Lecture 5 - Recommended Problems
Solutions

☆☆ Problem 7, Chapter 6

The Troubled Asset Relief Program (TARP)
Consider a bank that has assets of 100, capital of 20, and short-term credit of 80. Among the bank's assets are securitized assets whose value depends on the price of houses. These assets have a value of 50.

a. **Set up the bank's balance sheet.**

Assets		Liabilities	
Securitized Assets	$50	Short-term credit	$80
Other Assets	$50	Capital	$20
Total Assets	$100	Total Liabilities and Equity	$100

Suppose that as a result of a housing price decline, the value of the bank's securitized assets falls by an uncertain amount, so that these assets are now worth somewhere between 25 and 45. Call the securitized assets "troubled assets." The value of the other assets remains at 50. As a result of the uncertainty about the value of the bank's assets, lenders are reluctant to provide any short-term credit to the bank.

b. **Given the uncertainty about the value of the bank's assets, what is the range in the value of the bank's capital?**
The range in the value of capital is from -$5 if things are bad to $15 if things are good. Below are the two corresponding balance sheets.

Assets		Liabilities	
Troubled Assets	$25	Short-term credit	$80
Other Assets	$50	**Capital**	-$5
Total Assets	$75	Total Liabilities and Equity	$75

Assets		Liabilities	
Troubled Assets	$45	Short-term credit	$80
Other Assets	$50	**Capital**	$15
Total Assets	$95	Total Liabilities and Equity	$95

As a response to this problem, the government considers purchasing the troubled assets, with the intention of reselling them again when the markets stabilize. (This is the original version of the TARP.)

c. **If the government pays 25 for the troubled assets, what will be the value of the bank's capital? How much would the government have to pay for the troubled assets to ensure that the bank's capital does not have a negative value? If the government pays 45 for the troubled assets, but the true value turns out to be much lower, who bears the cost of this mistaken valuation? Explain.**
If the government pays \$25 for the troubled assets, the bank will be left with \$50+\$25=\$75 in assets, versus \$80 in liabilities. The bank would have negative equity, or in other words the bank would be insolvent. If the government instead pays \$25 for the troubled assets, the bank will be left with \$50+\$45=\$95 in assets, versus \$80 in liabilities. The bank would have capital of \$15. Once the government buys the asset, it faces all the risk associated with the asset. If the government paid \$45 dollar it would take the loss if the value turns out to be lower. Similarly, if the government paid \$25 it would enjoy all the upside if the value turns out to be higher.

Suppose instead of buying the troubled assets, the government provides capital to the bank by buying ownership shares, with the intention of reselling the shares when the markets stabilize. (This is what the TARP ultimately became.) The government exchanges treasury bonds (which become assets for the bank) for ownership shares.

d. **Suppose the government exchanges 25 of Treasury bonds for ownership shares. Assuming the worst-case scenario (so that the troubled assets are worth only 25), set up the new balance sheet of the bank. (Remember that the firm now has three assets: 50 of untroubled assets, 25 of troubled assets, and 25 of Treasury bonds.) What is the total value of the bank's capital? Will the bank be insolvent?**
The new amount of assets would be \$25+\$25+\$50=\$100. With liabilities of \$80, this leaves us with \$20 of capital. Since the bank has positive capital, it will now be solvent even in the worst-case scenario.

Assets		Liabilities	
Troubled Assets	\$25	Short-term debt (e.g. deposits)	\$80
Treasury Bonds	\$25	Ownership shares	\$20
Other Assets	\$50		
Total Assets	\$100	Total Liabilities and Equity	\$100

e. **Given your answers and the material in the text, why might recapitalization be a better policy than buying the troubled assets?**
Recapitalization allows the government to make the bank solvent without spending any cash, just by giving Treasury Bonds (which it issues!) to the bank. In other words, the government owes money to the bank, and the bank if owned by the government. This can be particularly attractive at a time when the government might have difficulty

of selling its bonds to the public (and in particular, the other banks). By becoming a shareholder of the bank, the government can insure that banks will indeed continue to finance the government.

☆ Problem 8, Chapter 6

Calculating the risk premium on bonds.

The text presents a formula where:

$$(1+i) = (1-p)(1+i+x) + p(0)$$

where we define p as the probability the bond does not pay at all (the bond issuer is bankrupt) and has a zero return, i is the nominal interest rate, and x is the risk premium.

a. **If the probability of bankruptcy is zero, what is the rate of interest on the risky bond?**
When there is no risk of default, $p = 0$ and thus $x = 0$ makes the equation hold. The interest rate on the bond is just i.

b. **Calculate the probability of bankruptcy when the nominal interest rate for a risky borrower is 8% and the nominal policy rate of interest is 3%.**
The previous equation writes:

$$\begin{aligned} (1+i) &= (1-p)(1+i+x) \\ \Rightarrow \quad p &= 1 - \frac{1+i}{1+i+x} \end{aligned}$$

Plugging in the values and solving numerically, we have:

$$p = 1 - \frac{1.03}{1.08} \approx 0.05$$

c. **Calculate the nominal interest rate for a borrower when the probability of bankruptcy is 1% and the nominal policy rate of interest is 4%.**

$$\begin{aligned} 1+i &= (1-p)(1+i+x) \\ x &= \frac{1+i}{1-p} - (1+i) \\ x &= \frac{(1+i)p}{1-p} \end{aligned}$$

and plugging in the values from the question, we have:

$$x = \frac{1.04 * 0.01}{0.99} \approx 0.01$$

d. **Calculate the nominal interest rate for a borrower when the probability of bankruptcy is 5% and the nominal policy rate is 4%.**
Since we are calculating the interest rate (and not the risk premium) we can use the following equation:

$$
\begin{aligned}
(1+i) &= (1-p)(1+i+x) \\
\Rightarrow \quad i+x &= \frac{1+i}{1-p} - 1.
\end{aligned}
$$

and plugging in the numerical values, we have:

$$i+x = \frac{1.04}{0.95} - 1 \approx 0.095$$

e. **The formula assumes that the payment upon default is zero. In fact, it is often positive. How would you change the formula in this case?**
Let's all the payment upon default D. Then the new formula would be:

$$1+i = (1-p)(1+i+x) + pD$$