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BANK CAPITAL AND RISK-TAKING: OLD AND NEW PERSPECTIVES FROM THE CRISIS



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Banks' capital has been at the heart of the discussions about financial regulation for more than two decades. It has become a very controversial topic between regulators, the banking lobby and academics in finance. Regulators require more equity to enhance the soundness of the financial sector. The banking lobby argues that holding more equity would have disastrous consequences on banks' value and governance but also on their activities such as credit distribution and liquidity creation. Finally, academics explain that some of the banks' arguments are not economically funded and contradict many basic principles of corporate finance. The positions of the different groups have not changed with the crisis and the debate is more heated than ever. With the emergence of Basel III, regulators seek to increase both the quality and the quantity of banks' capital. On the other hand, banks keep being reluctant to hold larger amounts of capital. Indeed, as soon as they pass regulators' stress tests, banks hasten to reduce their level of equity by paying dividends or repurchasing their own stocks. Today, many voices are raising doubt about whether banks have sufficient capital to cope with financial difficulties such as the sovereign debt crisis (or another future crisis).

The fundamental question behind this debate is whether the banks' leverage or equivalently their weak level of equity is responsible for risk-taking. The way financial leverage can induce risk-taking is well understood in corporate finance. Banks are special in regard to this issue, given their high leverage and the existence of deposit insurance and bailout guarantees. The debate is not new but the crisis provided a wonderful experiment to test the importance of the perverse incentives linked to these protections. Moreover, the evolution of banks, which are far more intertwined with the capital markets than they used to, considerably reinforced their ability to take risk, and changed the nature of the risk as well. The concepts of collective risk-taking and procyclicality of leverage were uncovered during the crisis, and their

mutual reinforcement better assessed. The role of the performance measures and the design of compensation in the banking industry were also strong vectors that pushed the leverage and risk-taking of banks. The way the regulation of bank capital was designed holds an important responsibility as well in fostering a very fragile business model of banks. The objective of this article is to offer a comprehensive approach of the question of bank capital and risk-taking for readers not familiar with the banking literature. It does not cover the wide range of causes of the financial crisis but focuses on banks' leverage which is per se a very important issue. The article is not a literature review on bank capital regulation either, but insists on the lessons from the crisis uncovered by the academic literature. Some articles surveyed provide strong empirical evidence, others are more policy oriented and suggestive. At last, some thoughts or hypotheses are more personal and may lead to future research.

■ I. LEVERAGE AND RISK-TAKING: THE SPECIFICITY OF BANKS

In their seminal 1958 article, Modigliani and Miller showed that when capital markets are perfect (i.e. in the absence of frictions), capital structure is irrelevant. Since then, a great part of the research in corporate finance has been focused on indentifying departures from Modigliani-Miller's frictionless world and understanding how they influence the choice of the capital structure. One of the frictions is the existence of agency conflicts between shareholders and debtholders. As far as the resolution of agency conflicts is concerned, the capital structure is no longer irrelevant as Jensen and Meckling (1976) argue. For example, given a certain level of debt, it may be in the interest of shareholders to increase the risk of the firm to transfer some value from the debtholders to the shareholders, even if doing so reduces the value of the enterprise as a whole. This phenomenon known as risk-taking or risk-shifting is closely linked to the limited liability provided to shareholders, which creates asymmetric payoffs: shareholders capture the upside but share

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the downside with debtholders. This asymmetry explains why shareholders have incentives to increase the riskiness of the firm, especially when leverage is high.

By nature, banks are firms that are leveraged. It is even the starting point of a bank's business as they have the vocation to collect deposits and to transform them into loans. In fact, due to the importance of deposits in their balance sheets the leverage of the banking industry is much higher than the one of any other industry. Given this highly leveraged nature, the link between capital structure and risk-taking is of particular interest in the case of banks and has given rise to much academic work. Indeed, even if banks are often left aside in the traditional corporate finance literature (given the atypical nature of their activities), many academics claim that the risk-taking problem is strongly relevant for banks (Admati, De Marzo, Hellwig and Pfleiderer (2010), Acharya, Mehran and Thakor (2011)).

