Government intervention in response to the subprime financial crisis: The good into the pot, the bad into the crop

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A B S T R A C T

The subprime-related 2007/2008 global financial crisis represented a major economic challenge. In order to prevent such episodes of market failure, it is vital to understand what caused the crisis and which lessons are to be learned. Given the tremendous bailout packages worldwide, we discuss the role of governments as lenders of last resort. In our view, it is important not to suspend the market mechanism of bankruptcy via granting rescue packages. Only those institutions which are illiquid but solvent should be rescued, and this should occur at a significant cost for the respective institution. We provide a formal illustration of a rescue mechanism, which allows to distinguish between illiquid but solvent and insolvent banks. Furthermore, we argue that stricter regulation cannot be the sole consequence of the crisis. There appears to be a need for improved risk awareness, more sophisticated risk management and a better alignment of interests among the participants in the market for credit risk.

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1. Introduction

The recent financial crisis has been of major economic policy concern for years. It not only vastly affects the financial system, but also has severe consequences for the global economic development. The extent of the crisis is enormous. According to the Bank of England (2008), the total volume of government support packages for the financial system amounted to approximately EUR 5.55 trillion as of October 2008. Due to the growing globalization and complexity of the financial system, the contagion effect throughout financial markets is unprecedented. The crisis clearly reveals the vulnerabilities of the financial system in its current form. Hence, it is of particular importance to understand what actually triggered the collapse of the financial system, and how such a collapse may be prevented in the future.

Our purpose here is to explain what led to the crisis, and which conclusions can be drawn from it.¹ We briefly describe the instruments fostering the instability of the financial system and show how the collapse of the financial system was eventually triggered. We then comment on the different possible means of government intervention, which aim at limiting the damage to the financial system. We show formally that only rescue packages including a purchase program for distressed assets create a setting in which illiquid, but otherwise solvent, banks are separated from insolvent banks. Furthermore, we provide an overview of the possible consequences for the design, as well as the regulation of the financial system in the future.²

So far, the amount of literature commenting on how bailout plans for the current crisis should be arranged is scarce. Hoshi and Kashyap (2008) investigate government intervention during the recent Japanese financial crisis. Given this experience, the authors draw conclusions for the design of the Troubled Asset Relief Program (TARP) in the United States. They argue that buying distressed assets is an appropriate way to recapitalize banks. Nevertheless, they conclude that the Japanese program lacks efficiency, as assets cannot be purchased for more than their economic value. As a consequence, the total amount of assets purchased remains low. Therefore, no capital is rebuilt and the system remains undercapitalized. Hence, the authors propose that besides buying distressed assets, government assistance should also be conducted via direct equity injections. Bebchuk (2008) comments on the design of the TARP emergency legislation. He agrees that asset purchases are suitable to cope with

¹ The authors would like to thank two anonymous referees, Thomas Wenger and participants at the 2008 Passau Symposium on the global financial crisis for helpful comments.

² A first sketch of the ideas discussed in this paper is also presented in Breitenfellner and Wagner (2010).
the financial crisis, nevertheless he proposes a redesign of the legislation in order to achieve the targets of the program, i.e. restoring stability in the financial system, while limiting costs to taxpayers. He argues that the possibility to overpay for certain assets is not in the interest of taxpayers. In order to prevent undercapitalization, he rather advocates allowing the purchase of securities newly issued by troubled institutions. Additionally, he argues that financial firms should be required to raise additional capital from their existing shareholders. A potential design of a government funded asset purchase program is presented by Bebchuk (2009). The author argues that, rather than setting up a single “Bad Bank”, there should be several privately managed funds which acquire the assets. Their capital should be provided by the government and by private investors. The fact that several funds compete for the troubled assets assures that the market for these assets is restored.

Closest to our paper are the papers of Aghion, Bolton and Fries (1999), Freixas (1999), Gorton and Huang (2004), Acharya and Yorulmazer (2008) and Wilson (2010a).

The paper of Aghion et al. (1999) examines optimal bailout policy for distressed banks in transition economies, optimal in a sense that the bailout policy minimizes costs to the public, while providing sound incentives to bank managers. The authors show that both hard and soft bailout policies have negative effects on bank managers' incentives. Hence, they propose a second-best recapitalization strategy, which includes the purchase of non-performing loans. However, in contrast to our work, the authors focus on transition economies. Hence, some of the model assumptions the authors impose may not apply to financial systems in general.

Freixas (1999) compares the costs and benefits associated with a bailout of a bankrupt bank. It is shown that the optimal bailout policy is determined by the amount of unsecured debt issued by the respective bank. Nevertheless, the author shows that in equilibrium the lender of last resort, i.e. the government, will not rescue all banks which have a certain amount of unsecured debt outstanding, since rescues are costly. Some of these costs are due to moral hazard at the bank management, because of the fact that managers anticipate the chance of being bailed out. Instead, the lender of last resort optimally follows a mixed bailout strategy, where it decides case by case whether to rescue a specific bank or not.

Gorton and Huang (2004) claim that the benefits of government bailouts depend on the type of liquidity shock faced by banks. The authors distinguish liquidity shocks from capitalization shocks. A liquidity shock is an event where banks suddenly need new resources. In contrast, capitalization shocks stem from a shock to the value of assets on a bank's balance sheet. Government bailouts may be a counterproductive response to banks facing liquidity shocks as shown by Diamond and Rajan (2002). In case banks face a capitalization shock, Gorton and Huang (2004) show that government bailouts via asset purchases are feasible, when the number of assets to be sold is too large to be absorbed by private investors. In this case the provision of liquidity by the government increases overall welfare.

Acharya and Yorulmazer (2008) provide a formal illustration of the optimal resolution of bank failures. They show that, in case a sufficiently large number of banks fail, government intervention is superior to a private sector resolution of failed banks in terms of social welfare. The authors argue that the best way for the government to intervene is through the provision of liquidity to surviving banks. These funds in turn are used by surviving banks to acquire the assets of failed banks. In contrast to our model, they assume that solvent and insolvent banks can be separated ex ante. Therefore, their model does not incorporate a mechanism to distinguish illiquid but solvent and insolvent banks.

