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**
  - GDP = $(P_A \times Q_A) + (P_O \times Q_O)$ = ($0.50 x 4) + ($1.00 x 3) = **$**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 inputs
  - 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
  - Nominal $GDP^{2018} = (P_A^{2018} \times Q_A^{2018}) + (P_O^{2018} \times Q_O^{2018})$
- **Real** GDP: Uses **constant** prices (base-year prices)
  - Real $GDP^{2017} = (P_A^{2009} \times Q_A^{2018}) + (P_O^{2009} \times Q_O^{2018})$
  - Real GDP varies **only if** the **quantities** produced **vary**
- **GDP deflator**: ***Price*** of output relative to its price in the base year

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

Calculating Nominal GDP

- Suppose that a very simple economy produces only four goods and services: eye examinations, pizzas, shoes, and cheese. Assume that all the cheese in this economy is used in the production of pizzas. Use the information in the following table to compute GDP for the year 2017.

Production and Price Statistics for 2017		
Product	(1) Quantity	(2) Price per Unit
Eye examinations	100	$50.00
Pizzas	80	10.00
Shoes	20	100.00
Cheese	80	2.00

Calculating Real GDP

- Suppose that a very simple economy produces only the following three final goods and services: eye examinations, pizzas, and shoes. Use the information in the table on the right to compute real GDP for the year 2017. Assume that the base year is 2009.

	2009		2017	
Product	**Quantity**	**Price**	**Quantity**	**Price**
Eye examinations	80	$40	100	$50
Pizzas	90	11	80	10
Shoes	15	90	20	100

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 April of 2019, BEA estimated **2018 GDP** to be **$18.765 trillion**
- Thus in calendar year 2018, the **value of all goods and services produced**, at **constant prices**, equaled $18.765 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**"

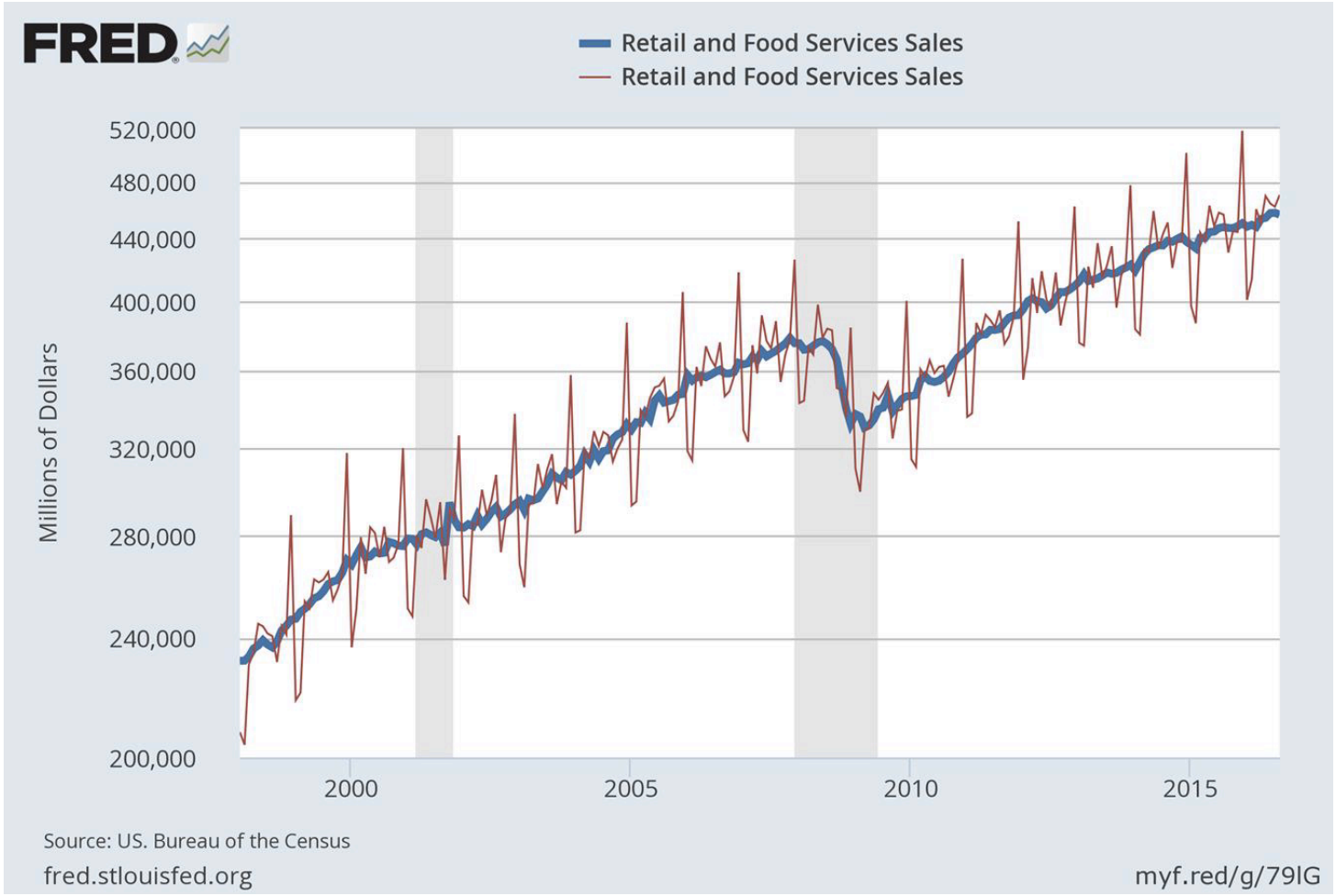
A Three Month Flow Annualized to A Year

2017:Q2 GDP = $17.995 trillion

- In the second quarter of 2017, all final goods and services , in constant dollars, accumulated at a **seasonally adjusted** **annualized** value of $17.995 trillion

