

## BANKING AND SECURITIZATION<sup>†</sup>

### Asset Fire Sales and Credit Easing

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In a January 2009 lecture on the financial crisis, Federal Reserve (Fed) Chairman Ben S. Bernanke (Bernanke 2009) advocated a new Fed policy of credit easing, defined as a combination of lending to financial institutions, providing liquidity directly to key credit markets, and buying of long term securities. The purchase by the Fed of risky securities, including mortgages and bonds of the government-sponsored enterprises, may seem controversial. Yet Bernanke's analysis and recommendations can be naturally considered in a model relying on two mechanisms: 1) fire sales reduce asset prices below fundamental values, and 2) financial institutions prefer speculation to new lending when markets are dislocated. We offered such a model of "unstable banking" in Andrei Shleifer and Robert W. Vishny (2009), and here review and relate it to Bernanke's views.

The model of unstable banking focuses on what Gary B. Gorton and Andrew Metrick (2009) call securitized lending, whereby financial intermediaries make loans to the real sector but then securitize and sell them off, retaining a portion as skin in the game. Banks can also borrow money short term in the capital markets, using retained securities as collateral. Banks maximize profits and fully realize that sentiment regarding the securities they hold on their balance sheets may shift in the future, forcing them to liquidate their security holdings just as their competitors do the same, a phenomenon known as fire sales (Shleifer and Vishny 1992).

Yet securitization is too profitable for banks to hold back, and they expand their balance sheets and leverage to the maximum that capital markets would allow, accepting the risk of fire sales.

When fire sales drive down the prices of assets serving as collateral, the equity of the banks is wiped out as they seek to maintain their holdings, so they cannot borrow more in private markets. Because asset prices are dislocated, banks strictly prefer to maintain their positions in securities or even add to their holdings to the extent they can. Such speculation comes at the expense of funding new projects, which cannot match the returns on distressed securities. Because efficient projects are not financed in such a crisis, there is room for ex post government intervention, including credit easing, to improve efficiency.

How does such intervention work? The problem here is not just liquidity shortages of financial intermediaries. When banks are liquidating collateral and asset prices are dislocated, the injection of new capital into banks, either through equity or through loans, will not by itself restart lending because banks will merely use the capital to hold onto or acquire more of these distressed assets. Speculation crowds out lending until asset prices recover. The advantage of government security purchases is precisely to raise security prices so that financial investment no longer dominates lending, and real investment can restart.

#### I. Model

We consider a model with three periods: 1, 2, and 3. Real activity consists of identical projects that become available in periods 1 and 2 and that all pay off in period 3. Each project costs \$1 to undertake. Whether they are started at  $t = 1$  or at  $t = 2$ , all these projects pay a known amount  $Z > 1$  in  $t = 3$  for certain. The supply of projects costing \$1 and yielding  $Z > 1$  at both

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$t = 1$  and  $t = 2$  is infinite, so their realization is constrained only by finance. Under these assumptions, there is no fundamental risk to investment. For simplicity, we assume that the risk-free interest rate is zero.

We assume that all projects must be financed by banks, perhaps because screening or monitoring by an informed intermediary is essential. When a bank finances a \$1 project, it collects an up-front fee  $f$  from the entrepreneur and a certain repayment of \$1 at  $t = 3$ . For simplicity, we assume that the entrepreneur pays the fee from his personal funds. In addition to funding projects, the bank can buy securities or hold cash. Let  $N_t$  be the number of new projects the bank finances at time  $t$ , with  $t = 1, 2$ .

The bank can do one of two things with these project loans. It can keep them on its books or securitize them and sell them in the financial market. We model securitization as simply the sale in the market of cash flow claims that would otherwise be held by banks, so that each individual loan to a firm can be sold off and represents a claim to \$1 for certain at time 3. In our model, all loans are the same. We assume that when the bank sells a loan in the market it must initially keep a fraction  $d$  of the loan on its own books. We can think of  $d$  as the bank's necessary initial "skin in the game" when it securitizes loans. If  $N$  projects are financed and the corresponding loans are securitized, the bank must hold  $dN$  of these securities on its balance sheet at the time of the underwriting. The bank does not need to hold on to these securities for more than one period. With  $d < 1$ , the bank may prefer securitization to holding the full loan on its books because securitization allows it to expand both its balance sheet and profits.

