Problem Set 1 · Main macroeconomic variables

1. 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 inflation rate associated with the GDP deflator.

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

2. Real GDP. Suppose that, between period t and period $t + 1$, the production of all goods remains constant. Is it possible for real GDP to increase from t to $t + 1$?

3. Rule of 70. If a variable grows at g per cent per year, it doubles approximately every $70/g$ years. Compute how many years are roughly necessary for a variable growing at the following rates to double.

rate (%)	*years*	*rate* (%)	*years*	*rate* (%)	*years*
0.1		3		7	
0.5		4		10	
1		5		50	
2		6		100	

4. GDP growth. The GDP of economy 1 is 1000. The GDP of economy 2 is 20. (i) If, every year, economy 1 grows a 2% and economy 2 grows a 12%, how many years are roughly necessary for the GDP of economy 2 to catch up 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 economy 1 in 10 years?

5. 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.

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

7. 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?

8. CPI. Imagine an economy where only two goods are produced, good 1 and good 2. The basket of goods of the representative consumer 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 associated with the GDP deflator; and (iv) the inflation rates associated with 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

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

10. CPI. Is a negative CPI possible? If so, what would a negative CPI mean?

11. Price index. Is it possible that, at the same time, the GDP deflator raises and the CPI falls? If so, why?

12. Unemployment. (i) Is it possible that, at the same time, the participation rate raises and the unemployment rate falls? If so, why? (ii) Explain the differences between frictional unemployment and structural unemployment. Suggest examples of both.

13. Nominal/real variable. The following table displays the monthly minimum (nominal) wage in Spain (€) and the CPI (annual average). Compute: (i) for each year, the annual 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
wage	442.2	451.2	460.5	513	540.9	570.6	600	624	633.3	641.4	641.4
CPI	88.024	90.699	93.456	96.604	100	102.787	106.976	106.668	108.588	112.058	–

Sources: http://www.ine.es/jaxiBD/tabla.do?per=12&type=db&divi=IPC&idtab=93 · http://www.salariominimo.es/

14. Nominal/real GDP. Consider Figure 1. (i) Is it accidental that the curves cross in 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?

