Rethinking the Regulatory Reform: the Complementarity between Capital and Liquidity Regulations

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Abstract:

Until nowadays, capital regulation has been conceived independently of liquidity regulation. In this paper we present some insights explaining that the underlying reduction in liquidity and capital ratio, the increasing vulnerability to market liquidity risk and the correlative increase in ROE are driven by joint factors. To capture the excessive risk taking in the banking system resulting from the increasing vulnerability to market liquidity risk, it is crucial for banking supervisors rethinking banking regulation in a new spirit. They should take the complementarity between capital and liquidity into account.

We develop a nonlinear approach for dimensionality reduction, the neural network approach, in order to capture the new interdependence between banks' liquidity and solvency fragilities. Our results support the main reorientation of the new regulatory framework and, are a plea in favor of a calibration of capital and liquidity requirements according the business model of banks i.e. the specific association of characteristics concerning their funding structure, their leverage and the insertion or not in a diversified financial group.

Keywords: bank regulation, capital adequacy ratios, liquidity risk, neural networks.

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1. Introduction

Since the eighties, the rules on bank capital have become one of the most prominent aspects of banking regulation. The rationale for regulatory bank capital ratio is to preserve bank solvency and so to protect the interests of creditors (especially small depositors) which are deprived of the expertise, incentives and ability to efficiently discipline bank managers (Dewatripont M and Tirole J. 1994).

Until nowadays, capital regulation has been conceived independently of liquidity regulation because it has been largely admitted that the key determinant of the size of capital buffer should be the riskiness of the assets with a crude valuation of risk with Basel 1 and a more sophisticated one with Basel 2. One of the key foundations of such a prudential design is that the roots of the potential solvency problems are strictly located on the assets side, because deposit insurance schemes protect banks from depositors' runs. This reasoning leads to a sharp distinction between solvency and liquidity which neglect the influence of liquidity stress on assets valuation. Therefore, the decreasing trend of the ratio of equity to assets observed during the 20th century was halted and reversed by the introduction of the Basel 1 agreement but, it was not the case for liquidity adequacy. This continuing downwards trend in bank's liquidity adequacy was permitted by the fact that international negotiations on the bank liquidity regulation failed in the 1980's.

The Achilles' heel of the prudential design based on a strict divide between solvency and liquidity is that it neglects fundamental changes in contemporary financial system. The financial globalization and the following explosion of market finance have upset the segmentation between banks and non-banks and, have led to the sacrament of shareholder returns maximisation as the main criteria for firm evaluation. Moreover, capital is a costly mode of funding for individual banks. The stockholder limited liability in the banking sector

introduces a risk taking bias because of the existence of a safety net and lender of last resort. Indeed, when the risks taken by the banking system materialized, the costs are mainly borne collectively by taxpayers and not by bankers. This situation partly explains the banks' shareholders preference for short term debt financing rather than raising capital.

The aggressive profit research and, shareholder preference for short term debt financing have introduced a drastic change in the bank business model. It led to the shift from the "originate and hold" to the "originate and distribute" business model. The first model involved the creation of funding liquidity through asset transformation from loans to deposits. In the second model, the bank creates market liquidity rather than funding liquidity by the transformation of "hard to sell assets" into funds that are easier to sell like bonds or other securities. This process allows the originating bank to sell assets to investors, recycle the capital and originate new loans which can in turn be securitized, yet it also dramatically increases the vulnerability of the bank to market liquidity risk. This new business model rests on the securitization of any type of credit sold as illiquid securities tranches to the investing community. Credits are "structured" and the bank depends entirely on market liquidity for its funding. So, the weakening of banks' capital position and the increased banks exposures to market liquidity crisis are intrinsically linked. This balance sheet distortion (lower capital and liquidity ratios) indicates an excessive risk taking in the banking system which generated an increased return required by shareholders.

During stress periods, the combination of a sharp deterioration in creditworthiness and a large maturity mismatch can provoke a drying-up of market liquidity, since market-wide events are perceived simultaneously by all market participants. Distress sales of shadow banks ensue from the slump of fuel price in equity markets. The latter shrink the capital cushion of the embattled firms and entails an adverse reappraisal of their risks (Adrian T and Shin H.S,

2008). With mark-to-market accounting, changes in asset prices rapidly impair the net worth of all the participants in the financial system. Consequently, in times of stress, a tightening in market liquidity quickly translates into changes in the banks and market intermediaries' equity base. There is a dynamic interaction between the liquidity and solvency of financial institutions, because if market participants have misgivings about the solvency of their counterparts, they cut off their access to funding and so themselves cause the solvency problem that they fear. Market and funding illiquidity are highly interconnected and self-reinforcing (Brunnermeier M and Pedersen L.J., 2009). It follows that solvency problems cannot be anymore interpreted as being exclusively due to the asset side. All market participants know these new interrelationships between market illiquidity and funding illiquidity[4] and the blurred frontier between illiquidity and insolvency in a market-based financial system. As we have seen previously, when a bank is highly leveraged, even a small decrease in asset value can lead to distress and potential insolvency. Bank's illiquidity and insolvency are closely linked.

In this paper we present some insights explaining that the underlying reduction in liquidity and capital ratio, the increased vulnerability to market liquidity risk and the correlative increase in ROE are driven by joint factors. To capture the excessive risk taking in the banking system resulting from the increased vulnerability to market liquidity risk, it is crucial for banking supervisors thinking banking regulation in a new spirit. We would like to argument that in the prevailing financial system it is necessary to consider jointly the design of capital and liquidity regulation. Many propositions from academics and regulatory authorities have been mentioned to improve the European banking supervision. Most of these proposals are solutions to cope with the actual banking regulatory framework loopholes.