A similar approach to ours is followed by Wilson (2010a). The author examines the Public Private Investment Partnership (PPIP) plan, relying on option pricing arguments. In contrast to our findings, he concludes, that only solvent banks will be willing to sell distressed assets. The reason for the different result lies in the fact that the author does not impose an exogenous liquidity need on the banks. Hence, there is no need for the banks to choose the refinancing option which is most favorable for them, as it is the case in our model.

We add to the literature on government intervention by providing a formal illustration of how the design of government bailout programs can influence decision making among financial institutions. As such, rather than providing informal arguments in favor of a certain design, we set up a simple and intuitive model, which helps to illustrate the effects of typical government bailout programs. We show that bailout programs can be designed in a way such that illiquid but solvent banks behave differently from insolvent banks. This provides a valuable signal to outsiders, including investors as well as government agencies.

The remainder of this paper is organized as follows. Section 2 briefly describes recent developments in the market for credit risk, which eventually led to the crisis. In Section 3, we discuss why the financial system broke down and how the crisis spread throughout the system. Some considerations referring to the use of government bailout programs and our model are presented in Section 4. The lessons learned from the current crisis are discussed in Section 5. Section 6 concludes the paper.

2. The tale of unlimited risk transfer

“Once upon a time there was a world where banks did not have to bear any risks, as they could get rid of them in no time.” This is an appropriate introduction for a tale about the market for credit risks. Unfortunately, this is not only a tale.

The market for credit risk has grown rapidly since the early 1990’s. It seemed to be one of the biggest success stories in the history of financial intermediation. The new paradigm was that underwriting and bearing credit risk could be perfectly separable. As such, credit risk could be transferred with hardly any constraints to banks to those seeking exposure in certain credit risks. On the other hand, any player in the financial system was able to gain exposure in the credit risk of certain entities, without direct involvement with the respective entity or even without upfront capital outlays.

The tools for credit risk transfer are numerous, among which Residential Mortgage Backed Securities (RMBSs), Collateralized Debt Obligations (CDOs), and Credit Default Swaps (CDSs) are the most prominent. The economic reasoning behind risk transfer is obvious. Financial institutions are able to specialize on certain segments of the banking landscape. For example, institutions with no expertise in the lending business are able to gain exposure in any kind of credit risk. On the other hand, originators are able to eliminate large positions from their balance sheet by passing them through to other market participants.

In turn, the relieved capital can be used to grant additional loans. This development paves the way for new cash flows to credit markets, allowing the whole economy, as well as the public to profit from eased funding opportunities, which would not have existed without the risk transfer. From an economic perspective, it might be questionable whether securitization actually generates additional cash flows to credit markets. Nevertheless, it fosters an optimal allocation of resources in the credit market, as banks with expertise in the lending business are best suited to allocate scarce financial resources among those in need of external funding.

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2 Wilson (2010b) shows that in some cases even solvent banks might be reluctant to sell toxic assets, as their shareholders possess an implicit option to put the bank in case of default. Furthermore, the toxic assets contribute significantly to the asset volatility of the bank, and since the value of the put option is positively related to the volatility of the bank’s assets, shareholders maximize their value by not selling the toxic assets.
2.1. Securitization

The classic way of transferring credit risk is by means of securitization. In a typical securitization transaction, a loan originator pools his loans into a portfolio and sells this loan portfolio to a special purpose vehicle (SPV). The SPV is refinanced via issuing bonds on the capital market, where bondholders’ claims are satisfied through the cash flows generated by the loan portfolio. Although the assets transferred to the SPV do no longer occur on the originator’s balance sheet, the ties between the originator and the SPV are manifold, e.g. through swap agreements or guarantees. Securitization transactions have many advantages for the originator. The proceeds from selling the loan portfolio can readily be used to grant new loans. Therefore, securitization can be regarded as a form of refinancing. Among the other advantages are the transfer of credit risk to the SPV (and eventually to investors) and lower regulatory capital requirements for the originator.

Overall, securitization transactions clearly augment lending capacities in the financial system and improve allocational efficiency of financial markets concerning both, funds and exposures. In turn, optimal allocation of resources helps to reduce the cost of credit (see e.g. Duffie, 2007). Unfortunately, the number of high quality obligors in the system will be limited. Hence, the overall proportion of low capacities in the system will be limited. Therefore, the overall proportion of low quality borrowers in the system will be limited. Hence, the overall proportion of low quality lenders will increase with the total volume of lending. At this point, a disadvantage of securitization becomes obvious. As the originator may eliminate all the credit risk associated with the loan portfolio, he will not be overly concerned with the quality of his obligors. Consequently, there will be loans included in the portfolio, which would not have been granted by the originator, if he still had to account for them. This is a classic adverse selection problem. The deterioration of the average loan quality is further amplified by the incentive schemes within the lending business, where employee compensation largely depends on lending volume rather than on risk-adjusted return (see e.g. Mills & Kiff, 2007).

Additionally, SPVs will typically try to obtain maximal funding from selling securities on the capital market. In turn, the proceeds are transferred to the originator as a compensation for acquiring the loan portfolio. Hence, SPVs have an incentive to overstake the quality of their loan portfolio, again a moral hazard problem, as the investors buying SPV bonds and commercial papers will typically have an information disadvantage concerning the quality of the loans contained in the portfolio. The complexity of many securitization transactions adds to this information asymmetry. The overall quality of the loans underlying the securitization transaction declines with every new transaction, as the amount of high quality borrowers in the financial market is limited. However, the capital inflow due to the securitization transaction, will tempt the originator to grant further loans, despite the lower quality of obligors seeking debt financing via loans. These loans are then in turn securitized, creating some sort of “vicious circle”.

