## Topics in Bank Management: Lecture 10

#### Ronaldo Carpio

May 18, 2015

Ronaldo Carpio Topics in Bank Management: Lecture 10

▲□ ▶ ▲ □ ▶ ▲ □ ▶

- As we've seen, the source of bank fragility is the bank's borrowing of short-term debt.
- Classically, this is demand deposits, but in the recent crisis, we have also seen banks rely on overnight funding and 1-3 month duration loans.
- The process by which a bank borrows at short-term durations, and lends at long-term durations, is called *maturity mismatch*.
- Why do banks rely on short-term debt, when it leads to the possibility of bank runs and bank failure?
- We'll look at some (seemingly counterintuitive) models that argue that short-term debt is actually a desirable feature of banks.
- We'll also see a critique of these models.

- This model is based on the idea of *renegotiation*: after a contract has been agreed to, the parties may still have the power to renegotiate the original agreed rules.
- Recall the model of debt that we saw in Chapter 4.5.1, based on Hart & Moore (1994).
- In that model, the key idea was that the entrepreneur can always walk away from the project.
- In fact, the entrepreneur cannot commit to not walk away;
- A contract that specifies that the entrepreneur stay with the project until completion would not be credible.

- This is called "inalienability of human capital".
- If the entrepreneur has all the bargaining power, then the schedule of repayments cannot exceed the value of future cash flows at each point in time.
- In general, the threat of renegotiation (i.e. walking away, or paying less than the promised amount) by one party in a contract will lead inefficiency.
- Some projects will not be funded, because the parties will not agree to a contract if it will simply be renegotiated to an unfavorable state.

マロト マヨト マヨト

- In the models with renegotiation we saw earlier, it is the borrower that has the power renegotiate (since he can always walk away).
- Now, we will look at a model where the *bank* has the power to renegotiate in its role as borrowing from depositors.
- Consider an economy with an excess of savings, so the opportunity cost of funds is 1 (i.e. a zero real interest rate).
- Entrepreneurs have projects, but no cash.
- An entrepreneur can invest Iy, where I < 1, into a project.
- This results in a riskless cash flow y at t = 1.
- A financier is willing to provide funds in exchange for repayment R.
- If the project is liquidated before completion, it returns  $V_1$ .

- We will assume that financiers have *specialized information* about the projects they are lending to; other, competing financers do not have this information.
- If another, competing financier replaced the original financier, then in liquidation, the new financier would only get  $\alpha V_1$ , where  $0 < \alpha < 1$ .
- This means the market for financing is not *competitive* (i.e. all financiers are price takers).
- A specialized financer has some market power over borrowers that he already has a relationship with.

- Assume the borrower has all the bargaining power in the event of renegotiation.
- Any repayment R higher than  $V_1$  will be lowered to  $V_1$ , since the bank still has an incentive not to liquidate if  $R \ge V_1$ .
- Therefore, the maximum amount that the entrepreneur can borrow is  $V_1$ , which may be lower than the actual cash flow y.
- This is inefficient because some profitable projects will not be funded.

(日本) (日本) (日本)

- Now, let's look at the relationship between the lender (the bank), and its funders, the depositors.
- Suppose the bank is funded by a single, uninformed lender. Since the bank will only lend V<sub>1</sub> to the entrepreneur, the single lender will only lend V<sub>1</sub> to the bank.
- Now, assume that the bank has some bargaining power with respect to the single lender.
- The bank can renegotiate its repayment to the lender down to  $\alpha V_1$ , since this is the amount that would be recovered if the project was sold to some other bank.
- Just as before, the threat of lowered repayment due to renegotiation will limit the amount the single lender is willing to lend to  $\alpha V_1$ .

- Now, suppose that the bank is funded not by a single uninformed lender, but by demand deposits.
- Any attempt by the bank to renegotiate down the total payment to  $\alpha V_1$  will trigger a bank run.
- Suppose there are two depositors who have a deposit contract that allows them to withdraw  $V_1/2$  at any time.
- If the bank tries to renegotiate down their payment to the depositors by amount e, the depositors are faced with a 2 × 2 game in which each depositor can choose to Withdraw, or Wait.