[4] Funding illiquidity occurs when solvent financial institutions have difficulty borrowing immediate means of payment to meet liabilities falling due.

Some of them have even already been introduced in the "Basel 3 package" announced on September 12, 2010 as for example the reinforcement of the quality of bank capital or the introduction of the Liquidity Coverage Ratio and the Net Stable Ratio to monitor bank liquidity risk. But beyond the crucial rectification of these loopholes, it is in our opinion the banking regulation spirit which should be reviewed. So, our proposition is set on a longer time horizon. We propose a framework which could provide guidelines for banking supervisors' reactions.

We develop a nonlinear approach for dimensionality reduction, the Neural Network approach, in order to capture the new interdependence between banks' liquidity and solvency. The dimensionality reduction method will help us to detect significant variables for explaining differences in the 2007-2008 crisis impact between banks. The variables describing management quality, leverage strategy, the partition between banking and trading book, the funding strategy and, bank specialization reveal to be significant according to the RMSQ criteria. The most important result is that what is really crucial to distinguish banks which encounter losses from the strong banks is neither the short term funding strategy nor the investment strategy, nor the risky leverage strategy taken alone, but the combination of risky funding and leverage strategies. Therefore, our results establish the importance of taking into account the complementarity between liquidity and solvency risks in the new regulatory framework.

The paper is organized as follows. In the second section of the paper, we present the neural network approach used in our study and we justify our choice in favor of this methodology. The third section details the variables and the data used in the empirical analysis. The fourth section presents the empirical results. Finally, the last section emphasizes the policy implications of our results.

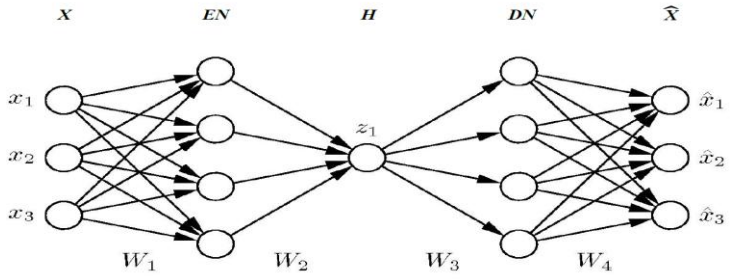
2. Methodology

Bank's managers take every year important decisions about the strategy the firm will follow. Those decisions will be determinant for the bank risk-taking, and consequently for its results. In the first part of the paper we turn out a dimensionality reduction to detect significant variables for explaining differences in the 2007-2008 crisis impact between banks amongst the whole variables traditionally used for estimating the risk a bank represents. Then, we couple those criteria to test which decisions in the bank strategy have a decisive impact on the bank results.

Here, we choose to develop a nonlinear approach for dimensionality reduction. Nonlinear approach is much more accurate than the linear method when one have to make decisions in real time as it could be the case for regulators' decisions. The reason is that the time to update information at decisions moments is reduced with nonlinear models. Moreover, nonlinear models take into account human imperfect economic decisions contrary to linear theoretical models which lean on restrictive hypothesis and, have significant unsupervised learning abilities. That is in part why nonlinear models in general and particularly self-organizing neural networks have grown in importance these last years. Recent research studies of self-organizing neural networks have appeared in many fields as for example for classification (Corridoni, DelBimbo and Landi, 1996; Deschenes and Noonan, 1995), clustering (Murtagh, 1995), and forecasting (DerVoort, Dougherty and Watson, 1996).

One special feature of banks' strategies is their interdependency. Indeed, they usually have to be jointly implemented by the bank[5]. The consequence is that the total effect of a particular strategy on the bank's result can be amplified by the existence of another strategy.

Schema1: Neural Principal Components.

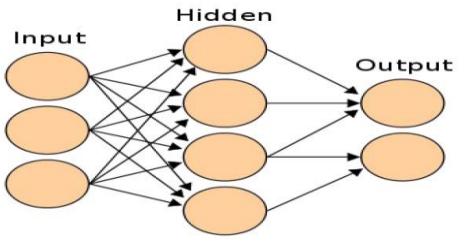


As the objective of the paper is to propose a framework which could provide new guidelines for banking supervisors' reactions, it is crucial to take these interdependences into account to anticipate banks' potential troubles. Therefore, we have to give up traditional linear methodologies which suppose linear relationships between dependant and independent variables and, neglect the nonlinear relationship resulting from the interdependence between inputs. We turn out to a nonlinear approach which seems to us more adapted to capture these complex relationships between the bank's strategies. The non linear method we chose to develop is the Neural Network approach which is one of the nonlinear dimensionality reduction methods (see schema 1). In this paper we are in line with the use of a neural networks approach for classification problematic.

[5] We can mention the paper of Galai and Masulis (1976) and the one of Saunders, Strock and Travlos (1990) for the relationship between bans' ROE and leverage. The papers of Brunnermeier and al (2009), and Adrian and Shin (2010) emphasize the interdependence between leverage and liquidity. And, Borio (2008) outlines the fact that banks' off balance sheet activities are usually supported by short term funding strategies.

The neural network structure for nonlinear principal components analysis appears based on the representation in Fotheringhame and Baddeley (1997). Artificial neural networks are relatively crude electronic networks of "neurons" based on the neural structure of the brain.

Schema 2: A neural network.



