

# Introduction to Macroeconomics · M4 · 2016-17

## Problem set 1 · Exercises

**1. Nominal GDP, real GDP, GDP deflator.** There are only two goods. Fill out the following table, as much as possible, providing a justification for each answer.

period	1	2	3
price $p_1$ of good 1	8	3	
amount $q_1$ produced of good 1	5		2
price $p_2$ of good 2		5	
amount $q_2$ produced of good 2		8	2
nominal GDP	100		60
real GDP (base period $t = 1$ )		80	
GDP deflator (base = 100)			300
GDP deflator inflation rate			

**2. Real GDP.** There are only two goods. The following table shows the price, and amount produced, of each good in each period.

$t$	$p_1$	$q_1$	$p_2$	$q_2$
1	4	6	2	8
2	9	$x$	3	$y$

- With  $y = 5$ , find out the value of  $x$  (that is, the amount of production of good 1 in period 2) ensuring that GDP at constant prices of period 1 remains unchanged from  $t = 1$  to  $t = 2$ .
- Answer (i) again if the aim is to keep GDP at constant prices of period 2 unaltered.
- If  $x = 5$ , calculate the value of  $y$  (the amount of production of good 2 in period 2) guaranteeing that GDP at constant prices of period 1 remains unchanged from  $t = 1$  to  $t = 2$ .
- Letting  $x = y$ , which is the smallest value of  $x$  under which GDP at constant prices of period 1 increases from  $t = 1$  to  $t = 2$ ?

**3. Real GDP.** Can real GDP increase from  $t$  to  $t + 1$  if the production of all the goods remains constant from  $t$  to  $t + 1$ ?

**4. Manipulating real GDP?** There are only two goods. The following table shows the price, and amount produced, of each good in each period. Verify if there is some value of  $x$  such that a change in the base period modifies the period with the largest real GDP.

$t$	$p_1$	$q_1$	$p_2$	$q_2$
1	4	6	2	8
2	$x$	9	3	5

**5. Redefining real GDP.** There are only two goods. The following table shows the price, and amount produced, of each good in each period. Real GDP with base period  $t = 1$  values production of every period by means of the price vector  $(p_1^1, p_2^1) = (4, 2)$  from  $t = 1$ . Real GDP with base period  $t = 2$  values production of every period by means of the price vector  $(p_1^2, p_2^2) = (3, 3)$  from  $t = 2$ . Consider a new definition of real GDP in which the price vector adopted to give value to production is the combination  $\lambda \cdot (4, 2) + (1 - \lambda) \cdot (3, 3)$  of the previous two price vectors. The parameter  $\lambda$  represents the weight attributed to the prices from period  $t = 1$  and satisfies the constraint  $0 \leq \lambda \leq 1$ .

$t$	$p_1$	$q_1$	$p_2$	$q_2$
1	4	7	2	8
2	3	9	3	5

- What does the case  $\lambda = 0$  represent? And the case  $\lambda = 1$ ?
- Computing every real GDP with the price vector  $\lambda \cdot (4, 2) + (1 - \lambda) \cdot (3, 3)$ , find the value  $\lambda'$  of  $\lambda$  that equates real GDP from  $t = 1$  with real GDP from  $t = 2$ .
- Being  $\lambda'$  the value computed in (ii), which period has the largest real GDP if  $\lambda < \lambda'$ ?
- In view of the preceding analyses, is it defensible the existence of a “correct” value for real GDP?

**6. GDP growth.** The GDP of economy 1 is 1000. The GDP of economy 2 is 20. (i) Economy 1 grows at an annual rate of 2%. Economy 2's rate is 12%. How many years are roughly necessary for the GDP of economy 2 to catch up with the GDP of economy 1? (ii) If economy 1 grows at 5% per year, what is the smallest growth rate that allows economy 2 to catch up with economy 1 in 10 years?

**7. GDP and GDP deflator.** For every period  $t$ , calculate: (i) nominal GDP; (ii) real GDP at constant prices of period  $t = 2$ ; (iii) the corresponding GDP deflator; (iv) the rates of growth of both nominal GDP and real GDP; and (v) the GDP deflator inflation rate.

