UNDERSTANDING THE ROLE OF DEBT IN THE FINANCIAL SYSTEM[1]

By Bengt Holmstrom, MIT

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Abstract

Money markets are fundamentally different from stock markets. Stock markets are about price discovery for the purpose of allocating risk efficiently. Money markets are about obviating the need for price discovery using over-collateralized debt to reduce the cost of lending. Yet, attempts to reform credit markets in the wake of the recent financial crisis often draw on insights grounded in our understanding of stock markets. This can be very misleading. The paper presents a perspective on the logic of credit markets and the structure of debt-contracts that highlights the information insensitivity of debt. This perspective explains among other things why opacity often enhances liquidity in credit markets and therefore why all financial panics involve debt. These basic insights into the nature of debt and credit markets are simple, but useful for thinking about policies on transparency, on capital buffers and other regulatory issues concerning banking and money markets as illustrated in the paper.

[1] I want to thank most particularly Daron Acemoglu, Tobias Adrian, Gary Gorton, Arvind Krishnamurthy, Antoine Martin, Jean Tirole, Andrei Shleifer and Robert Wilson for extensive discussions on this topic. Numerous others should be listed (and will be in later editions.) The paper draws on my Presidential Address before the Econometric Society, January 2012 and on my joint work with Tri Vi Dang and Gary Gorton.

1. Introduction

A lot of progress has been made in understanding the financial crisis since it erupted in full force after Lehmann's fall in September 2008. But there is still limited consensus on what caused the crisis. Many blame Wall Street greed and wrong incentives as well as the ratings agencies that appeared seriously off the mark. Others blame the government for subsidizing subprime lending. Still others find the problem in the new originate-and-distribute model of mortgage lending, which was at the core of the rapidly growing shadow banking system. What appears so puzzling in hindsight is that a slew of new complex and opaque products appear to have been so poorly understood even by the experts on Wall Street. As Michael Lewis wonders in his best-seller study *The Big Short*: How could Wall Street trade in securities that they knew so little about? Why did no one ask questions?

He suggests that the purpose of opaque securities was to deceive investors. But it is hard to believe that they would be colluding massively to defraud investors. After all, most of the trade took place within Wall Street. The risk that someone in that great collusion would have pulled the plug seems too big to make this theory plausible. It is equally hard to believe that hard-nosed profit hungry Wall Street players would be ignorant out of ignorance.

So what could explain the silent, high-volume trading in debt securities? I will argue that a state of "No Questions Asked" is the hallmark of money market liquidity;[2] that this is the way money markets are supposed to look when they are functioning well. The near-universal calls for pulling the veil off money market instruments and making them transparent reflect a serious

[2] For the most part I use the term "money markets" in the way it is covered by Stigum's (1989) classic book, though my main focus is on credit intermediation in money markets.

misunderstanding of the logic of debt and the operation of money markets. This misunderstanding seems to be rooted in part in the public's view that a lack of transparency must mean that some shady deals are being covered up. Among economists, the mistake is to apply to money markets the lessons and logic of stock markets.

The key point I want to communicate today is that these two markets are built on two entirely different, one could say diametrically opposite logics. Ultimately, this is because they serve two entirely different purposes. Stock markets are in the first instance aimed at sharing and allocating risk. To do it effectively requires a market that is good at price discovery. By price discovery I do not mean that the market has to discover the true fundamentals – we will never observe whether that is the case. By price discovery I mean the same as the Efficient Market Hypothesis posits: that no one can legally have a very substantial informational advantage for a long time and not at all without paying a commensurate price for the effort of obtaining such an advantage. Put in terms of the EMH, information will quickly be reflected in prices and since prices are common knowledge, beliefs will not be biased one way or the other to permit someone with just the knowledge of prices to make money.

Invoking the empirical success of the Efficient Market Hypothesis (in a variant they call relative efficiency), Gilson and Kraakman (2014) among others have advocated the same recipe to be applied to money markets as have worked so well for stock markets. Foremost among them is the recommendation that transparency about asset values should be a high priority in regulatory reforms. This is supposed to provide market discipline and also warn about impending build-ups of systemic risk. It is unclear exactly how such transparency is to be achieved for a simple reason: money markets do not have the ability to establish prices for the collateral that backs up the financial claims and it is hard to see how they could. They are bilateral markets, not

exchanges. More importantly, I will argue that money markets are expressly designed to obviate the need for price discovery.

Why does this matter? It matters because a wrong diagnosis of a problem is a bad starting point for remedies. We have learned quite a bit from this crisis and we will learn more. There are things that need to be fixed. But to minimize the chance of new, perhaps worse mistakes, we need to analyze remedies based on the purpose of liquidity provision and the changes that have taken place. In particular, the very old and robust logic of collateralized debt needs to be properly understood. It is possible that the recent developments in the money market may alter this logic and require a fundamentally new perspective. But as Carmen Reinhart and Ken Rogoff have reminded us: this time is unlikely to be different.

The information perspective I will offer can make sense of many standard features of money markets, including the use of collateralized debt as well as the secrecy and opacity that have characterized banking throughout its history and now shadow banking. It is possible, even likely, that more transparency is needed, but it will not be because of the logic of EMH and the desire to increase liquidity in money markets. Rather, it may be needed to contain excess growth of liquidity for instance in money market mutual funds. More generally, the view that opacity and information-sparseness mostly serve a useful purpose requires much more sophisticated arguments for how and why we should increase transparency in money markets.

Some of what I have to say here has been said before, but I believe the message is important and worth elaborating on. Also, I want to present the message from a conceptual perspective that starts with the most basic question: why is debt so ubiquitous, especially since it seems time and again to lead us into financial crises? Unfortunately, financial crises appear to be an inevitable

part of the logic of debt. Understanding the role of limited information in money markets will be useful in evaluating the benefits and the costs of interventions and regulations in these markets.

2. From pawnshops to repos.

Let me begin by talking briefly about the pawn shop – the 1000+ years old mitochondrial credit institution. The earliest documents on pawn brokering date back to the Tang dynasty in China (around 650 A.D.) and are described in the captivating book "On the Origins of Wealth," by William Goetzmann and Geert Rouwenhorst (2005, pp 54-64). A few hundred years later pawning was widespread in China. The first evidence of debt is a lot older than the first evidence of equity (in the early 13th century) and of stock markets (in the early 17th century). The point of mentioning these dates is that anything that has survived nearly intact for so long must be based on very robust and sound economic principles. I submit that this principle, in numerous new incarnations, is the one that is most relevant for understanding money markets even today.

The pawn shop is a brilliant invention, because it permits a borrower to get money against collateral that does not have to be precisely priced. There is no need for price discovery. If I have a watch that I think is worth 500 dollars, because it is my grandfather's watch with emotional value to me, and if the pawn broker thinks it is worth only 100 dollars, I can still get a loan for 100 dollars. If I had to get the money by selling the watch, it would be inefficient, because I am the highest value owner of the watch. By pawning it, I can get my watch back at an agreed upon price later on. I get my liquidity and my watch too if I conduct my affairs responsibly.

There is the risk that the pawnbroker loses or sells the watch and I will not get it back when I come to redeem it. This used to be a big problem in the old days and may explain why the

ancient Chinese pawnshops were run by Buddhist monks; their moral character served as a guarantee.

The pawn shop is still in existence – the oldest financial species perhaps. The business has not grown much, and it has a slightly shady reputation today. But that should not deny the pawning the credit it deserves. It has been a fabulous success in spawning improved versions of collateralized debt like mortgages and repo contracts. These modern variants are similar to the age-old pawn shop, except that the collateral is different, the agents may not be desperate for money and the ways to deal with collateral risks are more nuanced and sophisticated.

Pawn brokers take custody of the pawn, while repo brokers buy the security and usually take possession of it. Who holds the collateral and who owns the collateral are important distinctions and the rules differ across jurisdictions. In the U.S. the lender takes legal possession of the security and, like the pawn broker, is entitled to sell it if I cannot repay the loan and redeem the collateral. This protects the lender, but raises my risk if, as often is the case, the lender is by contractual agreement entitled to resell the security to someone else while our agreement is still open. If the lender is unable to return the security to me, it could put me in a difficult position because the security may be someone else's that I lent money to.

I will come back to the reasons why reselling (or rehypothecation, as it is called) is allowed. It is one way in which repo differs materially from pawning. My grandfather's watch does not have a substitute, but in repo markets a range of collateral may be acceptable substitutes, depending on the agreement between the parties involved.

There is another more significant functional difference between repo contracts and pawning. In pawning the initiative always comes from the borrower who has a need for liquidity. In repo the

motive is often the opposite: someone with money wants to park it safely by buying an asset and doing a repo (or reverse repo as it is called from the lender's perspective.) This feature played a key role in the rapid rise of shadow banking that preceded the crisis as I will discuss later.

3. Money markets

Money markets trade in debt claims that are backed by collateral. Often the collateral is itself debt for a reason that I think we understand well. I will provide a very robust logic for using debt as collateral. For now, let us take debt as given and focus on the simple fact that if the collateral used for trading in repo markets, for instance, is itself debt, price discovery is going to be even more difficult. By design, there was no need to discover the exact value of the collateral backing up the initial debt. And now that this debt is used as collateral for the repo it will be even more difficult to discover the underlying value. Gorton (2008) describes in detail the debt pyramiding that took place in structuring securitized products before the financial crisis, emphasizing the information that gets lost at each new layer of the pyramid.

