Captive Funds and Banks' Capital

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Abstract: A simple leverage ratio restriction is not efficient because it does not discriminate between risky and safe banks. We use a structural and comprehensive model of the firm's asset growth to describe the equity buy-out portfolios' stylized facts for two types of banks. We derive a leverage ratio that depends on the level of risky investments, and balances between the spread on such investments, the cost of capital and the overall power of the supervisor to enforce the capital requirements. This method is more transparent and requires fewer parameters than other commonly used methods. We obtain an incentive-compatible constraint on banks to carry the minimal adequate amount of capital. This constraint enhances the supervisors' ability to enforce the rules *ex post*, and provide banks with a further incentive to reveal their risk type truthfully.

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1. Introduction:

Private equity investments, which exceeded $3 trillion worldwide in 2013, have become an increasingly important part of financial institutions' portfolios. In this paper we try to shed some light on the relatively obscure blend of private equity with banking. No research has yet been done on this subject and we intend to complement the literature by investigating this shortcoming. Prior research on the Basel's optimal capital requirements focuses on balancing the traditional lending and investment activities of banks as a main area of interest. We propose a framework for strategic private equity investments by banks that is able to incorporate the fact that risky banks may hold less than optimal amount of capital because supervisors are unable to observe bank quality ex-ante. This paper complements prior research by investigating the capital requirements in the presence of private equity investments. We introduce a penalty by the regulator as a way to reduce this problem but not completely eliminate it. We extract a leverage ratio restriction which is effective in reaching the best outcome.

While proponents of the Volcker Rule credibly argue that banks' proprietary trading and hedge fund investing were important contributors to the 2008 financial meltdown, the scant empirical evidence doesn't support the idea that such activities are intrinsically risky to the degree that they need to be banned. One could argue, perhaps, based on the recent crisis, that subprime and commercial real estate lending are too risky for banks to assume. However, banks are in the business of lending; in this process, they take calculated risks in the scheme of their asset-liability management. Such calculated, and many times, carefully hedged risks must be borne by the providers of financing to the bank. Therefore, if the Rule requires more equity in financing the bank's need than debt, the losses of riskier investments would not pose a macro risk to the economy, since it would be only the bank's shareholders who would suffer such consequences.

Furthermore, if the Volcker Rule were to completely deny banks partaking in this risky class of assets, their profit potential would be restricted in the interest of more constancy of their returns. Not only would banks be stopped from helping the formation of new businesses, a valuable socio-economic function, they would also relinquish opportunities to reap higher returns. That is, because the mixture of banking with private equity investing permits the cross-selling of extra services to target firms builds relationships for their lending activities, and leads to economies of scope across different bank departments.

Besides, bank regulators in the process of their risk-based supervision, already have all the needed authority to access banks' information pertaining to their investment, trading and risk-extenuating undertakings; hence, this rule seems to be superfluous. Even when applied to banks, it does not preclude them from buying bad assets.

Private equity, predominantly buy-outs, represent an asset class not well appreciated in the literature (see Bongaerts and Charlier (2009)). They mention that the size of private equity holdings may be marginal in Europe compared to the rest of their balance sheet. Although equity exposures generally represent a modest part (i.e., bank-affiliated private equity funds represent 30% of all U.S. private equity investments making up over $700 billion of assets , see Fang, Ivashina and Lerner (2013)) of total bank exposures, they are volatile and can have a large impact on the bank's profitability and cumulatively on its financial stability.

Carefully chosen alternative investments, including private equity[i], were prominently shown in Cumming, Hass and Schweizer (2014), to provide positive diversification benefits to institutional investors. Another example, found in Cumming and Johan (2007), mentions that pension funds have a larger exposure in terms of their assets in private equity than banks or insurance companies. This implies that banks' participation in alternative investments is a necessary tool and is effectively applied in efficient risk management.

A number of other studies have examined the impact of capital regulation on banking activities. Berger et al. (1995) and Drumond (2009) review bank behavior and the business cycles. The Basel regulation that emphasized risk-weighted capital requirements tends to be pro-cyclical by requiring banks to hold higher capital during recessions. This inhibits them from extending more credit at these times, adding to the business cycle. Barth, et al. (2008), find that many countries increased banking system instability by escalating regulatory restrictions on bank activities. Gennaoili, et al. (2013) describe a rational expectations, shadow banking system; they suggest that overall bank leverage offers a better instrument to control expansion of risky activities than risk-weighted capital requirements. Diamond and Rajan (2001) argue that capital requirements, among others, may diminish liquidity formation. Hanson, et al. (2011) explain how higher capital and liquidity requirements on banks invite more securitization of loans (i.e., held by hedge funds) who are not subject to bank capital regulation.

Gropp and Heider (2010) observed heterogeneity in capital structure choices across banks. Farhi and Tirole (2012) show that strategic complementarities can lead banks to correlate their risk exposures, thus highlighting a different channel than the one analyzed in this model. Metrick and Yasuda (2009) show that buy-out managers rely on past experience to grow their size larger than venture capital firms thus leading to higher revenue per partner. Suarez et al. (2005) observed from data that Basel II does not provide enough assurance regarding the capital adequacy of banks with respect to equity investments.