We denote by  $P_t$  with  $t = 1, 2$  the price of the securities at time  $t$ . Because all projects pay off the same \$1 to security holders at  $t = 3$ , all securities are identical. Prices of securitized debt can deviate from the fundamental value of 1 because of investor sentiment, which can reflect either beliefs or institutional factors. We assume for simplicity that  $P_1 = 1$ , so the market is rational at  $t = 1$  and banks only profit from securitization because they can finance more projects and collect fees from more entrepreneurs. (Shleifer and Vishny (2009) also consider the case of an initial bubble at  $t = 1$  with  $P_1 > 1$ , which makes the results stronger.) We focus on the interesting case in which  $P_2 < 1$  and furthermore the

bank actually *knows*  $P_2$ . We are thus looking for conditions under which the bank expands its balance sheet at time 1 through securitization even when it knows that good times are about to end. We assume that the bank understands the model, including the fact that the fundamental value of securities is 1 at all times (recall that the interest rate is zero). The bank pays out its profits from fees at  $t = 1$  as dividends or employee compensation.

The representative bank comes into period 1 with  $E_0$  in equity and no deposits. Let  $E_t$  be the bank's equity at the end of time  $t = 1, 2, 3$ . The bank can also borrow in financial markets short term, using the securities it holds as collateral. We denote by  $L_t$  the stock of short-term borrowing by the bank from the market at time  $t = 1, 2$ . Because borrowing is collateralized, we assume that the lenders always liquidate collateral quickly enough to be left whole, so these loans are safe and bear the interest rate of zero. To keep themselves safe, lenders to the bank insist that the bank must at all times maintain a constant haircut  $h$  in the form of securities on its debt; that is,  $L_t = (1 - h) \times \text{collateral}$ . When  $P_2 < 1$ , the bank might have to liquidate some of its securities to maintain the haircut. We denote by  $S$  the number of securities the bank sells at  $t = 2$ .

To model the determination of  $P_2$ , we use a variant of the "limits of arbitrage" model of Shleifer and Vishny (1997), with the banks playing the role of arbitrageurs. Specifically, we assume that noise traders have unlimited aggregate resources but that their demands for individual securities are unit elastic. If  $\sigma$  is the sentiment shock, then total noise trader demand for a given security is given by  $(1 - \sigma)/P_2$ . The equilibrium price is determined by aggregating noise trader and bank demands for each security with outstanding supply, equal to 1.

## II. Equilibrium.

Without providing all the details discussed in Shleifer and Vishny (2009), we focus on equilibria in which in period 1 the bank goes all out to finance and securitize projects. It holds no cash at  $t = 1$  because securitization is too profitable to hold resources back, even though  $P_2 < 1$  and hoarded cash could earn high returns if invested in underpriced securities at  $t = 2$ . We first describe the behavior of the bank taking  $P_2$

as given, and then consider the determination of  $P_2$ .

When the bank commits all of its resources to securitization, including raising short term debt, the definition of the haircut implies that the ratio of equity to assets is equal to the haircut.

$$(1) \quad \frac{E_1}{E_1 + L_1} = \frac{E_2}{E_2 + L_2} = h.$$

The skin in the game condition with  $P_1 = 1$  amounts to

$$(2) \quad E_0 + L_1 = Nd.$$

Solving for the equilibrium number of projects, we obtain

$$(3) \quad N = \frac{E_0}{dh}.$$

Here collateral is  $Nd = E_0/h$  and the loan is  $L_1 = (1 - h) \times \text{collateral}$ . Equation (3) captures the fundamental mechanism of balance sheet expansion in our model. The bank finances  $1/dh$  times its equity in projects. Securitization and short term borrowing, through  $d$  and  $h$ , have multiplicative effects on the bank's balance sheet and profits, given by  $fN$ .

Suppose that the  $t = 2$  demand shock for securities is severe enough that  $(1 - P_2)/P_2 > f$ , so banks would choose to hold on to their securities, or to buy more, rather than lend to new projects. To maintain the haircut, the bank must now sell securities. The number of securities  $S$  that the bank sells is given by

$$(4) \quad S = \frac{E_0}{h} \left[ \frac{1 - P_2}{P_2} \frac{1 - h}{h} \right] \\ = dN \left[ \frac{1 - P_2}{P_2} \frac{1 - h}{h} \right].$$

The bank must liquidate the fraction  $((1 - P_2)/P_2) \times (1 - h)/h$  of its portfolio. When  $h = 1$ , there is no liquidation. When  $P_2 = 1 - h$ , the bank must liquidate everything, so assume  $P_2 \geq 1 - h$ , i.e., the creditors do not liquidate the entire portfolio.