- BEA collects 3 months of data and **multiplies it by 4**

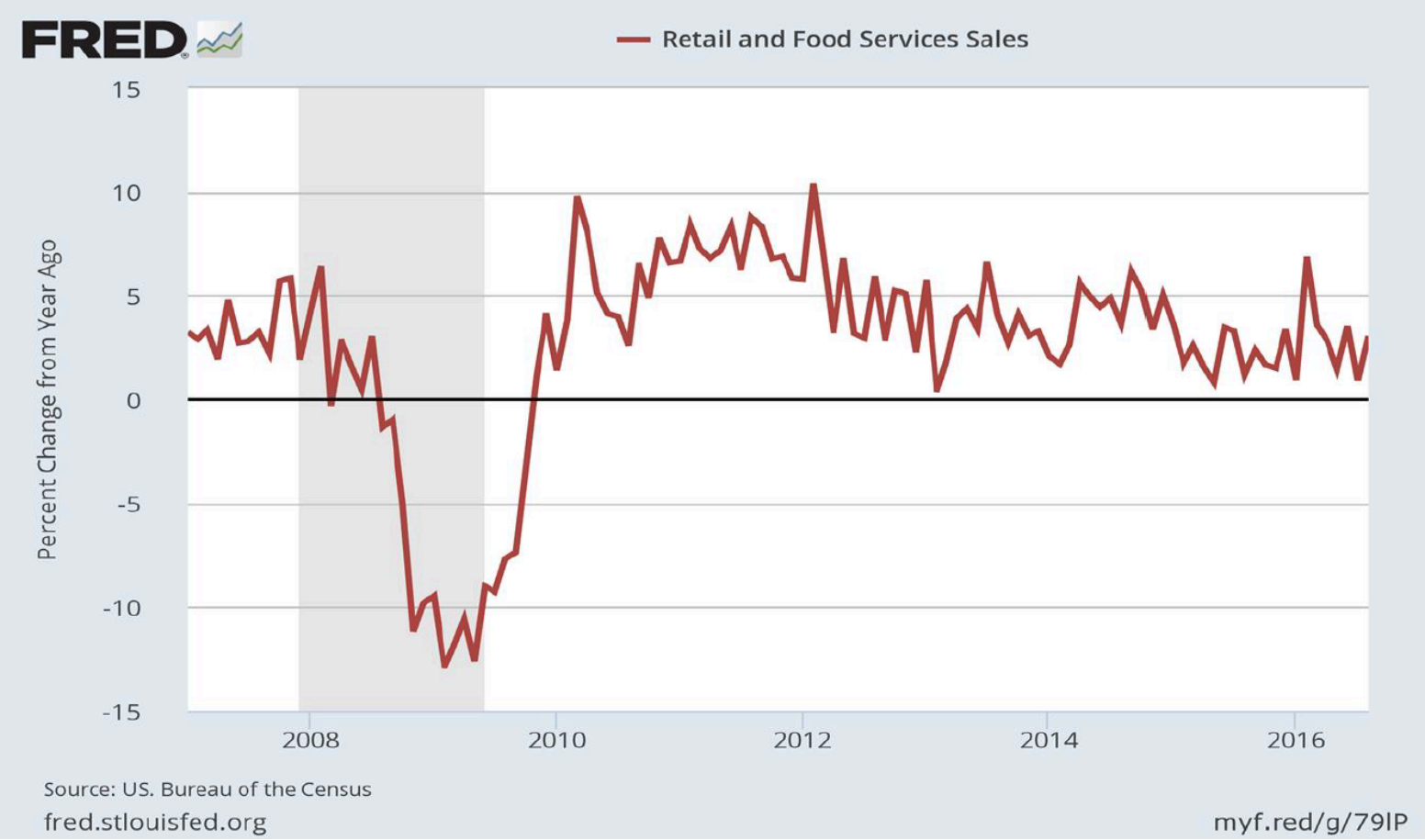
Seasonal Adjustment: Separating Signal from Noise



- 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

$$[(GDP_{Q2}/GDP_{Q1})^4 - 1] \times 100$$

- For 2017:Q2

$$[(17{,}995/17{,}863)^4 - 1] \times 100 = 2.9\%$$

Other Measures of Income: GNP

- How do we link output and income?

- GDP = Gross **Domestic** Product (Domestic Income)
  - Domestic means ‘on U.S. soil’

- GNP = 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

$$NNP = GNP - Depreciation$$

- A better measure of income

$$National\ Income = NNP - Statistical\ Discrepancy$$

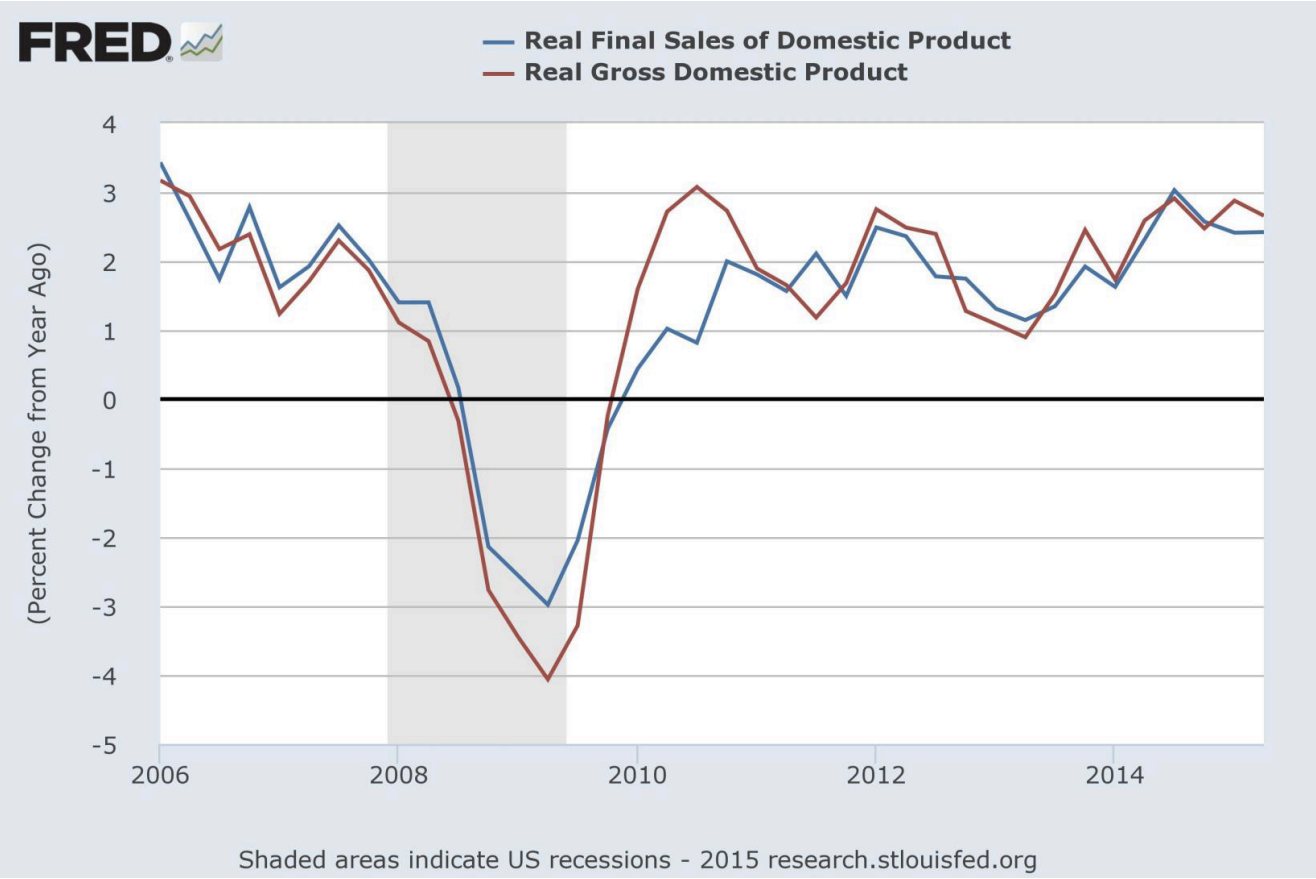
Alternative Aggregate Measures: Final Sales

