SØK2010 Spring 2021 Exam

1 Central Bank

Assets	Liabilities
Securities Discount loans to banks Gold Buildings Foreign reserves	Reserves of banks Currency in circulation

The ones that belong to the asset side is securities, discount loans to banks, gold, foreign reserves and buildings.

2 Bank Run

Three ways to stop or reduce the risk of a bank run is reserves and capital requirements, government deposit insurance, and lender of last resort. I will start by looking at reserves and capital requirements. The difference between the banks' capital requirement and reserve requirement is that the reserve requirement is recorded on the assets side of the banks' balance sheet and the capital requirement is recorded on the liabilities side of the banks' balance sheet. More specifically the reserve requirement is the minimum percent of the customers deposits and notes that the bank must keep as reserves, and it is set by the central bank. The capital requirement is the amount of capital the financial regulator requires the bank to hold. We can express the capital requirement as a capital adequacy ratio of equity as a percent of risk-weighted assets. This means that it might vary depending on for example how risky the banks loans are. The way these stop or reduce the risk of a bank run is that the reserves requirement makes sure that the bank always has some cash/liquid assets to give to those who come to take out their deposits. The capital requirement makes sure that the banks does not become insolvent by taking on excess leverage. A limitation with the use of reserves and capital requirements is that they reduce the efficiency in the banks' use of money. This increases the credit costs of capital for all costumers. Even though reserves and capital requirements are important in preventing bank runs, they are very difficult to use if a bank run has already started.

Next, we will look into government deposit insurance. Government deposit insurance means that the government ensures bank customers money even if the bank goes under. If the bank were to go under people would still get their money back. This is effective in stopping a bank run because the agents do not need to run on the bank to try and save their money. A limitation of government insurance is if people are worried that the government itself is about to run out of money, they still might make a run on the bank. Maybe a more important limitation is that when the customers know that their money is insured, they might take little interest in monitoring that the bank takes good care of their money. This causes a problem of moral hazard. Lastly, government deposit insurance might cause what is known as the too-big-too-fail problem. The problem is that if a bank becomes insolvent this would normally mean that the government would bail out the bank, or that the bank must

close. Since banks often owe each other large amount of money, closing the bank could cause insolvency problems at other banks because they do not get their loans paid back. This would make very hard for the government to let large banks fail, as it might have a ripple effect.

Lastly, we have the lender of last resort. The intuition here is that when people run to take out their money the bank would not run out of money of, they could borrow large amounts of money fast. This could be an effective way to stop the run, as one proves to the people that the bank does not run out of money. A key here is that the central bank is the lender of last resort, meaning that this will only be an option if there are no other. Still, there are several issues regarding the central bank being a lender of last resort. First, this might be a huge risk for the central bank, as it might create a great moral hazard problem. It also blurs the lines of what is fiscal policy and giving individual institution assistance might cause reputational issues.

3 Agency Problems

A) The government deposit insurance is a problem of moral hazard. A problem of moral hazard is a problem that occurs after a contract has been written and is a problem of "hidden action". The reason why government deposit insurance poses a problem of moral hazard is because it is not if the bank is good or bad that causes the problem. The key thing here is that having the government insuring deposits gives the bank incentives to take on larger risks to get higher expected profits. The bank can do that because there is asymmetric information. The government cannot fully control what project the banks take on and the bank utilises this to create bigger profits for themselves and dumping the risk on the government. This is something the bank does because it figures that it has higher expected value than undertaking only safe loans, it does not do this because it is the type of bank that is risky. In other words, we have a situation where the banks action is hidden and signing the contract with the government changes what is more profitable for the bank. This is the essence of moral hazard.

B) Lenders not being able to identify which firms have good and bad projects is a problem of adverse selection. A problem of adverse selection is, like problems of moral hazard, caused by asymmetric information. If the bank had full information, it would not lend to the firms with projects that have negative NPV because this imposes a loss on the bank, in addition to being not optimal for society to undertake at all. The things that characterize problems of moral hazard is that the problem before the contract is written and it is a problem of "hidden types". In our case it is determined in advance if the project of the firm has a positive or negative NPV, the problem is that the bank cannot tell them apart. This causes the bank to sign contracts with "bad" firms as well, underlining that the problem occurred before the contract was written.

