The Data of Macroeconomics

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Today's plan:

- Why GDP matters?

- What is GDP?

GDP and Welfare

Why macroeconomists focus so much on GDP per capita in evaluating how the economy is doing?

It is common among non-economists to be critical of our focus on GDP per capita.

Before trying to address this question, let me give you the formal definition of GDP:

Gross domestic product (GDP) is the market value of all final goods and services produced within a country in a given period of time.

- We will go back to this soon!

But, we should care about welfare, not GDP, right?

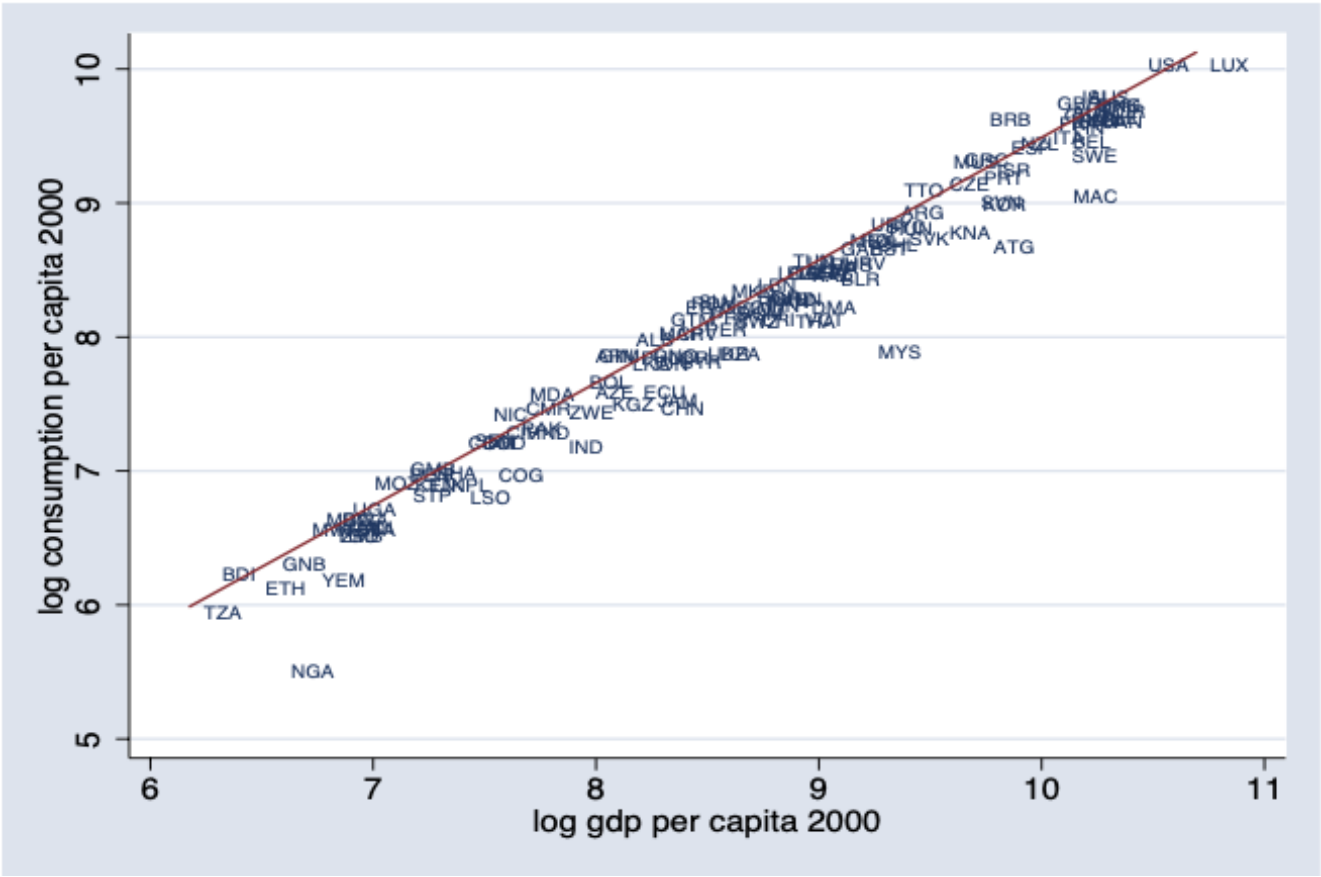
- The next 2 figures will show that GDP is strongly correlated with what we associate with welfare.
  - Now is a good time for you to throw something at me because of what we learned in our last class!
- The last figure correlates GDP with survey data on "life satisfaction".

GDP and Welfare

We care about consumption!

- For instance, I love Amazon.