- 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

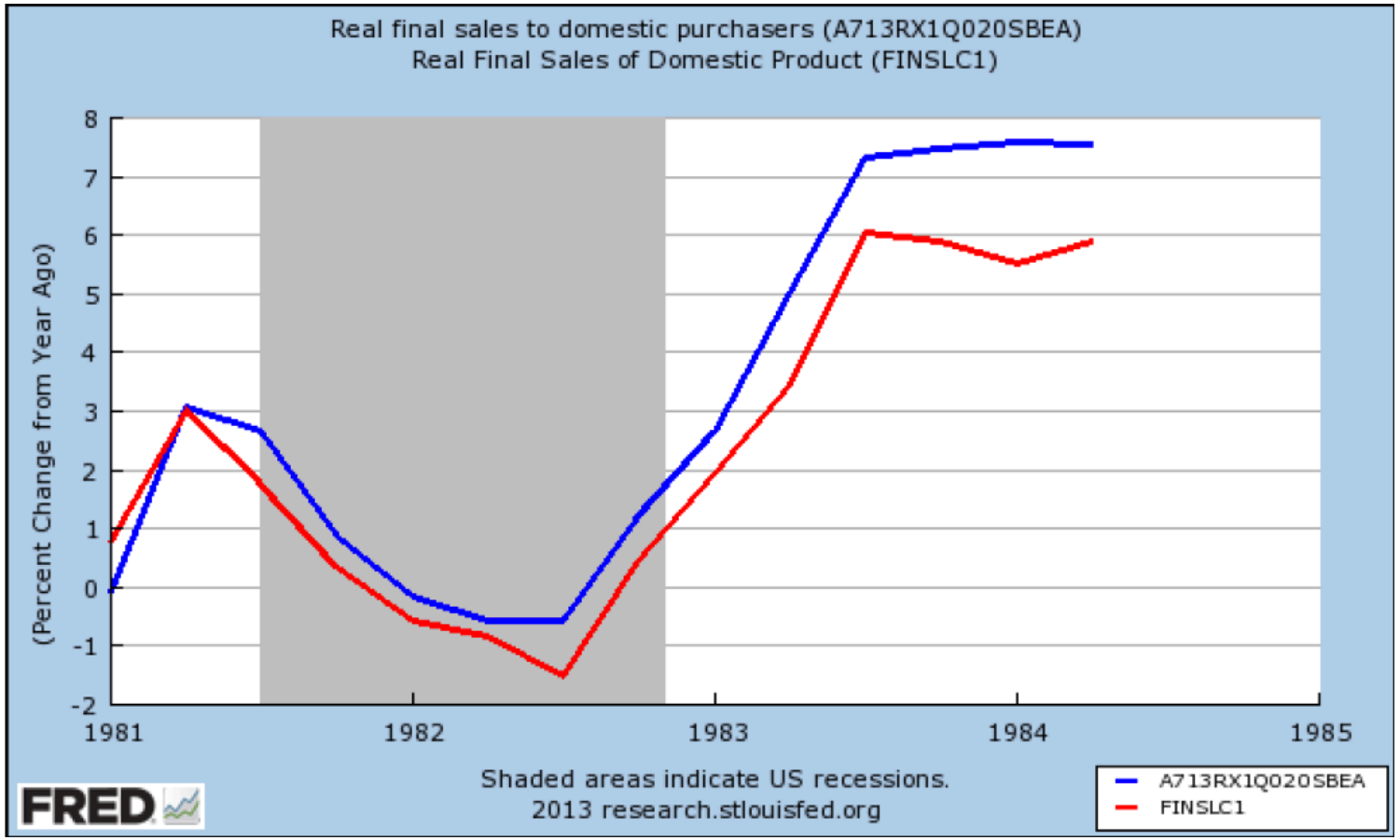


Alternative Aggregate Measures: FSDP

- Final Sales exclude inventory changes
- But what happens if a surge in spending is on imports?
- Economists like to know '**how much** was sold **in the U.S.?**'
- **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



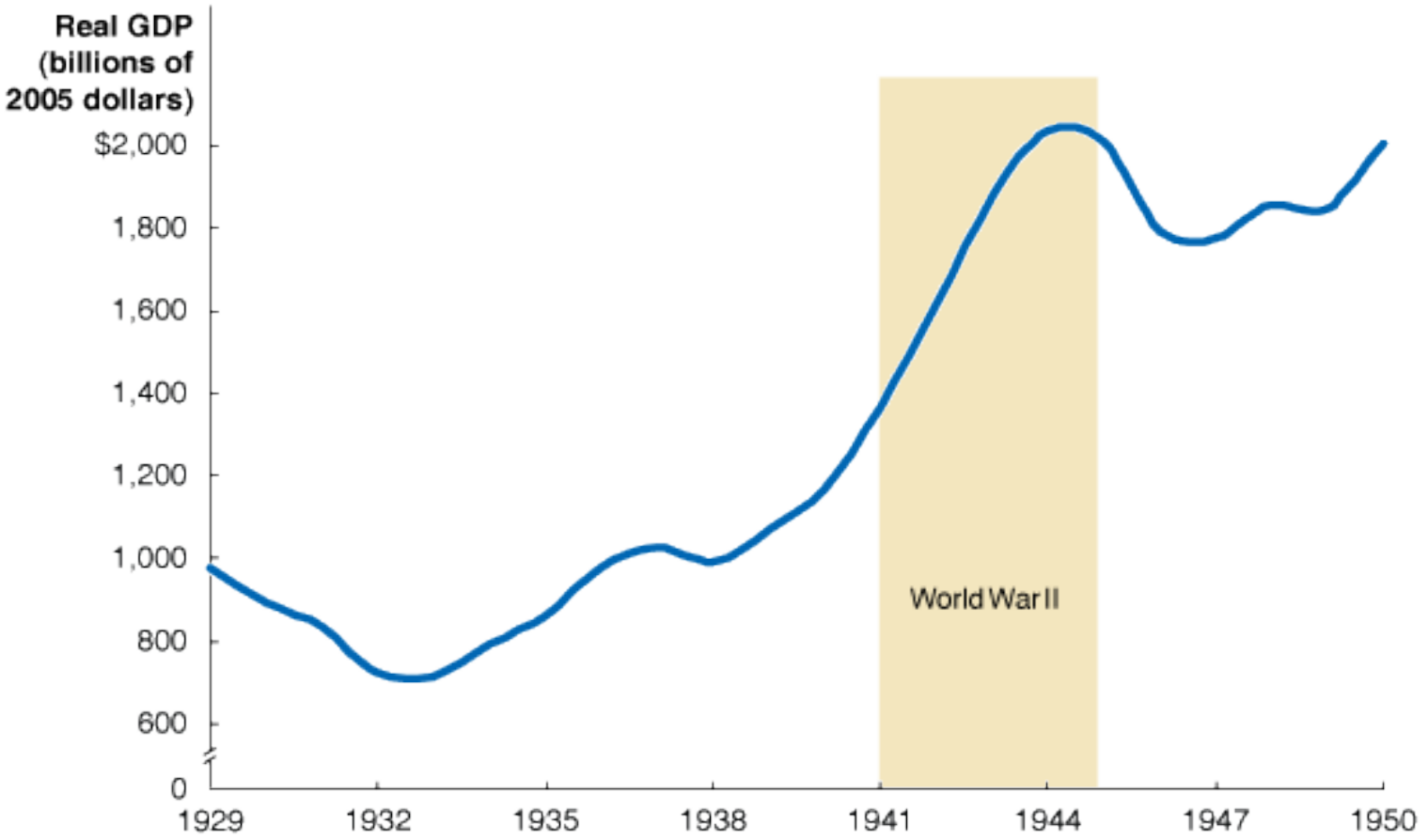
Does GDP Measure What We Want It to Measure?