$t$	$p_1$	$q_1$	$p_2$	$q_2$	$p_3$	$q_3$
1	5	1	6	4	0	0
2	6	2	3	3	1	2
3	5	3	5	2	2	4
4	3	4	9	1	3	6

**8. Rule of 70 (Rule of 72).** If a variable grows at a rate of  $g$  per cent per year, it doubles approximately every  $70/g$  ( $72/g$ ) years. Compute how many years are roughly necessary for a variable growing at the following rates to double using each of the two rules.

rate (%)	years	rate (%)	years	rate (%)	years
1/10		3		7	
1/5		4		10	
1		5		50	
2		6		100	

**9. CPI.** Imagine an economy where only two goods are produced, good 1 and good 2. The basket of goods associated with the CPI consists of one unit of good 2 and two units of good 3, which is an imported good. Given the table below, find: (i) for each period, the GDP deflator with base level 100; (ii) for each period, and also with base level 100, the CPI; (iii) the inflation rates based on the GDP deflator; and (iv) the inflation rates corresponding to the CPI.

period	$p_1$	$q_1$	$p_2$	$q_2$	$p_3$	$q_3$
1	5	100	1	400	6	100
2	4	100	2	300	7	200
3	3	100	3	200	6	150
4	2	100	2	100	8	300
5	1	100	1	300	7	250

**10. GDP.** What happens to the GDP deflator if nominal GDP and real GDP are both increased twofold?

**11. CPI.** (i) Is a negative CPI possible? (ii) If so, what would a negative CPI mean?

**12. GDP deflator.** Find the approximate value of the GDP deflator inflation rate if real GDP has increased by 10% and nominal GDP has fallen by 5% (see 18).

**13. Real and nominal GDP.** (i) Can real and nominal GDP be equal in a period  $t$  different from the base period? (ii) If so: (a) what would it mean?; (b) could the real GDP from that period  $t$  be larger than real GDP from the base period?; (c) could nominal GDP?

**14. Real and nominal variable.** The following table displays the monthly minimum nominal wage in Spain, in euros, and the CPI (annual average, base 2011). Compute: (i) for each year, the monthly minimum real wage; (ii) the sequence of growth rates of the nominal wage; and (iii) the sequence of growth rates of the real wage. (iv) Optional: draw a chart with the results.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
wa ge	44 2.2	451 .2	46 0.5	513	54 0.9	570 .6	60 0	62 4	633 .3	641 .4	641 .4	645 .3	645 .3	648 .6
CPI	78. 55	80. 93	83. 39	86. 20	89. 23	91. 72	95. 46	95. 19	96. 90	100	102 .44	103 .88	103 .73	103 .21

<http://www.ine.es/jaxiT3/Tabla.htm?t=10305&L=01>  
<http://www.salariominimo.es/> (2016: 655.20 EUR)

**15. Real and nominal GDP.** Consider two periods of an economy with two goods. Find the prices and the quantities of the goods so that from period 1 to period 2 nominal GDP falls and real GDP rises.

**16. Real and nominal consumption.** What can be inferred from having a nominal consumption larger than the real consumption?

**17. CPI and GDP deflator.** (i) Explain the differences between the GDP deflator and the CPI. (ii) Identify two differences between real GDP and CPI. (iii) Can the CPI inflation rate be positive and, simultaneously, the GDP deflator inflation rate be negative? (iv) What is the effect of a change in the price of imported goods on: (a) CPI; (b) GDP deflator?

**18. Rates of change.** For any given variable  $v$ , let  $\hat{v}$  designate the rate of change of  $v$ : absolute change  $v_1 - v_0$  in  $v$  divided by the initial value  $v_0$ . (i) Compute the relative error that arises when the correct rate of change of the variable  $z = x \cdot y$  is approximated by the rule  $\hat{z} \approx \hat{x} + \hat{y}$  [the correct value is given by  $1 + \hat{z} = (1 + \hat{x}) \cdot (1 + \hat{y})$ ]. (ii) Do the same when the correct rate of change of the variable  $z = x/y$  is approximated by the rule  $\hat{z} \approx \hat{x} - \hat{y}$ . (iii) Find the formula of the correct value in (ii).

