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Debt and optimal opacity in money markets

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"If I owe you a pound, I have a problem;

but if I owe you a million, the problem is yours."

John Maynard Keynes

Abstract

Il mercato azionario e il mercato monetario si basano su concetti molto diversi. Mentre il primo ha come obiettivo la scoperta del prezzo in modo da rendere ottimale l'allocazione del rischio, il secondo tende ad ovviare la scoperta del prezzo utilizzando il debito come collaterale per ridurre il costo del credito indirizzato ad approvvigionare liquidità nel sistema finanziario. L'obiettivo di questo elaborato è di descrivere una prospettiva teorica sulla logica dei mercati monetari e la struttura dei contratti di debito, evidenziando le caratteristiche di ottimalità di quest'ultimo. La teoria sostiene che il debito è ottimale per l'approvvigionamento di liquidità ed è anche ottimale usarlo come collaterale per coprire il debito. Quando il debito viene utilizzato come garanzia per un altro contratto di debito, il cosiddetto "debito-su-debito", la simmetria informativa è conservata e la liquidità nel mercato monetario è massima. Questo accade perché il debito è la garanzia meno sensibile all'informazione e riduce al minimo gli incentivi a produrre informazioni private sugli payoff. Nonostante sia ottimale, il debito non è privo di rischio. Una scossa esterna sui mercati finanziari, capace di innescare dubbi tra gli agenti sul valore del collaterale (nel nostro caso debito), può causare selezione avversa. A questo punto gli agenti, per evitare i rischi, tendono a ridurre la quantità di credito negoziata. Di conseguenza lo shock viene amplificato e il risultato è la crisi finanziaria (Dang, Gorton, Holmstrom 2009).

Stenzel & Wagner (2015) dimostrano che la correlazione tra trasparenza e liquidità nei mercati monetari non è monotonica. Quest'affermazione è contraria all'opinione comune, che di solito si aspetta una correlazione positiva. Gli stessi autori affermano che il mercato monetario non ha bisogno di trasparenza, ma di simmetrie informative tra gli agenti. Per questo motivo le politiche economiche che intendono a aumentare la trasparenza tendono a diminuire la liquidità nel mercato.

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To Mom, Dad and Sister for their unconditional support and encouragement,

to my love Maria Francesca for being close in every of moment of my life,

to professors from University of Padua for guidance and professional insights,

to everybody who has been part of my life's journey and helped me to build a dream.

Thank You!

Introduction

Debt was the first form of commerce (barter system) documented in human history and existed about 2,900 years prior to the invention of coinage (Graeber 2011). Today there are many examples of lenders of monetary debt that include sovereign nations, banks, credit card companies, payday loan providers, individuals, etc., who in many instances subject their borrowers to contractual terms that designate the amount and timing of repayments of the debt and that frequently include the payment of principal and interest.

Anthropologist David Graeber in his award winning book ''Debt: The First 5000 Years'' writes that the difference between a debt and an obligation is that the former is quantified and needs some form of money. Money and debt arrived on the historical scene together, and "the easiest way to understand the role that debt has played in human society is simply to follow the forms that money has taken, and the way money has been used, across the centuries." For Graeber, when money first appeared its primary purpose was to act as a unit of account, to denominate debt. He writes that coins were originally created as tokens which represented a unit of account rather than being an amount of precious metal which could be bartered. The conception that money is essentially equivalent to credit or debt has long been used by those advocating particular reforms of the monetary system, and by commentators calling for various monetary policy responses to events such as the Financial crisis of 2007–08. Debt refers to something that is owed or due either physically or metaphorically. In the physical sense, the parties to debt are lenders (those who give) and borrowers (those who receive). In the metaphorical sense, debt refers to a moral obligation not based on physical value (Graeber 2011).

Nowadays debt market is a bigger source of borrowed funds than the banking system. The market for debt is larger than the market for equities (larger than the stock market). By dollar volume the largest category of the debt market in the United States is in Mortgage-Backed Securities (MBSs), followed by corporate bonds, federal treasury securities, money market instruments, Government Sponsored Enterprises (GSEs) and municipal bonds, in that order. About half the US national debt is in Treasury Department securities, while the other half represents inter-governmental borrowings, notably money borrowed by the Treasury Department from the Social Security trust fund, which is in excess of one trillion dollars (Cook and LaRoche 1998).

The debt market is commonly divided into the so-called money market (short-term debt, maturity of one year or less) and the so-called capital market (long-term debt). Both of these terms are misnomers. All productive assets are capital (including equities). The terminology may be rationalized by the convention that capitalized expenses are amortized over periods in excess of one year. "Money market" instruments are debt and although they can be used as a store of value they can only be regarded as a medium of exchange in the sense that they are readily sold at a price which is usually predictable within a short time frame (Cook and LaRoche 1998).

According to the same authors, in funding markets investors trade hundreds of millions or even billions of dollars very quickly without the need to conduct due diligence about the value of the security. Prime examples are Treasuries, repos, asset backed commercial papers (ABCP), Agency mortgage-backed securities (MBS) and money market fund (MMF) shares. Investors trade these debt instruments so as to manage their cash balances and short term liquidity needs. For a long time period these short term debt funding markets had been working very well. Therefore, the sudden breakdown of several types of these markets during the recent financial crisis came as a big surprise and raises several questions about how debt funding markets are functioning. Understanding the nature of liquidity provisions for financial institutions and corporations is central for the regulation of the banking and financial system. A key characteristic of debt trading in funding markets is that investors trade debt instruments which use other debt contracts as collateral. ABCP is debt that is backed by commercial papers which are debt. MBS is debt and backed by a pool of mortgages which is debt. Repo is a debt contract that uses other debt instruments as collateral. Institutional investors can write checks (a debt claim) backed by MMF shares (portfolio of highly rated debt).

