Practice Set 9

Banking & The Monetary System [60 – 80 min]

This set contains problems for your own practice. Do not just read the provided solutions — try to solve the problems first, and use the solutions only when you are stuck. Reading solutions without attempting the problems first has the same value for your preparation as watching someone else run a marathon and then expecting to be able to run it yourself. If you are unable to comprehend the solution of a problem even after reading the instructional answer key, you have most likely missed the relevant part of the material underlying this problem. Direct any questions about this problem set to your section's teaching assistant.

1. A central bank pays interest on the reserves that commercial banks hold with it (IORB).
   (a) Explain why the IORB works as a floor for the interest rates banks charge on loans.
   (b) Suppose the IORB is 2%. Client A has a 1% probability of defaulting on the loan, in which case the bank recovers nothing. What is the minimum interest rate at which the bank is willing to lend to clients like A?
   (c) Client B has a 2.5% probability of default. How does the minimum rate for client B compare with that for client A?
   (d) The central bank now lowers the IORB to 1%. What happens to the minimum rates for the two clients? What does this imply for lending in the economy?

2. Bank X always wants to hold at least 5% of its total deposits in cash for liquidity reasons. Its calculations show that only 40% of the value of any new loan is withdrawn in cash or transferred to other banks, and the remaining 60% stays deposited at Bank X. Bank X's T-account (in $ millions) is:

Assets		Liabilities	
Cash	9	Deposits	180
Reserves	40	Net Position	40
Government securities	50		
Loans	121		

   (a) The central bank lowers the interest rate, and clients demand $20 million of new loans from Bank X. Show how its T-account changes.
   (b) The central bank lowers the interest rate further, and clients demand another $100 million of new loans from bank X. Show how bank X can meet the demand for new loans if the central bank is willing to conduct open market operations to assist bank X.
   (c) Why would the central bank purchase securities from Bank X in (b) instead of lending Bank X the shortfall as an advance?

3. If banks create money when they lend, what stops them from lending an unlimited amount?

4. You currently have $24,000 in a debit account that yields 0% interest. You know you will need exactly $2,000 per month to cover your living expenses for the next 12 months. You are considering moving some of your funds into a money market account. This account offers an interest rate of 1% per month, but it charges a 4.5% withdrawal fee every time you take money out.
   (a) How much money should you transfer to the money market account?
   (b) If the money market account's monthly interest rate increases to 1.6%, will you hold more or less cash for your daily transactions?
   (c) Based on the above, explain how an increase in the interest rate affects the demand for money.

Problems and solutions by Kosmas Marinakis, Ph.D. for Economics & Society at SMU. © 2019-2022.

5. Consider Cornovia, a country that exclusively produces corn. This year, Cornovia's real GDP is 1,000 kg of corn. The Central Bank of Cornovia has issued a fiat money supply of 500 cornals (the national currency) that Cornovians hold.
   (a) If the price of 1 kg of corn is 10 cornals, how many transactions per year is a single cornal used for on average?

   Cornovia's Central Bank prints an additional 50 cornals and gifts them to the government to buy corn and trade it with another country for vaccines against "cornvid-19."

   (b) Assuming the average number of transactions per cornal remains constant, what will happen to the price of corn?
   (c) What percentage of *real purchasing power* did a cornal lose?
   (d) What is the *inflation rate* in Cornovia?
   (e) Why would the Central Bank print the extra 50 cornals knowing that this would weaken the currency?
   (f) How much real purchasing power will a Cornovian lose if she used her entire cash reserves of 20 cornals to buy 2 kg of corn right before the Central Bank printed the extra money?

Answer Key

This key is written to teach, so the answers are more detailed and in depth than what you need to write. If a similar task appears in the test or exam, a concise answer with the key reasoning is sufficient.

1. A central bank pays interest on the reserves that commercial banks hold with it (IORB).

   (a) Explain why the IORB works as a floor for the interest rates banks charge on loans.