- **Shortcomings** of 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?

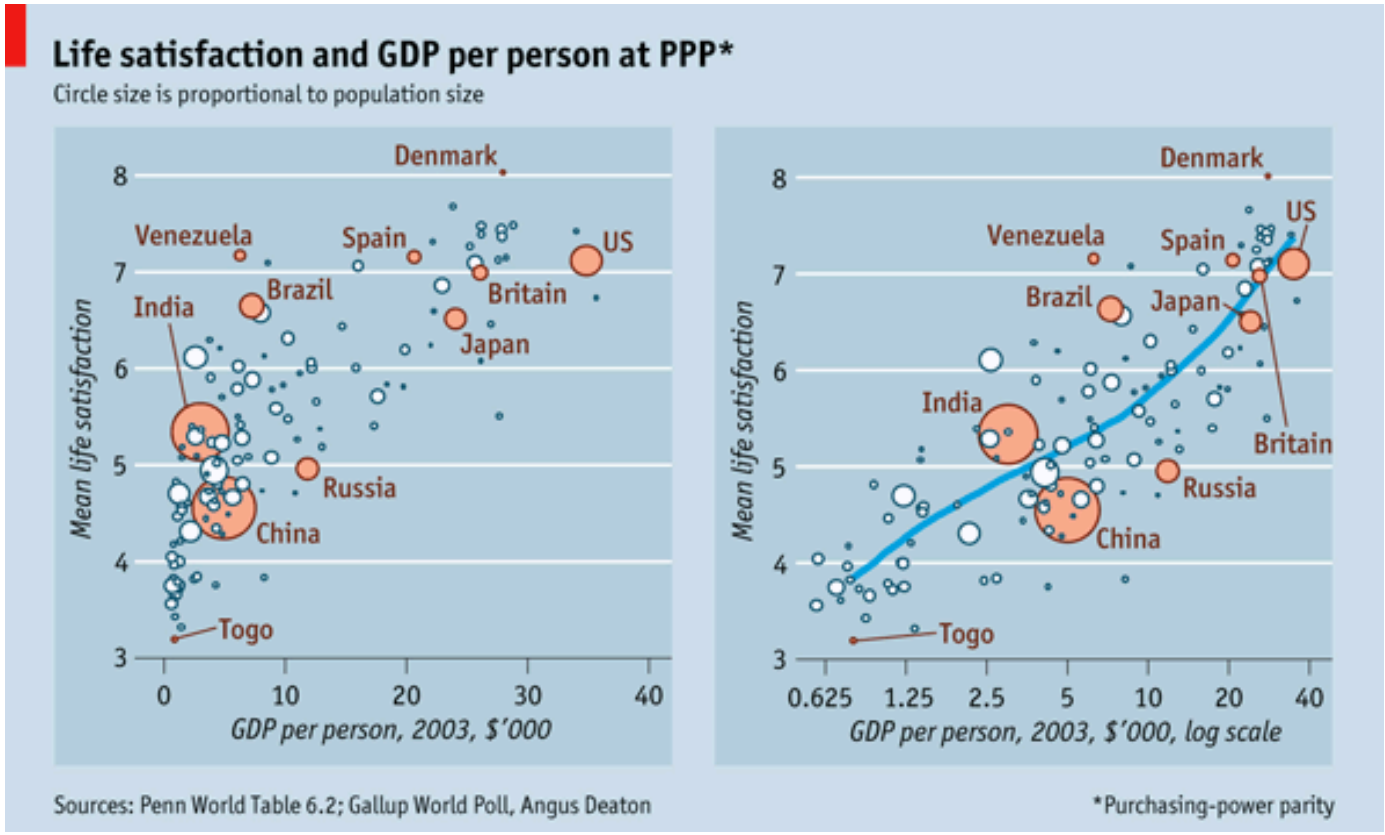
- **Shortcomings** of GDP as a **Measure of Well-Being**
  - The value of **leisure is not included** in GDP
  - GDP is **not adjusted for pollution** or other negative effects of production
  - GDP is **not adjusted for changes in crime** and other social problems
  - GDP measures the size of the pie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

Did World War II Bring Prosperity?



Beyond GDP


Well-being and wealth
OECD Better Life index (10=best) and GDP per person, 2009*
Better Life index
GDP per person at purchasing-power parity, $'000
Sweden
Canada
Australia
New Zealand
Denmark
Switz.
Norway
Finland
Neth.
Iceland
United States
Britain
Austria
Ireland
France
Belgium
Germany
Slovenia
Spain
Japan
Czech Republic
Israel
South Korea
Italy
Poland
Slovakia
Greece
Hungary
Portugal
Estonia
Mexico
Chile
Turkey
Source: OECD
*Or latest available year