This thesis focuses on a theory of funding markets by Holmstrom, Dang and Gorton (2009) that explains the optimality of debt-on-debt, a theory which has not been the focus in policy discussions but it is a central aspect of trade in funding markets. The theory also shows that a collapse of trade in debt funding markets (financial crisis) is a discontinuous event and occurs when public news about fundamentals make investors "suspicious" about the value of the debt collateral that backs the tradable debt. The recent financial crisis has been blamed in part on the complexity and opacity of financial instruments, leading to calls for more transparency. On the contrary, the theory shows that symmetric ignorance creates liquidity in funding markets. Furthermore, the theory shows that the public provision of information that is imperfect can trigger the production of private information and create endogenous adverse selection. Agents can most easily trade when it is common knowledge that no one knows anything privately about

the value of the security used to transact and no one has an incentive to conduct due diligence about the value of the security. Debt backed by debt-collateral has this property. (Holmstrom, Dang and Gorton 2009).

Chapter I – An overview of markets for liquidity provision

1.1 The Money-market and its purpose

The major purpose of financial markets is to transfer funds from lenders to borrowers. Financial markets participants commonly distinguish between the "capital market" and the "money market," with the latter term generally referring to borrowing and lending for periods of a year or less. According to Cook and LaRoche (1993) the money market is very efficient in that it enables large sums of money to be transferred quickly and at a low cost from one economic unit (business, government, bank, etc.) to another for relatively short periods of time. The need for a money market arises because receipts of economic units do not coincide with their expenditures. These units can hold money balances—that is, transactions balances in the form of currency, demand deposits, or NOW accounts—to insure that planned expenditures can be maintained independently of cash receipts. Holding these balances, however, involves a cost in the form of foregone interest. To minimize this cost, economic units usually seek to hold the minimum money balances required for day-today transactions. They supplement these balances with holdings of money market instruments that can be converted to cash quickly and at a relatively low cost and that have low price risk due to their short maturities. Economic units can also meet their short-term cash demands by maintaining access to the money market and raising funds there when required. Money market instruments are generally characterized by a high degree of safety of principal and are most commonly issued in units of $1 million or more. Maturities range from one day to one year; the most common are three months or less. Active secondary markets for most of the instruments allow them to be sold prior to maturity. Unlike organized securities or commodities exchanges, the money market has no specific location. It is centered in New York for United States and London for Europe, but since it is primarily a telephone market it is easily accessible from all parts of the nation as well as from foreign financial centers (Cook and LaRoche 1993).

The money market encompasses a group of short-term credit market instruments, futures market instruments, and central banks discount windows. The major participants in the money market are described in Table 1 (Cook and LaRoche 1993).

The Money Market

Instrument	Principal Borrowers
Federal Funds	Banks
Discount Window	Banks
Negotiable Certificates of Deposit (CDs)	Banks
Eurodollar Time Deposits and CDs	Banks
Repurchase Agreements	Securities dealers, banks, nonfinancial corporations, governments (principal participants)
Treasury Bills	U.S. government
Municipal Notes	State and local governments
Commercial Paper	Nonfinancial and financial businesses
Bankers Acceptances	Nonfinancial and financial businesses
Government-Sponsored Enterprise Securities	Farm Credit System, Federal Home Loan Bank System, Federal National Mortgage Association
Shares in Money Market Instruments	Money market funds, local government investment pools, short-term investment funds
Futures Contracts	Dealers, banks (principal users
Futures Options	Dealers, banks (principal users
Swaps	Banks (principal dealers)

Table 1: Money markets participants

1.2 A focus on Repo Agreements

An important instrument used by the banks in the money market is the Repo Agreement. The terms repurchase agreement (repo or RP) and reverse repurchase agreement refer to a type of transaction in

which a money market participant acquires immediately available funds by selling securities and simultaneously agreeing to repurchase the same or similar securities after a specified time at a given price, which typically includes interest at an agreed-upon rate. Such a transaction is called a repo when viewed from the perspective of the supplier of the securities (the party acquiring funds) and a reverse repo or matched sale-purchase agreement when described from the point of view of the supplier of funds. In general, whether a given agreement is termed a repo or a reverse depends largely on which party initiated the transaction. The use of margin or haircuts in valuing repo securities, the right of repo borrowers to substitute collateral in term agreements, and the use of mark-to-market provisions are examples of repo features that typically are characteristics of secured lending arrangements but are rarely found in outright purchase and sale transactions. The repo buyer's right to trade the securities during the term of the agreement, by contrast, represents a transfer of ownership that typically does not occur in collateralized lending arrangements (Cook and LaRoche 1993).

Although most repo transactions involve the exchange of Treasury and federal agency securities, including mortgage-backed pass-through securities, and other instruments with real or perceived low credit risk, the agreements themselves are not risk-free. RPs, especially longer-term contracts, entail both interest rate risk and credit risk, which must be taken into account when an RP contract is negotiated. Typically, the securities used as collateral are valued at the current market price, plus accrued interest calculated to the maturity date of the agreement when coupon-bearing issues are used, less a margin of overcollateralization or "haircut" for term agreements (Cook and LaRoche 1993).

1.3 The difference between Money Markets and Stock Markets

The near-universal calls for pulling the veil off money market instruments and making them transparent reflect a serious 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 (Holmstrom 2015).

The key point of this analysis is that these two markets are built on two entirely different, diametrically opposite, logics. Ultimately this is because they serve two very different purposes. Stock markets are in the first instance aimed at sharing and allocating aggregate risk. To do that effectively requires a market

that is good at price discovery. The price discovery doesn't mean that the market has to discover the true fundamentals – we will never observe whether that is the case. It means the same as the Efficient Market Hypothesis (EMH) 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. 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 (Holmstrom 2015).

The contrast between money markets and stock markets, showed in the Table 2 below, describes how different they are in many respects.