I.1. THE STRONG ABILITY OF BANKS TO SHIFT RISK

A firm's leverage can create incentives for risk-taking but effectively achieving risk-taking depends on the assets of the firm and on the extent to which they can be changed at low cost into riskier assets. In this respect, banks' assets are interesting. Indeed, an important characteristic of banks lies in their opacity and in the ease with which risk-taking can be achieved. Morgan (2002) provides empirical evidence on opacity, revealing that the scale of disagreement of bond ratings is larger for banks than for non financial firms. Moreover, as banks hold highly liquid and easily tradable assets, they can modify their risk easily and quickly. This singularity of banks' assets makes the risk-taking problem more severe for banks than for non financial firms. This argument is related to the dark side of liquidity argument developed by Myers and Rajan (1998), for which holding very liquid assets makes it difficult for a company to credibly commit to a specific investment strategy and raise external financing.

Interestingly, the ease with which banks can alter their risk has increased over time following changes in the composition of banks' assets. Indeed, as Haldane, Brennan and Madouros (2010) reveal, trading assets have become more and more important in banks' activities. The share of the trading book has even doubled from 20% to 40% over the period 2000-2009, meaning that close to half of the assets are possibly changed overnight in many banks. Banks have not only increased the proportion of trading assets they hold but they have also increased the liquidity of their other assets. As argued by Boot and Marinč (2011), the aim of recent financial innovations in banks was to increase the marketability of their assets. Notably, the rise of securitization had a profound impact on the evolution of banks' balance sheet. This securitization process is supposed to improve the diversification of risk and create liquidity through the creation of marketable products. The "originate to distribute" model¹ adopted by many banks has also main drawbacks. One of them is the modification of the incentives of the bank to screen out the best risks in the first place and monitor them afterwards. The securi-

tization process not only increased the ability of banks to change the risk on the asset side, but it also modified the quality of the assets originated by the banking industry, that were in the end bought back by the banks...

I.2. THE ELIMINATION OF DEBT MARKET DISCIPLINE

On average, firms for which risk-taking is a serious issue, tend to have lower levels of leverage, as the expectation of an opportunistic behaviour by the debtholders would increase the cost of debt. However, in the case of banks, this mitigation effect is not strong. Indeed, deposit insurance and bailout guarantees introduce serious distortions in this process.

Deposit insurance and bailout provisions are meant to prevent bank runs and reduce the fragility of the financial system. However, despite their importance, those guarantees have some undesirable effects that further accentuate banks' risk-taking. The most important one lies in the fact that they eliminate market discipline. In a non financial company, risk-taking incentives are generally curbed by two complementary mechanisms. First, if a firm is highly leveraged, its creditors will anticipate the consequences of any risk-taking strategy and will ask for a higher interest rate. As a result, the increase in the cost of debt will induce the firm to limit its leverage and its risk-taking. Second, the creditors of a highly leveraged firm will also monitor very carefully or impose stringent covenants in order to impede the firm from taking too much risk at their expenses.

In the case of banks, those two mitigating mechanisms are eliminated. As argued by Acharya, Mehran, Schuermann and Thakor (2011), deposit insurance and bailout guarantees make the price of banks' debt very insensitive to the amount of leverage. Indeed, depositors and senior creditors anticipate that they will be bailed out ex post, and their ex ante assessment of risk takes into account the existence of this protection. In other words, the debt is subsidized and this creates a strong incentive to increase the financial leverage. Moreover, since as a result of bailout guarantees, depositors and other senior creditors' claims are riskless, they have few incentives to monitor and understand the risks banks can take, nor, do they intend to impose any covenants. The only debtholders that might have an incentive in monitoring banks and preventing them from taking huge risks are the most junior creditors. However, many holders of hybrid products and subordinated debt have also been bailed out during the subprime crisis which clearly questions their future (and past if they were expecting to be bailed out) incentives to monitor.

The existence of bailout guarantees not only gives rise to a lack of monitoring and a "mispricing" of bank debt (given the underlying risk of the banks' assets), but it also eliminates any bankruptcy costs for banks. Even worse, Acharya and Thakor (2010) argue that Lender Of Last Resort (LOLR) interventions tend to be so quick that even banks for which liquidation would have been necessary and efficient are kept operating. As a result, banks have no incentives to internalize bankruptcy costs when they determine their capital structure, which further increases their incentive to choose high leverage. There

is now a wide consensus among academics about the role played by bailout guarantees and deposit insurance. Merton (1977), Berger, Herring and Szegö (1995), Acharya and Thakor (2010), Admati, De Marzo, Hellwig and Pfleiderer (2010), Acharya, Mehran and Thakor (2011) all recognize that they have created a bias inducing banks to increase their leverage and to invest in risky projects (even negative NPV projects).

