Macroeconomic Analysis · 2025-26

List 2 of exercises and questions

INSTRUCTIONS

- **Answer the following exercises**

Two exercises from Exercises 1–6	By answering Exercise 25 or Exercise 26, you are entitled to answer just: ▪ one exercise from Exercises 1–6 ▪ Exercise 7 or Exercise 8 ▪ one exercise from Exercises 9–12 ▪ one exercise from Exercises 13–16 ▪ two exercises from Exercises 17–23 ▪ in Exercise 24, one statement in each interval.
Exercise 7 or Exercise 8	
Two exercises from Exercises 9–12	
Two exercises from Exercises 13–16	
Three exercises from Exercises 17–23	
In Exercise 24 two statements from each interval $[1+10(x–1), 10x]$ of statements, with $x \in \{1, 2, 3, 4, 5\}$	

- 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.

Warning: do not take for granted that answers exist for all questions.

1. Triangular arbitrage

Exchange rates are $e_{\$¥} = 1$ \$/¥, $e_{€¥} = 2$ €/¥ and $e_{€\$} = 3$ €/\$.

(i) Check for the existence of arbitrage opportunities.

(ii) Compare the direct exchange rate between dollar and euro and the indirect rate between dollar and euro through the yen.

(iii) Identify the sequence of transactions that generates a sure loss.

(iv) Explain how taking advantage of arbitrage opportunities equalizes direct and indirect exchange rates.

2. Triangular arbitrage

Between which currencies can triangular arbitrage not be carried out if the exchange rates are those in the following table?

€/\$	€/£	€/¥	\$/£	\$/¥	£/¥
1	2	3	4	5	6

3. Triangular arbitrage

Between which currencies is triangular arbitrage profitable if the exchange rates are those next? Find the exchange rate £/€ that avoids triangular arbitrage.

\$/€	£/€	¥/€	\$/£	\$/¥	¥/£
4		2	5	6	3

4. Triangular arbitrage

With exchange rates 2 €/\$, 2 €/¥, x \$/¥ and 2 €/£, calculate some value for x that, at the same time:

(i) creates triangular arbitrage opportunities between euro, dollar and yen, and

(ii) prevents the existence of such opportunities between euro, dollar and pound.

5. Triangular arbitrage

Complete as far as possible the table below assuming that no opportunity for triangular arbitrage exists.

€/\$	€/£	€/¥	\$/£	\$/¥	£/¥
1		3	4		

6. Triangular arbitrage

Complete the following table in everything that is justified by triangular arbitrage (the column indicates the currency to be placed in the denominator in the exchange rate units).

	₾ lari, Georgia	₺ lira, Turkey	₼ manat, Azerbaidjan	৳ taka, Bangladesh	₦ naira, Nigeria
₾	1	2			
₺		1	3		
₼			1	4	
৳				1	5
₦					1

7. Direct and indirect exchange rates

The direct exchange rates of the euro (against dollar, yen, pound and bitcoin) are, respectively,

2 \$/€ 3 ¥/€ 4 £/€ 5 ₿/€ .

Calculate all direct exchange rates (not involving the euro) that can be calculated assuming that any indirect exchange rate between two currencies A and B (obtained through a third currency C) matches the direct rate between A and B. Display the results in a 4×4 matrix (constructed following the order of currencies \$, ¥, £ and ₿).

8. Exchange rates

Tables T1 and T2 below (taken from the website http://www.x-rates.com/) show exchange rates. In T1, for example, €1 is worth \$1.35357: the exchange rate is 1.35357 \$/€. Also in T1, the inverse of this rate is 0.73879 \$/€: one dollar is worth 0.73879 euros.

(i) Does the euro appreciate or depreciate against the dollar when moving from T1 to T2? By how much?

(ii) Identify any currency against which both euro and dollar appreciate between T1 and T2.

(iii) Find a currency that, in the transition from T1 to T2, appreciates relative to the dollar but depreciates relative to the euro (or vice versa).

