Solution and grading guidelines to Final SØK2010 Banking, NTNU

Question 1, 25 points

[8 points for each of the 3 questions]

1. What problems does "asymmetry of information" create in the loan market? Can banks help to reduce the impact of this problem? [8 points]

PS3, Q4

One of the biggest problems within the loan market is that of asymmetric information. The banks does not necessarily know as much about the borrower in terms of creditworthiness, as he/she knows about herself. This can create problems, because banks may choose the wrong borrowers to lend out to, and not giving out a loan to someone who "deserves" it.

The two biggest problems of asymmetric information in the loan market is that of Moral hazard and Adverse selection.

1. Moral hazard is the risk of one part taking advantage of the situation between two parties ***after*** a contract has been settled, at the cost of the other part. A so called "hidden action". This could be for example a bank taking high risk by leveraging its assets to obtain a higher ROE (return on equity) with their own customers money, expecting to be bailed out by the central bank/government in case anything goes wrong. Another example could be a worker who just got a new work-car. Getting the new car could lead to more reckless driving, because the driver know that it will be the firm who pays, and not him in case anything goes wrong (crash etc).

2. Adverse selection on the other hand is the problem of distinguishing between different "types" of people ***before*** a contract is settled. For example, a bank may find it hard to determine if the borrower is a risky or a safe type and may be uncertain of what the loan is going to be used for.

Solutions to Moral hazard in general:

Monitoring: The bank can monitor the borrower, to make sure that he/she use the money as indented.

Collateral: Collateral is a valuable asset that the borrower pledges as security for obtaining the loan. An easy example is when you buy a house, the bank may take collateral in the house, in case you fail to pay down on your mortgage.

Solutions to adverse selection in general:

Collateral: Collateral is a valuable asset that the borrower pledges as security for obtaining the loan. An easy example is when you buy a house, the bank may take collateral in the house, in case you fail to pay down on your mortgage.

Signaling: The borrower can signal that they have gotten loans earlier from another bank, to show that they can be trusted, and that the bank will not lose money when they issue a new loan or finance a project. Furthermore, the borrower can show the bank their former projects, to convince the other banks that the project they have taken before are safe, and not likely to default.

Screening: The banks who are unsure on whether or not they should finance the borrower/project, can screen for example by acquiring credit information by credit bureaus, to see their financial status, and if they are more prone to making risky choices.

2. What is the difference between a bank that is insolvent and one that is illiquid?

[8 points] PS5, Q2,1

A bank that is illiquid is one that does not have sufficient cash or liquid assets to meet its immediate obligations such as deposit withdrawals and other payments. Such a bank may be unable to meet the demands of its depositors and other creditors on a daily basis, but it is still solvent in the long term because it has sufficient assets that can be liquidated to pay off its debts.

On the other hand, a bank that is insolvent is one that has liabilities that exceed its assets, meaning it cannot meet its financial obligations. An insolvent bank cannot pay off its debts or meet its financial obligations in the long term. Insolvency can be caused by a variety of factors, such as bad loans, poor investments, or mismanagement. When a bank is insolvent, it may be forced to declare bankruptcy, be taken over by regulators, or merged with another institution.

3. What is the link between the safety net provided by the government to the banking system and the relatively heavy regulation of the same industry by the government? PS5, Q2,3 [8 points]

The link is that the safety net provided by the government to the banking system, such as deposit insurance and access to the lender of last resort, is intended to protect depositors and prevent financial crises. However, this safety net also creates moral hazard, which is the tendency of banks to take on more risk than they would in the absence of government protection. Knowing that their deposits are insured and that they have access to emergency funding from the central bank, banks may be more willing to engage in risky activities that could lead to insolvency.

To mitigate this moral hazard, the government imposes regulations on the banking industry. These regulations are intended to ensure the safety and soundness of the financial system, prevent excessive risk-taking, and protect consumers. The regulations can take many forms, such as capital requirements, liquidity rules, and restrictions on activities such as proprietary trading.

Overall, the link between the safety net provided by the government and the heavy regulation of the banking industry is that the safety net creates moral hazard, which necessitates regulation to mitigate the risk-taking behavior of banks.

Question 2, 25 points, PS2, Q4 [5 points for each of the five parts = 25 points, partial credit can be given to correct setup but wrong calculation]

(1)

$$\max_x \; logc_1 + 0.9logc_2$$

$$s.t:$$

$$c_1 = 2 - x$$
$$c_2 = 1 + 1.25x$$

Insert c1 and c2 into the utility function, then derive with respect to x, and set equal to zero.

$$\max_x \; \log(2 - x) + 0.9\log(1 + 1.25x)$$

$$FOC: \; -\frac{1}{2 - x} + 0.9 * \frac{1.25}{1 + 1.25x} = 0$$

$$x^* = 0.5263$$

This is the investment for the agent in period 1.

