

Tracking the economy: GDP and price indices

EC 201

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Context

- 1 How do economists use aggregate measures to track the performance of the economy?
- 2 What is gross domestic product (GDP) and how is it calculated?
- 3 What is the difference between real GDP and nominal GDP and why is real GDP the appropriate measure of real economic activity?
- 4 What is a price index and how is it used to calculate the inflation rate?
- 5 Reading: Chapter 7 in the textbook

Why is GDP useful?

- Is China's economy bigger than the U.S. economy?
- How can you compare the sizes of two economies when they produce different things?
 - ▶ By comparing the value of their production.
- Gross domestic product (GDP) is the most important and common way to estimate an economy's size.

Important terms we will use

- **Consumer spending** is household spending on goods and services.
- **Government purchases** of goods and services are total expenditures on goods and services by federal, state, and local governments.
- **Investment spending** is spending on productive physical capital (such as machinery and construction of buildings) and on changes to inventories.
- Goods and services sold to other countries are **exports**. Goods and services purchased from other countries are **imports**.

The expanded circular flow diagram

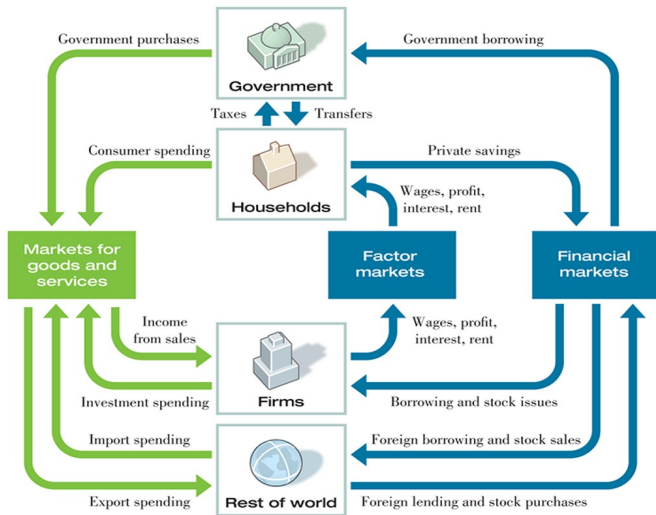


FIGURE 7-1 Krugman/Wells, *Macroeconomics*, 5e, © 2018 Worth Publishers

What is GDP?

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

Crucial points to note about GDP:

- **Value:** We cannot add tyres and sandwiches! So, we add up the market value of the output, expressing them in Dollars. Non-market goods are excluded from GDP.
- **Final:** To avoid double counting, we count only the value of final goods and services. We exclude intermediate goods such as Tyres bought by BMW to use in its cars.
- **Goods and services:** Goods are tangible and can be stored, but services such as haircuts cannot be stored. But both represent output and are counted in GDP.

What is GDP?

Crucial points to note about GDP:

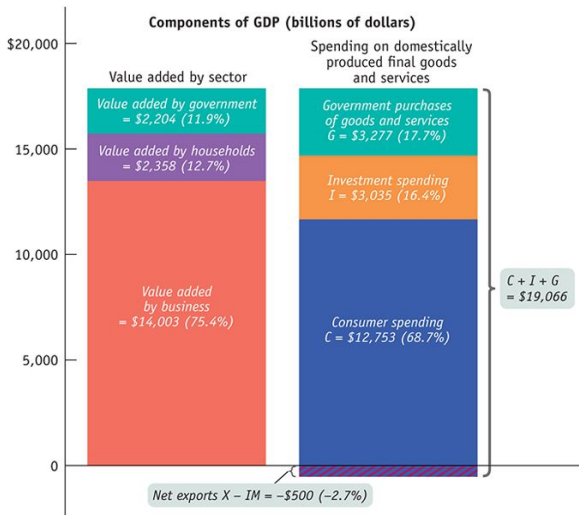
- **Production:** GDP measures value of final goods produced, NOT sold. The sale of financial assets, such as stocks and bonds, are NOT included because they are just transfers/sales, not new production.
- **Within a country:** Cars produced in Mexico by American firms: NOT included in the U.S. GDP. Cars produced in the United States by Japanese firms: ARE included in the U.S. GDP
- **In a year:** GDP is like an annual income: it measures production during a given period. Check this out: <https://www.bea.gov/>

How to calculate GDP ?

There are three ways to calculate GDP. All must give you the same number.