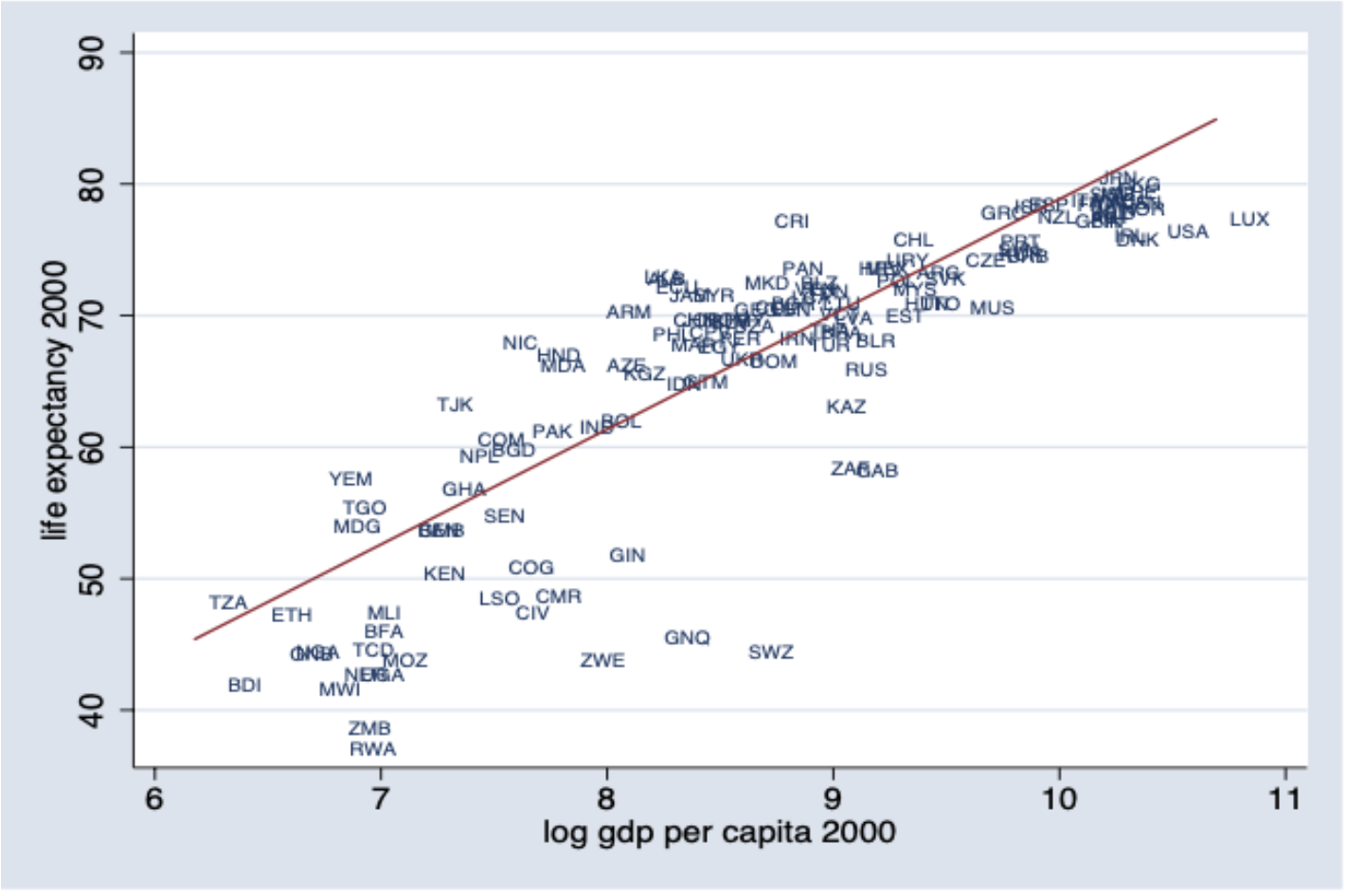
The following plot shows how GDP per capita correlates with consumption per capita for several different countries in 2020.



GDP and Welfare

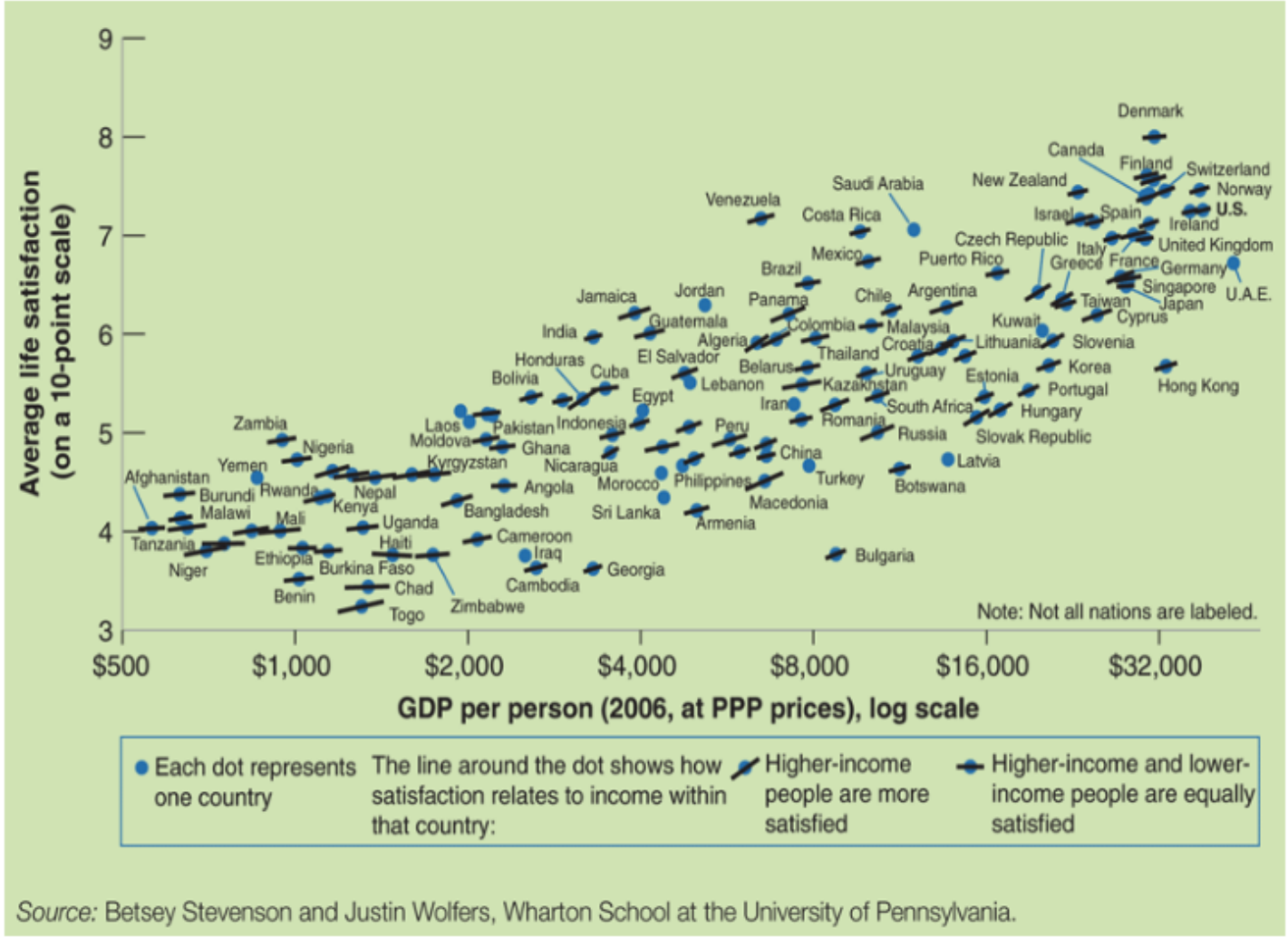
We also care about health!

