	18
Mexico	1995-	12-15

Source: Goldstein and Turner (1996).

The prudential regulation helps to prevent bank crises by requesting the financial intermediary, among other several recommendations and rules, to sustain a certain level of (own) capital into its accounting. The Basle Accord, signed in 1988, represents the international agreement for a unified prudential regulation of banks relating to minimum capital and off-balance operations.

This work is divided into two main parts. Chapter II reviews the Basle Accord, focusing on the Accord's background and the general rules developed. The chapter III develops a simple model of a banking firm and thereafter analyzes the possibilities of external supervision to implement an optimal incentive scheme. The final chapter summarizes the work and its main insights.

II - A review of the Basle Accord

This section reviews the Basle Accord focusing in the Accord's background and the general rules developed.

II.A - The Background of the Accord

The Basle Accord arises from the consensus between G-10[2] countries for an unified prudential regulation of banks. Several banking crises occurred in Europe and America during the 1970s and 1980s in Europe and America. This section gives a brief description of the main events that led to the Accord and its publication in July 1988.

In 1974, the bankruptcy of three main European banks, Herstatt Bank (Germany), Franklin National Bank (U.S.A.), and British-Israel Bank (U.K.), sounded an alert to the supervisory authorities involved. As a result, the first meeting of the Basle Committee on Banking Regulation and Supervisory Practices was held in 1975. The document produced from the meeting is entitled as "1975 Concordat."

The 1975 Concordat was merely an analysis of the problems the international financial system was encountering. One of the main points of this document was the internationalization of banks. With the spreading of branches across the world, major banks had became more exposed to financial crises overseas. The 1975 Concordat set out several proposals concerning the identity specification of banks, defining such terms as branch, subsidiary, and joint venture. These definitions were meant to facilitate the exchange of information between the central banks. The lack of concrete results, however, reflected the weakness of the 1975 Concordat as a tool of supervisory policy.

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[2] The Basle Committee on Banking Regulations and Supervisory Practices comprises representatives of the central banks and supervisory authorities of the Group of Ten countries (Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom, United States) and Luxembourg.

As banking crises lessened between the 1975 Concordat and the Latin American debt crisis in the 1980s, discussions regarding a unified supervisory policy ceased during that period.

The debt crisis of the early 1980s caused difficulties to several international banks, especially to American banks. This crisis produced in 1981 a total amount of claims that reached almost 30$ billion U.S.. Moreover, the American banks held nearly 30% of all Latin American external debt during that decade. No other industrialized country held more than 12% of those bonds.

The bank failures in the American financial system increased greatly during the 1980s. **Table 2** shows the number of bank failures in United States over the period 1985-91. The cases of failure increased constantly between 1980-88, reaching a total of 233 in 1988, almost 20 times more than in the earlier years. Boyd (1993) notes that of the total 944 cases of bank failures in United States during the second half of the decade, the majority of banks had assets up to 5$ billion U.S.. Despite the fact that most banks that suffered from the crisis were relatively small, the crisis shook two banks with more than 30$ billion U.S. in assets; the First Republic Bancorporation and the Continental Illinois[3].

[3] See Bovenzi-Muldoon (1990).

Table 2 - Number of cases of bank failures in the U.S. between 1980-91.

Year	Total number of cases	Increase (%)
1980	13	
1981	15	15.38%
1982	41	173.33%
1983	56	36.59%
1984	97	73.21%
1985	128	31.96%
1986	149	16.41%
1987	188	26.17%
1988	233	23.94%
1989	193	-17.17%
1990	163	-15.54%
1991	75	-53.99%
Total	1351	

Source: FDIC/Boyd (1993)

The crisis roused two main courses of action from the financial authorities in the United States. The authorities played a more pragmatic role in devising a solution to the Latin American debt crisis. Second, they development a supervisory policy intended to strengthen the soundness and stability of the American banking system. The American authorities were convinced that such stability could only be possible with the participation of international supervisory authorities.

Initially, the rule adopted by the American supervisory authorities was a ratio capital/assets of 5,5%. The risk-based capital measure, later a main point of the Basle Accord, was created by the Bank of England in 1979. An agreement signed between the U.S. and the U.K. in July 1986 provided a risk-based capital measure applicable to both nations, and an agreement-in-principles on minimum standards. As a result, supervisory authorities could measure the risk of off-balance sheet instruments or transactions. Such transactions (e.g., letters of credit, derivatives (swaps), etc.) do not

appear in balance sheets. As part of the agreement between the U.S. and the U.K., off-balance transactions should be included to determine minimum capital standards.