   The IORB is what a bank earns by holding reserves at the central bank, with no risk. A loan carries the risk that the borrower defaults. If the loan pays no more than the IORB, the bank takes on risk and earns nothing extra for it, so it is better off keeping the money in reserves. A loan therefore has to pay the IORB plus compensation for credit risk, which makes the IORB the lowest rate banks will charge.

   (b) Suppose the IORB is 2%. Client A has a 1% probability of defaulting on the loan, in which case the bank recovers nothing. What is the minimum interest rate at which the bank is willing to lend to clients like A?

   If the bank loans out $1 to client A, it will receive:
   - *(1 + r) with probability 99%, if A does not default,*
   - *Zero, with probability 1%.*

   The expected return from the loan is $0.01 \cdot 0 + 0.99(1+r) = 0.99(1+r)$.

   If the bank holds the $1 in reserves, the expected return will be 1 + IORB = 1.02.

   The bank is willing to lend to client A if $0.99(1 + r) \geq 1.02$ or $1 + r \geq 1.0303$ or $r \geq 3.03\%$.

   Here, we could have used the shortcut "IORB + default probability" and calculated r as 3%, which is quite close to the actual result for the purpose of this course.

   (c) Client B has a 2.5% probability of default. How does the minimum rate for client B compare with that for client A?

   Using the shortcut, rate for client B ≈ 2% + 2.5% = 4.5% (the exact result is r = 4.62%).

   Client B's minimum rate is 1.5 percentage points higher than client A's. The riskier the borrower, the larger the premium above the IORB.

   (d) The central bank now lowers the IORB to 1%. What happens to the minimum rates for the two clients? What does this imply for lending in the economy?

   Rate for client A ≈ 1% + 1% = 2% (exact: 2.02%).

   Rate for client B ≈ 1% + 2.5% = 3.5% (exact: 3.59%).

   Both minimum rates fall by about one percentage point, the same as the cut in the IORB, and the risk premium is unchanged. Loans that were not worth making before, for example to a client like A willing to pay 2.5%, now become profitable for the bank, so lending in the economy should increase. The central bank can influence borrowing and lending by adjusting the IORB.

2. Bank X always wants to hold at least 5% of its total deposits in cash for liquidity reasons. Its calculations show that only 40% of the value of any new loan is withdrawn in cash or transferred to other banks, and the remaining 60% stays deposited at Bank X. Bank X's T-account (in $ millions) is:

Assets		Liabilities	
Cash	9	Deposits	180
Reserves	40	Net Position	40
Government securities	50		
Loans	121		

(a) The central bank lowers the interest rate, and clients demand $20 million of new loans from Bank X. Show how its T-account changes.

*Bank X has **ample** reserves, because its existing reserves ($40 million) are sufficient to meet the additional demand for loans. Of the $20 million in new loans, 40% or $8 million will be withdrawn or transferred to other banks, and 60% or $12 million will remain deposited at Bank X. This means that Bank X must increase its cash by 0.05 × 12 = $0.6 million. Thus:*

- *Cash will increase by $0.6 million (converted from reserves).*
- *Reserves will decrease by 8 + 0.6 = $8.6 million: $8 million for the withdrawals and transfers, and $0.6 million converted into cash. Notice that this is much less than the new loans Bank X granted.*
- *Loans will increase by $20 million.*
- *Deposits will increase by $12 million.*

Bank X's T-account will become:

Assets		*Liabilities*	
Cash	*9.6*	*Deposits*	*192*
Reserves	*31.4*	*Net Position*	*40*
Government securities	*50*		
Loans	*141*		

(b) The central bank lowers the interest rate further, and clients demand another $100 million of new loans from bank X. Show how bank X can meet the demand for new loans if the central bank is willing to conduct open market operations to assist bank X.

