Liability Regimes, Competition and the Subprime Crisis

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Abstract

This article explains how a relaxation of the maximum leverage of investment banks in the year 2004 has played the role of a catalyzator for the current subprime crisis. In particular, we show that not only limited liability itself, but also the existence of different liability regimes has lead to an asymmetric risk behavior in the US mortgage market. Our model suggests that the risk-allocation is determined by the player being least regulated. This result prevails qualitatively also after introducing deposit insurance, however, with a different impact depending on the funding of the insurance. We recommend a uniform regulation for financial institutions on the national basis, but also an international harmonization as our model can also be interpreted in the context of a competition of laxity game between countries.

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1 Introduction

Being faced with global financial writedowns of $2.2 trillion (IMF 2009) - a sum that is equal to the total GDP of Italy - the world was shocked by the happenings in 2008. Although governments take huge debts to mitigate the short-run effects, major economies are now tumbling into the most serious downturns since the Great Depression in the 30s of the last century.

Still economists are searching for the causes of the financial collapse, initiated by problems in the subprime mortgage market. Nevertheless, there is no single issue that has triggered the present crisis; rather it was the composition of an on the one hand dangerous macroeconomic development in the US that is characterized by a large trade balance deficit with a policy of low interest rates and on the other hand a remarkable deregulation process leading to excessive risk-taking behavior by banks. This paper concerning the latter, we point out that regulation in the banking sector has failed, since no policy instrument was able to avoid a collapse on such a scale.

It is well-known that banks have much lower equity-to-asset ratios compared to firms in the non-banking sector. However, this is not a phenomenom of the 21st century, but was observed for many decades. In general, regulators in recent years aimed to boost the equity-to-asset ratios in banks' balances. But the capital requirements introduced by the Basel Accords as a supranational capital measurement system were lost upon, as banks were able to design complex transactions to shift risk and disguise the sliding value of assets. Therefore, the question arises, which events emerged to reinforce the risky asset portfolio decisions of commercial banks?

In our opinion the main catalyzator of the 2008 collapse was a regulatory change by the Security and Exchange Commission (SEC) in August 2004, that relieved the five biggest investments banks from the "net capital rule" and undermined the Basel Accords. In 1975, the Rule *15c3-1* (calles "net capital rule") was formed to limit the maximum leverage of brokers to 15, meaning that for one dollar of equity capital the broker was not allowed to grant credit by more than 15 dollars. Since this rule was abolished in 2004, the leverage of the five investment banks exploded to numbers far above 30. However, in retroperspective this perceived advantage was not beneficial for these banks: Three of them do not exist anymore, the remaining two are even more regulated than before 2004. In this paper we will show that the artificial ermergence of the mortgage market that has initiated the current crisis was crucially induced by such a regulatory switch.

Besides the explanation of the subprime crisis the aim of this paper is to suggest an optimal form of regulation in the sense of promoting stability in the banking sector. It is well known that banks that are profitable and well-capitalized are best positioned to sustain shocks to their balance sheet.

The probability of a bank being faced with a shock will depend on its risk-taking behavior. In a seminal paper, Jensen and Meckling (1976) pointed out that highly leveraged firms as banks have an incentive to engage in risky asset portfolios.[3] If the gamble succeeds, the bank benefits, if it fails, the lenders bear the cost.

According to Hellman, Murdock, and Stiglitz (2000) large banks with market power have incentives to minimize their risk-taking-behavior and improve the quality of their assets,

[3] A major reason for this result is the existence of information asymmetries in banking. Since unsound investment policies of banks cannot be monitored by households the imperfect information promote moral hazard behavior of banks. Thus, in the following we regard bank products as lemon goods.

thus creating a franchise value. Franchise value can be defined as the capitalized expected benefits that accrue to a bank from its future operations, and it represents the opportunity cost of going bankrupt. In determining its risk-taking behavior, a bank must balance the gains from increased risk-taking with the loss of franchise value if it fails. Since banks with more market power have higher rents, the franchise value provides risk-constraining incentives to banks to protect these intangible assets.

In fact, empirical studies confirm this link between liberalization and gambling. Keeley (1990) and Demsetz, Saidenberg, and Strahan (1996) find that franchise values are positively correlated with banks' capital holdings and negatively correlated with bank risk.[4]

This paper addresses the question what form of regulation supports economic stability in two steps. First in a static setting, Section 2 presents a two-stage model based on the theory of banks having a de facto convex utility function due to limited liability (Sinn, 2008). We extend this model by introducing the possibility for commercial banks to sell bank products of the subprime market to investment banks with an even higher risk-preference. Via this form of securitization we show that the risk-allocation in the mortgage market is determined by the least regulated player. Compared to a benchmark case with a uniform liability regime, our analysis suggests welfare losses induced by regulatory differentials. These results persist also after introducing deposit insurance, however, with a different impact depending on the funding of the insurance.

