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Comments on
Understanding the Role of Debt in the Financial System

by Bengt Holmström

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Bengt Holmström's paper is a response to the Great Financial Crisis of 2007 – 2009, a crisis that started in the U.S. mortgage market, almost brought down the world economy, and has led to the European Debt Crisis of 2009 – 2012, which is still holding much of Europe in its grip. This crisis has been one of the most dramatic economic events of the last 100 years, and it poses considerable challenges to economists and economics. Different from what media and politicians sometimes suggest, economic theory has a lot to say in order to understand what went wrong, but considerable questions remain, and whole subfields of economics are slowly changing their focus and their relative importance in the overall discipline.

Very few scholars are as qualified to take stock and ask basic questions about these developments as Bengt Holmström. His work about incentives, institutions, and market failures has shaped economics since 1979, when his first paper on moral hazard and observability was published. In the light of what happened in financial markets since 2007, the economic profession, finance professionals, and regulators would have been well advised if they had taken Holmström's work even more seriously.

Holmström's theme in his present paper is basic in the best sense of the word and goes right to the heart of finance. He argues that collateralized debt, the cornerstone of the financial system, is highly beneficial and dangerous at the same time. It is beneficial because it enables financial transactions at the lowest possible information cost most of the time, and it is dangerous because the informational advantage can turn into a severe disadvantage in adverse conditions.

His argument is based on work on optimal security design with Dang and Gorton (in particular, Dang, Gorton and Holmström (2011) – the references to this line of research are somewhat opaque). This research shows that debt is optimal in a framework where an economic agent wants to buy a security knowing that she may later have to sell the security, after the possible arrival of new information. In this framework debt is optimal because it is least information-sensitive. This is true in the even more general security design problem, where the initial buyer of the security can use this security to design a new security in the future: she will want to buy debt today in order to issue collateralized debt tomorrow. Hence, “debt on debt” or hypothecation chains in the shadow banking world of the 2000s are optimal responses to information asymmetry or information acquisition incentives. They are optimal precisely because they minimize informational requirements along the contracting chain. Therefore debt is opaque for as long as “the music is playing”, as the famous saying by Ch. Prince, the CEO of Citigroup, went in 2007.

This argument that debt is the optimal financial security in response to informational problems between borrowers and lenders has been made in several other contexts: debt economizes on information collection costs at the contract execution stage (Townsend, 1979), debt economizes on liquidation costs of collateral (Hart and Moore, 1998), debt mitigates managerial moral hazard (Innes, 1990), debt is an optimal response to private information at the contracting stage (Nachman and Noe, 1994), debt is least information-sensitive to ex-post public information (DeMarzo, Kremer, and Skrzypacz, 2005), and debt can optimize information collection if lenders screen borrowers at the contracting stage (Inderst and Müller, 2006). All these are, or can be cast in terms of, information-based theories of debt. This list is not exhaustive, and Dang, Gorton and Holmström add an important new element to the list, which is particularly relevant for the recent experience of shadow banking. In the present paper, Holmström builds on the whole list of information-based theories of debt, to emphasize that the informational advantage of secured debt, very generally, comes at a necessary cost: at times where returns are bad, markets that are not well equipped to deal with information processing get overloaded and can become dysfunctional.

Underlying this general argument is the general feature of debt expressed in the classic picture of the inverted hockey stick in Figure 1: if the value X of the asset underlying the debt contract (project cash flow or collateral) is sufficiently high, then debt is trivial and mechanic, if it is low, then the value of debt depends very strongly on the underlying asset value, because the payout is given by the 45-degree line in the diagram.

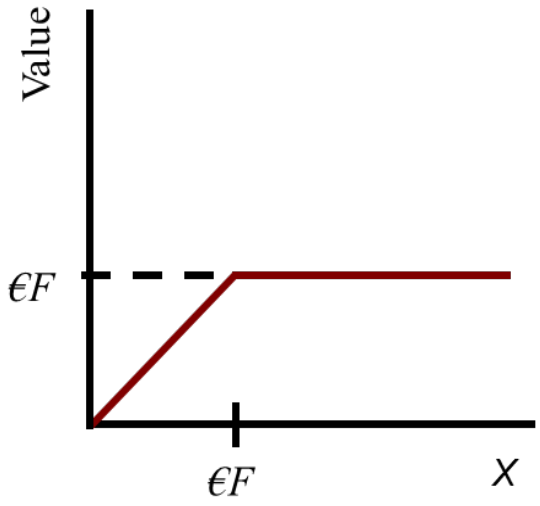

Figure 1: The inverted hockey stick

This fundamental feature of secured debt that it economizes on information production and facilitates trade leads to a clustering of attributes of debt markets that is structurally very different from those of equity markets. Some of these features are collected in Table 1 below, but the list is by no means exhaustive. This view of debt markets is likely to be very important for policy, but also intellectually fascinating. Although this analogy is not drawn in the paper, it is reminiscent of Holmström's and Milgrom's (1994) work on the theory of the firm. In that work, they argue that the firm should be understood as a cluster of complementary attributes. The current paper can be viewed as an attempt to carry this kind of reasoning further into the organization of markets.