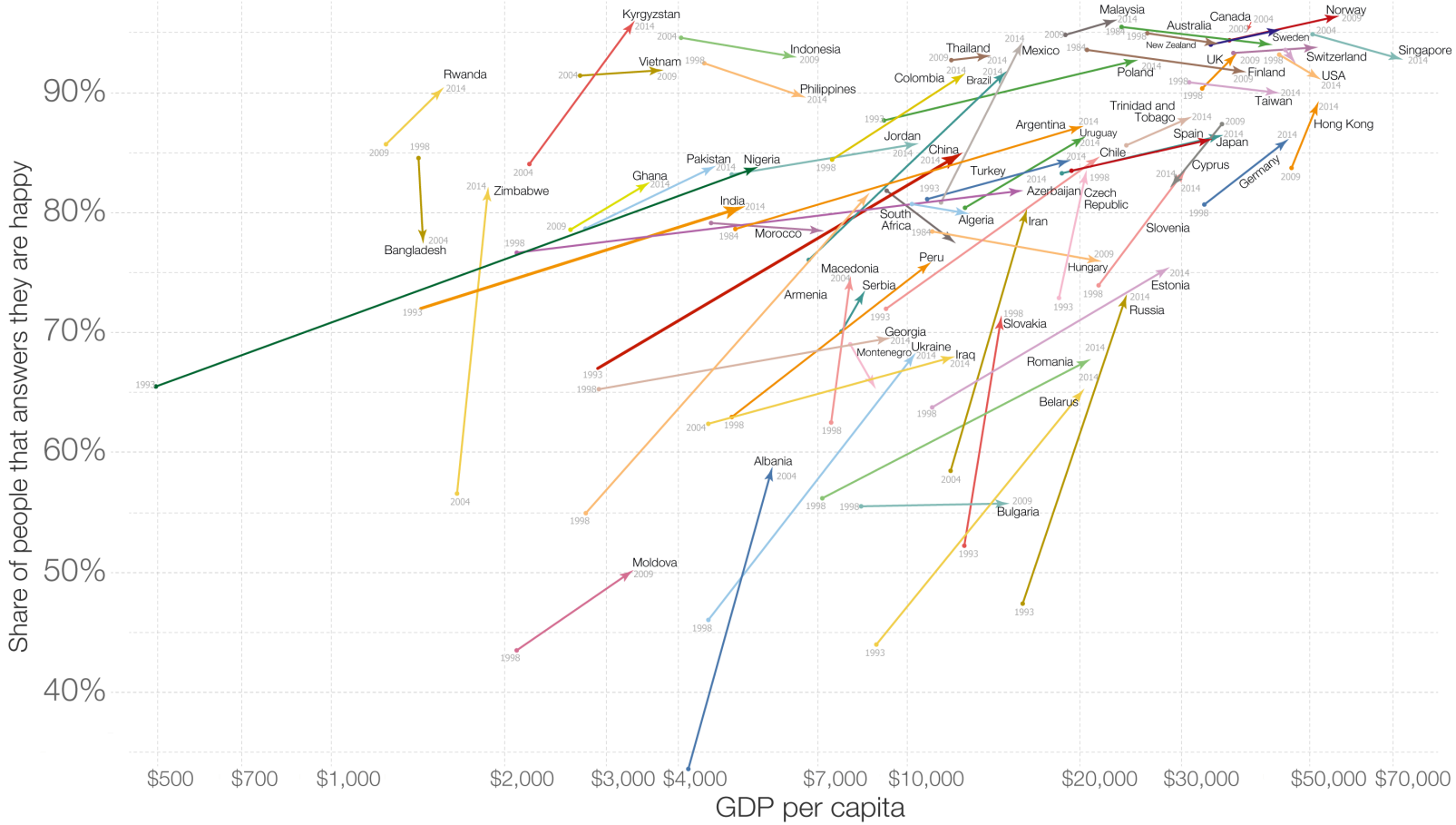

Life satisfaction and GDP per person at PPP*
Circle size is proportional to population size
Mean life satisfaction
GDP per person, 2003, $'000
Denmark
Venezuela
Spain
US
India
Brazil
Britain
Japan
Russia
China
Togo
GDP per person, 2003, $'000, log scale
Sources: Penn World Table 6.2; Gallup World Poll, Angus Deaton
*Purchasing-power parity

Beyond GDP

Self-reported happiness vs income over time

Our World in Data

The vertical axis shows the share of people who say they are 'very happy' or 'rather happy'. The horizontal axis measures average national income. Each country is drawn as a line joining first and last available observations.



Data source: self-reported happiness from the World Value Survey; GDP per capita from the Penn World Table.
The interactive data visualization is available at OurWorldinData.org. There you find the raw data and more visualizations on this topic.

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 the 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:
  - **Financial investments** – Buying a stock or a bond does not produce a flow of new product
  - 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 G&S 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**

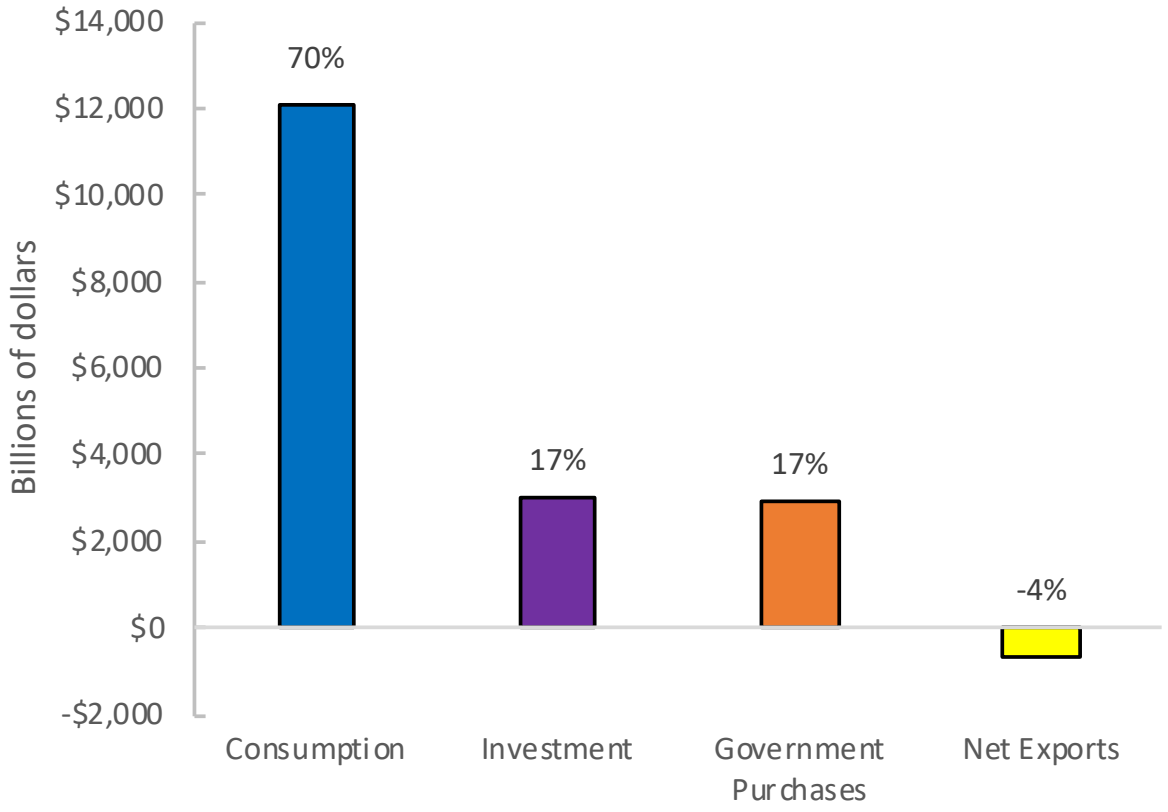
- What do NX > 0 and NX < 0 mean?

- Why do we subtract imports?
  - Do higher imports mean lower GDP?