Several events contributed to the creation of the Basle Accord, which was finally concluded in July 1988. The 1986 agreement between the U.S. and the U.K. was, at that time, misunderstood by the rest of the European Community. The U.K. was accused of favoring a non-European country, rather than looking within the Community. During this period, the financial system in Japan was booming in proportion with its growing economy. Wishing to enter the US market, the Japanese banks adhered to U.S. and U.K. agreement by the end of 1987. The adhesion of Japan was a key factor at that time, since seven of the ten largest banks in the world were Japanese. As a result, the Basle Committee used the U.S. and U.K. agreement as a basis for the establishment of an international agreement.

Kaptstein (1991) finds that the Basle Accord contributed to the restoration of the American financial system - American banks needing to increase capital merging to more healthier banks. After the 1980s, when some important American banks faced solvency problems, several fusion involving American banks took place. In 1995, the Chase Manhattan Bank associated with the Chemical Bank to create the largest American bank, with total assets up to 297,8$ billion U.S..

II.B - General rules of the Basle Accord concerning capital measurement and capital standards

Capital adequacy based on a weighted risk ratio is a key proposal developed by the Basle Committee. According to this proposal, the capital has to be related to several classes of assets or off-balance sheet exposure, weighted according to classes of risk. As stated by the Committee (BIS (1988)) the advantages over this approach are twofold. First, it assists in linking international banking systems more fairly. Second, it permits off-balance sheet exposures to be incorporated into the standard measure.

As a result, riskier assets need greater amount of capital to cover possibilities of default. The framework of weights used is: 0, 10, 20, 50 and 100%. Tirole (1994) represents the capital adequacy based on a weighted risk ratio using the following expression:

$$Capital \geq 8\% \left\{ \begin{array}{l} \left[\sum_i a_i * \ on-balance\ asset\ type\ i \right] + \\ \left[\sum_{i,j} a_i\, b_j * \ Off-balance\ asset\ type\ i,j \right] + \\ \left[\sum_{i,k} \alpha_i\, \beta_k * \ Off-balance\ exchange\ or\ interest\ rate\ contract\ type\ i,k \right] \end{array} \right\}$$

The regulatory rule stated by the Basle Committee requires capital up to 8% of total assets of the bank. Each asset has to be weighted according to its risk, and/or the liquidity of the operation.

The on-balance and off-balance assets are weighted according to the nature of the loan (i). **Table 3** shows, by category, the different values of ***ai***.

Table 3 - Risk weights by category of on-balance sheet asset

a1	0%	Cash, claims on their own central governments and central banks denominated in national currency and funded in that currency, claims on Member States of OECD
a2	20%	Claims on (or backed by) international organizations, regions and municipalities in the OECD, banks incorporated in the OECD, and banks outside OECD with maturity up to one year
a3	50%	Residential mortgage loans which are fully secured by mortgage residential property
a4	100%	All other assets, especially loans to the private sector, excluding banks.

Source: BIS (1988)

The off-balance assets are weighted by the ***ai***s, and based on the riskiness of the operation, represented by ***bj***. The weight ***bj*** is function of the duration and characteristic of the operation. **Table 4** defines the weights applicable to off-balance assets.

Table 4 - Credit conversion factors by category of off-balance sheet asset

b1	0%	Short-term commitments or commitments which can be unconditionally canceled at any time, it is agreed, generally only low risk;
b2	20%	short-term, self-liquidating trade-related contingent liabilities arising from the movement of goods (e.g. documentary credits collateralised by the underlying shipments);
b3	50%	certain transaction related contingencies (e.g. performance bonds, bid bonds, warranties and standby letters of credit related to particular transaction); commitments with an original maturity serving broadly as a proxy for higher risk facilities);
b4	100%	Those which substitute for loans (e.g. general guarantees of indebtedness, bank acceptance guarantees and standby letters of credit serving as financial guarantees for loans and securities).