Moreover, it is worth observing that the existence of deposit insurance and bailout guarantees has somehow changed the nature of the risk-taking problem.

I.3. SHAREHOLDERS' ABILITY TO EXTRACT WEALTH IN DISTRESSED BANKS

Deposit insurance and bailout guarantees imply that the claims of depositors and senior debtholders (and even those of other junior creditors) are ensured by the government. The nature of the conflict has therefore changed as it becomes a conflict between shareholders and taxpayers and no longer between shareholders and debtholders. Indeed, when banks are bailed out by governments, taxpayers' funds are transferred to debtholders and consequently it is in the end the taxpayers who support the bad outcomes of banks' risk-taking and share the losses with bank shareholders.

The opportunity to transfer value to shareholders even when the bank is rescued further accentuates risk-taking. Indeed, banks' shareholders have been able to cash out large dividends even though huge losses were expected or when banks were receiving public support (Acharya, Gujral and Shin (Forthcoming)). According to their analysis, this breakdown of debt seniority has resulted from the inertia in accounting numbers that allows a financially distressed bank to appear healthy. Strictly speaking, there is no violation of debt seniority as far as the claims of debtholders are not affected. However, by extracting cash from the banks when losses are expected, shareholders which should be the first to bear the loss are capturing value which they are not entitled to. As the money captured by the shareholders should have helped the bank to cope with financial distress, it increases in the end the cost of the government's bailout. This violation of priority in case of financial problems and injection of public money reinforces the mechanisms already at play that influence risk-taking. Indeed, it means that even when banks are getting financially distressed or rescued by the government, not only do shareholders share the losses with the debtholders and taxpayers but they also manage to appropriate a slice of the residual value.

■ II. LEVERAGE AND RISK-TAKING : NEW PERSPECTIVES FROM THE CRISIS

II.1. THE COLLECTIVE RISK-TAKING

Deposit insurance and bailout guarantees strongly accentuate the standard risk-taking in the case of banks. They also give rise to a new kind of risk-taking, called

“collective risk-taking” which is specific to the banking sector and does not exist elsewhere. Indeed, in the case of a collective failure, a bank is much more likely to be rescued than in the case of an isolated failure. It is therefore in the shareholders' interests not only to take risks but also to take risks which are highly correlated with those of other banks. Acharya, Mehran and Thakor (2011) explain for example that asset substitutions are often correlated across banks and attribute this phenomenon to the existence of government guarantees and the interventions of a LOLR. Indeed, since a collapse of the entire financial system would result in disproportionately high social costs, governments cannot allow the joint failure of several banks.

The existence of this new kind of risk-taking is consistent with several empirical findings. For example, Schuermann and Stroh (2006) show that among S&P 500 firms, equity return correlation is much higher in the banking industry than in any other industry. This idea of collective risk-taking is well captured by the notion that banks are “too interconnected to fail”. In particular, Adrian and Shin (2010) stress the fact that the size of the sub-prime mortgage exposures was small compared to the size of the aggregated liabilities of the financial sector but that they were strongly correlated between banks.

As mentioned previously, the severity of the risk-taking problem in the banking sector is to a large extent attributable to side effects resulting from the existence of deposit insurance and bailout guarantees. In response to those undesirable effects, regulators have introduced capital requirements in order to limit banks' leverage. Those capital requirements are based on risk weighted assets and may have played a part in reducing risk-taking problems. However, one can wonder whether they have not involuntarily accentuated the collective risk-taking problem. Indeed, in order to overcome the constraint imposed by regulators, banks have all invested in securities and assets for which the capital required is low. In other words, regulation and capital requirements may be to blame in the sense that they have prompted banks to invest in the same kind of assets and so indirectly favoured the risk correlation between banks. Atkinson and Blundell-Wignall (2012) argue for example that regulatory risk weights create a bias against diversification and encourage concentration in asset classes. The asset classes favoured by regulation were residential real estate, sovereign debt and interbank claims. Those asset classes have been at the heart of the crises and the concentration of banks' investments in those assets has given rise to stronger system interconnectedness. The emergence of banks which are not only too big to fail but also too interconnected to fail might result to some extent from the introduction of capital requirements.