I do not believe obfuscation as such was the purpose of building complex structured products, but it was a beneficial or at least benign feature of debt until the crisis struck. The most highly-rated tranches were highly liquid. Billions of them were issued and traded in repo and other money markets before the summer 2007.

People often assume that liquidity requires transparency, but this is a misunderstanding. What is required for liquidity is symmetric information about the payoff of the security that is being traded. Without symmetric information there is a risk that adverse selection will stick up its ugly head and prevent trade from taking place or in other ways impair the market (Akerlof, 1970).

In stock markets adverse selection is minimized by making sure that the process of price discovery is efficient. A key ingredient is full transparency including a publicly observed price. But it is expensive to discover the price. Billions of dollars are spent just on slight improvements in speed in today's high frequency trading race.

Collateralized debt is the cheapest way to reach symmetric information. Make information about price nearly irrelevant so that there is no need to discover price. This is achieved by over-collateralizing debt sufficiently so that if a trading partner has private information or has the ability to acquire private information such information is nearly irrelevant for judging the payoff of debt. We saw this in the pawn contract. It did not matter that the pawnbroker's valuation of the watch was different from mine nor would it have mattered had we had private information. The same logic underlies structured products in money markets: the highest quality tranches are sufficiently over-collateralized so that no one has an informational advantage with regard to payoffs.

From this observation, it is a short step to see that obfuscation may be beneficial, because when no trader knows anything of relevance – when there is "symmetric ignorance" about the payoff – the market will be completely free of fears of adverse selection and therefore very liquid. By contrast, transparency can be harmful if the information released makes private information relevant (see e.g. Holmstrom, 2009, and Pagano and Volpin, 2012). I will provide specific examples below.

The desire to circumvent price discovery is a natural consequence of lending. Lending is a bilateral contract. As the pawning example suggests, price discovery in a bilateral setting is typically very costly or impossible. Reference prices and gross characteristics can of course be

helpful. Traders talk to each other a lot. Their trading screens will give information on past trades that are similar, though it is usually hard to find an exact match. So this type of information acquisition is best described as due diligence. Traders want to make sure that when someone approaches them with an offer, the price is acceptable. There is no precise price discovery in the sense of stock markets. Even bonds that are traded on exchanges suffer from thin trading, so posted prices are often proxies for what a bond could be sold for. The spreads are big.

Information-sparseness in money markets manifests itself in other ways too. There are no analysts monitoring money markets and relatively few that follow bond markets. The information of most interest in bond markets concern interest rates and prepayment risks. Interest rates are available continuously for everyone and assessing prepayment risk is not a source of adverse selection for those trading in these markets, though traders often have different views on such risks. When new bonds are issued, the issue is typically sold in a day or less. Little information is given to the buyers. It is very far from the costly and time consuming road shows and book building that new stock issues require in order to convey sufficient information.

4. Stock markets

The main purpose of stock markets is to share and allocate risk. The first stock market was set up (in Amsterdam) to share the risk of dangerous voyages to the Far East. Over time, stock markets have come to serve other objectives too, most notably governance objectives, but the pricing of shares is still firmly based on the cost of systemic risk (or a larger number of factors that cannot be diversified). Discovering the price of systemic risk requires markets to be transparent so that they can aggregate information efficiently. The Efficient Market Hypothesis posits that

information will be reflected rapidly in share prices and as a first approximation this seems to be empirically true.

It is an obvious but critical point: one cannot share risk without a price. And the more accurate the pricing is the more efficient the allocation of risk will be. A prerequisite for all the derivate securities such as stock options which contribute to efficient risk sharing is a reliable stock price.

Unlike money markets, which tend to involve few participants with large unit trades, stock markets benefit from having a large number of small investors. The average dollar volume of daily trade on the New York stock exchange is of the order of 100 Billion with substantial volatility. The value of each order is small. By comparison, the daily turnover in repo markets is several Trillion dollars, though much of it entails rolling over short-term contracts. There is very little volatility in the volume.

The stock market is not a significant source of funding for firms. Start-ups, family businesses and other companies that list themselves for the first time on a stock exchange do raise substantial amounts of money at times, but little of it goes into the firm. The purpose is usually to allow entrepreneurs and family members to reduce their risk exposure, or resolve conflicts of interest that are common among closely held firms with large shareholders.

Colin Mayer's (1990) study of investments by private firms' over the period 1970-85 in five developed countries provides shows the limited role of equity financing. He finds that equity issues (as well as bond issues) are a very small percentage (less than 5%) of the aggregate funding of net investments. The principal source of funding comes from retained earnings (about 70%) and from bank loans (about 25%). These numbers vary quite a bit across countries and years, but the common denominator is that equity markets play a minor role in funding and not

infrequently, there are years when equity markets drain companies of funds. In the U.S. this was the case in the 1980s when stock repurchases grew big.

The importance of price discovery in stock markets goes hand in hand with the incentives for price discovery. Every minute piece of information is relevant for judging the value of the stock (and more so if the firm is leveraged). This is reflected in the billions of dollars that investment banks and other analysts and individuals spend on learning about firms. This brings a continuous flow of information into the stock market, maintaining the relevance of prices. Equity is information sensitive while debt is not.

In summary, stock markets are in almost all respects different from money markets: risk sharing versus lending, price discovery versus no price discovery, large versus small number of traders, small average trades versus large average trades, information intensive versus information sparse, impersonal versus bilateral. To this should be added the important difference that money markets operate under much greater urgency than stock markets. There is generally very little to lose if one stays out of the stock market for a day or longer. This is one reason the volume of trade is very volatile in stock markets. In money markets the volume of trade is very stable, because it could be disastrous if, for instance, overnight debt would not be rolled over each day. In some cases, such stoppages can instigate crises, as was the case with Bear Stern and Lehmann Brothers. Both companies failed rapidly when their overnight short-term debt was not rolled over. In both cases the whole market, reacted, because of the strong signal it sent to counter-parties due to the bilateral linkages of debt.

In organizational design language, the different sets of attributes that characterize stock markets and money markets form two coherent clusters of attributes. The money market attributes tend to

reinforce each other just like the stock market attributes do. Each cluster is carefully designed so that the parts fit together. Recognizing the linkages between the different attributes is of the essence as one considers redesigning some part of either vehicle. For instance, changing the degree of transparency in the debt market will have ramifications throughout the system. This should be kept in mind by regulators.

5. The optimality of debt.

Cost of default

The pawn shop example highlighted that lending against collateral has low information costs because there is no need for precise price discovery. Is debt the optimal contract and if so in what sense? I want to be a bit more formal about this question, because there are several senses in which debt incurs low information costs. It is important to distinguish between them in order to understand the multiple reasons why debt is cheap. Some are especially relevant for trading debt or using debt as collateral as is done extensively within shadow banking.

In Figure 1, I have drawn in red the payoff of a collateralized debt contract at the time of expiration. It has the familiar shape of an inverted hockey stick. The horizontal axis measures the value of the collateral, denoted x. The vertical axis measures the value of debt. The hockey stick has the functional form s(x) = Min[D,x], where D is the face value of the debt.

Before the date of expiration, the value of the debt contract (to the lender) is less than at expiration, because of the risk of default. This is represented by the black line in the figure. The shape of the line is the familiar shape of a put option. In asset pricing theory, the debtor has a put option, so one could use a standard option pricing formula to value the put. Here the match is

imperfect, because the debt is typically not traded and the borrower may value the collateral more highly than the lender. I will ignore this complication.

It is important to note that a real debt contract does not make any reference to the value of collateral x, because there typically is no value that both parties observe. It says something to the effect that if the borrower pays D the contract is closed and the collateral returned if it is held by the lender. The reason for being particular about this point is that it underlines a second information-related benefit of collateralized debt. Not only does it avoid a precise assessment of the collateral value at the time the contract is signed. It also avoids the cost of price discovery whenever the debt is paid in full. Only default will trigger a value assessment, usually through a bankruptcy process that can be quite costly. Note that in the pawnshop case, the cost of default is likely to be low, because part of the expertise of the pawnshop is to sell the pawn if it has not been redeemed.

The much used Costly State Verification (CSV) model of Townsend (1979) and Gale and Hellwig (1985) shows that debt is an optimal contract for funding an investment, precisely because debt minimizes the cost of price discovery.[3] If one were to write a contract that instead of having a flat part like debt would be strictly increasing in x like a share, say, then the execution of such a contract would be a lot more expensive since it would always require an assessment of the collateral value at termination in order to be implemented. One could sometimes use a reference price to determine the final value and hence the payments to be made, but it would often induce considerable risk into the contract in addition, of course, to the costs of

[3] This feature is present also in several of the financial models of Hart and Moore; see for instance Hart and Moore (1995).

agreeing on a price in advance. Debt is information insensitive both ex ante and ex post in a simple lending situation.

Information sensitivity of debt in trade

If debt contracts could end up being traded later, for instance because a repo fails or because someone wants to hedge against a liquidity shock in the future by buying debt today, there are two additional concerns that arise. First, how well does debt preserve its value as new, public information arrives? Second, how well does debt fare against potential private information that a buyer may acquire?

Let me take the second question first. If we go back to Figure 1 it is clear that debt is information insensitive to private information if it is deep in the money, that is, the distribution of the collateral value is so far out in the right tail that the market value of debt at the time of sale (call it tomorrow) will equal its face value D with high probability. On the other hand, if the distribution is concentrated closer to the kink of the hockey stick, it may pay the buyer to learn more about the underlying collateral of debt. In this case debt is information sensitive to information acquisition. I have marked a hypothetical range along the x axis where the mean of the value of collateral determines whether debt is information sensitive or not. I have in mind that the shape of the distribution is symmetric and does not change its shape as the mean moves along the x-axis. I will return shortly to discuss factors influencing the point where information acquisition will be triggered.