Neural networks[6] process records one at a time, and "learn" by comparing their arbitrary classification of the object with the known actual classification of the object. The errors from the initial classification of the first bank is fed back into the network and used to modify the networks algorithm the second time around and so on for many iterations. Roughly speaking, a neuron in an artificial neural network is compounded of a set of input values (x_i) and associated weights (ω_i), a function (g) that sums the weights and maps the results to an output (y). Neurons are organized into layers. We have first the input layer. The next layer is called a hidden layer. There may be several hidden layers. The final layer is the output layer (see schema 2).

The input variables in this network are encoded by two intermediate log-sigmoid units in a dimensionality reduction mapping. These encoding units are combined linearly to form H neural principal components. The H-units in turn are decoded by two decoding log-sigmoid units in a reconstruction mapping, which are combined linearly to regenerate the inputs as the output layers. The equations for a neural network are the following:

[6] This description of the Neural Network method is taken from the book "Neural networks in finance" written by McNelis in 2005.

$$EN_j = \sum_{k=1}^{K} \alpha_{j,k} X_k \quad (1)$$

$$EN_j = \frac{1}{1+\exp(-EN_j)} \quad (2)$$

$$H_p = \sum_{j=1}^{J} \beta_{p,j} \mathrm{EN}_j \quad (3)$$

$$DN_j = \frac{1}{1+\exp(-H_p)} \quad (4)$$

$$\hat{X}_k = \sum_{j=1}^{J} \delta_{k,j} DN_j \quad (5)$$

Where EN is the Encoding Neuron; DN is the Decoding Neuron; H is the Neural Principal Components; X is the Inputs and, $\hat{X}$ is the Output.

The coefficients of the network link the input variables X to the encoding neurons and to the nonlinear principal components. The parameters also link the nonlinear principal components to the decoding neurons, and the decoding neurons to the same input variables X. The experiments using Neural Network are performed in MATLAB.

3. Data and variables selection

Our choice of explanatory variables reflects both the theory of the determinant of banking risk-taking strategy and data availability. All the organizational choices taken by the bank will affect more or less its solvency. The analysis will help us to see which aspects of these organizational choices are decisive to estimate the potential impact of a crisis on the bank's results. The variables and their codes are presented in Annex 1.

Amongst the variables we consider in our analysis there is shareholders' Return on Equity (ROE). ROE is introduced as an explanatory variable because it may be used as a proxy for the riskiness of an individual bank strategy which adversely affects the solvency of the

institution during stress periods. Such positive correlation between excessive risk taking behaviour and high ROE in banking activity stems from the stockholder limited liability in the banking sector in a context of protective safety net which introduces an asymmetry between the privatization of gains in the good states of the world and the socialisation of losses in the bad states of the world. Among the possibilities for the banks to benefit this asymmetry between gains and losses, we can mention the fact that they can originate assets which themselves have asymmetric returns. Subprime loans are a good example. These assets yield a high payoff (after the reset of interest rates) in the good state of the world but in bad states the increased defaults generate huge losses.

In addition to ROE, bank leverage is used to test the hypothesis that high losses may be driven by excessive and risky strategies. Indeed, the simplest way to exploit the asymmetry of payoff arising from limited liability is to increase the leverage[7]. So, a high ROE is likely to be associated with high leverage strategy. In spite of the capital regulation, banks could dramatically increase their leverage ratio largely because the statistical models which have been placed at the core of the capital regulation are conducive to regulatory arbitrage and to regulatory capture through complex modelling assumption and calibration procedures (Danielsson 2008, 2009, Hellwig, 2008).

The partition between banking and trading book can also give information about the bank's risk-taking strategy. As trading assets are valued in mark to market, an increased proportion of assets held in the trading book relative to assets held in the banking book raises the sensibility to aggregate market fluctuations (β) and boosts the profitability and ROE in the boom period of the financial cycle as well as it generates huge losses in the bust period of the

[7] See the formula of Modigliani and Miller (1958) that measures the leverage effect.

financial cycle. To test the potential role of the partition between banking and trading book on banks' exposition to losses we introduce the ratio banking book to assets.

The ratio of off-balance-sheet items over total assets partly captures the bank's sensitivity to market risk. This variable may matter for at least two reasons. Firstly, off-balance-sheet activities (in particular securitization and credit derivative) have been one of the main causes of the actual financial crisis. Credit risk transfer mechanisms are supposed to transfer assets from banks' balance sheet to other investors in the economy but instead banks exploited theses mechanisms for regulatory arbitrage. Moreover, the "originate to distribute" model which permits an increase of the potential of credit distribution for a given level of capital reduces the bank's incentives to correctly assess the solvency of debtors and so generates an aggravation of the decrease in asset quality which already characterized the credit boom periods (Dell'Ariccia, Igan and Laeven 2008). The securitization of low quality credits contributes to create a direct channel of contagion through the dissemination of bad quality structured credit products. The second reason for taking into account the off balance sheet ratio is that it reflects an increased dependency to markets which reveals to be disastrous during market liquidity freezing episodes. In particular when banks were obliged to engage themselves in a massive re-intermediation process of their off-balance-sheet vehicles through purchases of assets from or extended credit to the off-balance-sheet vehicles that they had created. (Basel Committee on Banking Supervision, April 2008).

We also introduce information about Management Quality and Asset Quality because they are variables traditionally used as predictors of banks' risk level[8].

[8] For instance, the CAMELS rating is a US supervisory rating of the bank's overall condition used to classify the US' banks. The components of CAMELS are Capital adequacy, Assets quality, Management, Earnings, Liquidity and Sensitivity to market risk.

