Process of convergence in EU

Measuring growth and convergence

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Basic concepts for review

- GDP, GNP, GNI
- GDP per capita, GNI per capita
- real and nominal GDP,
- price deflators, CPI
- Exchange rate, PPP, PPS
- growth rate

→ See any Macroeconomics textbook
(e.g. Burda&Wyplosz, Macroeconomics – European text, Ch.2)

GDP – Gross Domestic Product

1. Sum of market value of all final goods and services produced within a country in a given period of time (usually a year)
2. Sum of value added occurring within a country during a year
3. Sum of final expenditure GDP = C + I + G + (X – IM)
4. Sum of incomes earned from economic activities within a country during a year

1. GDP as sum of market value of all final goods and services produced within a country in a given period of time (usually a year)
   - The value of the final goods already includes the value of the intermediate goods, so including intermediate *and* final goods in GDP would be double counting.

2. GDP as sum of value added occurring within a country during a year
   - **Value added**: the value of output minus the value of the intermediate goods used to produce that output

Example:

- A farmer grows a bushel of wheat and sells it to a miller for €1.00.
- The miller turns the wheat into flour and sells it to a baker for €3.00.
- The baker uses the flour to make a loaf of bread and sells it to an engineer for €6.00.
- The engineer eats the bread.

Compute value added at each stage of production and GDP

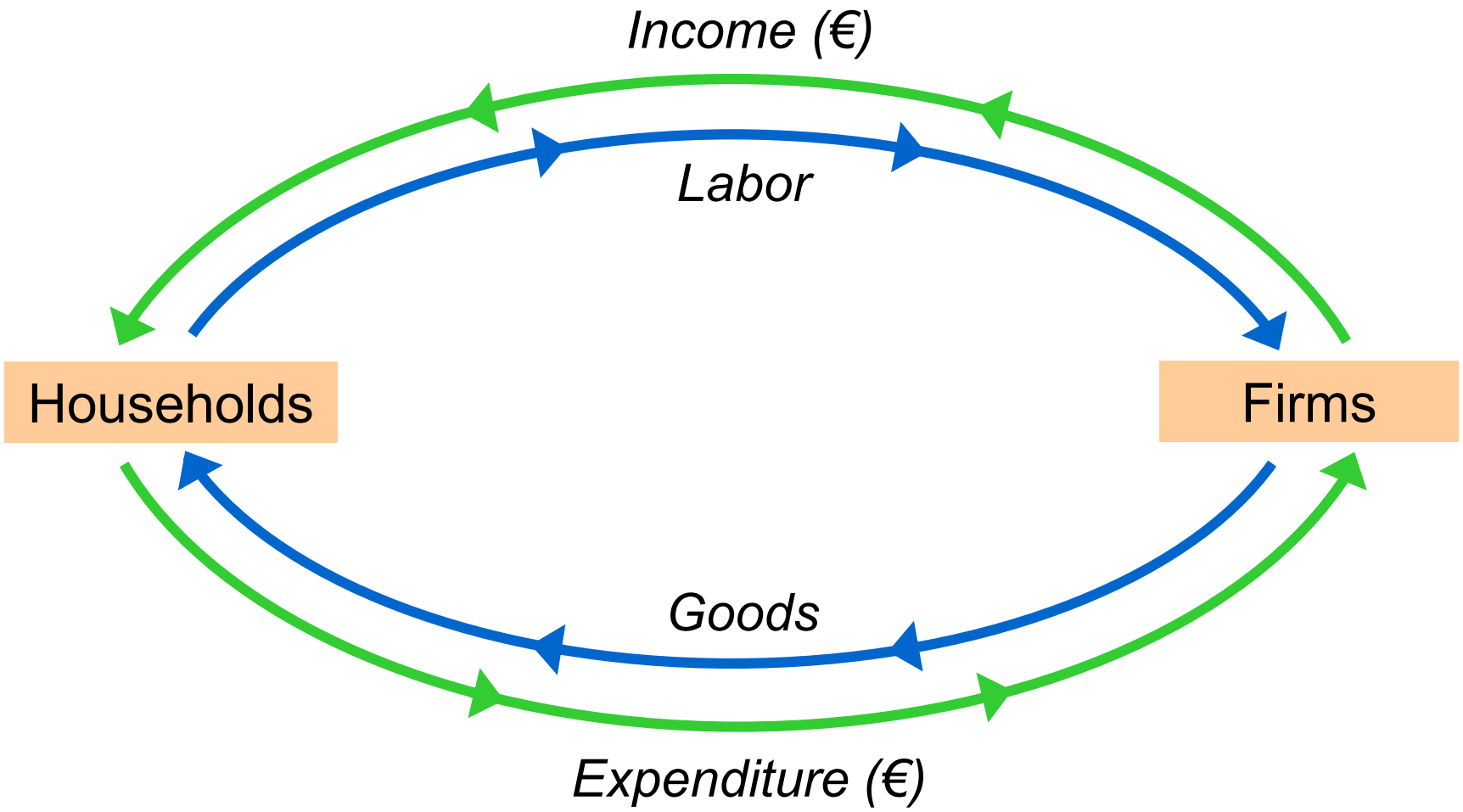
3. GDP as total expenditure on domestically-produced final goods and services

and

4. GDP as total income earned by domestically-located factors of production.

Expenditure equals income because every euro a buyer spends becomes income to the seller.

The Circular Flow



The expenditure components of GDP

- consumption, ***C***
- investment, ***I***
- government spending, ***G***
- net exports, ***NX***

$$Y = C + I + G + NX$$

value of total output

aggregate expenditure

Consumption (C)

definition: The value of all goods and services bought by households. Includes:

- ***durable goods***
  last a long time
  e.g., cars, home appliances
- ***nondurable goods***
  last a short time
  e.g., food, clothing
- ***services***
  intangible items purchased by consumers
  e.g., dry cleaning, air travel

Investment (I)

- Spending on capital, a physical asset used in future production
- Includes:
  - ***Business fixed investment***
    Spending on plant and equipment
  - ***Residential fixed investment***
    Spending by consumers and landlords on housing units
  - ***Inventory investment***
    The change in the value of all firms' inventories

Government spending (G)

- Includes all government spending on goods and services.
- Excludes transfer payments (e.g., unemployment insurance payments), because they do not represent spending on goods and services.

