

Breaking the Ice: Government Interventions in Frozen Markets

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he recent financial crisis began with a fall in housing prices in 2006, followed by an increase in delinquencies on subprime mortgages in early 2007.¹ As subprime borrowers began to default on their mortgages, the value of assets backed by these loans declined, resulting in substantial losses on the balance sheets of many financial institutions in the United States and across the globe. However, as many have noted, these losses were too small to account for the crisis that followed.² Therefore, a central challenge in the aftermath has been to understand how relatively small losses within the financial sector could be propagated and amplified to the rest of the economy.

A leading theory contends that after assets such as mortgage-backed securities (MBS) began to fall in value, what truly sparked the financial crisis was the inability of financial institutions to reduce their leverage, either by selling these assets and paying down their debt or by raising new equity. This freeze led to further declines in

¹ For a detailed description of this sequence of events, see the accounts by Gary Gorton or Markus Brunnermeier.

² For example, as Tobias Adrian and Hyun Shin argue, the total value of outstanding adjustable-rate subprime mortgages in 2008 was less than \$1 trillion. Therefore, even if an unprecedented number of households defaulted on these mortgages, total subprime losses would still have been equal to just a small fraction of the decline in the total market value of publicly traded companies that occurred between October 2007 and March 2009, which was about \$30 trillion.

asset values and ultimately reduced credit to households, firms, and even state and local governments. Without access to credit, households reduced their level of consumption, while firms and government agencies contracted by employing fewer workers and cutting back on capital investments. As a result, the economy plunged into a recession from which it has still not fully recovered.

Economists have proposed a variety of explanations for why financial institutions had difficulty selling assets and raising new capital. One prominent explanation for why banks had difficulty selling assets such as MBS is that the market for them was plagued by *asymmetric information*. When buyers cannot distinguish good assets from bad ones, the highest price they're will-

ing to pay is an average of the values they would normally attach to good and bad assets. However, if sellers know the quality of their own assets, then sellers with good assets will choose not to sell at this average price, leaving only bad assets for sale in the market. In this way, the market can unravel, and good assets simply won't trade.

A prominent explanation for why financial institutions had difficulty raising new capital is that they suffered from *debt overhang*. According to this explanation, a bank with large amounts of risky debt will find it expensive to issue new equity because the proceeds of any new investments would accrue first to the bank's bondholders rather than its shareholders. If this problem is sufficiently severe, existing shareholders will oppose issuing new equity even if doing so would generate profits (or reduce losses) for the bank.³

Although economists have explored a number of alternatives, asymmetric information and debt overhang offer two useful theories for understanding why banks found it so difficult to reduce their leverage.⁴ Using

³ To read more about the phenomenon of debt overhang and the role it can play in financial crises, see the *Business Review* articles by Satyajit Chatterjee and Burcu Eyigungor.

⁴ In his *Business Review* article, Yaron Leitner provides a nice summary of several alternative explanations for market freezes. For example, asset markets can freeze and prices can plummet if market participants face binding capital constraints. Alternatively, during times of crisis and unusually high uncertainty, investors sometimes behave as if they are extremely risk-averse, which can stall trade. Finally, banks might not want to sell assets for fear they would have to mark other assets on their balance sheets to the market price.



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these two theories, we can explore several forms of government intervention that were proposed or implemented to enable banks to reduce leverage and restore liquidity to crucial markets.

WHY FINANCIAL INSTITUTIONS COULD NOT SELL ASSETS

While there are many reasons that MBS and similar assets became very difficult to sell, there is consensus that a major factor was the presence of asymmetric information. As housing prices fell and delinquencies on mortgages rose, it became apparent that some MBS could be worth considerably less than had previously been claimed. In the language of Nobel laureate George Akerlof, these low-quality assets were “lemons.” Of course, not all MBS were lemons; many were of higher quality, with fundamental values at or near precrisis valuations. However, these assets are fairly complex, and to make things worse, they were combined to form even more complicated securities. This bundling made it very difficult for buyers to differentiate high-quality assets from low-quality assets. Sellers, on the other hand, typically had a better idea about the quality of the assets they owned. In many cases, the sellers had purchased the underlying assets (e.g., mortgages), worked closely with the rating agencies to bundle them into more opaque securities, and monitored their cash flows before attempting to sell them.