For at least two reasons, we also consider information on regulatory capital adequacy. On the one hand, it permits to observe banks' solvency that is to say, to assess if the bank correctly covers the risks associated to its activity. On the other hand, it allows to test if current regulatory tools are still efficient to detect risky banks. As supposed in the Basel 2 capital regulation, we consider that the Total risk-based capital ratio can be used as a proxy of bank's solvency (Basel Committee on Banking Supervision, 2004). We expected those traditional regulatory tools to be insignificant due to the dynamic interaction previously explained between illiquidity and insolvency of financial institutions and, to the fact that internal models of risk are useful for measuring risk of frequent small events but not for systematically important events (Danielsson, 2002). Nevertheless, we suppose that the ratio tier 1 capital to risk based total assets may constitute a better proxy for bank's solvency. So, we incorporate this latter in addition to the ratio of total capital to risk-based assets to capture the proportion of high quality capital available for each bank. Indeed, as recognized by the Basel Committee on banking supervision, the vulnerability of the banking sector to the buildup of risk in the system was primarily due to excessive leverage and, too little capital of insufficient quality.

The maturity mismatch exposes banks to liquidity risk. This liquidity risk can be limited by forcing banks to match a percentage of the resources they collect with assets of the same maturity and/or by requiring a minimum ratio of liquid assets over total assets in the balance sheet. Adverse financial circumstances should be less likely to lead to high losses in banks with sufficient liquid assets to face short term commitments and with stable funding relations. The more the bank is risky in terms of liquidity, the more the deleveraging process will be important. Thus, high proportion of liquid assets coupled with low short term funding mean less exposure to liquidity risk, wiser management and consequently a sounder bank. To capture liquidity risk, we use both the ratio of total deposits, Money markets and Short Term funding over total funding and, the ratio liquid assets to short term funding. We exclude

customer deposits from short term funding because despite their liquid feature, they can be considered as a stable funding source.

Finally, banking losses may be related to the fact that it benefits or not from the "Systemically Important Financial Institution" status. It is important because this status gives to the bank an implicit government bailout which can be a high incentive to excessive risk taking. To capture the systemic feature of banks one can observe the size, the interconnectedness, the leverage, opacity/complexity, correlation of exposures, maturity mismatches or concentration risk (FSB, 2009). In order to test this hypothesis; we choose to introduce information about bank size in our variables to capture the systemic or not systemic feature of the bank.

We also construct a dummy variable that takes a value of one for commercial banks, of two for investment banks and, of three for cooperative banks to discriminate the analysis of the results according to bank's specialization.

For the second step of the analysis, we add an explained variable to examine the impact of the variables previously selected by the dimensionality reduction process on banks' results. As the explained variable, we use the variation of credit supply as a proxy for losses encountered by banks. It is a proxy of the impact of the crisis on banks' results. Indeed, in time of financial stress when banks face large losses, bank's shareholders generally prefer the rationing of credit supply rather than raising fresh capital. Indeed, the cost of raising new capital is bear by banks' stockholders who suffer a dilution of their powers whereas the benefits are mainly appropriated by the bank's creditors and the deposit insurance (Berger A., Herring R and Szego G, 1995). That's why shareholders prefer credit rationing. The more the losses are important, the more the contraction of credit offer will be important. So, variation in credit supply can be used as a proxy for bank's losses.

To analyze banks' risk-taking strategy and its impact on banks' results during the crisis, we have identified and dated the beginning and the end of a complete financial cycle including a rising phase and a return phase. We make this choice because excessive behaviors are built up during the ascendant phase of the cycle so, it is important to capture what happens before the difficulties occur (Minsky H.P. (1986), Kindleberger C., 2000). As the study focuses on the recent crisis, the period of study goes from 2000 to 2008 to integrate the whole financial cycle. We begin our study in 2000 because it corresponds to the end of the NITC financial cycle and the beginning of a new one. The year 2008 corresponds to the subprime crisis which ends this cycle.

For our analysis, we use a set of European commercial, cooperative and investment banks established in 14 European countries[9]: Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and, UK. To determine which banks to include, we began with all the European banks with data available for the period of study. The dataset contains 747 observations[10]. We then eliminated banks with less than 7 years of observations for the variables considered. Other banks had to be eliminated because the main financial data series were missing or mostly incomplete. Finally, 437 observations were excluded because the Matlab is highly sensitive to the existence of missing data even if it is only one observation missing for each bank. This process of elimination left us with 307 observations. The final dataset is compounded of 239 commercial banks, 35 cooperative banks and 33 investment banks[11]. The final dataset for the

[9] We choose to exclude Italy from our sample because there are a large number of small Italian cooperative banks in the Bankscope database. Doing so, we minimize the selection bias.

[10] As our empirical analysis proceeds with cross-section data, one bank in two different years is considered as two different observations.

[11] The entire dataset is then divided into training and validation subsets. The objective of the training set is to stock the empirical knowledge and the aim of the validation set is to validate the results obtained by the training set through a

analysis contains 12 explanatory variables and the dependant variable for 307 banks. Ten out of these 12 independent variables are financial ratios. The two last variables are more qualitative variables. We use banks' consolidated statements to better capture the real situation at the group level. All the data are annual data taken from the Bankscope database.

4. Results

Dimensionality reduction's results

Contrary to classification problems where the results obtained are groups, in the case of the dimensionality reduction, the result we obtain is criteria's significance. So, the first part of the analysis consists in identifying the most significant variables over the 12 variables previously selected for explaining differences in the 2007-2008 crisis impact between banks. The descriptive statistics for the variables are provided in annex 2.

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generalization process. The training set consists of randomly chosen 106 banks which encountered losses and 138 banks which increase their credit supply, whereas the validation set consists of 18 banks which encountered losses and 43 banks which increase their credit supply.

Table 1: Variable selection (Results of the standard error and the RMSQ tests).