Stock markets	**Money markets**
Risk sharing	Liquidity provision/lending
Price discovery	Obviating price discovery
Information sensitive	Information insensitive
Transparent	Opaque
Big investments in info	Modest investments in info
Many traders (exchanges)	Few traders (bilateral)
Trading not urgent	Trading urgent
Volatile volume	Stable volume

Table 2: The differences between two markets

1.3.1 Stock markets

A substantial literature establishes a link between transparency and liquidity in stock markets. For example, Lang, Lins and Maffett (2011) examine the relation between firm-level transparency, stock market liquidity, and valuation across countries, focusing on whether the relation varies with a firm's characteristics and economic environment. The authors document lower transaction costs and greater liquidity (as measured by lower bid-ask spreads and fewer zero-return days) for firms with greater

transparency (as measured by less evidence of earnings management, better accounting standards, higher quality auditors, more analyst following, and more accurate analyst forecasts). The positive relation between transparency and liquidity is more pronounced in periods of high volatility, when investor protection, disclosure requirements, and media penetration are poor, and when ownership is more concentrated, suggesting that firm-level transparency matters more when overall investor uncertainty is greater. Increased liquidity is associated with lower implied cost of capital and with higher valuation. Finally, a mediation analysis suggests that liquidity is a significant channel through which transparency affects firm valuation and equity cost of capital (Lang, Lins and Maffett 2011).

1.3.2 Money markets

The characteristics of markets for liquidity provision, as mentioned in Table 2, are different from that of the stock markets. Money markets trade in debt claims that are backed, explicitly or implicitly, by collateral. If the collateral is used for trading in repo markets, for instance, is itself debt, and price discovery is going to be even more difficult. By design, there is 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 (2009) 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 (Holmtrom 2015).

The banking industry is famous for its ability to build opaque products. Sato (2014) argues that the opacity price premium incentivizes financial engineers to render transparent assets opaque deliberately. Indeed, after the subprime mortgage crises many economists blamed the industry saying that less transparency was essential for hiding profits and deceiving investors. However, is hard to believe that obfuscation was the main purpose in building complex structured products. Less transparency is a beneficial feature because it increases the liquidity, which is essential in money markets. To proof that let's take a closer look at recent subprime mortgage crisis. Billions of AAA subprime tranches were issued and traded in repo and other parts of the money markets before the summer of 2007. Prior to the crisis, market participants viewed AAA-rated asset-backed securities as a safe investment, nearly indistinguishable from a Treasury bond. In the early stages of the crisis, investors started to recognize that some of these securities were likely to pay less than face value. Moreover, it was difficult to determine the exact assets that backed each individual security. Anticipating that she might later have to sell it, the owner of an asset has an incentive to learn its quality. On the other hand, it may not have been

profitable for potential buyers to investigate the quality of all possible assets because they did not know which assets would later be for sale. Moreover, the price that buyers are willing to pay for a high quality asset will be depressed because the market is less liquid. That is, even if a buyer somehow understood that a particular asset would pay the promised dividends with certainty, he would pay less for it because he would anticipate having trouble reselling it to future buyers who don't have his information. Illiquidity therefore further depresses asset prices. In particular, seller's knowledge of the quality of their assets depresses their liquidity and may depress the value of all securities even if the average quality is unchanged (Guerrieri & Shimer 2012).

This explains why liquidity don't require transparency. Liquidity requires symmetric information about the payoff of the security that is being traded so that adverse selection does not impair the market.

"Liquidity", in the described theory, means the ability to trade a given amount quickly without the transaction moving prices, and without an uninformed party losing money to a privately informed party. Akerlof (1970) shows that private information complicates the process of trading, reducing liquidity. Such asymmetric information means adverse selection, which reduces trade, possibly such that the market disappears (Holmstrom 2015).

Symmetric information facilitates trade. One form of symmetric information is symmetric ignorance.

In a trading context welfare is highest under symmetric ignorance. Debt optimally facilitates trade because debt provides the smallest incentive for private information production, which creates adverse selection. Even if there is adverse selection in the market, debt maximizes the amount of trade at the lowest cost to the uninformed. Finally, debt's value is least sensitive to public signals. But, for the economy as a whole there is a systemic risk: an aggregate shock, if bad enough, can be made worse by triggering private information production, causing adverse selection when debt becomes information-sensitive (Dang, Gorton and Holmstrom 2012). This happens when systemic ignorance is broken by public information that makes some traders' private information relevant. Pagano and Roell (1996) argue that expert traders who can interpret publicly released information better than the average trader may gain an informational advantage that results in adverse selection and reduced liquidity.

Chapter II – Optimality of opacity and debt in money markets

2.1 Optimal opacity and correlation with liquidity

Opacity and illiquidity are two central concepts in economics. They are, however, rarely distinguished from each other. Both arise from incompleteness of information. An asset is said to be opaque when there is a common lack of knowledge about its pay-offs. By contrast, when some agents know more than others about an asset, the asset tends to be illiquid because of adverse selection problems. The difference between opacity and illiquidity thus boils down to whether the incompleteness of information is of a public or private nature. How can the two be related? At first, one would expect a positive link between opacity and illiquidity. When there is more opacity, there is more scope for agents having different information sets. Adverse selection should then be more pronounced and liquidity be low. This reasoning is consistent with common thinking among policy makers that transparency is beneficial for the financial system: more public information should deter wasteful private acquisition of information and also reduce the potential for asymmetries among investors. This argumentation, however, ignores the fact that private information is endogenous (Bhave 2014).

Gathering it is costly, hence it has to be profitable for investors to acquire it. The relationship between opacity and liquidity will thus depend on the scope for private information as well as on the incentives to acquire such information. It is not obvious why the value of information should be higher for opaque assets. Casual observation also throws doubt on an exclusively positive link between opacity and illiquidity. Many spreads opaque assets are frequently traded and have low bid-ask. A case in point is the banking industry. Banking is considered a very opaque business. Nonetheless, the major banks are heavily traded and their stocks display high liquidity. For a completely transparent asset, there is no scope for private information. Such an asset trades without an adverse selection discount and hence is liquid. At the other extreme, for a very opaque asset the scope for private information is maximal. At the same time, however, the incentives to acquire information are low. The reason is that acquiring knowledge about a certain number of states is then less valuable as these states constitute a smaller share of the overall number of opaque states. For a sufficiently high level of opacity, it can be shown that it is never optimal to acquire any information (Stenzel & Wagner 2015). Complete symmetry of information

is preserved and the asset is liquid. At intermediate values of opacity, however, the investor always acquires information and there is adverse selection.