Hence, this market had many of the basic ingredients of Akerlof’s (1970) “market for lemons”: Assets were heterogeneous in quality, and sellers had better information about the quality of their assets than did prospective buyers. In his seminal paper, Akerlof shows that these ingredients can lead to a breakdown in trade. To illustrate, suppose that the market is composed of a large group of sellers, half of whom own lemons (such as

MBS with many loans that are likely to default) and half of whom own peaches (such as MBS with few loans that are likely to default). The owners of lemons are willing to sell for no less than \$100, while the owners of peaches are willing to sell for no less than \$200. Buyers are willing to pay no more than \$120 for a lemon and \$240 for a peach. There is potential for trade as long as the maximum price that buyers are willing to pay exceeds the minimum price that sellers are willing to accept.

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However, whether trade will actually occur depends critically on what buyers and sellers know. If all market participants can distinguish lemons from peaches, then all assets will trade: Lemons will sell at some price between \$100 and \$120, and peaches will sell at some price between \$200 and \$240.

However, suppose instead that sellers know what type of assets they own, but buyers cannot distinguish lemons from peaches. It should be clear that the two types of assets could never sell at two different prices, as owners of lemons would always choose to pass off their assets as peaches in order to sell at the higher price.⁵ Therefore, at a given price, a buyer is willing to pay only a weighted average of his valuation across the two types of assets for sale. In this market, since there is an equal share of each type, the most

⁵ In the language of information economics, the only possible equilibrium outcome is a pooling equilibrium, in which lemons and peaches sell at the same price. If the two types of assets sold at different prices, economists would describe the outcome as a separating equilibrium.

a buyer would pay for a randomly selected asset would be $\$180 = (1/2) \times \$240 + (1/2) \times \$120$. However, note that owners of peaches aren’t willing to sell for \$180. As a result, owners of peaches would drop out of the market, leaving only lemons to trade (at some price between \$100 and \$120). In real-world markets, where there are many different asset qualities, this unraveling can be even more alarming, as only the very lowest-quality assets will trade; the rest of the market will be frozen.⁶

WHY BANKS COULD NOT RAISE CAPITAL

As an alternative to selling their assets, financial institutions could issue new equity to reduce leverage. Yet this, too, proved difficult during the financial crisis. Again, there are a number of potential reasons for why this was so, but a leading candidate is debt overhang, which was first analyzed by Stewart Myers. When a bank has risky outstanding debt — i.e., when investors believe the bank may default on its obligations to its bondholders — the bank’s existing shareholders may find it unprofitable to sell new shares, given that these shares must be priced at their fair market value. The reason

⁶ To see how unraveling works, note that all assets must sell at the same price, and this price must equal the average price for all qualities in the market. Therefore, all sellers who own assets that are more valuable than the average will drop out of the market. However, after these sellers withdraw, the only possible price is one equal to the average value of the assets remaining in the market. Again, all sellers with assets more valuable than the average will drop out. Following this logic to its conclusion, only the lowest-quality assets remain.

shareholders resist is that, should the bank default, a portion (or even all) of the proceeds from issuing new equity would be used to increase the payoffs to existing debt holders before any of the bank's shareholders would see a single cent. Existing shareholders incur the full cost of raising new capital, as the value of their shares is diluted, but they reap only a fraction of the benefit. As a result, these original shareholders may not support new issues even if it is common knowledge that the bank has investment opportunities that are sure to deliver a positive return.⁷

To illustrate this phenomenon, suppose a firm has \$80 in debt and a risky asset (e.g., a pool of MBS) that will yield either \$100 or \$0 with equal probability. If the asset yields \$100, the equity holders will repay the debt holders \$80 and keep \$20 for themselves. If the asset yields \$0, the firm will default on the debt, and the equity holders will have nothing. Hence, the expected value of existing equity is $\$10 = (1/2) \times (\$100 - \$80) + (1/2) \times \0 , while the expected value of the debt claim is $\$40 = (1/2) \times \$80 + (1/2) \times \$0$.

Now suppose the firm has an investment opportunity that will cost \$25 but will return \$40 with certainty. Would the existing equity holders choose to issue new equity — thereby giving up a share of the firm's profits — in exchange for the \$25 required to finance this project? The answer de-

pends on how large a share they would have to give up.

Table 1 can help us determine the share of the firm's equity that new investors would require in exchange for \$25. Suppose they received 1/6 of the firm's equity, which corresponds to the first row of the table. If the MBS yield \$0, the extra \$40 in revenue from the new investment is still not enough to prevent the firm from defaulting on its \$80 debt, and the equity holders (old and new) receive nothing. But if the MBS yield \$100, then the equity holders split the profit of $\$60 = \$100 + \$40 - \80 . Hence, the expected value of a 1/6 share of the firm's equity, reported in the second column, is $\$5 = (1/6) \times [(1/2) \times \$0 + (1/2) \times \$60]$. The new equity holders would be providing \$25 in exchange for an expected return of just \$5, resulting in an expected loss of \$20. Clearly they would never agree to such a deal. Instead, scanning down the third column, one can see that new equity holders would demand at least a 5/6 share in ex-

change for a \$25 investment.