Blum (2008) provides a detailed discussion of the capital requirements under the Basel II Capital Framework. He constructs an asymmetric information model representing safe and risky banks that cannot easily be observed by regulators. Risky banks do not correctly report their category; maximum leverage ratios generate an incentive for banks to report truthfully their risks. The supervisor examines banks *ex post* (after returns are generated) and accurately spots the banks'

true kind. If the bank has misrepresented its true type *ex ante*, the supervisor imposes a fine *ex post* on the dishonest bank. All of the bank's assets are lumped in a single risk category.

This paper extends the analysis in Blum (2008) in two dimensions. First, it introduces private equity as a separate asset class on the bank's balance sheet, differentiating between loans and more volatile equity investments (buy-outs). Second, examining the net return on assets spread, it derives the leverage ratio in terms of the private equity investments. A structural model that uses capital requirements explicitly under the internal rating approach is well-suited for this analysis, since it allows us to explore the effect of adding penalties and a leverage ratio restriction.

There are two bank types: safe banks [ii] are able to invest in the buy-outs without taking risks that exceed their average lending portfolios and risky banks that are less efficient in weeding out excessively risky investments. Risky banks hold too little costly capital relative to the first-best solution. The threat of penalties imposed by the regulator becomes less effective, in the limelight of high expected returns on equity investments. We demonstrate that even when supervisors are capable of detecting and punishing dishonest banks, an additional leverage ratio augments the supervisor's abilities, while balancing the expected profitability of these investments.

To our knowledge, this is the only paper that restores the optimal outcome when private equity investments are present. It achieves this objective with minimal chances of bailouts to the banking system and without excluding banks from the private equity investments, which can further diversify the bank's portfolio. This result is made possible through the imposition of a leverage ratio restriction, proportional to the amount of risky investments, and consistent with the risk-weighted capital requirements.

2. Banks' exposures to private equity[iii]:

Banks, naturally multifaceted organizations, have assets ranging from loans to government and corporate securities, to illiquid investments in buy-outs. Banks' equity investments, can take the form of securitized loans, subordinated loans to help cover equity pledge of a private equity firm, or ownership of equity in public firms. Private equity is money collected privately from investors in large sums and committed for long periods of time, at times in illiquid, highly risky form that lack transparency. Different definitions of private equity exist, depending on geographical context.[iv] We only consider Leveraged Buy Outs (LBO), in this paper.[v] Many private equity firms conduct these, where large amounts of debt are issued to fund a large purchase. The private equity firm will then try to improve the financial position and forecasts of the company. Firms involved in these deals are normally more established and create operating cash flows.

Overall, these investments represent more of a challenge for regulators with risk calculation and detecting dishonest banks. The market for private equity may not favor disclosure of bad news if it materializes in the future. This would make the companies have to pay higher (lemons) premiums when issuing new funds. Therefore, managers of such companies become reluctant to share any information publicly. The regulatory framework for banks, as outlined in the Basel accords, aims to support capital adequacy with the underlying risks that banks assume. In economic downturns, lending activities become riskier and decrease. Banks find themselves holding excess funds that are arguably attracted to the more risky alternative investments, including hedge funds or private equity funds. Banks's investment in private equity, usually in the form of a limited partnership[vi], could reflect bank managers' incentives to raise revenues and exploit instability.

In a crisis, the extensive use of leverage in buy-outs can lead to forced liquidations, particularly for hedge funds that invest partly in illiquid investments. This can start domino effects through the immediate relationships of the hedge funds with their intermediaries, and indeed failing counterparty banks can lead to the suspension of hedge funds. Systemic risk worries are further aggravated by the noticeable role of hedge funds in the financial markets. Such behavior may be specially motivated by large banks that benefit from implied bail-out guarantees.

The Volcker Rule[vii] in the 2010 Dodd-Frank Act calls for significant cutbacks in private equity activities[viii], with an attempt to limit systemic risk, to protect customer deposits made to US banks. It prohibits US depository institutions from carrying out "proprietary trading" (potentially bearing trading losses), unless such trading was ordered by their clients. The Volcker Rule also limits a US bank's possession of hedge or private equity funds to a total of 3% of its Tier 1 capital and to 3% of one private equity group or hedge fund. However, it is unclear whether banks will still be required to adhere to such minimal investments if they also originate the fund[ix].

Having rules in place for investor protection and corporate governance not only affect the role and space of active investors but can introduce some moral hazard effects. For example, Cumming and Zambelli (2013) present evidence on the inefficacy of excessive regulation (as in prohibition) of private equity funds in Italy; it resulted in reduced supply of capital and because the quality of the capital suffered, lowered returns on such capital. Bongaerts and Charlier, 2009 find that capital requirements in private equity should be lower than in Basel II; this could lead to unfair competition among banks. They also find that internal model capital requirements are higher than the ones applied by the European Union; this can give banks adverse incentives for using sophisticated risk management techniques.

Basel II started a risk-management process, delegating the risk assessment to the banks themselves. Obviously, inspectors cannot effectively validate the bank's risk assessments; hence Basel II was insufficient to provide incentives for banks to truthfully reveal their risk level. Moreover, when hedge funds and proprietary trading contribute to a global financial meltdown, possessing high quality capital becomes essential in mitigating the systemic risk of banks on the economy. Basel III focuses on banks getting an adequate amount of high-quality capital and sets minimum regulatory capital requirements **a la** leverage ratio rule[x]. Particularly, the risk-weighting framework provides incentives for improved risk management practices when investing in private equity funds[xi]. However, this presupposes that banks have a plausible reason for telling the truth, which may not always be exact. Regulation should not overlook that banks, as investors or as lenders/investment managers in private equity, nurture businesses and generate employment.

