

## Lecture 1. Gross Domestic Product

February 20<sup>th</sup>, 2014

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# Course Info

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**Lecturer:** Dragana Stanišić

**Classes:** Thursdays, 10:00 – 13:00, MO 309

**Course page:** <http://home.cerge-ei.cz/dragana/Macroeconomics14.html>

**Textbook:** Mankiw, N. G. (2007). Principles of Economics (**any edition**)

# Class Policies

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- Attendance list
- Active participation is **encouraged**

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## Assignments

- ✓ Presentation (20 min)

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## Grading

Written evaluation to the Head of the Economics Department

# Introduction (Cont.)

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**Macroeconomics** (*Greek makro means **big***) describes and explains economic processes that concern **aggregates**

**Aggregates:** multitude of economic subjects that share some common features.

The **Fallacy of Composition:** the whole is different from the sum of individual parts it is comprised of.

Roots of macroeconomics in the Great Depression (1920s–1930s)

- **Classical** belief in market forces
- **Alternative** approach: John Keynes  
“The General Theory of Employment, Interest and Money” (1936)

**N!B!** Mankiw, G. (2006) **The Macroeconomist as a Scientist and Engineer**. NBER Working Paper 12349

# Introduction (Cont.)

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## **Goals of the Economy**

- Economic growth (increase in output)
- Price-level stability (low inflation)
- Full employment (low unemployment rate)
- External balance (avoiding trade deficit)

## **Policy tools**

- Monetary policy: interest rate and money supply
- Fiscal policy: taxes and government spending

# Time Dimension

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What determines the level of economy's output ?

**Short run:** several years

- Changes in demand

The **IS-LM model** (goods + financial markets)

**Medium run:** a decade

- Supply of factors
- Aggregate supply- Aggregate demand model (AD-AS)

**Long run:** several decades/ half a century and more

- Technological progress and factors' accumulation

**Czech Republic**  
**Gross Domestic Product**  
(in current prices)

**N!B!**

We will be using a **short scale**:

**Million** = 1,000,000

**Billion** = 1,000,000,000

**Trillion**= 1,000,000,000,000

• **Size of the economy**

**In 2011**, GDP of Czech Republic in  
US \$ :

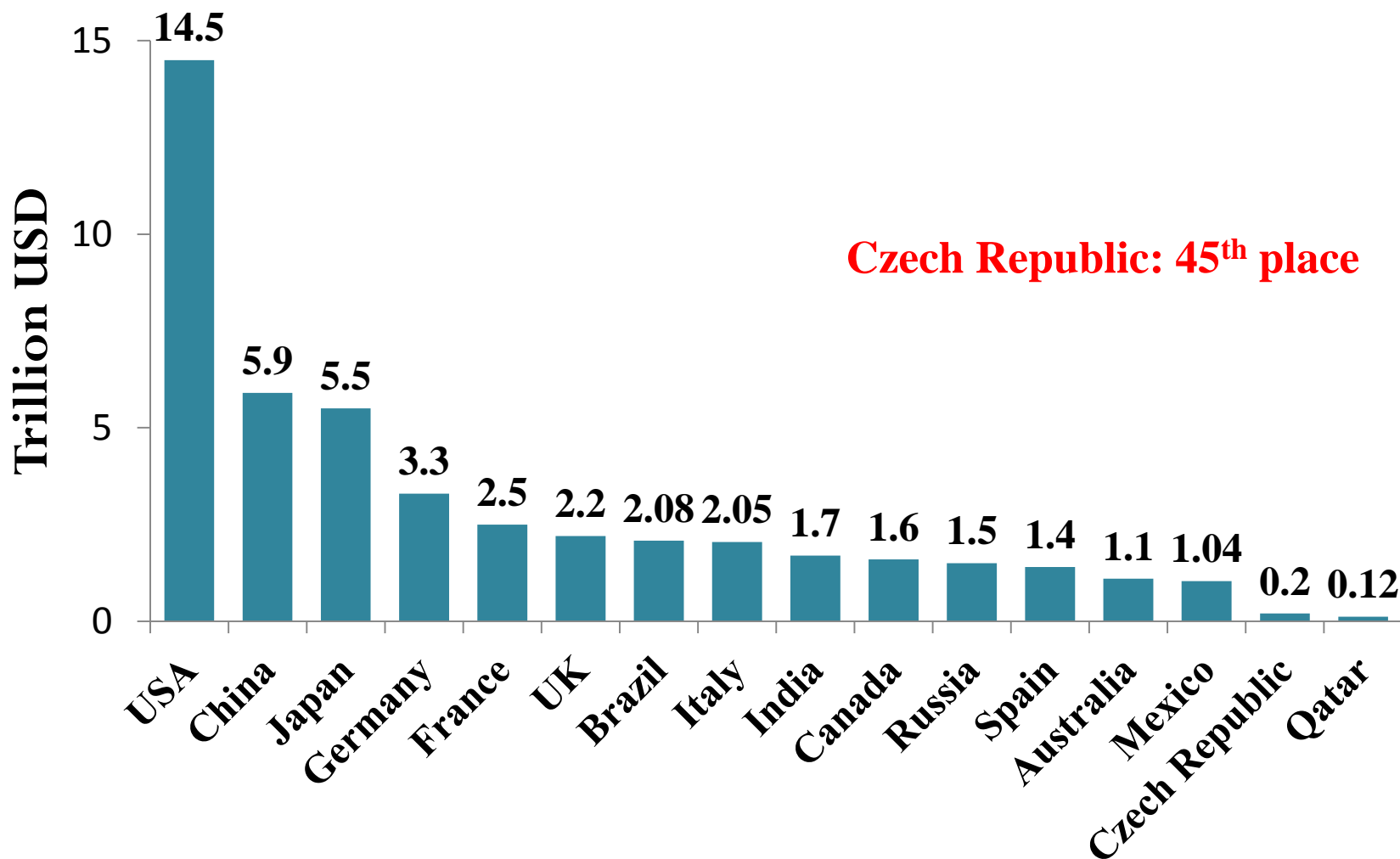
$3,841,370 / 19.94 = \$192,6$  billion

<b>Year</b>	<b>GDP (mil CZK)</b>
<b>1990</b>	632,691
<b>1991</b>	815,579
<b>1992</b>	925,476
<b>1993</b>	1,144,645
<b>1994</b>	1,323,328
<b>1995</b>	1,533,676
<b>1996</b>	1,761,575
<b>1997</b>	1,884,924
<b>1998</b>	2,061,583
<b>1999</b>	2,149,023
<b>2000</b>	2,269,695
<b>2001</b>	2,448,557
<b>2002</b>	2,567,530
<b>2003</b>	2,688,107
<b>2004</b>	2,929,172
<b>2005</b>	3,116,056
<b>2006</b>	3,352,599
<b>2007</b>	3,662,573
<b>2008</b>	3,848,411
<b>2009</b>	3,758,979
<b>2010</b>	3,799,547
<b>2011</b>	3,841,370

*Source: Czech Statistical Office*

# How big is the size of Czech economy?

## The largest economies in 2011



Source: IMF statistics database



# Gross Domestic Product (GDP)

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## DEFINITION I

### ▪ **Production approach**

**GDP** is a market value of all final goods and services produced within an economy in a given period of time.

- GDP is a measure of **output**
- Is a single number expressed in **monetary units**

### **Why do we care?**

Output is **correlated** with many important variables: standards of living, wages, unemployment, inflation, budget and trade deficit.

# Adding Apples and Oranges

**TE** The US economy output in 2012: 2 airplanes + 5 hamburgers

**GDP** is a **market value** of all final goods and services produced within an economy in a given period of time

**Market value = Market price**

<b>Goods</b>	<b>Quantity (Q)</b>	<b>Unit Price (P)</b>
Airplanes	2	\$1,000,000
Hamburgers	5	\$1

$$GDP_{2012}^{USA} = 2 \cdot P^{Airplane} + 5 \cdot P^{Hamburger}$$

$$GDP_{2012}^{USA} = 2 \cdot \$1,000,000 + 5 \cdot \$1 = \$2,000,005$$

# Multiple Counts

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**TE** McDonald's hamburger costs \$1

Ingredients used for production (meat, veg., bread) cost \$0.5 per hamburger



**Contribution to GDP: \$1 or \$1+\$0.5 ?**

**GDP** is a market value of all **final goods and services** produced within an economy in a given period of time

**Final good/service:** consumed by the end user and does not require further processing

**Intermediate goods:** used as inputs for production of other goods

**N!B!** Some goods can be both final and intermediate

To GDP will be include **only \$1** (price of a hamburger)

The value of intermediate goods is **included** in the market price of a final good

# Value Added

- The difference between the price of finished product and the costs of inputs used in production
- Increase in value that a business creates by undertaking the production process.

<b>Producer</b>	<b>Price of output</b>	<b>Price of inputs</b>	<b>Value added</b>
<b>McDonalds</b>	\$1	\$0.5	\$ 0.5
<b>Farmer</b>	\$ 0.5	\$0	\$ 0.5
<b>Total</b>	\$1.5	\$ 0.5	\$1

← **Contribution to GDP**

## DEFINITION II

GDP is the **sum of value added** in the economy during a given period

- Firms pay taxes on the value added of their activities (VAT)
- Firms report sales

# Used Goods

- You are buying a Rembrandt's painting from another collector at the price of 1,000,000 Euros
- You are buying stuff at your neighbor's garage sale for 20 CZK

## What is the contribution to GDP?

**GDP** is a market value of all final goods and services **produced** within an economy **in a given period of time**

GDP includes only the value of **currently produced** goods and services

- Resale of goods represents a transfer of an asset



# GDP vs. GNP (Output vs. Location)

TE Czech Beer Factory operating in Slovakia



**GDP** is a market value of all final goods and services produced

**within an economy** in a given period of time

- within a country's boarder
- Output of Volkswagen operating in CR is counted in Czech GDP

**Gross national product (GNP)** is a market value of all final goods and services produced in a given period of time using factors of production owned by the

**residents of a country**

# GDP Accuracy

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Does **not** account for

- Goods and services not sold in the market (home production, child care)
- Underground economy: legal activities hidden from government and illegal activities
- Imputed values