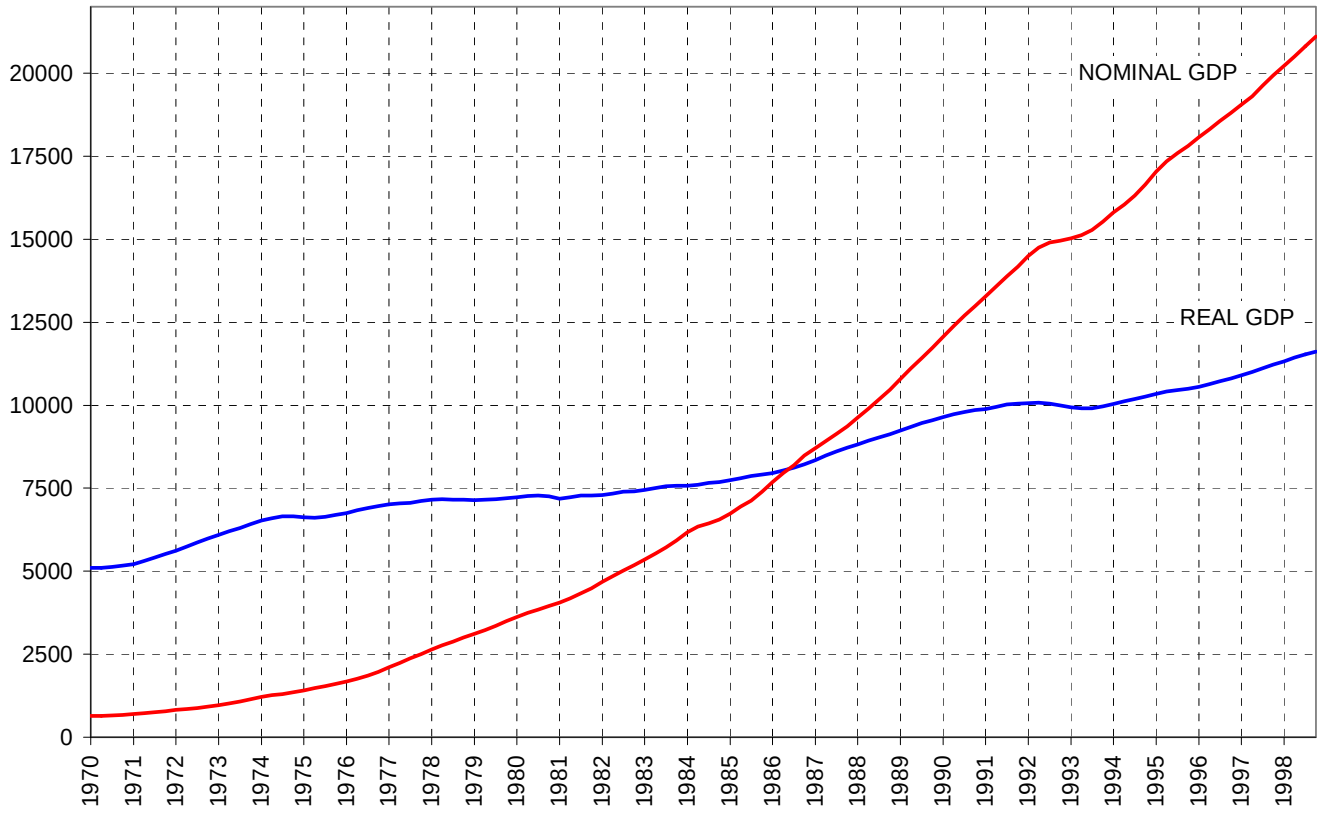

Fig. 1. Real GDP and nominal GDP, Spain, quarterly data, 1970-1998
Base 1986, billions of pesetas · http://www.ine.es/daco/daco42/daco4214/cntrb86.xls

15. Unemployment. Suppose that both the unemployment and the total population of working age remain constant. If the female unemployment rate falls, what happens to the male unemployment rate and to the number of unemployed men?

16. 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 of the first economy? (ii) What if "nominal" were replaced by "real"?

17. Rates of change. For any given variable v, let g_v designate the rate of change of v. (i) Compute the relative error that arises when, in the first table, the correct rate of change of the variable $z = xy$ is approximated by the rule $g_z \approx g_x + g_y$. (ii) Do the same in the second table when the correct rate of change of the variable $z = x/y$ is approximated by the rule $g_z \approx g_x - g_y$.

case	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%			

case	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%			

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

case	*growth rate of the nominal GDP*	*inflation rate associated with the GDP deflator*	*population growth rate*	*growth rate of the real GDP per capita*
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

19. 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 inflation rate that corresponds to the GDP deflator? (iii) And the inflation rate associated with the CPI?

20. Rates of change. [Difficult and at discretion] For any given variable v, let g_v designate the rate of change of v. (i) Prove that if $z = xy$, then $(1 + g_z) = (1 + g_x)(1 + g_y)$. (ii) Show that, for small values of the rates of change, $g_z \approx g_x + g_y$. (iii) Using the previous results, demonstrate that $z = x/y$ implies that $(1 + g_z) = (1 + g_x)/(1 + g_y)$ and that, for sufficiently small values, $g_z \approx g_x - g_y$.