Source: BIS (1988)

The third term, the off-balance contracts (swaps, futures, options, etc.) are weight by αi and βi where $\alpha i = ai$, except $a4$=50%. The weight factor $\beta i \in \{0,0.5\%,$

1%,2%,5%} is related with the duration of the operation and its weight for foreign exchange is different from interest rate contracts.

The solvency requirements take account of the accounting value of bank assets weighted for their individual risk. Correlation among assets and between assets and liabilities (related to portfolio risk) do not affect the rule; interest rate risk which exposes the bank's equity to considerable fluctuations can be reduced by indexing loan or by using financial transactions such as swaps.

III - A simple model of the banking firm

The preceding section provided a background to the bank regulation pertaining to the Basle Accord. This section develops a simple model of the banking firm. In particular, we will describe a standard managerial moral hazard within a firm; this model will provide limitations of the formal incentive schemes (bonuses, etc.) The possibility of external involvement in management by supervisory authorities can provide the necessary incentives.

Sections A to C of this chapter describe a moral hazard model with shareholders and the bank manager. The basic concept is the presence of commitment between the agents in order to provide the necessary incentives to the manger's higher effort. The lack of commitment induces a poor manger's performance. In order to restore the right incentives sections D and E introduce an external agent, the banking supervisory authority. Given a minimum capital rule (Basle rule) the shareholders and the manager have to commit to this external threat and the manager can exert higher effort.

Section A creates the basic structure of the banking model. The model rests on the idea that within a banking firm the shareholders try to monitor the manager. The main hypothesis lies on the relation between the revenue's expectancy and the macroeconomic scenario, which the manager has no influence. Section B shows that the lack of commitment don't provide the necessary incentives to the manger. Shareholders' intervention on the manager is based on the expected revenue, which is calculated using the macroeconomic scenario. Having no power on this variable, the manager has no incentives to exert higher effort. Section C describes a game with total commitment. We can find an intervention rule, the optimal managerial incentive scheme, for which the agents can commit providing the manger's effort incentives.

Section D makes the inclusion of a minimum capital rule, which the agents have to commit. As it will be shown in section E this minimum capital rule can, in part,

produce the right incentives to the manager. Finally, section E discusses two different kind of minimum capital rule and its supervisory efficiency.

Extensive work was conducted in this regard by Tirole and Dewatripont (1994), where the authors debate several important issues of the bank regulation. The following model was developed by the authors.

III.A - The basic structure of the model

A simplified balance sheet of a financial intermediary is used to represent the bank's activities. The model assumes that assets are represented by loans in such a balance sheet. By hypothesis, the initial capital and deposits are given. We will have that liabilities, composed by deposits and capital, equal assets; then, the bank uses its deposits and initial capital to finance loans. We will have that the profit is the sum of risky assets and safe assets (Treasury bonds):

$$\pi = \varepsilon + p, \qquad (1)$$

where π is the profit, p safe loans, and ε risky loans.

The profit earned by the bank is the result of a two-period decision. At the first period, the bank receives deposits and proceeds, at the same time, to concede loans. The result, profit, is known at the second period. We assume that, at Date 1, the risky loans have an uncertain final value but the result of safe loans is known. The importance of this two-period structure is such that the all decisions are made at the first period, based on expected result of ε.

The manager determines his or her level of effort in carrying out his or her work, which affects, among other things, decisions in the selection of loans and, consequently, the quality loans. The manager's effort $e \in \{e', e''\}$, where $e'' > e'$, and its

cost is defined by **c(.), c(e')=0** and **c(e'')=K,** having **K> 0**. The low level of effort has no cost to the manager but the high level of effort costs him or her **K**.

The macroeconomics scenario, represented by ***s***, is a variable associated with bank revenue, ε, and lies beyond the control of the bank. The set of ***s*** is

$$s \in [s', s''] \quad , \text{where } s' < s''. \quad (h.1)$$

A higher ***s*** can be interpreted as a growth economy scenario where loans repayments are sustained, thereby increasing expected profit.