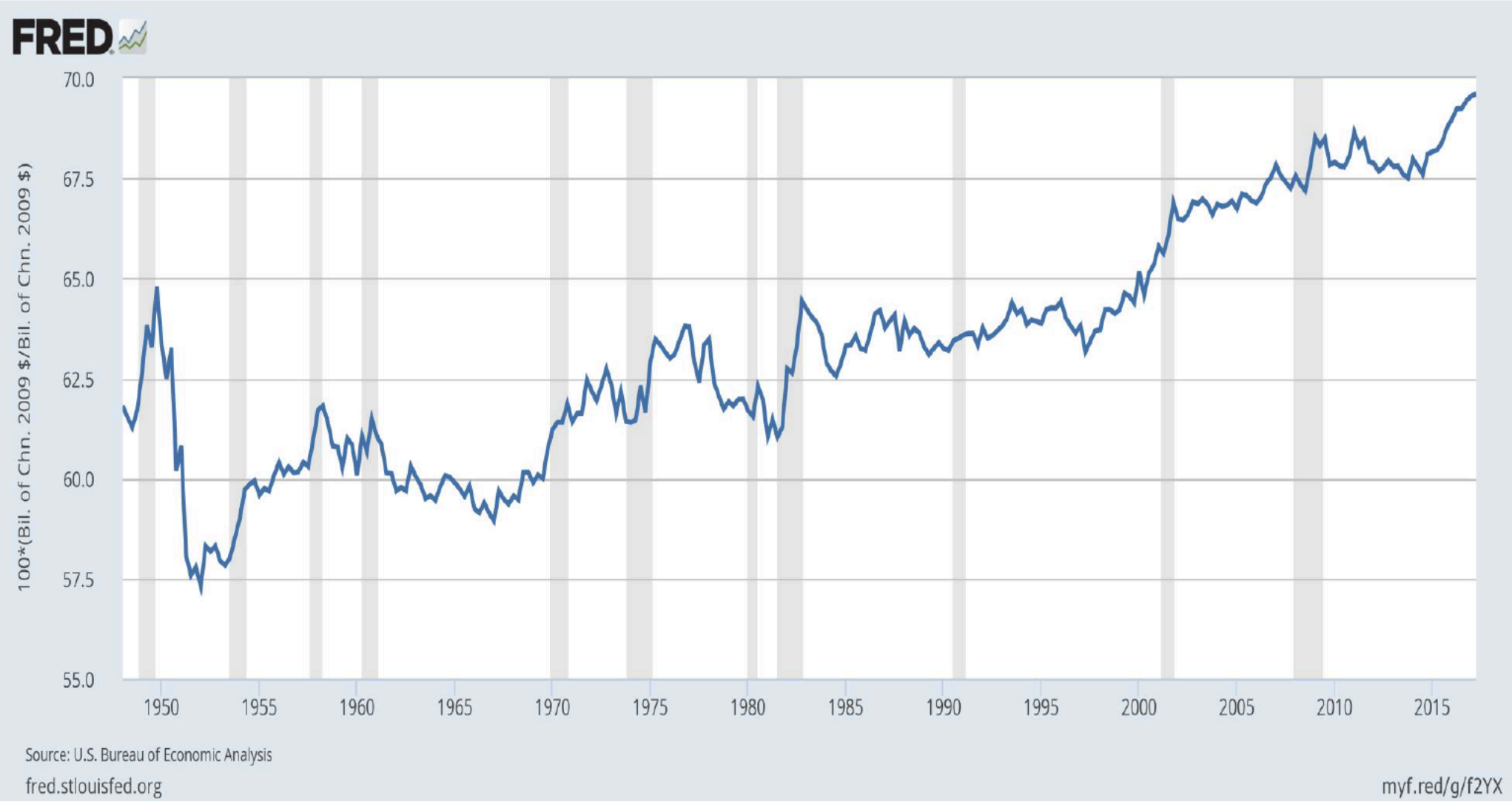
Components of GDP in 2017

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**

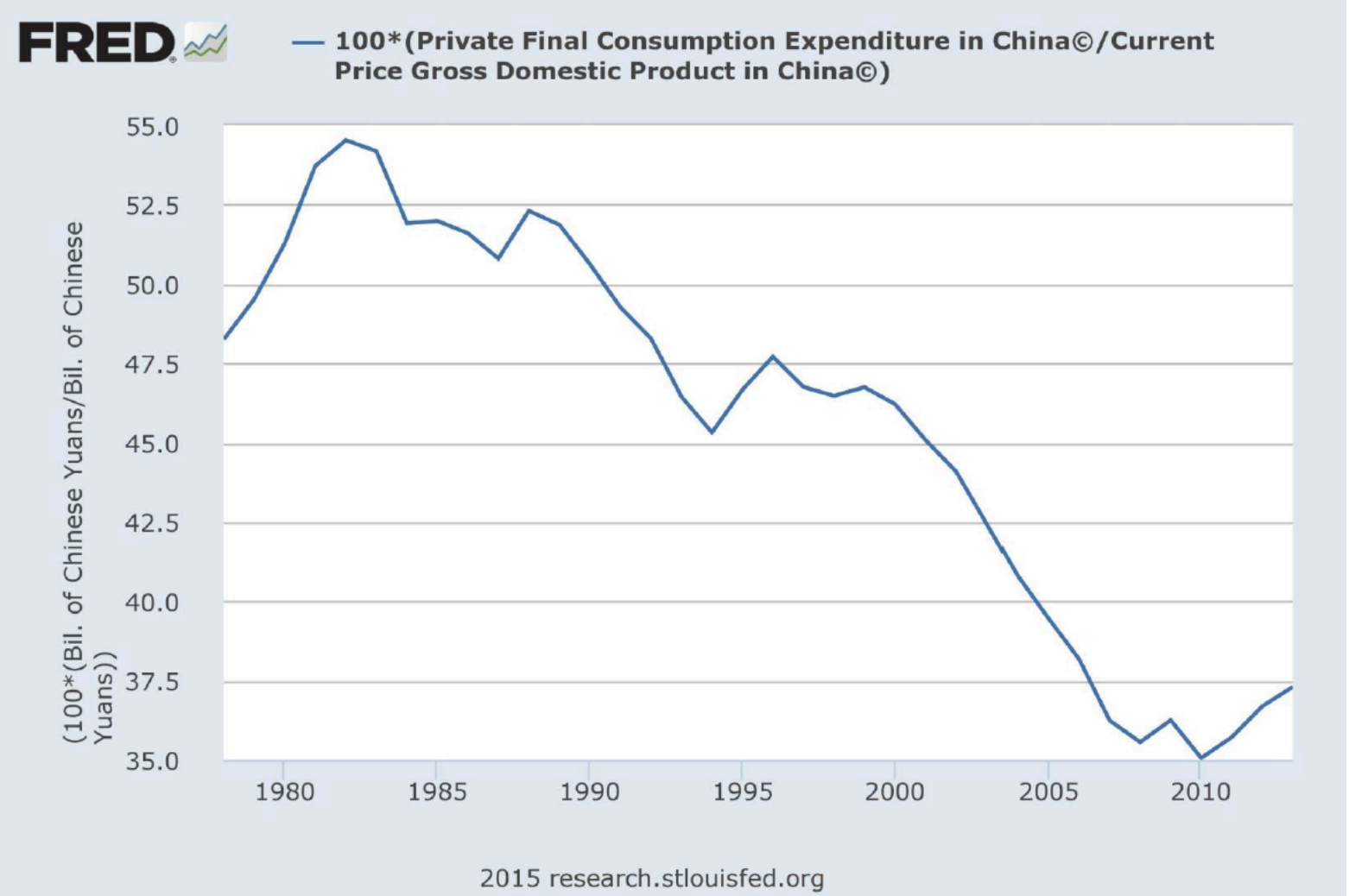
Source: Bureau of Economic Analysis (BEA)