4 Agency Problems

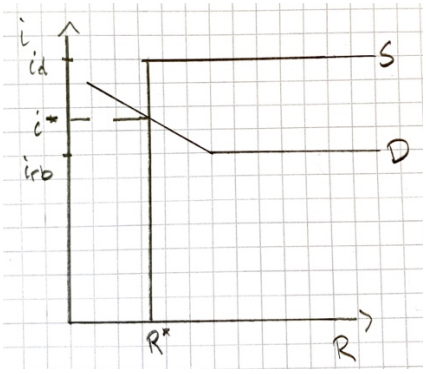
To mitigate problems of moral hazard, one can use collateral or monitoring. If the government can monitor how much risk the banks take, they can impose a penalty for taking on excessive risk. A penalty could be a fine, or something else. This would disincentivise the banks to take on excess risk. However, this might be hard to do in practice as it would require a good measurement of risk and it might be expansive to implement. Using collateral might not be the easiest to implement when the government is trying to mitigate the moral hazard problem of the banks taking on excessive risks. Anyway, the way it would work is that having pledged some collateral, the bank would take a greater loss themselves when the bad case occur, here meaning that the risky investments impose a loss on the government. If the loss for the bank was sufficiently large, this would also disincentives them from taking excess risks.

In the case of adverse selection one can use screening, signalling, and collateral to mitigate the problem. Screening would in our case involve the lender using for example a credit rating or a credit bureau to try and separate the firms with good projects from the firms with bad projects. One can imagine that having a history of undertaking bad projects makes it more likely that the project at hand is bad as well. Next, we have that the firms could try to signal to the bank which type they are. This they could do by showing to previous projects, showing the detail of the project and such. Lastly, collateral can also be used as a way of mitigating problems of adverse selection. This works because if the size of the collateral is set right, it can make the project unprofitable for the firms with bad projects. This is because if the project fails or if it just is bad, some of the cost would be transferred to the firm. If this cost is high enough it will disincentivise the firms with bad projects to undertake them. A problem with collateral is that not everyone might have access to it, meaning that firms with good project might not get funding. This means that there is a loss associated to the use of collateral as well, and a reason why the collateral shouldn't be set higher than necessary.

5 Central Banking

To analyse how the actions of the central bank affect the interbank overnight interest rate we will need to examine the banking system's demand for reserves and the central banks supply of reserves. This I will do by using a graph to show both the demand and supply, and thereby show how the actions of the central bank influence the interest rate. For simplicity I will sometimes refer to the interbank overnight interest rate as just the interest rate.

Graphically the supply and demand curves will look as following when we have reserves (R) in the first axis and the interest rate (i) on the second axis.

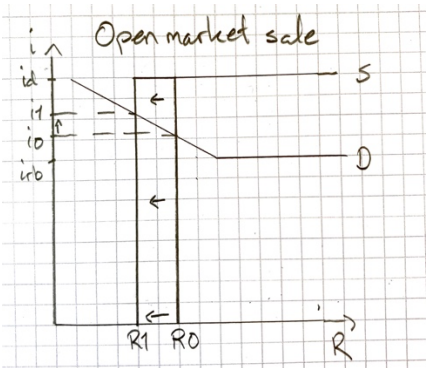


First, we look at the supply curve. The supply curve is vertical because the supply of reserved are fixed to the amount the central bank set. We assume that the central bank can set the supply of reserves as it wishes to meet its objectives. The reserves can be divided into two categories, borrowed reserves and nonborrowed reserves, where the borrowed reserves are discount loans and the nonborrowed reserves are given by open market operations. Next, we see that as the interest rate reaches the level of the discount rate the central banks sets (i_d), the supply curve becomes horizontal. The reason why the supply curve becomes horizontal at this point is that no bank would loan money from another bank, when it could loan money more cheaply from the central bank.

The demand curve is downward sloping at first but eventually becomes flat. The banks need to hold reserves that are required, but they might also choose to hold excess reserves. The demand curve is drawn, assuming that all other things than the interest rate is held equal. The first part of the demand curve reflects that when the interest rate is high, the alternative costs of holding reserves is high, and the banks will choose to have low levels of reserves. This is because when the interest rate is high, they can choose to lend out their excess reserves and earn a high return. When the interest rate decreases the alternative costs of reserves is decreasing as well, and the demand of deserves will therefore increase.

Lastly, we have that the equilibrium in the interest rate market is where the supply and demand curves intersect. This gives the reserves R* and the interest rate i*. In the following tasks we will see how different actions of the central bank will affect the interest rate.

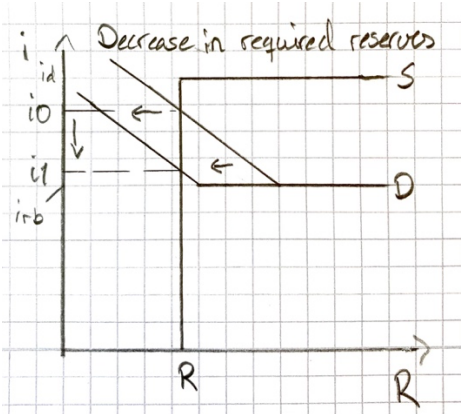
A) An open market sale of government bonds will decrease the supply of reserves, and graphically we can show this as a shift in the supply curve to the left.



