Part 1: Short Questions

1. Central Bank

i. Securities are on the assets-side of a central banks balance sheet. Securities are what the central bank owns, so it must be on the assets-side of the balance sheet. The central bank can buy and sell securities.
ii. Foreign reserves are also on the assets-side. The central bank can own foreign reserves, for example currency denominated in foreign currency.
v. Discount loans are loans the central bank can give to commercial banks, which means it is on the assets-side of the balance sheet.
vi. Gold is also on the assets-side. The central bank can hold gold, as a reserve.
vii. Buildings can be seen as being on the assets-side. If the central bank owns the building it is an asset. If the central bank leases the building it is a liability.

The other items not mentioned is on the liabilities-side.

2. Bank run

On way to stop a bank run is to force the banks to have a set of requirements. These requirements can be having reserve requirements and capital requirements. Reserve requirements is a proportion of its checkable deposits it needs to hold in cash. If the bank holds enough cash on hand it can meet high demand for cash on a short notice if demand should rise drastically. If many depositors want their money back, the bank has enough cash to meet demand without selling illiquid assets. Capital requirements is a ratio of equity to debt the bank needs to hold. The bank needs to hold enough to cover it losses and so the bank doesn't take on too much leverage. Too much leverage might force the bank to become insolvent. If people gets to know that a bank in on the edge of becoming insolvent, people might force a bank run on the bank. These requirements limit the bank efficiency. The bank can´t lend out all their money, since they need to hold back some. Thereby increasing the cost of borrowing money for the economy.

Another way of is lender of last resort. The lender of last resort works that a lender is available to provide credit if accessibility to credit has dried up. A bank with credit-needs can lend money from the central bank, when they have low amount of credit/cash. The bank borrows from the central bank and will now have enough credit/money to meet demand. Challenge with lender of last resort is adverse selection. The bank might be in financial trouble already, without the central bank knowing it. Also, lending to many banks might create moral hazard. The banks might leverage more and take on higher risk, knowing it can lend from the central bank if the bank goes into credit trouble.

A third way is for the governments to insurance deposits up to set amount. The governments say its insure people´s deposits even if the bank goes bankrupt. This can stop bank runs since depositors knows their money is guaranteed by the government. This stops the risk of losing their deposits in the banks. Challenge with government deposit insurance is that depositors might not have an incentive to monitor and look at how the banks manage risk. Bank might take excessive leverage to get high returns. By having deposit insurance, the risk of blowup from the banks excessive leverage goes on to the government. And since governments money is actually taxpayer's money, the risk actually goes back indirectly to the people/depositors.

3. Agency problems

a) A is an example of a moral hazard problem. Moral hazard are problems that come after a contract is written. It can be seen as hidden actions, which this example is. The depositors don't know how the bank is behaving. By having government deposit insurance, the banks take hidden actions knowing that depositors wouldn't monitor them as much. They can therefore invest in high-risk and high-reward projects. Leaving the risk to the government.

b) This is an adverse selection problem. Adverse selection are problems before a contract is written, called hidden types. In this case, the lender doesn't know the quality of the borrower. Maybe the borrower is good or bad. The lender doesn't know, therefor it is an

adverse selection problem. The lender might get their money plus interest back if the project goes well. If it goes bad, the lender might lose money.

4. Agency problems

To mitigate the moral hazard problem in 3a, the depositors can monitor the banks behavior. The depositors can check how much leverage and risk the bank takes. If the banks take too much leverage, depositors might want to change bank. This affects the profitability of the bank. Another way is to force capital requirements on the banks. Discussed earlier, the requirement limits the banks leverage. It forces the bank to have enough capital, which can be seen as collateral in this case.

Mitigating adverse selection problem in 3b can be done by signaling or screening. By signaling the lender can ask for the firm to see other projects it has done or the project that the firms wants financing for. Or the firm can use a credit bureau or credit rating to show the lender. For screening, the lender can ask a credit bureau or credit rating to look at the firm's financials. The lender can use the credit rating to evaluate the riskiness of the project and the firm. Lender will hopefully know after the rating what type of borrower the firm is.