A crucial point in this model is the timing of the variables. At Date 1 safe loans and the economy scenario are known; the risky loan will be known at the next period. Both ***s*** and ***p*** are positively correlated with the managerial effort. The density of **p** is **f'(p) if e=e'**, and **f''(p) if e=e''**. For **s** the densities are **g'(s) if e=e'** , and **g''(s) if e=e''**. The model makes the assumption that a high level of effort increases performance, formally the *standard monotone likelihood ratio*. We have that **f''(p)/f'(p)** is strictly increasing in **p**, and **g''(s)/g'(s)** is increasing in **s**, more precisely,

$$\frac{\partial f'(p)/\partial p}{f'(p)} < \frac{\partial f''(p)/\partial p}{f''(p)} \qquad (2),$$

$$\frac{\partial g'(s)/\partial s}{g'(s)} \leq \frac{\partial g''(s)/\partial s}{g''(s)} \qquad (3)$$

The expectancy of ε is made conditional to signal ***s***, dependent of some action **A**; therefore, we have a density function $h_A(\varepsilon|s)$ and a cumulative distribution $H_A(\varepsilon|s)$.

The action **A**, chosen by the shareholders in relation to the manager's work, consists in "intervening," represented by **I**, and "continuing," **C**; formally, $\mathbf{A} \in \{\mathbf{I}, \mathbf{C}\}$. The intervention, in this case, represents corporate reorganization, layoffs or even liquidation. The shareholders' choice is made before the profit is known, based on the expectancy of the risky loan.

Then the timing of model without bank regulation (supervisory authorities) is:

Date 0: (i) initial capital and liability (d) realized.

Date 1: (ii) values of the macroeconomic scenario and the safe asset, (s,p), are observable;

(iii) manager chooses his or her level of effort, e;

(iv) shareholders decide on their action (intervention or continuity) towards the manager based on s, $A \in \{I, C\}$, without observing the manager's effort.

Date 2: (v) value of the risky asset, ε, is realized.

We will make two assumptions using the distribution of the risky loan, ε:

Assumption 1: The action "intervention" has a smaller impact, comparing with "continuing", when the macroeconomics scenario gets better. Then,

$$\frac{\partial H_I(\varepsilon|s)}{\partial s} > \frac{\partial H_C(\varepsilon|s)}{\partial s} \quad . \qquad \text{(h1)}$$

Assumption 2: A positive macroeconomics' scenario, ***s*** close to ***s''***, improves the expectancy of the assets, ε. Using this assumption we will have,

$$\frac{\partial H_A(\varepsilon|s)}{\partial s} < 0, \text{ where } \mathbf{A} \in \{\mathbf{I}, \mathbf{C}\}. \quad \text{(h2)}$$

III.B - The game's 'backward induction' solution without commitment

Without commitment the shareholders make the decision whether to intervene on the manager's work based only on the expected revenue of the risky asset.

Following the last section, the first assumption, (h1), allows us to define **D(.)** as the monetary incentive to the shareholders to choose action **C**. The function **D(.)** represents the difference between the expected revenue under each action.

$$D(s) = \int_0^\infty \varepsilon \left[h_C(\varepsilon|s) - h_I(\varepsilon|s) \right] d\varepsilon \quad (5)$$

Developing (5) we will have,

$$D(s) = \left[\varepsilon \left(H_C(\varepsilon|s) - H_I(\varepsilon|s) \right) \right]_0^\infty + \int_0^\infty \left[H_I(\varepsilon|s) - H_C(\varepsilon|s) \right] d\varepsilon \quad , \quad (6)$$

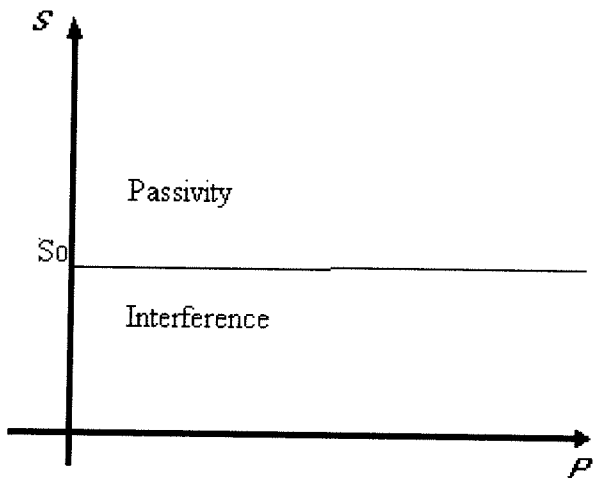
and,

$$D(s) = \int_0^\infty \left[H_I(\varepsilon|s) - H_C(\varepsilon|s) \right] d\varepsilon \quad . (7)$$

Let s_0 be defined by $\mathbf{D(s_0)=0}$; the macroeconomics scenario under which the expected revenue is the same at each action. For $s \geq s_0$ we have the case where **C** is the ex post efficient action; then, if the probability of interference by the shareholders is not related to the manager's performance, the manager exerts no effort. The model needs to develop an optimal managerial incentive scheme to support the manager's choice for a high level of effort.

