

Macroeconomic Data

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Content

- Overview
- GDP
 - Expenditure
 - Income
- Inflation
 - CPI
 - GDP Deflator
- Unemployment

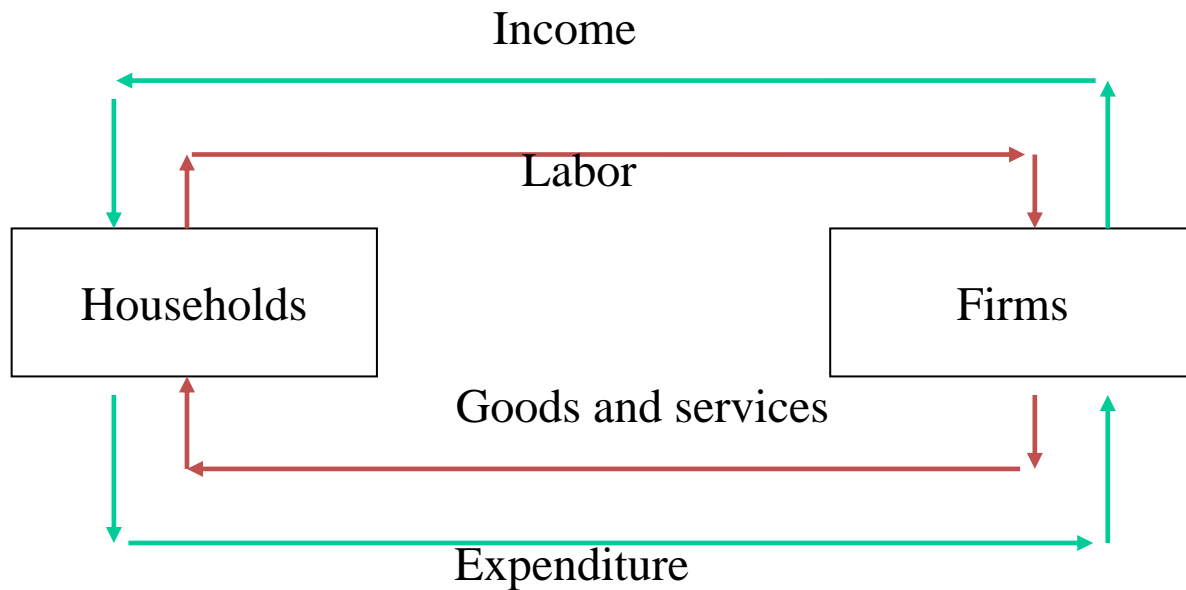
The importance of data

- Sherlock Holmes: It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to fit facts.
- Systematic v.s. casual observations
- Economic data or statistics offer a systematic and objective measure of the state of economy.
- In this lecture, we focus on three statistics:
 - GDP: total income or expenditure
 - CPI: price level
 - Unemployment: fraction of employment

National Income Accounting

- GDP (Gross Domestic Product) is essentially the total value of all transactions in the economy within a time interval (say, a quarter).
- Three ways to view GDP:
 - [production] the total value of final goods and services produced in the economy
 - [income] the total income generated from transactions of domestically produced goods and services
 - [expenditure] the total expenditure generated from transactions of domestically produced goods and services
- Total income must equal total expenditure, because every transaction generates an income to the seller and an equal amount expenditure to the buyer.

The Circular Flow



Computing GDP

- GDP: the market value of all final goods and services produced within an economy in a given period of time.
- Mathematically, $GDP_t = \sum_{i=1}^M q_{it}p_{it}$, where q_{it} and p_{it} are quantity and price, respectively, of i -th item produced period t .
- If the economy produces 4 apples and 3 oranges, with market prices 0.5 and 1 RMB, respectively, then

$$\begin{aligned} \text{GDP} &= (\text{Price of apples} \times \text{Quantity of apples}) \\ &\quad + (\text{Price of oranges} \times \text{Quantity of oranges}) \\ &= (0.5 \times 4) + (1.0 \times 3) = 5.0 \text{ RMB} \end{aligned}$$

Rule for Computing GDP: Use Market Price

- Use market prices, when available, to calculate the value of goods and services.
- Imputed price for those goods that are not sold in the marketplace. For example, home ownership and government services.
- No imputation is made for goods and services in the underground economy.

Rule for Computing GDP: Final Goods Only

- Intermediate goods are not doubly counted in GDP.

GDP = value of final goods produced
= sum of value added at all stages of production

- Used goods not included
 - The treatment of inventories depends on if the goods are spoilable.
 - If they spoil, GDP remains unchanged.
 - If the goods do not spoil and they are stored for future sale, their value is included in GDP. When the goods are finally sold out of inventory (possibly next year), they will be treated as used goods (and not counted in GDP).