There is a simple measure that captures the information sensitivity of debt to information acquisition: it is the expected savings to the buyer from avoiding a loss-making purchase if she acquires information. Call this measure IAS (Information Acquisition Value). If it is larger than

the cost of information acquisition C, the buyer will acquire information else she will refrain from acquiring information.

This definition can be applied to any contract, not just debt. It is natural to ask which contract has the lowest IAS among all contracts with the same expected value. The answer is debt. If some arbitrary contract with expected value V does not trigger information acquisition, neither will a debt contract of the same value. Debt is the least information sensitive contract in the sense that it is the most resilient contract to information acquisition.

How is the information sensitivity of debt (IAS) affected by changes in parameters?

- Assuming the debtor values debt like a put option, the lender's value (the black line) is concave. From the standard option formula we also know that less risky collateral (in the sense of a mean preserving spread) implies a higher value of debt: the thin line will get closer to the expiration value of debt. Therefore, less risky collateral expands the information insensitive region of debt, but it also increases the information sensitivity of debt once the distribution of collateral gets closer to the kink. The regime shift will be more dramatic when the boundary is crossed.
- The effects are similar (and for much the same reason) when the duration of a debt is reduced: the value of debt increases uniformly because it is an option. Short-term debt which is sufficiently well in the money is less information sensitive than long-term debt with the same face value. This comparison reverses itself once the mean of the distribution gets close to the kink. The regime switch will be more dramatic again.
- A reduction in the face value of debt, keeping collateral the same, will expand the region where debt is information insensitive. This happens for two reasons: the black line will get

closer to the red line and the flat part of the stick will become longer. With more of a buffer, debt will naturally be safer, but there will be less of it. This trade-off is relevant when one thinks of higher capital requirements. Conceptually, one can imagine that the collateral in Figure 1 is the aggregate value of all collateral in the economy. If one "issued" safer debt by lowering the amount of debt in Figure 1 that safety could only come by issuing less such debt. If one argues for more equity in the banking system, as Admati and Hellwig (2013) have done, there is a potential price being paid because the amount of safe assets will be reduced. It is true that those assets will be safer, but it is unclear how to compare safer and less with less safe and more.

- Finally, if more collateral is added, debt will be safer and there will be more of it (in the sense that one can issue more debt with the same level of safety).

Let me elaborate on the first bullet stating that less risky collateral makes debt less information sensitive. It hints at one of the main results in Dang et al (2013). In that paper we study a setting where a person wants to invest in a security today in order to provide for liquidity needs tomorrow as discussed above (see Figure 2a). To meet her liquidity needs, the person plans to sell the security tomorrow. Between today and tomorrow, public information (news) will arrive that affects the value of the security. This raises the concern that the security becomes information sensitive as discussed above. In case of bad news, the buyer may want to acquire information, in which case the seller cannot get the full market value of the security. It may then be best for the seller to use the initial security as collateral for another security that is less information sensitive and consume any balance that remains after the payment of the new debt at a later date.

We know from the earlier discussion that whatever the initial security that the seller buys today, the optimal contract to issue tomorrow to a buyer that can acquire information is debt. The question is what kind of security the person should buy today, considering that this security will serve as collateral for debt issued tomorrow?

The answer is again debt. Debt is the best collateral, because the value of debt is also least sensitive to public information. Its value varies less than any other contract with the same initial expected value. This is then a third sense in which debt is information sensitive: it is least information sensitive to public information. This simple, but remarkable result can be found in DeMarzo et al (2005).[4] The same result also shows that equity is most sensitive to public information. This is a definitive and very general answer to the first question posed earlier.

The main result in Dang et al (2013) states that debt-on-debt is optimal (see Figure 2b). It is optimal to buy debt as collateral to insure against liquidity shocks tomorrow and it is optimal to issue debt against that collateral tomorrow. In fact, repeating the process over time is optimal, that is, debt is in a very robust sense the best possible collateral, given a fixed amount of assets as the collateral base.[5] This provides theoretical support for using some of the complex constructs in the shadow banking system.

Figure 2 also describes the optimal strategy for the buyer when she needs to sell the asset. It will, as just noted, always be debt. The interesting part is that if news is bad enough the seller will either have to deal with adverse selection (trade may not happen) or less of the debt will have to be issued to prevent information acquisition. Bad news leads to a "double-whammy" for liquidity

[4] Lemma 5.
[5] Matters are obviously more complicated if the assets one can work with are differentially sensitive to public information. Then they cannot be pooled together even conceptually into a single asset.

support (in the words of Jean Tirole). Debt falls in value and on top of that, not all of it can be sold.

Another implication of the optimality of debt-on-debt is that it suggests that banks should use debt on both sides of their balance sheets. We can interpret agent B in Figure 2 as a bank that invests in A and issues liabilities to C. Both legs use debt. Banks should hold assets that have the lowest sensitivity to public information, which includes debt without traded equity such as mortgages, and they should issue debt on the liability side, because such liabilities will be least likely to trigger information acquisition.[6] Dang et al (2014) provides a more detailed model of why banks should keep secrets and why low-risk assets are more desirable (see also Breton (2007)).

4. Purposeful opacity.

There are several papers that show that one may want to limit publicly available information or hide information to make public information less revealing. For instance, if a bank does not show the composition of its assets in detail then news about the economy may not be as valuable for updating one's beliefs about the prospects of the bank's collateral. The bank will appear more opaque which can be valuable. See e.g. Kaplan (2006), Breton (2007), Dang et al (2014), and Monnet and Quintin (2013). The spirit of these arguments are similar to Hirschleifer's (1971) celebrated result, which states that public information will in similar settings limit contracting opportunities and be socially costly. In particular, insurance opportunities will be destroyed.

[6] The logic behind the second part of statement may not be the best one for explaining why banks issue debt. I am more inclined to believe in the logic of Gorton and Pennacchi (1990) where debt is issued to provide information insensitive assets for uninformed future traders.

Intentional opacity is a rather ubiquitous phenomenon. Here are some illustrative examples, first from trading and then from financial markets.

- *De Beers* sell "wholesale" diamonds in a way that does not give its buyers the opportunity to inspect diamonds on offer in order to pick out the best ones to buy (Milgrom and Roberts, 1992). Instead, buyers submit periodically an order for "envelops" of diamonds with certain gross characteristics (weight, color, shape, quality). The diamonds in an envelope are meant to be homogenous, but necessarily exhibit individual variation. De Beers offers the set of envelopes (the "sight") on a take-it-or-leave-it basis. The intended buyer, but only that buyer, is allowed to inspect the sight in any desired detail and may reject it. In case of rejection, the buyer will be excluded from further trading. Buyers appear to inspect, but solely for the purpose of correcting mistakes De Beers may have made in classification of the diamonds.

  So buyers have to buy on De Beers' terms essentially without inspection (except pro forma). They never inspect or compete for the same "sights." One purpose of this "block booking" system is to prevent adverse selection that might arise if several buyers were allowed to look at the same "sights" and pick among them. Evidently, the system is held up by De Beers' reputation for honest trading, the ability to inspect gross violations, the long-term relationship and the rents that such a relationship provides. Over time, variations in quality will wash out and the time saved and the cost and consequences of information acquisition more than offset the benefits.

- *Car auctions.* A related example is offered by the wholesale used cars market in which cars are auctioned to dealers; see Genosove, (1993). Dealers are allowed to inspect the car externally before the auction, but not open doors or the hood. Mileage, options, year and

make will be known at this stage as well as any damage to the body. When the auction starts, bidders can open the door and the hood for a short time to do some perfunctory checks (read odometer, test air conditioner function, start engine.) But there will be no time for a close inspection. From the time the car arrives on the block to the time it is driven away, about a minute and a half has passed.

One virtue of this auction is that it is quick. The other virtue is that closer inspection might invite "winner's curse" and result in lower bid prices. Opacity alleviates the winner's curse by reducing the advantage of any expertise that bidders may have in interpreting detailed information such as service records.

Purposeful opacity can also enhance liquidity provision. Banking has always been an opaque industry, one where you are supposed to trust the bank; as the saying goes, if a banker has to prove his credit-worthiness, he has already lost it. Transparency may reveal information of value or it may make public information more relevant and increase the volatility of the collateral that is backing debt in Dang et al (2013), for instance. Here are some real examples from financial markets.

- *Money market mutual funds* have daily information about their investment positions and the book value of these positions. The book values change constantly as the funds trade their portfolios and investors add and withdraw money from the fund. Yet, the funds do not have to report the daily NAV (Net Asset Value). They only have to file quarterly reports with the SEC and even then the reported value is not the current NAV, but the NAV thirty days ago. It is a purposeful effort to avoid a continuous flow of information into the market. The likely rationale for this restriction is that it gives MMMFs time to adjust to fluctuations in the daily

NAV so that investors are unable to judge whether the fund is close to “breaking the buck”. MMMFs make an implicit promise to pay back principal, but if the value of the fund is below par, it exposes itself to a run. The fund can manage its NAV by selling undervalued (overvalued) assets depending on whether it is below par or above par. It has to report to the SEC out of sequence if the NAV falls more than 50 basis points below par or goes 50 points above par, which defines “breaking the buck”.