We see that the result from the open market sale is that the equilibrium level of

reserves decreases from R0 to R1, and the equilibrium interbank overnight interest rate increases from i0 to i1.

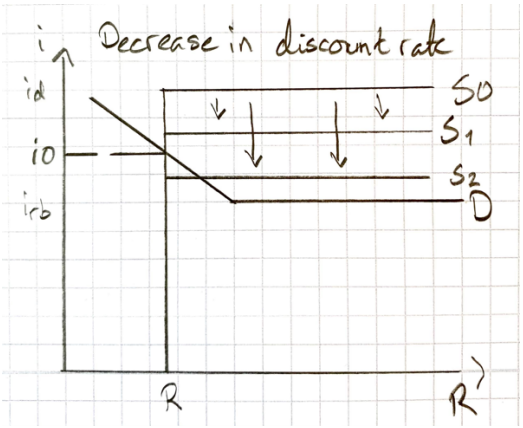
B) A decrease in the required reserves ratio does not affect the supply of reserves, but the demand. When the banks need to hold less reserves the demand for deserves will decrease, and graphically we can show this as a shift in the demand to the left.



What we see is that the decrease in the required reserves ratio does not change the level of reserves as the supply is fixed, but it does influence the interest rate. The equilibrium interbank overnight interest rate decreases from i0 to i1.

However, decreasing the required reserves ratio is not normally a tool used to influence the interest rate. Therefore, it is often done together with an open market operation, here it would be an open market purchase, to avoid change in the interest rate.

C) A decrease in the discount rate does not necessarily have a direct effect on the interest rate. When the discount rate is decreased this effect the roof of the interest rate, but if the equilibrium interest rate is below the roof it will not be directly affected.



Graphically, we see that even though the roof shifts downward it does not directly influence the interest rate. However, if it is moved down below the equilibrium interest rate it will force the interest rate down, but this is not normally done. The reason why the discount rate is change is usually to keep the distance from the

interest rate to the discount rate the same or similar, even if the interest rate change. The discount rate more often works as a "punishment" for banks to lend in the central bank, instead of in the interbank lending market.

6 Debt, Collateral and Agency Problems in Banking

A) The net present value of the project can be written as following.

$$NPV_P = pU + (1-p)D - 1$$

The net present value is the expected payoff minus the cost.

B) If the bank is a monopolist, the R will be set so that the firm will barley break even, and the bank will take all the payoff from the project. We kind find this level of R by setting up the participation constraint for the firm. The firm will only participate if it has an expected payoff that is greater than or equal to zero. We assume that U > R. Since the firm is limited liability, it will get 0 if the project is a failure.

$$P_F \geq 0$$

$$p(U-R) + (1-p) \cdot 0 \geq 0$$

$$pU - pR \geq 0$$

$$pR \leq pU$$

$$R \leq U$$

We get that if the bank is a monopolist R will be equal to the payoff of the project in the good case. This gives sense because the firm will participate if it has a net present value at least of 0, and since it does not lose anything in the bad case it will get a net present value of 0 if the bank takes the entire profit in the good case. If the firm would get some profit in the good case, it would have an expected payoff higher than 0.

In the case where the credit market is competitive the banks expected payoff will be competed down until they barely break even. In other words, the R in this case will be determined by the bank's participation constraint. This means that we can find the R in this case by letting the bank's expected payoff be higher than or equal to 0.

$$P_B \geq 0$$

$$pR + (1-p)D - 1 \geq 0$$

$$pR \geq 1 - (1-p)D$$

$$R \geq \frac{1-(1-p)D}{p}$$

Here we see have the expression that determines the R in the case where the credit market is competitive.

C) Now we have a competitive credit market, and the R is therefore determined by the following expression that we found in the last task.

$$R = \frac{1-(1-p)D}{p} = \frac{1-D+pD}{p}$$

To see how R is affected by an increase in p, U, and D, everything else equal, we find the derivative of R with regards to each of the variables.

$$\frac{\partial R}{\partial p} = \frac{pD-(1-D+pD)\cdot 1}{p^2} = \frac{pD-1+D-pD}{p^2} = \frac{D-1}{p^2} < 0$$

$$\frac{\partial R}{\partial U} = 0$$

$$\frac{\partial R}{\partial D} = 1-\frac{1}{p} < 0$$

We see that R will decrease as the probability of the good outcome increases, everything else equal. This gives sense because if the bad case occurs less often, the rent needed to compensate for the times it does needs to be less. Next, we have that R is not affected by U, the payoff in the good case. This is because if U > R, as we have assumed, the bank will only receive R in the good case, regardless of how big U is. Lastly, we find that an increase in D will decrease R, everything else equal. This is because if the bank loses less in the bad outcome, they will have to take a smaller rent in the good outcome to compensate for the loss.