	USD	GBP	CAD	EUR	AUD
USD	1	0.63804	0.99588	0.73879	0.96732
GBP	1.56729	1	1.56082	1.15789	1.51607
CAD	1.00414	0.64069	1	0.74185	0.97133
EUR	1.35357	0.86364	1.34799	1	1.30933
AUD	1.03378	0.65960	1.02952	0.76375	1

T1 Refresh in 0:38 | Feb 07, 2013 06:49 UTC

	USD	GBP	CAD	EUR	AUD
USD	1	0.74210	1.39565	0.85265	1.51449
GBP	1.34753	1	1.88068	1.14898	2.04083
CAD	0.71651	0.53172	1	0.61094	1.08516
EUR	1.17281	0.87034	1.63683	1	1.77621
AUD	0.66029	0.49000	0.92153	0.56300	1

T2 Refresh in 0:43 | Oct 04, 2025 08:54 UTC

9. Uncovered parity

Represent graphically the uncovered interest parity model if the domestic interest rate is 5%, the foreign interest rate is 10%, and the expected exchange rate is 2 \$/€ .

(i) Calculate the exchange rate implied by the uncovered parity and identify it on the graph.

(ii) Does the result of section (i) mean that an appreciation of the euro or an appreciation of the dollar against the other currency is expected?

(iii) Answer parts (i) and (ii) again if the foreign interest rate doubles.

(iv) What change in the expected exchange rate would neutralize the change in the equilibrium exchange rate calculated in (iii)?

(v) What change in the domestic interest rate would neutralize the change in the equilibrium exchange rate calculated in (iii)?

10. Uncovered parity

Quoting the exchange rate in \$/€, the uncovered interest rate parity between euro and dollar is satisfied. Quoting the exchange rate in ¥/\$, the uncovered interest rate parity between dollar and yen is met. Quoting the exchange rate in ¥/€, show that the uncovered interest rate parity between euro and yen holds provided the direct exchange rate (either spot or expected) between two currencies coincides with the indirect rate.

11. Uncovered parity from a foreign perspective

(i) Find, and justify, the exact formula (and the approximate version as well) of the uncovered interest rate parity taking the perspective of the foreign economy (so that, for example, it is initially one dollar, and not one euro, that must be invested and the exchange rate is quoted in euros per dollar).

(ii) Graph the domestic and foreign return functions (now in dollar units). Graph separately the effect on the exchange rate of a change in each interest rate and in the expected exchange rate.

12. Uncovered parity and relative parity

(i) According to the uncovered parity, what is the approximate expected rate of appreciation of the dollar against the euro if the US interest rate is 4% and the eurozone interest rate is 3%? With these data, what is the exchange rate if the expected exchange rate is one euro per dollar?

(ii) According to relative purchasing power parity, what is the rate of appreciation of the dollar against the euro if the US inflation rate is 4% and the eurozone inflation rate is 3% ? With these data, what is the exchange rate now if the future exchange rate is one euro per dollar?

13. Covered parity

Represent graphically the covered interest rate parity model if the domestic interest rate is 5%, the foreign interest rate is 10% and the spot exchange rate is 2 \$/€.

(i) Calculate the forward exchange rate implied by the covered parity and identify it on the graph.

(ii) Does the result in (i) mean that a forward exchange rate premium occurs (forward rate higher than its spot rate) or that a spot exchange rate premium occurs? By how much the premium?

(iii) Answer parts (i) and (ii) again if the foreign interest rate doubles.

(iv) What change in the spot exchange rate would neutralize the change in the equilibrium exchange rate calculated in (iii)?

(v) What change in the domestic interest rate would neutralize the change in the exchange rate from (iii)?

14. Covered parity

Represent graphically the interest rate parity model if the interest rate in the eurozone duplicates the US interest rate and the spot exchange rate duplicates the forward exchange rate.

(i) Calculate the forward exchange rate implied by the covered parity and identify it on the graph.

(ii) Is there a forward premium (forward above spot) or a forward discount (forward below spot)? By how much?

(iii) By what percentage should the American rate be modified to double the premium or discount in (ii)?