VARIABLES	CODES	RMSQ	ERROR
Management Quality	O/TA	0,005292625	-0,006104731
Leverage	LEV	0,020935879	-0,035684605
Trading Book/Total Assets	TB/TA	0,079948251	-0,05186226
Short Term Funding/Total Funding	STF/TF	0,088353454	-0,065218818
Liquid Assets/Short Term Funding	LA/STF	0,099609994	-0,083020789
Bank specialization	SPE	0,355615355	-0,364829743
Off-Balance-Sheet	OBS/TA	1,458396679	0,591797855
Total Capital Ratio	RBCR	2,623696412	4,124347015
Tier 1 Capital Ratio	T1R	3,020728482	3,123873024
Asset Quality	LLRR	3,079051651	-0,152373413
Return On Equity	ROE	9,982479008	4,251940857
Size	TA	198064,3035	-38406,82836

Source: Authors' calculations.

The variable selection process can be summarized as follows. First, among the entire variable we only selected the variables that were chosen by the "RMSQ" criteria (McNelis PD, 2005). Table 1 presents the variables selected by the RMSQ criteria. The variables O/TA, LEV, TB/TA, STF/TF, LA/STF, and SPE reveal to be significant according to the RMSQ criteria. At the opposite, the variables RBCR, T1R, OBS/TA, ROE and, TA reveals to be insignificant according to the same criteria.

The off-balance-sheet responsible for the global financial crisis is a new form of off-balance-sheet with new short term funding coming from wholesale financial markets. But, the data available from the Bankscope database we used to construct our variable don't allow us to capture this new form of off-balance-sheet. Information on this item is out of regulatory range consequently it is impossible to find. We suppose that this fact explains the non-significance of off-balance-sheet variable in our study.

The result obtained for the ROE can be explained by the fact that it is a non discriminating criterion for distinguishing banks mainly because almost all the banks adopt a similar ROE

policy setting which consists in maximizing ROE. Nevertheless, this result doesn't mean that the ROE doesn't give significant information to explain the impact of the crisis on a bank because, what is really important is less the level of the ROE than the way used to reach it.

The result obtained for the Total capital to risk-based assets ratio and for the Tier 1 capital to risk-based assets ratio confirms the criticism addressed to current regulatory tools. Most of the banks which had been bailed out during the 2007-08 financial crisis, were found well capitalised according to Basel 2. For instance, the two largest Swiss banks (UBS and Credit Suisse) were among the best-capitalised large international banks in the world (Hildebrand P, 2008), it was also the case for Northern Rock (Ondo Ndong S and Scialom L, 2009). Thus, this result highlights the need of considering other indicators of risk and more generally of rethinking banking regulation.

We can justify the result obtained for the variable asset quality by the fact that loan loss reserve ratio used to proxy assets quality is basically a backward-looking variable.

Finally, the result obtained for the variable bank size is justified by the fact that as revealed by the recent crisis, other information than the size as for example the interconnectedness, the leverage, the opacity/complexity, the correlation of exposures, the maturity mismatches or the concentration of risks have to be considered as better detector of systematically important banks.

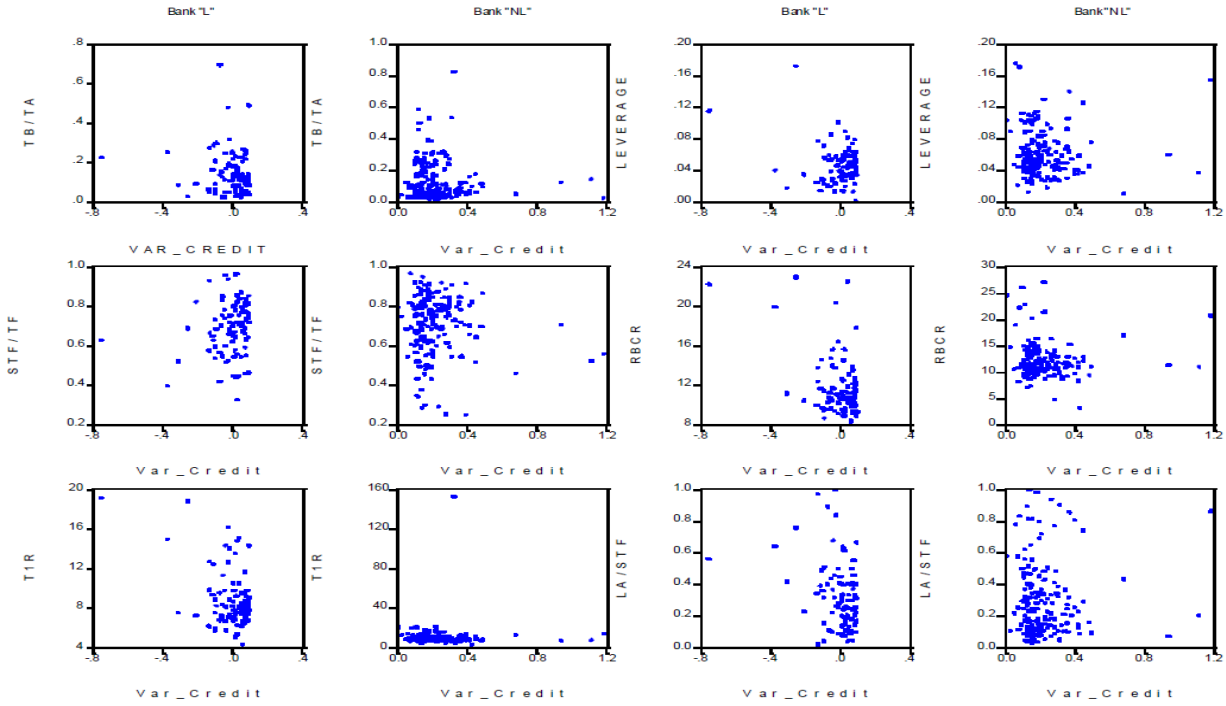
Now, we couple those criteria to test which decisions in the bank strategy have a decisive impact on the bank results. It allows us questioning ourselves about prudential concerns. So, in this part of the analysis we are no more analytically neutral. We divide our banks in two separate groups and, we compare banks which reduced their credit supply with the ones which, at the contrary highly increased their credit offer. It will help us detecting the decisions in the banks' risk-taking strategy which, have the more decisive impact on banks' results.