	Withdraw	Wait
Withdraw	$\left(\frac{\alpha V_1}{2}, \frac{\alpha V_1}{2}\right)$	$\left(\frac{d}{2}, \alpha V_1 - \frac{d}{2} - \varepsilon\right)$
Wait	$\left(\alpha V_1 - \frac{d}{2} - \varepsilon, \frac{d}{2}\right)$	$\left(\frac{d}{2}-\varepsilon,\frac{d}{2}-\varepsilon\right)$

- The only Nash equilibria is where both depositors withdraw (a bank run).
- If the depositors run on the bank, they will deal directly with the entrepreneur, who will offer  $V_1/2$  to each depositor, the same as the original deposit.
- The only loser in this situation is the bank.
- Thus, demand deposits provides a thread of a bank run, which allows the bank to commit to a larger non-renegotiable payment.
- This allows the bank to borrow larger amounts, which allows the financing of larger projects.
- In this model, the role of the bank is to "tie human capital to assets".

# Calomiris & Kahn (1991)

- Calomiris & Kahn (1991), "The Role of Demandable Debt in Structuring Optimal Banking Arrangements", AER
- This is an earlier model that also argues that the benefits of short-term debt funding is to discipline the bank.
- In this model, the bank manager has the option to *abscond*, i.e. "run away" with the money before repaying the depositor.
- Just as in the case of the "inalienability of human capital", the bank manager cannot commit to not run away; a contract that specified this would not be credible.
- To prevent the bank manager from "runnning away", the bank can be *liquidated*: an outside party (e.g. the courts) will take over the bank and sell its assets for whatever can be obtained
- Liquidation will occur if there is a bank run.
- As in Diamond & Rajan, the possibility of a bank run disciplines the bank, and therefore allows larger amounts of financing.

(日) (日) (日)

- Another feature of this model is that depositors must monitor the bank in order to learn if the banker will run away.
- If monitoring of the bank is costly but benefits all depositors, this leads to free-riding
- The sequential service contraint (i.e. first come, first served) is efficient, because it gives an incentive to monitor.
- Depositors who monitor the bank will get the benefit of being first in line to withdraw.
- These models are counterintuitive in that the seeming cause of weakness (short-term financing) is actually a benefit.
- Are these models believable?

# Admati & Hellwig (2013)

- Admati & Hellwig (2013), "Does Debt Discipline Bankers? An Academic Myth about Bank Indebtedness"
- In response to the financial crisis, Admati & Hellwig, and many other observers, recommended to increase bank equity requirements substantially.
- This will reduce the amount of short-term debt (e.g. deposits) that banks use.
- Could potentially also reduce the lending capacity of banks.
- Short-term borrowing results in fragility of banks. Why do they do it?
- Diamond & Rajan (2001): bankers may renegotiate with depositors and repay them less.
- Calomiris & Kahn (1991): bankers may take the funds and "run away"
- The threat of bank runs prevents this behavior, and depositors will be willing to finance more projects.

- What do bankers in industry think of these arguments?
- "this narrative is not much heard in public debate; bankers do not refer to it in their lobbying, and it actually sounds odd to people outside the academe."
- from an article by a New Zealand central banker (Harrison 2004): "This approach appears to be little more than a theoretical curiosity and is perhaps more useful in explaining why banks do not get into situations where they can be gamed rather than explaining why financial fragility is a key aspect of efficient loan management."
- This is consistent with views of industry people that I have met.
- Nevertheless, it can be useful to see exactly where the differences between these models and industry experience lies.

マロト マヨト マヨト

- Another prominent theory for why banks depend on short-term debt is proposed by Gary Gorton.
- Summarized in his books "Slapped by the Invisible Hand: The Panic of 2007" (2010) and "Misunderstanding Crises: Why We Dont See them Coming" (2012).
- In this theory, banks' creditors prefer short-term durations and are willing to lend more under these conditions.
- Historically, bank notes could serve as a kind of money, because they were very convenient to use for transactions.
- In order for this to be possible, bank debt should be "informationally insensitive": since the bank is believed to be safe, new information does not affect the value of the debt.

・ロト ・回ト ・ヨト ・ヨト

- Note that this contradicts the discipline models: there, the depositors had to constantly monitor the bank in order to threaten runs.
- Here, the depositors believe they don't need to monitor the bank, which is why bank notes can be used as money.
- Banks are thought to be safe the vast majority of the time; when banks do get into trouble, it debt starts to lose its money-like properties (e.g. it trades at a discount, less people are willing to use it in transactions).

