Macroeconomic Analysis · 2025-26

List 1 of exercises and questions

INSTRUCTIONS

- **Answer the following exercises**

One section of Exercise 1	Choose three exercises from Exercises 9-14
Exercise 2	Exercise 15
Exercise 3	Exercise 16
Section (i) of Exercise 4 and another section of your choice	Choose either Exercise 16 and three events of Exercise 17 or discard Exercise 16 and choose seven events of Exercise 17
Exercise 5	
Three sections of Exercise 6	
Exercise 7	Exercise 18
All sections of Exercise 8 except two	In Exercise 19, twelve non-consecutive statements: six between 1–21; and six between 22–43

- **Handwrite your answers on paper. Intelligible handwriting will be most appreciated.**
- **Separate the end of an answer and the start of next with a horizontal line from one end of the paper to the other.**
- **Make a pdf of your answers (by scanning or taking photographs). If one pdf is too big, make several ones.**
- **Send the pdf(s) to aqa@urv.cat before 14:00 on Thursday the 13th of November, 2025.**
- **Answers need not be even close to perfect to be considered good, acceptable or correct. Some questions may have an open answer, in which case what matters most is that the answer makes some sense or can be convincingly justified. On numerical exercises a correct approach may be enough.**
- **If you need some specific help, write to aqa@urv.cat.**

1. Forms of money (E, R, D) and monetary aggregates (M0, M1)

Remind that

- **E** stands for cash
- **R** stands for (central bank) reserves
- **M0** is the monetary base (the sum $\mathbf{E}+\mathbf{R}$, the total amount of central bank money)
- **D** stands for deposits (bank money)
- **M1** is the money stock (the sum $\mathbf{E}+\mathbf{D}$, the total amount of money available to the non-banking private sector)
- r is the reserve ratio $\mathbf{R/D}$ (all reserves included in **R**: mandatory and voluntary)
- l is the liquidity ratio $\mathbf{E/D}$.

(i) Cash is half of reserves. Reserves are twice as large as deposits. **M1** is 100. If there is enough information, calculate **M0**, cash, reserves and deposits. If not, specify the missing information.

(ii) With $\mathbf{M1}=1000$, $\mathbf{M0}=500$, $r=3/8$ and deposits 800, calculate the liquidity ratio and cash.

(iii) With $\mathbf{M1}=1200$ and $\mathbf{M0}=300$, find the reserve ratio r if r is half the liquidity ratio.

(iv) Find the reserve ratio if the monetary base is 350, deposits 1000 and the liquidity ratio 1/4.

(v) Find **M0** if $\mathbf{M1}=1200$, the reserve ratio is 1/10 and cash is 200.

2. Properties of the forms of money

The three basic forms of money are cash, (central bank) reserves, and bank money (deposits). Each of these satisfies two of the following three properties: being electronic (P1), being created by the central bank (P2), and being universally acceptable (P3). Suggest a possible form of money (that exists, has existed or could exist) that:

(i) only satisfies P1;

(ii) only satisfies P2;

(iii) only satisfies P3;

(iv) satisfies none of the three properties;

(v) satisfies only two of the three;

(vi) satisfies the three properties.

3. Forms of money

If possible, calculate the liquidity and reserve ratios from the data on the right, published by the Bank of England; if not possible, explain why or what information is missing.

https://www.bankofengland.co.uk/explainers/how-is-money-created

4. Money creation model

The demand function for loans that banks consider solvent is $L^d = 100 - 5i$, where the interest rate is a percentage. The liquidity ratio is $1/6$. The reserve ratio (voluntary plus required ratios) is $1/5$. The central bank sets a one percent interest rate. Banks charge a premium of 100% .

(i) Calculate the volume of loans, the volume of deposits, the demand for reserves, cash, and **M1**.

(ii) Determine the change that would be required in the central bank's interest rate if the central bank's objective were to double **M1**.

(iii) Determine the change that would be required in the central bank interest rate if the central bank's objective were to double the volume of loans.

(iv) Determine the change that would be required in the central bank interest rate if the central bank's objective were to double the demand for reserves.