When the variation of the credit supply is negative or positive but < 0.1, we consider that the bank decreases its credit supply and, when the variation is positive and > 0.1, we consider that the bank increases its credit supply. To facilitate the understanding of the text, we will call "L" (for Losses) the group of banks which reduced their credit supply and, "NL" (for Non-Losses) the group of banks which highly increased their credit supply.

Analysis of banks' single risk taking strategies

We first compare risk-taking decisions for the two groups of banks. We look successively the leverage, the partition between banking and trading book and the percentage of short term funding over the total funding for each group of banks which can be considered as strategies basically used to increase profits. Each of them plays a crucial role on the risk and consequently, on the impact of the crisis on the banks' results.

Table 2: bank's single risk-taking strategies.



Source: Authors' calculations.

The graphs presented in the table 2 present the variables described above for the two groups of banks.

Focusing on leverage level, we note that the leverage is higher than 10 for each bank of the sample. It means that leverage ratios are almost always <0.06 for the banks included in the group "L" and, >0.06 for around half of the banks included in the group "NL". This result may suggest that the banks with a risky leverage strategy are the ones which encountered more losses. Nevertheless, the fact that leverage ratios missed half of the banks also suggests that even if the observation of leverage ratios improves the effectiveness of capital ratios as risk indicators, they don't constitute a panacea. This limit is due to an excessive focus on capital neglecting its interaction with liquidity. Therefore, the leverage strategy can be a useful criterion for distinguishing between the group "L" and the group "NL". Nevertheless the fact that it doesn't take the off balance sheet nor the interaction between illiquidity and insolvency into account fails to make it decisive.

The observation of the short term funding strategy doesn't allow us to discriminate between the two groups of banks. We obtain similar results for the two groups of banks suggesting that all the banks highly lean on short term funding. So, they all adopt a risky funding strategy. This result reveals that a funding strategy resting highly on short term wholesale funding doesn't necessary imply that the bank is involved in risky market activities on the assets side. It is consistent with the Northern Rock experience. Northern Rock was a medium size bank specialized in mortgage lending but its business model which relied on wholesale markets rather than on retail deposits to finance most of its lending – more precisely it relied on recurring securitization of its mortgages – constituted a major source of vulnerability to liquidity squeeze. The disruption which occurred in market liquidity during the summer 2007 made Northern Rock unable to face its commitments anymore what led to its failure.

Consequently, the short term funding strategy alone isn't a decisive criterion for distinguishing between the group "L" and the group "NL".

The results obtained for TB/TA highlight that as observed for the group "NL", banks in the group "L" have kept mainly a traditional banking activity. The trading book is smaller than 30% for almost all the banks of the sample. Thus, the banking book is almost 70% for each bank of the sample which is quite high. The partition between banking and trading book isn't a decisive criterion for distinguishing between the group "L" and the group "NL".

We are now going to test banks' risk aversion focusing on the level of buffer implemented to encompass the risk they are exposed to. We look successively the RBCR and the T1R which, are the current capital adequacy measures used by banking supervisors for each group of banks. Then, we focus on the liquid assets ratio which, give us information about bank coverage against the new risks they are exposed to. These items give information about the bank's coverage strategy against usual operating risks. The graphs of the variables described above are also presented in table 2 for the two groups of banks.

For the two groups of banks the RBCR is always higher than 8 so, they are considered as safe banks according to the regulatory capital ratio. Obviously, this result was expected for the banks included in the group "NL" which have well resisted to the crisis. For the ones included in the group "L", this result confirms the deficiency of this prudential ratio.

Similarly, the T1R is higher than 4 for most of the banks. The bad result obtained for the T1R can be explained by the fact that the definition of tier 1 capital is too large. What is crucial in the tier 1 capital is the level of core tier 1 capital. This result justifies the reinforcement of the quality of bank capital announced in Basel 3 agreement[12]. But, this non discrimination

[12] http://www.bis.org/press/p100912.htm

between banks according to theses prudential capital ratios not only reflects a problem concerning a too soft definition of capital (numerator) but also a problem with the denominator of the ratio. Indeed, since 1996, Basel agreement allows banks to use their internal risk rating and approach to measure market risk for regulatory capital purpose. This logic has been extended to credit and operational risk with Basel 2. The global financial crisis has revealed a dramatic under coverage of risks especially those related to capital market activities: trading book, securitization products, counterparty risk on OTC derivatives and repos. So our results are not surprising. As a response to the low quality of bank capital, the "Basel 3 package" announced on September 12, 2010 promotes a substantial strengthening of the definition of capital with a greater focus on common equity, the highest component of bank's capital and the progressive elimination of subordinated debt as a substitute of regulatory capital.