The bankers have so far successfully objected to a “floating” NAV, a practice that all European MMMFs have to follow. The argument is inconvenience and more importantly that the MMMF industry would not be able to serve the customers like a bank any longer. Consequently the clientele would change. This may well be true, since transparency will eat into the “moneyness” of MMMF deposits. If so, it would show that transparency does reduce liquidity – the opposite conclusion to what one would draw from making stock more transparent. However, reduce liquidity or “moneyness” may be a good reason to make MMMFs more transparent. Even though opacity is purposeful for the MMMFs, that does not mean that opacity is socially desirable. My general argument is that opacity will in many instances enhance liquidity, not that it is socially desirable necessarily.

“Breaking the buck” can be a highly disruptive event, because investors who were debt holders are suddenly in the position of equity holders as Figure 1 indicates. The discontinuity comes in part from bulky information. Investors are not concerned about swings in yields, which could be larger than the 50 basis point drop that triggers reporting.

- *Coarse bond ratings* provide another good example of purposeful opacity in money markets. It is an effort to make approximately equal collateral be equal in the minds of the investors.[7] Coarse ratings promote "commonality of beliefs" in the langue of Morris and Shin (2006). They show theoretically, that commonality is desirable because it reduces problems of adverse selection. Furthermore, because an investor does not care just about her own views of value, but what other investors think about her views and so on, as in Keynes' famous beauty contest, even small disruptions in commonality of beliefs (technically, departures from common knowledge) can result in big swings in market outcomes (e.g. trigger a run). Managing liquidity is very much about being sufficiently opaque when price discovery is not possible or desirable.
- *Money* itself is surely the most opaque of all instruments. No one knows what exactly backs up the government issued money. "The full faith and credit" of the government is a very vague promise. But the beauty of money is that even if I do not know the exact value of the collateral backing my government's promise, neither does anyone else. So we are symmetrically ignorant – a blissful state in many situations.

  It is interesting to speculate whether knowing the explicit value of the European rescue fund is a problem for the credibility of the euro. It seems that way, because governor Draghi's famous pledge to do "whatever it takes" finally put an end to a silent run on some of the sovereign bonds in the euro area. The most opaque of statements worked where ever larger public commitments to explicit rescue funds failed to calm nerves.

[7] The empirical evidence in Adelino (2009) suggests that this is not entirely successful; investors have valuable information beyond ratings.

Central banking policies. There is a slew of evidence that central banks have historically promoted opacity to avoid singling out weak banks. The use of the discount window is secret. TAF, the first liquidity facility provided by the Fed in the current crisis, was also secret. The first stress tests that the U.S. conducted were designed not to reveal who needed government injected capital and who did not. Gorton (2013) goes through the history of opacity in U.S. banking, showing that opacity has always been part of liquidity provision and efforts to maintain the value and credit of public and private money. The obvious reason for being so secretive is to avoid singling out one bank from the pack and make it vulnerable to a run that could be contagious.

One final example from Gorton (2013) that is especially interesting in light of the European situation is the private organization of banking clearinghouses that were common in the second half of the 19th century. These organizations cleared checks, but they also provided mutualized insurance in times of crisis. During panics, clearing houses would close ranks and make individual debt the shared obligation of all its member banks. The clearing house issued loan certificates which individual banks could buy in exchange for their impaired assets; something that sounds quite similar to the Fed's first QE intervention. At the same time, the clearinghouse would no longer report on individual data of its member banks. The data were sparse to begin with – gross statistics of the kind that is typical in money markets – but shutting down all information still increased the level of opacity.

When the crisis was over (that is, when loan certificates traded at par again), the clearinghouse would revert to its pre-crisis state of organization and reporting. The interesting question is why? As a single entity, the clearing house was apparently stronger than when the banks were separate. Gorton and Mullineaux (1987) argue that it improved incentives for monitoring the banks both within the clearinghouse and by the depositors. Another argument is that even if the clearing

house might have been stronger as a single organization (think of Japanese keiretsus), the consequences of default would have been more traumatic. With a run on the clearinghouse rather than just one bank there would be no one that could come to rescue. The decentralized system provided a solvent backstop and the first bank to fail an early warning sign.

5. Panics: The ill consequences of debt and opacity

Over-collateralized debt, securitization, coarse ratings, reference pricing, trust and maintaining "symmetric ignorance", all make sense in good times and contribute to the liquidity of money markets. But there is a downside. Everything that adds to liquidity in good times pushes risk into the tail. If the underlying collateral gets impaired and the prevailing silence is broken, the consequences may be cataclysmic. This is why panics always involve debt.

The occurrence of panics supports the main informational thesis that is being put forward here. Panics happen when information insensitive securities and institutions turn into information sensitive ones as in Figure 1. A regime shift occurs from a state where no one feels the need to ask detailed questions, because it is not worthwhile, to a state where there is enough uncertainty that some investors begin asking questions and finding out information. This can lead to rapid drops in prices and reduced liquidity of the securities that were issued and the banks that underwrote them. Such events can be cataclysmic precisely because the original liquidity of the securities rested on trust rather than a precise evaluation and discovery of collateral values. A panic is an information event that shatters the shared understanding and beliefs on which liquidity rested.

The inherent trade-off between creating liquidity through trust and silence and paying the consequences if the trust is broken is at the center of all policy discussions on how to regulate

money markets. How should we weigh the pros and cons? It is an unpleasant trade-off, because we do not understand the triggers and the dynamics of panics well. It is tautological to say that the cause of the panic is excess leverage. That is a common denominator of all panics and wisdom after the fact. The question is how much leverage is tolerable and what that level depends on.

It is tautological to say that the cause of the panic was excess leverage. That is a common denominator of all panics. What one would like to know is whether panics could be eliminated or at least predicted so that measures could be taken to contain them. But we do not know what may trigger a crisis nor do we understand the dynamics of panics well. Precautions can be taken, but the path the panic will take if it starts is as unpredictable as a forest fire or an avalanche. In the wake of the recent financial crisis, there is little reason to believe panics can be eliminated. We thought we were done with them in the U.S. and Europe, but it has been a rude awakening to see the return of panics.

I will say a few words about what the information view can say about precautionary measures in a moment. But first, I want to show some evidence that suggests that panics are information events. Look at Figure 3 taken from Perraudin and Wu (2008). The picture represents the residuals from fitting a complex forecasting model to data on prices of bilateral trades in AA-rated tranches of subprime home equity loans (HEL). I am not qualified to judge the goodness of fit of the model. This is a challenging area where experience and judgment in the use of sophisticated time series techniques is required. Nevertheless, I think the figure is compelling, because the same model has been fitted over the whole period that covers the crisis.

There is a clear discontinuity around the date when two Bear Sterns Funds, heavily exposed to subprime home equity loans, were besieged by investors and collapsed in June 2007. Before the collapse investors had a shared view of pricing. I suspect that questions were asked, but more to do due diligence and check reference prices than get new, private data on the underlying collateral. The true value of the collateral was apparently behind a veil given the tightness of price residuals. A shared understanding and herding around the same information is consistent with the picture. When news about the troubles at the two Bear Stern Funds surfaced and spread everything changed. The scatter suggests that private information became relevant in the sense that everyone tried to make the best of their understanding of the situation, based on their experience and expertise. The event shows that significant new information caused beliefs to diverge rather than converge. More information led to illiquidity and dispersed views, rather than a quick adjustment to a common, lower price level.

Figure 4 describes spreads in high-grade subprime tranches of the ABX index as reported in Stanton and Wallace (2011). These tranches traded essentially at par until the Bear Sterns funds collapsed in late June 2007 and especially when the collapse of the BNP Paribas funds followed in August 2007. Issuing of tranches in all asset backed securities dropped sharply (Figure 6).

These events started a run in the asset-backed commercial paper market (ABCP) as described in Covitz et al (2013). Multiple reinforcing factors come into play once a run gets started (see Brunnermeier, 2009). Information contagion, fire sales, domino effects interlinked balance sheets, and so on, all contribute to the course of the panic. It is very hard to disentangle at that point what drives what. What I wanted to argue here is that panic is at the beginning triggered by

some information event (not necessarily a dramatic one) making some assets information sensitive.[8]

Would transparency have helped contain the contagion?

The question above is speculative, but worth asking. A strong believer in the informational efficiency of markets would argue that once trading in credit default swaps (CDS) and then the ABX index began there was a liquid market in which bets could be made both ways. The market would find the price of risk based on the best available evidence and that would serve as a measure of systemic risk and a warning of an imminent crisis. Pricing of specific default swaps might even impose market discipline on the issuers of the underlying debt instruments.

There is evidence that traders were sensitive to some risk factors. Gorton (2008) and others report that the tranches issued in 2005 were less risky than those issued in 2006 (there is of vintage effects also in Figure 4). The reason for this, Gorton shows, is that subprime securitization used dynamic buffers: initially, the buffer was very thin, but with time, as housing prices rose and refinancing took place in favorable conditions, some of the incoming cash was channeled to strengthen the buffer. The 2005 issues had more than double the buffer of the 2006 issues and fared much better throughout the crisis.

We can also see from Figure 5 that ABX pricing was sensitive to the ratings of tranches. It is conceivable that risk was accurately priced conditional on the sparse available evidence.

[8] I should note that one can generate a significant discontinuity in prices without asymmetric information, from a model where the price of the security evolves behind a veil: investors only observe whether the price drops below a critical barrier or stays above it. When the price crosses the barrier in such a model, price drops discontinuously due to "trapped information" being released. Caplin and Leahy (1994) provide a model of this kind based on herding and social learning. But that type of model cannot explain the complete collapse in issuing of new tranches that we see in Figure 7 or the dispersion in prices in the Perraudin-Wu picture. Gorton and Ordonez (2013) present a model of the run up and collapse of collateral values using based on Dang et al (2011), where values drop and economic activity falls, but heterogeneity in beliefs is not being modelled.

