Problem Set 5

ECON 40364: Monetary Theory and Policy
Prof. Sims
Fall 2020

Instructions: Please answer all questions to the best of your ability. You may consult with other members of the class, but each student is expected to turn in his or her own assignment. This problem set is due on Sakai by 2:20 pm on Wednesday, November 11.

1. **Banking**: Suppose that First Source Bank has the following balance sheet:

Assets	Liabilities plus Equity
Loans: $100	Deposits: $90
Securities: $10	Borrowings: $20
Cash Reserves: $10	Equity: $10

Loans are illiquid. If they are held, each period they earn 20 percent interest. But if First Source has to sell a lona, they must do so at a 50 percent discount (i.e. selling $1 of loans generates only $0.50 in cash). Securities earn 10 percent interest if held and can be sold dollar-for-dollar in the event the bank needs to raise cash. The bank pays no interest on deposits. If pays 10 percent interest on borrowings.

(a) What is the bank's leverage ratio?

(b) If the bank sells no loans or securities, has no withdrawals or extra deposits, and does no additional borrowing, what will be its profit? What will be its return on equity?

(c) Suppose that the bank's initial balance sheet is as shown above. Suppose that it faces a $20 withdrawal. Assuming it cannot adjust its borrowings, how will the bank adjust the asset side of its balance sheet to meet the withdrawal? How will the bank's equity be affect? Show in a new T-Account.

(d) Now assume the initial balance sheet is what you end up finding in part (c), but that there is another $20 withdrawal. Assuming it cannot adjust its borrowings, how will the bank adjust the asset side of its balance sheet to meet the withdrawal demand? How will the bank's equity be affected? Show in a new T-Account.

(e) Based on your answers above, discuss the pros and cons of holding relatively more liquidity on the asset side of the balance sheet (i.e. more securities and cash compared to loans).

2. **Bank Runs I**: Suppose that there are 1000 households with $1 each. These households live for three periods: 0, 1, and 2. The households have no need for consumption in period 0. A fraction $\frac{1}{2}$ of households will need to consume in period 1; the other fraction $\frac{1}{2}$ have the option of waiting to consume until period 2. In period 0, a household does not know whether it will need to consume in period 1 or can wait until period 2.

There is an illiquid long term investment opportunity which costs $1 to invest in. If held until period 2, the project offers a gross return of 1.8. If liquidated in period 1, the project only returns $\frac{1}{2}$. Suppose that the household's utility function if $\ln C$. If a household chooses to not to invest its $1, it can simply store it and have consumption $C = 1$ in whatever period (1 or 2) the household needs to consume.

(a) What is the expected (gross) return on the investment opportunity? Is this higher or lower than the expected (gross) return on storage?

(b) Suppose that each household gets utility from consumption given by the function $U = \ln C$. Calculate the household's utility from storing its \$1 as well as the household's expected utility from investing in the project. Will the long run project get funded directly by households?

(c) Now suppose that there is a mutual bank which takes deposits from the 1000 households. The bank anticipates that 500 households will need to withdraw their money in period 1. The bank promises households who withdraw in period 1 a gross return of $r_1 = 1.1$. How much of the \$1000 in deposits it receives should the bank store in its vault, and how much should it invest in the investment project? What return can the bank promise households who withdraw their money in period 2 (i.e. what is r_2)?

(d) Calculate the household's expected utility from depositing with the bank and verify that it is greater than expected utility from storage.

(e) What is the maximum number of additional withdrawals (additional meaning withdrawals from depositors who do not have to consume) in period 1 before the bank will be unable to pay back deposits the promised r_1?

(f) Suppose that you are a household who does not have to consume in period 1. If you expect $N \geq 0$ other "patient" households to withdraw their money in period 1, it would also make sense for you to withdraw. Solve for N.

3. **Bank Runs II**: Suppose that time lasts for three periods, $T = 0, 1, 2$. In period 0, 100 different households have \$1 to invest each. A household will need to consume in period $T = 1$ with probability p, and in period $T = 2$ with probability $1 - p$. In period 0, a household doesn't know whether he/she will need to consume in $T = 1$ or $T = 2$. Households have access to an investment project. If a household invests \$1 and liquidates in period $T = 1$, it earns $r_1 = 0.5$. If it keeps its money in the project until $T = 2$, it will earn $r_2 = 2.5$. Alternatively, a household can simply store its money in cash, where cash returns $r_1^C = r_2^C = 1$ in either period. With probability $p = 2/3$ the household will need to consume in period $T = 1$. With probability $1 - p = 1/3$ the household does not need to consume until period $T = 2$. A household's utility function is given by the natural log: $u(C) = \ln C$, where C is consumption. 20 points total.

(a) Would a household prefer to invest in the project directly or hold cash? Show your work to justify your answer. (3 points)

(b) Now suppose that there is a mutual bank which takes deposits from households and invests in the project. Suppose that the bank offers a household a (gross) return of $r_1^d = 1.1$ on deposits liquidated in $T = 1$. What is the r_2^d that the bank can offer households who withdraw their deposits in $T = 2$? Show your work to justify your answer. (7 points)

(c) With these returns on deposits, will the household prefer to invest directly in the project, hold cash, or gives its money to the bank in the form of deposits? Show your work to justify your answer. (3 points)

(d) Suppose that in $T = 1$ a household is revealed to not need to consume until period $T = 2$. But suppose that he/she thinks that a fraction $f > p$ of households will withdraw in period $T = 1$. Suppose that $f = 3/4$. Would it make sense for the household to withdraw in period $T = 1$? (7 points)

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4. **Terms:** Please provide brief definitions of the following term and discuss their significance during the Financial Crisis and ensuing Great Recession.

   (a) Securitization

   (b) Mortgage backed security

   (c) Underwater mortgage

   (d) Shadow banking system

   (e) Repurchase agreement

   (f) Haircut

   (g) Fire sale

   (h) Quantitative easing

   (i) Forward guidance