2.2. The market for credit protection

Another segment of the market for credit risk is the market for credit protection. As shown in Fig. 1, the market for credit protection has grown rapidly in recent years. As of June 2008, it amounted to a total volume of about USD 57.3 trillion of notional principal. Unlike securitization and credit insurance, buying and selling credit protection in the credit derivatives market does not require owning the underlying asset. In other words, credit protection is a synthetic transaction allowing market participants to gain exposure in credit risk with no initial cash outlay, or without owning the underlying asset.

Among the most common products of the credit protection industry are CDSs and CDS indices (which can be regarded as single tranche CDOs). Such products compensate the protection buyer for her losses associated with a credit event related to the underlying asset of the transaction. Due to the absence of an upfront payment, or the need to actually own the underlying asset, credit protection can be regarded as a convenient and widely used instrument for investors to gain exposure to various kinds of credit risk. This is clearly favorable from a diversification perspective. Additionally, credit protection can be used as a hedging instrument for exposures in the credit market, as given for example by corporate bond portfolios. Hedging by means of credit protection also has an effect on the regulatory equity cushion as required by the Basel II accord. Credit exposures which are hedged via credit protection transactions are no longer subject to regulatory capital requirements. Only the swap itself is accounted for, which reduces regulatory capital requirements as long as the swap carries a lower risk weighting than the underlying (see Basel Committee on Banking Supervision, 2004).

3. A rude awakening

3.1. The collapse of credit markets

So far, we argued that the market for credit risk is to the benefit of the economy. So why did we experience such a devastating crisis? The answer is quite simple. There has been a lack of risk awareness and overconfidence among market participants.

As stated above, securitization transactions were widely used by originators to eliminate credit portfolio risk from their balance sheets. An explanatory hypothesis would be that the notion was that loans which are off-balance sheet do not contribute to the institution’s risk profile. This proved to be rather myopic. With the increasing number of securitization transactions, the quality of the loan portfolios declined. Those who invested in the tranches of the securitization transactions often were unaware of the inherent risk and relied on the external assessments of rating agencies, which in many cases were overly optimistic. After the burst of the housing bubble in the United

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4 Corton and Souleles (2005) provide a detailed overview of such transactions.

5 Mostly subprime loans are securitized through SPVs. High quality mortgages can be passed to one of the two agencies Fannie Mae or Freddie Mac which pool the loans and issue bonds against them.

6 At least, this seems to be the case in the first place. Nevertheless, this is not quite adequate as we discuss later.

7 Details on credit derivatives can e.g. be found in Scheicher (2003), who also addresses some early warnings on financial stability.

8 Still in mid-2007, market participants believed that advances in credit risk modeling would prevent severe losses on highly rated tranches and credit derivatives, see e.g. Mills and Kiff (2007).

9 See e.g. Shiller (2008) for a discussion of the role of bubbles in the subprime crisis.
States, more and more loans defaulted. Consequently, those who invested in securitization transactions incurred severe losses on their tranches, in particular on the first-loss-piece. Therefore, they had to write down their investments. This in turn put investors on the spot to liquidate their positions in order not to run into over-indebtedness. Additionally, the growing uncertainty concerning the actual risk profile of the securitization tranches led to an erosion of liquidity in the secondary market. As a result, tranches of securitization transactions were traded with enormous discounts, if they were sellable at all. This created a vicious circle in the market for securitization tranches, which consequently collapsed. The market failure led to further write-downs on financial institutions’ assets, which absorbed much of the financial system’s liquidity.

As a consequence, although exposures due to the loan portfolios securitized were not on the banks’ balance sheets in the first place, they finally got there through the back door. Given increased illiquidity within the financial system, financial institutions ran into refinancing problems. The fact that many financial institutions heavily relied on short term refinancing, while being highly leveraged, further boosted the crisis. What made things even worse was the psychological effect of a loss of trust in the overall financial system. To avoid over-indebtedness, all kinds of assets had to be liquidated in fire-sale transactions, and the crisis spread throughout the system. The contagion effect was enormous throughout institutions, markets and regions.

3.2. The CDS-domino-effect

Of course, the crisis in financial markets also spilled over to the market for credit protection. Fig. 2 illustrates the impact of the crisis, which led to significantly wider spreads in the market for credit risk. Here again, the contagion was fostered by the structure of the market. Most players in the market for credit protection hedge their exposures by an offsetting transaction, thus exposures are passed on throughout the market. This seems perfectly reasonable as long as there is no counterparty risk. Unfortunately, this was actually not the case, as the market for credit protection is an over-the-counter (OTC) market. The financial turmoil at American International Group (AIG) clearly revealed the vulnerabilities of the market structure.

Given the setting in the market for credit risk described above, a CDS-domino-effect emerges as follows. In case a major player defaults, the CDS contracts it has written become virtually worthless. This leads to large unhedged positions at his swap counterparties. This may in turn force them into default, e.g. via increasing regulatory capital requirements, despite their given financial solvency. Again, exposures which seem to be perfectly hedged, instantly become a serious risk position, as they are not (fully) buffered by an equity cushion. The result is a domino-effect spreading throughout the market for credit protection, further destabilizing the overall financial system, caused by the failure to recognize the inherent counterparty risk in such credit protection contracts. In fact, the counterparty risk in a swap transaction does not solely depend on the respective direct counterparty, but it is rather determined by the weakest link (i.e. weakest protection seller) in the system, as the collapse of one major player may force the whole system into distress. This setting adds a major portion of systemic risk to the market for credit protection, which has to be accounted for.

3.3. The drying up of the interbank lending market

As discussed above, disruptions, both in the market for securitization tranches and the market for credit protection, absorbed much of the liquidity in the global financial system. This effect was further emphasized by a loss of trust in the banking system. Rising uncertainty concerning the financial health of the banking system led to an increased reluctance among banks to lend money to each other in the wholesale market. This is illustrated by the behavior of LIBOR rates during the crisis as given in Fig. 3. Even interventions by central banks were not able to offset the negative effects due to the loss of trust. Fears in the market were further fostered by the failure of Lehman Brothers. Unfortunately, many banks were highly dependent on wholesale funding as a consequence of major balance sheet expansions during the times of economic growth and business models based on high leverage. This failure of the interbank lending market was another cornerstone of the crisis. It forced many banks to liquidate large positions of liquid assets, leading to severe losses as for example in the equity markets.