However, the contagion from the Bear Sterns and the BNP Paribas events also suggest that substantial amounts of information had been hidden from the markets.

As for crisis forecasting, the continued impairment of subprime tranches as measured by ABX spreads did nothing, really, to forecast the systemic risk. Figure 7, taken from Gorton (2009), superimposes the development of an average (across tranches) of ABX subprime spreads (in red) on the path of the Libor-OIS spread (in blue), which is a widely used measure of systemic risk. At no point does the blue line show a clear warning of an imminent crisis, though the Libor-OIS spread did jump to a somewhat higher (some would say more normal) level after the summer of 2007. This appears typical of the way contagion develops. The fire spreads around the periphery (see Figure 5) until some significant event like Lehman's collapse gets people to realize that the core is at risk. For quite a while Europe was confident that the financial crisis would be contained within the U.S., showing how little traders knew about the interconnections and the European involvement in the U.S. subprime market.

6. Shadow banking

The rapid growth of shadow banking and the use of complex structured products have been seen as one of the main causes of the financial crisis.[9] Before we jump to the conclusion that shadow banking was based on unsound, even shady business practices, it is important to try to understand the rapid and remarkable growth in shadow banking. Even Wall Street has a hard time surviving on products that provide little economic value. So what drove the demand for the new products?

[9] Shadow banking constituted roughly ten per cent of the financial intermediation sector in 1980; by 2008 it was more than half of it at sixty per cent. See Potszar et al (2010).

It is widely believed that the global savings glut played a key role. Weak financial markets and high savings rates led Asian money to seek a safer haven. The US with its highly developed financial system was perceived to be safe. As U.S. current account balances began to deteriorate rapidly in the mid-1990s, interest rates kept falling, suggesting that money was being pushed rather than pulled into the U.S. (see Caballero et al, 2008). The fact that the U.S. current account deficit grew roughly in tandem with the growth in the shadow banking system makes suggests that a large part of the foreign money flowing into the U.S. was intermediated by the shadow banking system.

Two obvious questions come to mind: Why did the money flow to the U.S. rather than Europe, which was perceived to be quite safe as well? [10] And why did shadow banks rather than commercial banks absorb the bulk of the inflow?

One reason why the U.S. might have been a better place was the U.S. consumer's willingness to go deep into debt. With interest rates low, private debt could and did go up. But this does not answer the second question. Another important reason must be that shadow banking, which was most advanced in the U.S. was readily available to create safe assets (or at least assets that were perceived to be safe) that were in demand by the foreigners. The originate-and-distribute model paired with securitization was an ingenious way for Wall Street to make more efficient use of the collateral potential of the large U.S. housing market (and was encouraged to do so by politicians). The shadow banking system was, in this view, replacing a piece of the traditional chain of intermediation with a cheaper, more efficient form of intermediation.

[10] Quite a bit of the Asian money did flow into Europe, but was passed on to the U.S. because of regulatory arbitrage. The shift to Basel II had expanded the European banks' "balance sheet capacity" and could, through U.S. subsidiaries utilize that capacity in the U.S. on better terms than the U.S. banks which operated on Basel I rules. See Shin (2012).

Let me discuss some of the economic efficiencies that made the shadow banking sector cheaper and more rapidly scalable than the commercial banking sector would have been alone.

A major advantage came from securitization. By tranching pools of assets one can create asset classes with different degrees of risk that can serve a heterogeneous group of investors. Pooling reduces idiosyncratic risk more efficiently than traditional banking, because the shadow banking system had a much larger reach and capacity to handle funds than individual commercial banks. But a key advantage was surely the ability to manufacture AAA-rated collateral not just from high-quality mortgages, but from much lower-quality assets, including subprime mortgages.

Many consider this alchemy. How can one create AAA-rated securities out of BBB-rated mortgages? If the pool of mortgages are perfectly correlated this is of course impossible. But with an imperfectly correlated pool, it is equally obvious that one can create AAA-rated securities thanks to the law of large numbers – how much depends on the correlation. Coval et al (2009) have studied, partly through simulations, how sensitive the different tranches are as a function of the quality and correlation of the underlying asset pool. The eye-opening finding is that the senior tranches of securitized asset pools deteriorate the fastest as asset quality declines and especially as the correlation increases. It is likely that the models used to rate structured products were far too optimistic about the low correlation of assets: as the financial crisis spread, the correlation kept increasing, a prospect that may have been very hard to forecast.

Unlike traditional banking, manufacturing of AAA-rated securities through securitization is highly scalable provided that there is readily available raw material, that is, assets that one can pool and tranche. The U.S. did have a large latent pool of assets available: housing. As discussed earlier, housing is an ideal collateral class. Housing prices move slowly and housing is by far the

big asset class that households own. Any house that was debt-free or underleveraged was potential raw material for securitization. Putting it more colorfully, a house without debt was an ideal parking spot for foreign money searching for a safe home – literally. Underleveraged homes were depriving foreigners from an opportunity to store wealth at low risk.

Home Equity Loans (HEL) exploded at the start of the new millennium. Those owning underleveraged houses at the time may recall the weekly, sometimes daily, phone calls from banks and other mortgage lenders peddling dirt-cheap loans. The search for collateral was aggressive. At its peak 50% of ABS issues came from HELs (Figure 6). It was a massive pool of potential parking space. Securitization was critical in meeting the demand for AAA-rated collateral. Initially, the process tapped into high-quality housing, but as the supply started to run out, securitization began using lower quality assets, including sub-prime assets. The move into more marginal assets was inevitable, but it should have been accompanied by lower leverage. We know it now, but it is much harder to tell whether one should have seen it before the collapse started in 2007. Housing prices had been going up for 70 years and the dynamic buffering mentioned earlier had worked beautifully for years.

Securitization only accounts for part of the efficiencies from shadow banking. Very significant was the ability to channel funds across long distances, and even around the globe. The lengthy chains of intermediaries that made up the shadow banking system: hedge funds, dealer-brokers, money market mutual funds, as well as Government Sponsored Entities (GSEs) are seen by some as way too complex. But one can also see this transportation network as instrumental and the result of organic growth and opportunities to match supply and demand. Figure 8, taken from Krishnamurthy et al (2011) gives a schematic picture of the system.

In the parking place metaphor, securitization and reclaimed unused parking space, by encouraging house owners to take on more debt. The distribution of tranches of debt throughout the system, slicing and dicing them along the way, corresponded to time contingent, hence more efficient use of parking space. Collateral is continuously being reallocated to support repo contracts, for instance. Through rehypothecation, the collateral can travel, like money, long distances to find investors. Also, the Tri-Party market, which facilitates daily substitution of collateral of like kind, permits a more flexible use of collateral (in the parking metaphor, the Tri-Party market is like a parking garage: there is space in the garage for the investor, but no particular spot is reserved).

It is a very different system of intermediation than traditional banking, where mortgages and business loans are kept on the balance sheet of a bank until it is repaid. Of course, regional banks continuously reallocate capital as loans are repaid and new ones are made, or as credit lines are expanding and contracting. But the circulation of collateral in this system is implicit rather than explicit, more limited and more local than within the shadow banking system.

I am describing conceptually a system the details of which we still understand poorly. Before the crisis, there was very little data about the flow of money and collateral within the shadow banking and we are only now beginning to see new data sets that give us an idea of the quantities and movements within the system (see Krishnamurthy et al, 2011, and Copeland et al, 2010, 2014). I venture the claim that the shadow banking system has significantly extended the reach of the traditional banking system as exemplified by the presence of foreign subsidiaries in the U.S., which invested heavily in U.S. asset-backed securities funded by MMMFs in the U.S.

The logic of shadow banking and the way it employs collateral more efficiently, makes it likely that its role in supporting the global financial system is going to increase rather than decrease. Traditional banking is or used to be relationship based. An important part of the collateral of the bank was its reputation with specific partners or clients. Creating such relationships take time. Longer distances and new relationships require harder collateral. This is why in the new global order it seems natural to expect asset backed securities and securitized products of other kinds to play a much bigger role.

The increasing popularity of covered bonds is illustrative. In Denmark covered bonds have been the main mortgage instrument for a long time. But the financial crisis and the shoratege of safe assets in the aftermath of it, has brought wider usage of covered bonds, especially in Europe. They have recently entered the financial markets of Norway, Sweden and Finland and are growing explosively. Covered bonds give the big banks better access to global funding markets and hence cheaper funding. The cost of it is that the assets that are used to cover the bonds have to be of highest quality, else they would not be accepted on the international markets. This eats into the fabric of traditional banking; the remaining collateral that backs up unsecured investors is poorer. The impairment of the general collateral need not concern the small depositors, whose funds are covered by the government. But it is a concern for the regulators, because it could raise the risk in the national banking system and the opportunity cost of funding for smaller companies. Regulators will surely put caps on what fraction of assets can be carved out.

There is relatively recent, but rapidly growing body of theoretical research on financial markets where the role of collateral is explicitly modelled and where the distinction between local and global collateral is important. Let me speak briefly about my work with Jean Tirole (1997, 1998, 2011), which has bearing on the discussion of contingent collateral use. We employ a model

where the income of firms cannot be fully pledged to investors because of moral hazard or enforcement problems for instance. Only the pledgeable income of firms can serve as collateral. In each state of nature there is some amount of aggregate collateral determined by the firms' investment plans (the total pledgeable income in the economy). In some states, there is a shortage of aggregate collateral much as there is said to be a shortage of safe private assets currently. In such states collateral earns a liquidity premium. This premium in turn will determine the firm's optimal investment and reinvestment plans. In equilibrium the prices and plans will match.