*Of the $100 million in new loans, 40% or $40 million will be withdrawn or transferred to other banks, and 60% or $60 million will remain deposited at Bank X. This means that Bank X must increase its cash by 0.05 × 60 = $3 million. To do so, Bank X needs 40 + 3 = $43 million in reserves, and it currently has only $31.4 million, a shortfall of $11.6 million. Reserves have become **scarce**, so the central bank assists by conducting open market purchases (OMPs). Let us assume it buys $15 million of government securities from Bank X, more than the $11.6 million minimum, so that Bank X still has some reserves after the new loans are settled.*

- *Cash will increase by $3 million.*
- *Reserves will fall by $28 million: +15 from the OMP, minus 40 for the withdrawals and transfers, and minus 3 converted into cash.*
- *Government securities will decrease by $15 million.*
- *Loans will increase by $100 million.*
- *Deposits will increase by $60 million.*

Bank X's T-account will become:

Assets		*Liabilities*	
Cash	*12.6*	*Deposits*	*252*
Reserves	*3.4*	*Net Position*	*40*
Government securities	*35*		
Loans	*241*		

(c) Why would the central bank purchase securities from Bank X in (b) instead of lending Bank X the shortfall as an advance?

An advance is a loan, so Bank X would have to pay interest on it and repay it. That raises Bank X's cost of funds, and with it the minimum rate at which it can lend, which works against the central bank's aim of lowering interest rates. An open market purchase is not a loan: Bank X swaps securities for reserves and owes nothing. It also supplies reserves to the banking system as a whole, so every bank

facing a similar expansion in lending benefits. Advances are given to one bank at a time, so using them to support a general fall in rates would keep the cost of reserves up across the system.

3. If banks create money when they lend, what stops them from lending an unlimited amount?

   Four constraints limit how much a bank can lend:

   i. ***Liquidity.*** *Borrowers spend the newly created money, and part of it is withdrawn in cash or transferred to other banks. These payments are settled with cash and reserves. The more a bank lends, the more reserves it needs, and a bank that runs short has to borrow them at a cost, which makes additional lending less profitable. When reserves are scarce across the system, this cost rises with lending.*

   ii. ***Capital and solvency.*** *Some borrowers default, and the losses are absorbed by the bank's net position. If losses exceed it, the bank is insolvent. The more a bank lends relative to its net position, the smaller the share of defaults that can sink it, so banks limit how much they lend. Regulators reinforce this with capital requirements, which in effect cap lending at a multiple of the bank's net position.*

   iii. ***Profitability and risk.*** *A loan must pay at least the risk-free rate the bank could earn at the central bank (the IORB), plus a premium for the borrower's credit risk. Riskier clients therefore need higher rates, and a bank will not lend where the expected return is below this minimum.*

   iv. ***Demand for loans.*** *Borrowers take a loan only if they expect to earn more from using the money than the interest costs. At higher rates, fewer clients want to borrow, so lending cannot grow without limit even if the bank is willing.*

4. You currently have $24,000 in a debit account that yields 0% interest. You know you will need exactly $2,000 per month to cover your living expenses for the next 12 months. You are considering moving some of your funds into a money market account. This account offers an interest rate of 1% per month, but it charges a 4.5% withdrawal fee every time you take money out.

   (a) How much money should you transfer to the money market account?

   Any funds transferred to the money market account must stay there long enough for the interest earned to exceed the 4.5% withdrawal fee. At 1% interest per month, the money must remain in the account for at least 5 months to become profitable. Thus, you will hold 5 months × $2,000 = $10,000 in your debit account and transfer the remaining ***$14,000*** *to the money market account. [Note: using compound rates in this question would not alter the answer]*

   (b) If the money market account's monthly interest rate increases to 1.6%, will you hold more or less cash for your daily transactions?

   With a higher interest rate of 1.6% per month, it takes less time to overcome the 4.5% withdrawal fee. Leaving the money in the account for just 3 months yields 3×1.6% = 4.8%, which covers the fee. The break-even period is now shorter, so you only need to hold 3 months' worth of expenses in your debit account: 3×$2,000 = ***$6,000****. We could also have calculated the compound interest in this question, but the time period is too short, and it would not make a difference to the answer.*

   (c) Based on the above, explain how an increase in the interest rate affects the demand for money.

   A higher interest rate increases the opportunity cost of holding liquid M1 money (cash or debit). It incentivizes individuals to convert it into interest-bearing assets such as money market accounts, fixed deposits, or bonds. As interest rates rise, people choose to hold less cash or debit — demonstrating the inverse relationship between interest rates and money demand.