Net exports (NX)

- **NX** = exports – imports
  - **exports**: the value of g&s sold to other countries
  - **imports**: the value of g&s purchased from other countries

GNP vs. GDP

- Gross **domestic** product (GDP):
  - total income earned by domestically-located factors of production, regardless of nationality
- Gross **national** product (GNP):
  - total income earned by the nation's factors of production, regardless of where located
- Gross national **Income** (GNI):
  - sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad

Real versus nominal GDP

Nominal GDP (GDP at <u>current</u> prices)

- measures the value of output *during a given year* using the prices prevailing during that year
- Rise in nominal GDP can result from either higher prices *or* more output

Real GDP (GDP at <u>constant</u> prices)

- measures the value of output in two or more different years by valuing the goods and services *adjusted for inflation*.
- For example, if both the nominal GDP and price level doubled between 2005 and 2015, the real GDP would remain the same.

Real and Nominal GDP

	2016		2017		2018	
	P	Q	P	Q	P	Q
good A	€30	900	€31	1,000	€36	1,050
good B	€100	192	€102	200	€100	205

- Compute nominal GDP in each year.
- Compute real GDP in each year using 2016 as the base year.

Answers

nominal GDP *multiply Ps & Qs from same year*

2016: €46,200 = € 30 × 900 + € 100 × 192

2017: € 51,400

2018: € 58,300

real GDP *multiply each year's Qs by 2010 Ps*

2016: € 46,200

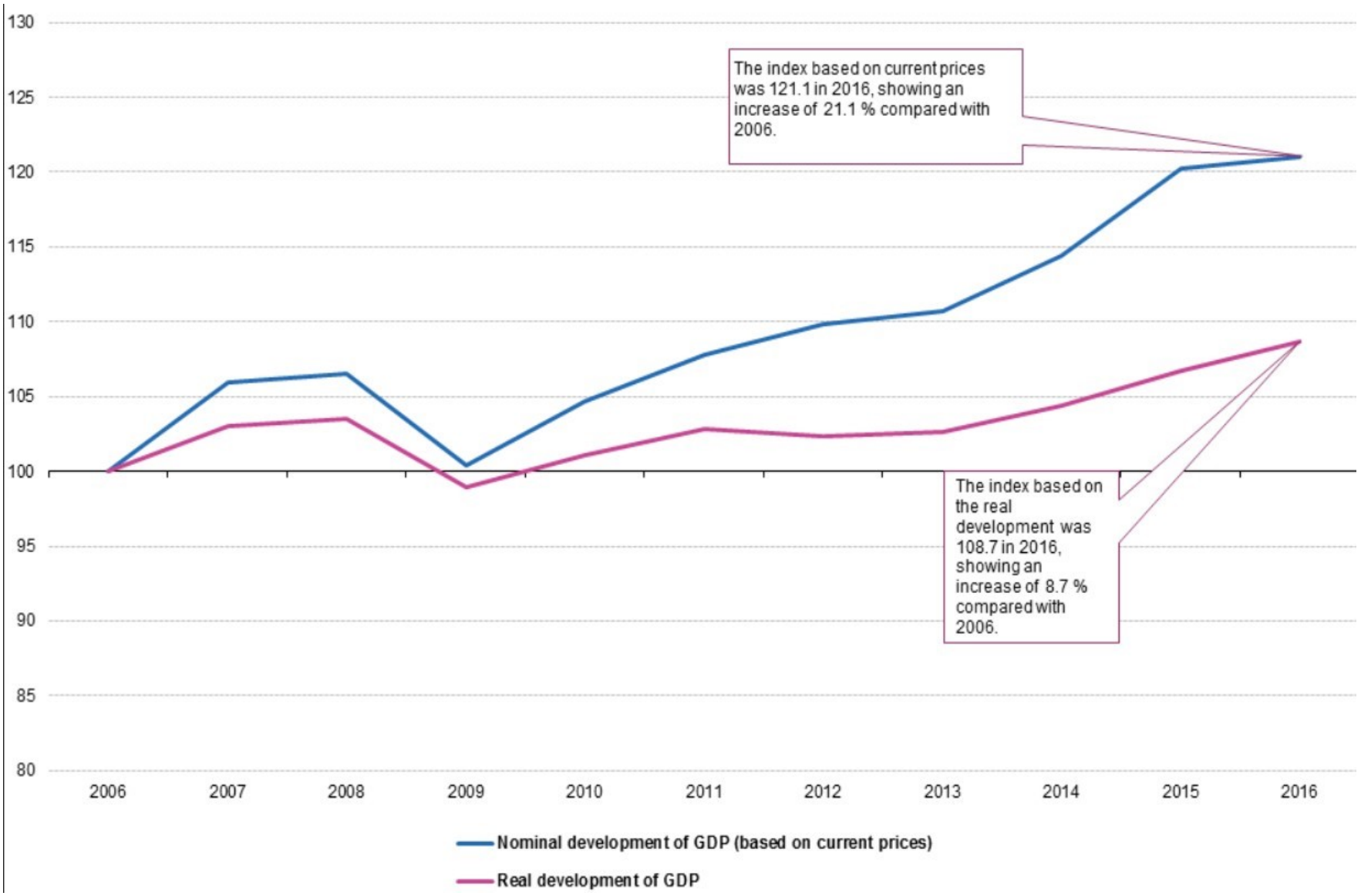
2017: € 50,000

2018: € 52,000 = € 30 × 1050 + € 100 × 205

Real GDP controls for inflation

- Changes in nominal GDP can be due to:
  - changes in prices
  - changes in quantities of output produced
- Changes in real GDP can only be due to changes in quantities, because real GDP is constructed using constant base-year prices.

Real and nominal development of GDP, EU-28



GDP Deflator

- **Inflation rate**: the percentage increase in the overall level of prices
- One measure of the price level is the **GDP deflator**:

$$\text{GDP deflator} = 100 \times \frac{\text{Nominal GDP}}{\text{Real GDP}}$$

GDP deflator and inflation rate

	Nom. GDP	Real GDP	GDP deflator	Inflation rate
2016	€46,200	€46,200		*n.a.*
2017	51,400	50,000		
2018	58,300	52,000		

- Use your previous answers to compute the GDP deflator in each year.
- Use GDP deflator to compute the inflation rate from 2016 to 2017, and from 2017 to 2018.