- **Product or value-added approach:** add up the total value of all final goods and services produced (summing the value of production)
- **Expenditure approach:** add up all spending on domestically produced final goods and services (summing the expenditures)
- **Income approach:** add up the total factor income earned by households from firms in the economy (summing income earned)

Components of GDP



Three ways to compute GDP

Remember, one person's spending is another person's income.

2. Aggregate spending on domestically produced final goods and services = \$21,500

	American Ore, Inc.	American Steel, Inc.	American Motors, Inc.	Total factor income
Value of sales	\$4,200 (ore)	\$9,000 (steel)	\$21,500 (car)	
Intermediate goods	0	4,200 (iron ore)	9,000 (steel)	
Wages	2,000	3,700	10,000	\$15,700
Interest payments	1,000	600	1,000	2,600
Rent	200	300	500	1,000
Profit	1,000	200	1,000	2,200
Total expenditure by firm	4,200	9,000	21,500	
Value added per firm = Value of sales – Cost of intermediate goods	4,200	4,800	12,500	

3. Total payments to factors = \$21,500

1. Value of production of final goods and services, sum of value added = \$21,500

What's in and what's out?

- **IN**

- 1 Domestically produced final goods and services, including capital goods, new construction of structures, and changes to inventories

- **OUT**

- 1 Intermediate goods and services
- 2 Inputs
- 3 Used goods
- 4 Financial assets, such as stocks and bonds
- 5 Spending on goods and services produced outside this country (import spending)

Are these transactions counted in GDP?

- Lauren buys a new iPhone 13 from Apple.
- Government buys 2000 new ventilators from Tesla to help treat COVID-19 patients.
- Goodyear produces 5000 brand new tyres this year, which are bought by BMW to use in its cars, which it sells to consumers.
- Oral-B produced 5M new toothbrushes but sold only 4M of them this year. What about the 1M unsold toothbrushes?
- Kobe bought an Alieaware computer last year, but this year he wants to get a new one. Once he got the new one, he sold his old computer to Will.
- Vinny created a software, which he sold to a firm in Finland for 2M.
- Aden bought an Ikea table, which was shipped directly from Sweden.

Calculating GDP: Value-added method

- **Value added** of a producer is the value of its sales minus the value of its purchases of intermediate goods and services.
- **Final goods and services:** goods and services sold to the final, or end, user
- **Intermediate goods and services:** goods and services (bought from one firm by another firm) that are inputs for production of final goods and services
- Sum of value added by all the producers in the economy is the GDP.

Calculating GDP: Expenditure method

This is the most popular method. You just add up all spending on domestically produced final goods and services. This means

$GDP = C + I + G + X - M$, where

- C = consumer spending
- I = investment spending
- G = government purchases of goods and services
- X = sales to foreigners, and
- M = imports (purchases of foreign goods)

$X - M$ is usually referred to as **Net Export**.

Exercise

Suppose country A sells \$100 million worth of goods and services to country B. Country B sells \$50 million worth of goods and services to country A. These are the only two countries in Macroworld. Net exports in country:

- B equal $-\$50$ million.
- A equal \$150 million.
- A equal \$150 million.
- B equal \$50 million.

What does GDP tell us?

- Tells us the size of the economy at a given time.
- We must be careful to compare the GDP numbers over time though. Why?
- U.S. GDP in 1997: \$8,608 billion
- U.S. GDP in 2016: \$18,566 billion
- Does that mean the size of the U.S. economy actually doubled over that period?
- Why or why not?

Hint: prices!

What Does GDP not Include?

An old line says that when a person marries the household cook, GDP falls. And it's true: when someone provides services for pay, those services are counted as a part of GDP. **But the services family members provide to each other are not.** Some economists have produced alternative measures that try to “impute” the value of household work—that is, assign an estimate of what the market value of that work would have been if it had been paid for. But the standard measure of GDP doesn't contain that imputation.

GDP estimates do, however, include an imputation for the value of owner-occupied housing. That is, if you buy the home you were formerly renting, GDP does not go down. It's true that because you no longer pay rent to your landlord, the landlord no longer sells a service to you—namely, use of the house or apartment. But the statisticians make an estimate of what you would have paid if you rented your dwelling, whether it's an apartment or a house. For the purposes of the statistics, it's as if you were renting from yourself.

If you think about it, this makes a lot of sense. In a home-owning country like the United States, the pleasure we derive from our houses is an important part of the standard of living. So to be accurate, estimates of GDP must take into account the value of housing that is occupied by owners as well as the value of rental housing.