Part 2:

5. Central Banking

To answer these questions I need to explain a model.
Our model has a demand and supply curves, with reserves on the x-axis and interest rate on y-axis. The demand is what the bank demands of reserves to meet their credit obligations, reserve requirements for example. The demand is also to hold excess reserves. Excess reserves are reserves the bank hold beyond reserve requirements. Excess reserves are for liquidity needs that come on short notice.

At a certain interest rate the demand curves becomes horizontal. This interest rate is the interest rate the central bank gives on banks reserves at the central bank. I will call this rate

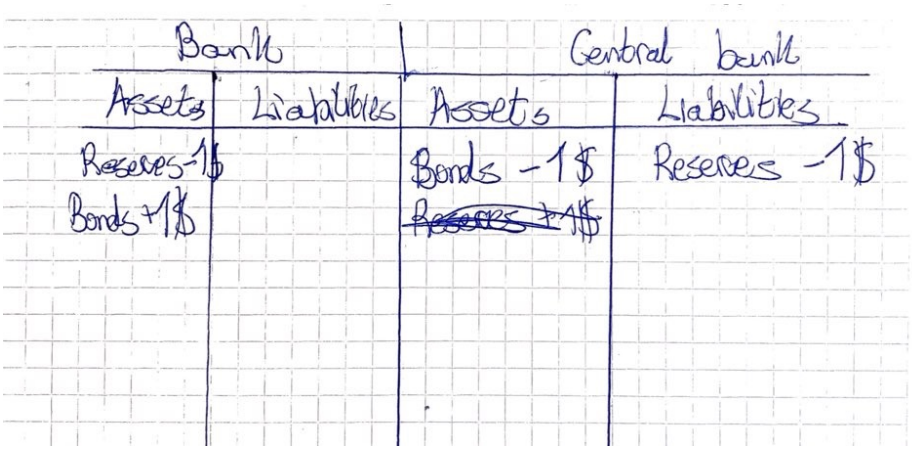
for i_{rb}. It becomes horizontal since no banks want to lend to other banks lower than the interest rate from the central bank, since it creates an arbitrage opportunity.

The supply curve is vertical since we assume that the central bank can set reserve at whatever it wants. This is so the central bank can meet its policy goals. At the interest rate the central bank gives on discount loans the supply curve goes horizontal. I will call this interest rate for i_d. At a lower interest rate than this, the demand to borrow from the central bank is zero, since banks can borrow for each other at lower interest rates. We are here assuming that banks don't face lending restrictions.

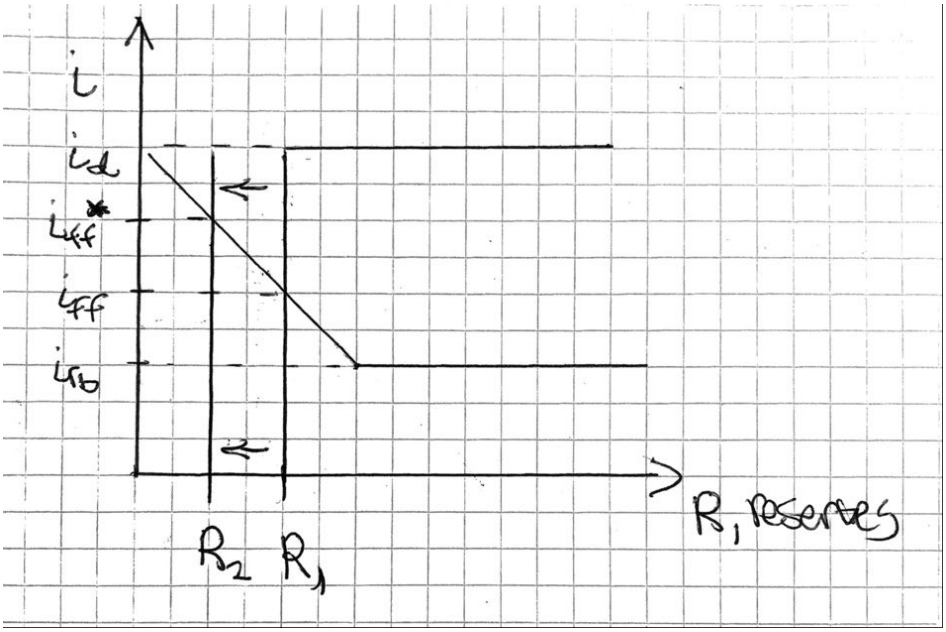
Other assuming factors is that market interest in other countries are held constant. We also assume that a higher interest on loans lowers demand for loans.

a) Open market sale of governments bonds.