However, whether the original equity holders would agree to such a deal depends on the expected value of their share of the firm after the new equity issue. If the original equity holders must give up 5/6 of the firm's profits in exchange for the \$25 investment, then their remaining 1/6 share is worth only \$5, as discussed above. Since the expected value of their equity was \$10 before the investment opportunity appeared, the original equity holders would lose \$5 by pursuing this investment; from the final column of Table 1, we see that the original equity holders would give up at most a 4/6 share of the firm in exchange for the \$25. Hence, the original equity holders would choose not to raise capital to invest in this project, even though it would earn the firm $\$15 = \$40 - \$25$.

Intuitively, the reason that debt overhang makes it so expensive for firms to raise money is that new investors know that their funds will be used to repay debt holders if the firm's MBS

TABLE 1

How Debt Overhang Can Impede New Equity Issuance

Share given to new equity holders	Expected value of new equity share	Expected payoff from investment	Remaining share for original equity holders	Change in value of original equity share
1/6	\$5	-\$20	5/6	\$15
2/6	\$10	-\$15	4/6	\$10
3/6	\$15	-\$10	3/6	\$5
4/6	\$20	-\$5	2/6	\$0
5/6	\$25	\$0	1/6	-\$5
1	\$30	\$5	0	-\$10

⁷ Note that the problem of debt overhang described below does not require any information asymmetries between the bank and its potential new equity holders. However, in the absence of asymmetric information, there must be a reason that the firm does not simply sell assets to finance an investment. As discussed in footnote 4, asset markets might freeze for a number of other reasons. Moreover, some assets are difficult to sell because their value depends on an existing relationship; for example, a bank may be able to enforce repayment of a loan because it has an ongoing relationship with the borrower, but this loan would be difficult to sell to a third party who lacks this relationship.

yield \$0, and they need to be compensated for this risk. Notice that this problem eases as the probability of default decreases: If the MBS yield \$100 with greater probability, it becomes less expensive for the firm to issue new equity, and the effects of debt overhang diminish.

POLICY OPTION: DIRECT ASSET PURCHASES

As we explained above, the presence of risky assets in the market can cause market activity to seize up. Moreover, the presence of risky assets on banks' balance sheets can make it too costly for them to raise additional capital by issuing new equity. One potential policy response is for the government to simply buy assets directly from these banks, thus removing them from both banks' balance sheets and the market at large.⁸

Although it is possible that bank regulators may have superior information about asset values through bank examinations, the more conservative assumption — and the one that most economic analyses make — is that the government has no better information than other potential buyers. However, even without an informational advantage, government purchases may be beneficial in several ways. When the government has no better information than other buyers in the market, the banks would likely sell their low-quality or “toxic” assets to the government. Once these assets have been purchased, the average quality of the assets remaining in the market

⁸ Indeed, the Troubled Asset Relief Program (TARP) was initially intended to support this type of policy. Signed into law on October 3, 2008, TARP authorized government purchases of up to \$700 billion of “troubled assets” such as mortgage-backed securities. Days later, however, Treasury Secretary Henry Paulson revised the TARP, opting instead to pursue some of the interventions described herein, including equity injections.

would increase. As a result, buyers would be willing to pay a higher price for a randomly selected asset, since the probability of receiving a lemon has declined. Therefore, if the government is able to remove a sufficiently large quantity of toxic assets from the market, it can alleviate the problem of asymmetric information and potentially rejuvenate trading among private investors. This idea has been formalized by Jean Tirole and by Thomas Philippon and Vasiliki Skreta.⁹ In addition to rejuvenating trade in private markets, direct asset purchases can also help banks issue new equity. By removing the most toxic assets from banks' balance sheets and replacing them with cash, the program makes existing debt less risky and hence reduces debt overhang. As a result, issuing new equity would be less costly, which could allow banks a better opportunity to raise capital. Therefore, for both of the reasons discussed above, banks could potentially use private markets to recapitalize after the initial purchases by the government, thus limiting the burden that would fall solely on the government.