In the second step of our analysis, we show that the main qualitative conclusions drawn above remain in the presence of a dynamic setting. We also explain which regulation creates a rationale for commercial banks to invest prudently. Policy implications are presented in Section 3, a conclusion in Section 4.[5]

2 The Static Securitization Model

As we noted in the introduction, to analyze the effect of securitization we study a simple environment that consists of two players, a commercial bank and an investment bank. Both are risk-neutral and receive an inelastic supply of funds, denoted by F_C and F_I with F_C normalized to unity. The essential points of interest in this analysis are the induced effects on the bank's risk-alloaction. As a benchmark we first model all decisions by the banks restricted by some form of capital requirements. We then contrast the environment with one where deposit rate insurance exists.

2.1 The Commercial Bank

This paper starts from the premise that a representative commercial bank receives funds, denoted by F_C. In return, depositors are rewarded by the interest rate $r_C - 1$. After funds have been raised, the commercial bank issues loans to its customer. For the following analysis one may think of mortgages in the subprime sector as an example for these loans.[6]By

[4]Furthermore, Besanko and Thakor (1992) examine loan and deposit markets in a theoretical model where banks can differentiate themselves from competitors. They find that loan rates decrease and deposit rates increase as more banks are added to the market. Recently Guzman (2000) finds that monopoly banks may choose to offer a lower deposit rate and where there is no credit rationing, a monopoly bank will charge a higher interest rate on loans.

[5]The second half of the paper (section 3 and 4) is to be continued.

[6]We interpret the bank's investment as an initially unmarketable loan to which only the commercial bank has access due to its superior screening possibilities.

giving the mortgages to borrowers, the commercial bank chooses a target return $q-1$, which describes the riskiness of the mortgages. Obviously, the higher the possible return is, the higher is also the probability that the borrower defaults. The probability of success can be described by the function $p(q)$, where $p'(q) < 0$.

The actual equity to asset ratio is denoted by α_C, and we assume that the bank must invest its equity capital at the safe rate $s-1$. A crucial assumption, which, however, turned out not be unrealistic as the subprime crisis has shown - is that the risk of the mortgages is perfectly correlated. In the US subprime market the risk was linked to the house prices. As long as the house prices were rising, no borrower was about to default, but then, when prices began to fall an avalanche was set off.

In general, we assume that the bank is risk-neutral, thereby simply maximizing expected profits. In a world where no limited liability for banks exists, the expected profits can be described by equation (1).

$$E\pi_C = p(q) \cdot q - r_C \tag{1}$$

As Sinn (2008) has shown, unlimited liability results in a pareto-optimal choice of risk. The optimality condition, $\frac{\partial E\pi_C}{\partial q} = 0$, is that the marginal expected return must be zero.[7]

$$p(q) + p'(q) \cdot q = 0 \tag{2}$$

However, as banks do enjoy the benefits of limited liability an additional term enters the expected profit function. Since the bank's capital at risk is then much lower than the liabilities to the depositors, it is not sufficient to meet all outstandings. Hence, the lenders will not receive the promised return if the bank's equity capital is exhausted. Thereby an implicit profit of the size $[r_C - s \cdot \alpha_C]$ arises for the bank, if the mortgage holders default since only a fraction of this lost is internalized by the bank. Thus a commercial bank maximizing its expected profits shows an asymmetric risk-behavior resulting from the limited liability.

Moreover, we introduce the possibility of commercial banks to sell mortgages with a given level of risk to investment banks, operating in the secondary market. This transaction is regarded as the beginning of the securitization process by which commercial banks were able to undermine the regulatory requirements on their equity, by placing these mortgages off their balance sheets. To keep the model simple, we assume that the commercial bank is effectively an intermediary between the investment bank and the borrower.[8]As the investment bank cannot originate mortgages itself, it purchases them from the commercial bank in the scale of F_I. Thus, on the one hand, the commercial bank is able to deduct these mortgages from the assets counting to towards the minimum equity requirement, and on the other hand, a transaction fee, $\gamma(q, \phi)$, can be retained. Therefore, the total expected profit of the commercial bank is described by equation (3).

$$E\pi_C = [p(q) \cdot q - r_C] + [r_C - s \cdot \alpha_C](1 - p(q)) + F_I \cdot \gamma(q, \phi) \tag{3}$$

[7]Note also that in the case of unlimited liability the interest rate r_C must equal s.

[8]In fact, in our model investment banks are a pars pro toto for the new creditors who buy the securitised claims. Indeed, they stand for institutional investors as hedge funds, insurance companies, pension funds as well as foreign investors such as foreign central banks who might, in turn, acquire credit risk to diversify their overall risk position.