5. Consider Cornovia, a country that exclusively produces corn. This year, Cornovia's real GDP is 1,000 kg of corn. The Central Bank of Cornovia has issued a fiat money supply of 500 cornals (the national currency) that Cornovians hold.

   (a) If the price of 1 kg of corn is 10 cornals, how many transactions per year is a single cornal used for on average?

   *The total value of all transactions in the economy is 1,000 kg of corn × 10 cornals/kg = 10,000 cornals. With only 500 cornals in circulation, the average number of transactions per cornal is: 10,000/500 = **20** transactions per cornal.*

   Cornovia's Central Bank prints an additional 50 cornals and gifts them to the government to buy corn and trade it with another country for vaccines against "cornvid-19."

   (b) Assuming the average number of transactions per cornal remains constant, what will happen to the price of corn?

   *There are now 550 cornals in circulation. The total value of transactions the money supply can support is 550×20 = 11,000 cornals, because each cornal is used for 20 transactions on average. Since citizens have more money to spend but the supply of actual corn has not changed (still 1,000 kg), the price of corn must rise: 11,000/1,000 = **11** cornals per kg.*

   (c) What percentage of *real purchasing power* did a cornal lose?

   *A loss in real purchasing power is how much less the currency can buy. A cornal originally bought 1/10 = 0.1 kg of corn. After the money printing, it buys 1/11 ≈ 0.0909 kg. The loss in purchasing power per cornal is (0.1−0.0909)/0.1 = **9.1%**.*

   (d) What is the *inflation rate* in Cornovia?

   *The inflation rate is the percentage increase in the price level. The price of corn rose from 10 to 11 cornals/kg, which amounts to **10%** inflation.*

   (e) Why would the Central Bank print the extra 50 cornals knowing that this would weaken the currency?

   Printing money allowed the government to acquire vaccines without raising income tax or sales tax, or issuing debt. By printing the extra 50 cornals, the Central Bank diluted the value of the pre-existing 500 cornals in circulation by 9.1%. Yet, this value was not lost. It was entirely transferred to the government. This perfectly illustrates seigniorage: printing money effectively transfers purchasing power from the citizens to the government, acting as a hidden "inflation tax".

   (f) How much real purchasing power will a Cornovian lose if she used her entire cash reserves of 20 cornals to buy 2 kg of corn right before the Central Bank printed the extra money?

   No purchasing power is lost. By converting fiat currency into a real asset (corn) before the inflation occurred, her wealth is protected. Only those holding cash or assets fixed in nominal terms are hurt by inflation.

Good afternoon! Once, I had written in a blue box like this one: "if you half-ass university, most likely you will half-ass your career later". A student emailed me the following reply: "Bill Gates, Steve Jobs, Mark Zuckerberg and many others became successful without even graduating college. Work experience matters more than education." Here is what I would answer: "There are a few things you are missing: First, Bill Gates, Steve Jobs, Mark Zuckerberg and others are the 0.1% of dropouts who knew what they were doing and became successful without formal education. The rest 99.9% of dropouts would have achieved and earned much more in their life, had they stayed in college. Second, Gates, Jobs etc. never intended to be hired. They created their own companies and shaped new industries. They took massive risks, and today we know them by name because those risks paid off. However, many other equally competent people took similar risks that unfortunately never paid off and thus, no one ever heard about their sad stories. Third, Gates, Jobs, etc. did not drop out of college because they could not keep up with their studies. They dropped out because their area of interest was new, very fast developing and the knowledge they would have acquired in college was objectively not useful to them in the pursuit of their goals. Fourth, Gates, Jobs, etc. did not half-ass their studies because they needed a diploma to include in their CV. Instead, they understood that their priorities were different; they dropped out completely and pursued their plan full-time. Successful people either do something right or they do not do it at all. So, there is nothing wrong in graduating with a C. Just don't fool yourself that this makes you a Bill Gates, a Steve Jobs, or even… a Mark Zuckerberg." *Kosmas*

Please report any typos, mistakes, or suggestions for improvement to kmarinakis@smu.edu.sg.