
Gross Domestic Product (GDP)

Measuring Output and Income

Outline

1. Computing GDP
 2. Alternative Measures
 3. Components of GDP
- Textbook Readings: Ch. 8

Gross Domestic Product (GDP)

Market value of all final goods and services produced within an economy in a given period of time

- **Market value**
 - $\text{GDP} = (P_A \times Q_A) + (P_O \times Q_O) = (\$0.50 \times 4) + (\$1.00 \times 3) = \5.00
- of all **final** goods and services **produced**
 - Ignores purchases of **intermediate** goods to avoid double-counting
 - Sale of **used** goods is not included as part of GDP
- **within an economy**
 - Honda made in US, Yes; Ford made in Peru, No
- in a **given period** of time
 - Quarter, Year

GDP is Output But is Measured in \$

- Two ways to view this statistic
 - Total **income** of everyone in the economy
 - Total **expenditure** on the economy's output of G&S
- For the economy as a whole **income = expenditure**
 - Every transaction has a buyer and a seller
- Challenge in measuring GDP
 - **Avoid double counting** (i.e. counting the same output more than once)

GDP Measuring Methods

- **Expenditure** Approach (Standard)
 - Add all **final sales** of goods and services produced
 - Unsold products counted as business expenditure → Inventory
- Factor **Income** Approach
 - Add all **payments** to providers of input
 - Payments = Wages + Interest + Rent + Profit
- **Value Added** Approach
 - Add all **additional value** produced along output chain
 - Value added: price sold – price bought



A Stylized Economy: One Unit of Final Output

	Finished Product		Total Income				
	Selling Price:	Value Added:	Payments =	Wages +	Rents +	Interest +	Profits
Alpha Lumber Company	\$10	\$10	\$10	\$8	\$1		\$1
Beta Furniture Factory	\$70	\$60	\$60	\$55			\$5
Gamma Retailer	\$100	\$30	\$30	\$20	\$2	\$3	\$5
Totals		\$100	\$100				

Nominal GDP vs Real GDP

- Nominal GDP: Uses **current** prices
 - $\text{Nominal GDP}^{2017} = (P_A^{2017} \times Q_A^{2017}) + (P_O^{2017} \times Q_O^{2017})$
- Real GDP: Uses **constant** prices (base-year prices)
 - $\text{Real GDP}^{2017} = (P_A^{2009} \times Q_A^{2017}) + (P_O^{2009} \times Q_O^{2017})$
 - Real GDP varies **only if the quantities produced vary**
- GDP deflator: *Price* of output relative to its price in the base year

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

Growth Rate of GDP Deflator

	2007	2008
NOMINAL GDP	\$14,078 billion	\$14,441 billion
REAL GDP	\$13,254 billion	\$13,312 billion

FORMULA	APPLIED TO 2007	APPLIED TO 2008
GDP Deflator	$= \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100$ $\left(\frac{\$14,078 \text{ billion}}{\$13,254 \text{ billion}} \right) \times 100 = 106$	$\left(\frac{\$14,441 \text{ billion}}{\$13,312 \text{ billion}} \right) \times 100 = 108$

$$\left(\frac{108 - 106}{106} \right) \times 100 = 1.9\%$$

Growth Rate of Real GDP

$$Real\ GDP = \frac{Nominal\ GDP}{GDP\ Deflator}$$

- Nominal GDP rises by 4.25%
- Overall prices rise by 2.05%
- Roughly speaking, real GDP rose by 2.2%

GDP: Statistical Approximations

- The Bureau of Economic Analysis (BEA) provides both **annual** and **quarterly** figures
- In August of 2015, BEA estimated **2014 GDP** to be **\$15.962 trillion**
- Thus in calendar year 2014, the **value of all goods and services produced, at constant prices**, equaled \$15.962 trillion

BEA: Quarterly Annualized Estimates

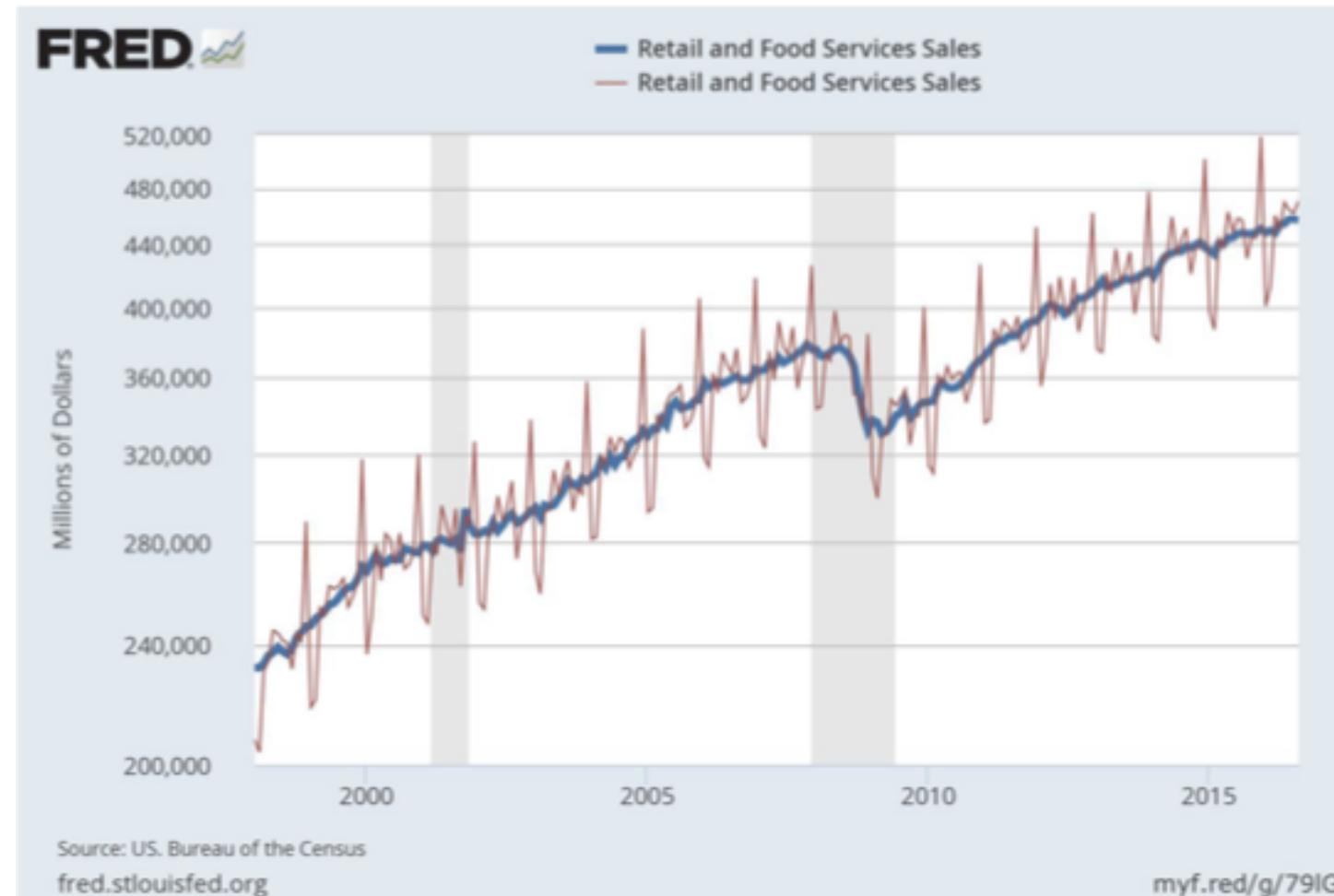
- One month after the conclusion of a quarter, BEA provides an estimate for **quarterly GDP**
- Quarterly estimates are provided as **annualized** figures
- They are also adjusted for recurring seasonal patterns – they are **“seasonally adjusted”**

A Three Month Flow Annualized to A Year

2015:Q2 GDP = \$16.324 trillion

- In the second quarter of 2015, all final goods and services , in constant dollars, accumulated at a **seasonally adjusted annualized** value of \$16.324 trillion
- BEA collects 3 months of data and **multiplies it by 4**

Seasonal Adjustment: Separating Signal from Noise



- Look beyond predictable seasonal changes!

How to Garner Signal from NSA Data?

- One way is to compare **comparable** months or quarters



Seasonal Adjustment Powerfully Alters Data

Retail Sales						
Seasonally Adjusted	Month- over- Month	Seasonal Factor	Not Seasonally Adjusted	Month- over- Month	NSA Year- over-Year	
\$ Millions	%		\$ Millions	%	%	
Dec-11	394.3	1.129	445.2			
Jan-12	397.1	0.7	0.918	364.5	-18.1	
Dec-12	414.6	1.14	472.6		6.2	
Jan-13	415.1	0.1	0.922	382.7	-19.0	
					5.0	

S.A. Data Can Deliver Useful Sequential Comparisons

U.S. Real GDP		
	\$ Billions	Annualized Growth Rate
2007:Q4	\$14,996	
2008:Q1	\$14,895	-2.7%
2008:Q2	\$14,969	2.0%
2008:Q3	\$14,895	-2.0%
2008:Q4	\$14,575	-8.3%

How Does BEA Calculate Quarterly GDP Growth Rates?

- The **annual growth rate** would occur if the **quarterly percent change** was replicated for a **full year**
- Formula

$$[(Q4/Q3)^4 - 1] \times 100$$

- For 2015:Q2

$$[(16,324/16,177)^4 - 1] \times 100 = 3.7\%$$

Other Measures of Income: GNP

- How do we link output and income?
- $\text{GDP} = \text{Gross Domestic Product}$ (Domestic Income)
 - Domestic means ‘on U.S. soil’
- $\text{GNP} = \text{Gross National Product}$
 - National Income: Dollars collected by U.S. Entities
 - ❖ U.S. Citizens
 - ❖ U.S. Corporations

GDP and GNP: Different Organizing Principles

- GDP based on **location**

- Ikea makes furniture in Florida 
 - Coca Cola makes soda in Brazil 

- GNP based on **ownership**

- Mercedes makes profits in US 
 - Apple makes profits in Germany 

- From GDP to GNP:

$$GNP = GDP + \text{Factor Payments from ROW} - \text{FP to ROW}$$

Other Measures of Income: NNP & NI

- **Gross** investment fails to account for the effect of wear and tear on the capital stock
 - Formally, it **ignores 'depreciation'**
 - Depreciation of capital: Cost of producing the economy's output
- **Net** National Product accounts for depreciation
$$\text{NNP} = \text{GNP} - \text{Depreciation}$$
- A better measure of income
$$\text{National Income} = \text{NNP} - \text{Statistical Discrepancy}$$

Alternative Aggregate Measures: Final Sales

- GDP includes **inventory changes**
- Economists like to know '**how much was sold?**'