The additional gain from selling mortgages to the investment bank can be seen as an immediate rent to the bank, which does not increase the capital at risk; indeed it would either be placed in new investments or distributed to the shareholder (the latter is assumed here), since it is never optimal for the bank to hold more than the actual minimum capital requirement (equation (4)).

$$\frac{\partial E\pi_C}{\partial \alpha_C} = -(1 - p(q)) \cdot s < 0. \tag{4}$$

2.2 The Investment Bank

In order to understand how the transaction fee for the sold mortgages, $\gamma(q, \phi)$, is generated, we introduce the expected profit function of the investment bank in equation (**??**). Similarly to the commercial bank, the investment bank receives inelastically funds of the size F_I and promises a rate of return of $r_I - 1$ to the investors. Moreover, the investment bank has an equity to asset ratio of $\alpha_I < \alpha_C$ and acts risk-neutral.[9]Since we want to focus on the mortgage market, we assume that the possible investment is buying mortgages which were originated by the commercial bank, thereby neglecting the existence of other business segments.

The expected profit function of the investment bank is very similar in its properties to the one of the commercial bank, also taking advantage of limited liabilty and minimizing equity capital, $\frac{\partial E\pi_I}{\partial \alpha_I} < 0$. However, the reason for introducing this function is to determine the fee for the mortgages sold.

$$E\pi_I = [p(q) \cdot q - \gamma(q, \phi) - r_I] F_I + [r_I \cdot F_I - s \cdot \alpha_I \cdot F_I] (1 - p(q)) \tag{5}$$

The fee payed by the investment bank for the mortgages is the result of a bargaining game. Taking into account the participation constraints of both banks (the commercial bank to sell mortgages, the investment bank to invest into mortgages), it is obvious that the scale for this fee ranges from zero to a maximum fee that would drive profits of the investment bank down to zero. Note that this maximum fee is $\bar{\gamma}(q) = [q \cdot p(q) - r_I] + [r_I - s \cdot \alpha_I] (1 - p(q))$.

To consider all the possible cases of fees in the intervall $[0; \bar{\gamma}(q)]$, we specify a parameter $\phi \in [0; 1]$ to capture the bargaining power of the commercial bank in comparison to the investment bank. We define bargaining power as the ability to influence the setting of the fee arising from some sort of monopoly or monopsony position in the market place. Hence, the actual fee is a function of ϕ (6).

$$\gamma(q, \phi) = \phi \cdot ([q \cdot p(q) - r_I] + [r_I - s \cdot \alpha_I] (1 - p(q))) \tag{6}$$

The intuition of this equation is as follows: If the investment bank has maximum bargaining power $\phi = 0$ the transaction fee will go down to zero. All rents of the transaction are captured by the investment bank. On the other side the fee will reach its maximum if the commercial bank gains all bargaining power $\phi = 1$.

[9]The condition $\alpha_I < \alpha_C$ refers to Krugman (2008), who claims that US investment banks are not legally banks and therefore less regulated like commercial banks (p. 163).

2.3 Asset-Portfolio Equilibrium

Now we begin our analysis of the risk-taking behavior of the commercial bank. The marginal effect of a change in the risk-allocation q on the expected profits is presented in equation (7).

$$\frac{\partial E\pi_C}{\partial q} = p(q) + p'(q)\cdot q - \underbrace{p'(q)\cdot[r_C - s\cdot\alpha_C]}_{\text{capital-at-risk effect}} + \underbrace{F_I\cdot\phi\cdot\big(p(q)+p'(q)\cdot q - [r_I - s\cdot\alpha_I]\cdot p'(q)\big)}_{\text{risk-export effect}} = 0 \tag{7}$$

For the subsequent analysis it proves useful to distinguish between a capital-at-risk and a risk-exporting effect. The former effect refers to the fact that a preference for risk is induced by having limited liability, as was already shown by Sinn (2008). Banks can externalize the adverse consequences of gambling and thus will choose to invest less prudent. Indeed, it is easy to see that the expression represents a marginal advantage of the bank enjoying limited liability. From the commercial bank's perspective increasing the risk q has the advantage that the depositors will more likely receive $s\alpha_c$ instead of r_c (see Figure 1). The risk of the commercial bank will rise for any $\alpha_c < 1$. In particular, compared with a situation with unlimited liability the externality e increases with less strict minimum capital requirements.