5. Money creation model

The banks' premium is 50%. Expressing the market interest rate i as a percentage, the loan demand function that banks consider solvent is

$$\begin{aligned} L^d &= 0 && \text{if } i > 60 \\ L^d &= 120 - 6i && \text{if } 60 \leq i \leq 10 \\ L^d &= 150 - 5i && \text{if } 0 \leq i < 10. \end{aligned}$$

The voluntary reserve ratio is $v = 1/27$. The required reserve ratio is $r = 1/54$. The liquidity ratio is $l = 1/9$. Represent the model graphically. If there is sufficient information, calculate the interest rate that the central bank should set for the demand for reserves be 108.

6. Payment systems

There are three types of payment systems: simultaneous, sequential and compensatory. Calculate the amount of money needed to satisfy the debts of each of the following debt networks according to each payment system (in the sequential case, consider all orders in which payments can be made sequentially; in the compensatory case, the net debts of each participant are paid simultaneously). Represent each debt network as a labeled graph where the nodes are the participants, the debt of participant x to participant y is represented by an arrow from x to y, and the labels of each arrow are the amount of the debt.

(i) A owes 9 to B; A ten 5 a C; C owes 3 to B; D owes 1 to C.

(ii) A owes 5 to B; A ten 3 a C; A ten 1 to D; D owes 2 to B; D owes 3 to C; C owes 1 to B; B owes 1 to C.

(iii) A owes 5 to B; B owes 5 to C; C owes 5 to D; D ten 4 to C.

(iv) There are 4 agents and each agent owes 2 to each of the other three agents.

(v) A owes 3 to B; B owes 2 to C; C owes 1 to D; D owes 4 to A.

(vi) There are 4 agents and one of them owes 2 to each of the other three agents.

(vii) There are 1, 2, … , n agents. For $i \in \{1, \dots, n-1\}$, agent i owes 1 unit to agent $i+1$; and agent n owes 1 unit to agent 1.

(viii) There are 1, 2, … , n agents. For $i \in \{1, \dots, n-1\}$, agent i owes 1 unit to agent $i+1$; and agent n owes 2 units to agent 1.

(ix) There are 1, 2, … , n agents. For $i \in \{1, \dots, n-1\}$, agent i owes 2 units to agent $i+1$; and agent n owes 1 unit to agent 1.

7. Central bank fixed rate auction

The Central Bank wants to temporarily provide banks with reserves worth 300 using a fixed-interest-rate auction. Five banks participate in the auction, making the following reserve demands: 100, 200, 300, 400, and 500.

(i) Find the allocation of reserves made by the central bank based on applying the percentage of allocation that the central bank's supply represents with respect to the total demand for reserves from banks.

(ii) Answer (i) again if the central bank, prior to the auction, guarantees each bank the allocation of 10% of the reserves provided by the Central Bank and next applies the procedure in (i) but the reduced central bank supply and the reduced demands by banks. Compare the allocations in (i) and (ii).

8. Central bank variable rate auction

The central bank wants to provide banks with reserves worth 300 using a variable interest rate auction. The minimum interest rate set by the central bank is 2%. Five banks making the following reserve demands, for interest rates of 2%, 3%, 4%, 5% and 6%.

interest rate	Bank 1	Bank 2	Bank 3	Bank 4	Bank 5
2%	$x + 10$	30	40	50	60
3%	$x + 5$	20	25	35	45
4%	x	15	20	25	40
5%	0	10	15	20	30
6%	0	0	0	10	15

(i) Calculate the minimum value of x for which the marginal auction rate is 6% (the marginal auction rate is the lowest interest rate at which the central bank satisfies, perhaps partially, the reserve demand by some bank).

(ii) Calculate the minimum value of x for which the marginal rate of the auction is 5%.

(iii) Calculate the minimum value of x for which the marginal rate of the auction is 4%.

(iv) Calculate the minimum value of x for which the marginal rate of the auction is 3%.

(v) Calculate the minimum value of x for which the marginal rate of the auction is 2%.

(vi) **Single-rate auction method (Dutch auction)**. Find the value of the reserves that each bank must return if, with $x = 5$, the central bank charges each bank the marginal interest rate of the auction.