In this equilibrium, banks finance no new investment at  $t = 2$ , even though there is an infinite supply of positive net present value projects. This equilibrium is inefficient. In the second best efficient outcome, banks would sell all their holdings of existing securities and use

the proceeds to finance new projects. But in equilibrium the banks end up selling as little as they possibly can to maintain the haircut, and in fact would strictly prefer to buy more at dislocated prices. Speculation strictly dominates new lending as long as  $(1 - P_2)/P_2 > f$ .

To compute  $P_2$ , we continue to assume that the banks neither want to nor have to fully liquidate their positions at time 2, which amounts to:

$$(5) \quad d + \frac{f(h - d)}{(1 + f)h} < \sigma \leq h.$$

From equation (4), the banks' demand for a given security,  $d - S/N$ , is given by

$$(6) \quad d \left[ 1 - \frac{1 - h}{h} \frac{1 - P_2}{P_2} \right].$$

The price of each security is determined by equating the total demand by the banks, given by equation (6), and by the noise traders, given by  $(1 - \sigma)/P_2$ , with the total supply of each security, which is 1. We can solve for  $P_2$  to obtain:

$$(7) \quad P_2 = \frac{h[1 + d] - d - \sigma h}{h - d}.$$

In a numerical example with  $h = 0.3$ ,  $d = 0.2$ ,  $f = 0.06$ , and  $\sigma = 0.25$ , all the conditions hold and  $P_2 = 0.85$ . The sensitivity of  $P_2$  with respect to the noise trader shock is given by

$$(8) \quad \frac{dP_2}{d\sigma} = \frac{-h}{h - d}.$$

When haircuts are small and therefore leverage is high, prices are extremely sensitive to shocks. Leverage is destabilizing in this very precise sense. Levered banks thus create both systemic risk and economic volatility. The instability would be even more extreme if the haircut  $h$  that lenders to the bank demand rises during the crisis, perhaps because these lenders are uncertain about bank solvency (Gorton and Metrick 2009). By pursuing securitization and funding their security holdings with debt, banks expose themselves to the risk of having to liquidate their portfolios in falling markets. Such asset fire sales

bring about further declines in asset prices in bad times, as all banks simultaneously sell and weaken the banking system as a whole. Since dislocated security prices at the bottom make holding onto distressed securities superior to direct lending, banks forgo funding real activity, leading to an economic and not just a financial crisis (Victoria Ivashina and David S. Scharfstein present evidence of declines in lending in 2008). To restore lending, the government must raise  $P_2$ , so speculation is no longer profitable.

### III. Credit Easing

To analyze government security purchases, we assume for simplicity that there is no securitization at  $t = 2$  but banks can borrow to finance unsecuritized loans, using those loans as collateral. The price  $P_2$  at which the bank is indifferent between lending \$1 to a new project and investing \$1 in securities equates the fees from lending to capital gains from investing,  $(1 - P_2)/P_2 = f$ .

This yields the equilibrium  $P_2^*$  needed to restart lending:

$$(9) \quad P_2^* = \frac{1}{1+f}.$$

In our numerical example,  $P_2^* = 0.94$ , so prices must be about 10 percent higher than their level without government intervention for lending to restart.

The government demand per security,  $G$ , for the equilibrium price to reach  $P_2^*$  is implicitly given by the market clearing condition that the bank, government, and noise trader demands add up to 1:

$$(10) \quad d \left[ 1 - \frac{1 - P_2^*}{P_2^*} \frac{1 - h}{h} \right] + \frac{1 - \sigma}{P_2^*} + G = 1.$$

From this we compute:

$$(11) \quad G^* = \sigma - (1 - \sigma)f - d \left( \frac{h - f(1 - h)}{h} \right).$$

At this level of government demand for securities, banks are just indifferent between selling securities and lending. As government security purchases rise above the level given by equation (11), banks begin selling securities and lending, but the price stays at  $P_2^*$ . This continues until government purchases reach  $G^{**} = \sigma - (1 - \sigma)f$ , which is the share of securities at which the banks are fully out of holding seasoned securities. If the government buys more, the price will rise above  $P_2^*$ . Under the assumption of unit supply, the government's per security demand  $G^*$  is equal to the share of securities it holds. This share is increasing in the noise trader shock  $\sigma$  and decreasing in the haircut,  $h$ . In our numerical example,  $G^* = 3.3$  percent and  $G^{**} = 20.5$  percent. We can also show that the total government spending on securities is increasing in the size of the banking sector  $E_0$ , and diminishing in  $d$  and  $h$  (the parameters of balance sheet expansion), as well as in the magnitude of sentiment shock.