Answers

	Nom. GDP	Real GDP	GDP deflator	Inflation rate
2016	€46,200	€46,200	100.0	*n.a.*
2017	51,400	50,000	102.8	2.8%
2018	58,300	52,000	112.1	9.1%

Two arithmetic tricks for working with percentage changes

1. For any variables X and Y,

percentage change in $(X \times Y)$

$\approx$ percentage change in X

$+$ percentage change in Y

EX: If your hourly wage rises 5%
and you work 7% more hours,
then your wage income rises
approximately 12%.

Two arithmetic tricks for working with percentage changes

2. percentage change in (X/Y)
$\approx$ percentage change in X
$-$ percentage change in Y

EX: GDP deflator = 100 × NGDP/RGDP.

If NGDP rises 9% and RGDP rises 4%,

then the inflation rate is approximately 5%.

Shortcomings of GDP

- GDP per capita does not provide any information relevant to the distribution of income in a country.

- GDP per capita does not take into account negative externalities from pollution consequent to economic growth.

- GDP per capita does not take into account positive externalities that may result from services such as education and health.

- GDP per capita excludes the value of all the activities that take (place outside of the market place (such as leisure.)

- GDP does not take into account the black market (e.g bartering: I helped you to build your house ten years ago, so now you help me)

- It ignores volunteer, unpaid work. For example, Linux.

- Quality of life - human happiness - is determined by many other things than physical goods and services

The gross national product includes air pollution and advertising for cigarettes and ambulances to clear our highways of carnage. It counts special locks for our doors and jails for the people who break them. GNP includes the destruction of the redwoods and the death of Lake Superior. It grows with the production of napalm, and missiles and nuclear warheads... it does not allow for the health of our families, the quality of their education, or the joy of their play. It is indifferent to the decency of our factories and the safety of our streets alike. It does not include the beauty of our poetry or the strength of our marriages, or the intelligence of our public debate or the integrity of our public officials. It measures everything, in short, except that which makes life worthwhile.

Robert Kennedy

...the welfare of a nation can scarely be inferred from a measure of national income. If the GDP is up, why is America down? Distinctions must be kept in mind between quantity and quality of growth, between costs and returns, and between the short and long run. Goals for more growth should specify more growth of what and for what.

1934, Simon Kuznets

Consumer Price Index (CPI)

- A measure of the overall level of prices
- Published by the National Statistics Institutes
- Consumers are surveyed to define composition of the typical consumer's "basket" of goods
- Every month, data are collected on prices of all items in the basket; compute cost of basket
- CPI in any month equals to:

$$100 \times \frac{\text{Cost of basket in that month}}{\text{Cost of basket in base period}}$$

Compute the CPI

Basket: 20 pizzas, 10 compact discs

prices:

	pizza	CDs
2012	€10	€15
2013	11	15
2014	12	16
2015	13	15

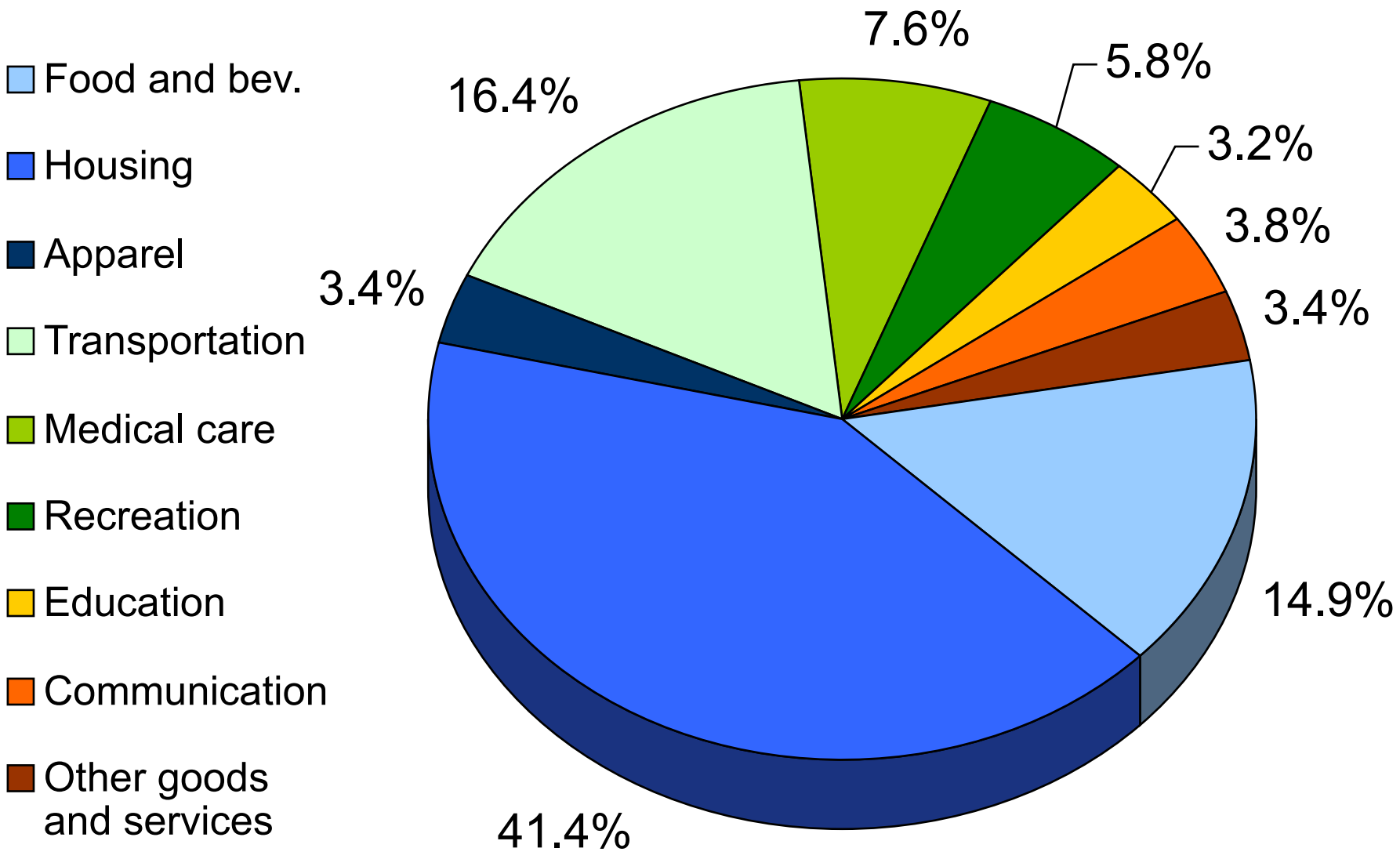
For each year, compute

- the cost of the basket
- the CPI (use 2012 as the base year)
- the inflation rate from the preceding year