period	$\hat{x}$	$\hat{y}$	value of $\hat{z}$ using the rule	correct value of $\hat{z}$	relative error (%)
1	1%	1%			
2	1%	10%			
3	1%	100%			
4	10%	-20%			
5	10%	20%			
6	0%	100%			

**19. GDP, GDP deflator.** Identify which of the following cases are possible and which are not.

Case	Nominal GDP	Real GDP	GDP deflator
1	increases	increases	increases
2	increases	decreases	decreases
3	decreases	decreases	increases
4	decreases	increases	decreases
5	decreases	increases	does not change
6	does not change	increases	decreases

**20. GDP growth.** (i) Can it be that the nominal GDP of an economy grows faster than the nominal GDP of a second economy and, simultaneously, that the real GDP per capita of the second economy grows faster than the real GDP per capita of the first economy? (ii) What if “nominal” were replaced by “real”?

**21. GDP, GDP deflator, CPI.** (i) If nominal GDP and real GDP both fall at the same rate, what is the GDP deflator? (ii) And the GDP deflator inflation rate? (iii) And the CPI inflation rate?

**22. Real GDP growth.** Find the approximate value of real GDP growth if the GDP deflator inflation rate is 5% and nominal GDP growth is -5%.

**23. Inflation rate.** Find the approximate value of the inflation rate if real GDP has increased by 4% and nominal GDP has decreased by 2%.

**24. GDP, GDP deflator, GDP per capita.** Complete as much as possible of the following table.

Case	Nominal GDP growth rate	GDP deflator inflation rate	population growth rate	Real GDP per capita growth rate
1	positive	positive	positive	
2		negative	positive	zero
3	negative		negative	positive
4			zero	zero
5	zero	negative	positive	
6		zero	negative	negative
7	zero	positive	zero	
8		positive		positive

**25. GDP deflator.** Nominal GDP in period 3 is 100. Real GDP in period 3 is 120. (i) Compute the GDP deflator inflation rate from period 2 to period 3. (ii) If, in period 2, nominal GDP was higher than real GDP, was the GDP deflator inflation rate positive or negative? Explain the answer.

**26. GDP, CPI.** Fill out the next table in a justified way if the two goods are produced in the economy and the CPI basket is  $(q_1, q_2) = (1, 4)$ .

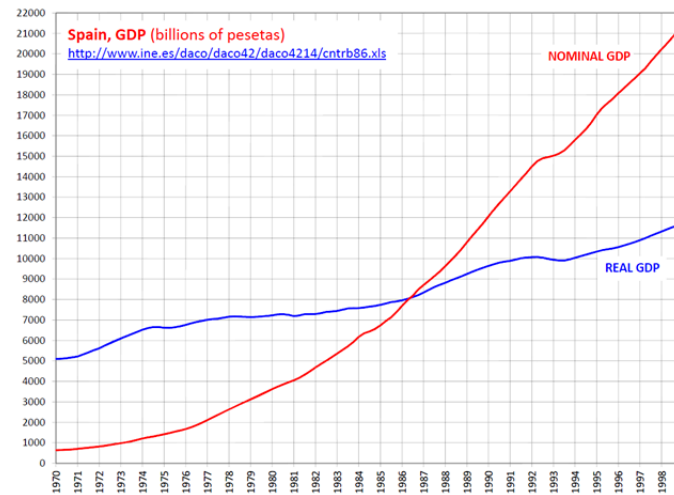
period	1	2	3
price $p_1$ of good 1		10	
amount $q_1$ produced of good 1	10		30
price $p_2$ of good 2			20
amount $q_2$ produced of good 2	20	40	
nominal GDP		2000	2000
real GDP (base period $t = 1$ )	1000	2000	
GDP deflator (base = 100)			
GDP deflator inflation rate			
value of the CPI basket	200		160
CPI (base period $t = 1 \cdot$ base level = 100)			

**27. Inflation rates.** If the GDP deflator inflation rate rises, what happens necessarily with the CPI inflation rate?

**28. Real and nominal GDP.** Draw a graph such that: (i) nominal GDP and real GDP both grow with time; (ii) initially, real GDP is larger than (lies above) nominal GDP; (iii) at a certain point  $t^*$  in time, nominal GDP equals real GDP; (iv) after  $t^*$ , nominal GDP remains always larger (is above) real GDP. (v) Does  $t^*$  have any special meaning? (vi) What information furnishes the fact that nominal GDP is above real GDP after  $t^*$ ? (vii) And the fact that nominal GDP is below real GDP before  $t^*$ ? (viii) Answer questions (vi) and (vii) if the curves representing real GDP and nominal GDP were mutually exchanged.