21. GDP per capita. Using Fig. 2, 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.

22. Inflation. Indicate in Fig. 3 periods of inflation, deflation, disinflation, and hyperinflation.

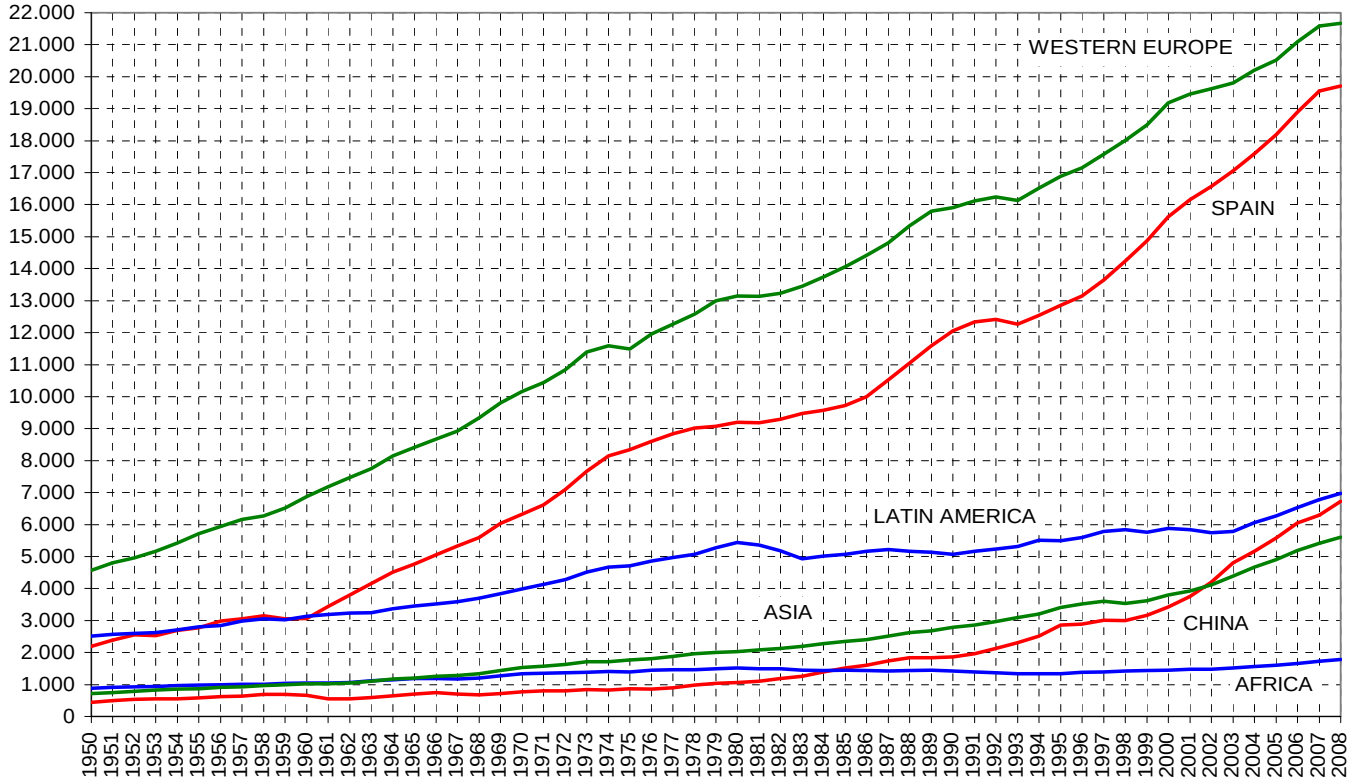

Fig. 2. Real GDP per capita, 1950-2008 · http://www.ggdc.net/maddison/Historical_Statistics/horizontal-file_02-2010.xls