The main difference of hedge funds from private equity lies in the former's inclination to invest in public securities. Moreover, hedge funds use short-selling, debt, and derivatives extensively. The commonality with private equity is in the buy-out part, in particular, the distressed assets. Private equity funds tend to gain control of the financially-struggling firm, reorganize and resell it; hedge funds usually trade securities of distressed companies with the purpose of benefiting by quickly reselling these securities.

Banks' exposure to private equity investments may be partitioned into four groups:
1. investing banks' own capital;
2. managing clients' assets;
3. lending to private equity funds;
4. lending to portfolio firms for acquisition and corporate expansion.

During the beginning of the 2000s, the bear market encouraged banks to turn to private equity as a source of alternative investment where they can claim to deliver returns on a variety of market conditions (see, Gumni (2013)). We consider in this paper only the first among the four aforementioned groups. Banks have traditionally invested their own funds (known as captive funds), and generally established to manage banks' monies into unlisted companies, in buyout, venture, and growth capital. Through such captive investments, banks expand their economies of scope and cross-sell services to their investment partners, securing higher returns.

Since all other lending can be considered as corporate loans held by any type of owner, this paper is mainly concerned with captive funds; other cases where banks lend directly or indirectly or through LBOs to investment funds are not considered here. The motivation behind

this concern is that banks that do not have enough 'skin in the game' have emanated as bad news to the private equity funds. Therefore, in order to reduce systemic risk, bank investments considered in this paper do not employ much leverage.

3. The model:

We follow the model in Blum (2008) in modeling profit-maximizing banks facing financing costs under asymmetric information in a one period game. We expand that model by adding the private equity class of assets in the balance sheet of the bank, in order to study how capital requirements are affected by this variable. This paper allows the bank to first reveal its type (safe or risky) and the supervisor consequently sets the bank's minimum capital provisional on the revealed type. We abstract from the fact that loans are inherently risky by supposing that they carry an average risk weight of 100%. It is assumed here that equity investment risk exceeds loan risk by a considerable proportion equal to *p,* greater than ½.[xii] Assume that net return on equity investment r^E, with a lower bound of -1 due to limited liability, exceeds the net return on loans r^L. The riskless rate is paid on deposits and it is supposed to be zero.

Suppose that the assets of the bank consist of loans *L*, and equity buyout investments *I*, more risky than loans. Liabilities consist of the total deposits *D*, and equity capital *K*.

When the assets are normalized to one, the balance sheet identity is

$$L + I = D + K \equiv 1. \quad (1)$$

The net return on the equity investment is r^E with probability *p* and $-r^E$ with probability *(1-p)*, where *p* is the probability that the investment succeeds. This makes riskier investments more desirable as they carry a risk premium.

As mentioned before, there are two types of banks, risky and safe. Safe banks, because they are better managed, only invest in the good buy-outs that return r^E with probability 1. Risky banks do not have quality management and end up with second-rate deals. They take a chance *(1-p)* that the investment generates a net loss of $-r^E$; there is also a chance *p* that their investment succeeds and returns r^E. This segmentation of the banking system into safe and risky institutions ensues within the market, as it maximizes the banks' use of implied government assurances.

Suppose that bank failure results in some social costs *S* made up of contamination outcomes and disruption of the financial system. These costs cannot be borne by the owners of the

insolvent bank because of limited liability, but they spillover to the rest of the banking sector. Capital is more costly than deposits and less costly than loans or private equity. The opportunity cost of capital r^k is larger than the interest rate on deposits assumed to be zero, $r^k > 0$. In order to prevent bankruptcy, risky banks hold amount of capital K_0 that has opportunity cost $r^k K_o$, with an expected insolvency cost of *(1-p)S*. Hence the cost of insolvency is sufficiently high,

$$S > \frac{r^K K_0}{1-p} . \quad (2)$$

Under this assumption on *S*, it is prudent for risky banks to hold enough capital K_o (the socially optimal level, first best solution)[xiii], to thwart insolvency and avoid cost *S.* For this reason, it becomes socially optimal for these banks to hold this capital to avoid bankruptcy.

Safe banks are assumed not to hold any (or minimal) shield capital since they do not think an insolvency is probable, and, therefore, carry on maximizing profit by foregoing most capital investment in order to avoid any financing costs. If safe banks hold any nonzero shield capital, the model's qualitative results would still hold.

A. No guideline:

We start with the absence of any guidelines from banking authorities, safe banks ex-post profits are given by:

$$\pi^s = r^L \mathrm{L} + r^E \mathrm{I} - r^K \mathrm{K} . \quad (3)$$

Because assets are normalized as in (1) above, this equation can be rewritten as:

$$\pi^s = r^L (1 - \mathrm{I}) + r^E \mathrm{I} - r^K \mathrm{K} . \quad (4)$$

This profit is maximized if K=0 (i.e., safe banks profit, acting competitively, take into account their "safe" status, therefore they can save on financing costs by eliminating the redundant shield capital in this case), or:

$$\pi^s = (r^E - \mathrm{r}^L)\mathrm{I} + r^L. \quad (5)$$

Safe banks capitalize on the spread of risky assets in balancing between their two assets. Since they are managed efficiently, their expected profit is certain.