Unfortunately, this type of program also has several disadvantages. For one, when the government is at an informational disadvantage (just like buyers in the private market), it will likely overpay for the assets, which is costly to taxpayers.¹⁰ Second, this type of government intervention will interfere with the process of price discovery. Private investors, such as hedge

⁹ Note that the timing of such programs is important. For example, if owners of lemons anticipate that prices will rise in the future, they may choose not to sell their assets to the government, and instead wait for the market to recover. But then, since lemons remain in the market, it doesn't recover! Braz Camargo and I study the importance of both the timing and duration of government interventions and show how policies that would seemingly speed up a market's recovery can inadvertently slow it down.

funds, spend valuable resources trying to figure out what an asset is worth, in the hopes of either buying an asset that is undervalued or selling an asset that is overvalued. As a result, the price at which an asset is bought and sold typically conveys information; at the very least, it provides some insight into what the buyer and seller believe the asset to be worth. This information can be valuable to other market participants who are trying to figure out what similar or even identical assets are worth. Government purchases may undermine the incentives for private investors to research an asset's value, making the ultimate price less informative. Finally, direct asset purchases will most likely allocate funds to the banks with the lowest-quality assets. Not only may this allocation be seen as unfair, but the funds may also be used poorly if these banks have other assets of similarly low quality or if these banks do not have strong investment opportunities.

POLICY OPTION: REDUCE THE RISKINESS OF ASSETS

As an alternative to buying assets directly, the government can help banks reduce leverage by making the assets they hold less risky and more attractive to potential buyers. There are a variety of ways to do this. For example, a mortgage modification program that encourages lenders to reduce

¹⁰ The government, of course, would try to limit the extent to which it overpays. In addition to carefully examining the assets before purchasing them, the government could try to determine a fair price through certain market mechanisms such as reverse auctions. Lawrence Ausubel and Peter Cramton describe one such mechanism. However, it is worth emphasizing that the government's ability to overpay is the fundamental reason it can play this role in thawing the market. Not only can the government bear losses that private investors are unwilling or unable to take; it can also take into account the benefits that are captured by other participants in the economy that no private investor would take into account.

either the principal amount of the loan or the interest payments may increase the value of MBS by improving the expected performance of the underlying loans — that is, by reducing the probability that homeowners will default. Alternatively, the government can make assets less risky by guaranteeing a minimum return, eliminating the possibility that the purchaser will suffer a large loss. Finally, the government can partner with private investors by assisting in the financing of asset purchases and assuming a portion of the downside risk. Since this last option is perhaps the least understood, let's explore it in greater depth.

Suppose the government offers a program in which a private investor who buys an asset is required to put up his or her own equity to pay a fraction of the purchase price and receives a nonrecourse loan from the government for the remainder in exchange for a share of the asset's returns.¹¹ When a private investor purchases an asset with a nonrecourse loan, the asset itself serves as collateral. Should the investor default, he can lose, at most, his equity investment, but he is not personally liable for any additional losses suffered by the lender; those are borne by the government. Therefore, this type of program essentially provides partial insurance to investors should they acquire a lemon, but the government also shares in the upside should the asset appreciate.

An advantage of this type of program is that private investors have an incentive to research and acquire information about the assets for sale because they have their own equity at risk, or "skin in the game." Although

¹¹ This hypothetical program captures the essential features of a program called the Public-Private Investment Program for Legacy Assets, which was introduced in March 2009 as a joint venture of the Treasury Department, the FDIC, and the Federal Reserve.

investors' losses are limited, they still lose money if they make poor, uninformed investment decisions. An immediate consequence is that prices are more informative, in that they more accurately reflect the true value of the assets. This information is valuable to other market participants. For example, once previously uninformed buyers observe the price and thus learn about

Given the severity of the information asymmetries during the crisis, raising any money to purchase MBS was challenging.

the market's assessment of one pool of MBS, they may be sufficiently informed to bid on similar pools of MBS, helping to unfreeze the market. In addition, since the purchase price is more likely to be closer to the true value of the asset, and the taxpayer shares in the gains should the asset appreciate in value, the total potential losses to the taxpayer are reduced.

However, it is important to note that the taxpayer is still exposed to risk under this type of program. Because buyers are partially insured against losses, they still have some incentive to gamble by purchasing risky assets; economists call this phenomenon *moral hazard*. When investors gamble and lose on a government-insured investment, the taxpayer ultimately covers some of the losses. Therefore, when designing a policy like this, there is a delicate balance between providing buyers with enough insurance to be willing to purchase the assets but not so much insurance that they bid recklessly. My coauthors, Braz Camargo and Kyungmin Kim, and I construct a theoretical model that captures this type of policy intervention, along with the inherent tradeoff that emerges, and we use this model to identify the optimal level of insurance.