Final Sales = GDP - Inventory Investment

Final Sales

- In 2010, the jump for GDP growth was not matched by sales strength

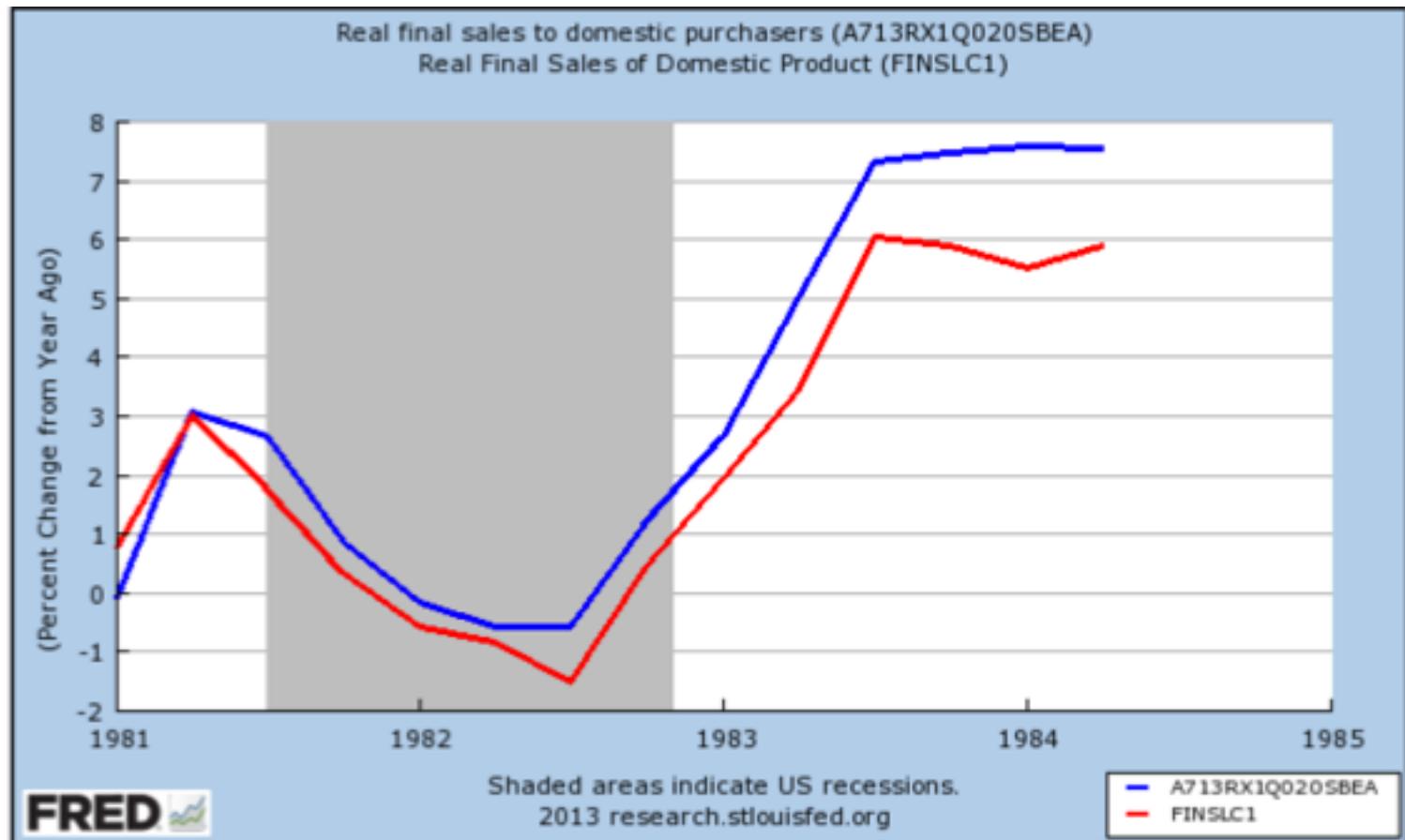


Alternative Aggregate Measures: FSDP

- Final Sales exclude inventory changes
- But what happens if a surge in spending is on imports?
- Economists like to know '**how much U.S consumers bought?**'
- **Final Sales to Domestic Purchasers** = GDP – (Inventories and NX)

Final Sales to Domestic Purchasers

- A big tax cut = Stronger consumer spending
- A sharp rise for interest rates = Stronger dollar
- Strong spending + Strong dollar = Surging imports



Does GDP Measure What We Want It to Measure?

- **Shortcomings** in GDP as a **Measure of Total Production**

- Household Production

- ❖ G&S people produce for themselves
 - ❖ Does not include pie made by grandma

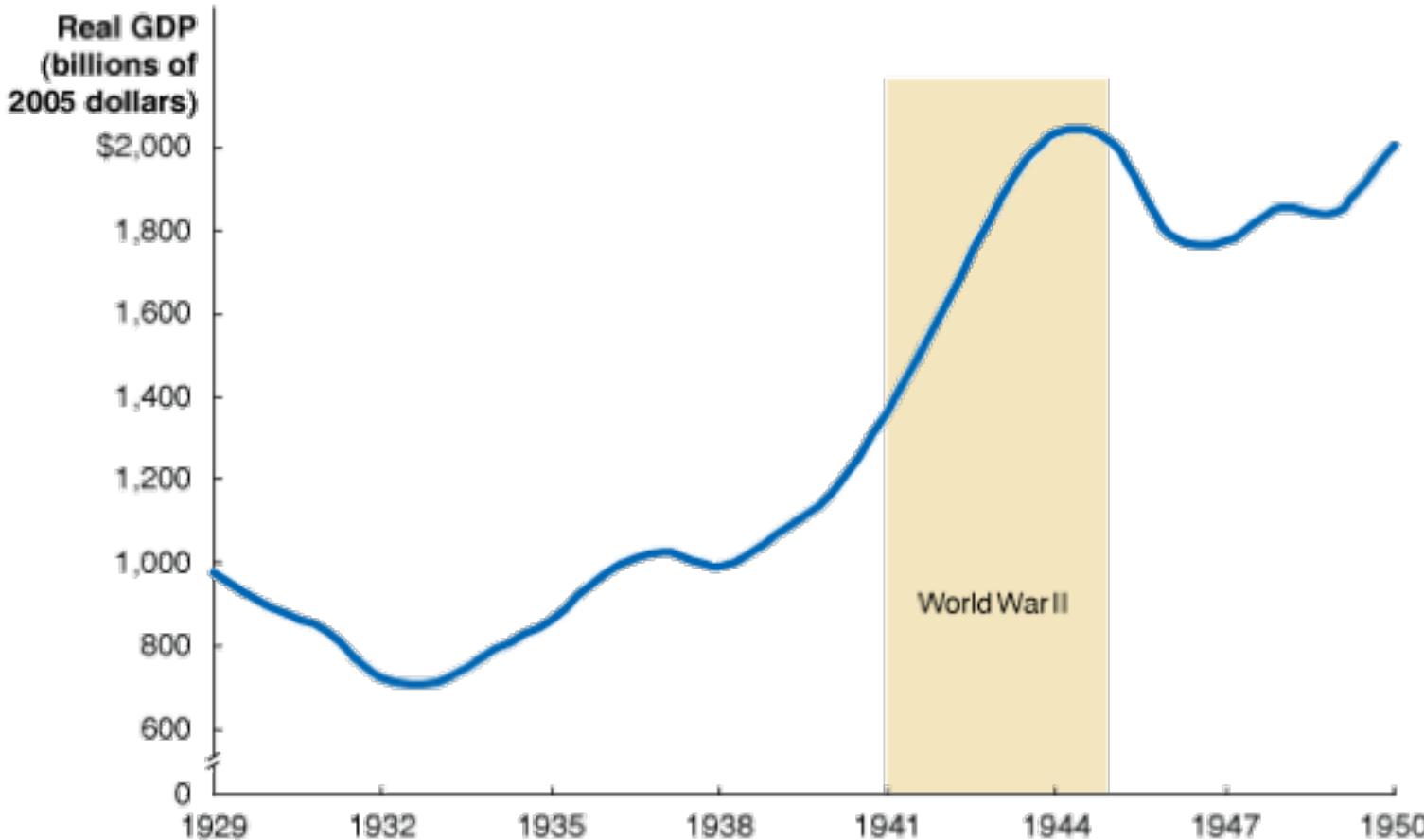
- The Underground Economy

- ❖ Buying and selling of G&S concealed from government
 - ❖ Avoid taxes or regulations
 - ❖ G&S are illegal

Does GDP Measure What We Want It to Measure?

- **Shortcomings** of GDP as a **Measure of Well-Being**
 - The value of **leisure is not included** in GDP
 - GDP is **not adjusted for pollution** or other negative effects of production
 - GDP is **not adjusted for changes in crime** and other social problems
 - GDP measures the size of the pie but **not how the pie is divided up**

Did World War II Bring Prosperity?



Components of Expenditure

- Not only interested about the economy's total output of G & S but also about the **allocation of output** among alternative uses
- GDP (Y) is divided into 4 broad **categories** of spending:
 - Consumption (C)
 - Investment (I)
 - Government purchases (G)
 - Net exports (NX)
- **GDP identity:**
$$Y = C + I + G + NX$$

Consumption (C)

- Personal Consumption Expenditures, or “Consumption”
 - Spending by *households* on G&S, not including spending on new houses
- Divided in following subcategories:
 - Goods
 - ❖ **Nondurable** goods like food and clothing
 - ❖ **Durable** goods like cars and TVs
 - **Services** like haircuts, banking and doctor visits

Investment (I)

- Gross *Private* Domestic Investment, or “Investment”
 - Spending by *private* sector on G&S that add to the nation’s *capital stock*
 - Examples: new factories, office buildings, machinery, and additions to inventories, and spending by HH and firms on *new* houses
- Investment does **not** include:
 - Does not include **financial investments** – Buying a stock or bond does not produce a flow of new product
 - Does not include purchases or sales of **existing or used houses**

Government Purchases (G)