Risky banks make profit of:

$$\pi^r = r^L \mathrm{L} + \mathrm{p} r^E \mathrm{I} + (1 - \mathrm{p})(-r^E \mathrm{I}) - r^K K. \quad (6)$$

Substituting from (1) and rearranging:

$$\pi^r = [r^E (2\mathrm{p} - 1) - \mathrm{r}^L]\mathrm{I} + r^L - r^K K. \quad (7)$$

The risky banks expected profits are maximized when the amount of capital *K* is set to zero:

$$\pi^r = [r^E\,(2p-1) - r^L]\mathrm{I} \;+\; r^L. \tag{8}$$

An unregulated risky bank will hold too little capital compared to the first-best scenario. Hence the risky bank's optimal choice is not socially efficient. Banks do not hold any capital because there is no private benefit to holding it.

B. A simple leverage ratio constraint:

A lower bound on the ratio of capital to total assets, a leverage ratio restriction, has long been used in bank capital regulation. Such a ratio defines the minimum amount of equity capital to be held as a percentage of the non-risk-weighted total assets. The popularity of these ratios stems from the fact that they are easily observed and thus more effectively monitored by regulators. This takes a form of a lower limit on the capital to assets (leverage) ratio, or simply a leverage ratio restriction. Here, this is equivalent to a restriction on the amount of capital K_m held by the bank since the total assets are standardized to one. The risky banks' capital cushion is large enough to prevent insolvency if:

$$k_m = \; r^L\mathrm{L} + r^E \;\mathrm{I}\,. \tag{9}$$

The risky banks' externality is resolved but the solution also requires the safe banks to hold an equivalent amount of capital since the supervisor cannot observe the bank *ex ante*. This imposes a financing cost on the safe banks that is not needed. Basel II tries to resolve this issue by allowing each bank to hold an amount of capital commensurate with its own level of risk. This is explored next.

C. Basel II: The IRB approach

The internal ratings based (IRB) approach asks the bank to establish riskiness of its credit portfolio based on its in-house calculations. The bank reveals these calculations to the supervisor who sets in the required capital based on such information. The supervisors require risky banks to hold the minimum amount of capital, enough to cover their total net revenues and stay solvent, in order to restore the first-best solution. From (9) above,

$$K_0(risky) = r^L\mathrm{L} + r^E\,\mathrm{I}\,. \tag{9'}$$

They require safe banks to hold no capital, or, $K_0(safe) = 0$. Safe banks always reveal their true type since they have no benefit to gain from misrepresenting it. Whereas, risky banks save on the capital financing costs if they play safe. In this case their profit will be the same as the safe bank's profit:

$$\pi^r(safe) = [r^E \;-\; r^L]\mathrm{I} \;+\; r^L. \tag{10}$$

On the other hand, if the risky bank is truthful, it will hold capital, $K_0 = r^L \mathrm{L} + r^E \mathrm{I}$. Their profit will be:

$$\pi^r(risky) = [r^E\ (2p-1) - r^L(1-\mathrm{r}^K) - r^K r^E\ ]\mathrm{I}\ \ +\ r^L(1-r^K). \tag{11}$$

This profit is less than the previous one by the amount $[r^K - 2(p-1)]r^E\ \mathrm{I} +\ r^L r^K\ \mathrm{L} > 0$. The profit resulting from being honest is clearly less than the one corresponding to cheating about the bank's type, or being dishonest. Therefore, the bank's voluntary disclosure of their risk type does not yield a socially optimal outcome. Since the risky bank has an incentive to lower its capital holding by lying about its type, an *ex post* penalty by the supervisor must be introduced to reduce the expected profit and encourage the truth-telling in this situation.

D. Basel II: Penalties added to the IRB approach

The supervisor imposes a fine *F* that is proportional to the amount of capital after profits, K_1. If a bank is solvent the supervisor can find out with a probability *q* if the bank has been dishonest. This fine is imposed if the risky bank is found to have lied about its type, given by:

$$F = s\ K_1\ =\ s\ [r^L L\ + r^E\ \mathrm{I}\ + K_0]\ . \tag{12}$$

Normally, *s* is a fraction of the bank's capital after profits and is less than unity. If the bank is safe, the case does not require any analysis since the bank does not hold any capital and is not required to: truth-telling will occur. If the risky bank has been honest about its type, this decision by the supervisor leaves its profit unchanged from (11) above:

$$\pi^r(risky) = [r^E\ (2p-1) - r^L - \mathrm{r}^K(r^E\ - \mathrm{r}^L)\ ]\mathrm{I}\ \ +\ r^L(1-\mathrm{r}^K). \tag{13}$$

If the risky bank is dishonest, it does not have to hold any capital, but is subject to the penalty if the supervisor catches it. Hence, the fine is $F = s[r^L\ L + yI]$, and the expected profit for this bank is:

$$\pi^r(safe) = r^L\mathrm{L} + r^E\ (2p-1)\mathrm{I} - qs\ [\ r^L\mathrm{L} + r^E\ \mathrm{I}]. \tag{14}$$