However, including an additional layer of banking, and thereby also a further liability regime, we find that there is even more risk-loving behavior by the commercial bank. Without having the opportunity to sell mortgages to the investment bank, the commercial bank would set marginal expected revenue from issuing mortgages equal to the increase in probability of not being able to repay all the liabilities (equation (8)). Therefore, the commercial bank reduces the marginal expected revenue below zero.

$$p(q) + p'(q)\cdot q - p'(q)\cdot[r_C - s\cdot\alpha_C] = 0 \tag{8}$$

With the opportunity of selling mortgages, the third term in the first order condition (7) comes into place. To see whether this term has an effect on the risk-taking of the commercial bank two factors are important. Firstly, the term tends to be positive (i.e. leading to more risk) if $(p(q) + p'(q)\cdot q - [r_I - s\cdot\alpha_I]\cdot p'(q))$ is positive, since $F_I\cdot\phi$ is non-negative in any case. This term has similarity to the first order condition of the commercial bank if no selling of mortgages is possible, however, here it is the difference in rents of investment banks in case of failure (r_I - $s\cdot\alpha_I$) which matters, in contrast to the one of commercial banks (r_C - $s\cdot\alpha_C$). As $p'(q)$ is negative, the whole term in brackets will be positive if the difference in non-covered deposits is positive, $r_I - s\cdot\alpha_I > r_C - s\cdot\alpha_C$, given that the commercial bank previously has set its marginal profit equal to zero.

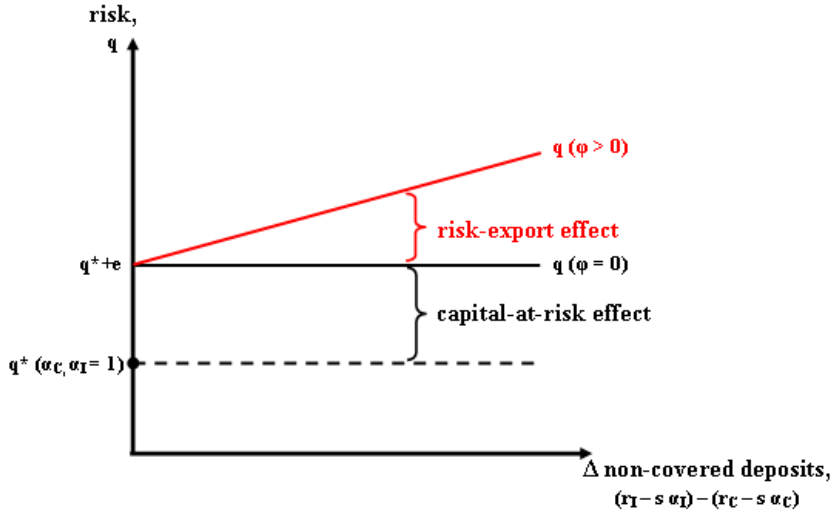
If an arbitrage condition for the households lending money to the two banks holds, they will incorporate a possible difference in equity capital in their demanded interest rate. For risk-neutral households this arbitrage condition is $r_I = r_C + s\cdot\frac{(1-p(q))}{p(q)}\cdot(\alpha_C - \alpha_I)$. Obviously, if we assume that the equity to asset ratio of the investment bank is below the ratio of the commercial bank, households will demand a higher interest rate from the investment bank, thus confirming that $r_I - s\cdot\alpha_I > r_C - s\cdot\alpha_C$ holds. We call this term risk-export effect since it enables the commercial bank to shift risk to the investment bank. As $\frac{\partial(\partial\pi_C/\partial q)}{\partial\alpha_I}$ $(= -F_I\cdot\phi\cdot s\cdot[-p'(q)]) < 0$, more lax regulation of investment banks permits

commercial banks to invest in more risky projects than would have been the case in the past. Moreover, equation (7) indicates that the expected profit of the commercial bank is increasing in the risk-export effect. This is the essence of the moral hazard problem in our model: the larger the gap in non-covered deposits between the two players, the more risky is the chosen asset allocation.

Moreover, we find that the second factor being important for the relevance of this effect is ϕ, the bargaining power of the commercial bank. When it reaches its maximum, then also the additional risk effect reaches its maximum, since then the commercial bank gains the most from a higher q. On the contrary, if the bargaining power of the commercial bank is low, then also the additional risk effect is low. Thus, the more bargaining power the commercial bank has, the more risk is taken and the farther is the allocation from the normative optimum. As a consequence, the scope for gambling by banks increases. We see that the risk-export effect of investment banks is zero when $\phi = 0$, but strictly positive for all $\phi > 0$. The argumentation is summarized in Figure 1.[10]An increase in ϕ results in a rise in q. In other words, the better the bargaining position of the commercial bank is, the bigger are the gains of securitization and the greater is the induced risk-export effect leading to a higher q. This reinforces our main conclusion: the possibility of securitization in the presence of liability differentials distorts the investment decisions of profit maximizing banks leading to a misallocation of risk.

A puzzling question that arises at this stage is, which of these two effects drive the risk-allocation more seriously, the risk-export or the capital-at-risk effect? To see this, recalling equation 7, the magnitude of the risk-export effect crucially depends on the volume of mortgages traded in the market-place. Therefore the next section examines the quantity-choice of deposits F_I implemented in the securitization market.