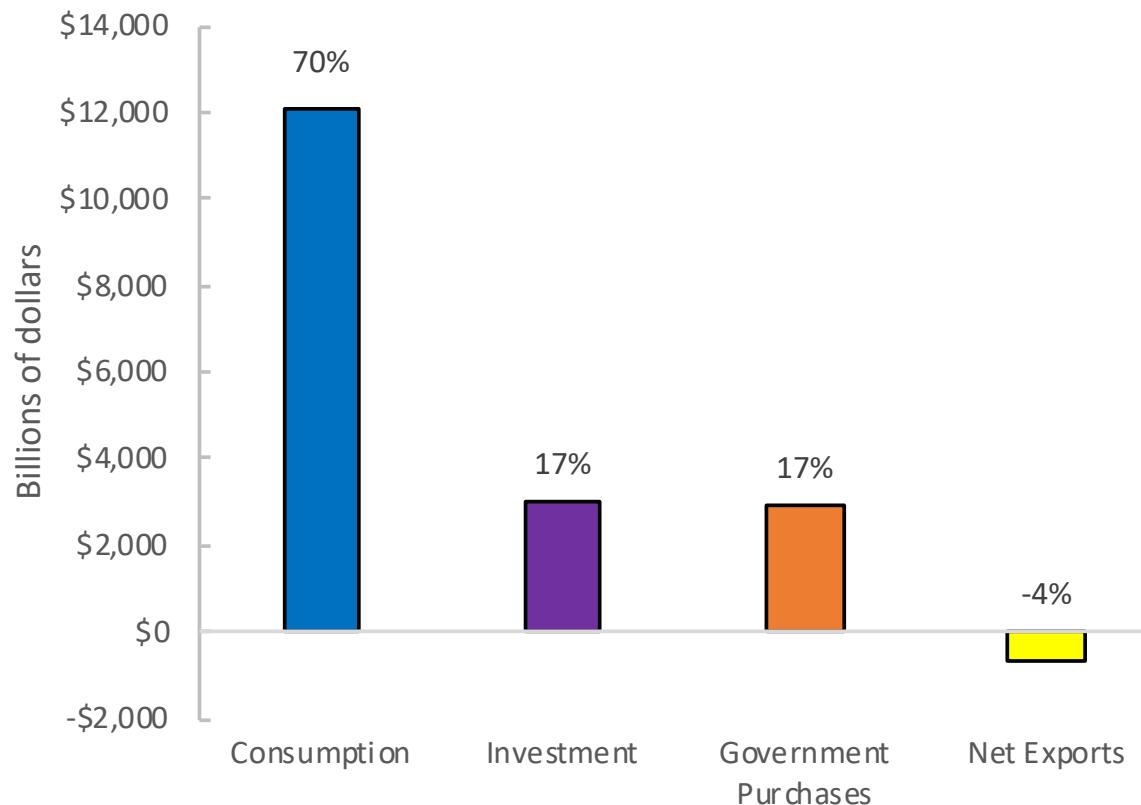
- Government Consumption and Gross Investment, or “Government Purchases”
 - Spending by federal, state, and local governments on G&S
 - **Examples:** military equipment, highways, service by government workers
- It does **not** include **transfer payments**
 - Federal money sent to retirees, for social security, does not count
 - Federal money sent to Medicare recipients does not count
- Why transfer payments are not included?

Net Exports (NX)

- Net Exports of Goods and Services, or “Net Exports” account for trade with other countries
 - **Net** expenditure from abroad on our G&S
 - **Exports** (EX): Value of G&S sold to other countries
 - **Imports** (IM): Value of G&S that foreigners sell us
 - **NX = EX - IM**
- What does it mean $NX > 0$ and $NX < 0$?
 - Trade surplus
 - Trade deficit

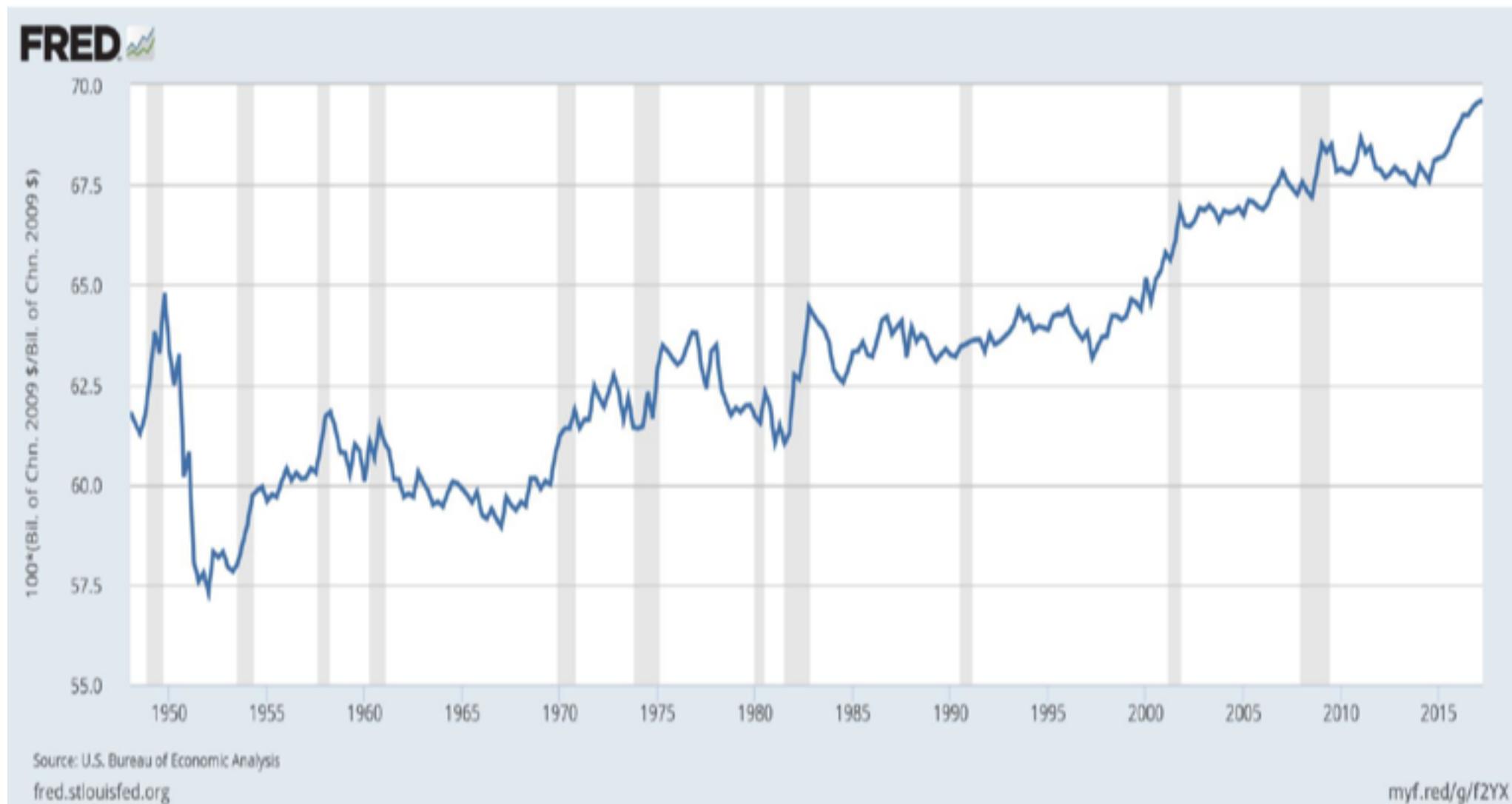
Components of GDP in 2017

COMPONENTS OF GDP (Billions of Dollars)	
Consumption	\$12,035
Durable goods	1,769
Nondurable goods	2,612
Services	7,730
Investment	3,011
Fixed investment	2,974
Residential	605
Change in private inventories	16
Government Purchases	2,922
Federal	1,126
State and local	1,794
Net Exports	-654
Exports	2,230
Imports	2,884
GDP	\$17,287

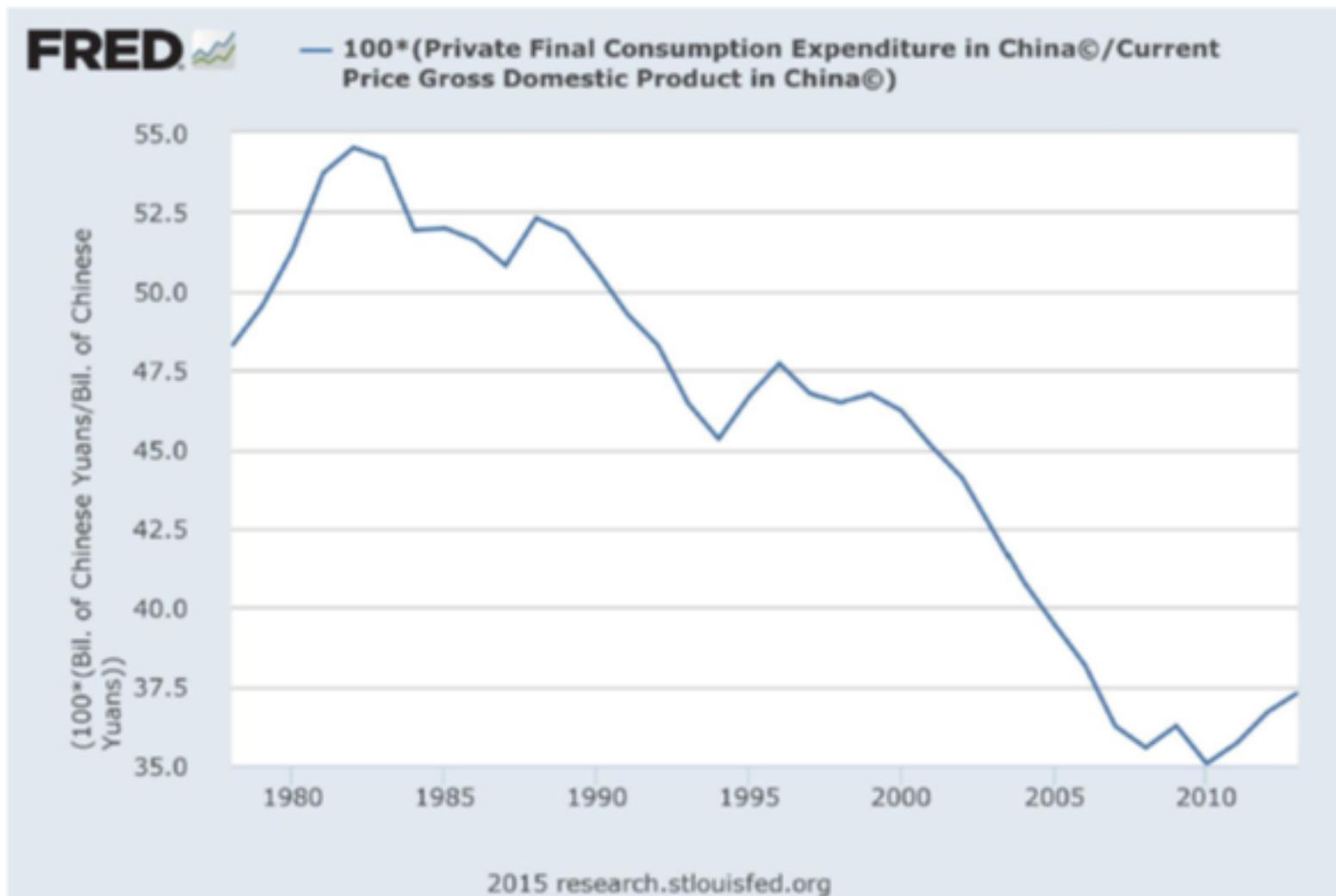


Source: Bureau of Economic Analysis (BEA)