Answers

	Cost of basket	CPI	Inflation rate
2012	€350	100.0	*n.a.*
2013	370	105.7	5.7%
2014	400	114.3	8.1%
2015	410	117.1	2.5%

The composition of the CPI's "basket": an example



Why the CPI may overstate inflation

- **Substitution bias**:
  The CPI uses fixed weights, so it cannot reflect consumers' ability to substitute toward goods whose relative prices have fallen.
- **Introduction of new goods**:
  The introduction of new goods makes consumers better off and, in effect, increases the real value of the euro. But it does not reduce the CPI, because the CPI uses fixed weights.
- **Unmeasured changes in quality**:
  Quality improvements increase the value of the euro but are often not fully measured.

CPI vs. GDP Deflator

Prices of capital goods:

- included in GDP deflator (if produced domestically)
- excluded from CPI

Prices of imported consumer goods:

- included in CPI
- excluded from GDP deflator

The basket of goods:

- CPI: fixed
- GDP deflator: changes every year

Cross-country comparison

current currency exchange rate

purchasing power parity exchange rate

Purchasing Power Parity (PPP) theory

- Law of one price (LOOP) - when there are no impediments to international trade, prices of the same product should be equal when converted to a common currency regardless of the location.

$$P_A^i = E_{A/B} \times P_B^i$$

Where:

P_A^i - price of the good *i* sold in country A in currencyA,

P_B^i - price of the same good *i* sold in country B in currency B,

$E_{A/B}$ - exchange rate between country A nad B.

PPP/PPS

- **PPP – Purchasing Power Parity** or **PPS – Purchasing Power Standard**
- Used in order to take into account the diffrences in purchasing power of money due to price differences across countries
- Purchasing power parity of a given country means how many national currency units equals the standard unit (PPP or PPS)
- One PPP(PPS) buys the same amount of goods and services in all countries, whereas different numbers of national currency units are needed to buy this volume of goods and services depending on the national price level.

Example – Big Mac Index

THE Big Mac index was invented by The Economist in 1986 as a lighthearted guide to whether currencies are at their "correct" level. It is based on the theory of purchasing power parity (PPP), the notion that in the long run exchange rates should move towards the rate that would equalise the prices of an identical basket of goods and services (in this case, a burger) in any two countries. For example, the average price of a Big Mac in America in July 2015 was $4.79; in China it was only $2.74 at market exchange rates. So the "raw" Big Mac index says that the yuan was undervalued by 43% at that time.

Source: The Economist

Measuring growth

1. Rate of change

Rate of change in discrete time:

note: the dot notation

$$\Delta Y = Y_{t+1} - Y_t = \dot{Y}$$

Rate of change in continous time ($\Delta t \to 0$)

$$\lim_{\Delta t \to 0} \frac{Y_{t+\Delta t} - Y_t}{\Delta t} = \dot{Y}$$

$$\dot{Y} = \frac{dY}{dt}$$

2. Growth rates

Growth rate in discrete time $$g = \frac{Y_{t+1} - Y_t}{Y_t}$$

Growth rate in continous time $$g = \frac{dY/dt}{Y} = \frac{\dot{Y}}{Y}$$

growth rate rules:

1. $g(xy) = g(x) + g(y)$.
2. $g(x/y) = g(x) - g(y)$.
3. $g(x^{\alpha}) = \alpha g(x)$.

Derivatives of the log of a given variable with respect to time:

$$\frac{dlnY}{dt} = \frac{dlnY}{dY} \times \frac{dY}{dt}$$

Equivalent expression of growth rates

$$g = \frac{\dot{Y}}{Y} = \frac{dY/dt}{Y} = \frac{dlnY}{dt}$$

because:

$$\frac{dlnY}{dt} = \frac{dlnY}{dY} \times \frac{dY}{dt} = \frac{1}{Y} \times \dot{Y}$$

3. Speed of growth

Average annual rate of growth

a) $g_1 = \frac{Y_1 - Y_0}{Y_0}$

$Y_1 = g_1 Y_0 + Y_0$

$Y_1 = (1 + g_1) Y_0$

b) $g_2 = \frac{Y_2 - Y_1}{Y_1}$

$Y_2 = g_2 Y_1 + Y_1$

$Y_2 = (1 + g_2) Y_1$

$Y_2 = (1 + g_2)(1 + g_1) Y_0$

Measuring real economic growth

- ***If g1=g2=g → Average annual rate of growth*** within a given period of time

[geometric average growth rate]

$$y_{t+n} = y_t(1+g)^n \longrightarrow g = \left(\frac{y_{t+n}}{y_{t_t}}\right)^{\frac{1}{n}} - 1$$

Alternatively: approximation of average annual rate of growth through log-differencing

$$g = \frac{1}{T} \ln\left(\frac{y_{it}}{y_{i,t-T}} \right) = \frac{1}{T} [\ln(y_{i,t}) - \ln(y_{i,t-T})]$$