Whether collective risk-taking is a voluntary strategy from part of the banks or a reaction to regulation is still an open question. Finally, it is worthwhile noting that in a context of collective risk-taking, leverage may no longer be the source of the risk-taking but rather a component of a risk-taking strategy. Indeed, by choosing a weak capital structure, banks increase the likelihood they will face financial difficulties at the same time. In other

words, being highly leveraged would be a way to achieve a collective risk-taking strategy. For future research, it would be interesting to investigate to which extent the perverse incentives of both kinds of risk-taking reinforce each other.

Capital requirements and in particular the definition of risk weights are to blame for having induced banks to invest simultaneously in the same class of assets, inducing systemic risk. The definition of bank capital adopted by the regulators also had an effect on risk-taking.

II.2. THE ROLE OF BANK CAPITAL DEFINITION

Financial regulation has contributed to the emergence of an approach of banks' financial structure based on risk management and the respect of a minimum equity ratio. Moreover, the determination of regulatory capital has created a distortion in banks' financial structure which has further contributed to strengthen risk-taking. In response to the pressure from bankers claiming that holding more equity would hurt banks, regulators have authorized banks to build up their regulatory capital with long term debt, subordinated debt and other hybrid products. The incorporation of those debt products in bank capital seems very hard to reconcile with the clear cut-off between debt and equity existing in corporate finance. Moreover, it has given rise to many problems and may have its part of responsibility in the severity of the subprime crisis.

Indeed, this blurred frontier between debt and equity turned out to be problematic during the financial crisis when risks and losses materialized. Granted, long term debt provides a cushion for deposits but not insurance against bankruptcy since it is unable to absorb losses or to limit the incentives to take risks. For example, Flannery (2005) and Hart and Zingales (2011) point out that the incorporation of long term debt into Tier-2 capital is coherent if the objective is to protect depositors. However, protecting deposits does not amount to ensure financial stability and this broader definition of capital exposes banks to a higher risk of failure. Indeed, long term debt is a junior claim compared to deposits but does not provide any cushion against bankruptcy. Consistently with the idea that the level of equity is more important than the level of regulatory capital, Demirguc-Kunt, Detragiache and Merrouche (2010) find that the positive effect of capital on banks' performance during the crisis is more relevant for Tier-1 capital and leverage ratio than for regulatory capital and risk adjusted Basel ratio². This result confirms that the quality of the capital matters and that risk-adjusted ratio may not capture all the banks' exposures.

This phenomenon led some academics (Acharya, Gujral and Shin (Forthcoming)) to warn that the capital of banks is of bad quality and does not play a role in deterring risk-taking incentives. This is easily explained by the fact that the gains that can be realized through risk-taking strategies depend on the level of "real" capital or leverage and not on the level of regulatory capital. Flannery (2005) argues that the decision of increasing the risk of a bank's portfolio, in order to raise the gains for the shareholders,

depends on the level of equity capital and not regulatory capital. As a result, allowing banks to incorporate debt products in their capital has increased "real" leverage and the associated risk-taking incentives.

II.3. THE PROCYCLICITY OF LEVERAGE

Through the definition of bank capital, the regulation certainly had a perverse effect on bank risk-taking. The definition of capital requirements encouraged a procyclical leverage policy that resulted in a higher risk as well. Indeed, Adrian and Shin (2010) show that banks' executives actively responded to any changes in the price of banks' assets by adjusting the leverage. More precisely, if asset prices go up, banks' balance sheets automatically become stronger and their leverage becomes lower. However, banks' executives respond to this surplus of capital by taking more debt on the liability side and purchasing more securities on the asset side, which creates an upward pressure on asset prices. This upward pressure in turn strengthens bank balance sheets encouraging leverage. In other words, the increase in the price of assets and the leverage tend to reinforce each other. A reverse mechanism is also at play. Indeed, as documented by Adrian and Shin, as soon as asset prices fall, further decreases in asset prices and deleveraging via asset liquidations reinforce each other. Those fire asset sales allow a bank to reduce its leverage, but have an adverse impact on the strength of other banks' balance sheets through the reduction of the price of assets they induce³. Consequently, the procyclicality of leverage induces a contagion effect and amplifies the systemic risk. The deterioration of some banks' balance sheets can quickly spread to other banks through deleveraging or fire sales. Interestingly, this impact of the procyclicality of leverage on systemic risk is all the stronger since banks tend to hold the same kind of assets, which amplifies the contagion effect of deleveraging.