So, how does opacity affect liquidity when investors can acquire information about an asset? The paper from Stenzel and Wagner (2015) has suggested that the link between the two is non-monotonic. Both very transparent and very opaque assets preserve commonality of information. While full transparency directly precludes information asymmetries, sufficiently large opacity deters acquisition of private information by making learning about an asset more costly. Assets with either very low or very high opacity can hence be expected to be liquid. Assets which display intermediate degrees of opacity, in contrast, are prone to information acquisition. These assets may suffer from adverse selection problems when they need to be traded. An empirical analysis of the cross-section of listed U.S. firms strongly supported a hump shape relationship between opacity and illiquidity. Figure 1 summarizes the relationship using analyst dispersion as a proxy for opacity and the bid-ask spread as a proxy for illiquidity (Stenzel and Wagner 2015).

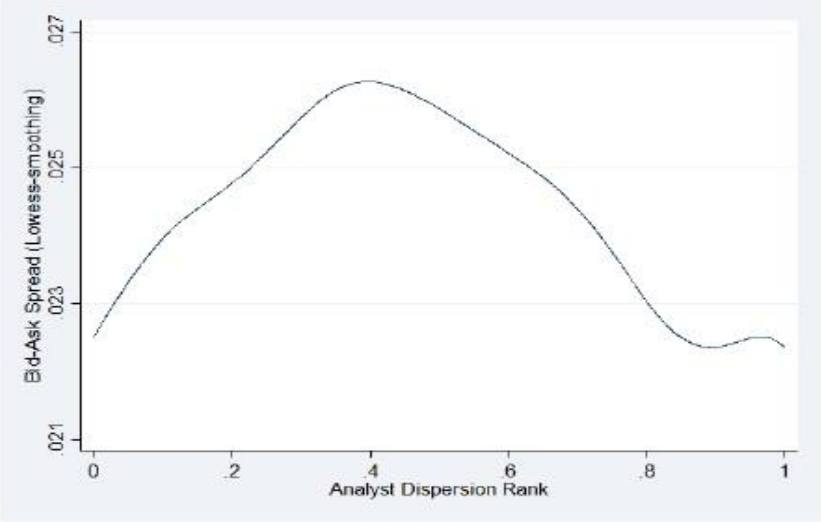


Figure 1: Relationship between Firm Opacity and Illiquidity [1]

Figure 2 shows equilibrium information acquisition $a^*(o)$ as a function of an asset's opacity o. At $o = 1$, the asset is fully transparent and it is not possible to acquire information ($a^* = 0$). For values of o between

[1] Source: Stenzel & Wagner 2015

l and $\bar{o}$, the maximum feasible amount of information is acquired ($a^* = o - l$). In this range, opacity increases information acquisition, as higher opacity increases the feasible amount. Beyond $\underline{o}$, however, opacity reduces information acquisition. This is until $\bar{o}$ is reached, at which point no information is acquired. While in the figure we have that $\bar{o} < 1$, this is not necessarily always the case.

If not, information will be acquired even at full opacity. What is the reason why opacity can deter information acquisition? When opacity is high, the public set is large and becomes less informative about payoffs. It means that learning about a given number of states in the public set becomes less valuable for the investor as the investor benefits from private information by selling to the market in cases where the asset is worthless (Stenzel & Wagner 2015).

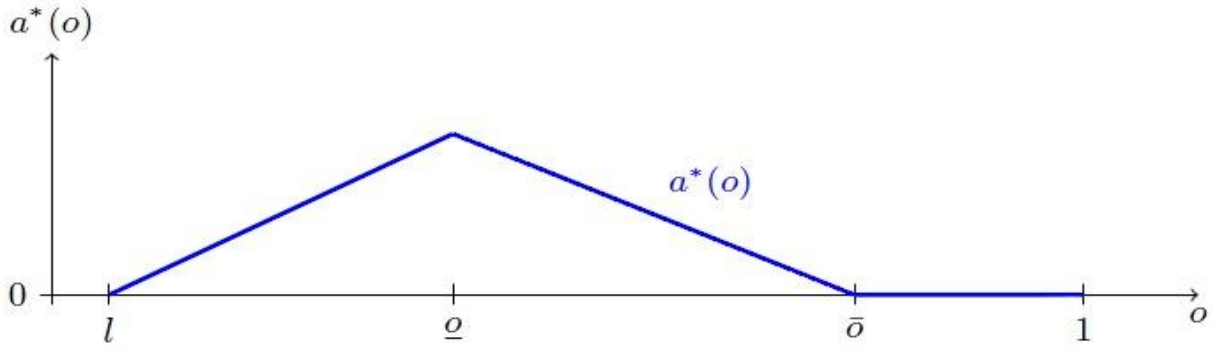


Figure 2: Information acquisition as a Function of o[2]

The non-monotonic impact of opacity on information acquisition translates also into a non-monotonic impact on liquidity as well as welfare. This is, first, because information acquisition always lowers liquidity, and second, because information acquisition is the only source of welfare losses in the model (Stenzel & Wagner 2015).

The authors analysis points to a significant benefit to opacity, which may help understand the phenomenon that issuers often choose to sell surprisingly opaque assets, as for instance observed in the case of securitization products. Policy makers thus have to be careful in equating opacity with inefficiencies. The results also have implications for transparency regulation. In particular, their analysis suggest that uniform transparency requirements are not desirable. This is simply because they may increase adverse selection for the more opaque assets in the economy. Rather, a more appropriate policy is to subsidize the provision of information by issuers. This can help internalizing the externalities

[2] Source: Stenzel & Wagner 2015

associated with opacity, while allowing issuers to optimally preserve heterogeneous transparency levels (Stenze & Wagner 2015).