Figure 1: Risk-taking and differences in liability



[10]Note that $e = \arctan\left(\frac{\partial^2(p(q)\cdot q)}{\partial q^2}\right) \cdot (r_c - s \cdot \alpha) \cdot p'(q)$

2.4 Government Interventions in the Securitization Market

Throughout the previous section, we assumed that the volume of deposits traded in the inter-banking market as given. In this section, we relax this assumption and consider the main case that these funds F_I are endogenously determined at an aggregate level. From equation 7 we can determine a critical volume of traded funds in the interbanking market, $\hat{F}_I$ such that for $F_I > \hat{F}_I$ the risk-export effect exceeds the capital-at-risk effect. The introduction of the endogenous determination of $\hat{F}_I$ in our model enables us to analyze adverse effects from government interventions in the securitization market to the risk-allocation of commercial banks.

Multiple adverse effects effects may occur at a general equilibrium level. Our extension of the model focuses on a limited number of first-order effects that can be assumed because of many reasonable equilibrium models. We introduce an aggregate demand and supply function that exhibit a few properties; a detailed microeconomic specification of the preferences would be beyond the scope of this paper. In order to measure the magnitude of the risk-export effect, we take a reduced form approach that allows us to capture fairly broad equilibrium feedback effects to the market for securitized mortgages. Denote the aggregate supply of securitized mortgages by S and the aggregate demand by D.

In particular, the demand for securitization depends on the interest rate r_I that depositors receive from the investment bank. Notice that the capital requirements, as well as the bargaining position of the investment bank deter the amount of traded mortgages: $D(r_I, \alpha_I, \gamma)$ with $D_{r_I}(\equiv \frac{\partial D}{\partial r_I}) \geq 0$, $D_{\alpha_I} \leq 0$ $D_\gamma \leq 0$.

In contrast, suppose that the supply of securitization depends on the number of mortgages M. Note that households can put their savings either into renting, or buying a house via credit, thus becoming homeowners. A reasonable assumption is that the number of owners of rented residential properties (= mortgages) is increasing in the household's own benefits g and decreasing in the returns of substitutes; e. g. subsidies on home ownership encourage creditworthy borrowers to buy a house. We therefore assume $S(M(g), r_C)$ with $S_{M(g)} \geq 0$, $S_{r_C} \leq 0$.

The equilibrium in mortgage-market is given by $S(M(g), r_I) = D(r_I, \alpha_I, \gamma)$. In a laissez-faire world for creditors the marginal costs of buying mortgages is equal to the benefits. This allocation of funds is efficient. However, policy interventions c. p. can influence F_I by two channels: via subsidizing home-ownership on the supply-side and via political pressure on financial institutions regarding investment decisions on the demand side. And so it was in the US mortgage market.

Government financial subsidies for home-ownership especially for low-income families, are a long-standing stance of the US-government redistributive policy.[11]Consequently several governmental interventions promote supply of mortgages, e. g. (1) the deductibility of mortgage interest on one's home creates tax advantages in buying rather than renting, (2) the provision of credits by special FHA programs (which permit over 95% leverage at origination) or (3) refinancing of housing mortgages to finance the purchase of private goods. Note that all these interventions raise the benefits of home-ownership g, shifting the

[11]In the US the Congress relaxes mortgage requirements that cannot be tightened without losing political support among wage earners: The government could not offered wage-earners higher wages, which have remained flat since 1970's partly via globalization, outsourcing and technical change, without violating the commitment to free markets and losing the electoral support. The politico economic solution was to offer home ownership through cheap and easily available (NINJA) mortgages. That's why the US government has pushed hard to make home-ownership more affordable.

aggregate supply curve of mortgages to the right.

Moreover, there are government funding subsidies via Federal Home Loan Bank lending and liability protection for investment banks that increased demand for subprime mortgages by Fannie Mae and Freddie Mac. The prospect of national loss compensation in case of failure increases optimism of market participants, inducing more trust into the intermediaries. As a result, the latter have no incentive for prudent investment, and even the depositors are less interested in monitoring since risky investments yielding to higher expected profits for all market participants (at the cost of the government). This creation of one-sided payoffs encourage banks to make excessively risky bets, therby encouraging the systemic risk that regulators usually are trying to avoid. However, in our model the net-effect of a full bailout to the risk-allocation is similar to a situation with $\alpha_I = 0$ since in a static setting there are no cost to defaulting in the form of losing assets for banks that can limit the risk-taking. Note that such interventions de facto work as a substitute for the abolishment of any capital requirements. In addition political pressure on these institutions to increase the "affordable housing" programs is observed in recent years. As a result of these interventions the subprime portfolios grow artificially.