As a result, financial regulation and the determination of capital weights resulting from it may have unintentionally contributed to increase systemic risk through different channels. First, they have prompted banks to operate regulatory arbitrages by investing in "capital-efficient assets". In particular, banks have had an interest in holding a higher proportion of trading assets which has increased their dependence to changes in the price of assets. Second, they have also contributed to increase the correlation between banks' risks as banks have invested in the same kind of assets, those that had the most favourable capital weights. In the end, they have encouraged the procyclicality of leverage and its contagion effect. The combination of these three elements has largely contributed to increase the correlation and the interdependence of risks between banks.

Deposit insurance and bailout provisions, as well as the perverse incentives of capital requirements have had an impact on the leverage of banks and risk-taking. The excessive use of certain performance measures in banks like return on equity, coupled with a poor understanding of the impact of leverage on shareholders' risk has certainly played an important role in the rise of the leverage of banks. The next section emphasizes the role played by

performance measurement and compensation to foster leverage and risk-taking.

■ III. RISK-TAKING AND LEVERAGE : THE ROLE OF PERFORMANCE MEASUREMENT AND COMPENSATION POLICY

One of the most important specificities of banks' financial structure lies in the fact that their level of equity is regulated. Indeed, contrary to other firms, banks have been forced to hold a minimum level of capital which is based on the risk of the assets they hold. By imposing a constraint on their level of equity, financial regulation may have contributed to the emergence of the belief that bank' equity is "costly" and should be minimized, negating Modigliani and Miller's propositions in the case of banks. This may also have triggered the use of performance measures such as return on equity (ROE)⁴, to which managers' compensation is often linked.

III.1. THE ROLE OF PERFORMANCE MEASUREMENT

The standard objective in finance is to look for a higher return adjusted to risk to increase value. This objective is clearly different in banks as the goal is to maximize the return on equity under the constraint of being compliant with the regulation, in terms of capital requirements in particular. But the regulation is not meant to control the volatility of equity but to avoid the risk of default. This confusion, together with the bailout provisions which offer a subsidy to debt financing, may be at the heart of the increase in leverage in banks, violating sound financial reasoning.

Many voices have been heard claiming that financial principles, in particular Modigliani and Miller's propositions, do apply to banks (Miller (1995), Pfeiderer (2010), Admati, De Marzo, Hellwig and Pfeiderer (2010) as well as Moussu, Ohana and Troëge (2011)). More debt increases the ROE of banks but also increases the required rate of return as the level of risk for shareholders is higher. To confirm this hypothesis, Kashyap, Stein and Hanson (2010) as well as Miles, Yang and Marcheggiano (2011) provide evidence of a positive relationship between the risk of banks' stocks and their cost of equity on one side and its leverage on the other side. Additionally, many papers document a negative association between leverage and banks' performance during the crisis. Bank leverage has a negative impact on accounting writedowns (Chesney, Stromberg and Wagner (2010)), the probability of survival, the market share and the ROE (Berger and Bouwman (2010)) and on the stock returns (Beltratti and Stulz (2012)). Demirguc-Kunt, Detragiache and Merrouche (2010) also document a positive association between bank capital and stock performance for the crisis especially for large banks. All this evidence tends to reveal that financial principles do apply for banks as for other firms, despite the specific subsidy to the use of leverage, linked to the implicit bailout provision. More

leverage means higher volatility of the stock returns and of equity value for shareholders.

Despite this well documented positive association between bank capital and performance during crises, banks keep being reluctant to reduce their leverage and to hold more equity. One reason may be due to the strength of the belief that equity is "costly" and should be minimized. Another reason may be that the CEO and executive pay in banks are very sensitive to metrics such as the ROE (or the earning per share). The impact of incentive compensation on leverage is an important issue for which some empirical evidence exists and should be emphasized.