The following plot shows how GDP per capita correlates with life expectancy for several different countries in 2020.



GDP and Welfare

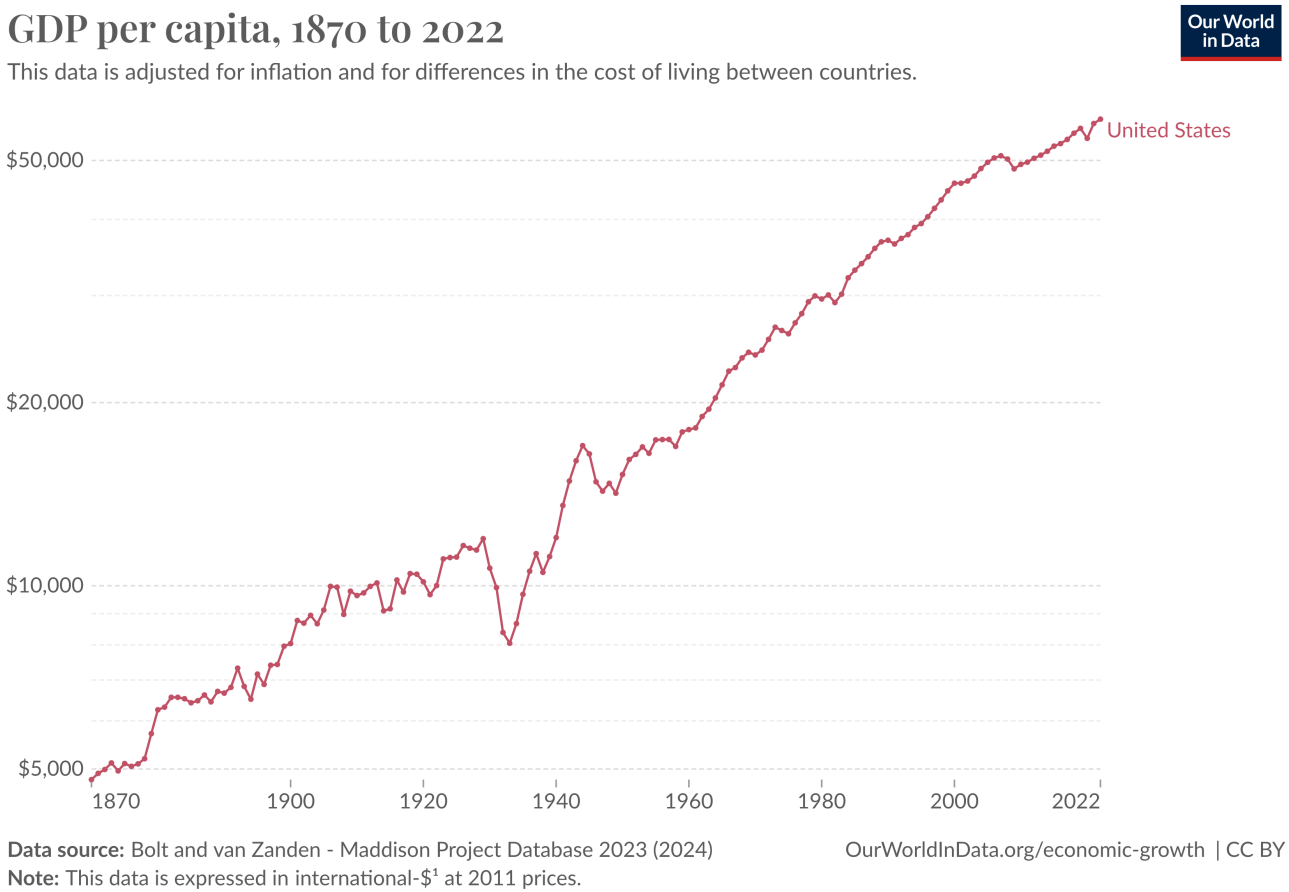
What if we asked people how much they enjoy their lives and see how this relates to the GDP, in several different countries?