Debt:	Outside equity
opaque	transparent
collateralized	unsecured
funding purpose	risk-sharing purpose
bilateral	anonymous
large average trades	small average trades

Table 1: Features of debt and equity markets

However, this information-based view of debt characteristics ignores one crucial aspect of debt that, in my view, is particular important for understanding financial crises. This is the fact that debt is usually provided for a limited, fixed period of time, while equity is committed forever. As a consequence, equity requires only a (variable) period return to investors, while debt requires a (less variable) period return to investors **and** the repayment of the principal at maturity. Hence, equity concerns only the period returns of a specific project or investment, while with debt the whole structure is at stake. This makes a big difference, because period returns are an order of magnitude smaller than the principal.

To see this point simply and clearly, let us remind ourselves of the basic valuation formula for a cash flow of 1€ accruing from next period until the end of times, if the period interest rate *r* is constant:

$$\sum_{t=1}^{\infty}\left(\frac{1}{1+r}\right)^{t}=\frac{1}{r} \qquad (1)$$

Thus, for example, even with a rate of interest of 5% (which in Europe would raise nostalgia in the today's era of Draghian monetary economics), the principal of an investment is 20 times larger than the coupon payment, if the investment is financed by infinite-maturity straight debt. With this difference in magnitudes, the fact that debt is less outcome-contingent than equity becomes less relevant. Let me make that case by constructing two different artificial securities that combine debt and equity characteristics somewhat differently from what we are used to.

The first security is an infinitely-lived debt security (a consol), which repays a fixed amount of cash each period forever, with no repayment of principal. The second security is a finitely-lived equity security, which repays x% of EBIT plus principal after one period. Comparing these two securities, the debt security is indeed very information-insensitive, while the equity security is very information sensitive, just like in Holmström's taxonomy. However, the debt security is the one that provides stability and is not likely to trigger crises, because it concerns only a very small part of the investment's value, while the equity security creates fragility, rather than absorb risk, because it puts the whole investment at stake every period.

The point here is, of course, the rollover risk usually associated with debt. This rollover risk may be due to information concerns, but does not have to. To put this differently, if fundamentals turn bad and a debt security becomes information-sensitive, then this concerns the 45-degree line of the whole investment in the picture of Figure 1. An equity security will always be sensitive to the underlying fundamental value, but this concerns only the returns generated by the investment, not the investment itself. That investment is never called into question by equity (the manager's fate is a different story). In a first-best world, this is all equivalent, and securities are refinanced if and only if this is warranted by the long-term cash flow fundamentals. In fact, formula (1) provides the simplest version of the link between the investment and its future cash flow stream. But, of course, we are discussing a second-best world here.

Even in practice this distinction may not matter most of the time. But the Great Financial Crisis has shown that collateralized short-term debt used as an instrument to fund longer-term investments in the shadow banking sector suddenly ceased to function according to the usual routine. Investors who believed that they were far out on the horizontal part of the inverted hockey stick, because they had regularly received their flow returns, suddenly believed that they were at the very bottom of the stick and that their whole investment was at stake. This happened in several key market segments, such as with ABS conduits after August 2007, in the tri-party repo market after March 2008 and in money market funds after September 2008. In all three market segments this change of mind led to precipitous losses of funding

during these key moments of the crisis and ultimately to more or less complete disintermediation in the fall of 2008.

This discontinuous unravelling of short-term debt markets is not part of Holmström's story, although it is not inconsistent with it. In Martin, Skeie, von Thadden (2014a, b), we propose a theory that addresses precisely this issue and propose a theory of the fragility of secured short-term funding markets due to roll-over risk, which has liquid and profitable borrowers in normal times along with the possibility of precipitous funding losses in crisis times.

The theory is cast in an infinite-horizon model of overlapping investors with one good that can be stored, consumed or invested. There are two classes of agents. First, "investors" who receive endowments each period, have no investment opportunities of their own, and are subject to liquidity shocks, and second, "borrowers" (broker-dealers, investment banks, …) who are long-lived, have heterogeneous profitable long-term investment opportunities, but no endowment of funds.