An additional concern with this type of program is that it still requires private investors to raise some capital on their own. Given the severity of the information asymmetries during the crisis, raising any money to purchase MBS was challenging. As a result, the scope of a program of this type could be limited by the capital constraints being faced by private investors.

POLICY OPTION: EQUITY INJECTIONS

A different approach to recapitalizing highly leveraged financial institutions is for the government to simply provide them with cash in exchange for either shares of stock (often preferred shares) or warrants, which are options to buy shares of stock at a predetermined price.¹² This type of policy has the advantage of being quick and direct: Banks immediately receive capital, and their leverage ratios fall.¹³ In

¹² A large portion of the TARP funds were ultimately used for equity injections under the Capital Purchase Program, in which the government injected billions of dollars into the largest U.S. banks (and some smaller ones) in exchange for preferred shares and warrants. Preferred shares are senior to common shares, so that owners of preferred shares have priority for the distribution of dividends or other assets in the case of liquidation. However, preferred shareholders are subordinate to debt holders, who typically have the most senior claim when a firm is liquidated. The Treasury Department regularly updates the status of the money disbursed under TARP, including how much has been repaid and the return on these investments, at <http://www.treasury.gov/initiatives/financial-stability/reports/>.

¹³ In addition to helping banks reduce leverage, this type of program also eases concerns about the solvency of financial institutions, which was an important rationale for government intervention as well.

addition, equity injections can provide more protection to the taxpayer. Unlike asset purchases, equity injections leave the government with a claim on both the good and the bad assets that a bank owns. If bank shares ultimately appreciate after the crisis subsides, the taxpayer shares in the gains.

However, this type of policy has disadvantages, too. Since markets are not purged of toxic assets, they may remain frozen for quite some time. For this reason, Christopher House and Yusufcan Masatlioglu argue that asset purchases are more effective than equity injections. Under an asset purchase program, banks are “re-warded” with new equity only when they take an action that helps markets recover, i.e., when they sell their assets and allow the average quality of assets in the market to increase. Similarly, since toxic assets remain on banks’ balance sheets after equity injections, debt overhang persists as well. In fact, as Linus Wilson points out, the seniority of the government’s preferred shares could even magnify the problems associated with debt overhang, since preferred shares are ultimately very similar to debt.¹⁴ Therefore, with preferred equity injections alone, banks would still find it costly to sell

¹⁴ See Thomas Phillipon and Philipp Schnabl for a study of the most efficient way to recapitalize banks through equity injections.

their assets or to issue new equity.

Finally, even if it is desperate to deleverage, a bank may hesitate to accept equity injections from the government for fear it could be viewed by the market as a signal that the financial institution is in trouble. Such a perception could trigger withdrawals or raise its cost of funds even further. To avoid this outcome, the government may encourage *all* large financial institutions to accept equity injections by offering very attractive terms, although doing so could make it less likely that the taxpayer will ultimately be compensated for the investment.¹⁵

CONCLUSION

The financial crisis began when banks needed to deleverage and were unable to do so. Banks could not sell many of their assets at an acceptable price, and issuing new equity was not profitable. A prominent explanation for the former type of market failure is asymmetric information, and a prominent explanation for the latter is debt overhang.

¹⁵ As Philip Swagel puts it, the terms have “to be the opposite of the ‘Sopranos’ or the ‘Godfather’—not an attempt to intimidate banks, but instead a deal so attractive that banks would be unwise to refuse it.” Note that the stigma associated with accepting equity injections could also be a relevant concern for the other types of interventions discussed here. In general, accepting any form of government assistance could be interpreted by the market as a signal that the bank is in trouble.

There are many potential ways for the government to intervene in an attempt to restore liquidity in crucial markets and allow banks to reduce their leverage. We have outlined several leading candidates and discussed their advantages and disadvantages. Ultimately, the government used a combination of them, making a variety of alterations and special provisions in an attempt to ameliorate the potential risks associated with each type of intervention.

However, it is important to remember that *all* interventions carry some risk. Each program we have discussed can be costly to taxpayers, ultimately transferring resources from the broader economy to the financial sector. An inevitable consequence is that some of the institutions responsible for creating this crisis will not bear the full costs of their actions, which may encourage risk-taking if financial institutions expect a similar government response in the future.

In addition, interventions typically need to be recalibrated as market conditions unfold. These adjustments impose an additional layer of uncertainty because market participants need to anticipate not only what other participants will do but what the government will do as well! Uncertainty can actually increase incentives for buyers and sellers to stop trading and simply wait for it to be resolved, causing markets to freeze even more.

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