(vii) **Multiple rate auction method (American auction)**. Find the total value of the reserves that each bank must return if, with $x = 5$, the central bank makes each bank pay the interest rate corresponding to each tranche of the award.

9. Creation of bank money

Explain if there is any contradiction, and what it is, in the following explanation (taken from the website of the Spanish central bank, the *Banco de España*).

> "Most of the money we use is created by commercial banks when they lend money. When a commercial bank issues a new loan to its customers and credits their current accounts with the corresponding amount, it is creating 'inside money'. This money will be used to buy goods or make investments and will eventually end up being deposited in other bank accounts. Conversely, when customers pay off their debts, that inside money is destroyed.
>
> To ensure that this process does not repeat itself endlessly and that the money in circulation does not exceed the desired amount (which would have an adverse impact on price stability and lead to inflation), the process of creating money is controlled and regulated by central banks and other supervisory authorities. Central banks set their official interest rates, influencing the amount of money that commercial banks create. Additionally, there are various regulations regarding bank capital and solvency, as well as minimum reserve requirements, which limit the creation of bank money." [Emphasis added]

https://www.bde.es/bde/es/areas/polimone/Preguntas-y-respuestas-frecuentas-sobre-la-politica-monetaria/definicion-y-funciones-del-dinero/como-se-crea-el-dinero.html

10. Creation of bank money

On 8 December 2011, the then Vice-President of the European Central Bank, Vítor Constâncio, in a speech at the 26th International Conference on Interest Rates, said:

> "Central bank reserves are held by banks and are not part of money held by the non-financial sector, hence not, *per se*, an inflationary type of liquidity. There is no acceptable theory linking in a necessary way the monetary base created by central banks to inflation. Nevertheless, it is argued by some that financial institutions would be free to instantly transform their loans from the central bank into credit to the non-financial sector. This fits into the old theoretical view about the credit multiplier according to which the sequence of money creation goes from the primary liquidity created by central banks to total money supply created by banks via their credit decisions.

In reality the sequence works more in the opposite direction with banks taking first their credit decisions and then looking for the necessary funding and reserves of central bank money. As Claudio Borio and Disyatat from the BIS [The Bank for International Settlements] put it: 'In fact, the level of reserves hardly figures in banks' lending decisions. The amount of credit outstanding is determined by banks' willingness to supply loans, based on perceived risk-return trade-offs and by the demand for those loans'. In modern banking sectors, credit decisions precede the availability of reserves in the central bank. As Charles Goodhart pointedly argued, it would be more appropriate talking about a 'Credit divisor' than about a 'Credit multiplier'."

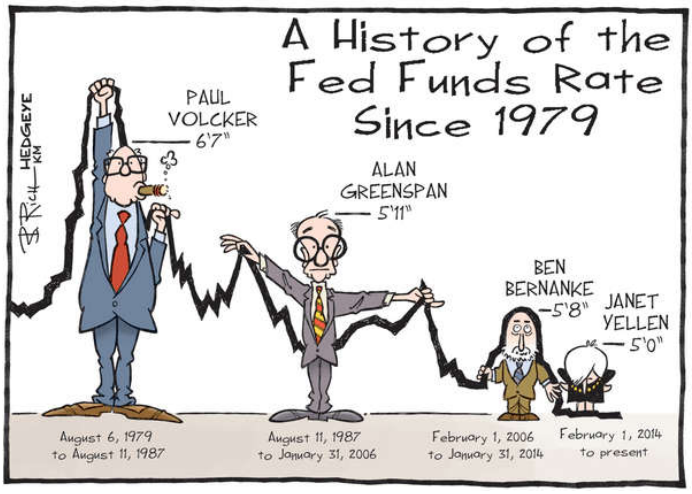
https://www.ecb.europa.eu/press/key/date/2011/html/sp111208.en.html

(i) Is the above explanation consistent with the money creation model in the lecture notes?

(ii) Does the speech present an orthodox or heterodox view of the process of bank money creation? [In the orthodox view, the central bank determines de money stock **M1** and, hence, deposits; and, moreover, banks need cash before lending. The heterodox view denies the orthodox claims.]