Therefore, the agent receives a payment in the second period of $0.5263 * 1.25 = 0.6579$

(2)

To find optimal consumption, we insert the optimal investing in the first period ($x^* = 0.5263$) into the expressions for c1 and c2. Then, we get the following results:

$$c_1 = 2 - 0.5263 = 1.4737$$

$$c_2 = 1 + 1.25 * 0.5263 = 1.6579$$

(3)

Without the financial market, the agent cannot invest a proportion of their income at t=1 and will not receive any interest from the investment at t=2. He then needs to consume his whole endowment (x=0) and receive a utility of:

$$log2 + 0.9log1 = 0.6931$$

However, with the financial market, the agent will invest $x^* = 0.5263$ at t=1 and therefore receive a total utility of:

$$\log(1.4737) + 0.9\log(1.6579) = 0.8428$$

The conclusion is that the agent increases his total utility by transforming some of his wealth from the first period to the second period.

(4)

The optimal decision of the agent depends on the value of x*.

$$\max_{x} \; logc_1 + \beta logc_2$$

$$s.t:$$

$$c_1 = Y_1 - x$$
$$c_2 = Y_2 + Rx$$

If we insert the expressions for c1 and c2 into the utility function and solve for x, we get the optimal decision for the agent:

$$\max_{x} \; \log(Y_1 - x) + \beta \log(Y_2 + Rx)$$

$$x^* = \frac{\beta}{1+\beta} * (Y_1 - \frac{Y_2}{\beta R})$$

Given the market fractions, we do not know whether the agent will borrow or lend at optimum, so we need first try one interest rate and then check the consistency.

1. First, we try the borrowing rate R_b by assuming that the agent borrows (or $x^* < 0$) at optimum.

$$x^* = \frac{\beta}{1+\beta} * (Y_1 - \frac{Y_2}{\beta R_b})$$

If $x^* < 0$, we get consistent result, so the agent does borrow in the market. However, if $x^* > 0$, we get inconsistent result, so the agent does not borrow in the market. In the latter case, the agent neither borrow nor lend.

$$x^* = \frac{0.9}{1+0.9} * \left(2 - \frac{1}{0.9 * 1.25}\right) = 0.5263 > 0$$

This positive result means that the agent saves at optimum, so it is inconsistent with using the borrowing rate.

2. Second, we try the lending rate R_l by assuming that the agent saves or lends (or x*> 0) at optimum:

$$x^* = \frac{\beta}{1+\beta} * (Y_1 - \frac{Y_2}{\beta R_l})$$

If x* > 0, we get consistent result, so the agent does lend x in the market. However, If x*<0, we get inconsistent result, so the agent does not lend in the market.

$$x^* = \frac{0.9}{1+0.9} * \left(2 - \frac{1}{0.9 * 1.15}\right) = 0.489 > 0$$

This is consistent with our assumption. Therefore, the agent will save 0.489 at optimum.

(5)

In the last task (4), we found optimal saving for the agent x*=0.489. To find the utility we need to insert the optimal x^* into the consumption functions $c_1 and\ c_2$, then insert these consumption functions into the utility function.

1. First calculate the utility achieved <u>with transaction costs</u>:

$$c_1 = Y_1 - x = 2 - 0.489 = 1.511$$
$$c_2 = Y_2 + R_l x = 1 + 1.15 * 0.489 = 1.56235$$

Inserting these into the utility function gives:

$$\log(1.511) + 0.9\log(1.56235) = 0.814$$

(The natural logarithm is used for consistency when comparing to the case with no transaction costs)

2. Second, we calculate the utility achieved with <u>no transaction costs:</u>
(Calculated this in task 3)

$$\log(1.4737) + 0.9\log(1.6579) = 0.8428$$

We see that the utility received when there are no transaction costs are higher than the case with transaction costs in the financial market.

Question 3, 25 points, PS3, Q2 [5 points for each of the five parts]

(1)

We know that $u(c) = 1 - \frac{1}{c}$.