III.2. THE ROLE OF COMPENSATION

This section does not intent to cover in detail all the literature on compensation and risk-taking in banks but rather examine the role compensation may play regarding leverage. Many papers have been investigating the role of incentive compensation on risk-taking. They reveal that risk-taking increases with the amount of compensation not explained by the size of the banks (Cheng, Hong and Scheinkman (2009)) and decreases with the horizon of the compensation (Bolton, Mehran and Shapiro (2011)). Risk-taking also increases with the emphasis being placed on equity based-pay (Mehran and Rosenberg (2007) and Balachandran, Kogut and Harnal (2010)) and annual bonuses (Erkens, Hung and Matos (2012)). At last, it increases with the sensitivity of CEO compensation to the stock return volatility⁵ (Chesney, Stromberg and Wagner (2010) and De Young, Peng and Yan (Forthcoming)). In a very interesting contribution, Bhattacharyya and Purnanandam (2011) show that banks' involvement in securitization activities was several years before the crisis accompanied by higher EPS performance but lower risk adjusted returns for shareholders. Despite this destruction of value for shareholders, banks' executives kept on being involved in securitization activities because their compensation was very sensitive to EPS, rather than to the stock price.

The way compensation is structured has a clear impact on the incentives of banks to take risk measured in several ways. Another way to look at those important results is to consider that banks' executives were strongly incentivized to take risks and that they positively responded to these incentives. This seriously questions the quality of bank governance, in particular the functioning of boards and compensation committees⁶. This also brings additional perspectives on the question of bank capital and risk-taking. Indeed, leverage can very well be endogenous to the structure of compensation. In other words, banks' executives who are incentivized to take risks and to focus on short term results through the structure of their compensation may choose to increase leverage in order to boost short term performance and their compensation. The idea that bank executives may choose to increase leverage in order to boost short term performance is consistent with the fact that the rise in banks ROE over the last decades was largely driven by an increase in leverage as suggested by Haldane, Brennan and Madouros (2010)⁷. The evidence is still suggestive so far. Testing whether the leverage of banks

increases with the sensitivity of CEO compensation to short-term performance measures is an important question that may be addressed in future research. Another important question is whether leverage is at the root of risk-taking or simply an instrument of risk-taking. Using leverage as a measure of risk-taking among other, Cheng, Hong and Scheinkman (2010) as well as Erkens, Hung and Matos (2012) reveal the incidence of compensation on leverage. This tends to provide a first validation of the hypothesis that compensation matters for bank leverage. But more research is definitely called for to provide an assessment of the causality between leverage and risk-taking in relation to compensation.

■ IV. CONCLUSION

The financial crisis has been a wonderful laboratory to assess the role of banks' capital on risk-taking. Old perspectives associated to deposit insurance and bailout provisions have proven to be important vectors of leverage and risk-taking by banks. The drastic evolution of the asset structure of banks was also an important factor that made this risk-taking possible and changed its nature. The way capital requirements were designed, combined with the new asset structure of banks, induced collective risk-taking and procyclical leverage, that reinforced each other. Interestingly, the counterproductive effect that an increase in capital requirements may have on risk-taking is not a new issue. Indeed, long before the subprime crisis, a trend of the academic literature started to focus on the theoretical foundation of capital requirements and how their implementation affects bank behavior⁸.

Capital requirements had certainly a profound impact on the leveraging of banks and their risk-taking as it crystallized the use of return on equity as a performance measure. As in any other firm, this objective turned to be a fallacy and a massive destruction of value for shareholders and society resulted from its maximization. Imposing higher capital requirements without a radical change in the way to assess the performance of banks and pay their managers may prove useless and may prepare the next crisis. In this regard, the regulators are to be extremely cautious about the impact

of their regulation on incentives, given the strength and the complexity of the mechanisms at play. One can even wonder whether maintaining deposit insurance and bailout provisions is not counter-productive without a drastic and quick evolution of the governance of banks. The perverse role of incentive compensation and the total failure of the boards during the crisis imply profound reforms of the governance of the banking industry. The strong willingness of the European Parliament to curb excessive pay and limit bonuses to the level of fixed pay is certainly a good start to limit risk-taking. If it results in an increase in fixed pay as banks claim, the higher operating risk it implies will call for more caution in the management of banks, as in any other firm. In the end, it will certainly result in a moderation of pay. There is nothing wrong to this return to normality.