Review

- 1 Why do the three methods of calculating GDP produce the same estimate of GDP?
- 2 What are the various sectors to which firms make sales? What are the various ways in which households are linked with other sectors of the economy?
- 3 Consider the first row of table we saw earlier and suppose you mistakenly believed that total value added was \$30,500, the sum of the sales price of a car and a car's worth of steel. What items would you be counting twice?

Real vs Nominal GDP

We want to track the quantity of total output over time.

- **Real GDP:** the total value of the final goods and services produced in the economy during a given year, calculated using the prices of a selected **base year**
- **Nominal GDP:** the value of all final goods and services produced in the economy during a given year, calculated using the prices **current** in the year in which the output is produced

Miracle in Venezuela?

Between 2013 and 2016, Venezuelan nominal GDP grew at an estimated 1,200%—compared with growth of only 11% in the United States. So did Venezuela experience an economic miracle?

On the contrary, its economy was a mess, partly because the price of oil—the country's main export—has plunged and partly because of erratic government policies that have disrupted production and led to widespread shortages of basic consumer goods. In fact, real GDP fell by an estimated 19% from 2013 to 2016. But those shortages have led to surging prices (especially on the black market, but even official prices were rising rapidly). Furthermore, the government, having lost much of its revenue thanks to falling oil exports, started to pay some of its bills simply by printing money, leading to accelerating inflation.

In other words, Venezuela is an extreme illustration of the importance of distinguishing between nominal and real GDP: it's producing fewer and fewer goods and services, but nominal GDP is soaring because the prices of the goods and services it does manage to produce are rising at triple-digit rates.

Real GDP: a simple economy example

How much would GDP have gone up if prices had not changed? To answer this question, we need to find the value of output in year 2 expressed in year 1 prices.

	Year 1	Year 2
Quantity of apples (billions)	2,000	2,200
Price of apple	\$0.25	\$0.30
Quantity of oranges (billions)	1,000	1,200
Price of orange	\$0.50	\$0.70
GDP (billions of dollars)	\$1,000	\$1,500
Real GDP (billions of year 1 dollars)	\$1,000	\$1,150

Real vs Nominal GDP

- Except for the base year, real GDP (output at prices of a base year) is not the same as nominal GDP (output at current prices).
- In reality, **chained dollars** are used to compute real GDP. But we do not go into that in this class.
- GDP per capita is usually used to measure the living standard. But it cannot be a policy goal in itself. Why?

Question

What is the GDP per capita in the following countries?

Country	GDP in millions of U.S. dollars	Population in millions
Wrigleyville	545.0	259.0
Longhornland	2247	151
Dinkytown		283.00

Hint: $\text{GDP per capita} = \frac{\text{GDP}}{\text{population}}$

Is GDP a flawless measure of economic prosperity?

GDP per capita is a popular measure of economic level of countries. But does that mean it has no shortcomings? Of course not. There are limitations.

- Money matters much less after a point.
- People care about happiness.
- GDP counts only market goods. How do you calculate the value of care parents give when we were kids?
- GDP numbers don't tell us who gets how much. Distribution of income and wealth matters!

How much does GDP Matter?

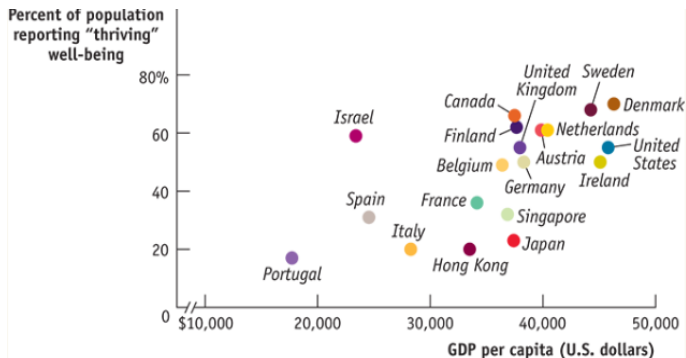


Source here

How much does GDP Matter?

Question: how do you rate your life at the current time and your expectations for the next five years?

This figure shows how rich countries are, and how people assess their well-being.



Data from: Gallup; World Bank.

How much does GDP Matter?

The graph shows the percentage of people who rated their well-being as “thriving.” Notice three things

- 1 Rich is better. Richer countries on average have higher well-being than poor countries
- 2 Money matters less as you grow richer. As GDP rises, the average gain in life satisfaction gets smaller and smaller. For example, Italy to Belgium vs Belgium to United States. Compare the difference in income vs life satisfaction.
- 3 Money isn't everything. Israelis, though rich by world standards, are poorer than Americans—but they seem more satisfied with their lives. Japan is richer than most other nations, but scores low on the survey of well-being.