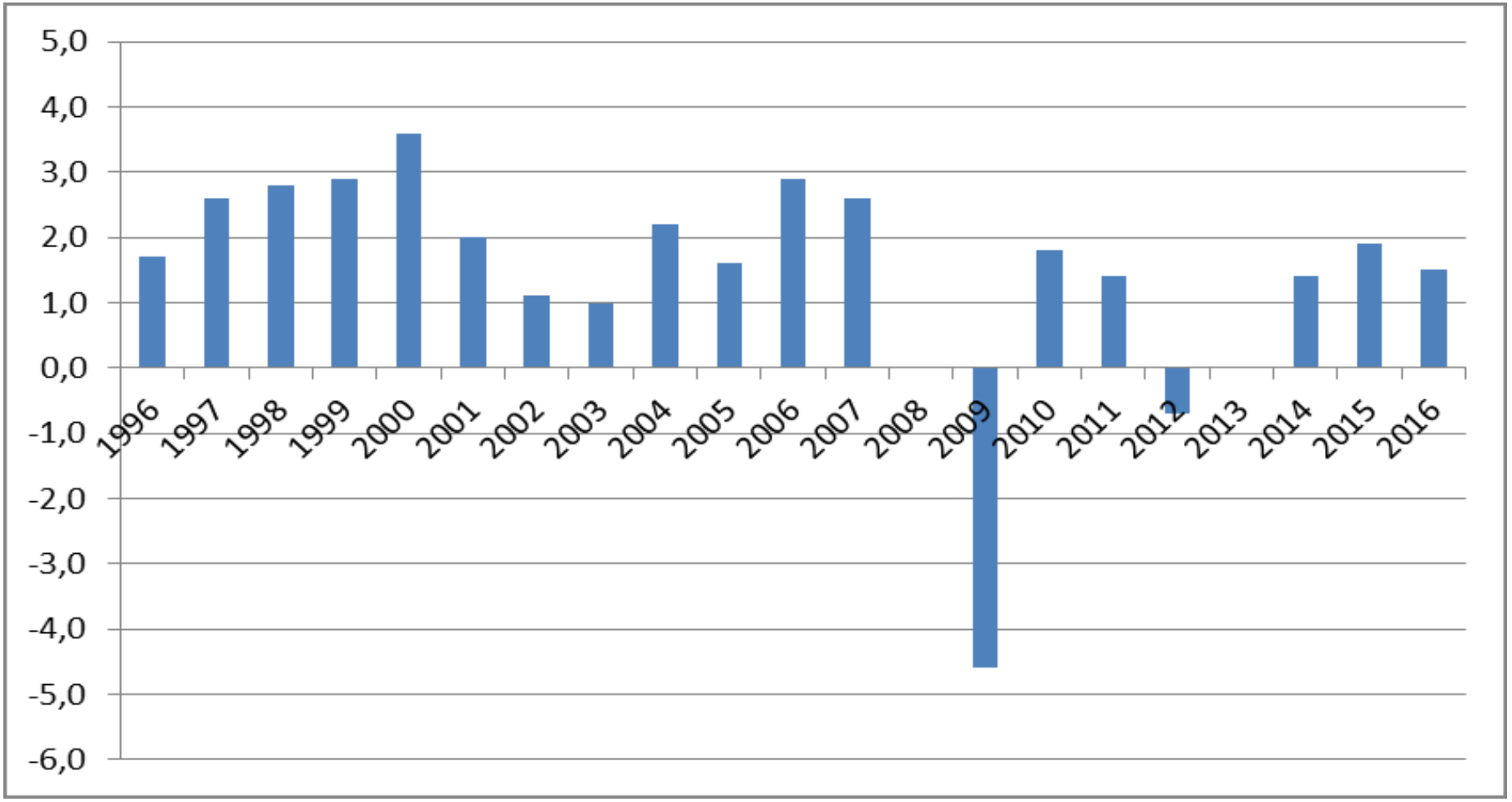
Real GDP growth rate , 2017

(% change on previous year)