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- 1 Purnanandam (2011) provides evidence that banks with more involvement in the Originate-to-Distribute market originated poor quality mortgages and were lacking incentives to screen their borrowers.
- 2 Other empirical studies on the link between bank capital and performance are presented in section 3.
- 3 Acharya and Thakor (2010) develop a model consistent with the contagion effect of a procyclical leverage, in which a bank sets its own leverage without internalizing the negative impact it has for other banks.
- 4 Haldane, Brennan and Madouros (2010) offer suggestive evidence on the ROE race in banks.
- 5 Vega or pay-risk sensitivity is the change in CEO wealth (in dollars) with respect to changes in stock return volatility (in annualized standard deviations).
- 6 This question is out of the scope of this article. Nevertheless, on the failure of banks' boards, one can read the article of Guerrero and Thal Larsen (2008) in the Financial Times, the discussion of Levine (2004) and the interesting article of Minton, Taillard and Williamson (2010).
- 7 The authors find out that over the last decades, banks' returns on equity have skyrocketed whereas returns on assets and risk-adjusted returns on equity have remained constant over the same period.
- 8 VanHoose (2007) offers a critical review of the literature about the supposed effect of capital requirements on bank soundness. Koehn and Santomero (1980) or Callem and Rob (1999) already provided models predicting that higher capital may result in risk-taking.

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Articles	Topics	Main results	Data	Sample and period
Acharya, Gujral and Shin (Forthcoming)	<ul style="list-style-type: none"> Quality of bank capital Violation of the priority of debt 	<ul style="list-style-type: none"> The composition of bank capital has shifted radically from one based on common equity to one based on hybrid products. Banks' financial structure has become increasingly levered. The erosion of common equity has been accelerated by banks' dividend policy. Marked-to-market leverage is strongly procyclical. Financial intermediaries react to price changes by adjusting their leverage. Procyclical leverage affects aggregate volatility and the price of risk. 	<p>The change in banks' balance sheets is studied with overall leverage, deposits versus non deposits leverage and the maturity of leverage.</p> <ul style="list-style-type: none"> Leverage growth is defined as the log difference in assets minus log difference in equity. The aggregate financial volatility as well as the price of risk are measured using the VIX index. 	<ul style="list-style-type: none"> The sample is composed of 21 large banks in the US, UK and Europe. The period of interest is 2000-2008.
Adrian and Shin (2010)	The procyclicality of leverage	<ul style="list-style-type: none"> Large banks with more tier-1 capital, more deposits and less funding fragility performed significantly better during the crisis. Banks which performed better during the crisis had less leverage and lower returns immediately before the crisis. 	<ul style="list-style-type: none"> The measure of performance is bank's buy-and-hold dollar stock returns. The variables related to banks' balance sheets are Tier-1 capital ratio, tangible equity, the ratio of deposits to assets and the funding fragility. 	<ul style="list-style-type: none"> Different samples are used: The six largest American banks, the US primary dealers and the aggregate balance sheet items from the Flow of Funds accounts. The period studied goes from the nineties to 2008. The main sample is composed of 164 banks in 32 countries with total assets in excess of \$50 billion in December 2006. The period goes from the middle of 2007 to the end of 2008.
Beltratti and Stulz (2012)	Bank capital	<ul style="list-style-type: none"> Capital improves the performance of banks of all size during banking crises. It also improves the performance of small banks during market crises and normal times. 	<ul style="list-style-type: none"> Performance is measured by the probability of survival, market shares and profitability (ROE). Capital is measured by the ratio of equity capital to gross total assets (averaged before the crisis over 2 years). 	<ul style="list-style-type: none"> The sample is composed of 18 405 US commercial and credit card banks. The period goes from 1984 to 2009. It covers two banking crises and three market crises
Berger and Bouwman (2010)	Bank capital	<ul style="list-style-type: none"> The residuals from total compensation on size are very heterogeneous between banks and strongly correlated to several measures of risk-taking. 	<ul style="list-style-type: none"> Several measures of risk-taking and stock performance are used including the beta, the return volatility, the correlation of the daily returns to the ABX AAA index, the cumulative stock return, the holdings of non-agency mortgage backed securities and book leverage. 	<ul style="list-style-type: none"> The sample is made of 3 separate groups of US financial firms: Primary dealers, banks and bank holding company, insurers. The sample period goes from 1992 to 2008.
Cheng, Hong and Scheinkman (2009)	Compensation	<ul style="list-style-type: none"> High compensation, high risk-taking and extreme performance go hand in hand for banks. 	<ul style="list-style-type: none"> The write-downs are only calculated for the period 2007-2008. They are defined both in absolute terms and relative to assets. The risk-taking incentives are measured using the delta and the vega of bank CEOs' compensation. 	<ul style="list-style-type: none"> The sample is composed of US financial institutions with data available on Execucomp. The sample period is the crisis period (2007 Q3-2008 Q4). Risk-taking incentives are calculated in the years preceding the crisis (2002-2005).
Chesney, Stromberg and Wagner (2010)	<ul style="list-style-type: none"> Compensation Bank capital 	<ul style="list-style-type: none"> Banks whose CEOs had strong risk-taking incentives had the highest write-downs during the crisis. Banks with the lowest level of Tier-1 capital also suffered higher write-downs. 		