Rearranging one gets:

$$\pi^r(safe) = [r^E\ (2p-1) - qs(\mathrm{r}^{\mathrm{E}}\ -\ r^L) - r^L]\mathrm{I} + (1-qs)\ \ r^L\ . \tag{15}$$

Comparing equations (13) and (15), the risky bank's payoff of being honest exceeds the payoff of being dishonest if

$$0 < r^K < qs\ . \tag{16}$$

The left hand side of the inequality is always positive which imposes a condition on the supervisor being able to detect *q* and able to punish *s* being sufficiently high in order to induce

truth-telling (i.e., *qs* measures the power of the regulator to induce truth-telling). The larger the cost of capital, the more is the incentive to cheat for the risky bank and the less likely condition (16) above to hold. Simply, higher risky returns in the presence of equity investments increase the fine that dishonest banks pay, but since they are risk neutral they will take the risk of cheating in order to receive such a spread. That is, since risky banks fare better when the prospects of earning a higher return are higher, and given that the risky returns relative to the lending returns are high; this leads them to lie about their type since they know this reduces the power of regulators, hence increases their expected payoff. If the ability of the supervisor to induce truth-telling is undermined (i.e., if any of these two parameters q = 0, the case of an uninformed supervisor, or s = 0, as in a situation where the supervisor is weak or unable to enforce the penalties) all risky banks lie about their types. In such cases, equation (15) reduces to $\pi^r(safe) = [r^E\,(2p-1) - r^L]\mathrm{I} + r^L$, clearly larger than π^r (risky) in (13) above and condition (16) will not apply. Therefore, an inefficient social outcome for risky banks will result. We next impose an additional leverage ratio restriction on banks to correct for this problem.

E. Basel III: Leverage control added to the IRB approach

Independent of announced type, all banks are subject to minimum holding of capital at level K_m, less than or equal to $r^L\,\mathrm{L} + r^E\mathrm{I}$, from equation (9) above. This is the new regulation advanced by Basel III that requires an overall adequate high quality capital. Assume that this new rule does not bind for safe banks. Therefore, the leverage ratio does not apply to these banks. For risky banks that claim to be risky, the IRB requires them to hold an adequate amount of capital according to K_m equal to $r^L\,\mathrm{L} + r^E\mathrm{I}$**.** For risky banks that play safe, the leverage ratio restriction is K_m. hence, their profit is the following:

$$\pi^{r\ levereage}(safe) = r^L\,\mathrm{L} + r^E\,(2\mathrm{p}-1)\mathrm{I} - \mathrm{qs}\,[r^L\mathrm{L} + r^E\ \mathrm{I} + K_m] - r^K\,K_m. \quad (17)$$

Note that $\pi^{r\ levereage}(safe)$ is decreasing in the leverage ratio requirement K_m. Rearranging this equation, one gets:

$$\pi^{r\ leverage}(safe) = \left[r^E\,(2\mathrm{p}-1) - r^L - \mathrm{qs}\,(r^E - r^L)\right]\mathrm{I} + r^L(1-\mathrm{qs}) - (\mathrm{qs} + r^K)\,K_m. \quad (18)$$

A dishonest bank's expected payoff is lower in the presence of the leverage ratio restriction, in other terms, $\pi^{r\ leverage}(safe) < \pi^r(safe)$, if the following condition is met:

$$(qs + r^K)\,K_m > 0\,. \quad (19)$$

Since the ability to detect risky banks q and the proportion of the bank's profits s and the cost of capital are all positive, as expected, the condition (19) is always satisfied. Consequently, dishonest banks' profits are reduced when the regulator imposes a leverage ratio restriction. The leverage ratio K_m is a function of the product qs. Let us find the leverage ratio that makes

risky banks indifferent between lying and telling the truth about their type. This is given by equating equations (13) and (18) above. This is equivalent to:

$$K_m = \left(\frac{r^K - qs}{r^K + qs}\right)[(r^E - r^L)\mathrm{I} + r^L]\,. \qquad (20)$$

This relationship produces the optimal leverage ratio restriction for a given supervisor's abilities *q* and *s.* It yields the optimal risky bank reporting in the presence of equity investments and risk-sensitive capital requirements. Equation (20) shows that the leverage ratio increases with the level of equity investments *I* (i.e., $\partial K_m/\partial \mathrm{I} > 0$) if $r^K > qs$. Therefore, if financing costs are larger than the product of the abilities of the supervisor, the risky bank requires a higher leverage ratio in order not to cheat. If the risky bank knows that it is less likely to be caught, the supervisor needs to decrease the expected payoff by raising the leverage ratio. Then, the level of risky investment becomes a gauge that signals to the regulators the minimal capital requirement.

The optimal leverage ratio induces telling the truth. It is an increasing function of the spread of risky investments over loans; it also increases with the level of net returns on loans. Consequently, introducing the capital ratio K_m**,** reduces the expected risky dishonest bank's profit, by placing more equity at stake for the supervisor to effectively seize in case dishonest banks are detected. Furthermore, the capital ratio leaves the owners wide open to lose private funds. Therefore, the supervisor can reduce the bank's incentive to improperly reveal its true type by setting a high enough leverage ratio.