Source: IMF world mapper

Emerging market and developing economies	4.2
Advanced economies	1.6
World	3.1

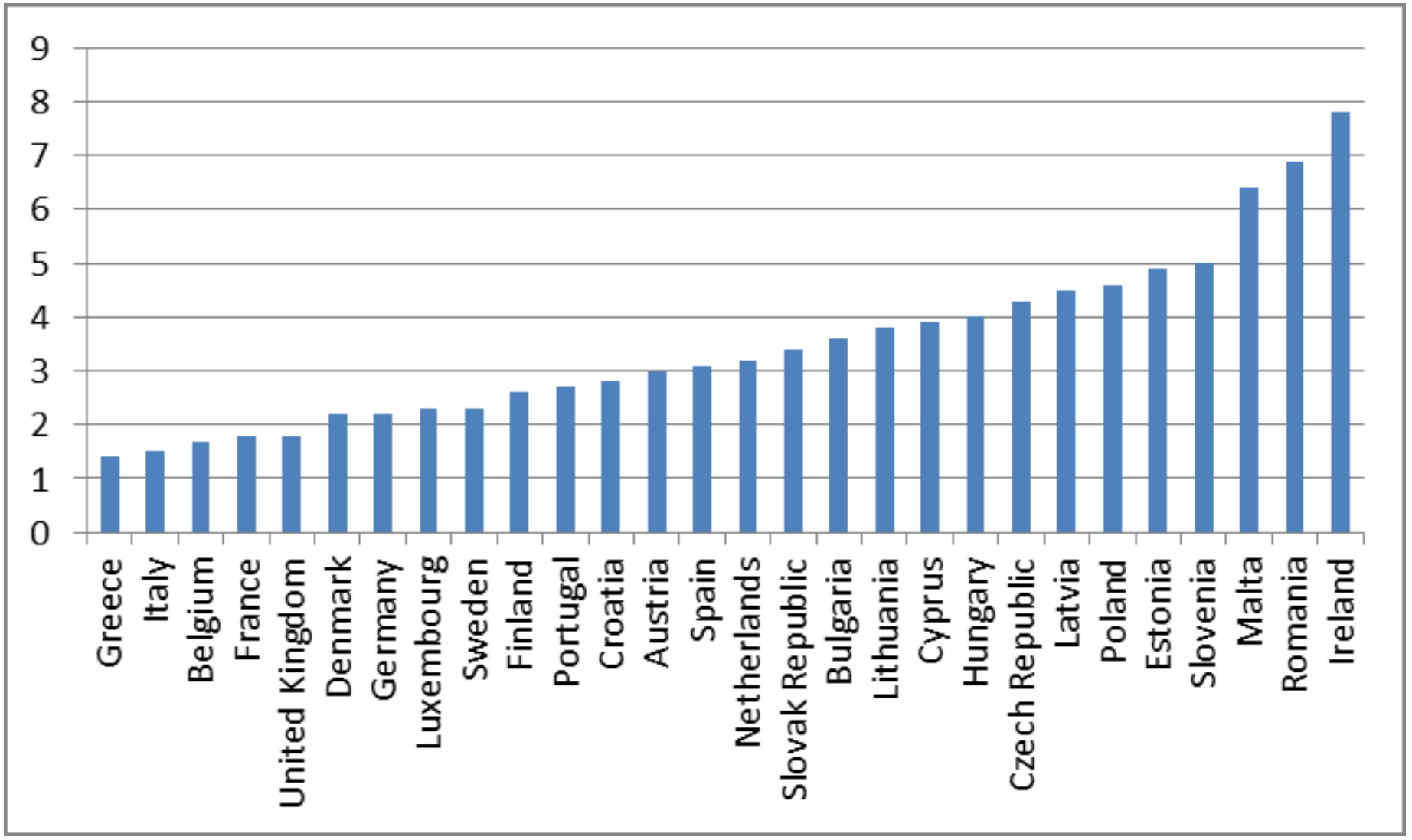
GDP change on previous year, EU=28



Source: own compilation based on data from Eurostat

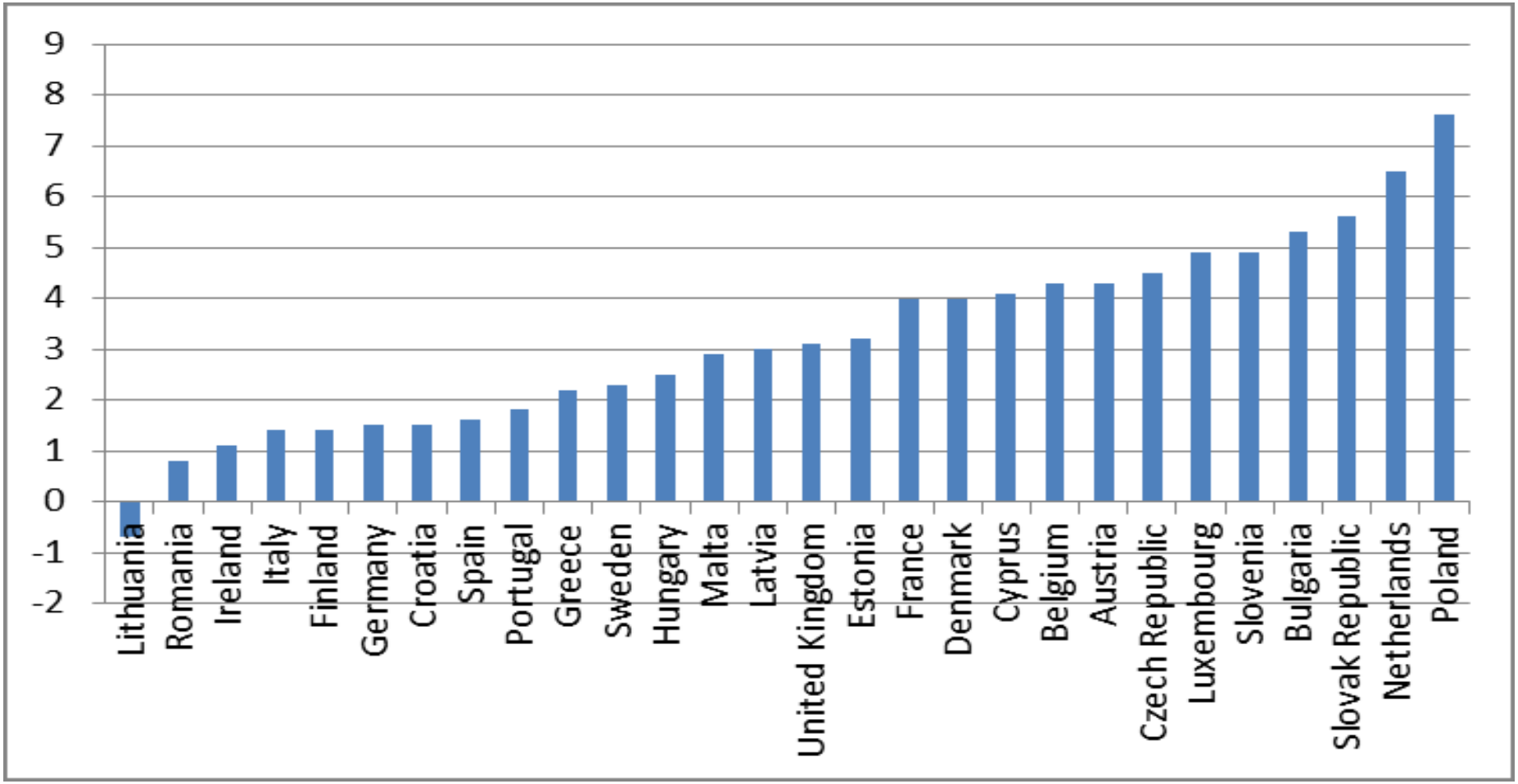
Real GDP growth (2017)

Percentage change on previous year



Source: World Bank

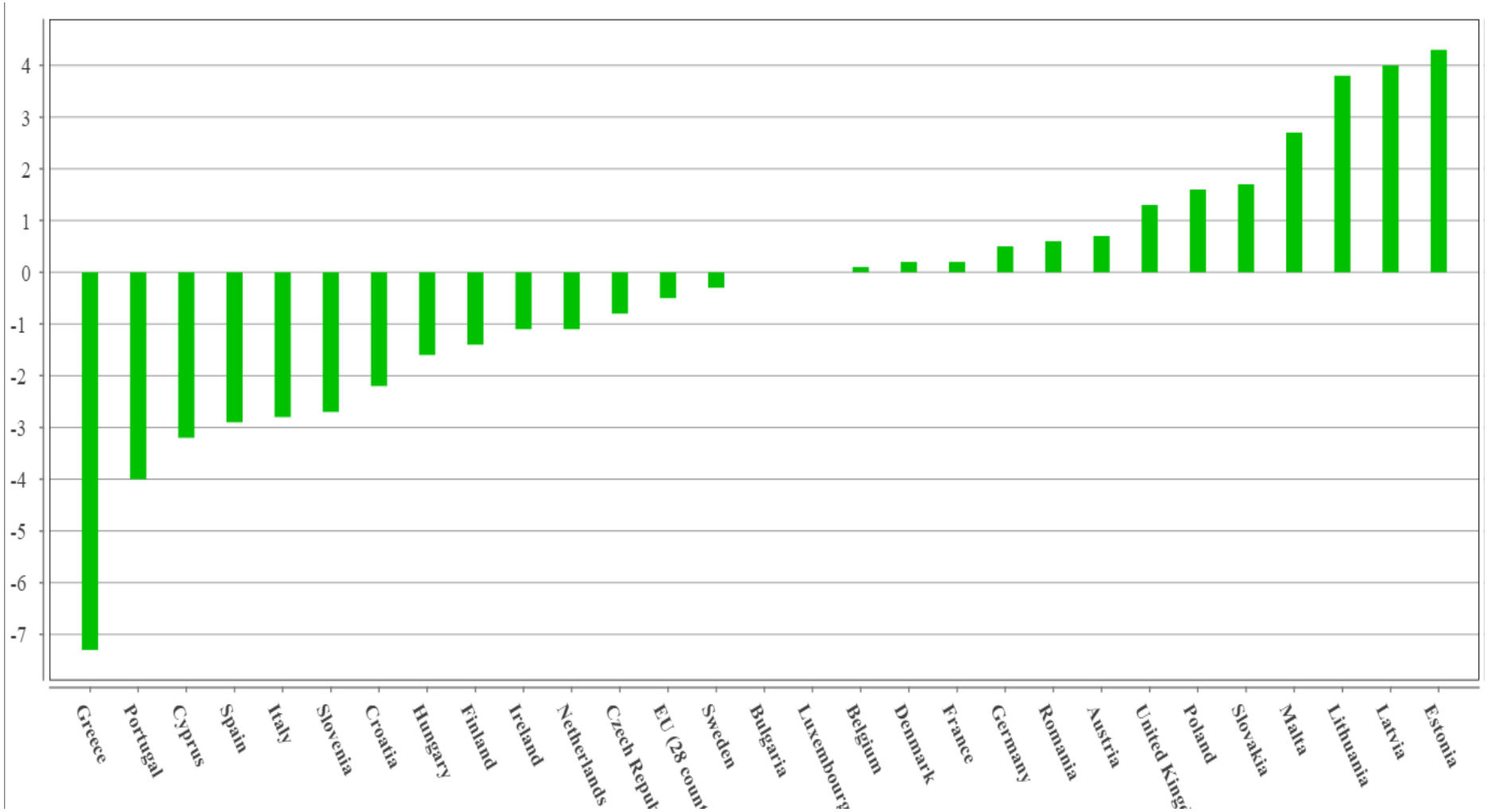
GDP per capita growth (annual %) (2017)