Source: Betsey Stevenson and Justin Wolfers, Wharton School at the University of Pennsylvania.

US GDP

Before we jump into defining precisely what GDP is, let's take a look at the GDP per capita for the United States.



1. International dollars: International dollars are a hypothetical currency that is used to make meaningful comparisons of monetary indicators of living standards. Figures expressed in international dollars are adjusted for inflation within countries over time, and for differences in the cost of living between countries. The goal of such adjustments is to provide a unit whose purchasing power is held fixed over time and across countries, such that one international dollar can buy the same quantity and quality of goods and services no matter where or when it is spent. Read more in our article: What are Purchasing Power Parity adjustments and why do we need them?

US GDP

- Note that the scale of the y axis on the last plot is logarithmic!
- For the last 150 years, if we neglect the short-term deviations, the graph looks almost linear.
  - These short term deviations is what economists describe as business cycle. We will study them in the last part of this course.
- If we remove these short-term deviations and calculate the slope of the line that best fits the resulting data, we would get something close to 2%
- This suggests that the average rate of growth of US GDP per capita is around 2% in the last 150 years.
  - Remember what we saw in the second part of the first lecture.

We will now define precisely what GDP is, and the challenges involved in calculating it.

GDP - Formal definition

Gross domestic product (GDP) is the market value of all final goods and services produced within a country in a given period of time.

- market: provided by firms (or government)
- value: price times quantity (for nominal GDP: current price, for real GDP: historic price).
  - We will go back to this discussion of nominal vs real GDP later!
- goods and services: not other things that people enjoy (such as clean air).
- produced: finished products/services (sold or put in inventory), not resold!
- within a country: inside the borders.
- in a given period of time: a year, typically.

It is worth emphasizing two points:

- **Within a country**: It doesn't matter who is producing (American or a Brazilian firm)
- **Final goods**: It's a way to avoid double counting. But be careful! Intermediary goods can also contribute to GDP.

Estimating GDP is not an easy task. We will see why!

Home Production - Challenge I

Items that are produced and consumed at home are not part of GDP.

Measuring these items is very difficult so they are simply excluded, even though they may be close substitutes to market goods and services (such as pre-cooked meals from the supermarket or a visit to Shake Shack).

Some weird stuff might happen:

- What happens to GDP if a woman marries her gardener?

- When economies grow at an early stage of development, their growth is exaggerated because many previously home-produced items become produced by the market. Production that was previously not measured becomes measured.

Transfers - Challenge II

Government transfers such as food stamps and payments of Social Security benefits to the elderly are not included in GDP.

The reason: these are transfer payments: They simply reallocate existing income and are not made in exchange for a currently produced good or service.

Similarly, for private donation to charity: although the money becomes income for the recipient, it is similarly just a reallocation of resources and does not count in GDP.

Used Goods - Challenge III

What happens when you decide to sell your used car to someone else?

Should we count the money you receive when you sell the car as part of GDP?

To answer this question, ask yourself: was something produced here?

- The answer is no! Nothing was produced!
- So there is no impact on GDP when you sell the car.

However, econ is hard!

Suppose you hired a used-car salesman to sell your car.

- He charges a 10% fee to sell your car.
- This fee is now part of GDP.
- Something was produced here: the service provided by the salesman!
- Same idea applies to eBay, for example!

Foreigners - Challenge IV

When a foreign citizen works in the U.S., his production is part of U.S. GDP.

- Me working as an instructor in this summer class is counted towards GDP, for example. Even though I am from Brazil.

However, when an American citizen owns a factory in China, the production at this factory is not part of U.S. GDP.

- In fact, it is part of China's GDP.

The key point here is: it doesn't matter who is producing but where the good is being produced.

Housing Services - Challenge V

Some goods and services are not sold in the marketplace and therefore do not have market prices.

If GDP is to include these goods, we need an estimate of their value. This estimate is called imputed value.

We will see two examples of when imputations occur:

- Housing services.
- Government services.

Housing services are included in GDP!

- For rental housing, it is the rent. No imputation needed since we have the rent value!
- However, for owner-occupied housing, the Department of Commerce estimates what the market rent for that house would be if it were rented and includes this estimate as part of GDP.
  - This imputed rent is included both in the homeowner's expenditure and in the homeowner's income.

Government Services - Challenge VI

- The government produces many goods and services.
- We also count them towards GDP.
- However, for certain services, it is hard to assign a value to them because they are not sold in a marketplace and therefore do not have a market price.
  - For example: police officers, firefighters, and senators.
- An imputed value is required!
- The national income accounts include these services in GDP by valuing them at their cost:
  - The wages of these public servants are used to measure the value of their output.

Underground Economy - Challenge (I lost the count[1])

- The underground economy is the part of the economy that people hide from the government.
  - Either because the activity is illegal or to avoid paying taxes.
  - Examples: workers paid "off the books" and illegal drug trade.