Government security purchases can thus be effective in this model in restarting project finance. In equilibrium, the government avoids a fire sale of assets and earns a return on its investment equivalent to the fees banks collect from funding entrepreneurs. We could have alternatively modeled a situation in which the government allows  $P_2$  to fall, but then intervenes after a crisis. In this case, government profits would be higher, but an asset fire sale would take place and some projects would be lost.

We can ask how security purchases compare to alternative policies of bank recapitalization, such as providing loans (liquidity) or equity injections to banks. These policies could also support markets for securities, but they are not without problems. First, banks may not use the increased liquidity to support key credit markets. For example, banks may use government loans or equity injections to repay their senior creditors (a feature not present in the model but important in the world). Banks may hoard liquidity either to satisfy regulatory capital requirements or because they expect an even bigger fire sale of assets in the future (Douglas W. Diamond and Raghuram G. Rajan 2009). Indeed, in 2009 banks used some of the injected liquidity to increase their reserves at the Fed. Banks may also buy distressed securities in markets that are so dislocated that new lending is unlikely to revive quickly even if asset prices rise sharply (see below). Liquidity injections may then be less effective than strategic

security purchases at raising security prices most relevant to stimulating new lending.

A second problem with providing loans or equity to banks is that such policies target whom to rescue. The government may end up providing resources to institutions that ultimately fail and perhaps even encourage some of the desperate lenders to gamble with government funds by taking on more risk. Security purchases, in contrast, address asset price dislocation directly, without picking winners. Importantly, the provision of liquidity can complement security purchases once security prices reach  $1/(1+f)$  because at that price level marginal liquidity goes straight into new lending.

One of the most interesting features of the Fed's security purchases in 2009 is its focus on the relatively less distressed assets, such as the debt of government-sponsored enterprises, rather than the relatively more toxic ones, such as sub-prime debt. The Fed also supported markets in several relatively safe financial instruments, such as commercial paper and money market funds. For reasons both in and beyond our model, this appears to be a good policy. The model predicts that security purchases that do not reduce returns on holding securities below those on making new loans will not restart lending. With the most toxic and severely dislocated assets, the government may not be able to raise prices enough to restart new lending in the short run. In contrast, the relatively safer assets the government propped up were in the less distressed areas, in which it was perhaps easier to get lending restarted. Indeed, the recovery of some of the most essential credit markets thanks to government security purchases can take place in the shadow banking system, largely avoiding the troubled banking sector.

The Fed's purchase of relatively safe securities also exposes it to less severe information problems and a smaller chance of losing money, which might be especially important for a public agency. At the same time, since the various securities are priced in the market relative to each other, the Fed's purchase of less toxic risky assets should also help to raise prices of the more toxic assets. This should strengthen bank balance sheets and facilitate the recovery of the more dislocated markets in the longer run.

In summary, there are two central messages of our analysis of the benefits of security purchases. First, compared to more targeted policies aimed at the sick institutions, such purchases protect the

government from wasting money and rewarding bad behavior while more directly stimulating credit markets as a whole. Second, the focus on propping up dislocated but still relatively safe securities offers perhaps the best chance for restarting lending quickly, as well as of introducing fewer fiscal and political risks.

We can finally comment on ex ante policies. Note that, as equation (1) makes clear, the haircut  $h$  works exactly like a capital requirement. An asset fire sale results as banks seek to raise cash to meet their capital requirements. Relaxing a capital requirement, which in the model is equivalent to reducing  $h$ , would also have a stabilizing influence. More generally, one could consider a policy of raising capital requirements in good times and reducing them in bad times. Such a policy would force banks to preserve liquidity for bad times and enable them to use that spare liquidity to make loans when they are needed.

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