15. Covered parity

The foreign interest rate is 30% . The domestic currency is expected to appreciate by 10% . The spot exchange rate is 1/4 domestic currency units per foreign currency unit. Assuming that the approximate formula for the uncovered parity is satisfied, calculate the forward exchange rate implied by the covered parity and identify it on a graphical representation of the covered parity model.

16. Covered parity

Assuming the covered interest rate parity, calculate the rate of change in the exchange rate (the rate of appreciation or depreciation) if the domestic interest rate doubles, the foreign interest rate remains constant and the forward exchange rate also doubles.

17. Parities

Justify between which two consecutive periods the uncovered, covered and relative parities are met (the inflation rate is the rate of change of the consumer price index, CPI). If not, modify a single value so that the parity you are considering is met. [The star symbol * identifies the foreign value.]

t	CPI	CPI*	i	i*	e	e^F	e^e
1	100	300	5%	4%	1 \$/€	3 \$/€	2 \$/€
2	200	200	0%	1%	2 \$/€	4 \$/€	1 \$/€
3	150	100	2%	−1%	4 \$/€	1 \$/€	1 \$/€
4	300	200	−1%	0%	3 \$/€	3 \$/€	3 \$/€

18. Forward speculation

You have 100 million euros.

(i) Explain how to profit from a forward exchange rate of 2 €/\$ if you are convinced that, when the forward rate is effective, the spot exchange rate will then be 2 \$/€.

(ii) What if you had 100 million dollars?

(iii) What result would the operation in (i) have produced if the spot rate had been 4 \$/€?

19. Arbitrage on the spot and the forward markets

Consider the following abbreviations:

C = "covered interest rate parity is met",

NS3 = "no triangular arbitrage opportunity in the spot market" and

NF3 = "no triangular arbitrage opportunity in the forward market".

The following result is demonstrated in the notes:

$$C \Rightarrow (NS3 \Rightarrow NF3).$$

Demonstrate the following:

$$C \Rightarrow (NF3 \Rightarrow NS3).$$

Consequently, the combination of the two results implies that the covered parity makes NV3 and NT3 equivalent: there is triangular exchange rate consistency in the spot markets if, and only if, there is triangular exchange rate consistency in the forward markets.

20. Relative parity

Show that if relative purchasing power parity is valid between any two countries, then the following is satisfied: with three currencies A, B and C, the rate of change of the exchange rate between A and B plus the rate of change of the exchange rate between B and C plus the rate of change of the exchange rate between C and A is approximately equal to zero.

21. Absolute parity and triangular arbitrage

The absolute purchasing power parity (PPP) theory holds that exchange rates equalize consumer price indices when they are expressed in the same currency units:

$$e_{PPP} = \frac{CPI_{\$}}{CPI_{€}}.$$

Prove that if the PPP theory is valid between any two countries (the exchange rate between their currencies coincides with the e_{PPP} value), then the condition of absence of triangular arbitrage is satisfied (the product of the exchange rates of three currencies, appropriately defined, is one).