**Assumption:** The level of inaccuracy in GDP calculations is roughly constant  
from year to year

=> **Inaccuracy can be neglected**

# GDP: Three Equivalent Approaches

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## 1. Production side

**Def I:** a market value of all final goods and services produced within an economy in a given period of time.

**Def II:** the sum of value added in the economy in a given period of time

## Fundamental identity

**Total production = Total income = Total expenditure**

## 2. Income method

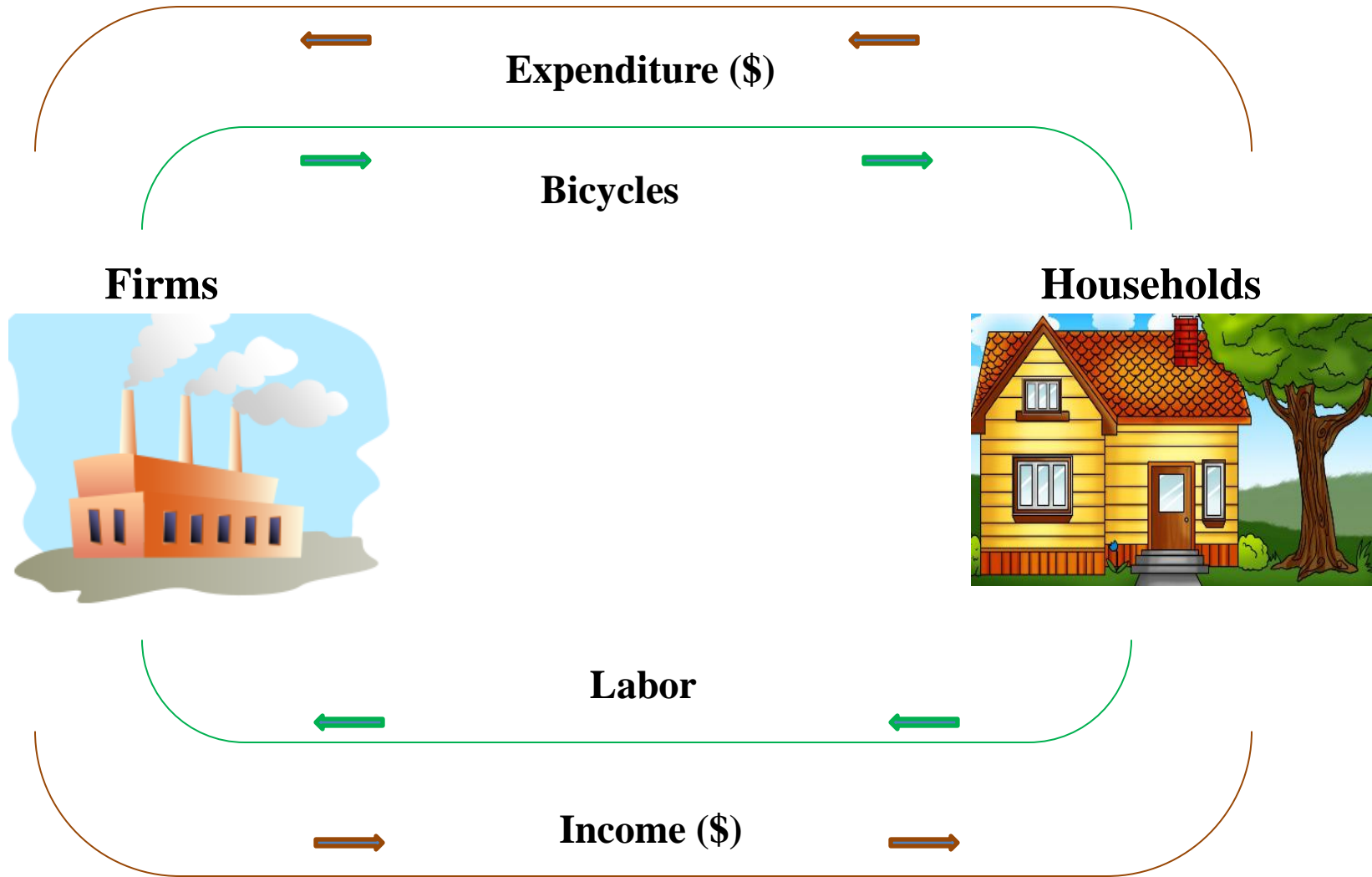
**Def III:** GDP is a nation's total income

## 3. Expenditure method

GDP is the total expenditure on national output of goods and service



# THE CIRCULAR FLOW MODEL OF MARKET ECONOMY



**The rule of accounting:** Expenditure of buyers = Income of sellers

# The Circular Flow Model

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## Assumptions

- A closed economy (no international trade)
- No government
- No savings

## Injections

- Government spending (G)
- Exports (EX)
- Investments (I)

## Leakages

- Taxation (T)
- Imports (IM)
- Savings (S)

# GDP: Three Equivalent Approaches (Cont.)

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**TE** Consider an economy consisting of two firms

**Firm 1:** Steel producer

Revenues from sale: €100

Wages: €80

Profit: €20

**Firm 2:** Car manufacturer

Revenues from sale cars: €200

Wages: €70

Profit: €30

**What is the GDP?**

**Production approach:** €200

**Income approach:** €80+ €20 + €70+ €30 = €200

**Expenditure approach:** €200

**Value added approach:** €100+ (€200- €100) = €200

# Treatment of Inventories

- Goods produced in a certain period but not sold

**TE** A farm fails to sell milk and the milk spoils

**Is GDP affected? NO**

- Spoiled milk is not sold – no effect on consumer expenditure
- The farm does not obtain additional revenue
- The farm's revenue after subtracting wages shrinks  
=> Neither total expenditure, nor total income are affected

**TE** The milk is put into inventory to be sold later

**Is GDP affected? NO**

- The farm “purchases” milk for its inventory – total expenditures are affected
- The farm gets additional revenue => additional profit => income is affected
- Later sale out of inventory is treated as a sale of used goods



# Services and Imputations

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- **Housing services**

- Home owners pay a “rent” to themselves
- Included in homeowner expenditures and income

**Imputed rent:** how much it would cost to rent out the owner’s dwelling unit

In the case of no imputations, what effect would the increase in house ownership have on GDP? **GDP would decline**

- **Government services** (Police officers, politician, etc.)