When an open market sale of governments bonds happens, the central bank will sell the bonds in exchange for currency/money. This makes the monetary base to decrease, since there is less reserves. Using a T-balance sheet to show this.



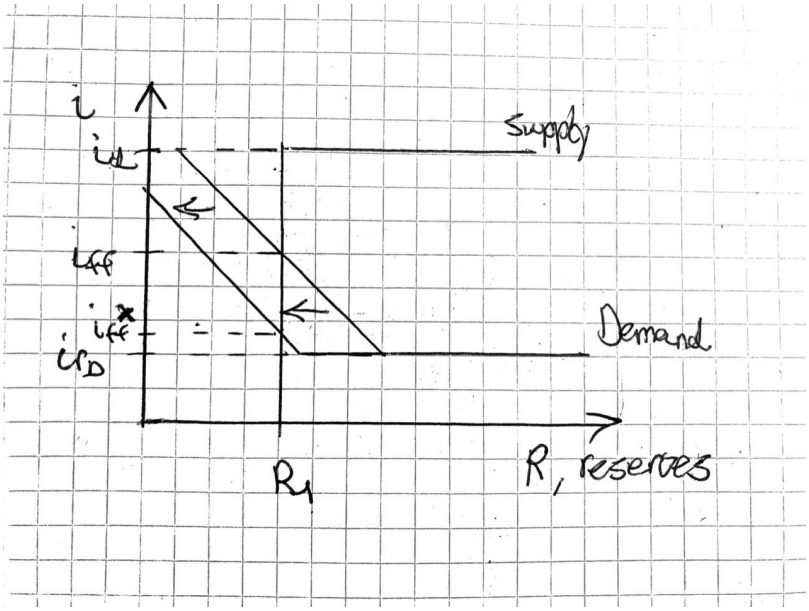
Less reserves shifts the demand curve to the left. Shifting to the left, equilibrium changes. The interest rate goes from i_{ff} to i_{ff}^*, because there are less reserves (R_1 to R_2) as seen in the model.



An open market sale of governments bond by the central bank increases the interbank overnight interest rate.

b) Decrease in the required reserves ratio

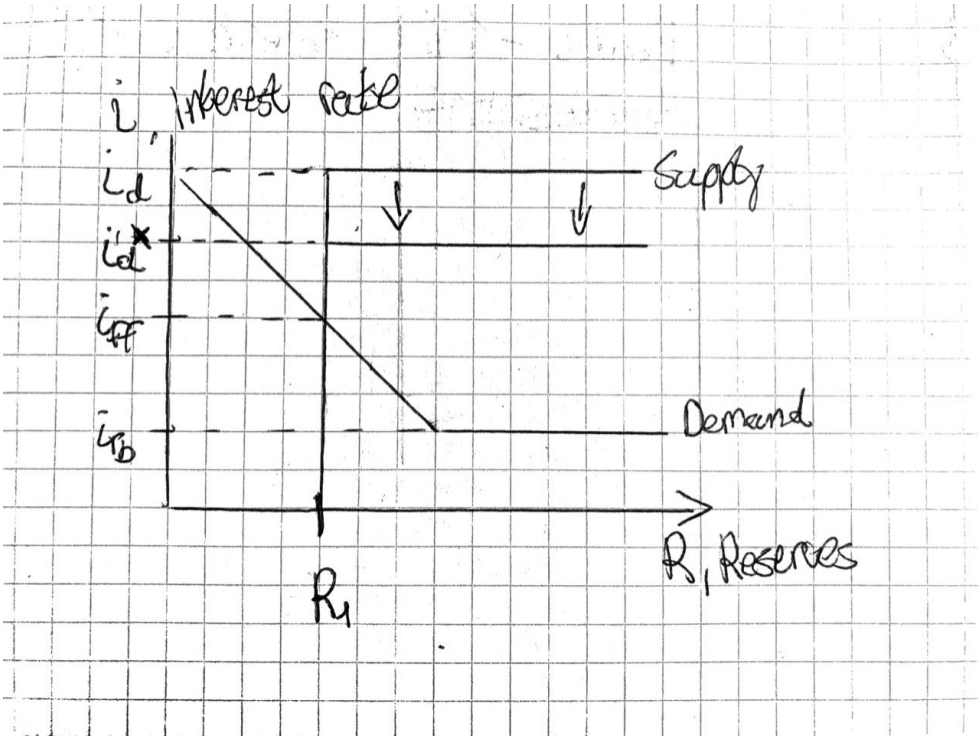
As mention in the start, the demand curve is the banks demand to meet their requirements and obligations. One of these requirements is the required reserve ratio. Changing the required reserves ratio shifts the demand curve for the banks. Higher requirement makes the banks require more reserves to meet requirement, meaning the demand curve shifts to the right. Lower requirement doesn't the opposite. It shifts the demand curve to the left.