4. Numerical example of leverage control

For certain parameter choice one can simulate the above equilibrium to generate the following results. Assume that the probability of a buyout investment to be successful is 0.60 and that the cost of capital, r^K, is equal to 0.17 and that the lending rate, r^L, is equal to 0.20. Further, assume that *q*, the probability of detection is equal to 0.60 and that *s*, the ability to punish, is 0.25. In order to show the plausible need for the regulator to enjoy a leverage control together with ability to impose penalties, we choose these probabilities so that the product of the abilities to detect and to punish *qs* is 0.15 and is less than r^K, the cost of capital . According to equation (16) above, this guarantees that the risky bank's payoff of being dishonest exceeds the payoff of being honest. This will help to show that, for the dishonest bank, barring the enforcement of a leverage ratio, the unregulated risky bank holds too little capital.

We assume that the fine *F*, imposed by the banks' regulator lies between 0.25 and 0.50 depending on the level of initial capital K_0 held by the bank before profits. Also, we assume that assets of the bank are divided between loans, *L*, equal to 0.70 and buyout investments, *I*, is equal to 0.30. It is assumed that this buyout investments' return, r^E, is equal to 1.00 (or 100%); consequently, the returns are made up of 60% chance of being successful and realizing a return of 1.00 on the invested amount and a 40% chance of being unsuccessful, which leads to a complete divestiture, and a loss of 1.00 of the invested amount, may be due to some closing and litigation costs.

Without any guideline from the banking regulator, the safe banks' profits, π^s can be calculated as 0.44 and the risky banks' profits, π^r compute to 0.20; we obtain the result that unregulated risky banks hold too little capital compared to the first-best solution.

Using the Internal Risk Based approach, the supervisor asks banks to hold capital K_0 of 0.44 to restore first-best. This gives π^r (safe) = π^s = 0.44 and π^r (risky) = 0.1252. The risky banks' profit from pretending they are safe exceeds their profits if they truly reveal their type. Therefore, voluntary disclosure of risk type leads to risky banks cheating.

When penalties are added to IRB, the risky banks' profit when they play safe, π^r (safe) is equal to 0.206, which exceed their profits when they truly reveal their type, π^r (risky) is equal to 0.1252. This result is due to the fact that the cost of capital exceeds the combined abilities of the supervisor to detect and punish the cheating banks; therefore, risky banks choose to cheat and pay the fine if caught. This case leads to a socially inefficient outcome for risky banks.

When a leverage control is added to IRB, K_m is set equal to $r^L \mathrm{L} + r^E \mathrm{I}$, or 0.44, the risky banks' profit when they pretend to be safe, $\pi^{r\ leverage}$ (safe) compute to -0.0068 which is less than their profit when they truly reveal their type, π^r(safe) of 0.206. Therefore, this capital ratio restores the truth-telling incentive of risky banks. The minimal capital ratio is inversely related to the supervisor's abilities, as depicted in the figure. The bank supervisors choose the optimal level of capital *K* to be 0.0275, or 2.75% of total assets. Since $r^K > qs$ in this example, the optimal choice of K_m is positive and as calculated here. When the abilities of the supervisor are at least as large as the opportunity cost of capital, the optimal leverage ratio equals to zero. The cost of financing this optimal level of capital, 0.47%, is a cost uniformly imposed on both types of banks. This optimal capital ratio makes risky banks indifferent between lying and telling the truth and restores the truth-telling behavior of banks at minimal social cost.

5. Sensitivity analysis

Looking at equation (20) one can notice that the leverage ratio necessary to induce truth telling decreases as the ability of the supervisor to detect banks' true type *q* is higher or the ability to enforce penalties *s* is higher. This is shown by:

$$\partial K_m/\partial(qs) = \{-2[(r^E - r^L)\mathrm{I} + r^L]r^K|(r^K + qs)^2\} < 0\,. \quad (21)$$

Therefore, a strong regulator, represented by a high *qs*, leads banks to lower their leverage ratio. This saves all the banks in the economy from holding high levels of costly capital.

In the worst case scenario, *q* is set to zero, the supervisor can never detect the true type or if *s* is set to zero, the supervisor cannot levy penalties. In this case, the capital regulation becomes the simple leverage ratio restriction discussed previously (in section 3.B) which does not lead to an optimal solution. In this case we obtain a value for K_m:

$$K_m = [(r^E - r^L)\mathrm{I} + r^L] = r^L\mathrm{L} + r^E\,\mathrm{I}\,. \quad (22)$$

It is easy to see that the leverage ratio in equation (22) is identical to the sub-optimal simple leverage with value in equation (9) above. This imposes a heavy financing cost on the safe banks that is unnecessary in this model.

If we consider the most optimistic scenario, when the abilities of the supervisor are quite high (i.e., $qs \geq r^K$) the additional leverage ratio (as given in equation (20) above) may be omitted: these abilities will ensure that the optimal leverage ratio[xiv] is zero. When the cost of capital is less than the combined abilities of the supervisor to detect and punish cheating banks, the threat of sanctions alone is sufficient to restore the truth-telling incentive for risky banks. The average case will obtain a capital ratio that lies somewhere in between zero (as implied by the optimistic scenario) and the simple leverage ratio given in equation (22) above (as implied by the worst case scenario).