2.2 The hockey stick model

According to Dang, Gorton, and Holmstrom (2015) trading in debt that is sufficiently over-collateralized is a cheap way to avoid adverse selection. Suppose Agent B (the buyer) must decide to buy the bond $(p=w, D)$ or not. If he knows the true value of the payoff, x, then he does not buy the bond in states where $x<w$ because his payoff *is* $s(x)=x<w$. Since the debt contract has slope one in this region of states, the buyer receives the maximum amount of repayment that is possible, there exists no other contract that has a smaller set of states that are information-sensitive. The Figure 3 below depicts the debt contract (the dark blue line). The set of states where information has value to the buyer is denoted by Q_B^D. It is easy to see that $Q_B^D \subseteq Q_B^S$ for all $s \in S$.

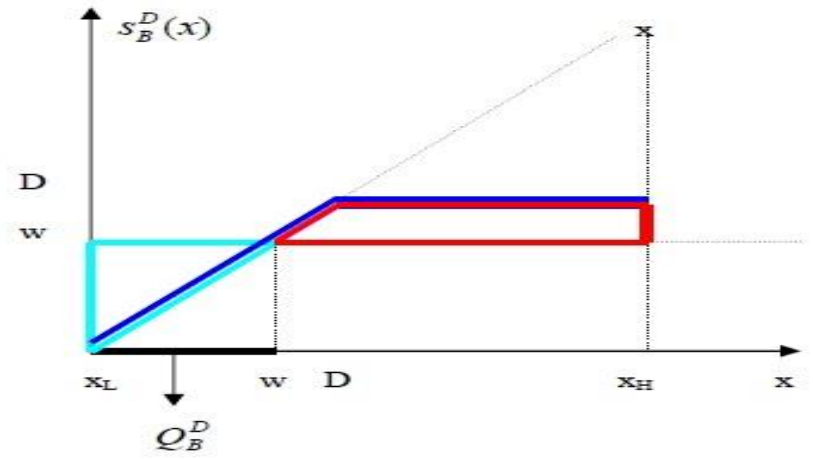


Figure 3: The hockey stick model[3]

The value of information to the buyer is that he avoids overpaying $p=w$, when the realization of x is less than that, $x<p$. The seller of the security, agent A, benefits from being informed to the extent that

[3] Source: Dang and Gorton (2009)

he avoids paying back too much when the realization of x is larger than w. In the states where $x<w$, the buyer must be compensated for his low payoff (the light blue triangle, evaluated with the density f(x)), with larger payoffs than w in states $x>w$ (the red area). The expected payoffs in these high states are exactly the states where information has value to the seller (Dang, Gorton and Holmstrom 2015).

Figure 4 compares the payoff on debt to three other securities. The figure shows the payoff to an equity contract, in panel (a), the payoff on levered equity in panel (b); and another least information-sensitive, debt-like, contract is shown in panel (c). In panel (a) the red triangle is the area where equity is more information-sensitive than debt. In panel (b) the information-sensitive area is the rectangle spanned by w and d and evaluated with the density is the value of information. In panel (c) the payoff is non-monotonic, compared to the flat payoff on standard debt (Dang, Gorton and Holmstrom 2015).

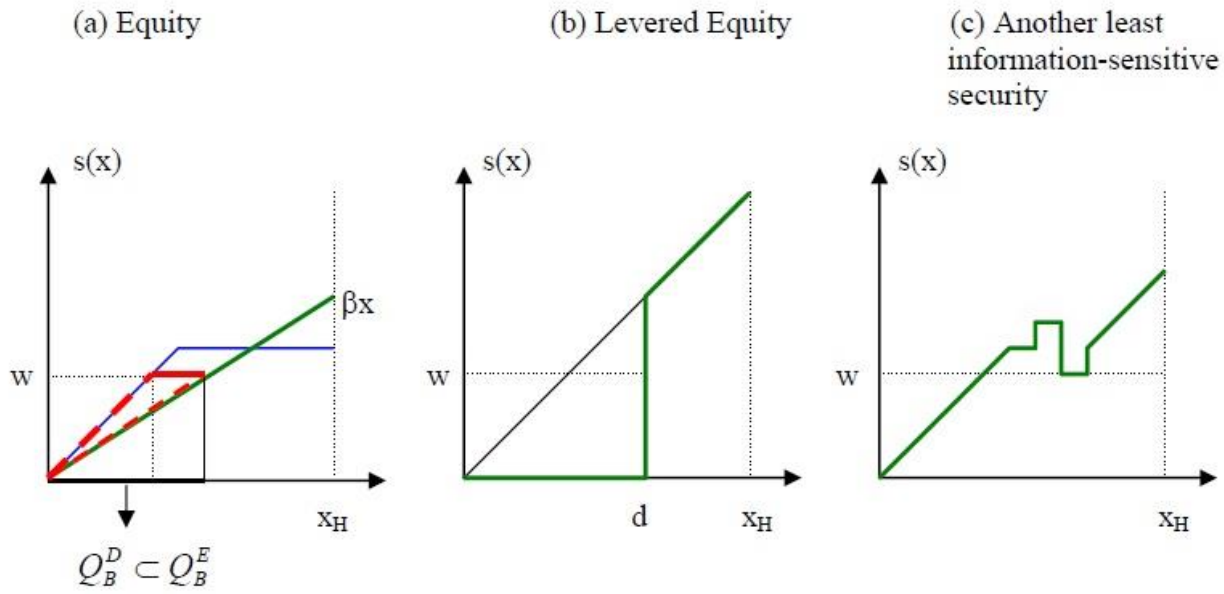


Figure 4: Payoff on debt off 3 different securities[4]

[4] Source: Dang and Gorton (2009)

After this analysis Dang, Gorton and Holmstrom (2009) conclude that in markets where agents want to prevent asymmetric information from arising, debt is the optimal trading security. In other words, if the trading of debt triggers information acquisition, then so does the trade of any other security with the same expected value (or price). When both parties know that in the process is enough collateral, more precise private information about the collateral becomes irrelevant and will not impair liquidity. The same logic underlies structured products in money markets: the highest-quality tranches are sufficiently over-collateralized so that no traders have any significant informational advantage with regard to payoffs, even though some traders may have more information or may have the ability to acquire such information. Lending against collateral has low information costs because there is no need for precise price discovery (Holmstrom 2015).