Source: World Bank

Real GDP growth in time of crisis:

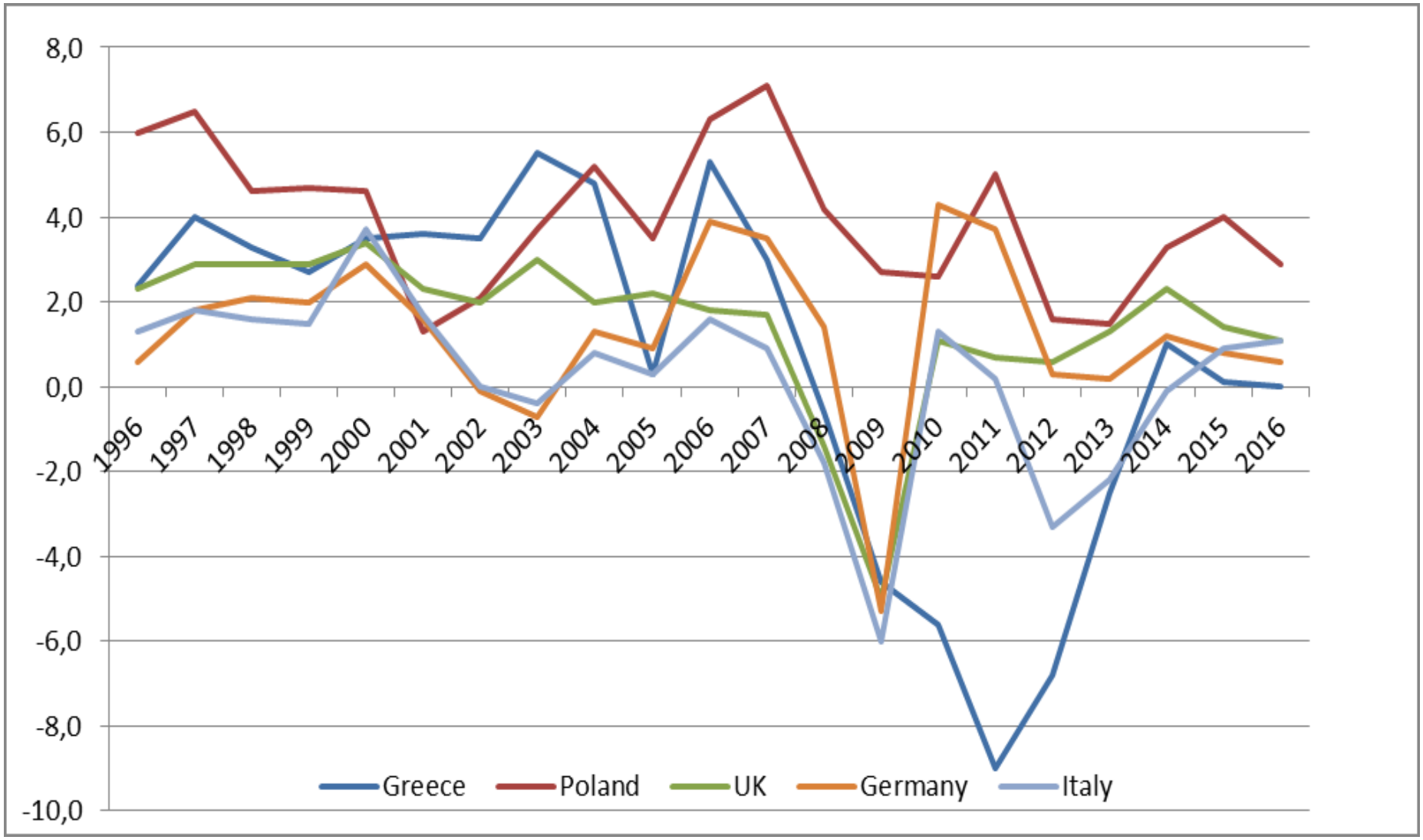
GDP growth rate (2012) -percentage change on previous year