4. Stabilizing the financial system - short term government intervention

There is no doubt that immediate action has to be taken in order to cope with a crisis of such magnitude. Otherwise, severe consequences for the financial system, as well as for the global economy would be inevitable. Due to the dimension of the subprime crisis, governments seem to be the only players which can achieve a significant impact from their interventions. The general reason behind government intervention and fiscal policy is subject to ongoing debate and beyond the scope of this paper. In this section, we focus on the design of short term government intervention, which aims at stabilizing the financial system.\footnote{A long term perspective of government intervention, i.e. deposit insurance, is discussed in Bryant (1980) and Diamond and Dybvig (1983) among others.}
4.1. Are rescue packages appropriate?

Governments worldwide have structured rescue packages to support financial institutions in distress.\(^\text{11}\) This raises an important question: Should distressed financial institutions be rescued by the government and consequently by tax payers? On the one hand, rescue measures seem appropriate given that the bankruptcy costs for the economy would exceed the costs of the rescue. On the other hand, with a government as the lender of last resort, there is little incentive for financial institutions to pursue sophisticated risk management strategies. In contrast, the incentive would be to increase the overall risk profile of the institution in order to obtain a higher expected payoff for shareholders. With a lender of last resort, shareholders are equipped with a put option written by the government, generating an incentive to increase the risk profile of the firm at the cost of the government. This again is a classic moral hazard problem.

In this light, guarantees as sole instrument of government intervention do not seem to be the appropriate measure to rescue banks. In case a rescue is inevitable, it should be perused with the help of capital injections rather than guarantees alone in order to avoid principal agent conflicts. Nevertheless, rescue packages should not be used arbitrarily. As stated above, the presence of a rescue package suspends the important market mechanism of bankruptcy. This mechanism ensures that only those financial institutions survive the crisis, which have pursued sound risk assessment and management. Those institutions with insufficient financial prerequisites, in the form of equity buffers, should fail in order to ensure the allocational efficiency of the financial system. Therefore, governments should not rescue financial institutions, as long as the bankruptcy costs borne by the economy do exceed the cost of rescue. It is important to mention that bankruptcy costs do not only comprise direct costs associated with the bankruptcy of a single bank. Additionally, the indirect costs of contagion effects within the banking system have to be incorporated, as claimed by Goodfriend and King (1988).\(^\text{12}\) In case the rescue of a certain financial institution is inevitable, these measures of assistance should come at a significant cost for the respective institution. Otherwise, the rescue packages could encourage institutions to rely on them as a cheap source of funding.

Given the above, an adequate design of rescue packages appears to be of particular importance. Among the possible means of government intervention are:

- Government guaranteed debt issuance programs,
- direct equity injections,
- purchases of distressed assets by the government.

In general, the design of a government rescue package for the financial services industry largely depends on its targets. Among those targets are the stabilization of the financial system via recapitalization, taxpayer protection, or separation between good and bad management performance, to name just a few. Unfortunately, some of these targets work in opposite directions, e.g. like recapitalization and tax payer protection. Furthermore, the costs associated with bank failure are hard to quantify, making it difficult to measure an exact trade-off.

An appropriate rescue package avoids principal agent conflicts, while providing immediate liquidity to institutions which are in the state of distress. Furthermore, the package should only be to the benefit of banks which are illiquid but solvent, or of systemic relevance. At a first glance, a superior method to rescue banks is via asset purchases, where financial institutions sell with a discount to the economic value of the assets. As the economic value of many of those assets is above their current market value, this strategy has two major advantages. On the one hand, only those financial institutions with severe liquidity problems will be willing to sell undervalued assets. On the other hand, the government itself can profit from the expected higher payoffs from those assets in the future. Nevertheless, banks which need to be rescued due to their systemic relevance, might not be able to sell distressed assets. Therefore, combinations of different means of recapitalization seem to be necessary.

4.2. A formal illustration of different means of government intervention

In this section we formally show how different means of government intervention can influence decision making within the financial sector. Our purpose is to illustrate the design of a rescue package, which allows to distinguish between illiquid but solvent versus insolvent banks. Although this focus might not be in the very best interest of taxpayers in the short run, at least it allows to identify and reward good management performance. In the long run, this separation is inevitable for the design of incentive mechanisms, which reward good management performance. This in turn can prevent future misconduct within the financial services industry.

In order to illustrate how the different means of government rescue packages can influence decision making among the financial services industry, suppose the following setting. There are two periods. In period \(t = 0\) financial institutions face a liquidity shortage and decide how their liquidity need has to be refinanced. In \(t = T\) the liquidity need vanishes and the capital obtained in period \(t = 0\) matures. Furthermore, the present value, \(V_{0}\), of a future claim is given by

\[
V_{0} = E_{0}[V_{T}]e^{-rT},
\]

where \(r\) is the continuously compounded risk-adjusted discount rate for asset \(i\) and \(E_{0}[V_{T}]\) is the time zero expected cash flow due to the claim at maturity.

We next assume that there are two types of banks in the financial system, good banks and bad banks, which differ in their default risk. The different risk profiles of the two types of banks largely stem from the quality of their balance sheets. Outside investors, including government authorities, cannot distinguish between the two types, due to information asymmetries.\(^\text{13}\) The risk-adjusted cost of external funding for good banks is \(r_{g}\) and the one for bad banks is \(r_{b}\), where \(r_{g} < r_{b}\).

Given the probability of ending up with a good bank is \(p_{g}\), \(0 < p_{g} < 1\) investors will require a rate of

\[
r_{i} = p_{g}r_{g} + (1 - p_{g})r_{b}
\]

for debt capital invested in a bank. Note that, due to asymmetric information, good banks suffer from losses due to higher than necessary refinancing costs. To overcome this problem, they could provide a signal to outside investors and profit from lower refinancing rates. However, as long as bad banks can imitate the signal without incurring significant costs, the signal of being either a good or a bad bank is worthless.