- Wages are used as a value of service

# Summary

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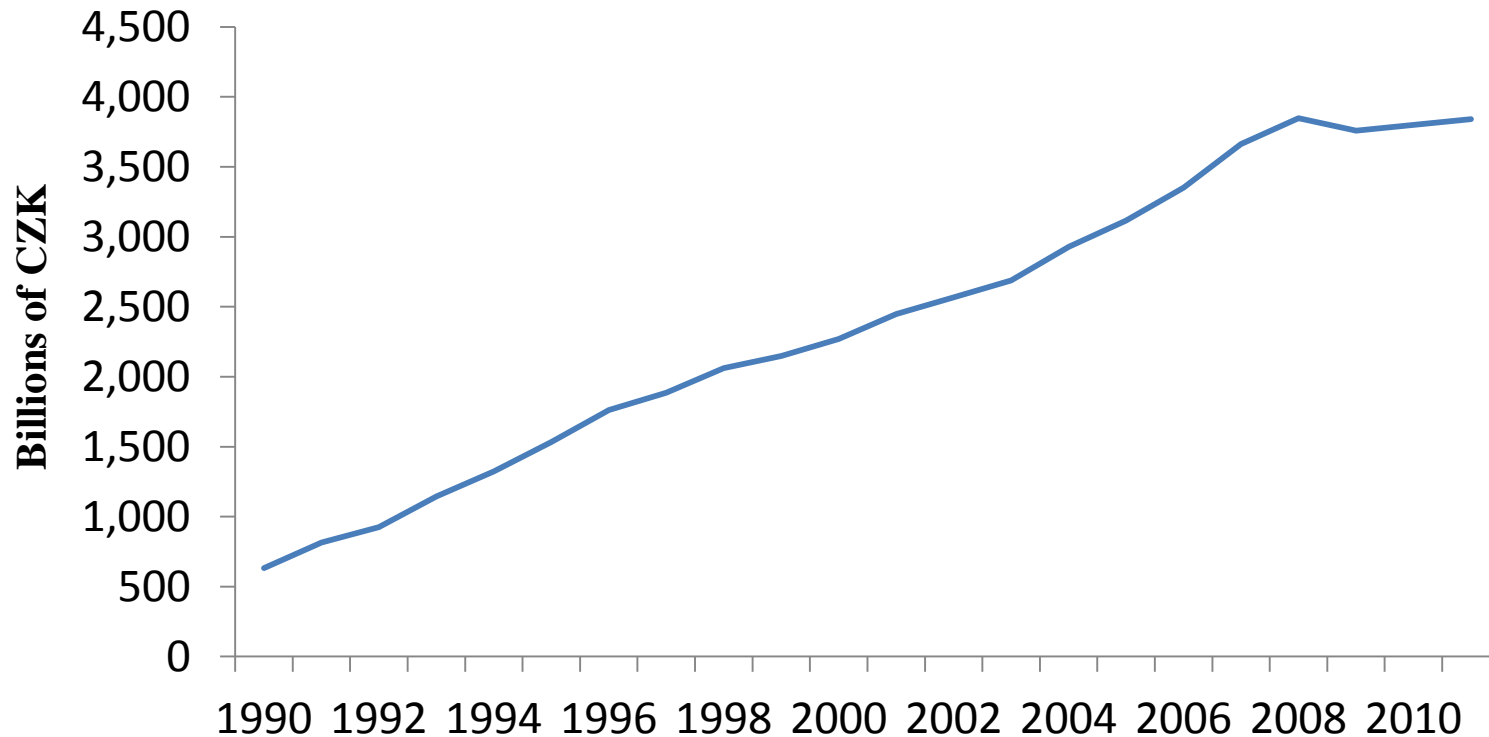
- ✓ GDP is a measure of aggregate output
- ✓ Approaching from production or income side
- ✓ Aggregate production = Aggregate income

## **THREE EQUIVALENT APPROACHES**

- ✓ GDP as the value of the final goods output
- ✓ GDP as a sum of value added
- ✓ GDP as a sum of income
- In a given period of time
- In a particular economy

# Comparison Over Time

## Czech Nominal GDP 1990-2011, CZK



**What are the reasons for such increase in GDP?**

$$GDP_t = P_t^1 \cdot Q_t^1 + P_t^2 \cdot Q_t^2 + \dots = \sum_{i=1}^N P_t^i Q_t^i$$