- The value of goods and services sold in the underground economy is not part of GDP

In case you are curious:

- In US, the underground economy is estimated to be less than 10% of the official economy.
- However, in some developing nations, the underground economy is more than half the size of the official one.

[1] Hopefully by now I convinced you all that measuring GDP is hard

Timing - Another Challenge

⚠ GDP does not include transactions involving items produced in the past!

- So if a house is built in 2010 and sold for $1M, GDP rises by $1M in 2010.
- But when it is re-sold, no new production is created, so no change in GDP in later years due to changes in house values!
- The same thing for a used car we saw earlier!
- However, when a broker sells a house for a client, the brokerage fee is part of GDP because he provided a service.

Intermediate Goods - Final Challenge

- Most of the goods are produced in stages.

- Raw materials are processed by one firm and then sold to another firm for final processing.
  - Consider the alloy wheel of a car, for example. Usually this is build by one firm and then sold to BMW, for example.
  - When the firm producing the alloy wheel sells it to BMW, that is counted towards GDP.
  - But then, the BMW sells the car to you, which includes the wheel (hopefully).
  - How should we deal with this?

- We want to measure the value at the end of the production process, avoiding double counting.

- In order to do that, we will learn another way of calculating GDP, by using the concept of Value Added.

GDP and Value Added

Value Added: The value added of a firm equals the value of the firm's output less the value of the intermediate goods that the firm purchases.

$$\boxed{\text{Value Added} = \text{Output} - \text{Intermediate Goods}}$$

GDP can be calculated by the sum of value added at all stages of production for all firms!

$$\boxed{\text{GDP} = \sum \text{Value Added}}$$

Example 1: A cattle rancher sells one-quarter pound of meat to McDonald's for \$1, and then McDonald's sells you a hamburger for \$3.

Solution

Value added by the cattle rancher is: $1 - 0 = 1$
Value added by McDonald's is: $3 - 1 = 2$
Impact on GDP is: $\boxed{1 + 2 = 3}$

GDP and Value Added

Example 2: A fisherman catches one fish and sells it to a Japanese restaurant in the U.S. for \$20. The restaurant then serves you a sushi meal for \$60.

Solution

Value added by fisherman: $20 - 0 = 20$
Value added by the restaurant: $60 - 20 = 40$
Impact on GDP is: $\boxed{40 + 20 = 60}$

Example 3: Your grandpa collects his \$30,000 pension from Social Security.

Solution

Impact on GDP is 0. Pension is just a transfer, nothing is produced!

GDP and Valued Added

Example 4: A US computer manufacturing company buys wires from an American company (cost is \$3), a hard drive from an American company (cost is \$2) and a processor from a company in China (cost is \$4) to produce a laptop. Bestbuy buys this laptop from the US computer manufacturing company for \$12 and sells it to you for \$18 who happily uses the laptop.

Solution

Value added wire company: $3 - 0 = 3$
Value added hard drive company: $2 - 0 = 2$
Value added processor company: 0 *It is in China!*
Value added computer manufacturing company: $12 - 3 - 2 - 4 = 3$
Value added Bestbuy: $18 - 12 = 6$
Impact on GDP: $\boxed{3 + 2 + 3 + 6 = 14}$

GDP: Different ways of measuring it

We've seen two different ways of constructing GDP:

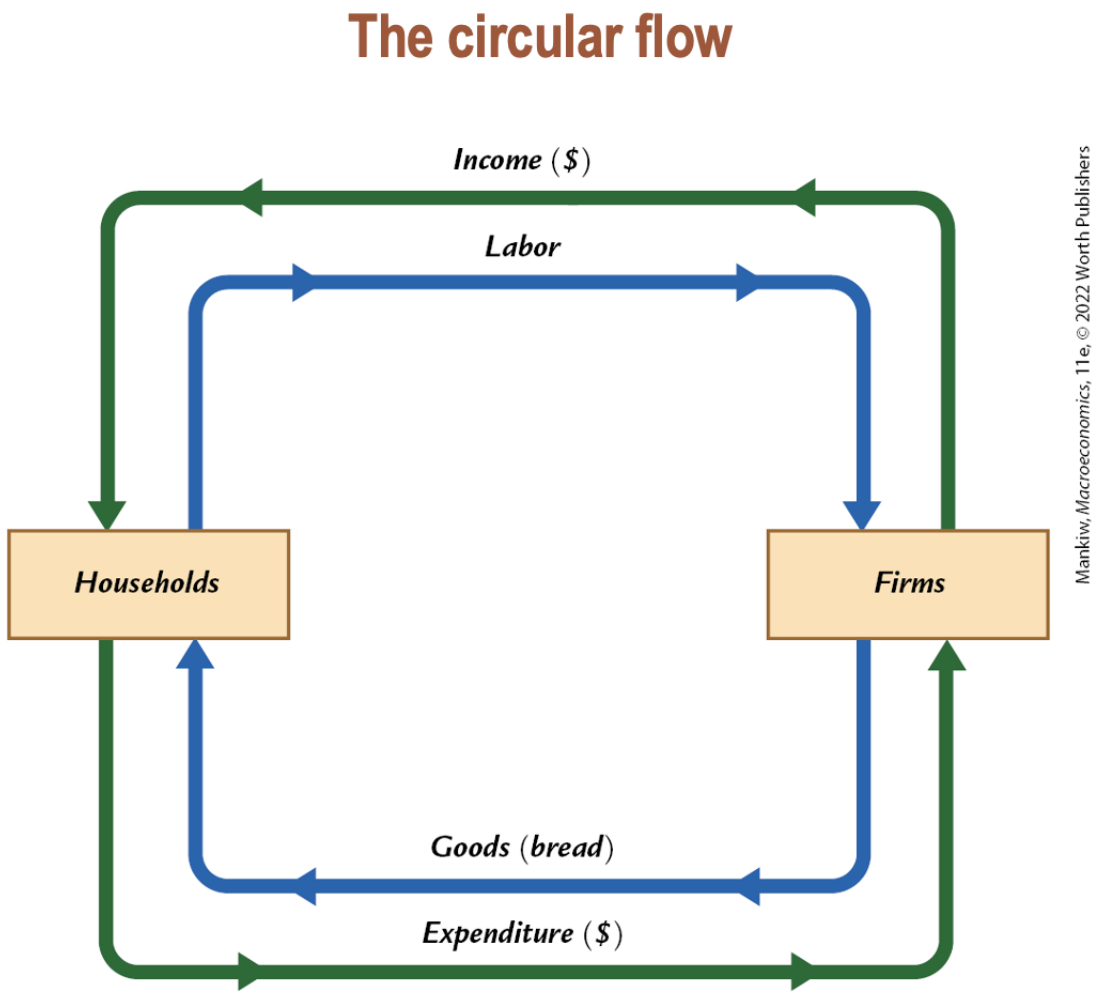
- Total output.
- The sum of value added at all stages in the production of final goods.