4.2.1. Guaranteed debt issuance programs

Suppose now that both types of banks suffer from liquidity problems due to a system-wide financial crisis and are in need of external debt capital. Both banks can acquire a guarantee for their debt issuance programs, allowing them to borrow at the risk-free rate \(r_{f}\) where \(r_{f} < r_{g}\). The guarantee comes at a cost at the rate of \(s\), which is the same for both types of lenders, as the government cannot

\(^{11}\) A chronological overview of related events is given in the Appendix.

\(^{12}\) Diamond and Rajan (2005) provide a formal illustration of how contagion effects might emerge in the financial system as result of bank failure.

\(^{13}\) This is not an overly restrictive assumption in case the financial system is in distress. In this case, the focus of the government is more on providing immediate liquidity rather than assessing the risk profile of banks in need of funding.
distinguish between them.\textsuperscript{14} In this setting, the rate at which a bank can be refinanced is given by

$$\min[p_g r_g + (1-p_g) r_b, \ r_f + s].$$ \hfill (3)

Banks of both types will rely on the government guarantee as long as the risk-free rate plus the fee \(s\) is lower than their initial refinancing costs. This is always true for both banks, since the good banks cannot provide a credible signal of being in the good cohort. As a consequence, government support packages will equally favor both types of banks or none of them. In this case state guarantees are not a consequence, government support packages will equally favor both types of banks or none of them. In this case state guarantees are not needed to create a setting where good banks can be separated from bad ones.

Government assistance in the form of guaranteed debt issuance programs has another important drawback. As the fee \(s\) charged for the state guarantee is a compensation for the risk of default of the guarantee taker, the government will incur a loss as long as the state guarantee is a compensation for the risk of default of the guarantee taker. In this case state guarantees are not a consequence, government support packages will equally favor both types of banks or none of them. In this case state guarantees are not needed to create a setting where good banks can be separated from bad ones.

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Consequently, the fair spread it should charge is given by

$$s = [p_g r_g + (1-p_g) r_b] - r_f.$$ \hfill (4)

The risk-adjusted fee, \(s\), charged for the guarantee is given by the risk-adjusted cost of debt capital less the risk-free rate. In this setting, the guarantee is either ineffective, as it does not lower the cost of capital for the bank, or it will result in a loss for the government, as the fee it charges does not cover the expected losses.

4.2.2. Direct equity injections

Another way to support distressed financial institutions is by means of direct equity injections. This can e.g. be conducted via an increase in share capital, either in the form of common or preferred stock. The risk-adjusted rate of return for preferred stock is \(r_f^{\text{p}}\) for a good bank and \(r_f^{\text{b}}\) for a bad bank, where \(r_f^{\text{g}} < r_f^{\text{b}}\), due to the higher default risk associated with a bad bank. Accordingly, a good bank is charged a rate of \(r_f^{\text{p}}\) for common equity, and a bad bank is charged \(r_f^{\text{b}}\). As equity capital has a lower seniority than debt capital, \(r_g^{\text{p}} \leq r_f^{\text{p}} \leq r_f^{\text{g}} \leq r_f^{\text{b}} \leq r_f^{\text{b}}\) and \(r_g^{\text{p}} \leq r_f^{\text{p}} \leq r_f^{\text{g}} \leq r_f^{\text{b}} \leq r_f^{\text{b}}\) must hold. Suppose that the government is willing to obtain preferred or common shares of a bank. The rate it charges for the equity injection is \(r_f^{\text{p}} + \lambda\), and \(r_f^{\text{b}} + \lambda\), respectively, where \(\lambda\) represents the risk premium. Again, investors cannot distinguish between good and bad banks. Thus, any bank can be refinanced via preferred shares at a rate of

$$\min[p_g r_g^{\text{p}} + (1-p_g) r_f^{\text{b}}, \ r_f^{\text{b}} + \lambda],$$ \hfill (5)

regardless of its risk profile.

The choice between refinancing via debt or equity largely depends on the structure of the respective bank’s balance sheet. In general, equity capital is chosen in case the bank aims at increasing its core capital ratio. In case a bank only seeks for liquidity, as it is otherwise healthy, it will rather choose to refinance via debt capital. Nevertheless, comparing the two possible cases, it is obvious that the problem faced by banks and investors is nearly the same in both of them. Both types of banks can refinance at the same conditions, regardless of their risk profile. Additionally, intervention in both cases will either result in a loss for the government (as long as the risk premium it charges is lower than the expected losses) or, otherwise, it will be ineffective.

4.2.3. Purchases of Distressed assets

Next suppose that the government, instead of providing guarantees on debt financing programs, aims at recapitalizing financial institutions by buying illiquid assets from their balance sheets. The purchase of the assets comes at a discount to the (pre-crisis) book value of the assets. The discount is given by \(d\), \(0 \leq d \leq 1\), so the \(i\)th asset is purchased at the time zero price

$$P_i = X_i(1-d).$$ \hfill (6)

where \(X_i\) is the book value of the \(i\)th asset.

Selling assets to the government has a similar effect on a bank’s leverage as being recapitalized via an equity injection. Both means of intervention help to decrease the bank’s leverage via increasing its core capital ratio. The difference between the two lies in the way through which this decreased leverage is achieved. Asset purchase programs result in reduced balance sheet totals at the banking sector, while this is not achieved via equity injections.

4.2.4. Combinations of different means

Most of the government bailout programs launched in the course of the subprime financial crisis are a combination of different means of government intervention.\textsuperscript{15} In this section, we consider a combination of debt issuance programs and asset purchases. Nevertheless, our results generally apply to other combinations as well.

Assume that \(V_{0,t}\) is the present value of the expected payoff from asset \(i\) at maturity. As long as \(V_{0,t} \leq P_i\) it is rational to sell the asset from the bank’s perspective. Furthermore, for banks with a need for liquidity, selling assets instead of obtaining debt financing can be rational even if \(V_{0,t} \geq P_i\). In any case, the costs of obtaining funding via selling an asset are given by

$$V_{0,t} - P_i;$$

The costs for obtaining external debt financing amount to

$$P_i(e^{\min[p_g r_g + (1-p_g) r_b, \ r_f + \lambda]} - 1),$$ \hfill (7)

assuming a time horizon of 7 years.