The demand curve shifts to the left, affecting the interbank overnight interest rate. The interest rate gets lowered as seen in the figure above from i_{ff} to i_{ff}^*. The banks don't need to hold as much reserves, and thereby can lend it out. More cash gets available, lowering the interest rate.

c) Decrease in the discount rate.

The discount rate is the interest rate banks can borrow at from the central bank. It is usually higher than the interbank overnight interest rate. It acts as a penalty for banks to borrow from the central bank, but if banks can borrow from each other at lower interest rate the banks will do so. That is why the supply curve is horizontal at i_d. In the model, the discount rate is stated as i_d. A decrease in the discount rate shifts the supply downwards. Banks can lend from the central bank at a lower interest rate as before.



Seen in the model, the supply curve shifts down to the discount rate the central bank sets. In this case, the interbank overnight interest rate gets unaffected. This is because banks can borrow from each other at a lower interest rate than the new discount rate. The central bank must lower the discount rate a lot to affect the interbank overnight interest rate.

6. Debt, Collateral and Agency Problems in Banking

Payoffs at date 1

Probability	[illegible]	p	$(1-p)$	
[illegible]	Investments	if $U \geq R$	if $U < R$	Total expected payoff
Project	1	U	D	$pU + (1-p) \cdot D$
Lender	1	R	D	$Rp + (1-p)D$
Borrower	0	$U-R$	0	$p(U-R)$

a) To find the net present value of the project I need to find total expected payoff and subtract intial investment for the project.

Total expected payoff is $p \cdot U + (1-p) \cdot D$

- $p \cdot U$: multiply payoff U with probability p
- $(1-p) \cdot D$: multiply payoff D with probability $(1-p)$

Initial investment = 1

$$NPV_{project} = p \cdot U + (1-p) D - 1$$

b) When the bank is a monopolist in the credit market, the bank can choose how much the interest rate should be. If the bank chooses a too high interest rate the borrower won't participate. Therefor we need to find borrowers constraint. The borrower will participate if the net present value for him is equal zero. We can write this by taking total expected payoff for the borrower minus initial investment (zero) and finding when R makes NPV for the borrower equal to zero:

$$NPV_{borrower} = p * (U - R) = 0$$

$$U = R$$

R is equal U when the bank is monopolist and will get all the payoff from the project.

If the credit market is competitive, the interest rate the lender can offer gets lower and lower so much that lender will make zero profit from the project. The lender will only participate if the he doesn't lose money on the project. We can therefor take the net present value for the lender and finding R for when the net present value equal zero. Net present value is total expected payoff minus initial investment (1).

$$NPV_{lender} = p * R + (1 - p) * D - 1 = 0$$

$$R = \frac{1 + D * p - D}{p}$$

R is equal $\frac{1+D*p-D}{p}$ when the credit market is competitive. Net profit for the lender is equal zero, since the borrower gets all the profit from the project.

c) Here I need to derivate R with the variable.

Increase in p:

Uses derivation rule:

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

$$\frac{\partial R}{\partial p} = \frac{D * p - 1 - D * p + D}{p^2}$$

$$\frac{\partial R}{\partial p} = \frac{D - 1}{p^2} < 0, negative\ since\ D < 1$$

When probability increases the interest rate decreases. This makes sense, since a higher probability of higher payoff, the interest rate the banks sets gets lower. Less probability of

bad payoff means the lender can set a lower interest rate, since the risk of defaulting is lower.