How does the availability of a growing secondary market now affect the misallocation of risk presented in the last section? The answer is quite simple: The expected profits of the commercial bank as financial intermediary is magnified by leverage.[12] According to equation 4 the profit maximizing bank will attempt to maintain the highest level of leverage consistent with limits set by regulation. In benign financial market conditions they expand balance sheets as they increase leverage. Although commercial banks yield higher leverage via other ways - e. g. returning equity to shareholders - the evidence shows a tendency to keep equity intact and adjust the size of total assets (see Adrian and Shin, 2007, 2008). Since balance sheets expand, securitization enables a situation in which new borrowers must be found to fill. When all prime borrowers have a mortgage but there is a need to expand, banks have to lower their lending standards in order to lend to subprime borrowers. In other words, the imperative to expand assets drives up risk. The discussed risk-export effect gains weight and worsen the risk-allocation decision of the commercial bank as the originator of the underlying mortgages. Consequently the securitization activity, strenghtening the capacity of banks to supply new mortgages, offers a self-energizing character. In this context Shin (2009) paints the picture of an inflating balloon which fills up with new assets.

This suggests that the risk-taking of commercial banks is endogenously determined by policy interventions, i. e. financial guarantees or lax regulation (subsidies for home-owners) inflate the bank's demand (supply) of mortgages, thus requiring higher risk. We have shown that the presence of government subsidies encourages the magnitude of the risk-export-effect. Consequently there exist a threshold of $\hat{F}_I$ where the risk-export effect exceeds the capital-at-risk effect. This result emphasizes the particular role played by governments. The level of risk that will be implemented by the commercial bank is determined by the player not only being least regulated but also being most monopolized by governmental interests. In other words, government financial subsidies are key triggering factors.

[12] Leverage is the ratio of total assets to equity.

2.5 Deposit Insurance

So far we have studied a model without deposit insurance for bank depositors. The reality is, however, somewhat different as we present in Table 1. Almost all countries have a deposit insurance system for depositors of commercial banks. In general, we can distinguish three kinds of deposit insurance fundings: funding by banks themselves (which is employes by a vast majority of the countries), funding by government, and a shared funding system.

In this paper we are mainly interested in the consequences of deposit insurance on the two effects identified in section 2.3. To examine this, we discuss a bank funded scheme and a government funded scheme. Moreover, the institution we call deposit insurance is defined as covering all deposits without an upper limit.

Table 1: Deposit Insurance

		Is it funded by the government, the banks, or both?		
		Banks	Government	Both
Is there an explicit deposit insurance protection system?	Yes	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxcmbourg, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, United Kingdom, Croatia, Norway, Switzerland, Canada, United States	Macedonia	Latvia, Malta, Japan
	No	Australia, New Zealand		

Source: World Bank (2007)

To study the impact of deposit insurance, we may once again take a look at the equilibrium condition of the households. Obviously, as the deposits are save now, the equilibrium condition for the depositors of the commercial bank reduces to $r_C = s$. Thus, the arbitrage condition between the commercial bank and the investment bank can be described by equation (9).

$$r_I = \frac{s}{p(q)} \cdot (1 - \alpha_I \cdot (1 - p(q))) \tag{9}$$

Government funded deposit insurance

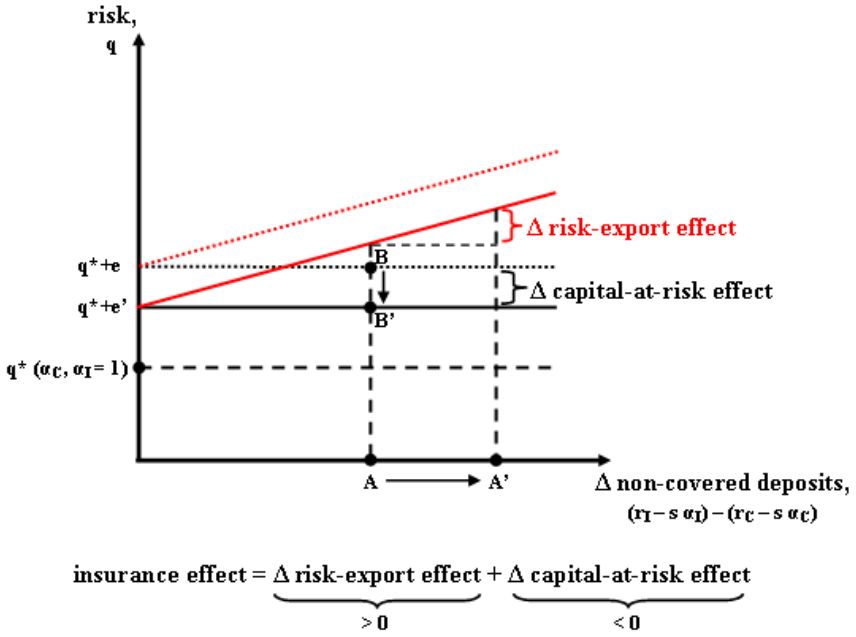
Coming back to the previously specified effects that drive the risk allocation, we see that an introduction of deposit insurance ceteris paribus boosts the magnitude of the risk-export effect as the interest rate for depositors r_C is reduced to a lower level (here: s). This can easily be understood by taking a look at the "more-risk" condition $r_I - s \cdot \alpha_I > r_C - s \cdot \alpha_C$, i.e. the difference in non-covered deposits between the commercial bank and the investment bank, which is now satisfied more strongly. Given this equation, the government funded insurance scheme implies risk taking expands from point A to point A' in Figure 2.