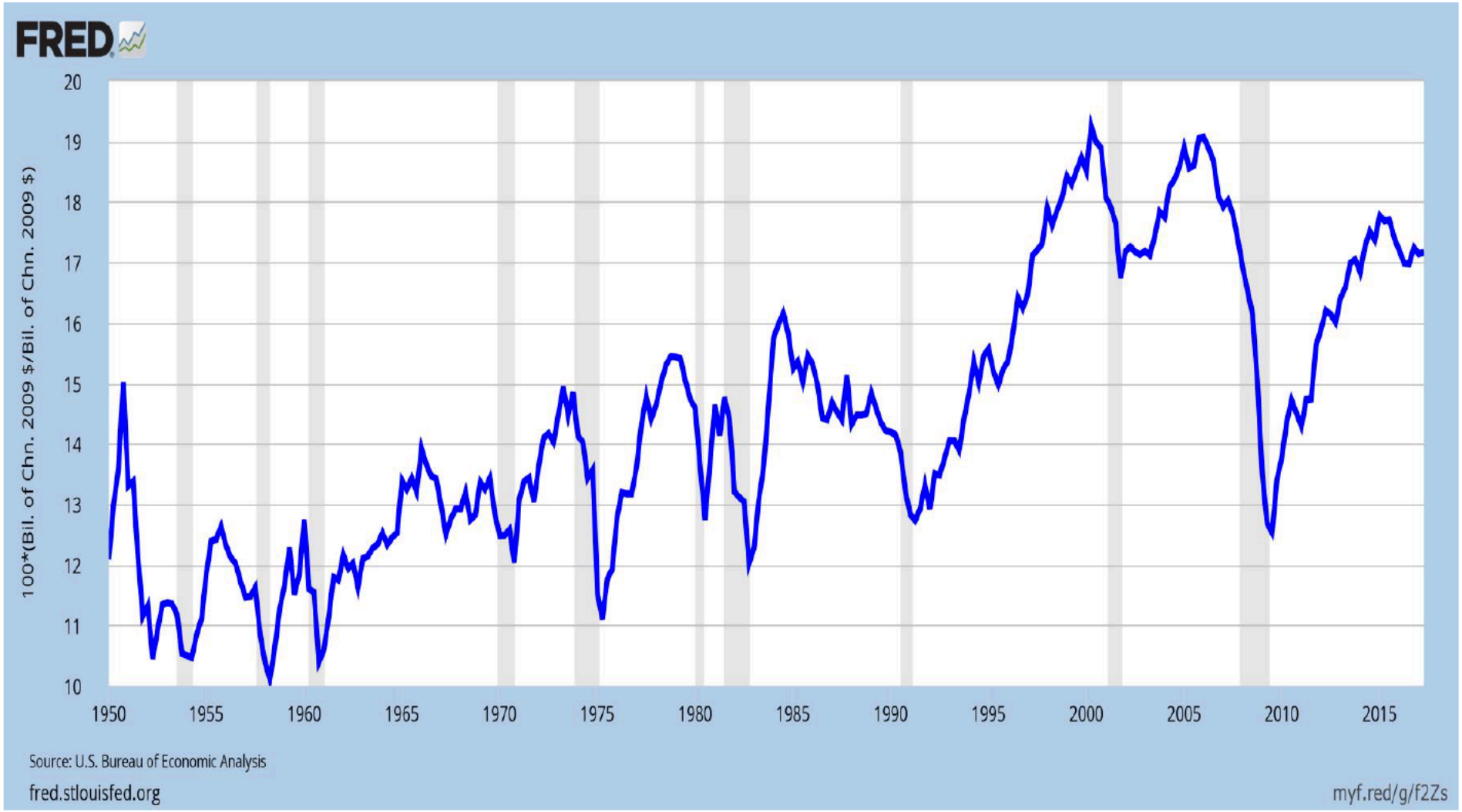
Consumption as Share of US Real GDP



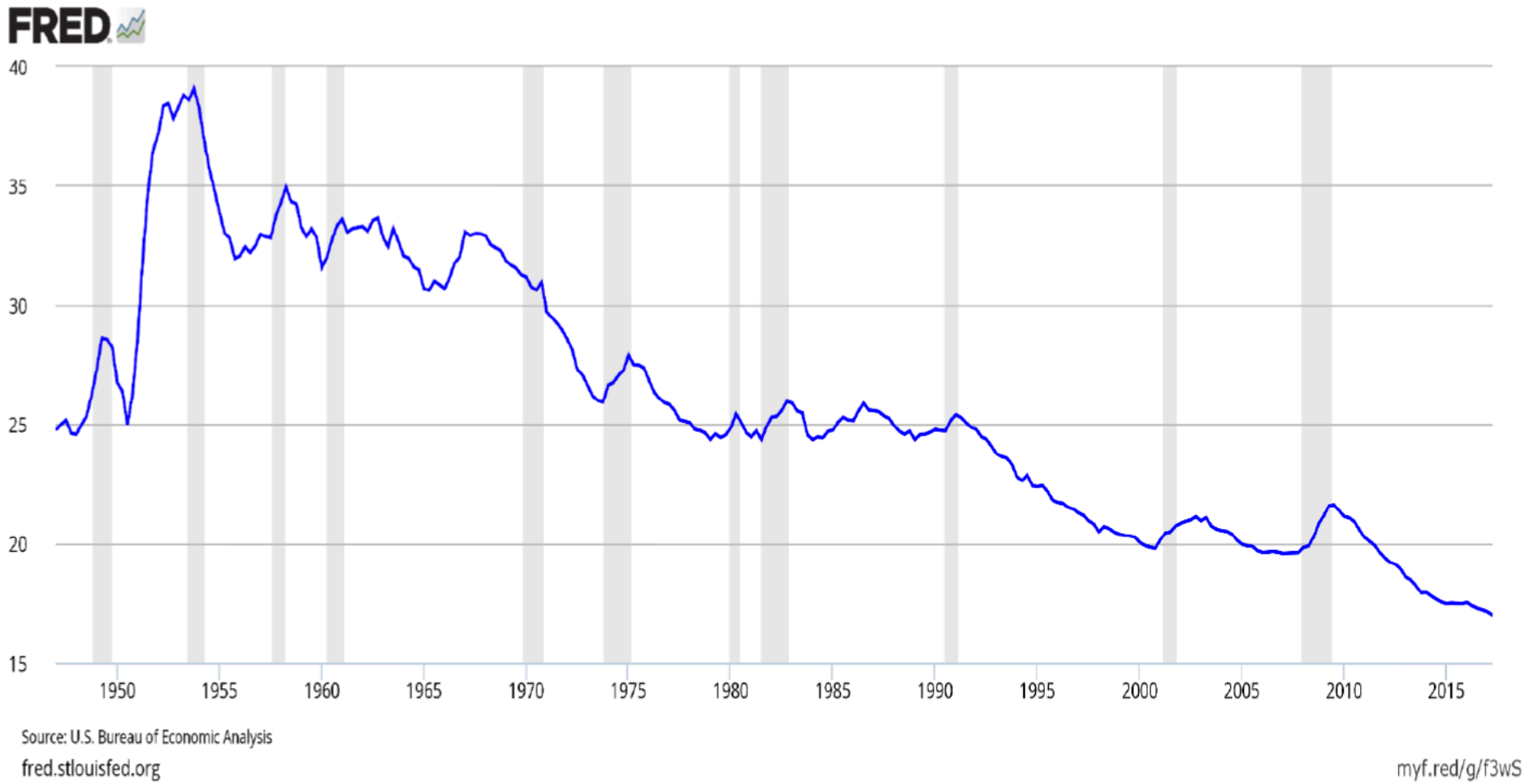
Consumption as Share of China's Nominal GDP