Consumption as Share of US Real GDP



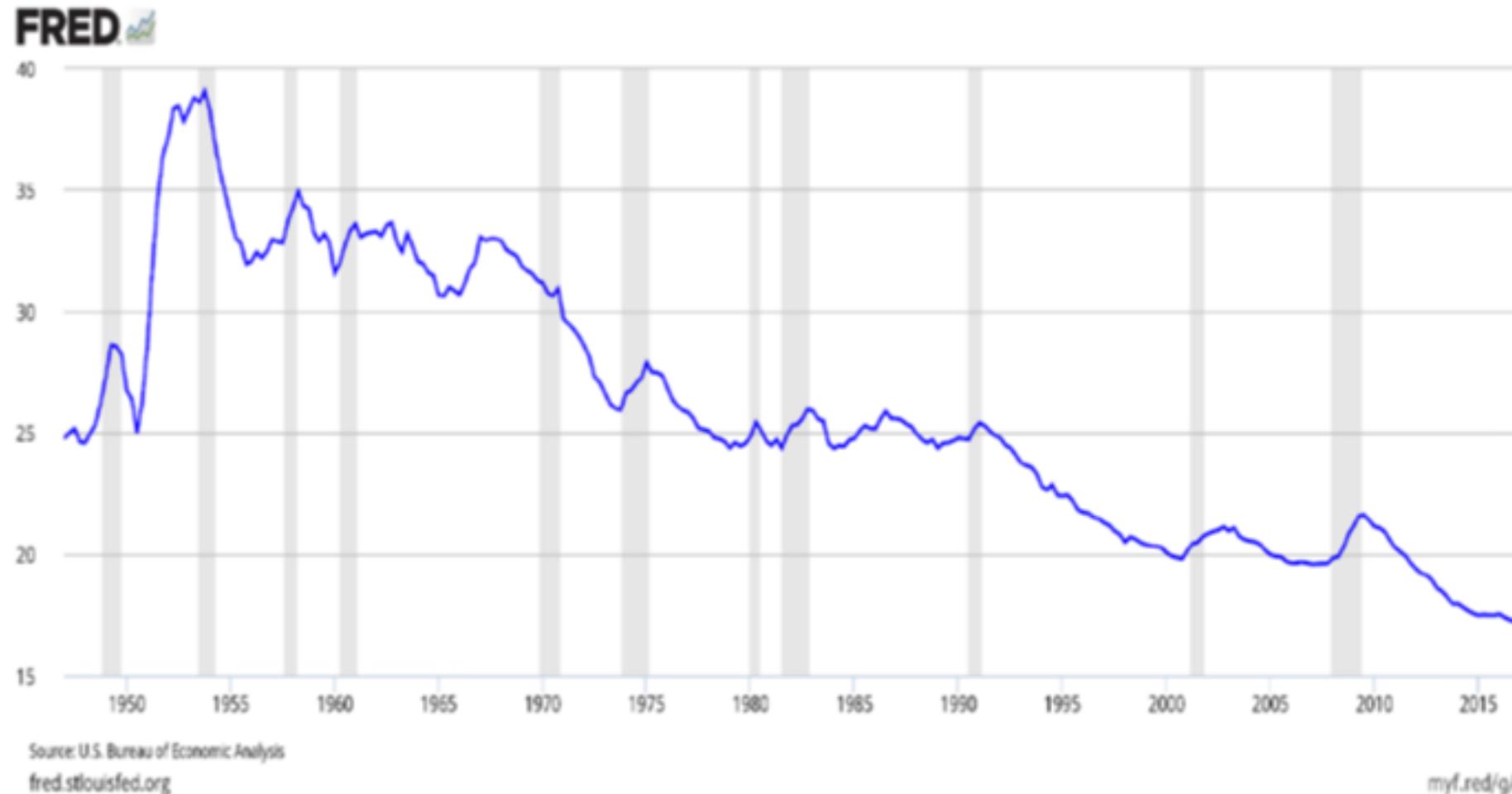
Consumption as Share of China Nominal GDP



Real Gross Private Investment as Share of US Real GDP



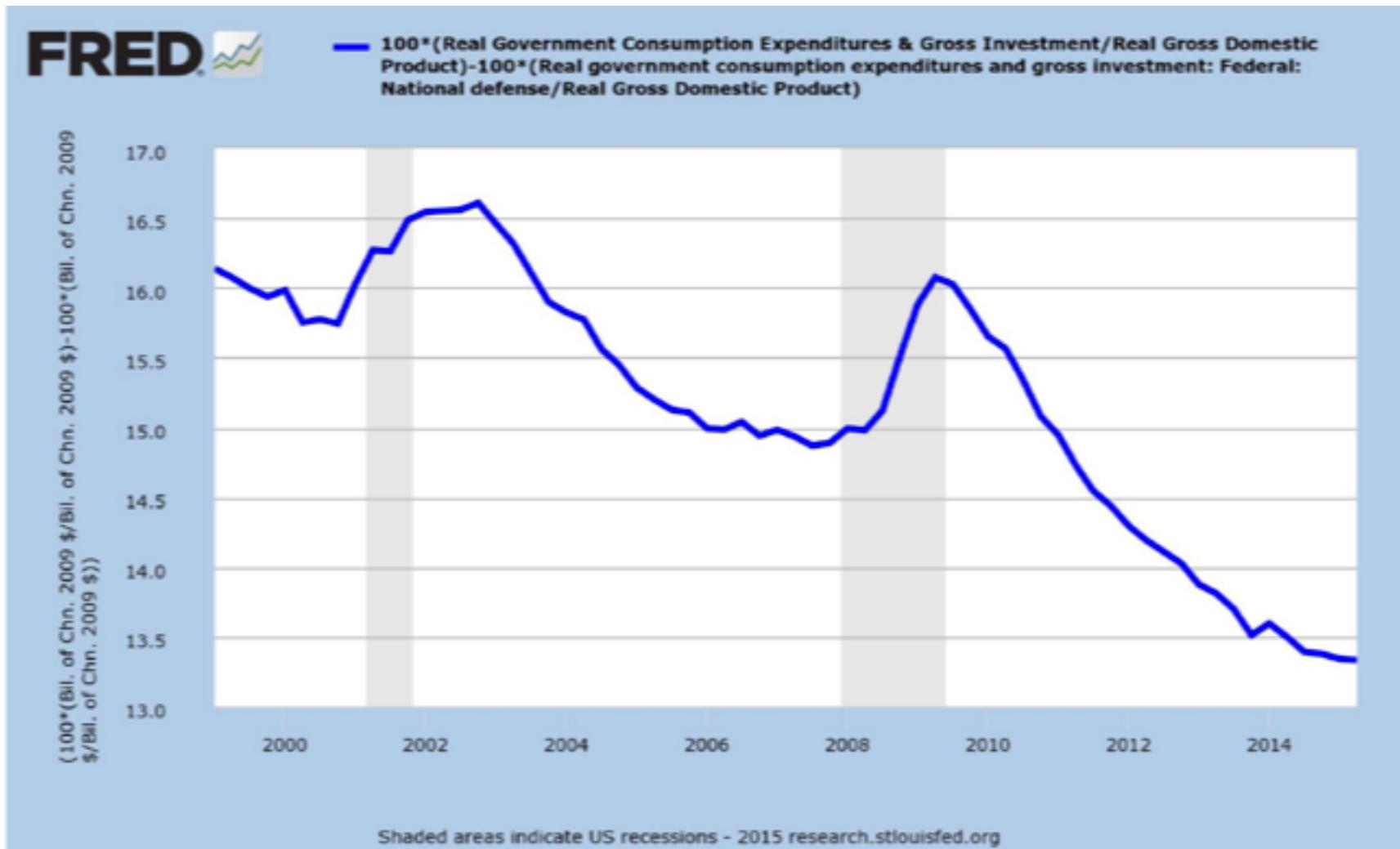
Real Government Expenditures as Share of US Real GDP



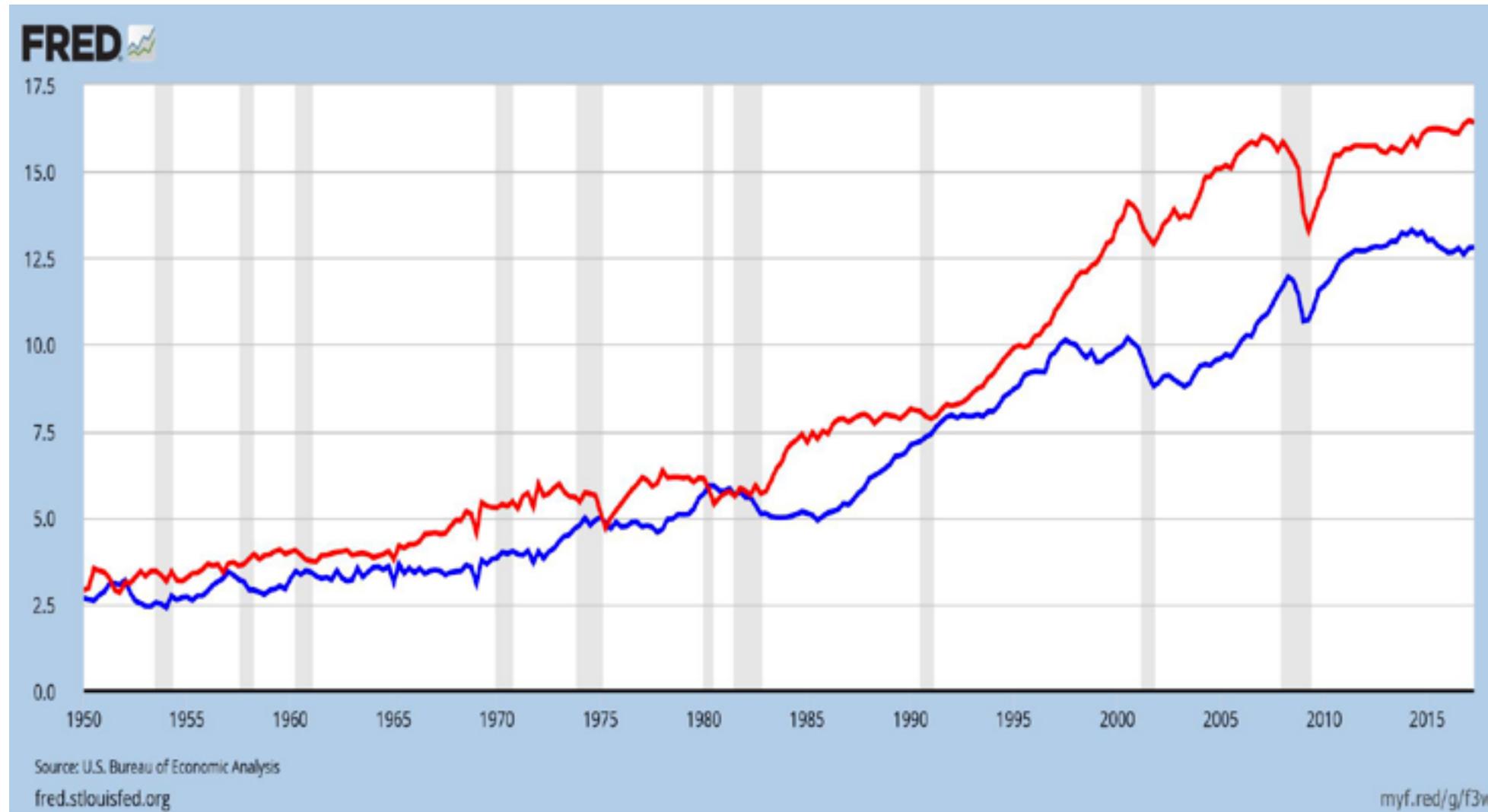
US Defense Spending as Share of US Real GDP