# Real GDP

Nominal values: expressed in **current** prices

**Nominal GDP in 2011-2012**

$$GDP_{2012}^{Italy} = Q_{2012}^{Pizza} \cdot P_{2012}^{Pizza}$$

$$GDP_{2011}^{Italy} = Q_{2011}^{Pizza} \cdot P_{2011}^{Pizza}$$

=> Changes in **quantity** produced **or/and** **prices** of goods

Real values: expressed in **constant** prices

**The base year approach:** Fixing prices by choosing a **base year (2011)**

$$GDP_{2012}^{real} = Q_{2012}^{Pizza} \cdot P_{2011}^{Pizza}$$

$$GDP_{2011}^{real} = Q_{2011}^{Pizza} \cdot P_{2011}^{Pizza}$$

**N!B!** Nominal GDP = Real GDP in the base year



## Real GDP (Cont.)

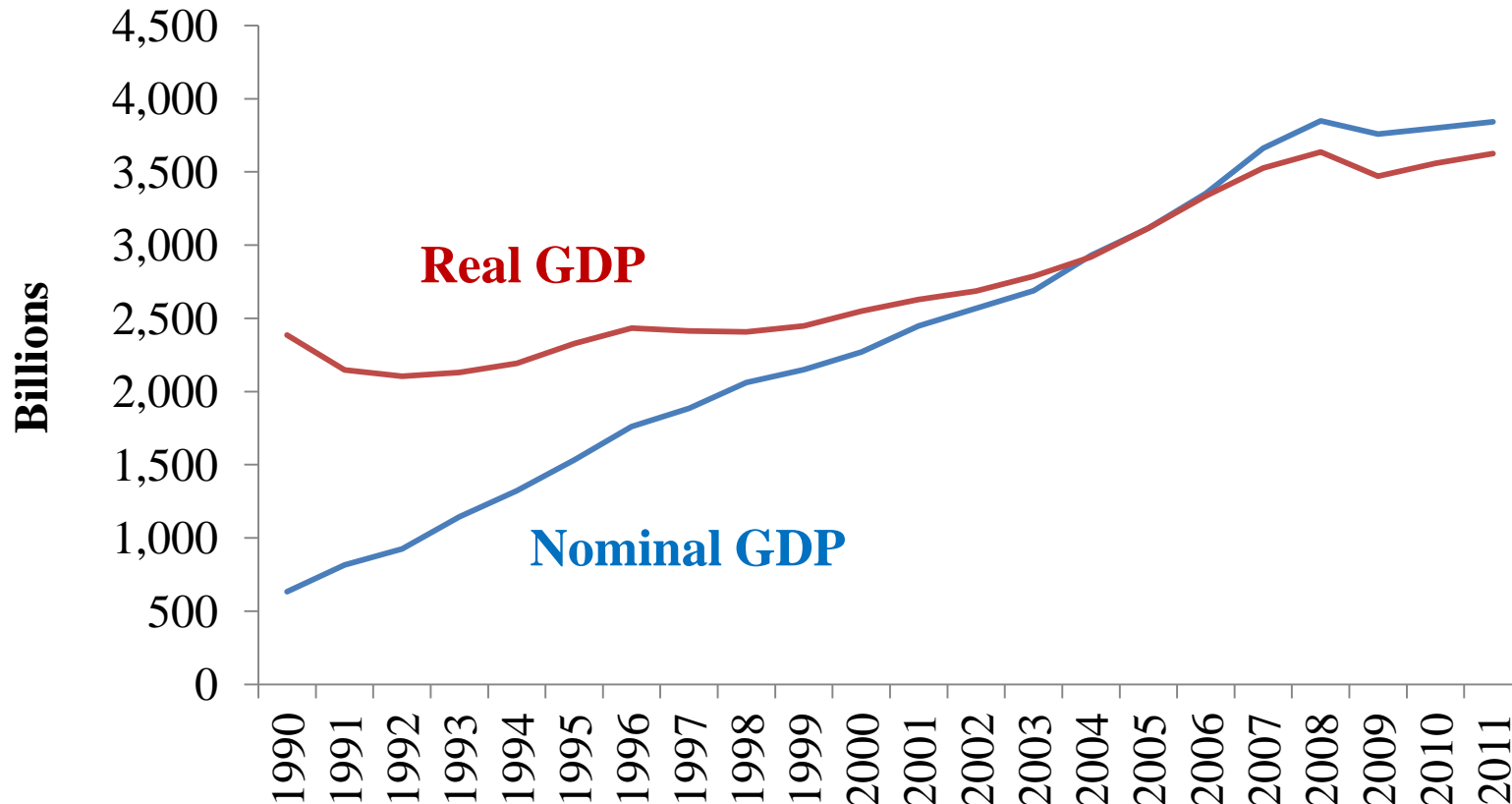
TE Consider again the pizza-producing economy

Year	Q	P (\$)	Nominal GDP	Real GDP (100=2005)	Real GDP (100=2000)
2000	10	5	50	80	50
2005	10	8	80	80	50
2012	15	10	150	120	75

- **Real GDP (100=2005):** Real GDP in 2005 prices

**N!B!** Change in the base year will lead to different levels of real GDP

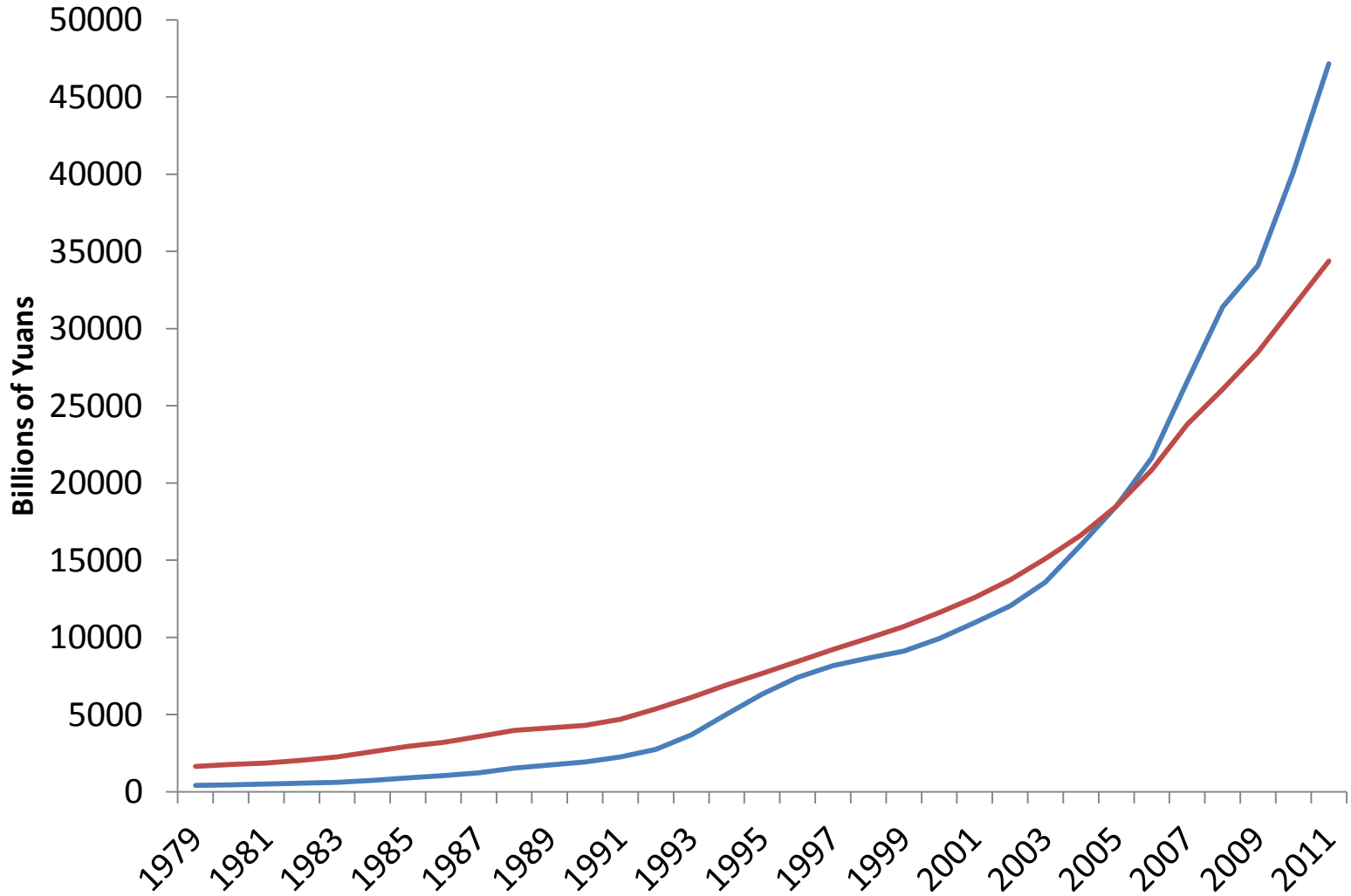
## Czech Nominal vs. Real GDP 1990-2011, CZK