In both cases we assume a liquidity need of \(P_i\).\textsuperscript{16} For any bank it is now rational to sell assets as long as

$$V_{0,t} - P_i \leq P_i(e^{\min[p_g r_g + (1-p_g) r_b, \ r_f + \lambda]} - 1).$$ \hfill (8)

It follows from Eq. (8) that the form of refinancing chosen by a bank in our world depends on the quality of its assets as well as the time horizon of the refinancing transaction. The willingness of the bank to sell assets will decline with a better quality of its assets and a shorter time horizon of its liquidity needs.

4.2.4.1. Equilibrium conditions 1. As assumed above, the different risk profiles of the two types of banks largely stem from the quality of their balance sheet. The quality of assets held by good banks is likely to be better than the one of bad banks’ assets. Let assets owned by good banks be denoted by the subscript \(g\) and let the ones owned by bad banks carry the subscript \(b\). All banks suffer a liquidity shock and have to obtain liquid funds in order not to default. Both types of banks face the problem characterized by Eq. (8). Nevertheless, in this setting, the two banks will behave differently. As the good banks own high quality assets, they will be reluctant to sell them and rather chose to be refinanced via external debt capital. In contrast, the banks of the bad cohort will sell a large fraction of their assets.

\textsuperscript{14} Merton (1977) derives entity specific prices for guarantees using option pricing arguments. However, this approach does not seem appropriate for banks, due to the dynamic structure of their assets.

\textsuperscript{15} The TARP program is a combination of equity injections and distressed asset purchases, while most European bailout programs combine government guaranteed debt issuance programs with direct equity injections.

\textsuperscript{16} In the special case that the fee equals the fair risk premium, the cost at which any bank may obtain external funding amounts to \(P_i(e^{\lambda} - 1)\).
Furthermore, as the illiquidity of the good banks is caused by a market shock, it is likely to vanish shortly after its occurrence. Therefore, the time horizon for which good banks have to obtain external capital is short (as they are only subject to the liquidity shock, but otherwise are solvent). The reverse holds for the bad banks, as their illiquidity is not only due to the market shock, but also a result of structural issues within the bank.

Therefore, we may assume that $T_g \leq T_b$. As long as
\[ V_{Oj} - P_j > P_j \left( e^{\min} p_j r_j + (1-p_j) r_j \cdot \eta_j + \tau_j T_b - 1 \right), \quad \forall j, \tag{9} \]

good banks will not sell any assets. This is a robust signal for market participants of being a good bank, as long as it is irrational for bad banks to mimic. If this is the case, good banks can obtain external funding at a rate of $r_b$, as long as we assume that $r_b < r_j + s$, and $r_j + s$ otherwise. Hence, the two types of banks can be distinguished as long as bad banks sell some of their assets. From a bad bank’s perspective, this is rational as long as
\[ \sum_{k=1}^n (V_{Oj} - P_j < \sum_{k=1}^n P_k \left( e^{\min} p_k r_k + (1-p_k) r_k \cdot \eta_k + \tau_k T_b - 1 \right). \tag{10} \]

supposing that their funding need amounts to $\sum_{k=1}^n P_k$. For inequalities (9) and (10) to hold, the discount $d$ must satisfy
\[ d > 1 - \frac{V_{Oj}}{\sum_{k=1}^n V_{Oj} \cdot X_k e^{\min} p_k r_k + (1-p_k) r_k \cdot \eta_k + \tau_k T_b} \quad \forall j \tag{11} \]

and
\[ d < 1 \frac{\sum_{k=1}^n V_{Oj} \cdot X_k e^{\min} p_k r_k + (1-p_k) r_k \cdot \eta_k + \tau_k T_b}{\sum_{k=1}^n X_k e^{\min} p_k r_k + (1-p_k) r_k \cdot \eta_k + \tau_k T_b} \tag{12} \]

If the discount is chosen according to Eqs. (11) and (12), government bailout programs including possible asset purchases generate a separating equilibrium between good banks and bad banks through a self-selection mechanism.12 The good banks are able to borrow money at their risk-adjusted cost of external capital and they are better off than in a situation where the government intervention is conducted via guaranteed debt funding programs only.18 As long as long as $V_{Oj} > P_j$, the government can profit from the rescue packages, as it acquires assets for less than their economic value. In sum, all three parties are better off than with government guarantees only.

4.2.4.2. Equilibrium conditions II. In the setting described above, good banks do not hold any assets for which
\[ V_{Oj} - P_j > P_j \left( e^{\min} p_j r_j + (1-p_j) r_j \cdot \eta_j + \tau_j T_b - 1 \right). \tag{13} \]

Putting it differently, we assume that good banks do not hold any distressed assets, which is not likely to hold in reality. Nevertheless, this assumption can be relaxed, be still, we are able to separate good and bad banks. This is achieved, as long as selling illiquid assets and obtaining external debt capital are mutually exclusive.13 In this case, banks are not allowed to obtain external funding, given that they have sold distressed assets to the government. Good banks, having a funding need of $\sum_{j=1}^n P_j$, will not sell any assets as long as
\[ \sum_{j=1}^m (V_{Oj} - P_j) > \sum_{j=1}^m P_j \left( e^{\min} p_j r_j + (1-p_j) r_j \cdot \eta_j + \tau_j T_b - 1 \right) \tag{14} \]

Banks will retain assets for which inequality (8) holds and they will incur a loss by retaining assets for which selling is rational. Nevertheless, this loss is outweighed by the loss they would incur by not being able to rely on external funding, due to the mutual exclusiveness of the two funding sources. The lower bound for the discount $d$, for which good banks will be reluctant to sell any assets, implied by inequality (14) is given by
\[ d > 1 - \frac{\sum_{j=1}^m V_{Oj}}{\sum_{j=1}^m X_j e^{\min} p_j r_j + (1-p_j) r_j \cdot \eta_j + \tau_j T_b} \tag{15} \]

The upper bound (12) remains unchanged. Hence, good and bad banks still behave differently in this setting.