According to Chan and Kanatas (1985) when borrower and lender possess the same information but have divergent opinions or beliefs, collateral functions as an observable variable upon whose value both borrower and lender can agree and base the loan contract. If the different valuations have an informational asymmetry as their origin, then the collateral serves to indirectly convey information between the two agents, that is, collateral has, a signaling role.

The 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 minimize the cost of price discovery. 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 of equity, as shown in Figure (4) a, then the execution of such a contract would be a lot more expensive since it would always require an assessment of the payoff at termination. Debt is information-insensitive both ex ante and ex post.

2.3 Information-sensitivity of debt in trade

We know from the earlier discussion that there is a precise measure that captures the information sensitivity of debt to information acquisition: it is the expected savings to the buyer from avoiding a lossmaking purchase if he acquires information. Let's call this IAS (Information Acquisition Sensitivity). If IAS is larger than the cost of information acquisition C, the buyer will acquire information; if IAS is smaller than C, he will refrain from acquiring information. He will, of course, buy only if the information reveals that the price is less than the expected payoff. Debt is the least

information-sensitive contract in the sense that it is most resilient to information acquisition (Dang, Gorton, and Holmstrom 2015).

If, for some reason, the debt is affected by a reduction in duration, then the value of debt increases uniformly as the duration gets shorter. Short-term debt which is sufficiently well in the money is less information-sensitive than long-term debt with the same face value, but this comparison reverses itself once the debt value gets close to the kink. The regime switch will be more dramatic for short-term debt than long-term debt (Holmstrom 2015).

If debt is affected by a reduction in its face value, keeping collateral the same, then the region where debt is information-insensitive will expand. According to Holmstrom (2015) this happens for two reasons: the blue line gets closer to the dark-blue line and the flat part of the stick becomes longer (Figure 3). 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. If one argues for more equity in the banking system, as Admati and Hellwig (2013) have done, there is a potential price to pay because the amount of safe assets will be reduced. It is true that the debt will be safer, but it is unclear how to compare less of safer debt with more of riskier debt.

But what happens if a debt contract ends up being traded? It hints at the main results in Dang et al (2015). The author explains with a sequence of moves among 3 agents. He wrote *(s(x), p)* for a contract which consists of two components, a security *s(x)* and its price *p*. The sequence of moves is shown in Figure 5. At date 0, agent B wants to buy a security to allow him to store some of his endowments until date 1. He makes a take-it-or-leave-it offer *(s0(x), p0)* to agent A, the owner of the project *X*. The offer consists of a price *p0*, the amount of goods that agent B intends to pay to agent A for *s0(x)*, that promises the payment *s0(x)* at date 2 to the holder of the security. If agent A declines the offer, the game ends and parties just consume their endowments. At date 1, agent B makes a take-it-or-leave-it offer (*s1(y),p1*) to agent C, where *y=s0(x)* is the collateral that backs B's promise to pay agent C at date 2. If agent C accepts, he pays agent B the price *p1* at date 1. The consumptions of the agents are described in Figure 5.

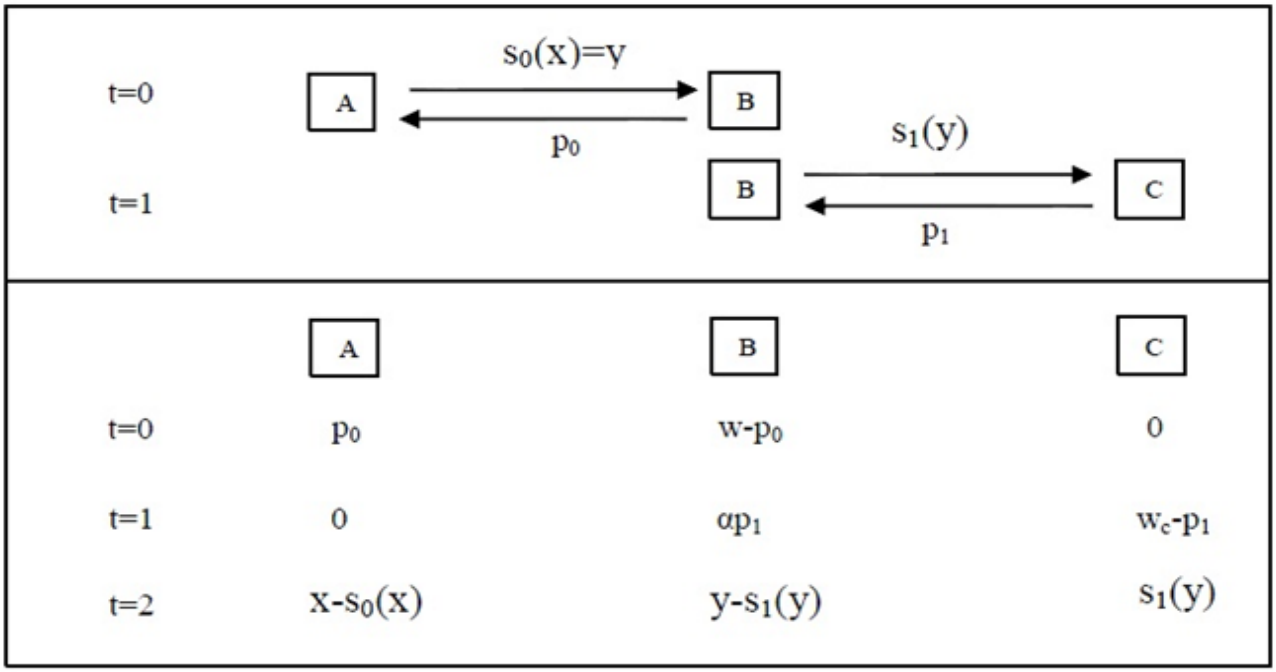


Figure 5: Optimality of debt in trade[5]