Therefore, only when the capital is more expensive relative to the abilities of supervisor to sanction risky banks, the cost of capital savings would outweigh the fine. In this case, the risky banks are more induced to cheat and pay the fine if they are caught by the supervisor. As mentioned in section (3 E) above, looking at equation (20), one can observe that the leverage ratio increases with the level of investment in private equity in this case. Hence, a specific level of K_m is necessary in addition to the risk-based capital requirement to ensure truthful revelation of banks' risk types.

Moreover, the larger the investment return spread above loans' return, the greater the incentive for the risky bank to invest in these assets in order to post some profits. Hence, the

leverage ratio in (20) above takes this spread in setting the optimal level of K_m, thereby automatically counteracting this tendency by making the risky bank behave more responsibly.

It has been assumed that there are only two types of banks. This assumption can be relaxed without loss of the generality of the results. All that is needed for the truth-telling behavior of banks to occur is to set the leverage ratio such that the riskiest bank behaves honestly. If the threat of sanctions and the drop of the put option value of limited liability are adequately sizeable for the riskiest type, they would be also sufficient to deter the less risky ones from understating their risk type. Automatically, the less risky ones are then persuaded to also disclose their risk type truthfully. Similarly, this is a one period model. Multi-periods can be allowed into the model; the rational expectations hypothesis insures that when the optimal leverage ratio is initially imposed, it leads to the truthful revelation of risk type in all subsequent periods.

6. Policy implications

We showed that a simple leverage ratio restriction when banks invest in captive funds is not efficient, since it does not discriminate between banks of different risk types. Safe banks are required to hold the same level of capital than risky banks, which is not socially optimal for that type of bank. Basel II waives a solution to this problem by delegating risk-assessment to individual banks. However, it was shown that this is not a real answer; banks do not always have an incentive to reveal the truth about their risk types. Because of the inherent conflict of interest with the internal ratings based approach, the banks, especially the risky ones, have a tendency to hold too little capital to save on financing costs. This tendency increases systemic risk.

In this paper, this result is re-established: a bank's own declaration of their individual risk types is unreliable. In a world of this kind, where banks are required to report their type, it is necessary to create a threat of being exposed and punished in order to persuade them to assess their risk candidly. Hence, Basel II would not bring about the socially desirable level of capital holdings without penalties. Otherwise, such capital rules may be unproductive.

Even though supervisors have some ability to detect and punish dishonest banks, often by using backtesting procedures, an additional leverage ratio proportional to the level of private equity investments of the bank may be needed to enhance this ability. Two main effects of this leverage reduce dishonest banks' incentive to misrepresent their risk type: first, a limit on the banks' put option value of limited liability since incurring higher risks will result in a bank's

owners bearing the brunt of losses occurring as a result of excessive risk-taking. Second, the higher level of capital grows the leeway of supervisors to threaten sanctions and impose fines proportionally to the bank's capital, while posing less of an insolvency risk on the bank.

The major point of this paper is that the regulators tie the leverage ratio directly to the amount of risky investments in equity buy-outs. If banks carry buyouts, as long as the financing costs (the marginal benefit from cheating) are larger than the product of the abilities of the supervisor to detect and punish the cheaters (the marginal cost of getting caught), the leverage ratio needs to increase with the size of the buyouts. However, if the abilities of the supervisor are greater than financing costs, this could serve as a deterrent to this kind of cheating activity; in this case, the leverage ratio reduces to zero. It would remove the social costs imposed on the safe banks. On the other hand, banks with less of these investments are required to carry lower levels of capital.

Additionally, the larger the spread between the lending rate and rate of return on buyout investments, the incentive to cheat is larger; therefore, the leverage ratio increases with that spread. This is to balance any tendency by banks to increase their operational risk, without having a corresponding increase in their capital.

Therefore, by looking at levels of equity investments, supposedly in accordance with the Volcker Rule, regulators can gauge capital requirements for the observed bank. Banks with more of these investments are made to carry higher levels of capital in order to protect their depositors and require fewer government bailouts. This would give more authority to the regulators when they are dealing with a higher risk bank, and it would reduce the systemic risks explained above, and work to make the system of banks' reporting their own risks work.

We predict the results of such a rule would be to reduce bailouts, while allowing banks to take advantage of delving into risky investments by reaping some returns. Namely, cross-selling of services to targeted firms that banks buy out up to the extent allowed by the Volcker rule, allows banks to increase information about their clients, saving on transaction costs and potentially increasing their profits. Safe banks would have to hold more capital than their socially optimal level based on the leverage rule. However, this is a necessary cost to insure that the banks hold an appropriate minimal amount of capital. Altogether, the mixture of risk-sensitive capital requirements and a leverage ratio constraint dominates the simple leverage ratio. This also yields a move in the right direction for the riskiest banks who, when using this mixture, would internalize (hold the socially optimal level of capital) their externality (tendency to hold too little capital) on the financial system, and help reduce the overall systemic risk.

7. Conclusion

Capital requirements for equity investments can be different for banks of varying exposures. They reflect the fact that these equities can suffer from a large loss of value even if the underlying investment is still solvent due to volatile market movements. Unlike mutual funds, private equity returns are difficult to study due to limited disclosure while investment in the private companies is under way. Such investments include whole companies, large-scale real estate projects, or other tangibles not easily converted to cash; they have a limited life, and are sticky and segmented. The groups investing in such assets have more control and influence over operations or asset management to influence long-term returns.