**29. Variables.** Find two nominal and two real macrovariables (whose names do not include the terms “nominal” or “real”) that cannot take negative values

**30. GDP.** If the GDP deflator has fallen by 2%, by how much should approximately vary real GDP in order to keep nominal GDP constant? Justify the answer by means of the corresponding formula.



**33. GDP per capita.** Spain seems to have surpassed Italy in GDP per capita for the first time. (i) Does this fact imply that the Spanish economy is bigger than the Italian economy? (ii) Explain the meaning of a GDP per capita surpassing another GDP per capita. (iii) Which changes in the variables that define GDP per capita could explain an increase in GDP per capita?

<http://www.expansion.com/economia/2016/03/25/56e16ed922601d9c238b457e.html>

**31. El Farol.** Why is El Farol bar problem relevant for macroeconomic analysis?

**32. Nominal/real GDP.** In the chart on the left, nominal GDP is larger than real GDP in 1998 but real is larger than nominal in 1970. Has the GDP deflator increased or decreased from 1970 to 1998?

**34. Fallacies.** (i) Define briefly the meaning of the *post hoc ergo propter hoc* fallacy and suggest an example. (ii) Explain by means of an example the fallacy of composition. (iii) Indicate something that the fallacy of composition and the fallacy of division have in common and something that differentiates them.

**35. Price indices.** (i) Is it possible for the GDP deflator inflation rate to be positive and, simultaneously, for the CPI inflation rate to be negative? Justify the answer. (ii) List four concepts directly related to, or built from, a price index.

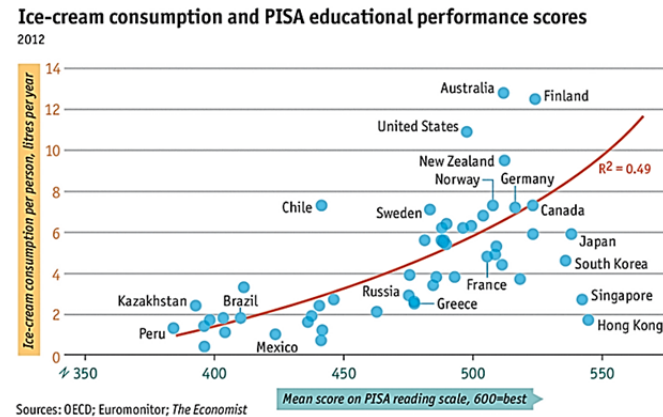
**36. GDP.** Can real GDP be larger than nominal GDP? Explain why or how.

**37. GDP, CPI.** (i) Real GDP has increased by 5% while the CPI inflation rate has decreased by 3%. By how much has nominal GDP varied approximately? (ii) The GDP deflator has fallen a 3%. Real GDP has increased by 2%. Find out by how much nominal GDP has changed approximately.



**38. ?** Which economic phenomenon is represented by the chart on the left? Justify the answer <http://www.economist.com/news/americas/21695934-venezuela-today-looks-zimbabwe-15-years-ago-spot-difference?zid=305&ah=417bd5664dc76da5d98af4f7a640fd8a>

**39. Fallacies.** The chart below suggests a strong relationship between ice cream consumption and reading ability. On its basis, it is claimed that “Though it may seem like an odd suggestion on a brisk early-April morning, year-round subsidised ice-cream for children could improve educational attainment. And ice-cream vans should park closer to libraries to help boost reading skills too”. Which fallacy, or fallacies, presented in class is illustrated by these claims?



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<http://www.economist.com/blogs/graphicdetail/2016/04/daily-chart>