The figure 1 represents the shareholders' ex post efficient action based only on the macroeconomic scenario (***s***). If s is greater than ***s*0**, then the shareholders' ex post efficient action is "continuing" (***C***). It is clear that in this case the shareholders' choice is independent of the level of effort chosen by the manager, in consequence the manger exerts no effort. In short, this scheme cannot induce the manager's effort.

Figure 1- Ex post efficient actions independent of the manager's effort.



III.C - The optimal managerial incentive scheme, solution with total commitment

With total commitment between the agents a optimal managerial incentive scheme can be found in order to minimize inefficiency choices by the shareholders. Let **θ(p,s)** be the probability that the action **C** is chosen by the shareholders. By definition, this probability is function of the macroeconomics scenario, ***s***, and the quality of the safe loan that measures the manager's performance, ***p***. Consequently, we have that **1-θ(p,s)** is the probability of **I**.

The **D(s)** can be divided into two different parts. Let **D+(s)** be the positive results of **D(s)**, **D+(s)= max(D(s), 0)≥0**, representing the expected revenue under action **C**. **D-(s)= min(o, D(s))≤0** denotes the non incentives to choose **C**. We will have

$$D(s) = D_+(s) + D_-(s) \quad (8)$$

The optimal incentive scheme is acquired by minimizing the expected ex post inefficiency by the shareholders' choice constraint to the manager exerting a high level of effort.

$$\underset{\theta(p,s)}{Min} \iint \left[(1-\theta(p,s))D_+(s) - \theta(p,s)D_-(s)\right] f''(p)g''(s)\,dp\,ds \quad (9)$$

subject to

$$B\iint \theta(p,s)\left[f''(p)g''(s) - f'(p)g'(s)\right] dp\,ds \geq K \quad (10)$$

In (9), **D-(s)θ(p,s)** represents the possibility of non interference when the expected revenue is negative. The symmetrical case is **D+(s)(1-θ(p,s))** where intervention occurs with positive expected revenue. The constraint (10) denotes the permanence of the manager exerting a high level of effort. The manger derives a private benefit **B>0** (social status, ego) from controlling the bank with no external interference. The high effort cost is **K >0**.

We will have the Lagrangian,

$$L(\theta(p,s)) = \left[(1-\theta(p,s)D_+(s)) - \theta(p,s)D_-(s)\right] f''(p)g''(s) - \mu B\theta(p,s)\left[f''(p)g''(s) - f'(p)g'(s)\right] \quad (11)$$

Using the derivative in (11) we have the first order condition with respect to **θ(p,s)**; at the optimal:

$$\frac{\partial L}{\partial \theta} = [-D_+(s) - D_-(s)]f''(p)g''(s) - \mu B[f''(p)g''(s) - f'(p)g'(s)] = 0$$

(12)

The first order conditions are expressed by (12) and (10). Substituting **θ(p,s)=0** in (10), we can show that the intervention is not in the optimal incentive scheme. Besides, the **θ(p,s)=1** can be part of the optimal scheme. Therefore, we can conclude that the passivity of the shareholders is necessary to minimize the expected ex post inefficiency.

Rearranging the terms in (12) and using the definition of D(s), we have that at the optimal:

$$D(s^*(p))f''(p)g''(s^*(p)) = \mu B[f'(p)g'(s^*(p)) - f''(p)g''(s^*(p))] \quad (13)$$