In this paper, we have investigated whether unregulated banks choosing to invest in buy-outs in addition to their regular lending activities hold the socially optimal level of capital in a scenario where supervisors do not know *ex ante* the type of banks. To this end, we have extended a model developed by Blum (2008) to represent facts about private equity investments. We have compared the *ex post* profits of risky and safe banks. It was found that risky banks will usually hold too little costly capital relative to the first-best solution, since supervisors cannot see through the dense bank operations before the difficult-to-predict returns are realized. The threat of penalties somewhat reduces the bank's incentive to cheat but does not completely eliminate it. Sometimes, it is tempting for the risky banks with higher returns to ignore the penalties. Any punitive action becomes less effective in this scenario. It then becomes necessary to introduce a leverage ratio restriction directly proportional to the amount of risky equity investments in conjunction with the risk-weighted capital requirements. Such a leverage ratio is effectively able to restore the optimal outcome with minimal cost and without depriving banks from reaping rewards associated with the risky investments.

The larger the spread of return of the risky investments over loans, the larger is the incentive of the risky bank to cheat. Therefore, the leverage ratio required to induce risky banks to reveal their type truthfully needs to increase in compensation for this added tendency. When supervisors are highly capable of enforcing the penalties and detecting the dishonest bank, they can restore the first-best solution with no (or minimal) capital required.

Finally, the case for restrictive provisions on a deposit-taking entity contributing to the private equity and venture capital industry needs to be carefully gauged by Basel III and its sequels, based on clear evidence of potential risk. Any regulatory reforms must not ignore that banks play an important role, whether as investors in the first place and as asset managers or lenders in allowing private equity and venture capital to grow firms and create employment.

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[i] The authors find the importance of alternative investments, mainly private equity, was underestimated prior to the global financial crisis in a defensive portfolio. In their Table 4, the authors show that hedge funds have a high diversification potential because of their lack of significant correlation with most of the other asset classes, while US buyouts are significantly negatively related to US government bonds.

[ii] Due to their prior successful experience, a good predictor of future success in managing such investments, are able to eliminate buy-outs inherent excessive risk.

[iii] This discussion mostly refers to Phalippou 2007.

[iv] In Europe, the asset class as a whole is called “private equity” and is divided into venture capital and buyout, whereas in the U.S. different terms are often used; the asset class as a whole is often called “venture capital” and buyouts are referred to as “private equity”.

[v] Though banks invest in funds of funds, mezzanine, and venture capital, over half said that small to mid-market buyout funds currently present the best opportunity and these banks are committing funds to such activities (see Pregin Special Report: Banks as Investors in Private Equity, last accessed on 7 May 2014 at https://www.preqin.com/docs/reports/Preqin_Special_Report_Banks_as_Investors_in_Private_Equity.pdf). For instance, investing in distressed firms can help investors potentially achieve much higher IRR; unlike other private equity investments, equity buyouts allow investors to achieve greater control over companies. If a bank is unwilling to lend, the management will frequently look to private equity investors to finance the majority of a buyout. A large fraction of management buyouts are financed in this manner. The private equity investors will invest cash in return for a part of the shares in the firm, though they may also grant a loan to the management. The exact

financial structuring depends on the sponsor's desire to balance the risk with its return, with debt being less risky but less profitable than capital investment. In this setup, banks take more risk by investing much of their own capital upfront, compared to leveraged buyout transactions. In such investments, banks also lose the tax shelter of interest payments on debt which increases their cost of capital; however, these adverse effects can be alleviated if the purchase price is sufficiently low.

[vi] Limited partners are not allowed to be involved in the daily operation of their investees, see Cumming and Johan (2007).

[vii] See http://web.archive.org/web/20111228204520/http://sec.gov/spotlight/dodd-frank/volckerrule.htm

[viii] The rule requires carried interest (i.e., any profits that the GP receives as compensation) to be considered as ordinary income (taxed at rate up to 37%) instead of capital gains (taxed usually at 15% rate), causing a significant drop in GP net remuneration.

[ix] The rule does not clearly prohibit US banks from investing in third party funds. Practically, this rule may force banks to dissociate risky assets and slow down trades, it may bring less competition to the private equity and hedge funds. The rule will not stop banks from purchasing 'bad' assets, only trading in them.

[x] The new rule calls for higher minimum capital requirements, additional capital buffers above those minimum requirements, a more restrictive definition of capital, and higher risk weights for various assets, which result in substantially more demanding capital standards for US banks. They need to hold more capital to account for potential losses from trading scandals and regulatory investigations. U.S. Basel III final rule removes the reference to the Volcker rule, see "Basel III, Final Rule", published by the Federal Reserve Board, July 2013 also available on http://www.federalreserve.gov/aboutthefed/boardmeetings/20130702_Basel_III_Final_Rule.pdf

[xi] Banks are required to apply a risk weight of 1250% to a fund's exposures to other funds, see "Capital requirements for banks' equity investments in funds", Basel Committee on Banking Supervision, Bank of International Settlements, July 2013.

[xii] The case where $p < 1/2$, leading to negative NPV investments, is not dealt with in this setup.

[xiii] Under this scenario, the socially optimal level of capital for risky banks is higher than the one without equity investments.

[xiv] Since this ratio cannot be negative, when qs exceeds r^k then the optimal leverage ratio is zero.