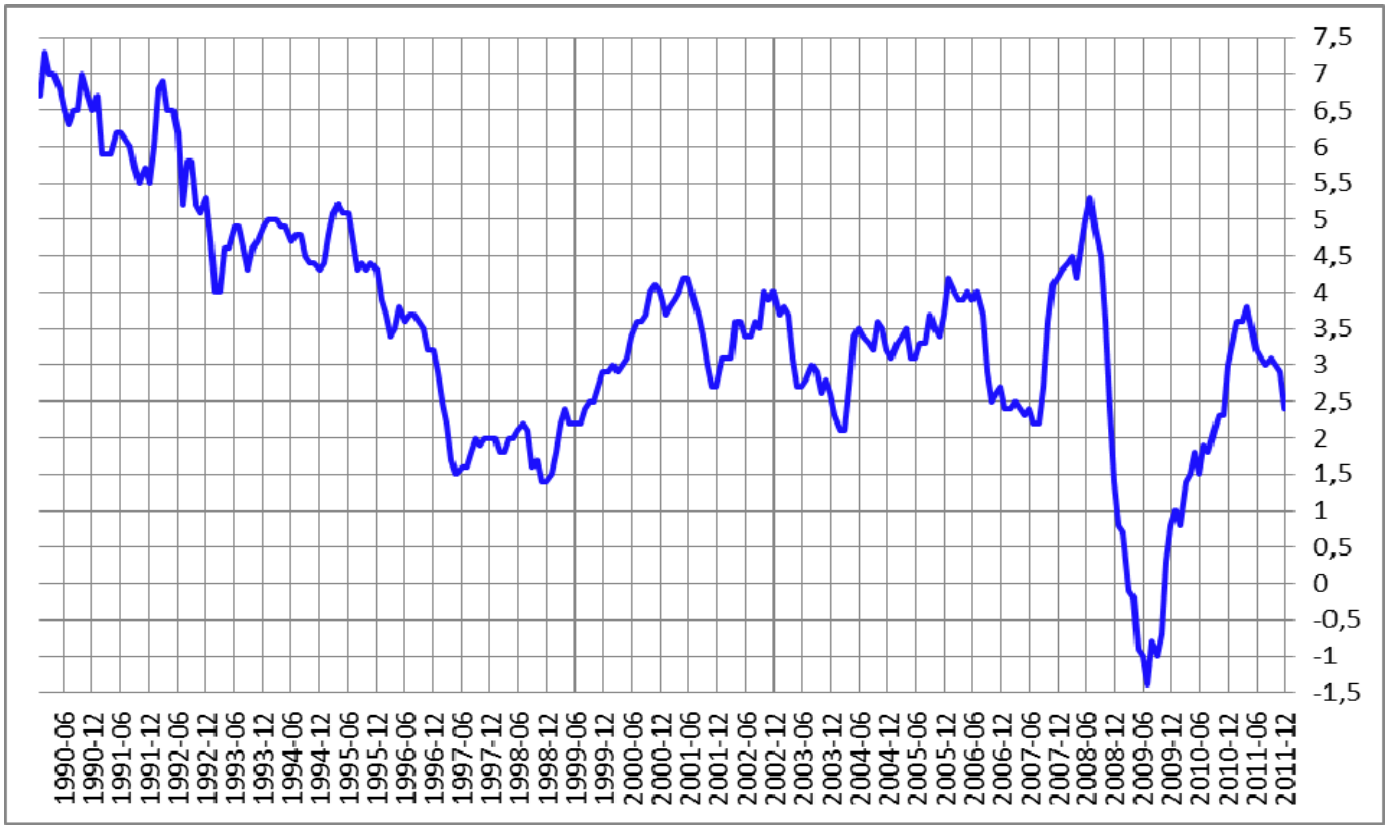

Fig. 3. Spain, annual inflation rate, monthly basis · http://www.ine.es/jaxi/menu.do?type=pcaxis&path=%2Ft25/p138&file=inebase&L=0

23. 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%.

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

Case	*nominal GDP*	*real GDP*	*GDP deflator*
1	*increase*	*increase*	*increase*
2	*increase*	*decrease*	*decrease*
3	*decrease*	*decrease*	*increase*
4	*decrease*	*increase*	*decrease*
5	*decrease*	*increase*	*constant*
6	*constant*	*increase*	*decrease*

25. GDP, CPI. [Nerve-racking exercise] There are only two goods, both are produced in the economy, and the CPI basket is given by two units of good 1 and 4 units of good 2. Fill out the following table, providing a justification for each answer.

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 1			20
amount q_2 produced of good 2	20	40	
nominal GDP		2,000	2,000
real GDP (base period $t = 1$)	1,000	2,000	
GDP deflator (base level = 100)			
GDP deflator inflation rate			
value of the CPI basket	200		160
CPI (base period $t = 1$ & base level = 100)			

26. Definitions. Explain briefly the meaning of the following concepts (some from Problem set 2):

Real gross domestic product per capita
Stock variable
Monetary aggregate
Financial asset
Gross domestic product implicit price deflator
Money multiplier process
Fisher equation
Discount factor
Money multiplier
Real variable
Arbitrage
Government deficit
Gross domestic product implicit price deflator inflation rate
Consumer price index
Monetary base
M1
Real gross domestic product
Flow variable
Liquidity of a financial asset
Real interest rate
Liquidity ratio
Macroeconomic identity
Rate of return of a T-bill
Trade deficit
Government surplus

Multiple choice questions

1. If nominal GDP is 600 and the CPI is 20, then the real GDP
(a) is 600 / 20 = 30.
(b) is 600 · 20 = 12,000.
(c) is necessarily 600 if the period considered is different from the base period.
(d) cannot be determined.

2. Identify a real variable.
(a) The CPI inflation rate
(b) The monetary base
(c) The reserve ratio
(d) None of the above

3. In which case the two variables are flow variables?
(a) The monetary base at a given point in time and the rate of growth of real GDP.
(b) Employment at a given point in time and the inflation rate.
(c) Nominal GDP and real GDP per capita.
(d) None of the above

4. Which sentence is not false?
(a) GDP at constant prices is a nominal variable.
(b) The unemployment rate is not a real variable.
(c) Real GDP may be smaller than nominal GDP.
(d) The CPI inflation rate minus the GDP deflator plus the unemployment rate multiplied by the rate of change of real GDP per capita divided by the base period is twice the base period minus the rate of change of nominal GDP per capita minus the participation rate plus the CPI.

5. Which variables are related by definition?
(a) Nominal GDP and unemployment rate.
(b) Real GDP and GDP deflator
(c) GDP deflator inflation rate and CPI
(d) None of the above

6. Which of the following variables measures the general price level of an economy?
(a) The unemployment rate
(b) The nominal GDP divided by the real GDP
(c) The nominal GDP per capita
(d) None of the above

7. In which case the two variables are real variables?
(a) The GDP deflator and the CPI.
(b) The nominal GDP per capita and the unemployment rate.
(c) The labour force and the purchasing power parity exchange rate.
(d) None of the above

8. Real GDP necessarily rises if
(a) nominal GDP rises.
(b) the GDP deflator falls.
(c) nominal GDP falls and the GDP deflator rises.
(d) None of the above

9. Which sentence is not true?
(a) The rate of growth of real GDP may be smaller than the rate of growth of nominal GDP.
(b) The unemployment rate may be higher than the inflation rate.
(c) The rate of growth of real GDP per capita cannot be negative.
(d) The CPI inflation rate may be different from the GDP deflator inflation rate.

10. In which case does a rise in the first variable necessarily cause a fall in the second variable?
(a) CPI inflation rate and unemployment rate
(b) GDP deflator and nominal GDP per capita
(c) Real GDP and nominal GDP
(d) None of the above