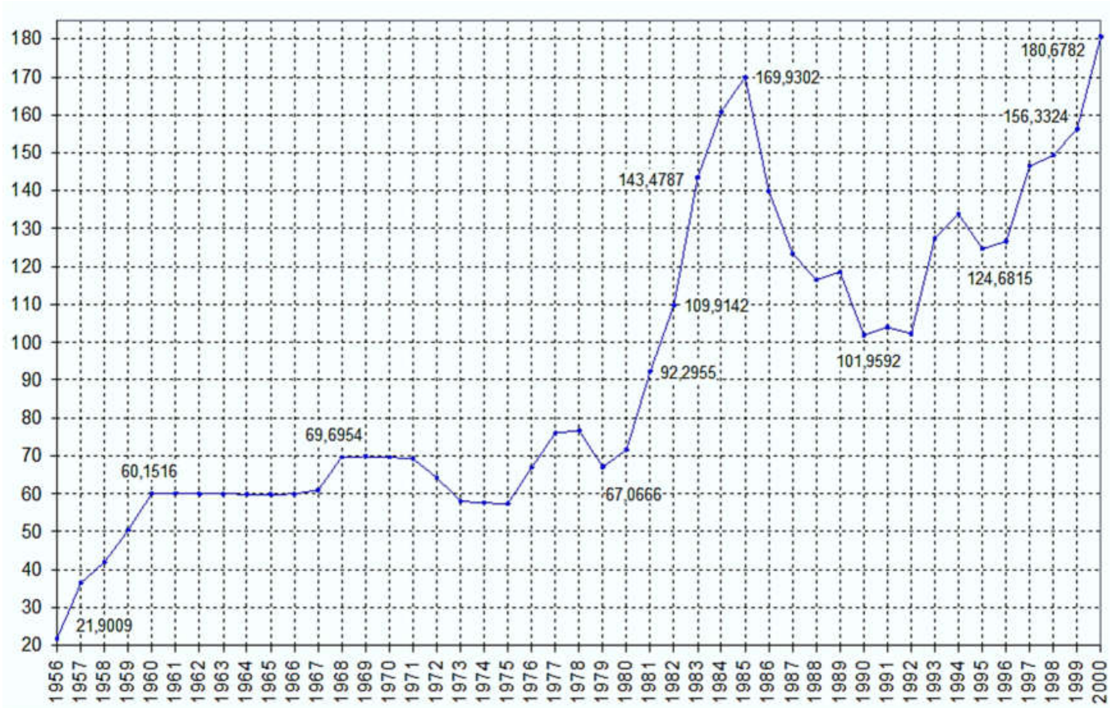
22. Peseta-dollar exchange rate

The graph below shows the peseta-dollar exchange rate (1956–2000): how many pesetas a dollar bought.

(i) Choose an interval during which the peseta depreciated against the dollar.

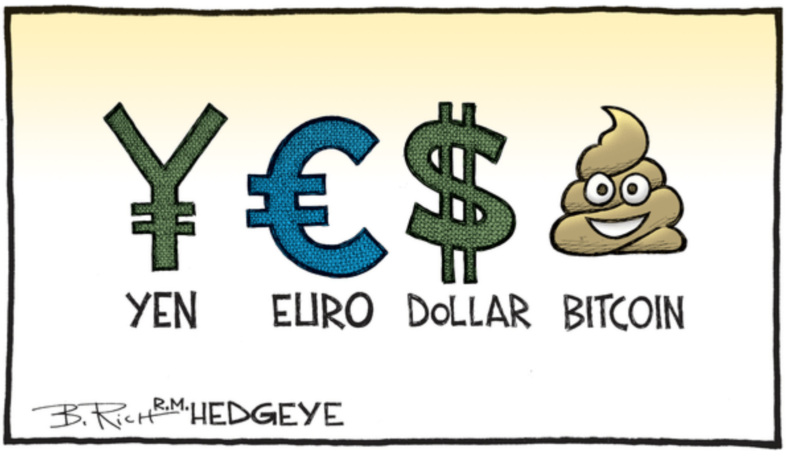
(ii) Select two years in which the peseta appreciated in relation to the dollar.

(iii) Guess what the graph would look like if it showed the dollar-to-peseta exchange rate (how many dollars one peseta could buy).