US Non-Defense Spending as Share of US Real GDP



Exports and Imports as Share of US Real GDP



Inflation

Outline

1. (Changes in) Price Level
 2. Core Inflation
 3. Nominal vs Real Distinction
- Textbook Readings: Ch. 9

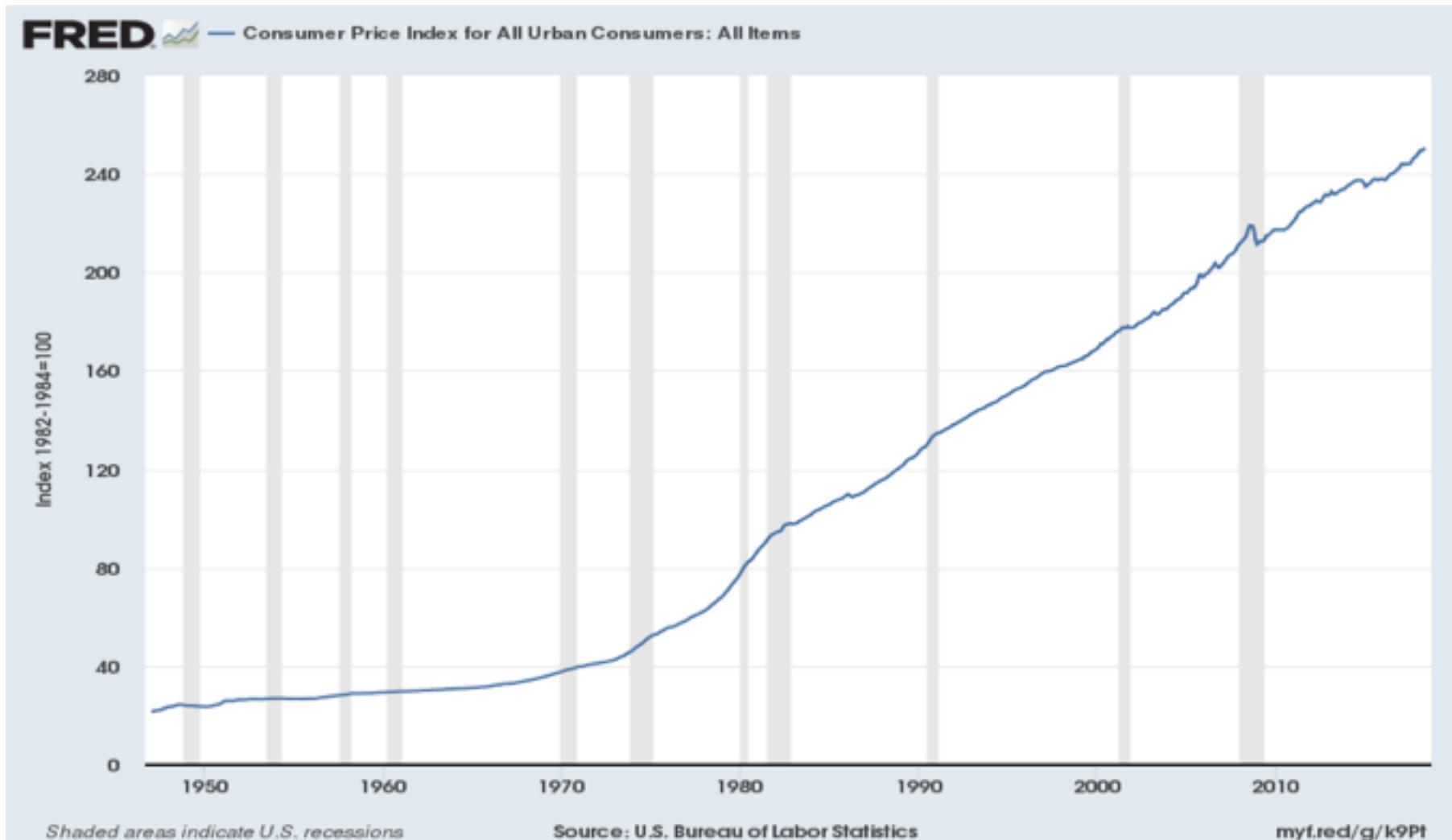
Measuring the Cost of Living

- One dollar today does not buy as much as it did 18 years ago
- The cost of almost everything has gone up
- How economists measure changes in the cost of living?

Measuring Inflation

- **Price level:** Measure of the average prices of G&S in the economy
 - Consumer Price Index (**CPI**): Average prices faced by **typical consumer**
 - Producer Price Index (**PPI**): Average prices faced by **producers**
 - Personal Consumption Expenditure (**PCE**) Deflator: From **C** in GDP
 - GDP Deflator: From **nominal and real GDP**
- **Inflation rate:** **Percentage increase** in the price level from one period to the next
 - Speed with which the economy's overall price level is rising

Price Level



Inflation: Changes in the Price Level



Changes in the Price Level

- **Inflation:** A percentage **increase** in the price level
 - If the price index *rises* in 2020, by 4%, **inflation** was 4%

- **Deflation:** A **decrease** in the price level
 - If the price index *falls* in 2020, by 2%, **deflation** was 2%



- **Disinflation:** If *inflation slows*, from one year to the next
 - If inflation was 4% in 2020 and 1% in 2021

- An **explosive** rise for the price index? **Hyperinflation**
 - Germany 1920s, Zimbabwe 2008, Venezuela Ongoing



Germany 1918-1923

- From 1 to 1 trillion paper Marks for 1 gold Mark



The Three Uses for the Price index

1. We use a price index to **separate** price changes from output shifts
 2. We use a price index to guard against **accelerating inflation pressures**
 3. We use a price index to guard against **deflationary pressures**
- We attempt to keep the overall price level rising at a **slow but steady rate**

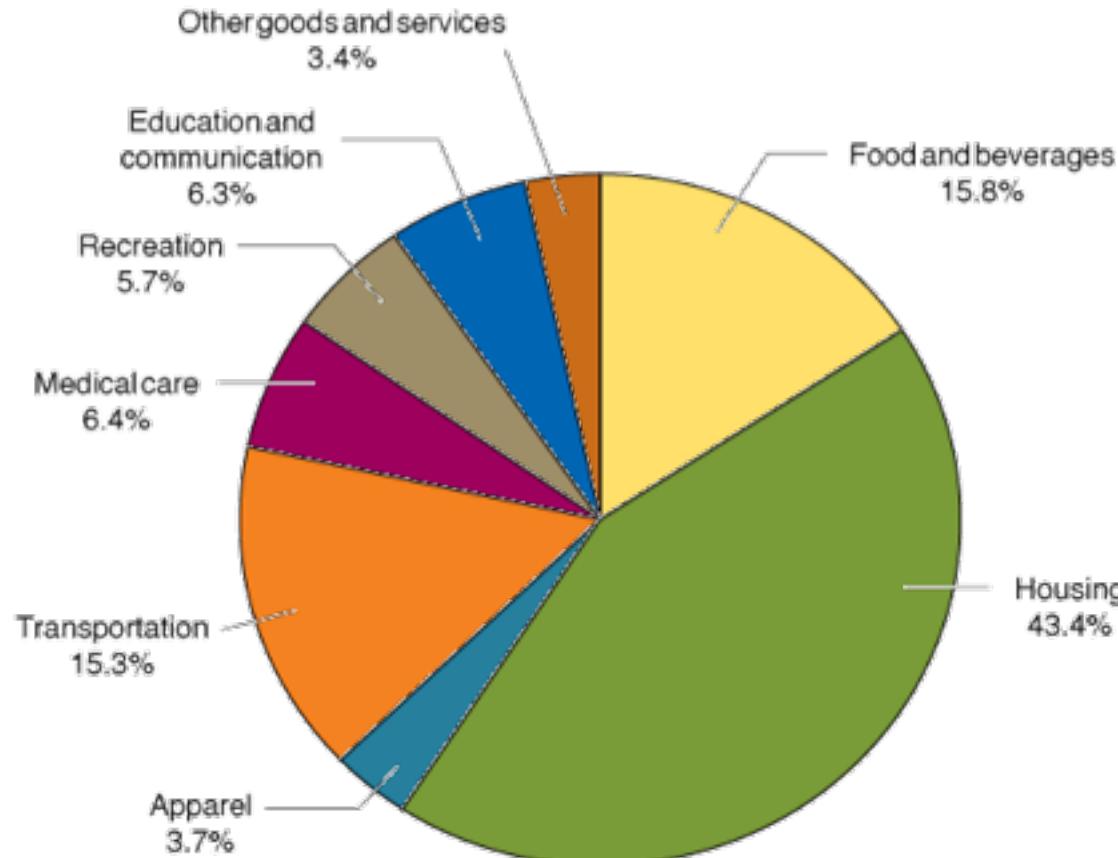
The Consumer Price Index (CPI)

- To calculate the CPI in a given year we need:
 - A **basket** of goods and services
 - The cost to purchase the basket of goods and services in a **base year**
 - The prices in the **current year**
- The CPI in the current year is the cost to purchase the basket of goods this year, divided by the cost in the base year
 - By convention we adjust the index level so that CPI in base year is 100
- **Important:** We assume that quantities bought are **fixed**
 - Spending increases **only** reflect price changes

The Consumer Price Index (CPI)

The CPI Market Basket, 2008

The Bureau of Labor Statistics surveys 30,000 households on their spending habits. The results are used to construct a *market basket* of goods and services purchased by the typical urban family of four.



CPI: An Example

PRODUCT	BASE YEAR (1999)				2016		2017	
	QUANTITY	PRICE	EXPENDITURES	PRICE	EXPENDITURES (ON BASE-YEAR QUANTITIES)	PRICE	EXPENDITURES (ON BASE-YEAR QUANTITIES)	
Eye examinations	1	\$50.00	\$50.00	\$100.00	\$100.00	\$85.00	\$85.00	
Pizzas	20	10.00	200.00	15.00	300.00	14.00	280.00	
Books	20	25.00	500.00	25.00	500.00	27.50	550.00	
TOTAL			\$750.00		\$900.00		\$915.00	

FORMULA	APPLIED TO 2016	APPLIED TO 2017
$\text{CPI} = \frac{\text{Expenditures in the current year}}{\text{Expenditures in the base year}} \times 100$	$\left(\frac{\$900}{\$750} \right) \times 100 = 120$	$\left(\frac{\$915}{\$750} \right) \times 100 = 122$

CPI-measured inflation rate in 2017 =
$$\left(\frac{122 - 120}{120} \right) \times 100 = 1.7\%$$

Using Price Indexes to Adjust for the Effects of Inflation

- How do we compare the purchasing power of a variable, say income, across different years?

$$\text{Value in 2014 dollars} = \text{Value in 1984 dollars} \times \left(\frac{\text{CPI in 2014}}{\text{CPI in 1984}} \right)$$

Is the CPI Accurate?