Source: Eurostat

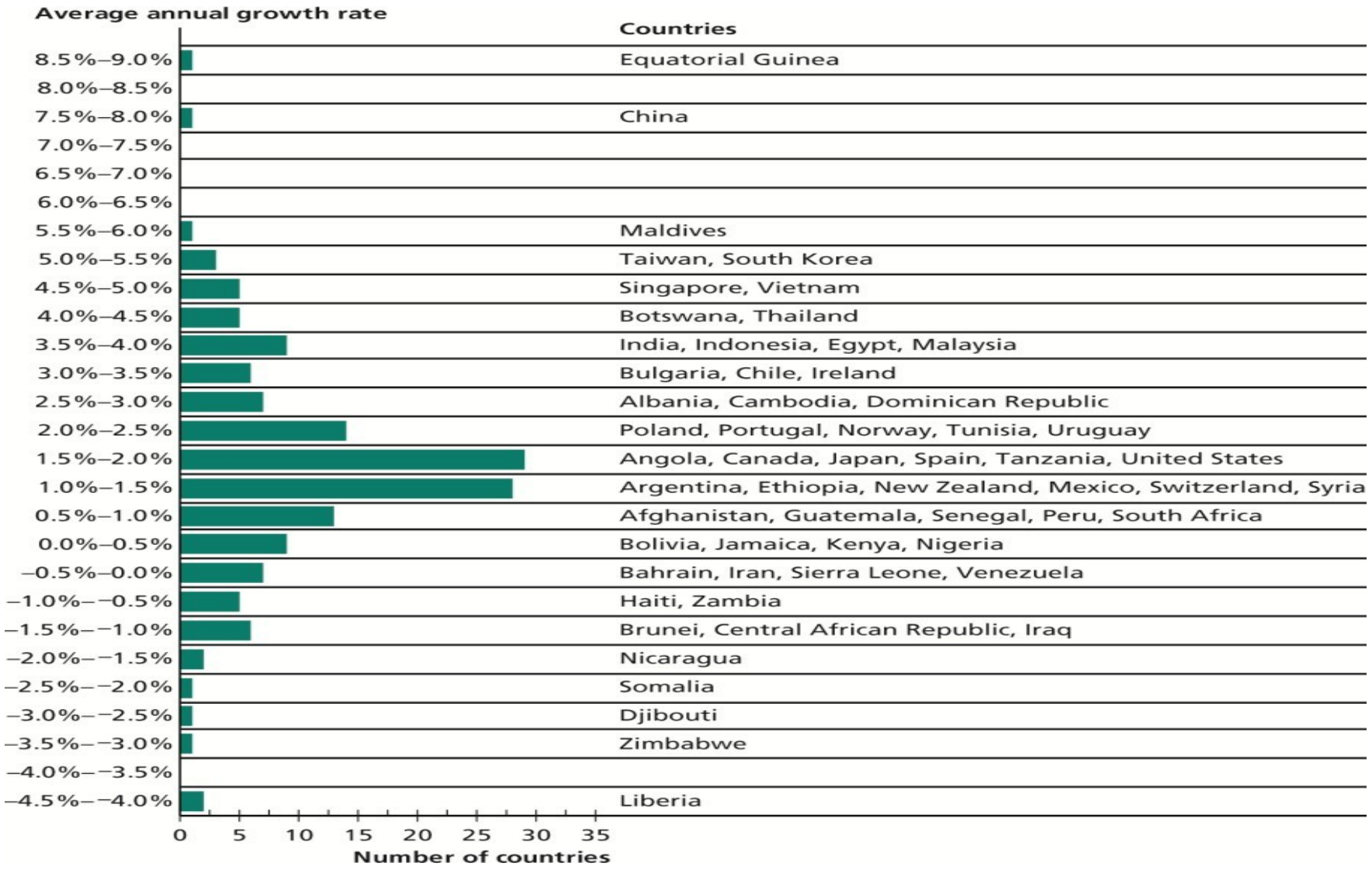
Economic growth in EU in the recent years

Real growth of GDP (% change on previous year)



Source: own compilation based on data from Eurostat

World distribution of Growth Rates



Source: Weil D. (2013)

Rate of growth of GDP per capita (1)

- **GDP per capita = GDP/population**
- Average annual rate of growth of GDPpc can be measured analogously to the rate of growth of GDP:

$$GDPpc_{t0+n} = GDPpc_{t_0}\ (1+g)^n$$

$$\downarrow$$

$$g_{GDPpc} = \left(\frac{GDPpc_{t0+n}}{GDPpc_{t0}} \right)^{\frac{1}{n}} - 1$$

Rate of growth of GDP per capita (2)

- Knowing how quickly GDP and population change, we can also approximate the speed of GDP per capita growth using the following expression:

Rate of growth of GDP per capita

~=rate of growth of GDP– rate of growth of population

Rule of 70:

After how many years Y will double?

$$Y_{t+1} = 2Y_0$$

$$2Y_0 = Y_0(1+g)^n$$

$$2 = (1+g)^n$$

$$ln2 = n \times \ln(1+g)$$

$$\frac{ln2}{\ln(1+g)} = n$$

$$\frac{ln2}{g} = n$$

$$ln2 \approx 0.693$$

$$\frac{70}{g\%} = n$$

if average annual rate of growth of y =g then y doubles after 70/g years

Example:

$$GDPpc_{t0+n} = GDPpc_{t_0}\ (1+g)^n \longrightarrow g_{GDPpc} = \left(\frac{GDPpc_{t0+n}}{GDPpc_{t0}} \right)^{\frac{1}{n}} - 1$$

g	GDP per capita doubles after	During 100 years GDP per capita increases
1%	70 years	3 times
2%	35 years	7 times
3%	23 years	20 times

Economic growth vs development

- Refers not only to the growth of GDP, but to the overall improvement in living conditions

- Apart from GDP while analyzing development we should consider:
  - Quality and accessibility of education
  - Life expectancy
  - Quality of environment
  - Quality of institututions
  - Safety
  - …
- Pace of economic development can be approximately measured by rate of growth of GDP per capita (it is only a *proxy* of economic development!)

GDP per capita as a measure of economic development

- **Level of economic development**
  - proxied by GDP *per capita* (income per person)
  - Often as an index with respect to the world, the whole group of countries etc (i.e. EU-27=100)

- **Process of economic development (~rising standard of living)**
  - Rising GDP per capita (growth rate of GDP *per capita* >0)
  - Note the difference with the process of economic growth! (growth of GDP)

Key terms:

- Gross Domestic Product (GDP)
- Nominal and real GDP
- Purchasing Power Parity theory
- Big Mac Index
- Average annual rate of growth
- Economic growth vs development

Sources:

- Weil D., Economic Growth, (2013) Pearson International Edition
- Todaro&Smith, *Economic Development*, 2015 and 2012 Pearson Addison-Wesley. Chapter 2
- The World Bank
- Eurostat
- UN, Human Development Reports