How do these economic changes affect GDP?

Consider $GDP(=Y) = C + I + G + X - M$ from the expenditure approach. C is personal consumption expenditure, I is investment expenditure, G is government expenditure, X is exports, and M is imports.

- 1 Lauren buys a new car for \$20,000; the car was produced in the United States. Which variables are affected?

(Personal consumption expenditures— C —increase by \$20,000, so GDP increases by \$20,000.)

How do these economic changes affect GDP?

Consider $GDP(=Y) = C + I + G + X - M$ from the expenditure approach. C is personal consumption expenditure, I is investment expenditure, G is government expenditure, X is exports, and M is imports.

- 1 Ian buys a new car for \$20,000; the car was produced in Germany. Which variables are affected?

How do these economic changes affect GDP?

Consider $GDP(=Y) = C + I + G + X - M$ from the expenditure approach. C is personal consumption expenditure, I is investment expenditure, G is government expenditure, X is exports, and M is imports.

- 1 BSC Inc. produces \$20,000 of car parts and exports them to Spain. Which variables are affected?

How do these economic changes affect GDP?

Consider $GDP(=Y) = C + I + G + X - M$ from the expenditure approach. C is personal consumption expenditure, I is investment expenditure, G is government expenditure, X is exports, and M is imports.

- 1 To reduce unemployment during a recession, the Birmingham city government hires unemployed people to clean and care for Birmingham city parks. Which variables are affected?

How do these economic changes affect GDP?

Consider $GDP(=Y) = C + I + G + X - M$ from the expenditure approach. C is personal consumption expenditure, I is investment expenditure, G is government expenditure, X is exports, and M is imports.

- 1 Tesla invests billions in self-driving car technology amid an uncertain future. Which variables are affected?

How do these economic changes affect GDP?

Consider $GDP(=Y) = C + I + G + X - M$ from the expenditure approach. C is personal consumption expenditure, I is investment expenditure, G is government expenditure, X is exports, and M is imports.

- 1 To improve infrastructure, the state of Alabama spends additional money on highways and bridges. Which variables are affected?

How do these economic changes affect GDP?

Consider $GDP(=Y) = C + I + G + X - M$ from the expenditure approach. C is personal consumption expenditure, I is investment expenditure, G is government expenditure, X is exports, and M is imports.

- 1 People expect a higher rate of unemployment in future and decide to save more by cutting back their spending on goods and services.
Which variables are affected?

How do these economic changes affect GDP?

Consider $GDP(=Y) = C + I + G + X - M$ from the expenditure approach. C is personal consumption expenditure, I is investment expenditure, G is government expenditure, X is exports, and M is imports.

- 1 U.S. imposes trade barriers on Chinese smartphones by imposing tariffs on their imports. U.S. consumers respond by buying fewer Chinese smartphones. Which variables are affected?

How do these economic changes affect GDP?

Consider $GDP(=Y) = C + I + G + X - M$ from the expenditure approach. C is personal consumption expenditure, I is investment expenditure, G is government expenditure, X is exports, and M is imports.

- 1 Truckvana Inc. buys a new delivery truck for \$50,000; it was produced in the United States, but the manufacturer used \$25,000 in imported parts in the production process. Which variables are affected?

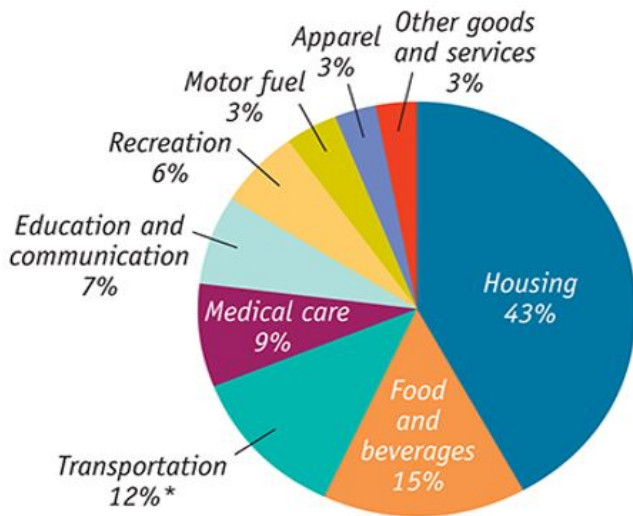
Price Indices

Looks like prices are important. Let's learn how economists measure aggregate prices and why they are useful. We will specifically look at the price index consumers care the most about: the **Consumer Price Index (CPI)**.