But GDP can also be constructed using:

- Total income.
- Total expenditure:
  - Consumption
  - Investment
  - Government Spending
  - Net Exports

The four approaches yield the same number!

GDP: Different ways of measuring it



Gross National Product - GNP

GDP measures the total income produced domestically.

However, some of this income belongs to foreign residents.

We want a measure of income that takes into account who is producing the goods and services.

Gross National Product (GNP) measures the total income earned by nationals (residents of a nation).

To calculate GNP we FIRST calculate GDP and we then:

- Add income earned by American citizens abroad.
- Subtract foreigners' income earned in US.

If a Japanese resident owns an apartment building in New York, is the rental income he earns part of U.S. GDP? what about GNP?

- It is part of U.S. GDP because it was earned here.
- It is not part of U.S. GNP because it is income earned by a foreigner.

Real vs Nominal GDP

GDP is the value of all final goods and services produced.

We need prices of the goods and services to calculate GDP, then!

Nominal GDP: goods and services valued at current prices.

$$Y_t^{\text{nom}} = \sum_i p_{it} q_{it}$$

where:

- q_{it}: quantity of good i produced in year t.
- p_{it}: price of good i in year t.
- We are summing for all good i (cars, bananas, apples...).

Real vs Nominal GDP

Real GDP: goods and services valued at constant (base) prices.

$$\boxed{Y_t^{\text{real}} = \sum_i p_{ib} q_{it}}$$

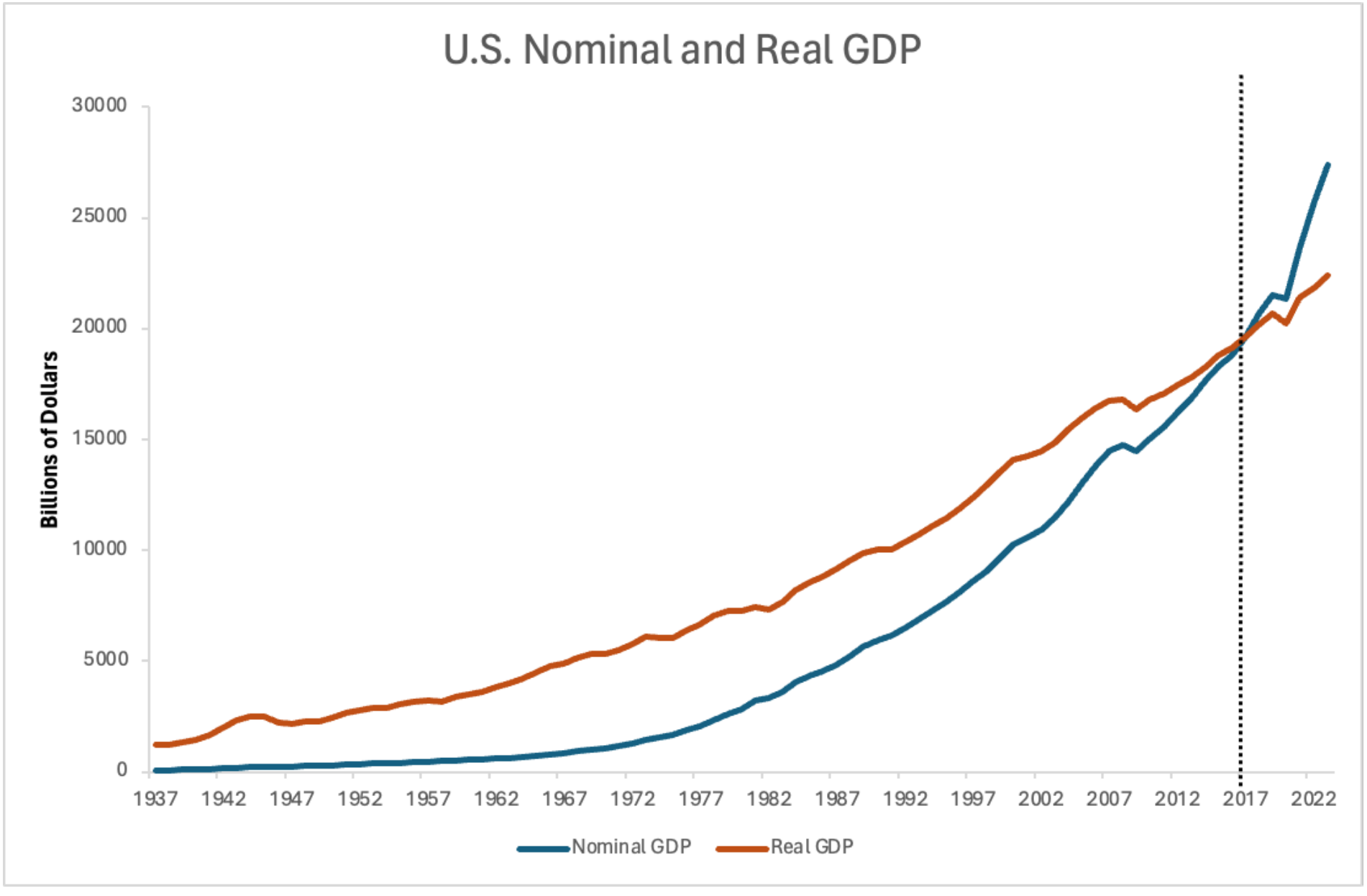
where:

- q_{it}: quantity of good i produced in year t.
- p_{ib}: price of good i in base year b.
- We are summing for all good i (cars, bananas, apples...).

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!

Real vs Nominal GDP - US



Inflation

- A dollar today doesn't buy as much as it did 20 years ago.
- The cost of almost everything has gone up.
- This increase in the overall level of prices is called inflation!
  - ⚠ Overall level of prices is key here.
  - If the price of only some goods increase, that's not inflation!
- We will talk more about inflation later.
- Now we will see how to measure it based on two indexes:
  - GDP Deflator
  - Consumer Price Index

Measures of Inflation

GDP Deflator: The ratio between nominal GDP and real GDP:

$$\boxed{P_t = \frac{Y_t^{\text{nom}}}{Y_t^{\text{real}}}}$$

Consumer Price Index (CPI): A measure of the overall level of prices.

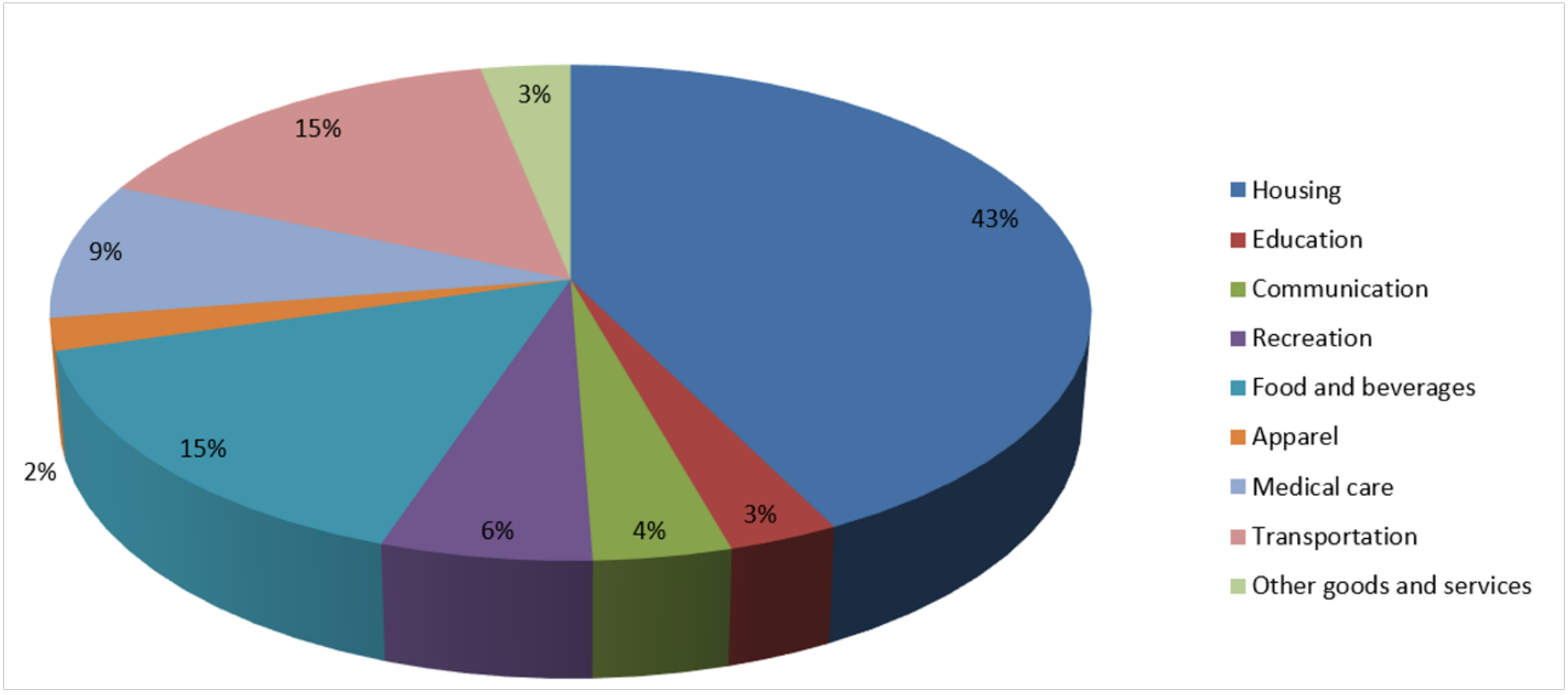
- Published by the Bureau of Labor Statistics (BLS)
- BLS surveys consumers to determine the composition of the typical consumer's "basket" of goods.
- Every month, it collects data on the prices of all items in the basket and computes the cost of buying the basket.