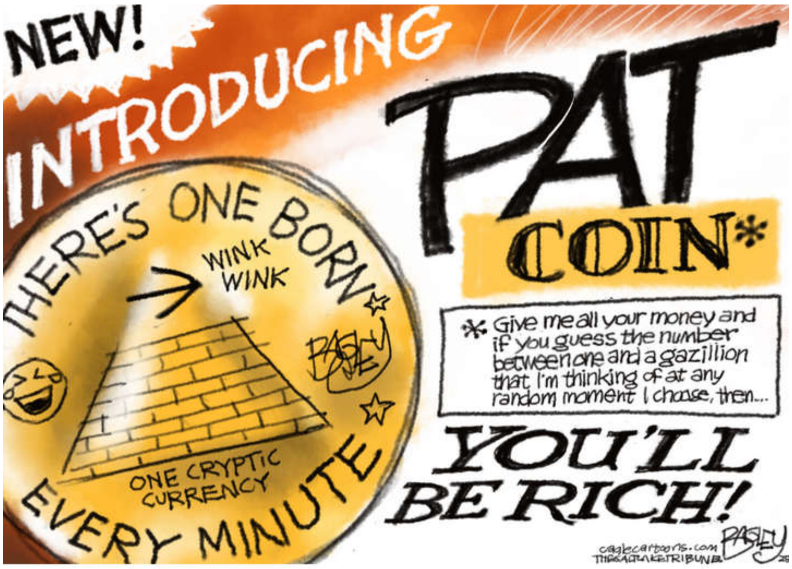


http://www.economicswebinstitute.org/data/world exchangerates.zip

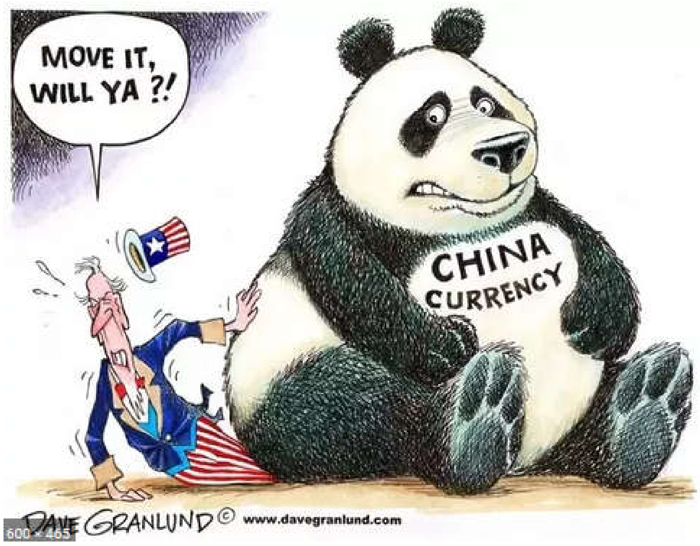
23. Interpret the following cartoons



https://app.hedgeye.com/insights/64906-cartoon-of-the-day-s-coin?type=cartoons

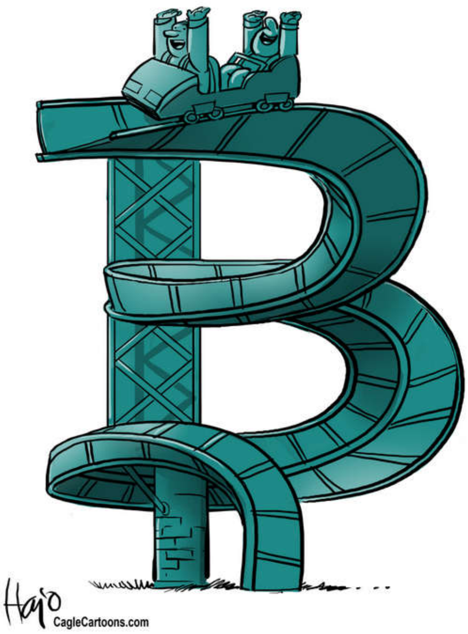


https://cagle.com/cartoonist/pat-bagley/2025/01/23/292123/crypto-coin



https://www.quora.com/How-does-a-country-manipulate-exchange-rates

https://cagle.com/cartoonist/pat-byrnes/2025/01/29/292301/trump-meme-coin-scam



https://cagle.com/cartoonist/hajo-de-reijger/2018/03/08/207674/bitcoin-rollercoaster

24. Explain whether each the following statements is true or false

(1) In at least two of the following four situations the dollar depreciates against the euro: from 4 \$/€ to 2 €/\$; from 2 \$/€ to 2 €/\$; from 2 €/\$ to 0.5 \$/€; from 2 €/\$ to 4 \$/€.

(2) Depreciation and devaluation differ in that depreciation is a reduction in the exchange rate and devaluation is an increase.