Demirgüç-Kunt, Detragiache and Merrouche (2010)	Bank capital	<ul style="list-style-type: none"> – More capital is associated with better stock market performance in particular for larger banks. – The association between capital and stock performance is stronger when leverage ratio rather than risk-adjusted capital ratio is considered. It is also stronger when capital is of higher quality. 	<ul style="list-style-type: none"> – Several types of capital ratios are considered: the leverage ratio, the Basel risk-adjusted ratio, Tier 1 and Tier 2 ratios and also tangible equity ratio. – Bank performance during the crisis is measured by stock performance. 	<ul style="list-style-type: none"> – The sample is composed of 381 international banks in 12 economies. A sample of 61 large banks from 8 countries is also considered. – The sample period is 2005-2009.
Erkens, Hung and Matos (2012)	Compensation	<ul style="list-style-type: none"> Financial institutions that relied more on annual bonuses (as opposed to equity-based compensation) in their executives' compensation structure suffered larger losses during the crisis and took more risk before the crisis. 	<ul style="list-style-type: none"> – Losses are measured by 3 variables: cumulative accounting write-downs scaled by total assets, capital raising and cumulative stock returns. – The measures of risk-taking are the expected default frequency and the equity to assets ratio. 	<ul style="list-style-type: none"> – The sample is composed of 306 international financial institutions from 31 countries. – The period of interest is the crisis period (2007-2008).
Haldane, Brennan and Madouros (2009)	<ul style="list-style-type: none"> – Changes in banks' activities. – Focalization on short-term measures of performance 	<ul style="list-style-type: none"> – During the last decades, banks' ROE has skyrocketed whereas ROA or ROE adjusted by risk have remained flat. – The increase in ROE has resulted from risk-taking strategies including increasing leverage and changes in banks' activities. 	<ul style="list-style-type: none"> Changes in banks' activities are assessed by the proportion of trading assets and the proportion of loans to customers in banks' balance sheets. 	<ul style="list-style-type: none"> – The main samples are made of UK banks or large international banks. – The period of interest covers the last decades and even the beginning of the 20th century.
Mehran and Rosenberg (2007)	Compensation	<ul style="list-style-type: none"> – Granting stock options to bank CEOs leads them to undertake riskier investments. – It also reduces the incentives to borrow and results in increased capital levels. 	<ul style="list-style-type: none"> – The riskiness of the investments is measured by the volatility of the assets and of equity. – The incentives to borrow are measured by the level of interest expenses and federal funds borrowing. 	<ul style="list-style-type: none"> – The sample is composed of US banks. The number of banks in the sample varies from 30 to 61 depending on the years. – The sample period is 1992-2002.
Miles, Yang and Marcheggiano (2011)	Bank capital: cost and risk	<ul style="list-style-type: none"> – Bank capital cost and risk increase with the leverage ratio. – The impact of leverage on the cost of equity is between 45% and 75% as large as Modigliani-Miller would predict. 	<ul style="list-style-type: none"> – The cost of equity is estimated using the beta of the bank. – The leverage is defined as a bank's total assets over its Tier 1 capital. 	<ul style="list-style-type: none"> – The sample is composed of major UK banks. – The sample period is 1997-2009.
Minton, Taillard and Williamson (2010)	Composition of Boards	<ul style="list-style-type: none"> – Financial expertise in boards is negatively related to bank performance during the crisis. – Stock performance prior to the crisis and leverage are positively related to the financial expertise of the board. 	<ul style="list-style-type: none"> – Bank performance is measured by changes in Tobin's Q and cumulative stock returns. – Leverage is measured by Tier 1 and total capital ratios. 	<ul style="list-style-type: none"> – The sample is composed of US commercial banks, savings and loan associations and investment banks with data available on BoardEx. – The sample period is 2000-2008.