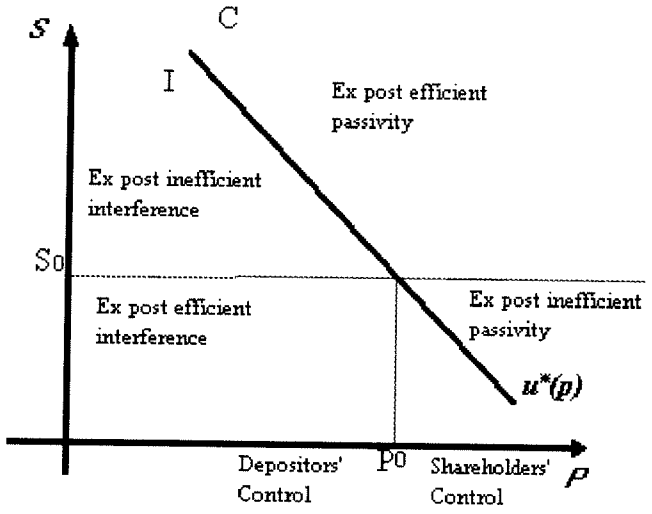
The optimization reveals an optimal ***s*** as function of ***p***, $s^*(p)$. We can show that $s^*(p)$ is negative related to ***p***, $\partial s^*(p)/\partial p \leq 0$.

Let p_0 be defined by $s^*(p_0) = s_0$. The shareholders' efficient decision rule is applied when the manager's performance is at least p_0. The optimal incentive scheme menaces the manager with intervention in case of poor performance ($p < p_0$) and maintains passivity when performance is good ($p > p_0$).
The implementation of this rule rests on the total commitment between the two agents.

As already seen, the optimal incentive scheme, which uses the safe asset (***p***) to measure the manager's performance, has a negative slope that is represented in figure 2. The difficulty to implement this kind of rule lies on the lack of commitment between the shareholders, and the manager. To implement this rule we have to accord control upon a third part (depositors) contingent on ***p***. Poor performance has to generate the depositors' control of the bank. Having the ***p*** to measure manager's performance we can induce him

or her to exert high level of effort. The trade-off between the safe asset and the macroeconomic scenario to make the decision whether to intervene can provide the incentives to the manger's effort. The external interference based on a third part representing the depositors is the key point to implement this optimal incentive scheme. It is clear that a 'bonuses' type of contract cannot implement this scheme.

Figure 2 - The optimal managerial incentive scheme



III.D - The bank supervision

Based on the preceding section, we now search for additional incentives that can provide a good management performance. The possibility of external involvement in management by outsiders, for example debtholders represented by the central bank, could provide such incentives. This subsection discusses the implementation of an optimal policy through adjusted voluntary recapitalization based on bank supervision.

It is necessary to adapt the rules of bank supervision used to maintain the solvency of the system to our model. The supervisory decision to intervene in a bank is the result of a non-satisfactory performance in terms of capitalization.

Capitalization can be based on assets; the main rule in the Basle Accord takes the risk-weight approach to find the minimum capital level needed for a bank. For example, in the case of Brazilian supervision, prior to 1995, the capitalization rule was based on liabilities. These two different rules will be represented using our model's framework.

As already demonstrated, the Basle Accord, not taking into account off-balance sheet activities, is a risk-weight rule where the capital has to represent at least 8% of the asset. We can interpret the foregoing as ***ratio = 8%*** $\leq$ ***Capital / [Σiαi Asset(i)].*** In our model, the asset, $\varepsilon+p$, has a different associated risk. Let a be the risk weight associated to the ε, and b associated to p. We will call d the amount in the liability side, then the equity (capital) will be represented by the difference between assets and liability, $\varepsilon + p - d$. Consequently, we will have,

$$\frac{\varepsilon + p - d}{a\varepsilon + bp} = r_x \text{ , (14)}$$

as a solvency ratio to the risk-weight rule. Let us assume now that intervention occurs, shifting the control from the shareholders to depositors (supervisory authority), when r_x falls under the threshold $r_x^{\min}$. The banks must then have a solvency ratio $r \geq r_x^{\min}$.

In the first period, without knowing the asset value, the supervisory authority uses the accounting value of the principal on those loans, $\bar{\varepsilon}$. We will have the ratio being calculated with $\bar{\varepsilon}$ rather than ε.

IV.E - Recapitalization

This section develops a structure to analyze incentives related to the shareholders' recapitalization. Before we do so, let us review the timing.

The timing of the model with external supervisory authority:

Date 0: (i) initial capital and liability (***d***) realized. The solvency ratio is estimated using the accounting value of the loans, $\bar{\varepsilon}$, and the supervisory authority reveals its intentions to intervene. If the solvency ratio is below the minimum level, $r(\bar{\varepsilon}, p) < r^{\min}$, shareholders are asked to recapitalize the bank in order to maintain its control rule.