- There are 4 **biases** that cause changes in the CPI to **overstate** the true inflation rate
 - Substitution bias
 - Increase in quality bias
 - New product bias
 - Outlet bias

Headline vs Core Inflation

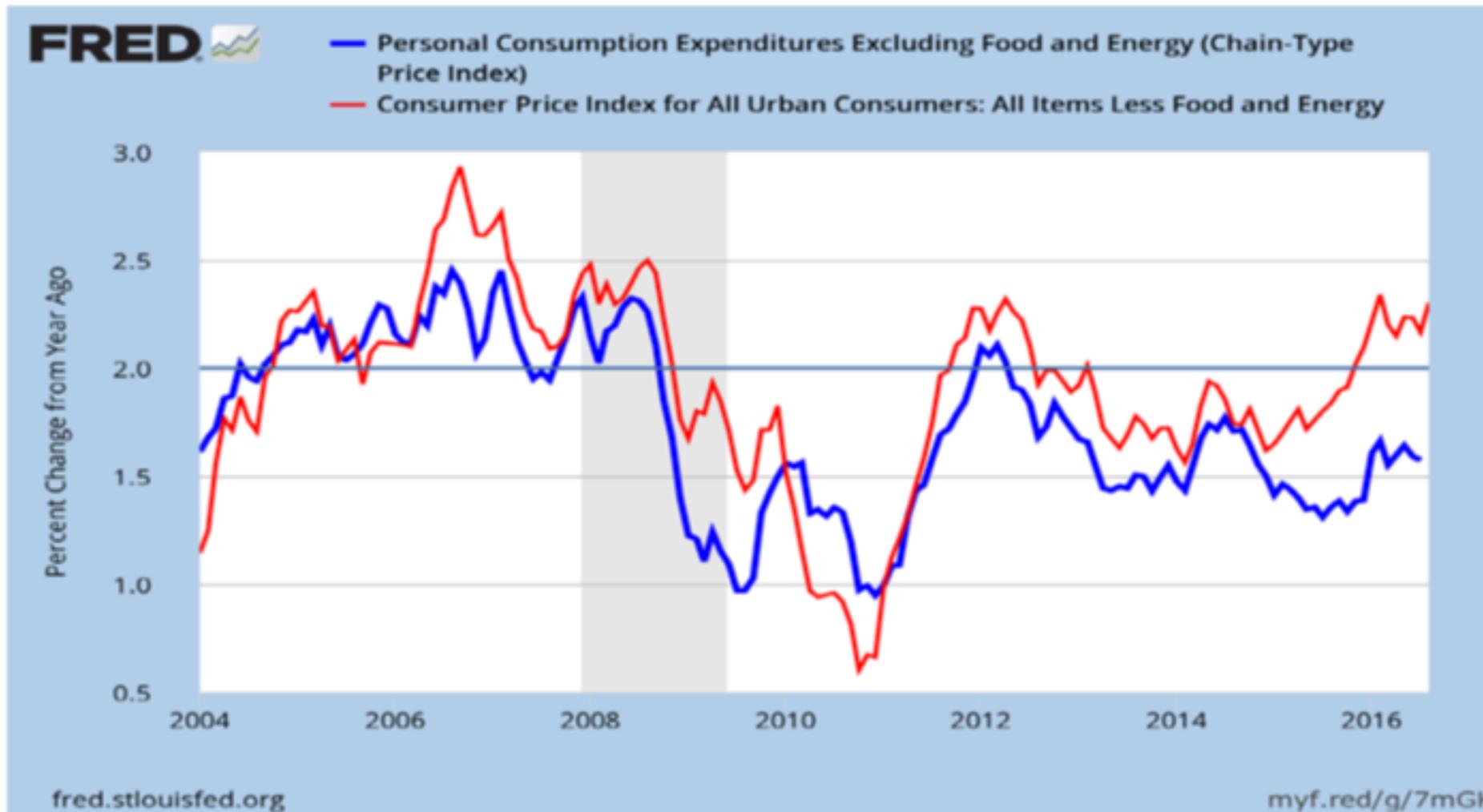
- Sub-indices for CPI and PCE are available
- **Core inflation** excludes food and energy products
- Why exclude food and energy prices?
 - In many instances, **very volatile**
 - Subject to **sector-specific pressures**
 - **Independent** of the pulse of the global economy
- Does that mean we can ignore food and energy swings?

Weights Used in the August 2017 CPI Report

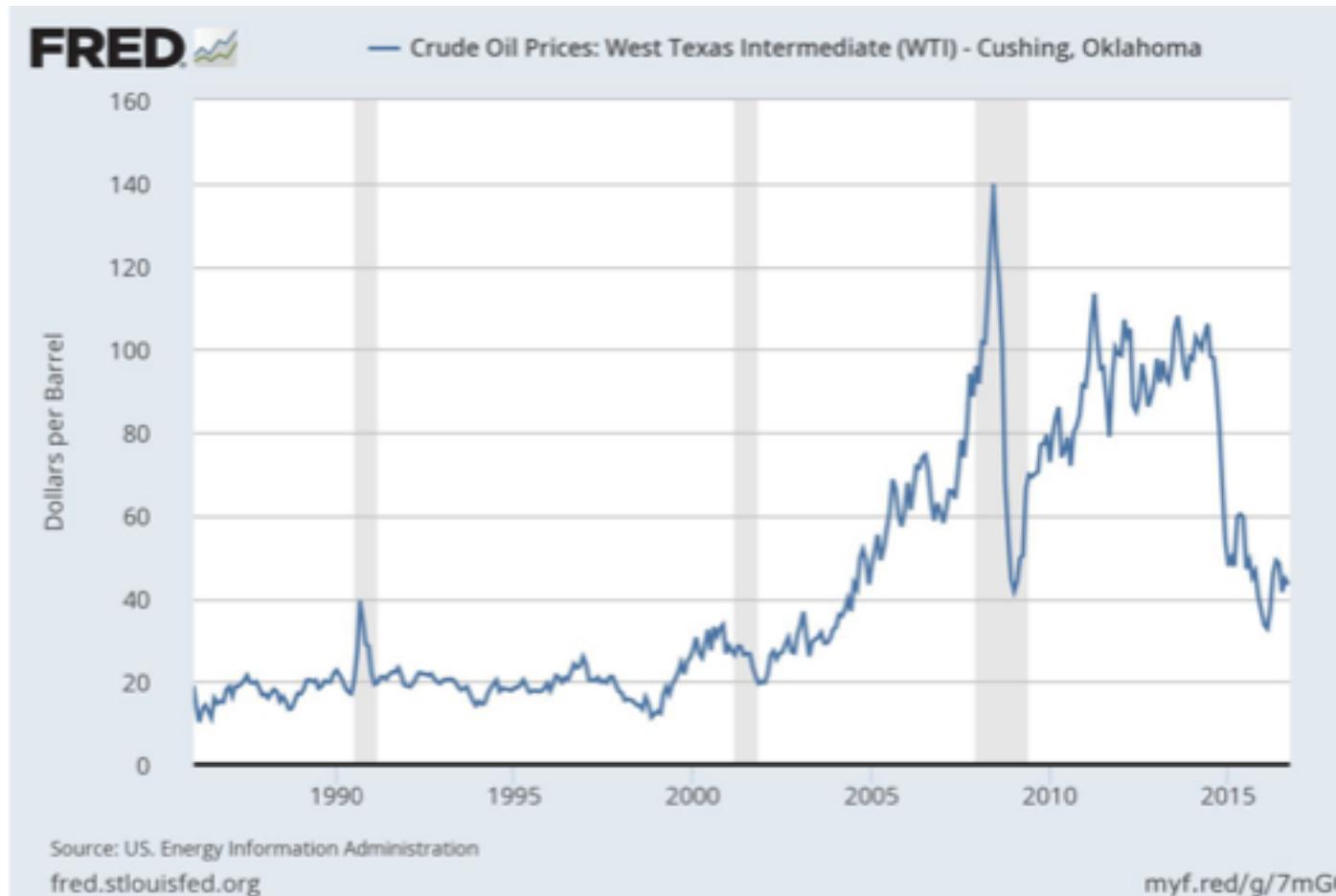
- Items organized into sub-categories

Food	14%
Energy	7%
Core (exc. Food and Energy)	79%
Goods exc. Food and Energy	19%
Core Services	36%
Owner's Equivalent Rent	24%
All Items	100%