Three points are worth underlining. First, the equilibrium outcome is constrained efficient, so contingent pricing and use of collateral is desirable. Second, if international investors consider less of the firms' collateral plegeable than domestic investors, the type of collateral that can attract international investors earn a domestic premium (as in the case of covered bonds). Third, when there is a serious enough shortage of collateral, the government will find it optimal to alleviate the situation by supplying collateral in that state using taxpayer money.

It is a leap to look at reality through this framework, but there are relevant connections. Shadow banking complements traditional banking by making collateral circulate faster and improving the contingent use of it. The collateral in use is of higher quality (until the crisis, that is) allowing it to travel further because it is more widely accepted. And the involvement of the government, which some decry, makes sense on rare occasions when a country encounters really unexpected contingencies. It does not make sense to prepare for the rarest contingencies in the private sector, because it would require producing additional collateral (a storage facility) for an event that the government can cover less expensively ex post by taxing consumers. Exchanging impaired

collateral for high-quality government assets, as has happened in the current crisis can be rationalized on these grounds.

7. Some policy implications.

My goal in presenting the information perspective on money markets has been to argue for its relevance in interpreting existing and emerging money market institutions, functions and behavior. I believe it is quite relevant also for policy, but mapping it into concrete policy advice would require much more detailed institutional knowledge than I have. So let me just point to some areas and questions that would benefit from the views put forward here.

At the most general level, the design of money market policies and regulations should recognize that money markets are very different from stock markets. Lessons from the latter rarely apply to the former, because markets for risk sharing and markets for funding have their own separate logic. The result is two coherent clusters of institutions and practices that are in almost every respect polar opposites.

I also believe that the risk of a financial crisis cannot be completely eliminated without throwing the baby out with the bathwater. Debt and institutions dealing with debt have two faces: a quiet one and a tumultuous one. This is evident already in the behavior of individual debt contracts as illustrated by the hockey stick, but seems to apply equally, though much less frequently, at the system level. The shift from an information insensitive state where liquidity and trust prevails because few questions need to be asked, to an information-sensitive state where there is a loss of confidence and a panic may break out is part of the overall system: the calamity is a consequence of the quiet. This does not mean that one has to give up on improving the system. But in making

changes, it is important not to let the recent crisis dominate the new designs. The quiet, liquid state is hugely valuable.

As an application of these general thoughts, consider the very concrete question how to get out of a crisis. In the fall 2008, the U.S. government was initially planning to spend its emergency fund on purchasing toxic assets. I do not know the details of the plans, but it did seem wrong-headed at the time and I think in hindsight as well. A crisis ends only when confidence returns. I submit that this requires getting back to the no-questions-asked state. It will not happen by opening the bags and removing the bad assets, because enough people would have to be convinced that the clean-out is sufficiently complete, a monumental task as Morris and Shin's (2005) work suggests. Even after toxic assets had been bought, people would still be wondering about the quality of the remaining assets on the balance sheets of banks. The logic of debt suggests that this road is far too expensive in a setting where no institutional infrastructure exits for price discovery. Transparency would likely have made the situation worse.

Fortunately it was not the path the U.S. chose. Instead, the core of the banking system was recapitalized. The process was somewhat transparent, because a large enough share of the public had to be convinced that enough was added to the balance sheet to obviate the need to ask detailed questions. The stress tests, and the degree of transparency, were instrumental in gaining back the credibility.

The European stress tests in the summer of 2011 were not successful, partly because they did not consider the scenario of Greece defaulting which led to implausibly small recapitalization needs In response to this, detailed information about the balance sheets of banks were made available for review, so that investors could make their own judgments about the likelihoods and costs of a

Greek default. As one could have expected, transparency alone did nothing to calm markets. On the contrary, transparency may have led to the subsequent sustained increase in European sovereign spreads. In all fairness, Europe may not have had the funds to recapitalize the European banking system, but transparency without remedial actions is a prescription for disaster.

What did eventually calm the European money markets? Governor Draghi's statement "we will do whatever it takes – and you better believe it is enough". This is as opaque a statement as one can have. There were no specifics on how calm would be reestablished, but the lack of specific information is, in the logic presented here, a key element in the effectiveness of the message. So was the knowledge that Germany stood behind the message – an implicit guarantee that told the markets that there would be enough collateral. A detailed, transparent plan to get out of the crisis, including rescue funds, which were already there, might have invited differences in opinion instead of convergence in views.

Regular stress tests strike me as a very good idea. Should they be transparent or kept secret? Schuermann (2013) and Goldstein and Leitner (2011) provide insightful and comprehensive reviews of the pros and cons. Transparency can provide market discipline and give early warnings of trouble, but it may also lead to strategic behavior by management and it could potentially trigger a run, unless there are assurances that weaknesses have been covered. The question of market discipline is especially thorny. Based on theory alone, it seems impossible to know what the consequences will be. I would be most concerned that banks are sufficiently well capitalized and if not, that corrective actions have been taken. Whatever is needed to assure the public that this is the case seems of first-order importance. I am less convinced that market

discipline will be particularly effective. If one wants to try that route, I would not do it until the banking system is on a strong enough footing.

As these remarks suggest, I believe more in the virtues of increased capitalization and higher quality collateral than on increased transparency. An interesting piece of evidence that sheds some light on the benefits of capitalization comes from Gorton's (2008) observation that the 2005 vintage of an ABX index fared much better in the crisis than the 2006 vintage, because the former had twice as big a buffer for absorbing shocks. Apparently, the amount of collateral makes a difference. The evidence may also be telling that transparency does not make that much of a difference as long as there is enough collateral. But again, how much is enough, is hard to tell. This is why panics always surprise.

8. Concluding remarks

Perhaps the most interesting question is to what extent and in what way shadow banking will change the traditional channels of financial intermediation and how it should be brought into the fold of banking and regulated. Some see shadow banking as shady product of regulatory arbitrage. I believe this driver is small relative to the value that shadow banking creates by making more effective use of collateral, both in risk sharing (through derivatives markets) and in lending. Shadow banking is a substitute for traditional banking in some activities, especially those related to handling large movements of funds nationally and around the globe, where there continues to be a strong demand for safe assets that back up financial transactions. As has been noted by the ICMA (2014), collateral is the new cash that is manufactured and employed within the shadow banking system.

Does this mean that the ancient logic of pawning is about to be replaced? The growing enthusiasm for covered bonds could be a harbinger of what lies ahead. Covered bonds are quite transparent. Banks are obliged to report regularly and in detail on the cash flow and substitutions of assets in their asset pools. Market monitoring may become more prominent because of the scarcity of safe assets. At the most general level, financial intermediation substitutes collateral for information and conversely, depending on the situation. If overcollateralization is becoming more expensive, because there are fewer safe assets, while at the same time the cost of monitoring could be shrinking due to better information technologies, then more intensive monitoring would be a logical consequence. The trade-off between collateral based intermediation and information intensive intermediation has always been around, but the balance may be shifting. Is it temporary or permanent is very hard to predict.

Let me close by noting that I have said very little about systemic risk. I have explained why money markets function the way they do and that most of it makes perfect sense. The errors were not so much in the designs as they were in the implementation and scale. But as the unpleasant trade-off emphasized, there is a danger in the logic of money markets: if their liquidity relies on no or few questions being asked, how will one deal with the systemic risks that build up because of too little information and the weak incentives to be concerned about panics. I think the answer will have to rest on being transparent about some types of information: aggregate statistics, especially of gross characteristics such as volumes of trade and amounts of different types of assets on balance sheets. But my first priority has been to exposit the current logic and hope that it will be useful for the big question about systemic risk.

REFERENCES

Acharya, V, P. Schnabl and G. Suarez (2010). "Securitization without Risk Transfer," WP 15730, NBER.

Adelino, M. (2009). "Do Investors Rely Only on Ratings? The Case of Mortgage-Backed Securities," mimeo, Federal Reserve Bank of Boston.

Adrian, T. and H. S. Shin (2008), "Financial Intermediaries, Financial Stability and Monetary Policy," in *Maintaining Stability in a Changing Financial System.* Symposium sponsored by The Federal Reserve of Kansas City at Jackson Hole, Wyoming.

Akerlof, G. "The Market for "Lemons": Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics*, 84(3).

Benmelech, E. and J. Dlugosz (2010), "The Credit Rating Crisis," in *NBER Macroeconomics Annual 2009,* ed (D. Acemoglu, K. Rogoff and M. Woodford, eds). National Bureau of Economic Research.

Berger A., R.J. Herring, G.P. Szegö (1995), "The Role of Capital in Financial Institutions," *Journal of Banking and Finance*, 19: 393-430.

Breton R. (2007), "Monitoring and the Acceptability of Money," mimeo, CNRS.

Brunnermeier, M. (2009), "Deciphering the Liquidity and Credit Crunch 2007-08", *Journal of Economic Perspectives*, 2009, Vol. 23 (1): 77-100.

Caballero, R. and E. Farhi (2013), "A Model of Safe Asset Mechanism (SAM). Safety Traps and Economic Policy." Working paper, MIT.

Caplin A. and J. Leahy (1994), "Business as Usual, Market Crashes, and Wisdom after the Fact," *American Economic Review*, 84(3).