On the other hand, we also observe a change for the capital-at-risk effect. Here, deposit insurance tends to reduce risk-taking simply because r_C is now lower, so the implicit profit

of not being able to repay all depositors has also declined. Reflecting the adjustment in the allocation decision, we move from point B to B' in Figure 2.

To sum up, there are two counteracting effects when a deposit insurance is introduced. While the risk-export effect is intensified, the capital-at-risk effect is reduced. Thus, the combined net-effect of a government funded deposit insurance depends how this trade-off enters the expected profit function of the commercial bank. Under the conditions of a dominating capital-at-risk effect, $F_I < \hat{F}_I$, the net-effect exters a downward pressure on q. In contrast, the efficiency effect of the deposit insurance turns out to be negative if the risk-export effect is sufficiently large. Thereby our findings of section 2.4 suggest that in recent years the risk-export effect gains in importance as a result of increasing governemntal interventions. From the standpoint of the model described above, we can conclude that we expect no improvements in the risk-allocation with a government funded deposit insurance subject to the constraint that there exist policy distortions in the securitization market.[13]

Figure 2: Risk-taking within a government sponsored deposit insurance scheme



Banks funded deposit insurance

As displayed in Table 1, most countries employ a deposit insurance system which is financed by the banks themselves. Therefore, we assume that banks must pay money into a pool that is available when a bank is not able to repay all outstanding to the depositors. The

[13] An interesting question that arise at this point is where do the funds come from that will be used to repay the depositors in case of bank failure. As we will analyze a scheme in which banks fund the insurance themselves in the next paragraph, we assume here that it has to be borne by the households (e.g. via a lump-sum tax) or increases government debt. The expected loss of the government is equal to the size of the externality.

expected profit function of the commercial bank changes in the following way, where $\bar{\tau}$ is the amount to be paid into the deposit insurance pool.

$$E\pi_{i,C} = [p(q_i) \cdot q_i - r_{i,C}] + [r_{i,C} - s \cdot \alpha_{i,C}]\,(1 - p(q_i)) + F_I \cdot \gamma(q, \phi) - \bar{\tau} \tag{10}$$

As $\bar{\tau}$ must cover all deposits that exceed the equity capital in the case of bank failure, we can define $\bar{\tau}$ as written in equation (11). Thereby, we assume that the payments into the pool are shared equally among all commercial banks.

$$\bar{\tau} = \frac{\sum_{j=1}^{N} [r_{j,C} - s \cdot \alpha_{j,C}]\,(1 - p(q_j))}{N} \tag{11}$$

Does the banks funded deposit insurance scheme improve efficiency of risk-taking? To answer this question, we characterize how the expected profits of a commercial bank behave in response to a marginal change in individual risk q_i. The deviate becomes

$$\frac{\partial E\pi_{i,C}}{\partial q_i} = \big(p(q_i) + p'(q_i) \cdot q_i\big) - \underbrace{p'(q_i) \cdot [r_{i,C} - s \cdot \alpha_{i,C}]}_{\text{capital-at-risk effect}} \tag{12}$$

$$+ \underbrace{F_I \cdot \phi \cdot \big(p(q_i) + p'(q_i) \cdot q_i - [r_I - s \cdot \alpha_I] \cdot p'(q_i)\big)}_{\text{risk-export effect}} + \underbrace{\frac{p'(q_i) \cdot [r_{i,C} - s \cdot \alpha_{i,C}]}{N}}_{\text{deposit insurance effect}} = 0.$$

As the capital-at-risk effect is partly offset by the deposit insurance effect, the risk-export effect gains importance. For $N \to 1$, i.e. if there is only one commercial bank, the capital-at-risk effect in equation (12) is fully counterbalanced. So in the absence of competition between commercial banks the bargaining power and again the volume of deposits in the securitization market deters the risk decision. Thus if we observe huge governmental interventions and/or regulation differentials, the use of a banks funded deposit insurance on a national level is not an efficient instrument to reduce risk.