4.2.5. A numerical example
To illustrate our findings we provide a small numerical example. Suppose $p_b = 0.5$, $r_b = 5\%$, $r_g = 8\%$, and $r_h = 16\%$. There are two banks, one of either type, which both have a liquidity need of 100 over the next two months. In the first case, suppose government assistance comes in the form of a guarantee at the cost of $s = 5\%$. Hence, the cost of obtaining external capital via state guaranteed lending for both banks is
\[ 100 \cdot \frac{(e^{-0.05} + 0.05) \cdot 4}{1 - 1.68} = 2.02. \]

Next, suppose government assistance comes in the form of a purchase of illiquid assets by state authorities. The good bank owns two assets. Each asset has a book value of 60. The first asset has a present value of 60 and the second asset has a present value of 45. The bad bank also owns two assets, each with book value of 60. The first asset has a present value of 60 and the second has a present value of 41. Further suppose that the discount is $d = 16.67\%$. For both the good and the bad bank, debt capital can be acquired at a cost of
\[ 100 \cdot \frac{(e^{-0.05} + 0.05) \cdot 1.06 \cdot 4}{1 - 1.68} = 2.02. \]

The cost of obtaining capital via selling assets for the good bank is
\[ (60 + 45) - 2 \cdot (60 \cdot (100\% - 16.67\%)) = 5. \]

Therefore, it will choose to obtain fresh capital via external debt funding. The bad banks cost of obtaining capital via an asset sale is
\[ (60 + 41) - 2 \cdot (60 \cdot (100\% - 16.67\%)) = 1. \]

Therefore, the bad bank will decide to sell the assets instead of relying on external funding. This provides a signal for outsiders allowing the good bank to lend at its risk-adjusted rate of $8\%$. Hence, it is better off than in the state guarantee case.

In this simple example, we showed that all three parties are better off when the government’s rescue package comes in the form of asset purchases. A drawback of this situation is that the bad bank is able to lend money at a lower rate than the good bank ($5.97\%$ compared to $8\%)$. Nevertheless, the two types can be separated, allowing to reward good banks in the future.

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12 We thank an anonymous referee for noting that the self-selection mechanism might fail if the discount offered is either chosen to be too large or too small. For the mechanism to work a prudent choice of the discount is of paramount importance.
13 As long as $r_g > s + r_h$.
14 This can be ensured by restrictive covenants in the purchase agreement. From the government’s perspective, this is clearly desirable. Otherwise, banks could use rescue packages as a “dump” for worthless assets, regardless of their own solvency.
5. Consequences in the long term — lessons learned

Given the above, several questions arise: What are the lessons learned from the current crisis? What has gone wrong and how can such failures be prevented in the future? Is there a need for stricter regulation in the financial system? It appears straightforward to blame the financial services industry for the crisis and to ask for stricter regulation, but unfortunately, the answer is not quite as simple as that.

5.1. The future role of securitization

In the public discussion, securitization is often blamed to be "the root of all evil", leading to the meltdown in the financial system. Given this, what consequences should the crisis have for the securitization market? Is there still room for securitization transactions, or do the drawbacks of securitization outweigh the advantages discussed above?

The advantages of securitization transactions do warrant the risks inherent in securitization transactions. However, the system has to undergo certain changes to avoid a collapse like the one we see today. As argued by the International Monetary Fund (2003) and Franke and Krahnen (2008), there currently is a misalignment of the incentives of the different counterparties in typical securitization transactions. As the originator can eliminate the whole credit portfolio from her balance sheet, she has little incentive to assure certain minimum quality requirements for loans contained in the securitized portfolio, which is confirmed empirically by Amiyatosh (2009). This can easily be prevented by requiring the originator to retain a certain share of the transaction, preferably a fraction of the first-loss-piece, on her books. This would ensure that no "toxic waste" is contained in the loan portfolio, since the originator is directly exposed to its inherent credit risk. Furthermore, the originator should be required to publicly declare the fraction and the tranches of the transaction she retains. This signal can be used by investors to assess the risk associated with a certain transaction.

The optimal size of the share of the transaction the originator is required to hold is subject to further research. On the one hand, if the share is too small, the alignment of incentives is not accomplished. On the other hand, if the share is too large, the whole securitization transaction becomes unattractive for the issuer, since other forms of refinancing, e.g. the issuance of covered bonds become more rewarding. This terminates the positive effects of securitization transaction for the economy. Requiring the originator to retain a certain share of the transaction has another positive effect, as it also limits the overall volume of loans granted. In case the originator retains a certain share of the transaction, she expends her balance sheet, which would not be the case if she fully passes on all the tranches of the transaction. This automatically limits the number of loans she can grant as she cannot (at least she should not) exceed a certain level of leverage. This assures that the quality of obligors does not decrease arbitrarily.

Another important issue, which led to the financial crisis is the enormous complexity of certain products in the market for credit risk. This complexity not only hampered investors' assessment of the risk associated with the products, even rating agencies were not able to specify and measure the risk underlying certain transactions. Unfortunately, many investors relied on external ratings, which were provided by overly optimistic rating agencies. Nevertheless, it is astonishing that investors relied on ratings and invested in products they obviously did not fully understand. The only explanation for this is that sophisticated risk assessment and management was sacrificed on the altar of irrational return expectations.

5.2. The role of internal risk management

The absence of proper risk awareness among market participants is surely among the basic causes of the current crisis. As argued above, market participants may assume that various risks can easily be eliminated through instruments like securitization and credit protection. What has been overlooked is the fact that there are risks besides credit risk, which cannot be eliminated easily, including market risks, liquidity risks, and counterparty risks.