11. Vignettes

The vignette on the right shows the height of the chairmen of the Federal Reserve (the Fed, the US central bank) between 1979 and 2017 and the evolution of the Fed's interest rate (for example, 5'11'' is 180.34 cm).



(i) In what fallacy does one incur by claiming that the taller the chairman, the higher the interest rate?

(ii) Assuming true the correlation, what does the height of 1.82 m of the current chairman (Jerome Powell, in office since February 2018) predict? Is the prediction consistent with evidence on interest rates between 2018 and 2025?

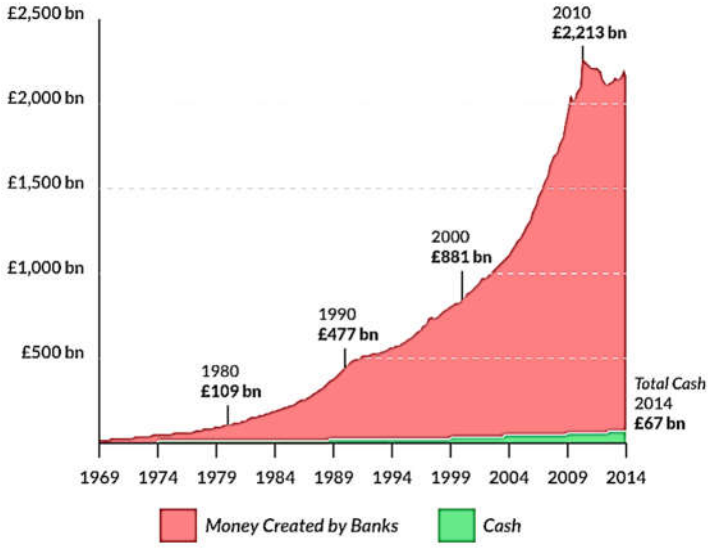
https://biographygist.com/jerome-powell/
https://d1yhils6iwh5l5.cloudfront.net/charts/resized/42193/large/Fed_Chairmen_cartoon_02.03.2016.png

12. Money creation

Which variable in the money creation model does the following statement refer to? "By creating money in this way, banks have increased the amount of money in the economy by an average of 11.5% a year over the last 40 years. This has pushed up the prices of houses and priced out an entire generation." Justify the answer.
https://positivemoney.org/how-money-%20works/how-banks-%20create-money/.

13. Money creation

What could explain, in the money creation model, the decline in bank money creation after around 2009 in the graph on the right? Suggest a similar graph that represents the evolution of reserves after around 2009.
https://positivemoney.org/how-money-works/how-much-money-have-banks-created/



14. Money creation

"From the time when the Bank of England was formed in 1694, it took over 300 years for banks to create the first trillion pounds. It took them only 8 years to create the second trillion."

Using a graphical representation of the heterodox model of money creation, what change (or changes) in the components of the model could explain this evolution? Justify your answer.

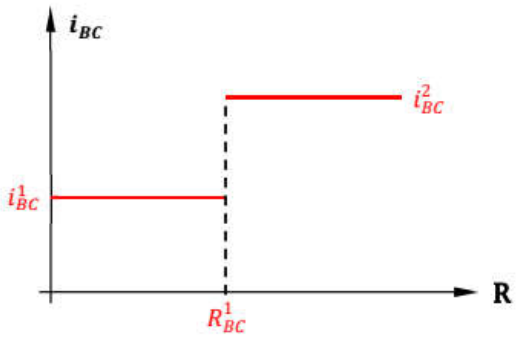
https://positivemoney.org/how-money-%20works/how-banks-%20create-money/

15. Forms of money

State one similarity and one difference between any two of the three forms of money. Why is not there a single form of money instead of three?

16. Generalization of the banking and Central Bank money creation model

By means of a graphical representation, identify the interest rate set by banks, the volume of loans, the volume of deposits and the demand for reserves in the following generalization of the money creation model: now the central bank sets two rates i^1_{BC} and i^2_{BC}, such that up to the volume R^1_{BC} of reserves the central bank charges the rate i^1_{BC} and, beyond R^1_{BC}, it sets the rate $i^2_{\text{BC}} > i^1_{\text{BC}}$ (as shown on the right).