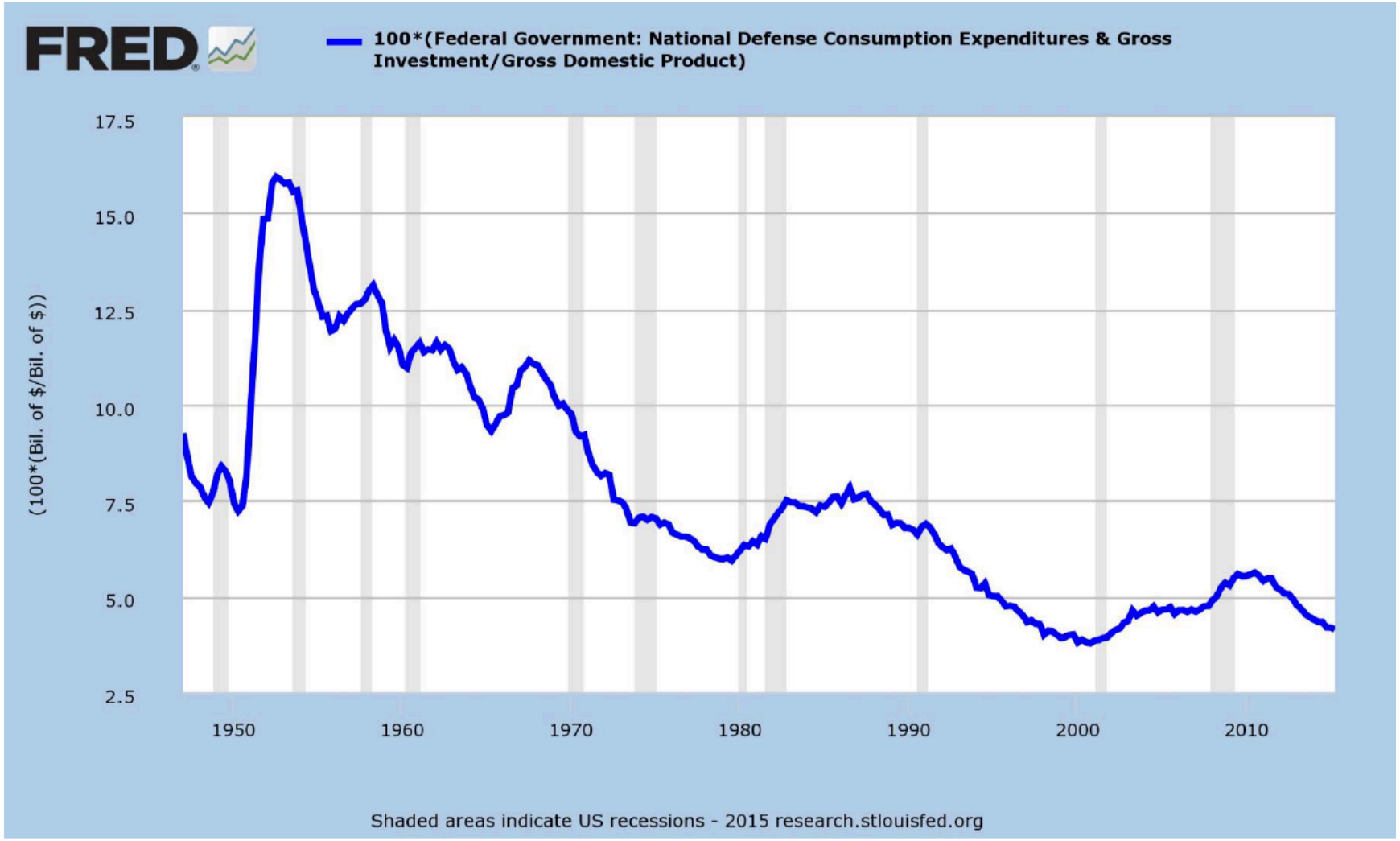
Real Gross Private Investment as Share of US Real GDP



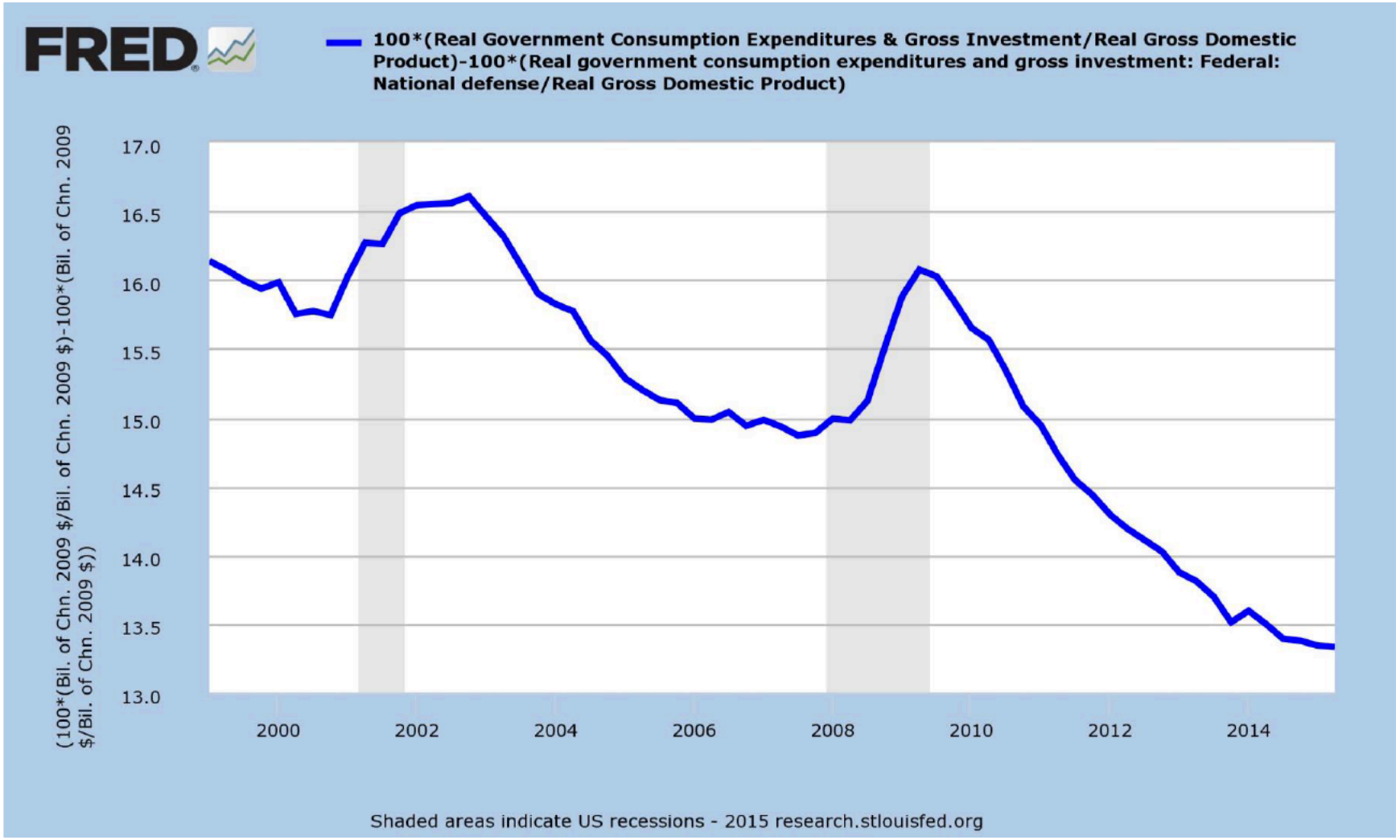
Real Government Expenditures as Share of US Real GDP



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