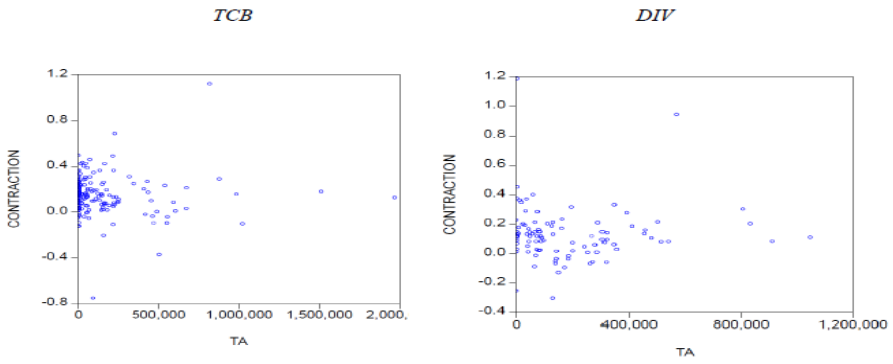
These observations mean that both the RBCR and the T1R are in average at least two points above the regulatory requirements what suggests the existence of an implicit market convention for bank capital level. This can be justified on the one hand by the fact that high capitalization is interpreted as a signal of safety, so banks try to respect the market convention and, on the other hand, by the cost involved by an undercapitalization (higher cost and rationing of funding, stricter supervision etc.). Our results suggest that whatever is the more or less risky strategy adopted by a bank, this strategy has no negative impact on bank's capitalization when we use regulatory capital ratio as a proxy of banks' capital level.

The liquid asset ratio is $\leq 50\%$ for almost all the banks of the group "L". The assessment is the same for almost all the banks of the group "NL". This result suggests that banks don't keep enough liquid assets at their balance sheet to wholly cover their short term liabilities. Consequently they are particularly vulnerable to market reversals. This negligence

(carelessness) can be explained by the fact that international negotiations on the bank liquidity regulation failed in the 1980's. Therefore, international rules to monitor banks' liquidity didn't exist. The introduction of the Liquidity Coverage Ratio and the Net Stable Ratio to monitor bank liquidity risk in the Basel 3 agreement will allow coping with this issue. This advancement was crucial to take into account fundamental changes in contemporary financial system.

What can also be important to determine banks' moral hazard risk, and consequently to discriminate between the banks which encounter large losses and the others may be the nature of the bank's activities that is to say if the bank remains mainly focused on traditional banking intermediation (true commercial bank) or, if the bank itself is an institution with diversified activities or a subsidiary (branch) of a larger and diversified financial institution. So, to refine our analysis, we look at the impact of the crisis on banks' results according to bank type. To test the consistence of this assumption, we distinguish between commercial banks with traditional credit activity (TCB) and commercial banks that belong to a more diversified financial group (DIV) i.e. a group developing financial activities on others segments than banking (investment banks, assets managements, insurance etc.).

Table 3: Analysis of risk taking incentives according to bank's structure.



Source: Authors' calculations.

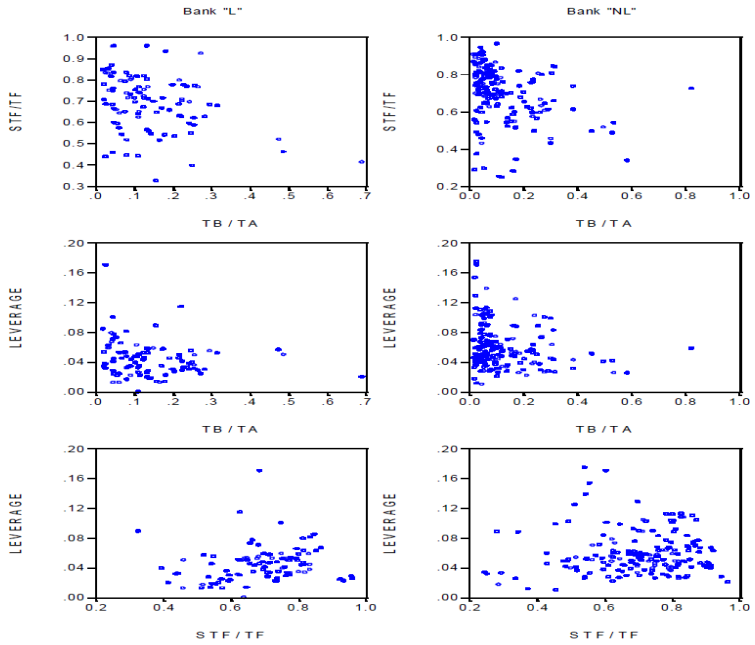
The graphs presented in table 3 show the relationship between the type of the bank and the variation of credit supply.

The variable "variation" is almost always located between 0 and 0.4 for commercial banks with traditional credit activity what indicates that most of them highly increased their credit supply despite the crisis. At the contrary, we note that the variable "variation" for commercial banks forming part of a diversified financial groups is almost located between -0.1 and 0.2 what suggests that most of them encountered losses according to the criteria we used to distinguish the two groups of banks. It suggests that the banks which made losses belong to the second group i.e. are included in large financial structures with important market activity through specialized subsidiaries or branches. This result is consistent with the fact that the recent crisis was directly related to banks' new market practices.

Analysis of the interdependence between banks' strategies

As none of these strategic decisions taken alone seems to be decisive to explain the difference observed in the results of the two groups of banks, we focus now on the combination of these different risk-taking decisions for the two groups of banks. One special feature of banks' strategies is their interdependency. Indeed, they usually have to be jointly implemented by the bank. The consequence is that the total effect of a particular strategy on the bank's result can be amplified by the existence of another strategy. Therefore, it is necessary to analyze the impact of these interdependences on banks' results. We look successively the combination of a high short term funding strategy with a more or less traditional investment strategy, the combination of a risky leverage strategy with a more or less traditional investment strategy and, the combination of a risky leverage with a high short term funding strategies for each group of banks.