CPI in month t is given by:

$$\text{CPI}_t = \frac{\text{Cost of basket in month t}}{\text{Cost of basket in base period}}$$

CPI Basket

The composition of the CPI's basket



Measures of Inflation

The inflation rate is the percentage change between t and $t-1$ in any of those two indexes.

Note that we will have two different measures of inflation, one for each index. Using the CPI:

$$\text{Inflation rate}_t^{\text{CPI}} = \frac{\text{CPI}_t}{\text{CPI}_{t-1}} - 1$$

Using the GDP Deflator:

$$\text{Inflation rate}_t^{\text{GDP Def}} = \frac{P_t}{P_{t-1}} - 1$$

In general, these two measures of inflation will be different from each other!

- Spoiler: You will see this in the HW!

CPI vs GDP Deflator

	GDP Deflator	CPI
Prices of Capital goods	✓	✗
Prices of Imported goods	✗	✓
Basket of Goods	Changes every year	Fixed

Weakness of CPI as a measure of inflation

CPI may overstate inflation because:

Substitution bias:

- The CPI uses fixed weights, so it cannot reflect consumers' ability to substitute toward goods whose relative prices have fallen.

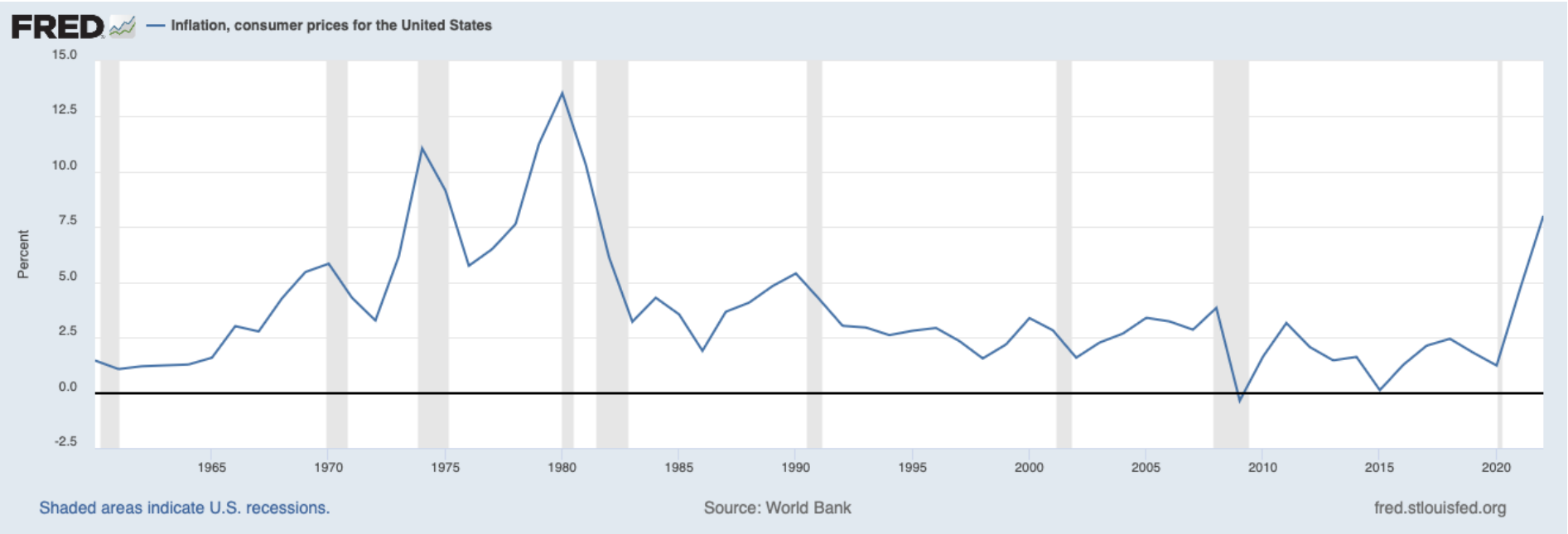
Introduction of new goods

- The introduction of new goods makes consumers better off and, in effect, increases the real value of the dollar.
- But it does not reduce the CPI because the CPI uses fixed weights.

Unmeasured changes in quality

- A PC has cost about $1,000 for almost 2 decades but quality has increased.

US Inflation



Key points:

- Big inflation period in 1970s.
- Low and quite stable from 1983 to 2021.
- Inflation surge in 2021 after COVID.