Price Indices and the aggregate price level

- Aggregate price level is a measure of the overall level of prices in the economy
- To measure the aggregate price level, economists calculate the cost of purchasing a market basket, a hypothetical set of consumer purchases of goods and services.
- The CPI basket includes a number of goods and services a typical urban household of four members consumes in a year.

What's in the CPI basket



*Excludes motor fuel.

Price Indices and the aggregate price level

Suppose a typical consumer bought 200 oranges, 50 grapefruit, and 100 lemons in 2015 and 2016.

	2015	2016
Price of orange	\$0.20	\$0.40
Price of grapefruit	0.60	1.00
Price of lemon	0.25	0.45
Cost of market basket (200 oranges, 50 grapefruit, 100 lemons)	$(200 \times \$0.20) +$ $(50 \times \$0.60) +$ $(100 \times \$0.25) = \95.00	$(200 \times \$0.40) +$ $(50 \times \$1.00) +$ $(100 \times \$0.45) = \175.00

Consumer Price Index

- The cost of purchasing a given consumer basket in a given year, where that cost is normalized so that it is equal to 100 in the selected base year.
- In our example, assuming the 2015 price index = 100, the 2016 price index is $\frac{175}{95} \times 100 = 184.21$

$$\text{Price index in a year} = \frac{\text{Cost of the consumer basket in a given year}}{\text{Cost of the same basket in the base year}} \times 100$$

How to calculate inflation rate

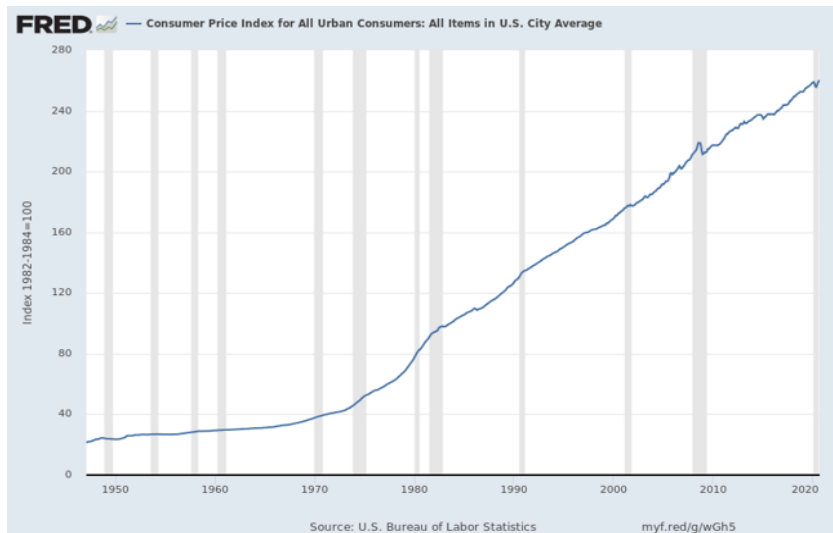
- **inflation rate** is the yearly percentage change in a price index, typically based on consumer price index (CPI), the most common measure of the aggregate price level.
- The CPI measures the cost of the market basket of a typical urban American family of four.

$$\text{Inflation rate} = \frac{\text{Price index in year 2} - \text{Price index in year 1}}{\text{Price index in year 1}} \times 100$$

Do Not Confuse

- Does a reported increase in the CPI mean that all prices of goods and services in the economy are increasing at the same stated rate?
- **NO!!**
- The CPI, or any price index, indicates the rate of change for the **average of all prices included** in the index.