Table 4: Banks' joint risk-taking strategies.



Source: Authors' calculations.

The graphs presented in the table 4 present the variables described above for the two groups of banks.

We first test if the association of a high short term funding strategy and, a low banking book is decisive to discriminate between the group "L" and the group "NL". We expect that banks with high STF/ TF coupled with high TB/TA i.e. banks adopting a short term-oriented strategy by leaving their traditional activities to be predisposed for losses. This hypothesis is not confirmed. The results highlight that as observed for the group "L" banks in the group "NL" have kept mainly a traditional banking activity. The two groups of banks also have a funding strategy resting highly on short term funding. This result suggests that the specific association of these two characteristics doesn't predispose banks to losses.

Now, we test if the association of a risky leverage strategy and, a low banking book is decisive to discriminate between the group "L" and the group "NL". As we have observed

above, banking book and leverage are rather important for all the banks of the sample. This means that the two groups of banks have kept mainly a traditional banking activity and, use leverage to increase their profits and, consequently shareholders' returns. Therefore, the results don't allow us to conclude that the banking book is small when the leverage is important. This result suggests that the specific association of these two characteristics doesn't predispose banks to losses.

Lastly, we test if the association of a risky leverage strategy and a high short term funding strategy is decisive to discriminate between the group "L" and the group "NL". We note that contrary to what we observe in the group "NL" where banks have either a high STF/TF ratio or a high leverage, in the group "L", almost all the banks have a high STF/TF ratio coupled with a high leverage. So, banks' leverage comes from their short term funding obtained in wholesale markets partly through their off balance sheet vehicles. Consequently, the most risky banks are logically the ones with the largest leverage, that is to say massively using indebtedness, combined with an important short term funding. This results suggests that what is really crucial to distinguish banks which encounter losses from strong banks is the combination of a short term funding strategy and a risky leverage strategy and not the short term funding strategy, the type of portfolio or, the a risky leverage strategy taken alone. Consequently, it seems, as we were expecting for, important to take into account the complementarity between liquidity and capital in the new regulatory framework.

5. Conclusion and policy implications

Our results support the main reorientation of the new regulatory framework. Indeed, Basel 3 package imposes a strengthening of the quality of capital through a stricter definition properly

focus on common equity, a more conservative risk weighted assets and so an enhanced risk coverage especially for the trading book, a non risk-based leverage ratio which includes off balance sheet items in the measure of total assets that supplements the risk-based capital ratio and serves as a safeguard against the model risk. It also imposes stricter regulatory requirements on systematically important institutions, and two liquidity ratios. With the Liquidity Coverage Ratio (LCR), banks would have to hold a stock of high quality liquid assets enabling them to respect their commitments for 30 days. The Net Stable Funding Ratio would have to influence the funding structure of the bank by favoring stable resources.

All these new requirements go in the right direction but rather than a juxtaposition of new constraints in terms of capital and liquidity our results pleads in favor of a calibration of capital and liquidity requirements according the business model of banks i.e. the specific association of characteristics concerning their funding structure, their leverage and the insertion or not in a diversified financial group.

Our results are also consistent with the plea for a reduction of banking groups' complexity what confirms that one of the most important point in the construction of the new European regulatory framework is the fight against too complex to fail banks.

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ANNEX 1

Variable description

A total of 12 dependant variables are selected as classifiers in the study. All the data are obtained from the Bankscope database. These variables with their codes are as follows:

VARIABLE	CODE	DESCRIPTION
VARIATION IN CREDIT SUPPLY	VARIATION	Δ Volume of Net Loans
CAPITAL ADEQUACY	RBCR	Total risk-based capital ratio
	T1R	Tier 1 capital to risk-based assets.
LEVERAGE	LEV	Equity to total assets ratio
ASSET QUALITY	LLRR	Loan Loss Reserve Ratio
MANAGEMENT QUALITY	O/TA	Overheads to total assets ratio
EARNINGS	ROE	Return on Equity
LIQUIDITY	STF/TF	Short term funding minus customer deposits to total funding ratio
	LA/STF	Liquid assets to short term funding ratio
SENSITIVITY TO MARKETS	OBS/TA	Off balance sheet items to total assets ratio
TRADING BOOK	TB/TA	Trading book to total assets ratio. To obtain the trading Book, we compute the total of Interbank Loans, Trading Securities and Derivatives
BANK SPECIALIZATION	SPE	The bank's main activity
BANK SIZE	TA	Total assets

ANNEX 2

Descriptive statistics

	TA	LEV	OBS/TA	O/TA	RBCR	T1R
Mean	143816.8	0.057008	0.302205	0.017223	12.40945	9.352769
Median	50222.00	0.050917	0.179300	0.015326	11.20000	8.400000
Maximum	1971800.	0.175100	17.70000	0.085262	27.10000	22.80000
Minimum	1391.300	2.81E-05	0.001288	0.000897	3.100000	0.000000
Std. Dev.	236973.3	0.030409	1.078660	0.012679	3.793709	3.698580
Skewness	3.356945	1.317833	14.06177	2.455758	1.837047	1.301378
Kurtosis	19.16531	5.061494	222.8242	11.02424	6.665859	5.184898
Jarque-Bera	3919.284	143.2218	628244.9	1132.209	344.5754	147.7197
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	44151748	17.50133	92.77699	5.287539	3809.700	2871.300
Sum Sq. Dev.	1.72E+13	0.282951	356.0332	0.049194	4404.023	4185.925
Observations	307	307	307	307	307	307

Source: Authors' calculations.