(3) Appreciation and revaluation differ in that appreciation is a decision by a public authority and revaluation is determined by the foreign exchange market.

(4) The dollar appreciates against the euro going from 2 \$/€ to 4 \$/€.

(5) The dollar does not appreciate against the euro going from 2 \$/€ to 2 €/\$.

(6) The dollar depreciates against the euro going from 2 \$/€ to ½ €/\$.

(7) The change from 2 \$/€ to 2 €/\$ does not mean that the euro is not depreciating against the dollar.

(8) In the euro-dollar foreign exchange market, anyone who buys euros is, at the same time, creating demand for dollars.

(9) In a fixed exchange rate system the domestic currency neither appreciates nor depreciates.

(10) In a fixed exchange rate system, revaluation is not possible, but devaluation is.

(11) In a fixed exchange rate system the impossible trinity becomes possible.

(12) According to the open economy trilemma, it is not possible to have a high interest rate, a low exchange rate and stable GDP growth at the same time.

(13) According to the open economy trilemma, it is not possible to have an expansionary open market operation, a declining reserve ratio and a fixed exchange rate at the same time.

(14) The open economy trilemma relates monetary policy, fixed exchange rates and capital controls.

(15) The open economy trilemma states that there is triangular arbitrage is not profitable when a fixed exchange rate is adopted and a speculative attack occurs.

(16) If the market exchange rate \$/€ is higher than the fixed exchange rate, the central bank can make them match by selling enough dollars in the currency market.

(17) The connection between interest rate and exchange rate in the very short term implies that a domestic expansionary monetary policy will tend to depreciate the domestic currency.

(18) It is possible to make profits through triangular arbitrage if the exchange rates are such that one dollar is exchanged for two euros, two euros for four yen and four yen for one dollar.

(19) Among the factors that contribute to the demand for euros in the currency market are imports of US goods made by eurozone producers.

(20) Among the factors that contribute to the supply of euros in the currency market are the sales of financial assets from eurozone residents to US residents.

(21) If eurozone citizens make more tourist visits to the US, the dollar tends to depreciate against the euro.

(22) An increase in the eurozone interest rate combined with a rise in the US interest rate necessarily causes an appreciation of the euro against the dollar.

(23) A decline in the eurozone inflation rate combined with a reduction in the US inflation rate necessarily causes an appreciation of the dollar against the euro

(24) According to the uncovered interest parity, the expected rate of appreciation of the domestic currency is approximately 2% when the foreign interest rate is twice the domestic interest rate.

(25) By the covered interest parity, an increase in the domestic interest rate increases the forward exchange rate.

(26) An implication of uncovered interest rate parity and relative purchasing power parity is that the expected change in the real exchange rate approximately matches the difference in nominal interest rates (foreign minus domestic).

(27) If triangular arbitrage is not possible between euro, dollar and yen, then triangular arbitrage is not possible between euro, dollar and pound sterling.

(28) According to uncovered interest parity, the expected rate of appreciation of the domestic currency is approximately 2% when the foreign interest rate is twice the domestic interest rate.

(29) By the covered interest parity, an increase in the domestic interest rate increases the forward exchange rate.

(30) An implication of uncovered interest rate parity and relative purchasing power parity is that the covered interest rate parity cannot hold.

(31) If triangular arbitrage is not possible between euro, dollar and yen, then triangular arbitrage is not possible between euro, dollar and British pound.

(32) Uncovered parity is not met if the exchange rate e is 2 \$/€, a 50% increase in e is expected, the foreign interest rate is 1%, and the domestic interest rate is 2%.

(33) If relative purchasing power parity hols, covered or uncovered parity necessarily must be satisfied .

(34) According to the covered interest parity, the forward exchange rate is approximately the difference between the foreign and domestic interest rates.

(35) Triangular arbitrage is not possible if the countries of the three currencies involved have their own (sovereign, independent) monetary policy and at least two of them have a fixed exchange rate between their respective currencies and the currencies of the other two countries.

(36) The Big Mac Index (*Burgernomics*) provides predictions of the value of exchange rates on the basis of the uncovered interest rate parity or on the basis of the covered interest rate parity.