What is the base year? **2005**

How would the graph change if we choose 1990 as a base year?

## Nominal and Real GDP for China



# GDP Growth Rate

- Percentage change in the quantity of goods produced from year to year

- Growth rate  $g_t = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$

Year	Q	P (\$)	Nominal GDP	Growth rate (%)
2010	10	5	50	--
2011	10	8	80	60
2012	15	10	150	87.5

$$g_{2011}^N = \frac{\$80 - \$50}{\$50} = 0.6 \text{ or } 60\%$$

$$g_{2012}^N = \frac{\$150 - \$80}{\$80} = 0.875 \text{ or } 87.5\%$$

- Nominal GDP growth rates reflect changes **in both** Q & P

## GDP Growth Rate (Cont.)

Year	Q	P	Nominal GDP	Growth rate (%)	Real GDP (100=2005)	Growth rate (%)
2010	10	5	50	--	80	--
2011	10	8	80	60	80	0
2012	15	10	150	87.5	120	50

$$g_{2005}^R = \frac{\$80 - \$80}{\$80} = 0 \text{ or } 0\%$$

$$g_{2012}^N = \frac{\$120 - \$80}{\$80} = 0.5 \text{ or } 50\%$$

Will the real GDP **growth rates** be affected by the change in the base year? **NO**

# GDP Growth Rate (Cont.)

TE Multiple goods

	Pizza		Haircuts		Nominal GDP (\$)
Year	Q	P (\$)	Q	P(\$)	
2011	10	5	5	3	65
2012	15	10	10	5	200

TE Real GDP

$$GDP_{2012}^R(100 = 2011) = \$5 \cdot 15 + \$3 \cdot 10 = \$105$$

$$GDP_{2011}^R(100 = 2012) = \$10 \cdot 10 + \$5 \cdot 5 = \$125$$

TE Real GDP growth rate

$$g_{2012}^R(100 = 2011) = \frac{\$105 - \$65}{\$65} = 0.62 \text{ or } \boxed{62\%}$$

$$g_{2012}^R(100 = 2012) = \frac{\$200 - \$125}{\$125} = 0.6 \text{ or } \boxed{60\%}$$

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# Real GDP: The Chain-Weighted Approach

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- Variety of goods of services
- Changes in relative prices of goods over time

⇒ The GDP growth rate is affected by the choice of the base year

**What year to be used as the base year?**

- A common practice, the base year is changed every 5 years

**What are the consequences?**

**Solution:** the chain-weighted approach

- Updates prices every year ⇒ more accurate

# Real GDP: The Chain-Weighted Approach (Cont.)

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## Three steps procedure

Calculating change in real GDP between year t and year t+1

### Step 1.

- Use year t as a base year => Real GDP => growth rate
- Use year t+1 as a base year => Real GDP => growth rate

$$g_{2012}^R(100 = 2011) = 0.62 \text{ or } 62\%$$

$$g_{2012}^R(100 = 2012) = 0.6 \text{ or } 60\%$$

**Step 2.** Calculate the **average of two** growth rates

$$g_{2012}^R = \frac{g_{2012}^R(100 = 2011) + g_{2012}^R(100 = 2012)}{2} = \frac{60\% + 62\%}{2} = 61\%$$

=> **Chain-weighted real GDP growth rate**



# Real GDP: The Chain-Weighted Approach (Cont.)

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## Step 3. Construct the real GDP index