CPI over the years

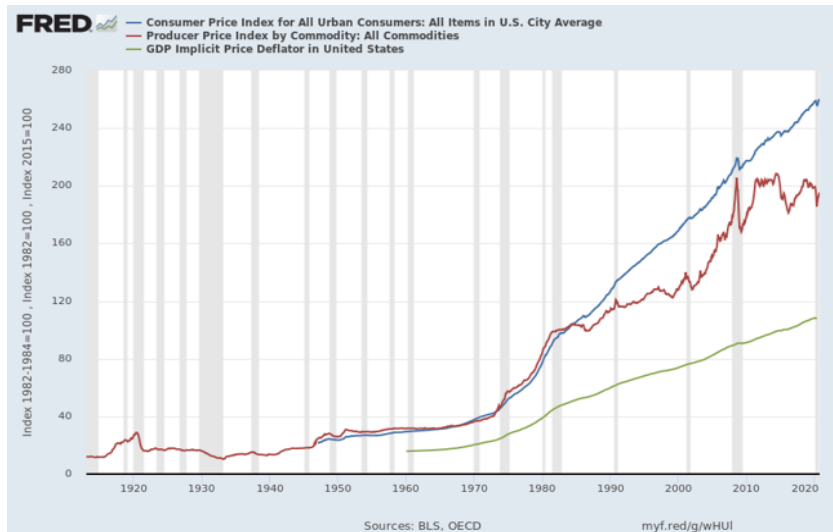


Other price indices

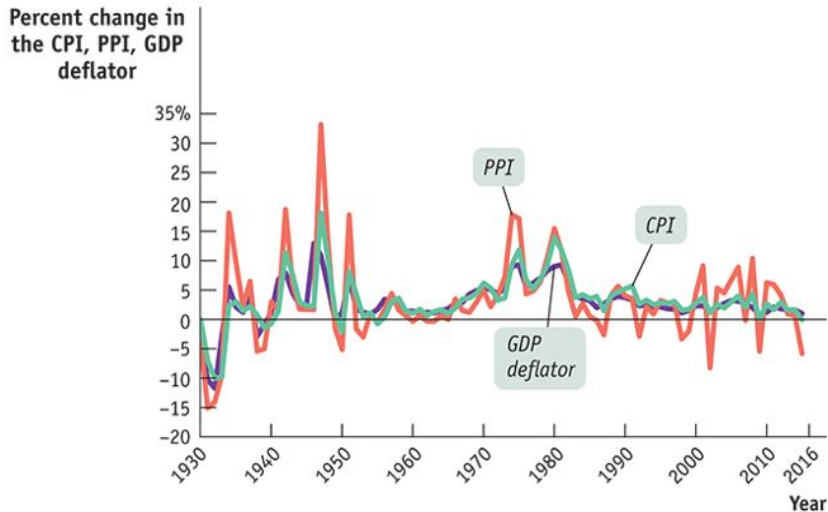
- **Producer price index (PPI)**: it's similar to the CPI, but it measures changes in the prices of goods purchased by producers
- Economists also use the GDP deflator that measures the price level by calculating the ratio of nominal to real GDP.
- **The GDP deflator** for a given year is 100 times the ratio of nominal GDP to real GDP in that year.

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

CPI, PPI, and GDP deflator over the years



Consumer, Producer, and Overall Inflation over the years



The Core CPI

- Inflation rate is an important input for policymakers in the government as well as in the Fed.
- The persistent trend of inflation over the years is crucial for making sound policies.
- For that purpose, they usually consider the CPI basket without the goods whose prices fluctuate a lot. It is called the Core CPI because it shows the “core inflation”.
- In the Core CPI, prices of energy goods and foods are excluded. Why?
 - ▶ Because their prices fluctuate a lot and including them could be misleading in the sense that they may overshadow the true behavior of inflation.
 - ▶ You can imagine how gas and food prices fluctuate around a hurricane for example. Such price changes are short lived and do not tell us much about the overall long-run trend in prices.

Biases in the CPI

- Although CPI looks like a good measure of inflation, we need to be cautious while interpreting the inflation numbers. Why? There are at least two biases to consider.

Substitution Bias

- We as consumers look for cheaper substitutes to the goods we purchase [recall the law of demand].
- When consumers substitute the more expensive goods for the cheaper alternatives (substitutes), the CPI will overstate inflation because the good included in the CPI basket is more expensive than the one we are actually consuming.
- If iPhone is part of the CPI basket but consumers start using OnePlus phones instead, the inflation rates calculated using CPI will be higher than the consumers actually face.

Quality/new good bias

- We are not only looking for cheaper goods, but also for better quality!
- Consider again, smartphones. The starting iPhone 12 cost is \$799 while iPhone 11 cost was \$699. While iPhone 12 price is higher, there are new features that consumers love!
- If the CPI basket ignores this improvement in quality and just tracks the price of iPhone over the years, it is going to overstate inflation.
- This is called the quality/new good bias.

Be cautious interpreting the inflation numbers

- The BLS does make efforts to overcome these biases by updating the CPI basket more frequently. It also adds new goods to the basket.
- BLS also tries to account for the quality improvements in the goods.
- But there will always be some lag between the arrival of new goods/better goods and when the CPI basket is updated.
- *Moral of the story: do not take the CPI and inflation numbers at their face value!*