17. Graphical analysis of money creation

Determine graphically in the representation of the money creation model (as shown next) the effect on the interest rate set by banks, the volume of loans, the volume of deposits, the banks' demand for central bank reserves, the unsatisfied demand for private loans, the banks' profits obtained from private loans and the central bank's income from the provision of reserves of the following events.

(i) The central bank lower its interest rate.

(ii) The central bank conducts an expansionary monetary policy.

(iii) Banks raise the premium.

(iv) The total demand for loans function shifts to the right.

(v) Botht the total demand for loans function and solvent demand for loans function shift to the right.

(vi) The solvent demand for loans function shifts to the left.

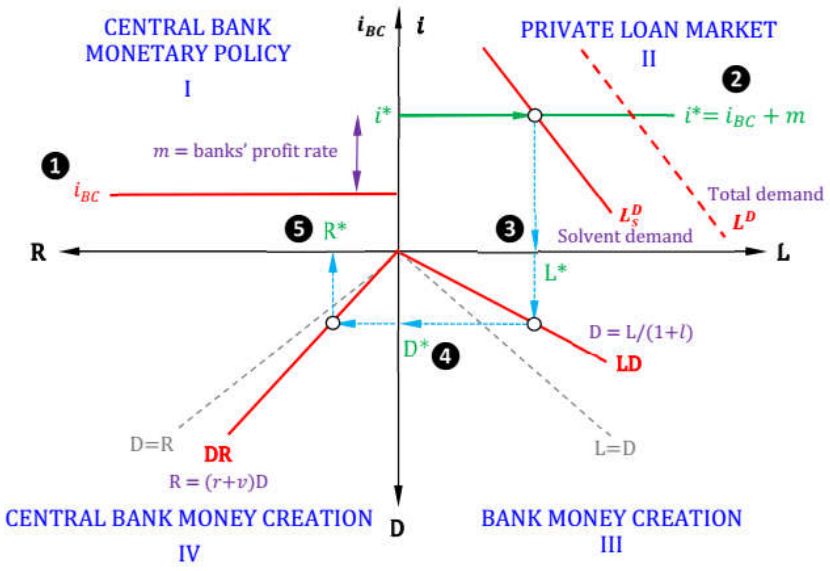
(vii) The liquidity ratio diminishers.

(viii) The mandatory reserve ratio decreases.

(ix) The voluntary reserve ratio increase.

(x) The mandatory reserve ratio increases and the voluntary reserve ratio decreases.

(xi) The amount of cash that the public wishes to hold per deposit unit increases.



18. Digital euro

In a brief speech on 23 January 2023 in Brussels, Fabio Panetta, a member of the Executive Board of the European Central Bank, said:

> "But let me be clear: the digital euro would never be programmable money. The ECB would not set any limitations on where, when or to whom people can pay with a digital euro. That would be tantamount to a voucher. And central banks issue money, not vouchers. We are also aware of some people's concerns that a digital euro could harm the confidentiality of their payment data. When it comes to the central bank, we propose that we do not have access to personal data."

https://www.ecb.europa.eu/press/key/date/2023/html/ecb.sp230123~2f8271ed76.en.html

(i) What do you think it is meant by 'programmable money'?

(ii) Do you find substantial differences between a possible digital euro (created by a central bank) and the digital form of euro that currently exists (created by private banks)? Is the latter not also exposed to losses of confidentiality?

19. Explain if the following statements are true or false

(1) One of the main functions of a central bank is to establish when money ceases to be a store of value and when it ceases to be a means of payment.

(2) It is not a difference between cash and deposits that cash is not a form of electronic money.

(3) All financial assets in an economy are forms of money.

(4) Reserves are a liability of both banks and the central bank.

(5) The creation of a deposit by a bank in favor of someone who deposits cash into the bank is recorded in accounting as an increase in the bank's assets.

(6) One of the missions of a central bank is to ensure that the sum of cash and reserves is not much higher than deposits.

(7) In the following list, there are at least four financial assets missing: book, Treasury bill, mobile phone, bond issued by a company, bond issued by the government, bank deposit, a two-euro coin.