(37) By the uncovered parity, a depreciation of the euro of approximately 3% should be expected if the US interest rate is 9% and the eurozone interest rate is 6%.

(38) The covered interest rate parity contends that the difference between the spot exchange rate and the forward exchange rate between the dollar and the euro depends on the difference in the US and the eurozone inflation rates.

(39) Relative purchasing power parity states that the euro appreciates against the dollar if the US interest rate is higher than the eurozone interest rate.

(40) By the covered interest rate parity, if the forward rate matches the spot rate, then the domestic interest rate matches the foreign interest rate.

(41) According to uncovered interest rate parity, if both the domestic interest rate and the foreign interest rate double, then both the exchange rate and the expected exchange rate double.

(42) When there is triangular arbitrage, monetary policy cannot be independent (that is, the central bank is not free to set the interest rate).

(43) If there is no possibility of triangular arbitrage between three currencies, then the addition of a fourth currency does not generate any possibility of triangular arbitrage either.

(44) When both the covered and uncovered interest parity are satisfied, triangular arbitrage produces no net gain.

(45) Uncovered parity is not fulfilled if the exchange rate e is 2 \$/€, a 50% increase in e is expected, the foreign interest rate is 1% and the domestic interest rate is 2%.

(46) According to the covered interest parity, the forward exchange rate is approximately the difference between the foreign and domestic interest rates.

(47) According to relative purchasing power parity, if the exchange rate increases, the foreign inflation rate grows more than the domestic inflation rate.

(48) The difference between arbitrage and speculation is that the latter takes place when the exchange rate is fixed and the former when it is flexible.

(49) A reason that would explain the appreciation of the dollar against the euro is that the eurozone CPI has grown less than the US CPI.

(50) In the currency market where euros are exchanged for dollars, US imports of eurozone goods generate a demand for euros, but US purchases of eurozone financial assets generate a demand for dollars (that is, a supply of euros).

25. Commercial arbitrage and the Big Mac index

The Economist's Big Mac Index database for January 2022 provides the following information (https://www.economist.com/big-mac-index , https://github.com/TheEconomist/big-mac-data).

	domestic price of a Big Mac	market exchange rate (per dollar)
Russia	135 rubles	77.4175
Ukraine	69 hryvnias	28.3673

(i) Calculate the price in dollars of the Big Mac in each country.

(ii) Find the purchasing power parity exchange rate (based on the price of the Big Mac).

(iii) Compare the parity rate with the market rate (derived by arbitrage of the exchange rate with the dollar) and determine the percentage of under or overvaluation of each currency with respect to its parity value.

(iv) Based on (iii) and the theory of purchasing power parity, was it to be expected an appreciation or depreciation of the ruble against the hryvnia?

(v) Assuming no transportation or transaction costs, explain how commercial arbitrage would lead to the ruble-hryvnia exchange rate being equal to the parity exchange rate.

26. More Big Macs

The Economist's Big Mac Index database provides the following information (https://github.com/TheEconomist/big-mac-data).

July 2021	domestic price of Big Mac	market exchange rate (per dollar)
Argentina	380	96.33375
Ukraine	65	27.22

July 2023	domestic price of Big Mac	market exchange rate (per dollar)
Argentina	1650	275,275
Ukraine	105	36.93145

January 2025	domestic price of Big Mac	market exchange rate (per dollar)
Argentina	7300	1050
Ukraine	120	42

(i) For each table:

(a) calculate the price in dollars of the Big Mac in each country;

(b) find the purchasing power parity exchange rate (based on the price of the Big Mac);

(c) compare the parity rate with the market rate (derived by arbitrage of the exchange rate with the dollar) and determine the percentage of undervaluation or overvaluation of each currency with respect to its parity value;

(d) based on (iii) and the theory of purchasing power parity, is an appreciation or a depreciation of the Argentine peso against the Ukrainian hryvnia to be expected?

(ii) Explain whether the data in the third table is consistent with predictions based on (i) the second table; (ii) the first table.