Date 1: (ii) The values of the macroeconomic scenario and the safe asset, (***s,p***), are observable;
(iii) Manager chooses his or her level of effort, ***e;***
(iv) Without observing the manager's effort, the shareholders decide on their action (intervention or continuity) towards the manager based on ***s***, $A \in \{I, C\}$, and they choose whether to recapitalize.

Date 2: (v) The value of the risky asset, **ε,** is realized.

We will analyze the recapitalization case focusing on the strength of the risk-weight rule for different macroeconomic scenarios. As noted above, the amount needed to undertake a successful recapitalization must be large enough to equalize the solvency ratio and the minimum required by the Basle Accord. In formal terms:

$$r_x^{\min} = \frac{\bar{\varepsilon} + p - d + \Delta k_x}{a\bar{\varepsilon} + bp} = r_x, \quad (15)$$

where Δk_x is the minimum amount that the shareholders have to pay to keep the bank from intervention. Using (15) we can find Δk_x in function of the other variables. We will have that $\Delta k_x = \bar{\varepsilon}\left(ar_x^{\min} - 1\right) + p(br_x^{\min} - 1) + d$.

The expected profit by the shareholders is, after recapitalization,

$$R_x = \int_{d-p-\Delta k_x}^{\infty} \left[\varepsilon + p - d + \Delta k_x\right] h_C(\varepsilon|s)\, d\varepsilon - \Delta k_x \ . \quad (16)$$

Assuming that the shareholder will recapitalize at the minimum amount needed, Δk_x, we can substitute (15) in (16), or equivalently,

$$R_x = \int_{d-p-\Delta k_x}^{\infty} \left[1 - H_C(\varepsilon|s)\right] d\varepsilon - \bar{\varepsilon}\left(a r_x^{\min} - 1\right) - p\left(b r_x^{\min} - 1\right) - d \quad . \quad (17)$$

Equation (17) expresses the shareholders' incentives to recapitalize. But the important issue here is the *net gain to recapitalize* represented by $\tilde{R}_x$, where we subtract the expected value of "stopping" :

$$\tilde{R}_x = R_x - \int_{d-p}^{\infty} \left[1 - H_I(\varepsilon|s)\right] d\varepsilon \quad (18)$$

Equation (18) can be used to find the derivatives of $\tilde{R}_x$ in terms of $\boldsymbol{p}$ and $\boldsymbol{s}$. In fact equalizing (18) to zero when shareholders are indifferent to recapitalize yields it gives the function $\boldsymbol{s}$ in terms of $\boldsymbol{p}$, $\tilde{s}(p)$. We will have two cases. The first case arises when $\boldsymbol{a=0}$ and $\boldsymbol{b=1}$, using the Basle's rules that the weight of the safe asset equals to zero and the risky asset equals to one:

$$\left.\frac{\partial R_x(a,b)}{\partial p}\right|_{a=0,b=1} = H_I(d-p|s) > 0 \quad , \quad (19)$$

$$\left.\frac{\partial R_x(a,b)}{\partial s}\right|_{a=0,b=1} = \int_{d-p-\Delta k_x}^{d-p} \left(\frac{-\partial H_C(\varepsilon|s)}{\partial s}\right) d\varepsilon + \int_{d-p}^{\infty} \frac{\partial\left(H_I(\varepsilon|s) - H_C(\varepsilon|s)\right)}{\partial s} d\varepsilon \quad .$$

(20)

The second case can be interpreted as a liability rule, when the minimum capital is based on the amount of deposits. Using this type of rule the risk is not weighted; we will therefore use the safe asset to derive the minimum capital. The

important issue is to disregard the amount of assets in risk. This case is represented using ***a=1*** and ***b=0***. The derivative with respect to ***s*** is the same as in (20), the other, with respect to ***p***, is as follows:

$$\left.\frac{\partial R_x(a,b)}{\partial p}\right|_{a=1,b=0} = \left(1 - r_x^{\min}\right) + H_1(d - p|s) \quad , \qquad (21)$$

It is clear that the derivatives expressed by (19), (20) and (21) are strictly positive[4]; as a consequence the slope of ***s*** in terms of ***p***, $\tilde{s}(p)$, is negative. This negative slope leads to the finding in section III.C, which is the optimal incentive scheme. (19)-(21) show that this optimal incentive scheme, by which the expected ex post inefficiency due to the shareholders' choice is minimized, can be achieved with external threats by the supervisory authority. The figure 3 represents the model of the banking firm with external threat by the supervisory authority based on a minimum solvency requirement.
Comparing the figure 3 with the figure 2, it is clear that the important feature regarding both figures is the existence of trade-off between ***p*** and ***s*** (***s(p)*** is downward sloping.)