Core CPI vs Core PCE Deflator

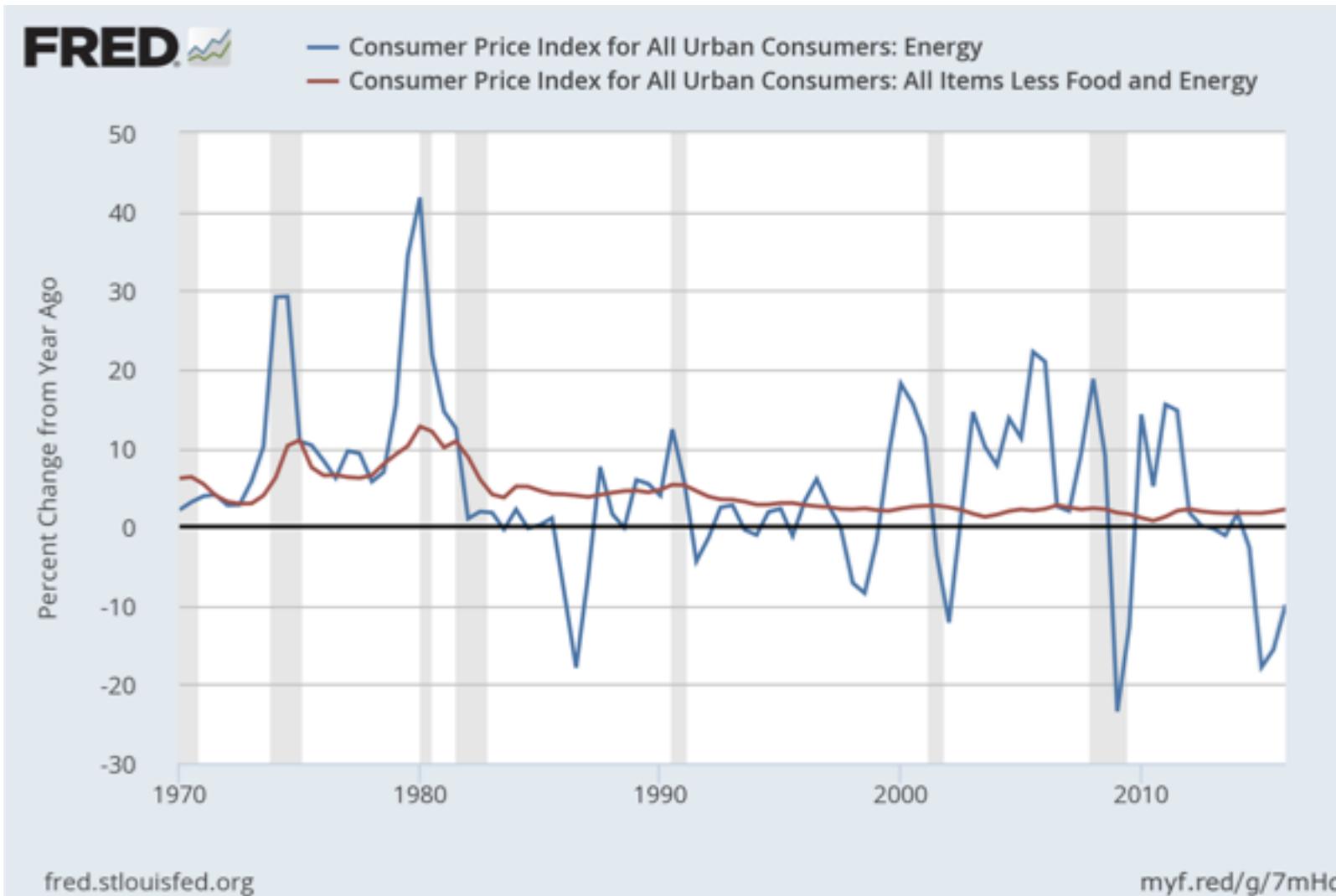


Oil Prices Drive CPI Energy



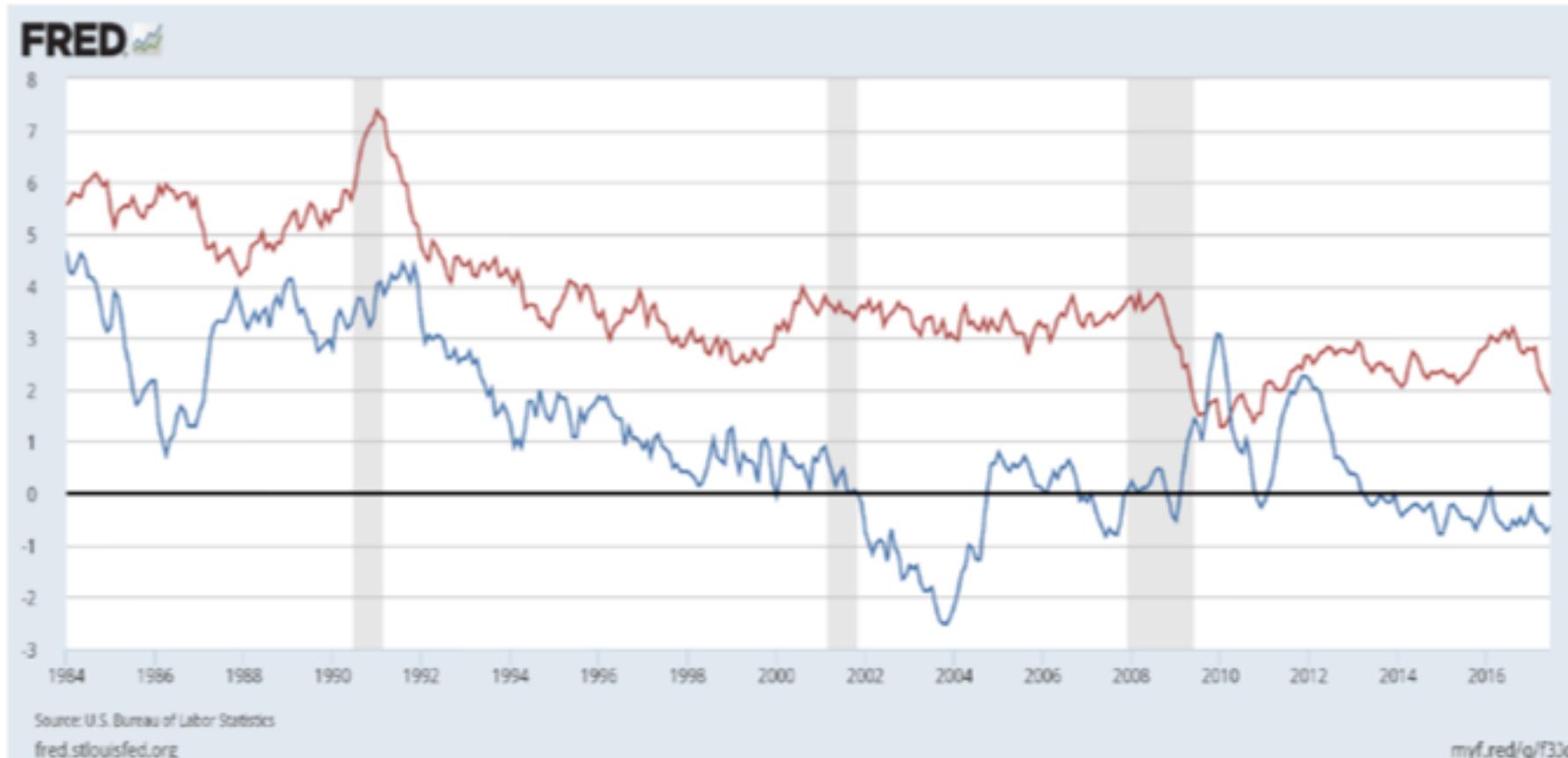
- Extremely volatile

Contrast CPI Energy (YoY) with Core CPI (YoY)



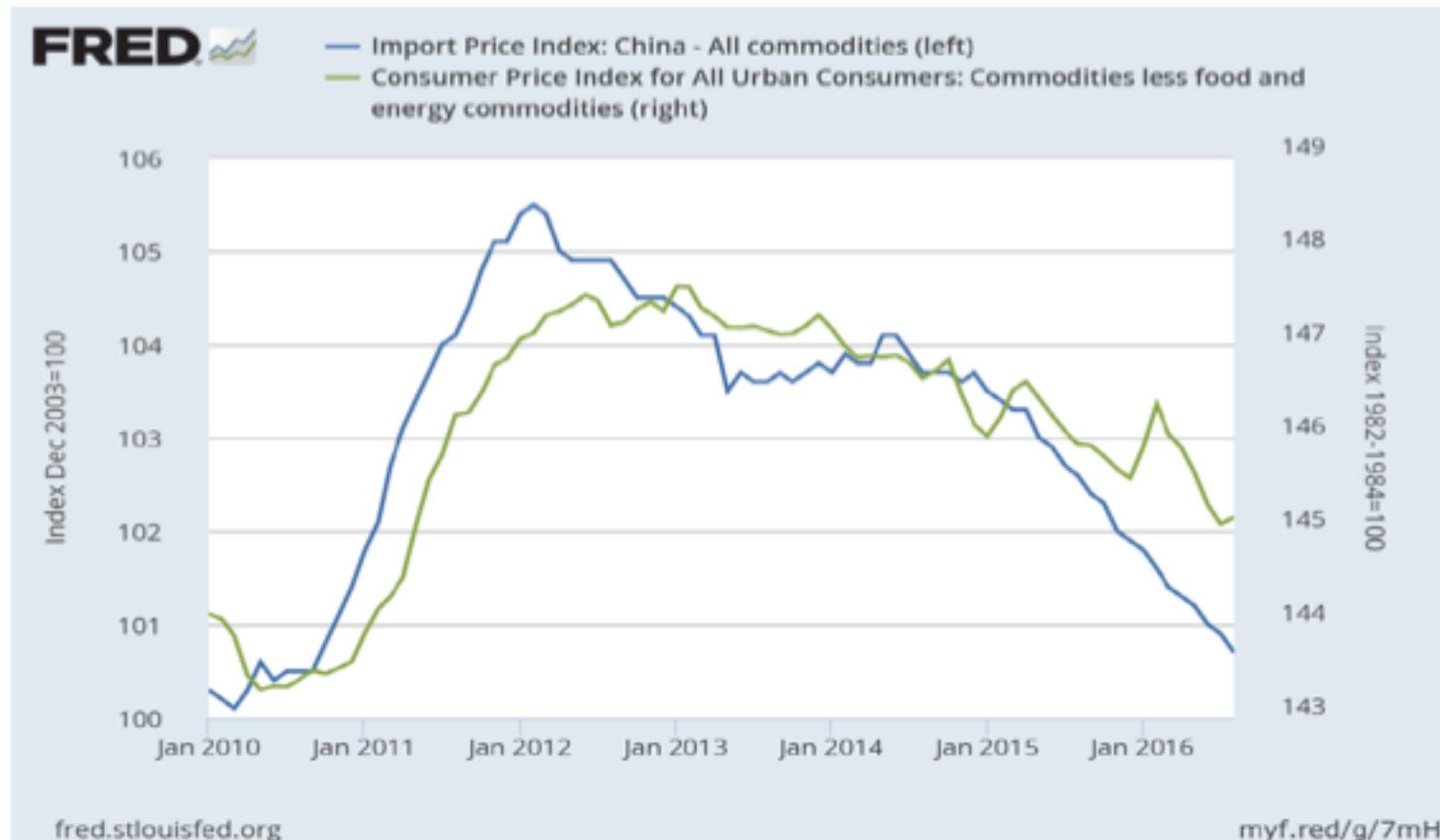
Core Goods vs Core Services

- Core Goods (19% of CPI) affected by China, while Core Services (36% of CPI) by US dynamics



Core Inflation and Imported Goods

- Price of imported products from China are a growing influence on U.S. core goods prices



The Three “Prices” of Money

1. Price relative to **time**
 - Interest Rate
 2. Price relative to **foreign currency**
 - Exchange rate
 3. Price relative to **all G&S**
 - Aggregate price level
-
- Recall: Price index helps to separate price from output changes

Nominal vs Real GDP

$$\text{Nominal GDP} = \text{Real GDP} \times \text{Aggregate Price Level}$$

- Nominal GDP rises by 4.25%
- Inflation of 2.05%
- Roughly speaking, real GDP rose by 2.2%