Copeland A., A. Martin and M. Walker (2010), "The Tri-Party Repo Market Before the 2010 Reforms," Staff Report 477, Federal Reserve Bank of New York.

Copeland A., A. Martin and M. Walker (2014), "Repo Runs: Evidence from the Tri-Party Repo Market," Staff Report 506, Federal Reserve Bank of New York.

Coval, J. D., J. Jurek and E. Stafford (2009), "The Economics of Structured Finance," *Journal of Economic Perspectives*, Vol 23 (1): 3-25.

Covitz D, N. Liang, and G. Suarez (2013), "The Evolution of a Financial Crisis: Collapse of the Asset-Backed Commercial Paper Market," *Journal of Finance*, 68(3):815-48.

Dang T-V., G. Gorton and B. Holmstrom (2011), "Ignorance, Debt and the Financial Crisis," mimeo, Yale University.

Dang T-V., G. Gorton, B. Holmstrom and G. Ordonez (2014), "Banks as Secret Keepers," mimeo, Yale University.

DeMarzo P, I. Kremer and A. Skrzypacz (2005), "Bidding with Securities: Auctions and Security Design," *American Journal of Economics*, 95(4): 936-958.

European Repo Council (2014). "Collateral is the New Cash: The Systemic Risks of Inhibiting Collateral Fluidity," memorandum, International Capital Market Association.

Flannery, M. S. Kwan and M. Nimalendran (2004). "Market Evidence on the Opaqueness of Banking Firms' Assets," *Journal of Financial Economics*, 71:419-460.

Flannery, M. S. Kwan and M. Nimalendran (2013). "The 2007-2009 Financial Crisis and Bank Opaqueness," *Journal of Financial Intermediation*, 22:55-84.

Gale, D. and M. Hellwig (1985), "Incentive Compatible Debt Contracts: The One-Period Problem," *Review of Economic Studies*, 52(4): 647-663.

Geanakoplos, J. (1996), "Promises, Promises," DP 1143, Cowles Foundation, Yale University.

Geanakoplos, J. (2010), "The Leverage Cycle," in *NBER Macroeconomics Annual 2009,* ed (D. Acemoglu, K. Rogoff and M. Woodford, eds). National Bureau of Economic Research.

Genesove, D. (1993), "Adverse Selection in the Wholesale Used Car Market," *Journal of Political Economy*, 101 (4): 644-665.

Gilson R. and R. Kraakman (2014) "Market Efficiency After the Financial Crisis: It's Still a Matter of Information Costs," *Virginia Law Review* (forthcoming).

Goetzmann W. and G. Rouwenhorst (2005), *The Origins of Value.* Oxford: Oxford University Press.

Goldstein, I. and H. Sapra (2013). "Should Banks' Stress Tests Be Disclosed? An Analysis of the Costs and Benefits," mimeo, The Wharton School, University of Pennsylvania.

Gorton, G. (2008), "The Panic of 2007," in *Maintaining Stability in a Changing Financial System.* Symposium sponsored by The Federal Reserve of Kansas City at Jackson Hole, Wyoming.

Gorton, G. (2013). “The Development of Opacity in the U.S. Banking,” *Yale Journal of Regulation*. Forthcoming, Yale University.

Gorton G. and Mullineaux (1987), “The Joint Production of Confidence: Endogenous Regulation and Nineteenth Century Commercial-Bank Clearinghouses,” *Journal of Money, Credit and Banking*, Vol 19 (4): 457-68.

Gorton G. and G. Pennacchi (1990), “Financial Intermediaries and Liquidity Creation,” *Journal of Finance*, Vol 45 (1): 49-71.

Gorton G. and G. Ordonez (2014), “Collateral Crises,” *American Economic Review*, 104(2): 343-78.

Gorton G. and G. Pennacchi (1993), “Security Baskets and Index-Linked Securities,” *Journal of Political Economy*, Vol 66 (1): 1-27.

Hart O. and J. Moore (1995), “Debt and Seniority: An Analysis of the Role of Hard Claims in Constraining Management,” *American Economic Review*, 85(3): 567-85.

Hirschleifer, J. (1971), “The Private and Social Cost of Information and the Reward to Inventive Activity,” *American Economic Review*, 61 (4): 561-574.

Holmstrom, B. (2008), “Discussion of ‘The Panic of 2007’ by Gary Gorton,” in *Maintaining Stability in a Changing Financial System.* Proceedings of the 2008 Jackson Hole Conference, Federal Reserve Bank of Kansas City.

Holmstrom, B (2010), “Discussion of “The Credit Rating Crisis,” by E. Benmelech and J Duglosz, in *NBER Macroeconomics Annual 2009,* ed (D. Acemoglu, K. Rogoff and M. Woodford, eds). National Bureau of Economic Research.

Holmstrom, B and J. Tirole (1997) "Financial Intermediation, Loanable Funds and the Real Sector," *Quarterly Journal of Economics*, 112(3).

Holmstrom, B and J. Tirole (1998) "Private and Public Supply of Liquidity," *Journal of Political Economy*.

Krishnamurthy, A, S. Nagel and D. Orlov (2013). “Sizing Up Repo,” Working paper, Kellogg School of Management, Northwestern University.

Mayer, C. (1990), “New Issues in Corporate Finance,” in G. Hubbard ed. *Asymmetric Information, Corporate Finance and Investment*. Chicago: University of Chicago Press.

Kaplan, T (2006). “Why Banks Should Keep Secrets,” *Economic Theory*, 27:341-357.

Kashyap, A, R. Rajan and J. Stein (2002). “Banks as Liquidity Providers: An Explanation of the Coexistence of Lending and Deposit Taking,” *Journal of Finance*, 57: 33-73.

Milgrom P. and J. Roberts (1992), *Economics, Organization and Management.* Englewood Cliffs, New Jersey: Prentice Hall.

Milgrom P. and R. Weber (1982). "A Theory of Auctions and Competitive Bidding," *Econometrica,* 50 (5): 1089-1122.

Monnet, C. and E. Quintin (2013). "Rational Opacity," Working Paper, Wisconsin School of Business.

Morris S. and H. Shin (2005), "Central Bank Transparency and the Signaling Value of Prices," *Brookings Institution.*

Morris S. and H. Shin (2007), "Optimal Communication," *Journal of the European Economic Association,* 5(2-3): 594-602.

Morris S. and H. Shin (2012), "Contagious Adverse Selection," *American Economic Journal: Macroeconomics,* 4(1): 1-21.

Pagano M. and P. Volpin (2012), "Securitization, Transparency and Liquidity," *Review of Financial Studies,* 25(8): 2417-2453.

Perihan, I, A. Reichert and D. Gramlich (2014). "Does Bank Transparency Matter?" *Banks and Bank Systems,* Vol 9 (1): 75-93.

Perraudin, W. and S. Wu (2008). "Determinants of Asset-Backed Security Prices in Crisis Periods," Research Paper 8/3, RiskControl, London, U.K.

Potzsar, T, T. Adrian, A. Aschcraft, and H. Boesky (2010). "Shadow Banking," Staff Report 458, Federal Reserve Bank of New York.

Schuermann, T. (2014). "Stress Testing Banks," *International Journal of Forecasting,*" forthcoming.

Shin, H. (2012). "Global Banking Glut and Loan Risk Premium," 2011 Mundell-Fleming Lecture, IMF.

Stanton, R. and N. Wallace (2011), "The Bear's Lair: Indexed Credit Default Swaps and the Subprime Mortgage Crisis," *Review of Financial Studies,* 24.

Stigum, M. (1989), *The Money Market*. New York: Dow Jones-Irwin.

Figure 1: Debt and information sensitivity

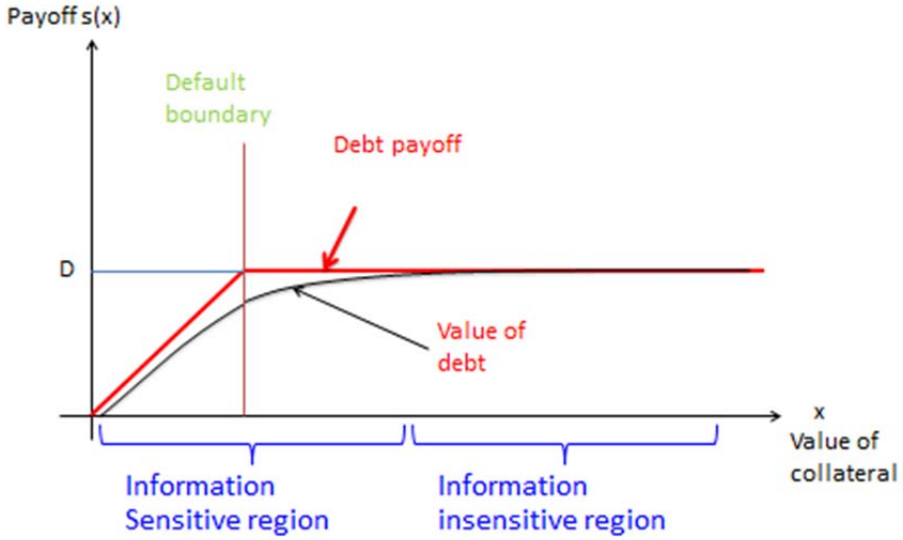
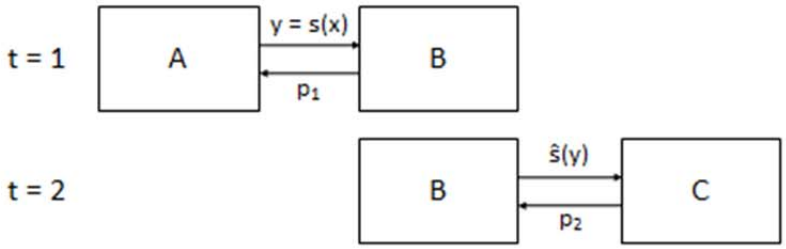