Increase in U:

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

If U increases, the interest rate doesn't change. The intuition is that the lender only gets money from the interest rate of the loan is lends to the borrower and since it is a competitive credit market the lender gets zero from the project.

Increase in D:

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

Most likely the interest rate gets lower if D increases. If p were 1, meaning only the good happens from the project R doesn't change. If the payoff from failure gets higher, the lender can set a lower interest rate to break even. The lender doesn't lose as much money if the project is a failure.

d) When there is, collateral put up, the lender gets the collateral and payoff from failure. We can therefore rewrite net present value for the lender:

$$NPV_{lender} = p * R + (1-p)(D+C) - 1 = 0$$

We are assuming credit market is competitive.

$$p * R = 1 - (1-p)(D+C)$$

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

R is now $\frac{1-(1-p)(D+C)}{p}$ when there is collateral.

$$\frac{\partial R}{\partial C} = \frac{p-1}{p} \leq 0, since\ p \leq 1$$

If collateral increases the interest rate decreases, since p is most likely less then 1. The intuition is that when more collateral is put up the bank doesn't need to ask for higher interest rate to cover for the risk, since the borrower puts up collateral the lender can take if failure from the project should happen. The bank will lower interest rate.

e) Here we need to calculate the net present value for the borrower for the different projects.

$$NPV_{safe} = payoff - borrowed * interest\ rate$$

$$NPV_{safe} = 1{,}25 - 1 * (1 + 0{,}1)$$

$$NPV_{safe} = 0{,}15$$

Now calculate the net present value from the risky project. Formula stated earlier:

$$NPV_{risky} = p * (U - R)$$

$$NPV_{risky} = 0{,}4 * \big(1{,}5 - 1 * (1 + 0{,}1)\big)$$

$$NPV_{risky} = 0{,}16$$

Since $NPV_{risky} > NPV_{safe}$ the borrower wants to undertake the risky project.

If the bank asks for an interest rate of 10% the borrower chooses the risky project. We can calculate net present value for the lender for the risky project to see if the bank can break even.

$$NPV_{lender_{risky}} = 1 * (1 + 0{,}1) * 0{,}4 + (1 - 0{,}4) * 0{,}6 - 1$$

$$NPV_{lender_{risky}} = -0{,}2$$

The bank can´t break even since NPV is negative with 0,2.

f) Borrower:

$$NPV_{safe} = 1{,}25 - 1 * (1 + 0{,}05)$$

$$NPV_{safe} = 0{,}2$$

Borrower risky:

$$NPV_{risky} = p * (U - R)$$

$$NPV_{risky} = 0{,}4 * (1{,}5 - 1{,}05)$$

$$NPV_{risky} = 0{,}18$$

Since $NPV_{safe} > NPV_{rsiky}$ the borrower wants to undertake the safe project.

If the bank asks for an interest rate of 5% the borrower chooses the safe project. We can calculate net present value for the lender for the safe project to see if the bank can break even.

$$NPV_{lender_{safe}} = 1 * (1 + 0{,}05) - 1$$

$$NPV_{lender_{safe}} = 0{,}05$$

The bank can break even with a profit of 0,05, which equal the interest rate.

g) To find what range of r the firm will undertake the safe project, we can think that the firm will take the safe project only if the safe project has a higher or equal net present value than the risky project. We can write this and solve for r:

$$NPV_{safe} \geq NPV_{risky}$$

$$1{,}25 - R \geq 0{,}4 * (U - R)$$

$$1{,}25 - 1 * (1 + r) \geq 0{,}4 * (1{,}5 - 1 * (1 + r))$$

$$1{,}25 - 1 - r \geq 0{,}4 * (0{,}5 - r)$$

$$0{,}25 - 0{,}2 \geq r - 0{,}4 * r$$

$$0{,}05 \geq 0{,}6 * r$$

$$\frac{0{,}05}{0{,}6} \geq r$$

$$0{,}0833 \geq r$$

The firm will undertake the safe project if the interest rate is equal or lower than 8,33%. Higher than this the firm will undertake the risky project.