- In the years before the financial crisis, banks greatly increased their dependence on short-term debt.
- However, creditors of banks did not seem to pay much attention.
- Instead, it was the shareholders of banks who had a large incentive to monitor; the troubles at the banks were reflected in their stock prices.
- It may be that creditors free-ride on the information generated by shareholders.

(日本) (日本) (日本)

# Discipline Can Be Costly

- Bank runs and sudden withdrawals can have intrinsic social costs that are not captured in the models.
- In Calomiris & Kahn, bank runs prevent an even greater loss due to the bankers running away with the money, so is actually socially beneficial.
- In Diamond & Rajan, bank runs are socially costly, but don't actually occur in equilibrium.
- If depositors get an imperfect signal, banks may be closed down even if keeping them open would have been better off for society.
- During the financial crisis, Lehman Brothers was allowed to go bankrupt. This led to runs on its counterparties and asset fire sales worldwide.
- If there is contagion, then this magnifies the social cost of allowing a bank to experience a bank run.

소리가 소문가 소문가 소문가

# Short-Term Debt due to Conflicts of Interest

- Admati & Hellwig propose another explanation for the reliance on short-term debt: conflicts of interest between creditors and debtors.
- Typically, most banks have debt exceeding 90-95 percent of assets.
- The debt overhang effect refers to the fact that once debt is in place, a borrower can benefit by taking additional risk, at the expense of earlier creditors.
- For example: the owners of a heavily indebted firm seeks to finance an additional risky project.
- The potential loss of the owners is limited, due to limited liability. Therefore, the marginal loss from taking on more debt is decreasing.
- New debt will dilute the claims of previous lenders, if bankruptcy occurs.

소리가 소문가 소문가 소문가

- Older lenders may try to protect themselves from dilution by requiring a higher priority of repayment.
- If new debt has a shorter maturity, it will be paid before the older debt, effectively gaining in priority.
- This creates incentives for everyone to lend at short durations, a "maturity rat race".
- This effect is further worsened by guarantees of debt due to the government.

(日本) (日本) (日本)

- An alternative explanation for the dependence of short-term debt views a bank as an *inventory management* problem.
- The first inventory management problem was proposed by F. Y. Edgeworth (1888), "The Mathematical Theory of Banking".
- This model has become widespread in management and operations research, but is not utilized much in finance.
- This is now called the *newsvendor problem*.
- Suppose you are a store that sells newspapers.
- Demand for newspapers will be a random variable *D*.
- You need to choose how much stock of newspapers, y, to order, to maximize expected profits.

- The amount sold will be min(D, y): you can't sell more than you have, and more than is demanded.
- The cost of ordering y is cy; the selling price is p.
- Any unsold inventory will have zero value.
- Suppose that *D* is standard normally distributed, with CDF  $\Phi$  and PDF  $\phi$ .
- Suppose the realization of demand is *D*. Profits will be:

$$v(y) = E[p\min(D, y) - cy] = p \int_{z=0}^{y} (1 - \Phi(z)) dz - cy$$

$$= -cy + p \int_{z=0}^{y} z\phi(z)dz + py(1-\Phi(y))$$

(4月) イヨト イヨト

$$v(y) = -cy + p \int_{z=0}^{y} z\phi(z)dz + py(1-\Phi(y))$$

• The first-order conditions for maximizing this expression are:

$$v'(y) = p - c - p\Phi(y) = 0$$

• Let *S* denote the optimal level of stock after ordering. Then:

$$\Phi(S) = \frac{p-c}{p}$$

- S is such that the probability that  $D \leq S$  is equal to (p-c)/p.
- This is called the *critical fractile* solution, which is the origin of the term "fractional reserve" banking.

- Note that the probability of stockout (i.e. D > S) is c/p, which is nonzero.
- It is optimal for the firm to accept some positive probability of running out of inventory.
- This is why hotels and airlines overbook their capacity (that is, promise more seats than are actually available).
- Some customers will fail to show up or cancel, so actual demand will be random.
- In a more modern example, cloud computing services "oversell" their capacity.
- Most customers will not be using the servers all of the time.
- > If the firm does not oversell enough, then costly capacity will go idle.

▶ For next week, please read Chapters 8.1-8.2.2 in the textbook.

<ロ> (四) (四) (注) (注) (注) (注)