Figure 3 - Minimum solvency requirement

[4] To see this in (20) we use the assumptions made previously in (h1) and (h2).

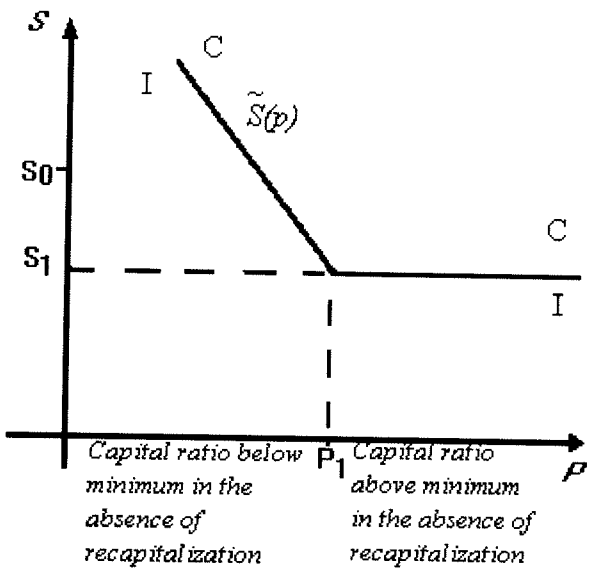


Figure 3 shows that points located above the $\tilde{s}(p)$ represent the "continuing" of the manager. It is important to emphasize the difference that we have with the minimum capital rule. At lower levels of the safe asset, which the capital ratio is below the minimum before the recapitalization ($p < p_1$), the supervisory authorities require the bank to recapitalize. The area located above the $\tilde{s}(p)$ and below p_1 represents points where the bank choice was to recapitalize and maintain the manager. "Intervention" below p_1 can be interpreted as refusal of recapitalization. With the level of the safe asset above p_1 we have the same kind of choice illustrated in figure 1, without commitment between the shareholders and the manager.

The positive derivative represented in (19) and (21) indicate that, under the asset and the liability rule, the lower the p, the higher the reluctance to recapitalize. Since $(1-r_x^{\min})$ is positive, then the derivative represented by (21) is higher than (19). In fact the effect of p in the reluctance to recapitalize is more significant under the liability rule.

The "intervention" by the supervisory authority occurs differently under either liability or risk-weighted asset rule. At a given s, the p needed to recapitalize under the liability rule is smaller than the asset rule. In other words, the manager performance

required, measured by p, is smaller under the liability rule. Not taking into consideration the risky asset, the liability rule is less tight than the asset one. In the search for a more strict rule, the risk-weighted asset rule calls for a better performance of banks.

III - Conclusion

The Basle Accord is an important step towards an international prudential bank regulation. The importance of a bank regulation in maintaining solvency and public confidence in the financial market has grown during the last two decades, due mostly to financial crises in the developed world. This work showed that the cost of bank crisis are, sometimes, excessive. Therefore, the maintenance of the banks' solvency is certainly rewarded in the long run.

The second section of this work reviewed the main events that led to a unified international prudential regulation of banks. Focusing at the level of the minimum capital, the regulation takes into account the off-balance transactions and weighs the assets operations in terms of their risks. For example, the capital adequacy based on a weighted risk ratio used by the Basle Committee requires no capital for assets held in cash or Treasury bonds. In the case of loans to private (non-financial) firms, the weight used is 100%, meaning that to each dollar held in this kind of asset the bank has to have another one in its capital.

Tirole and Dewatripont (1994) developed a model of a bank firm showing the limitation of the formal incentive schemes. As shown in the third section, the external regulation can provide the necessary incentives in management. Moreover, this section showed the utility of the rule based on the weighted asset by its risk achieving a more strict bank regulation.

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