- Chose an arbitrary base year: 2011
- Nominal GDP in the base year is equal to real GDP
- **Chain-weighted real GDP** in the following year

$$GDP_{2012}^R = GDP_{2011}^R (1 + g_{2012}^R)$$

$$GDP_{2013}^R = GDP_{2012}^R (1 + g_{2013}^R)$$

N!B! For the years before the base year

$$GDP_{2010}^R = GDP_{2011}^R / (1 + g_{2011}^R)$$

**Chain to the base year:** in order to calculate next year real GDP, we need to know the previous year figure

# The GDP Deflator

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- Changes in the overall price level
- The price of output relative to its price in a base year

$$\mathbf{GDP\ Deflator(t) = Nominal\ GDP\ (t)/Real\ GDP(t)}$$

- It is an index
- Equals to 1 in the base year
- Its level has no economic interpretation
- Removes the inflation out of nominal GDP
- Rate of change = **inflation rate**

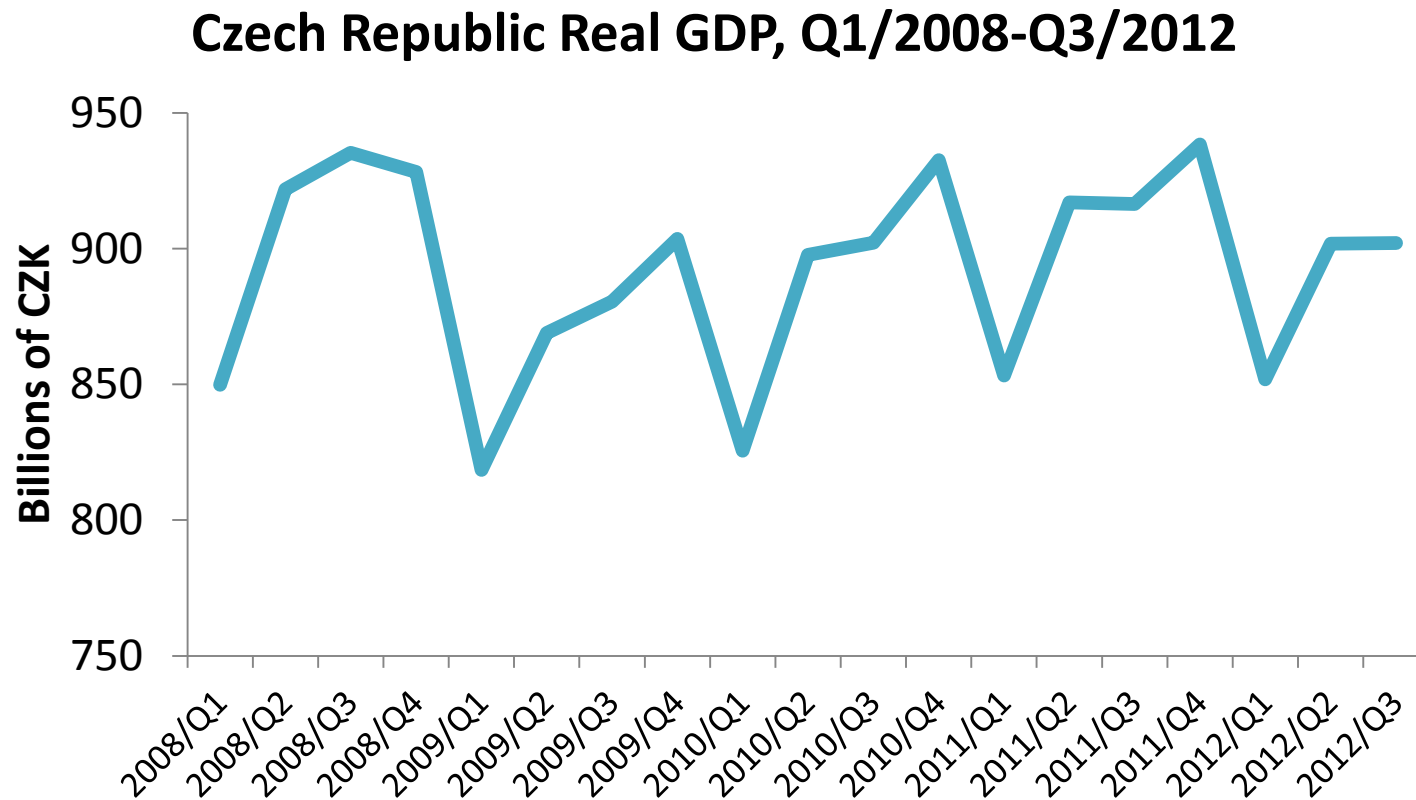
$$GDP_t^R = \frac{GDP_t^N}{GDP\ Deflator_t}$$

$$Inflation_t = \frac{GDP\ Deflator_t - GDP\ Deflator_{t-1}}{GDP\ Deflator_{t-1}}$$