One interpretation of what is happening in the model is as follows. Agent B is a (regional) bank that has excess cash at date 0. The bank wants to store the cash by using *s0(x)*. At date 1, depositors of the bank want to withdraw the amount *k* so that the bank wants to sell *s0(x)* to agent C to raise cash. Or in the context of repo, we can interpret *s0(x)* as a long term bond that agent B buys and when he needs cash at date 1 he uses *s0(x)* as collateral for a repo trade with agent C. The theoretical analysis is general and more abstract in the sense that the author allows agent B to design a new security *s1(y)* that uses *y=s0(x)* as collateral and to sell it to agent C. So, in conclusion, the author states that 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, too, so debt is in a very robust sense the best possible collateral. This provides a strong reason for using debt as collateral in the shadow banking system (Dang, Gorton and Holmstrom 2015).

However, debt is shown to be uniquely optimal only then its aggregate cash flow is fixed. In the paper from Yang (2015) the author states that information acquisition purely creates an adverse selection problem that reduces the social surplus. The seller thus designs the security to discourage information

[5] Source: Dang, Gorton and Holmstrom 2015

acquisition. The ideal security should have a constant repayment level, which gives the buyer no incentive to acquire information. When this level is too high to be supported by the underlying cash flow, the limited liability constraint binds and gives rise to the 45-degree-line portion of the debt security. Yang also considers several alternative settings other than the hockey-stick model. He shows that debt remains optimal if the roles of seller and buyer are switched, if the buyer also has some bargaining power in security design, if the same party designs the security and acquires information, if there are multiple underlying assets, and if the information cost takes more general functional forms. Fixed aggregate cash flow remains the key feature in all of these alternative settings. Hence, the basic intuition of the hockey-stick model goes through and debt remains optimal.

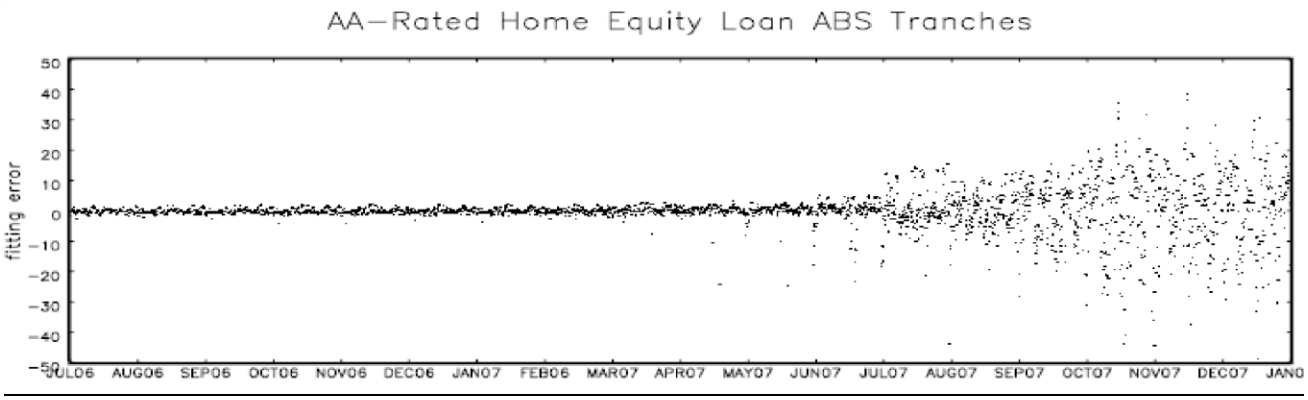
2.4 Panics: A shift to information sensitive region

Panics always involve debt. Panics happen when information-insensitive debt (or banks) turns into information-sensitive. In order to describe this theory we can take a closer look at the financial crisis of 2007-2008. The problem of "toxic assets" first hit the headlines when the subprime crisis heralded the beginning of the global financial crisis in August 2007. The market for certain asset-backed securities, especially those backed by subprime residential mortgages, was the first to suffer extreme illiquidity, as trading slowed to a trickle and market clearing prices became virtually impossible to establish (Gorton 2010). The opaqueness of the asset-backed securities market and the attendant potential for adverse selection has frequently been blamed for the sudden drying up of liquidity. Yet, there is a puzzle at the heart of the crisis. Uncertainty about the true value of an asset should not invariably lead to the breakdown of trade. The stock market is a good illustration of how financial markets are normally well adapted to aggregating the diverse information of traders and arriving at a market-clearing price.

Morris and Shin (2012) resolves this puzzle. The starting point of their analysis is adverse selection resulting from information asymmetries on the true value of the asset. For asset-backed securities, the heterogeneity of the underlying loan pools that back the securities gives ample scope for greater expertise and information in ascertaining the fundamental value of the securities. As noted by Gorton and Pennacchi (1990), when overall economic fundamentals are strong, such asymmetric information need not matter for the value of the particular asset-backed security, since such securities are debt claims that are insensitive to the value of the underlying claims. However, when a shock impacts the economy (such as reversal of the housing market that ultimately underpins the value of the security), then the true value

of the debt security becomes more sensitive to private information and the asymmetric information begins to exert an influence in the trading decisions. A regime shift occurs from a state where no one feels the need to ask detailed questions, to a state where there is enough uncertainty that some of the investors begin to ask questions about the underlying collateral causing significant drops in prices. Such event is cataclysmic precisely because the liquidity of debt rested on over-collateralization and trust rather than a precise evaluation of values. Investors are suddenly in the position of equity holders looking for information, but without a market for price discovery. Private information becomes relevant, shattering the shared understanding and beliefs on which liquidity rested (Morris and Shin 2012).