Then $E(u(c)) = \frac{1}{4} * u(1) + \frac{3}{4} * u(2) = \frac{1}{4} * \left(1 - \frac{1}{1}\right) + \frac{3}{4} * \left(1 - \frac{1}{2}\right) = \frac{3}{8}$

(2)

We know that to make the customers *just as well of* as in part 1, we need to achieve the same utility of $\frac{3}{8}$. Then, we need to find the value of c, such that we achieve a utility of $\frac{3}{8}$.

Calculations:

$$u(c) = 1 - \frac{1}{c}$$

$$\Rightarrow \frac{3}{8} = 1 - \frac{1}{c}$$

$$\Rightarrow \frac{1}{c} = 1 - \frac{3}{8}$$

$$\Rightarrow \frac{1}{c} = \frac{5}{8}$$

$$\Rightarrow c = \frac{8}{5} = 1.6$$

(3)

Notation:

- P = Profit
- S = share of depositors wanting their money back

1. *The banks expected profit:*

First, we calculate the expected return of the investment:

$$E(x) = \frac{1}{4} * 1 + \frac{3}{4} * 2 = \frac{7}{4}$$

The expected profit is the expected value of the investment, minus the amount the bank pays to its customers (which we found in task 2):

$$E(p) = E(x) - c = \frac{7}{4} - 1.6 = 0.15$$

2. *Maximum share of depositors that could demand their money after one period without making the bank insolvent:*

If the bank is going to maintain a profit over zero (p>0) when depositors demand their money back, then:

$$E(s) - c \geq 0 \quad \Longrightarrow \quad s * 1 + (1 - s) * 2 - 1.6 \geq 0$$

$$s \leq 0.4$$

Meaning: The expected share of depositors taking out money in one period, subtracted with the amount the bank pay out to its depositors, must be above or equal to zero. When we solve this inequality, we get that the maximum share of depositors that could demand their money back after one period without making the bank insolvent is 0.4.

(4)

We do the same exercise as in (2), but with the new amount to be payed by the bank: c = 1.7

1. *The banks expected profit:*

$$E(p) = E(x) - c = \frac{7}{4} - 1.7 = 0.05$$

2. *Maximum share of depositors that could demand their money after one period without making the bank insolvent:*

If the bank is going to maintain a profit over zero (p>0) when depositors demand their money back, then:

$$E(s) - c \geq 0 \quad \Longrightarrow \quad s * 1 + (1 - s) * 2 - 1.7 \geq 0$$

$$s \leq 0.3$$

Meaning: The expected share of depositors taking out money in one period, subtracted with the amount the bank pay out to its depositors, must be above or equal to zero. When we solve this inequality, we get that the maximum share of depositors that could demand their money back after one period without making the bank insolvent is 0.3.

(5)

No, independency with regards to withdrawing deposits is not reasonable to expect. The main reason for this is that of contagion. When several people rush to withdraw their money, it is reasonable to assume that this is because of issues the bank may be facing. The rumor will spread, and the bank may face a bank run if enough people withdraw their money at the same time. If a lot of people are suspecting that the bank may become insolvent, it is in their own interest to withdraw their deposits before anyone else, to secure that you get back your money. Because of this, the bank run is an "all" problem, where everyone is rushing to withdraw their deposits. For the reasons given above, assuming independency of depositor's liquidity demands is not wise.

Question 4, 25 points, PS5, Q1 **[6 points for each of the four parts, partial credit for correct formula but wrong numbers]**

1. Return on Equity (ROE)

$$ROE = \frac{Net\ income\ \ (1)}{Equity\ (2)}$$

$$Pretax\ net\ Income = \ \ Income\ before\ Taxes = 8000$$
$$(1) Net\ Income\ \ = income\ before\ Taxes - Tax = 8000 - 3000 = 5000$$

$$(2)\ Equity = Common\ Stock + paid - in\ capital + retained\ earnings$$
$$= 12000 + 4000 + 12000 = 28000$$

$$ROE = \frac{Net\ income\ (1)}{Equity\ (2)} = \frac{5000}{28000} = 17.85\%$$

2. Return on assets

$$ROA = \frac{Net\ Income}{Total\ Assets} = \frac{5000}{183000} = \ 2.73\%$$

3. Equity multiplier

$$Equity\ Multiplier = \frac{Total\ Assets}{Equity} = \frac{183000}{28000} = 6.54$$

4. Net interest margin

$$Net\ Interest\ Margin = \frac{Net\ interest\ income}{Total\ assets}$$

$$= \frac{Total\ interest\ income - total\ interest\ expenses}{Total\ assets}$$

$$= \frac{20000 - 11000}{183000} = 4.9\%$$