(8) All financial assets are created by the central bank or by banks.

(9) Not all three basic forms of money are created by the central bank or by banks.

(10) All financial assets must be purchased by paying with deposits or cash.

(11) The central bank participates in all transactions that take place in the financial sector.

(12) The real sector of the economy is defined by the financial assets that actually exist, excluding fictitious financial assets, such as bitcoin. [Remark: 'bitcoin' refers to the cryptocurrency; 'Bitcoin', to its associated software.]

(13) It is logically (and also materially) impossible to create a form of money that satisfies the properties of being electronic, created by the central bank and be universally accessible.

(14) One difference between reserves and cash is that reserves are used in real sector transactions but cash is only used in financial sector transactions.

(15) The difference between money and financial assets is that all financial assets are a form of money but not all forms of money are financial assets.

(16) In the money creation model, the increase in the central bank interest rate ends up causing an increase in the demand for reserves that banks hold at the central bank.

(17) In the model of money creation, a leftward shift of the loan demand function could neutralize the effect on the demand for reserves of an increase in the central bank interest rate.

(18) In the model of money creation, an increase in the reserve ratio can neutralize the effect on the demand for reserves of an increase in the premium that banks charge.

(19) If an individual wants to transform a deposit into cash and their bank requests the cash from the central bank, it is foreseeable that the volume of reserves in the private banking sector will also change.

(20) A central bank can temporarily increase the volume of reserves in the private banking sector through a reverse repo (or resale agreement: the central bank buys assets with the commitment to resell them in the future).

(21) Reserves allow a bank to accept the transfer of bank money created by another bank, as the transfer of bank money will typically be accompanied by an equivalent transfer of reserves.

(22) The main interest rate set by the European Central Bank is between the marginal lending facility rate and the deposit facility rate; specifically, above the former and below the latter.

(23) In the consolidated balance sheet of the central bank and private banking sector reserves and deposits are both a liability.

(24) When a bank uses its central bank's credit facility, the bank reduces the volume of financial assets and increases the volume of reserves, and the central bank increases both its volume of reserves and financial assets.

(25) Accountingly, the sum of the central bank's reserves and cash is always equal to the total loans granted by the banking sector.

(26) It does not destroy deposits if a bank customer makes a cash withdrawal from the bank.

(27) According to the money creation model, the reduction in the interest rate set by the central bank causes an increase in the demand for reserves in the banking sector.

(28) One difference between reserves and cash is that reserves are only used in transactions between banks and cash is only used in transactions between banks and individuals.

(29) Open market operations are the only way banks can obtain reserves from the central bank.

(30) If **M0** does not change, the amount of cash is reduced and the reserve ratio increases, then deposits have decreased.

(31) If the difference between **M1** and **M0** increases, then cash has decreased.

(32) A worker, with a liquidity coefficient of ¼, has received a deposit as salary. Then the worker received a deposit of 1200 if he has withdrawn cash worth 240.

(33) Banks cannot create a form of money that is electronic and universally accessible.

(34) When the central bank creates reserves, it simultaneously creates cash of an equivalent value and makes it circulate in the economy.

(35) Any form of money that is good as a means of payment is necessarily a bad store of value.

(36) The liquidity ratio is the inverse of the reserve ratio: when one increases, the other decreases.

(37) If financial assets A and B differ in only two properties, it is plausible that if A is as liquid as B, then Bmust be more profitable than A.

(38) If financial assets A and Bdiffer in only two properties, it is likely that if A it has more risk than B, then B it must be more profitable than A.

(39) If financial assets $A$and Bdiffer in only two properties, it is likely that if $A$is less liquid than B, then B it must have more risk than A.

(40) It is unlikely that a highly liquid financial asset with a high return is extremely risky.

(41) If financial asset $A$is more liquid than financial asset B, and financial asset C is less liquid than B, then it is necessarily A riskier than C.

(42) If the financial asset $A$is more liquid than the financial asset B, and the financial asset C is riskier than B, then it is necessarily C more liquid than A.

(43) If the financial asset A is more liquid than the financial asset B, and B is equally liquid as C, then necessarily C is more profitable than A.