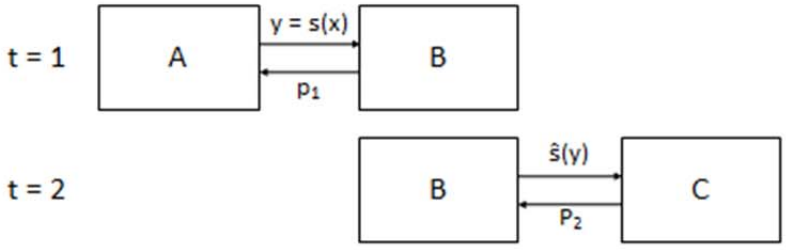
Figure 2a: Trading game



Information
t = 1 : Symmetric information. Distribution of x is F(x)
t = 1.5 : Public information z arrives → F(x|z)
t = 2 : Agent C can learn x **at cost c** before accepting contract
(Interpretation: lower **c** = higher transparency)

Dang, Gorton, Holmstrom (2013)

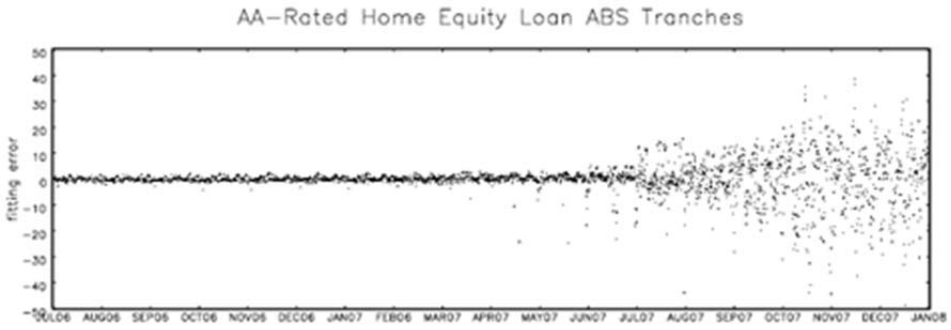
Figure 2b: Debt on debt is optimal



t = 1: A sells debt tranche to B for $p_1 = w$

t = 2: (i) Good news. B resells tranche to C
(ii) Bad news case I: B resells tranche to C worth $p_2(z) < p_1$
(iii) Bad news case II: B cannot sell all of debt to C, because it would trigger information acquisition. Double whammy.
(iv) Bad news case III: Adverse selection. Limited trade.

Figure 3: Residuals of prices of AA Home Equity Loan tranches Aug 2006-Jan 2008



Perraudin-Wu (2008)

Figure 4: ABX Spreads (Stanton-Wallace, 2011)

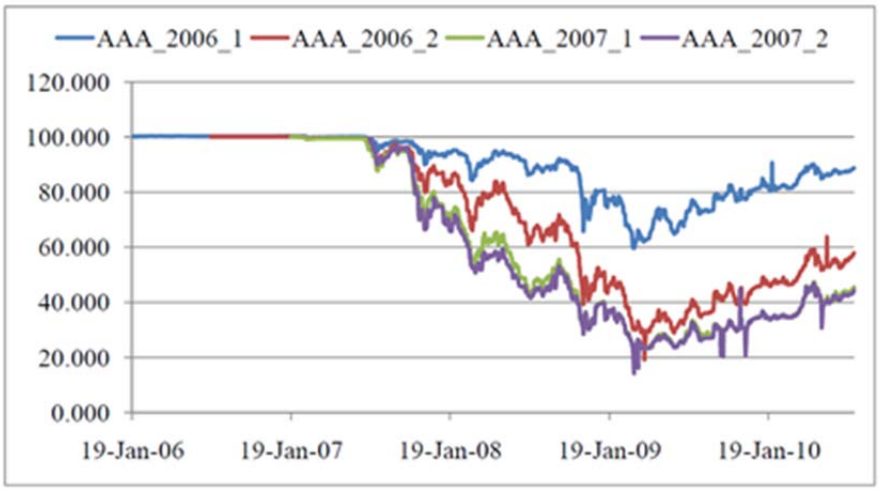


Figure 5: ABX spreads by class Jan 07 – Apr 08 (Gorton, 2009)

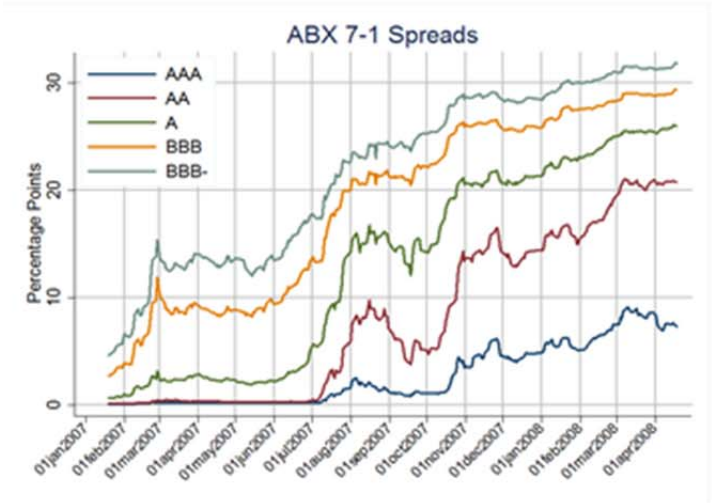
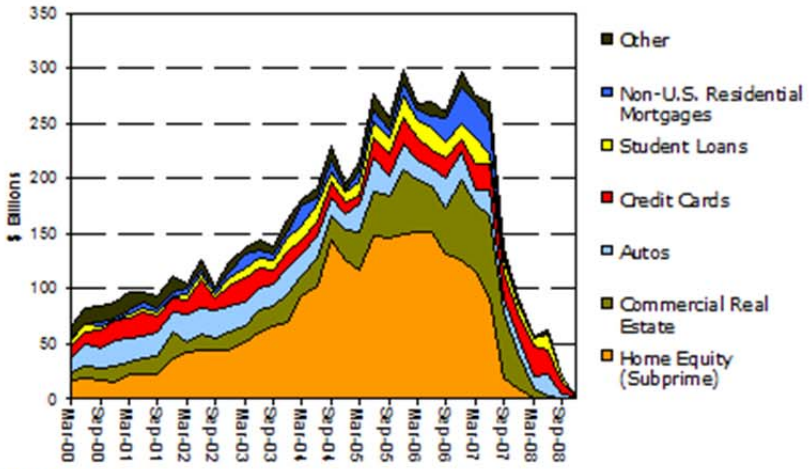
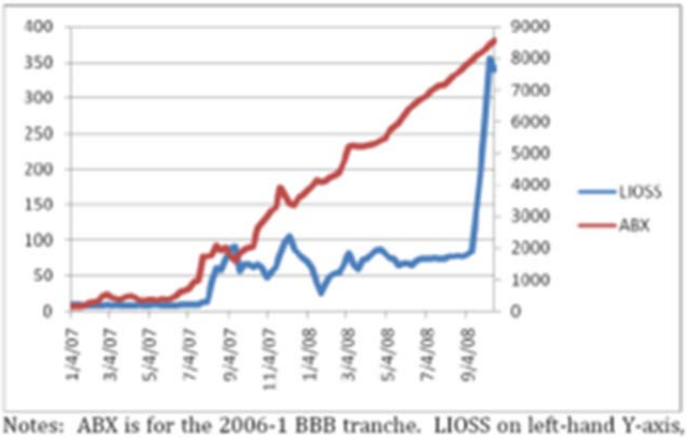


Figure 6: New Issuance of Asset Backed Securities (previous three months)



Source: JP Morgan

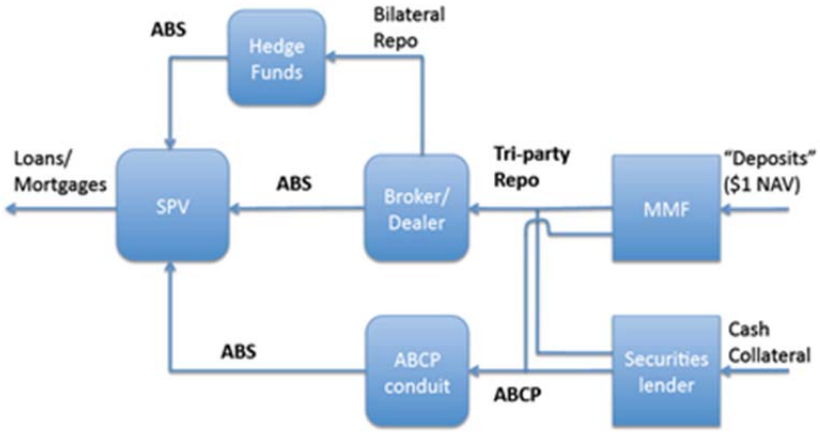
Figure 7: ABX aggregate (BBB tranche) versus LIOS spread



Notes: ABX is for the 2006-1 BBB tranche. LIOSS on left-hand Y-axis, ABX spreads on right-hand y-axis.

Source: Gorton (2009)

Figure 8: Intermediation in shadow banking



Krishnamurthy, Nadel and Orlov (2011)