In contrast to $N = 1$, introducing more competitors erodes the deposit insurance effect, since the single bank does not fully internalize the negative external effect of bearing the cost in case of bancruptcy. Obviously, as $N \to \infty$, own risk behavior has no impact on the payment into the pool, thus it becomes the dominant strategy to take higher risk. This incentive is more pronounced the more commercial banks compete in the market, thus strictly increasing in N. From the perspective of a supranational regulator an additional dimension of moral hazard occurs and the commercial banks are locked into an equilibrium with even more excessive risk-taking.

Thus, the following result can be statet: a banks funded insurance scheme does improve the risk allocation if and only if (1) there is no perfect competition between commercial banks and (2) we observe a uniform liability regime without policy distortions - thus under quite heroic assumptions.

3 Policy Implications

Our static analysis suggests that regulation of financial institutions is necessary to prevent exaggerated risk-taking. However, not all options one may think of are actually suitable, e.g. a complete abolishment of limited liability would surely create negative side-effects so that it cannot be regarded as a pareto-optimal solution. On the other hand, financial institutions having equity-to-asset ratios far below the average ratio of non-financial companies constitutes an unhealthy incentive structure. Therefore, we recommend minimum equity requirements for banks, that go beyond the agreements of Basel II.

Moreover, our model identifies an negative effect on the risk allocation due to differences in liability regimes. In our model these difference result from the existence of more than one layer of banking, however, in practice they may also arise from regulatory competition between countries. For both cases it is true that the introduction of players that are less regulated cause an asymmetric risk behavior if passing down of risk is possible. In fact the least regulated player exports all its risk-preference to the originator of the underlying mortgages. Obviously, as financial markets become more and more interlinked spreading of risk between market participants is not only possible but also an efficiency increasing element. However, it should happen in order to evade own regulatory requirements. Thus, it is important to harmonize the regulatory requirements, in particular with respect to equity capital, for all market participants, regardless of the fact whether they are located in different countries or fulfilling different services within a country.

Closely related to the previous point, our static model suggests that more competition between commercial banks overcomes the problem of different liability regimes as they compete for the rent from securitizating risky projects. To understand the effects of competition between commercial banks it is useful to start by considering the case of a monopoly where the commercial bank gains a first-mover advantage - thus maximum rent - from securitization of risky mortgages. The introduction of a competitor will reduce the rents and may well destroy them completely when the number of competing banks becomes sufficiently large. In fact, as it is similar to the standard rent-seeking game à la Tullock (1980), the more banks compete for the rent, the more of it gets dissipated until it is no more profitable for the commercial bank to sell mortgages. Hence, more competition between mortgage issueing banks leads to a better risk allocation. The welfare gain will be directly proportional to the loss of bargaining power of commercial banks in the interbanking mortgage market. However, in the presence of a banks funded deposit insurance scheme more competition does not eliminate the moral hazard.

4 Conclusion

This article explains how a relaxation of the maximum leverage of investment banks in the year 2004 has played the role of a catalyzator for the current subprime crisis. In particular, we show that not only limited liability itself, but also the existence of different liability regimes has lead to an asymmetric risk behavior in the US mortgage market. Commercial banks as the originators of mortgages were willing to grant mortgages to subprime borrowers since they could pass them down to market participants with even lower equity-to-asset ratios. Thereby, our model suggests that the risk-allocation is determined by the player being least regulated. This result prevails qualitatively also after introducing deposit insurance, however, with a different impact depending on the funding of the insurance. As a

consequence, we recommend a uniform regulation for financial institutions on the national basis, but also an international harmonization as this model can also be interpreted in the context of a competition of laxity game between countries.

Appendix

Proof of the existence of the risk-export effect:

Let (13) be the first order condition of the commercial bank without deposit insurance and after substituting the household equilibrium condition.

$$\underbrace{-F_I \cdot \phi \cdot \left(p(q) + p'(q) \cdot q - p'(q) \cdot \left[r_C - s \cdot \alpha_I + s \cdot \frac{(1-p(q))}{p(q)} \cdot (\alpha_C - \alpha_I) \right] \right)}_{\text{risk-export effect}}$$

$$= p(q) + p'(q) \cdot q - \underbrace{p'(q) \cdot [r_C - s \cdot \alpha_C]}_{\text{capital-at-risk effect}} \tag{13}$$

The risk-export effect is positive, if and only if the inequality (14) holds.

$$\left[r_C - s \cdot \alpha_I + s \cdot \frac{(1-p(q))}{p(q)} \cdot (\alpha_C - \alpha_I) \right] > [r_C - s \cdot \alpha_C] \tag{14}$$

Obviously, it does hold whenever $\alpha_C - \alpha_I > 0$ is true, since it then reduces to

$$\frac{(1-p(q))}{p(q)} > 0 \tag{15}$$

which is always positive. On the other hand, the effect is zero for $\alpha_C - \alpha_I = 0$.

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