In Holmstrom (2015) the author presents 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) over the period August 2006–January 2008 (Figure 6). In June 2007, two Bear Stearns Funds, heavily exposed to subprime home equity loans, were besieged by investors and collapsed. Before the collapse investors appear to have had a shared view of pricing. Holmstrom suspects that traders mainly relied on ratings and, if they checked reference prices, it was mostly from common sources using the same valuation models rather than trying to find out private information about the underlying collateral. Herding around the same information is certainly indicated by the picture. Once news about the troubles at the two Bear Stearns Funds surfaced and quickly 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 public information caused beliefs to diverge rather than converge to a common, lower price level. Finally, Holmstrom (2015) argues that the panic is consistent with an information event (not necessarily a dramatic one) which starts with debt becoming information-sensitive.



Source: Perraudin-Wu (2008)

Figure 6: Residuals of prices of AA Home Equity Loan tranches Aug 2006-Jan 200

Chapter III – Economic policies and final discussions

3.1 Some policy implications

The crisis is not just the bad shock about fundamentals that back debts. Instead, the crisis is a bad enough shock to cause information-insensitive debt to become information sensitive. Agents who are capable to produce information have an incentive to learn about tail risks. Other agents become "suspicious" in the sense of fearing about adverse selection. There are two potential equilibrium states. There is information acquisition and adverse selection and there is positive probability that no trade occurs. Another potential equilibrium outcome is that agents avoid private information production by trading at a price that is less than the fundamental value of the debt conditional on the public news. Such a "write-down" of debt, to "fire sale" prices, can be preferred because it recovers information-insensitivity and where no agent has an incentive to produce information, but an inefficiently low amount is traded. A financial crisis is a manifestation of the "tail risk" that is endogenously created by agents in the economy in order to trade. If maintaining symmetric ignorance is central for liquidity provisions in debt funding markets, then this has implications for the regulation of the banking and financial system. For example, should money market funds reveal their net asset value in a timely fashion? Should banks that create short term liabilities for trade, provide more information about the value of, their assets on the balance sheet? Should the regulator announce the outcome of stress test of banks so that investors have better information about individual banks and can run their own valuation models? Public provision of imperfect information can reduce liquidity because it can make information insensitive debt become information sensitive and triggers endogenous adverse selection concerns. When agents have an incentive and need to conduct due diligence about the value of money-like instruments, these financial instruments will lose their money-like property (Dang, Gorton and Holmstrom 2012).

Prior to the crisis of 2007-2009, disclosure policies were predominantly targeted at protecting investors in standard securities (debt and equity). Following the breakdown of trade in various classes of asset-backed securities, a new focus of regulation is on the transparency of assets issued by financial institutions. For example, the Dodd-Frank act requires disclosure of information about asset-backed securities. Transparency policies typically take the form of minimum standards. Issuers are obliged to follows these standards, but are free to implement higher standards of transparency. The non-monotonic

nature of opacity suggests that a (uniform) minimum standard is not a desirable approach to regulation. Stenzel and Wagner (2015) showed that transparency reduces adverse selection only when transparency is sufficiently large, while increasing it otherwise. Consider Figure 2, which depict the (smoothed) cross-sectional relationship between opacity and bid-ask spreads at the firm level. The turning point at which transparency reduces asset liquidity is around the 40th percentile, suggesting that a mandated increase in transparency may increase bid-ask spreads for a large share of the population of firms. Since higher transparency brings about costs for issuers, the net effect of uniformly higher transparency may hence easily be negative. This does not imply that transparency regulation per se is undesirable as actual opacity levels already reflect existing efforts to enhance transparency. Nonetheless, their analysis provides a clear rationale for regulation: issuers do not internalize the full cost of opacity for other agents in the economy and may hence choose inefficiently low amounts of transparency. Firm-specific disclosure standards that take into account that optimal opacity is heterogenous are in principle welfare-enhancing. However, the extent to which transparency is optimal depends on deep parameters such as the cost of information to firms and investors. Regulation that conditions on these parameters seems practically infeasible. Dang and Gorton (2009) are going further by arguing that in such economies government policies that increase transparency would reduce welfare. This would seem to be counter to the intuition built from the idea of efficient markets. But, that theory does not say what the optimal amount of information that should be available is, but only that security prices reflect whatever information is available.

3.2 Concluding remarks

Even before deposit insurance, checks changed hands without due diligence about the banks backing them. Billions of dollars are traded in sale and repurchase (repo) markets overnight, very quickly, every day, without extensive due diligence (information production) on the bonds used as collateral. Much corporate debt is purchased and traded based only on ratings. Trade is facilitated by a lack of information, in fact, by ignorance. Opacity Pareto-dominates (even partial) transparency when agents trade.

Debt is the optimal contract for providing liquidity. It is optimal in three senses. First, with respect to public signals, it retains the most value and so produces the most intertemporal carrying capacity. Second, when costly private information can be produced, causing adverse selection, debt minimizes

the incentive to produce private information and so reduces the adverse selection. Finally, when there is adverse selection, debt is optimal in maximizing the amount of consumption that can be achieved via trade. In the first two cases, debt is optimal because it least information-sensitive. In the third case, debt is optimal because it maximizes the amount traded. But, while debt is optimal there can be a collapse of trade when the public signal causes information-insensitive debt to become information-sensitive. In that case, less is traded than would be traded were no information privately produced.
With respect to this measure debt is the optimal security for liquidity provision. Systemic crises concern debt. The crisis that can occur with debt is due to the fact that the debt is not riskless. A bad enough shock can cause information insensitive debt to become information sensitive, make the production of private information profitable, and trigger adverse selection. Instead of trading at the new and lower expected value of the debt given the shock, agents trade much less than they could or even not at all. There is a collapse of trade. The onset of adverse selection is the crisis (Dang, Gorton, and Holmstrom 2009).

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