D) Including collateral will have a similar effect as increasing D, which we found would decrease R. With collateral we can find the lenders expected payoff an calculate the R again as the bank barely breaking even.

$$P_B \geq 0$$

$$pR+(1-p)(D+C)-1 \geq 0$$

$$pR \geq 1-(1-p)(D+C)$$

$$R \geq \frac{1-(1-p)(D+C)}{p}$$

R will be equal to the expression above if the borrower can pledge collateral equal to C. We find the change in R for an increase in C by taking the derivative of R with regards to C.

$$R = \frac{1-(1-p)(D+C)}{p} = \frac{1-D-C+pD+pC}{p}$$

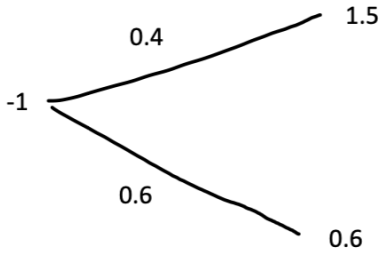
$$\frac{\partial R}{\partial C} = -\frac{1}{p} + 1 < 0$$

An increase in the amount of collateral will decrease R. This is because increased collateral means that the bank will lose less in the bad case (we know they still lose because D + C < 1), and the rent they need to take in the good case to break even will therefore be smaller.

E) We know have two projects, one risky project and one safe. We can visualize the projects as following.

Safe

Risky



We start by calculating the firms expected payoff from the safe project.

$$P_S = 1.25 - 1(1+0.1) = 0.15$$

Next, we calculate the firms expected payoff from the risky project.

$$P_R = 0.4\big(1.5 - 1(1+0.1)\big) + 0.6 \cdot 0 = 0.16$$

The firms expected payoff from the risky project is higher than the firms expected payoff from the safe project, and the firm will therefore choose the risky project.

Since we know that the firm will choose the risky project, we can calculate the banks expected payoff in this case to see if the bank can break even.

$$BP_R = -1 + 0.4\big(1(1+0.1)\big) + 0.6 \cdot 0.6 = -0.2$$

The bank will not break even when the firm takes on the risky project and the interest rate is 10%. If the case where that the firm took on the safe project the bank would break even, but since the firm have a higher expected payoff from the risky project the firm will choose the risky project and the bank does not break even.

F) If the bank asks for an interest rate of 5% the firms expected payoff from the safe project will be:

$$P_S = 1.25 - 1(1 + 0.05) = 0.2$$

Next, we calculate the firms expected payoff from the risky project when the interest rate is 5%.

$$P_R = 0.4\big(1.5 - 1(1 + 0.05)\big) + 0.6 \cdot 0 = 0.18$$

When the interest rate is 5% the firms expected payoff from the safe project is higher than the firms expected payoff from the risky project. In this case the firm would choose to undertake the safe project.

To see if the bank can break even, we will calculate the banks expected payoff from the safe project when the interest rate is 5%.

$$BP_S = -1 + 1(1 + 0.05) = 0.05$$

We that the banks expected payoff when it offers an interest rate of 5% is 0.05. In other words, will the bank break even in this case, because with an interest rate of 5% the firm chooses the safe project.

G) The firm would undertake the safe project if the firms expected payoff from the safe project is at least as high as the firms expected payoff from the risky project. We can formulate this and solve for r in the following way.

$$P_S \geq P_R$$

$$1.25 - 1(1 + r) \geq 0.4\big(1.5 - 1(1 + r)\big) + 0.6 \cdot 0$$

$$1.25 - 1 - r \geq 0.4 \cdot 1.5 - 0.4 - 0.4r$$

$$r - 0.4r \leq 1.25 - 1 - 0.4 \cdot 1.5 + 0.4$$

$$0.6r \leq 0.05$$

$$r \leq 0.08333$$

We would expect the critical interest rate to be somewhere between 5% and 10%. This is because between these two values the firms expected value of the safe project went from being higher than that of the risky, to being lower. We have found that for interest rates lower than 8.33% the firm will take on the safe project.