The number of bad loans in the economy does by no means justify the enormous volume of financial products which are labeled as "toxic waste" during the recent period of market stress. The essential problem is that there no longer exists a market for these products, due to a lack of liquidity as well as due to a lack of trust in those products. This fact, in connection with the fair value accounting principle, causes serious write-downs on investments in those assets, although these write-downs might only in part be driven by a lack of quality of the product itself. The possibility of such an erosion of secondary markets has obviously not been taken into account. This is clearly a failure of internal risk management within financial institutions. In this light, one has to discuss the question, whether or not this failure can be prevented by stricter regulation.

A possible solution may be to require financial institutions to hold an increased equity cushion in order to absorb losses due to market and liquidity risk. On the other hand, it seems doubtful whether or not this is really an issue for regulators. Normally, those market participants which had not accounted properly for their exposure to market and liquidity risks would be wiped out, and those with appropriate risk management systems in charge would prevail. Unfortunately, this market mechanism was suspended by the rescue packages initiated by governments worldwide.

5.3. Long-term profitability versus short term cash generation

The above discussion leads us to another trigger of the financial crisis, namely inappropriate management incentives. Typical performance measures (such as the Return on Equity (ROE), among others) do not seem to be sound target figures for financial institutions as they do not account for risk. Instead of rewarding sophisticated risk management, such measures rather induce managers to increase leverage and to pursue a more risky business model. This strategy may yield sound performance figures in the short run, but does not necessarily promote the long-term stability of an institution. This corporate governance issue could be resolved via shareholders. Unfortunately however, the number of long-term investors seems to be steadily decreasing in the markets. Instead, investors with a short term investment horizon, e.g. hedge funds, own significant shares in many financial institutions. Their focus is frequently on short term cash generation rather than sustainable growth. This clearly plays a supporting role in a failure of internal control mechanisms of publicly listed companies. Rather than assuring that the management acts in the sake of long-term stability, via linking compensation to typical performance ratios, management is offered an incentive to increase short term profitability.

20 Gorton (2009) disagrees with the opinion that securitization transactions lead to a decline in the quality of mortgages originated. He argues that, despite the fact that the credit risk is eliminated from the originator's balance sheet, she is still exposed to the performance of the securitized mortgage portfolio, e.g. through servicing fees and warehousing risks.

21 According to Bank of England (2008) estimates, about 37% of the mark-to-market losses on US subprime RMBS can be attributed to discounts for illiquidity and uncertainty rather than actual credit risk.

22 Admittedly, it is impossible to hold equity cushions to absorb any potential losses due to market and liquidity risk. The October 2008 market meltdown is clearly some tail event, which cannot be fully absorbed. Nevertheless, it seems doubtful that the situation would have spread the way it did, had market participants at least provided enough capital to absorb moderate losses due to market and liquidity risk.
6. Conclusion and outlook

The current turbulences in the global financial system are unprecedented. They highlight the need for massive structural changes in the financial services industry. In our view, stricter regulation is not the sole answer to the problem. In the future, financial institutions need to focus on appropriate risk management and risk assessment instead of maximizing short-term profitability. In this light, government support packages granted to financial institutions have to be seen with prudence, as they may hinder the future development of sound risk management strategies. Rather than solely providing guarantees, government support should aim at appropriate capital ratios within the banking system.

We show formally that recapitalization in terms of asset purchases is a possibility to separate illiquid but solvent and insolvent banks. In our view this separation is important to assure the stability of the banking system in the future. However, for the separation mechanism to work, the price the government bids for the distressed assets is of vital importance. The fact that this price is difficult to determine in the future might in part explain why governments worldwide seem to be reluctant to recapitalize the banking systems by asset purchases.

This recapitalization must come at a significant cost in order to provide accurate incentives.

Another interesting issue is why banks seem to be reluctant to rely on government bailout programs. Most programs are designed in a way that allows financial institutions to lower their refinancing costs. Hence, it would seem reasonable to rely on government assistance from a shareholder value perspective. Nevertheless, the restrictive covenants of the packages (e.g. caps on management salaries, as well as the stigma of being in need of state assistance), seem to tempt some managers to proceed without assistance.

Furthermore, it remains questionable whether market participants have learned their lesson from the current crisis. The worldwide development of treasury bonds since the early 1980’s may indicate yet another bubble. Time will tell when and how the financial system will cope with its future potential crises.

Appendix

Important financial distress events related to the 2007/2008 crisis include the following:

- June 22, 2007: Failure of two Bear Stearns structured credit hedge funds;
- July 30, 2007: IKB in distress, later rescued by government-owned KfW;
- September 14, 2007: Northern Rock bank run, central bank emergency funding;
- March 17, 2008: Bear Stearns failure, rescue by the FED and JP Morgan;
- July 11, 2008: IndyMac Bank failure;
- September 7, 2008: Fannie May and Freddy Mac rescued by government;
- September 15, 2008: Lehman Brothers failure;
- September 15, 2008: Merrill Lynch acquired by Bank of America;
- September 16, 2008: AIG rescued by government taking 80% stake;
- September 26, 2008: Washington Mutual failure, assets acquired by JP Morgan;
- September 29, 2008: Wachovia banking operations acquired by Citigroup;
- September 29, 2008: Bradford and Bingley is nationalized;
- September 29, 2008: HRE in distress, rescued by government later taking 90% stake;
- September 29, 2008: Fortis in distress, joint bailout by three governments;
- October 6, 2008: Iceland nationalizes its banking system;
- October 16, 2008: UBS assigns USD 60 Billion to central bank secured Bad Bank;
- October 19, 2008: ING in distress, government takes stake;
- November 24, 2008: Citibank receives government bailout package;
- October 28, 2008: Aegon in distress, government takes stake;
- January 16, 2009: Anglo Irish Bank nationalized;
- January 8, 2009: Commerzbank in distress, government takes 25% stake;
- January 16, 2009: Bank of America receives government bailout package;
- November 1, 2009: CIT Group bankruptcy.

References


On March 30, 2010, it was announced that the Irish National Asset Management Agency (NAMA) would buy risky loans worth EUR 16 billion at a discount of 47%. September 30, 2008: Dexia in distress, joint bailout by three governments;