# Seasonally Adjusted GDP

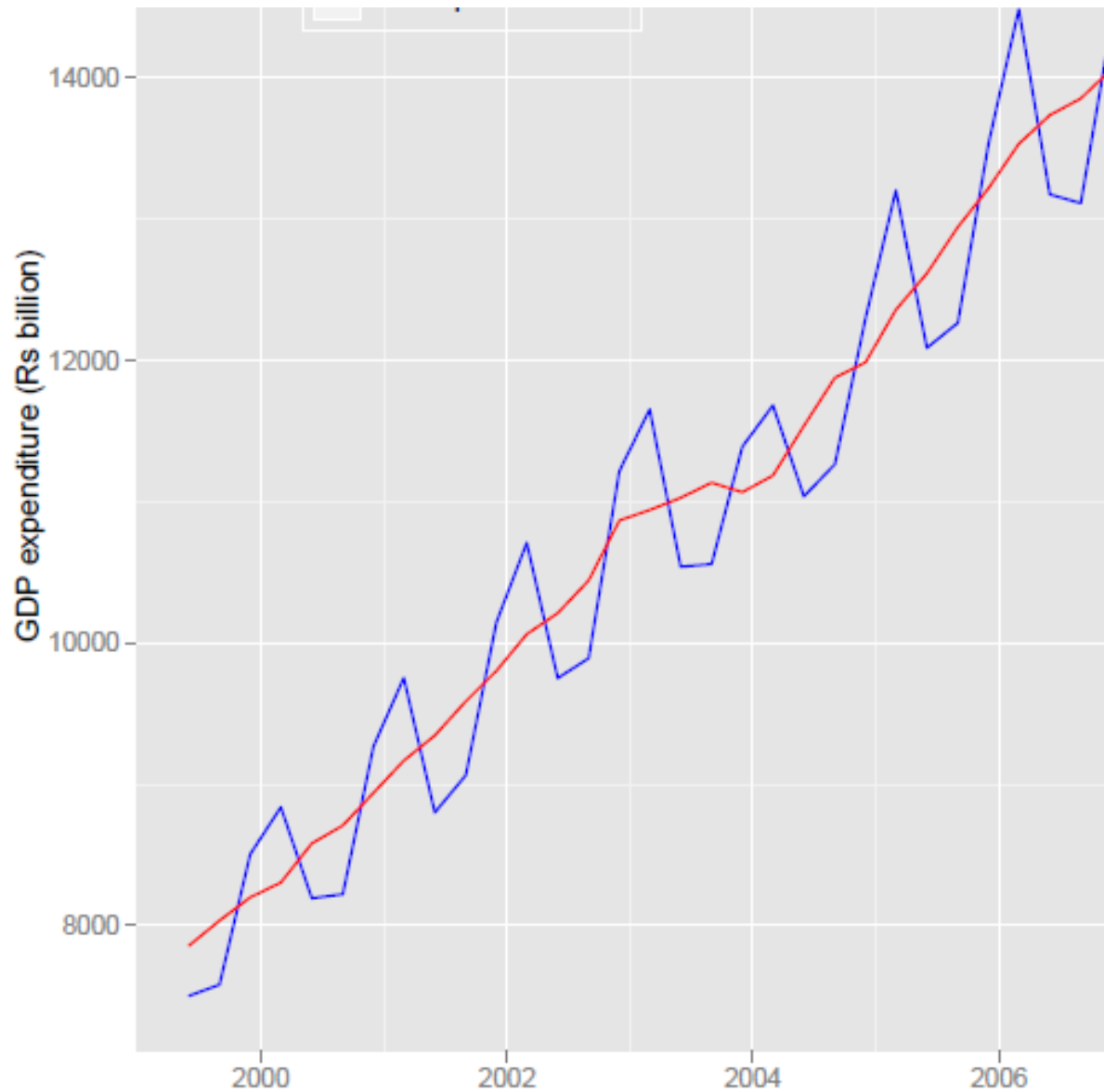
- Quarter-to-quarter fluctuations
- A pronounced seasonal pattern:

Steady growth over the year - peaking in Q4 - sharp drop in Q1



Source: IMF Financial Statistics Database

# Seasonally Adjusted GDP (Cont.)



Source: Indian Statistical Institute, 2010

# GDP Per Capita

- Average standards of living of the country

$$GDP_t^{per\ capita} = \frac{GDP_t}{Population_t}$$

Country	USD	Rating
Luxemburg	114,508	1
Norway	98,102	2
Qatar	92,501	3
Switzerland	83,383	4
USA	48,112	14
Czech Republic	20,587	39
Russia	13,089	53
China	5,445	90
India	1,489	139
Togo	588	>190
Niger	365	>190

# PPP Adjusted GDP

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- Comparing the standards of living (GDP per capita) across countries
- Converting GDP into common currency using currency exchange rates

## Issues:

1. Variation of exchange rates
2. Difference in prices of basic goods

**Solution:** using a common set of prices which reflects the **purchasing power**

**Purchasing power parity:** The price of a typical basket of goods is equal across countries being converted into the common currency

# GDP as a Measure of Well-Being

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GDP does **not** account for:

- Non-market transactions
- Leisure
- Improved product quality
- Distribution of income
- Quality of environment
- Depletion of resources
- Developed by Simon Kuznets in 1930 for BEA as a tool which allows to monitor the effect of government policy

# GDP as a Measure of Well-Being (Cont.)

Country	Real GDP per Person (2007)	Life Expectancy	Adult Literacy (% of population)	Internet Usage (% of population)
United States	\$45,592	79 years	99%	63%
Germany	34,401	80	99	45
Japan	33,632	83	99	67
Russia	14,690	66	99	15
Mexico	14,104	76	93	18
Brazil	9,567	72	90	19
China	5,383	73	93	9
Indonesia	3,843	71	92	7
India	2,753	63	66	3
Pakistan	2,496	66	54	7
Nigeria	1,969	48	72	4
Bangladesh	1,241	66	54	0.3

*Source:* Mankiw , G. (2011). Principles of Economics

**N!B!** GDP is correlated with a well-being indicators, but is an imperfect measure of the well-being itself



# Data Sources

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## **Czech Republic: Czech statistical office**

Český statistický úřad (CSU)

[www.czso.cz](http://www.czso.cz)

Czech National Bank: Global Economics Outlook

## **USA**

U.S. Bureau of Economic Analysis (BEA)

[www.bea.gov](http://www.bea.gov)

## **European Union**

Directorate General on Economic and Financial Affairs of the European Commission

[http://ec.europa.eu/economy\\_finance/eu/index\\_en.htm](http://ec.europa.eu/economy_finance/eu/index_en.htm)

## **OECD**

[www.oecd.org](http://www.oecd.org)

**Next class:** The National Accounts. Economic Growth