Nominal vs Real Interest Rates

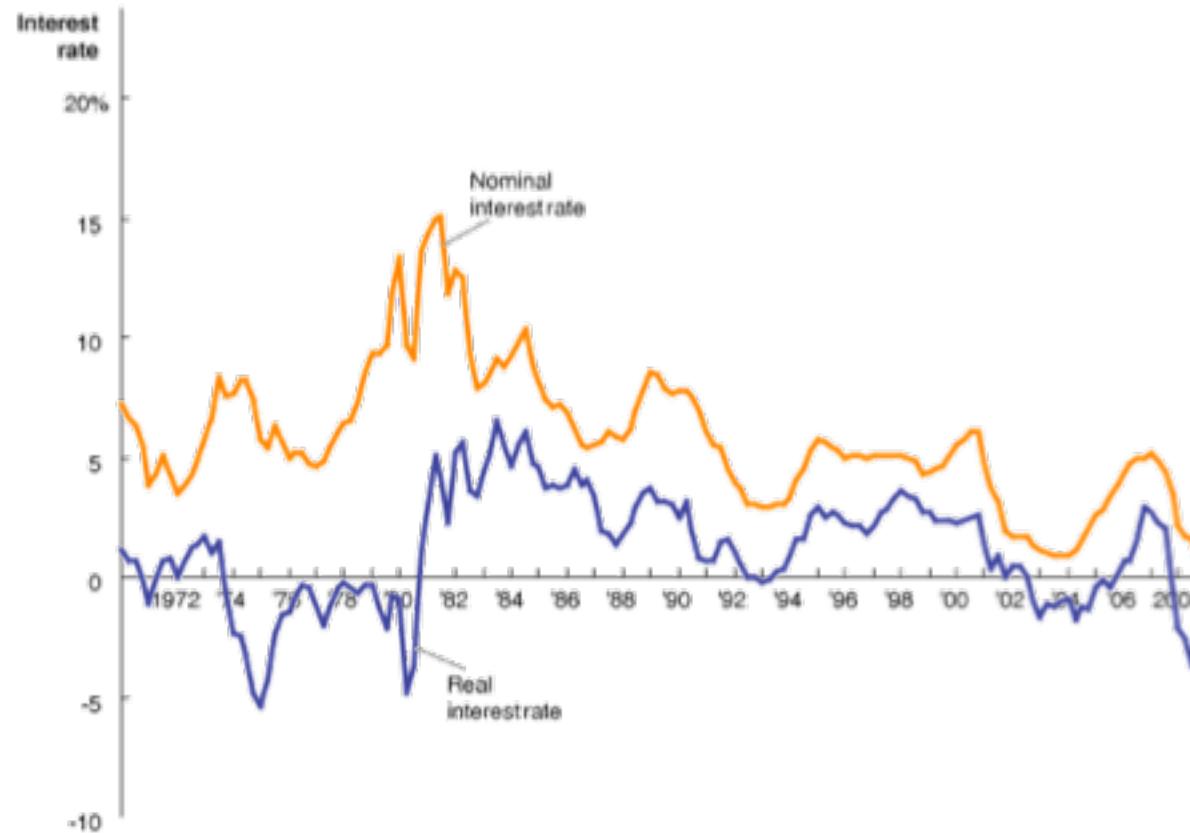
- **Nominal** interest rate: The stated interest rate on a loan
- **Real** interest rate: The nominal interest rate adjusted for inflation

Real Interest Rate = Nominal Interest Rate – Inflation Rate

- Think of it as: How much purchasing power goes up

Nominal vs Real Interest Rates

Nominal and Real Interest Rates, 1970–2008



Question

Which interest rate provides a better measure of the true cost of borrowing and the true return to lending?

- a) The nominal interest rate.
- b) The real interest rate.
- c) The interest rate on three-month U.S. Treasury bills.
- d) All of the above.

Question

The stated interest rate on a loan is:

- a) The nominal interest rate.
- b) The real interest rate.
- c) The rate of inflation.
- d) Neither the nominal nor the real rate of interest envisioned by economists.

Nominal vs Real

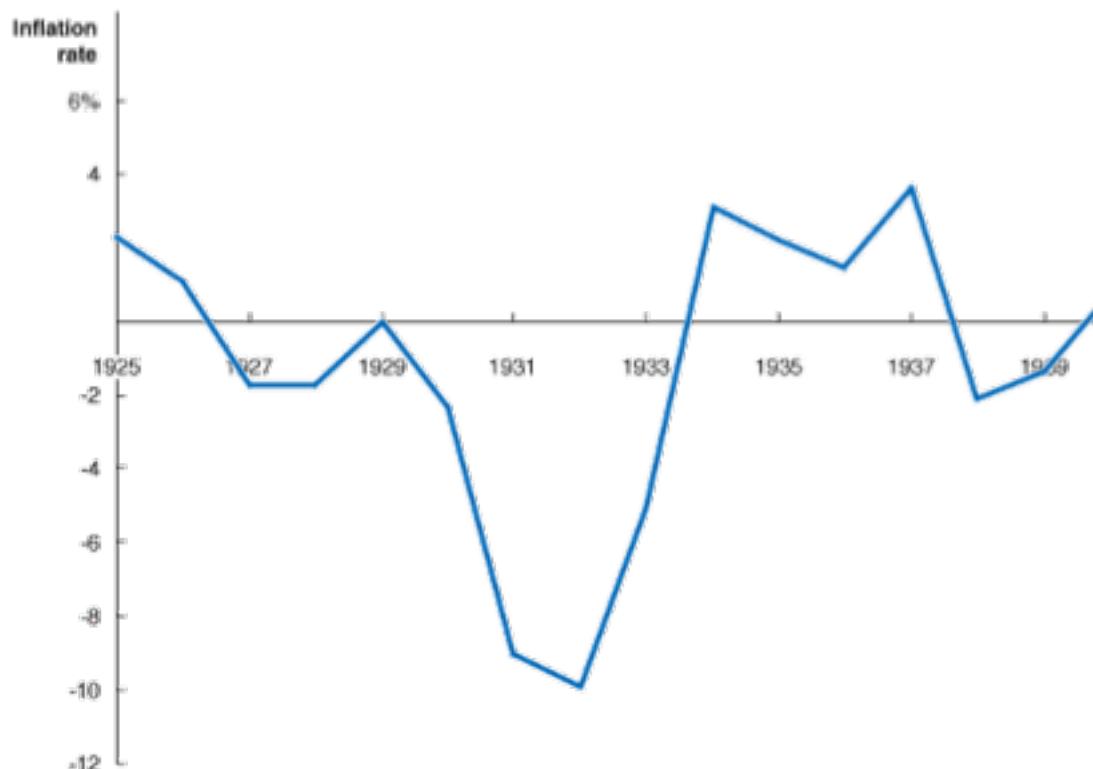
- So far we have made a nominal vs real distinction for **GDP** and **interest rates**
 - The distinction between nominal and real can be applied to **exchange rates** as well
- **Nominal** variables are expressed in **dollars** terms
- **Real** variables are expressed in **quantity** terms (inflation adjusted)

Does Inflation Impose Costs on the Economy?

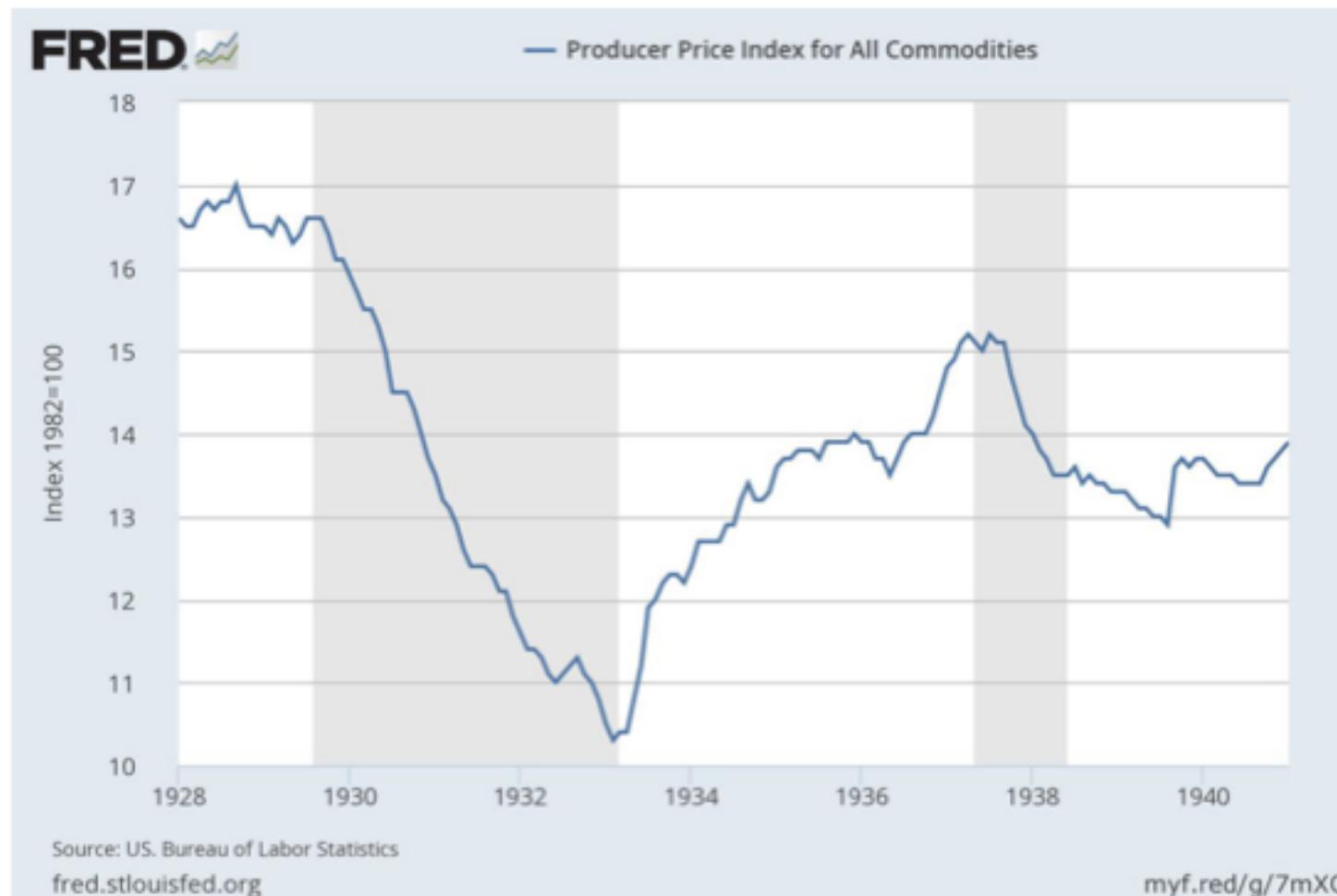
- Inflation affects the **distribution of income**
 - The extent depends in part on whether it is anticipated or unanticipated
- The problem with **anticipated** inflation
 - **Menu costs:** The costs to firms of changing prices
 - **Shoe leather costs:** The cost of time and effort (going to bank)
- The problem with **unanticipated** inflation
 - When the *actual* inflation rate turns out to be very different from the *expected* inflation rate, **some people gain and other people lose**

What's So Bad about Falling Prices?

	1929	1930	1931	1932	1933
Nominal interest rate	5%	5%	5%	5%	5%
Change in the consumer price level	0	-2.3	-9.0	-9.9	-5.1
Real interest rate	5	7.30	14.00	14.90	10.10



Deflation During the Great Depression



- Prices fell by 37%, and bankruptcies soared