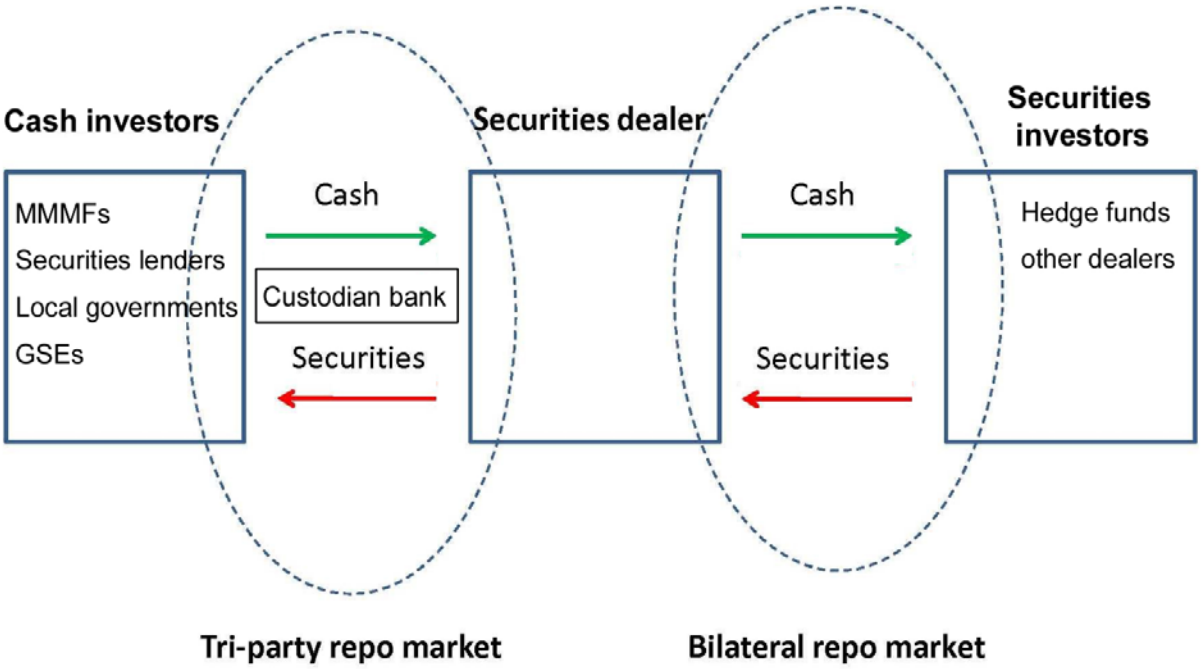

Figure 2: A typical hypothecation chain

Figure 2 provides a stylized description of the hypothecation chain in repo markets. The model applies to the left-hand part of that chain, where the tri-party repo market is central, and equally to the right-hand part, which pictures the bilateral repo market. But the model is sufficiently general to also cover other institutions, such as borrowing and lending by money market mutual funds (which would be located to the left of the chain in the figure).

In the equilibrium of the model, investors lend short-term to borrowers against sufficient collateral, where collateral is necessary to give borrowers the incentive to repay. The amount of collateral is not pinned down in equilibrium, as long as it is sufficiently large, and it does not enter equilibrium payoffs, because collateral is never liquidated. This is exactly as in Holmström's pawn shop, where borrower and lender do not have to assess the value of the watch as long as it is clear that the value is sufficiently large. Borrowers invest long-term and make positive profits. The reason why competition between borrowers does not erode profits is that if borrower profits were too low, they would have no incentives to borrow and would rather invest internal funds, such that the market for loanable funds would not clear, which is inconsistent with equilibrium. Hence, borrowers generate endogenous liquidity each period, which gives them the ability to withstand liquidity shocks.

Equilibrium therefore results in an endogenous maturity mismatch of borrower balance sheets, which provides a formal underpinning for Gorton's and Metrick's (2012) interpretation of repo and related markets as shadow banking. Investors have no fundamental reason to worry about this mismatch, because they obtain positive short-term returns and can roll over the principal, but the situation is fragile in the sense that the borrowers' equilibrium liquidity buffers may not be sufficient to guarantee all outstanding stocks of loans.

The balance sheet mismatch now can give rise to runs. These are collective decisions of investors not to continue lending and/or not to provide new funds. They can be triggered by the (self-fulfilling) anticipation of future runs, as argued by He and Xiong (2012), by sunspots, by new public information about collateral quality (which is not equilibrium relevant, as noted above), or by investor sentiments such as in Gennaioli, Shleifer and Vishny (2013). Two conditions are necessary for a run on a

borrower to occur. First, the borrower must not survive the run, because runs don't occur if individual claims are not in jeopardy. Second, the run must be self-enforcing for investors in the sense that individual investors find it optimal to participate if sufficiently many other investors participate.

We show that both conditions may be satisfied, but need not, and this depends on borrower characteristics, equilibrium behavior, and the microstructure of the market under consideration. In particular, there is a sense in which the bilateral repo market is more resilient than the tri-party repo market, which is consistent with the experience of 2008.

Unlike some other models of multiple equilibria, the debt model sketched here does have some predictive content:

- The model makes sharp predictions about who is prone to runs and why
- The model can differentiate the impact of market microstructure on the determinants of runs (Martin, Skeie and von Thadden, 2014a)
- The model can be used to evaluate contractual and regulatory responses to fragility
- The model can distinguish between individual borrower illiquidity and market illiquidity (Martin, Skeie and von Thadden, 2014b)

Like Holmström's theory of debt, the theory sketched above emphasizes that collateralized debt provides stable funding for beneficial financial activity in "normal times" and that debt can become dangerous if new public information arises and/or market perceptions change. However, it does not emphasize the dangers of the slippery 45-degree line and of private information acquisition in the build-up of crises, but rather the danger looming in the stock of short-term debt when expectations change: a shift of stocks debt outstanding can be more dangerous than a change in flows. This perspective may be a useful addendum to the brilliant broad brush that Bengt Holmström has offered us in his overview.

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