

# Introduction to Macroeconomics · M5 · 2013-14

## Problem set 1

**1. Nominal GDP, real GDP, GDP deflator.** There are only two goods. Fill out the following table, 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	$y$

- (i) 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  $t = 2$ .
- (ii) Answer (i) again if the aim is to keep GDP at constant prices of period 2 unaltered.
- (iii) 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  $t = 2$ .
- (iv) 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 of the previous two price vectors:  $\lambda \cdot (4, 2) + (1 - \lambda) \cdot (3, 3)$ . 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

- (i) What does the case  $\lambda = 0$  represent? And the case  $\lambda = 1$ ?
- (ii) 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  $t = 2$ .
- (iii) Being  $\lambda'$  the value computed in (ii), which period has the largest real GDP if  $\lambda < \lambda'$ ?
- (iv) In view of the preceding analyses, is it defensible the existence of a "correct" value for real GDP?

**6. 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

**7. Rule of 70 (72).** If a variable grows at  $g$  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 both rules.

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

**8. 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?

**9. 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.

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

**11. 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?

**12. 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 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

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

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

**15. 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%.

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

**17. Real and nominal variable.** The following table displays the monthly minimum (nominal) wage in Spain (in euros) and the CPI (annual average). 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
wage	442	451	460	513	540	570	600	624	633	641.	641.	645
	.2	.2	.5		.9	.6			.3	4	4	.3
CPI	78.	81.	83.	86.	89.	91.	95.	95.	97.	100.	102.	103
	66	02	50	33	31	90	46	26	06	10	58	.89

<http://www.ine.es/jaxiBD/tabla.do?per=01&type=db&divi=IPC&idtab=109>  
<http://www.salariominimo.es/>

**18. Real and nominal GDP.** Consider the graphs depicted on slides GDP-16 and GDP-17. (i) Is it accidental the crossing of curves at 1986? (ii) What information furnishes the fact that nominal GDP is above real GDP after 1986? (iii) And the fact that nominal GDP is below real GDP before 1986? (iv) What could be inferred if the labels of the curves were mutually exchanged? (v) Is it of any significance the point at which nominal consumption crosses real GDP? (vi) Is it of any significance that nominal consumption is higher than real GDP in 1997?

**19. Size of an economy.** (i) Of the charts on slides GDP-20, GDP-28, and GDP-40, which one is useful to ascertain the number of times that, approximately, the Spanish economy was bigger or smaller than the German economy in 2012? (ii) Ascertain that number. (iii) Has it increased or decreased since 1980?

**20. Interpreting graphs.** (i) Interpret the length of the arrows shown on slides GDP-20 and GDP-43. (ii) What does it mean that, on slide GDP-56, the distance between the two curves increases after 2007?

**21. 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”?

**22. Rates of change.** For any given variable  $v$ , let  $g_v$  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  $g_z \approx g_x + g_y$  [the correct value is  $1 + g_z = (1 + g_x) \cdot (1 + g_y)$ ]. (ii) Do the same when the correct rate of change of the variable  $z = x/y$  is approximated by the rule  $g_z \approx g_x - g_y$  (what is the formula of the correct value?).

period	$g_x$	$g_y$	value of $g_z$ using the rule	correct value of $g_z$	relative error (%)
1	1%	1%			
2	1%	10%			
3	1%	100%			
4	10%	-20%			
5	10%	20%			
6	0%	100%			

**23. GDP per capita.** (i) Using slide GDP-43, make a rough estimate of the number of years that, in 2008, Latin America, Asia, Africa, and China lagged behind Spain in terms of real GDP per capita. (ii) If possible, do the same for the year 1998.

**24. Inflation.** (i) What does it mean that, on slide GDP-59, in some years the inflation rate according to the GDP deflator is higher than according to the CPI? (ii) Indicate on slide GDP-67 periods of inflation, deflation, disinflation, and hyperinflation. (iii) According to slide GDP-68, is there some period during which Spain has inflation and Catalonia deflation?

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

**26. 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%.

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

**28. 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

**29. 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

**30. 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.

**31. Definitions.** (i) For each of the following pairs of concepts, identify a common feature: (1) inflation / disinflation; (2) deflation / disinflation; (3) inflation / deflation; (4) real GDP / nominal GDP per capita; (5) inflation rate according to the CPI / GDP deflator; (6) stock variable / nominal variable; (7) potential GDP / GDP at constant prices; (8) core inflation rate / wealth; (9) inflation rate / GDP growth rate; and (10) CPI inflation rate / CPI. (ii) For each pair, identify a differentiating feature.

**32. Nominal and stock variables.** Consider the slides with label "GDP". Identify eight slides with a graph representing a nominal variable and another eight with a graph representing a stock variable.

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

**34. GDP, CPI.** Fill out the 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)			