Rule for Computing GDP: Produced within the Country

- Goods and services that are imported for consumption or investment within the country are not counted in GDP.
- They are counted in investment or consumption, though.

Nominal and Real GDP

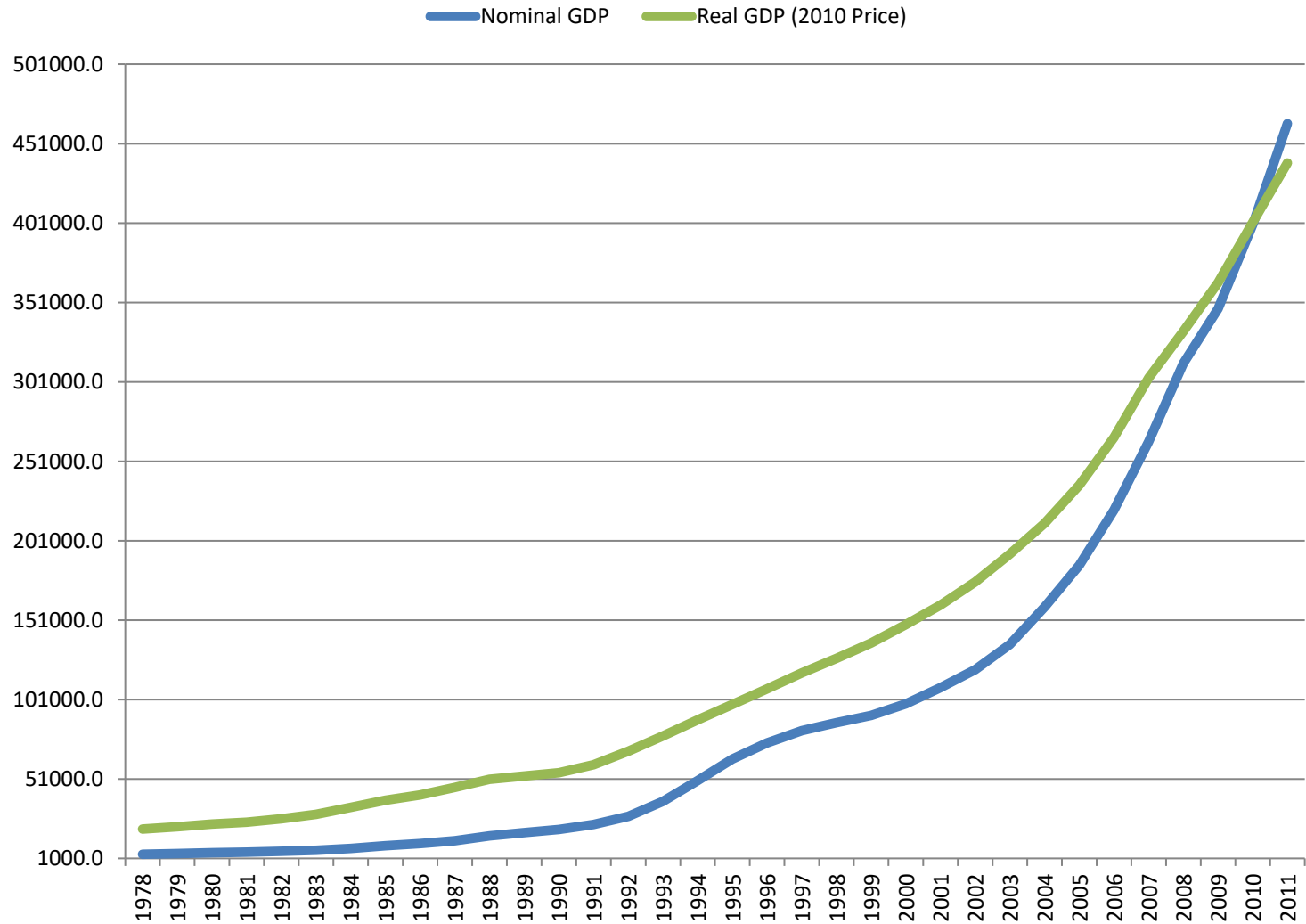
- In the calculation $GDP_t = \sum_{i=1}^M q_{it}p_{it}$, current price is used. We call it nominal GDP.
- Nominal GDP can change over time, either because there is a change in the amount (real value) of goods and services or a change in the prices of those goods and services.
- Real GDP measures the value of final goods and services at constant prices,

$$RGDP_t = \sum_{i=1}^M q_{it}p_{it_0},$$

where t_0 stands for the base year and p_{it_0} is a constant for each i .

- The relationship between nominal and real GDP can be characterized by $GDP_t = P_t \cdot RGDP_t$, where P_t is called GDP deflator, or implicit price deflator for GDP.
- Taking real measurements is essential for gauging growth or improvement (e.g., real wage) without distortion of price changes.

The Real and Nominal GDP of China



Real GDP Growth of China (Annual)



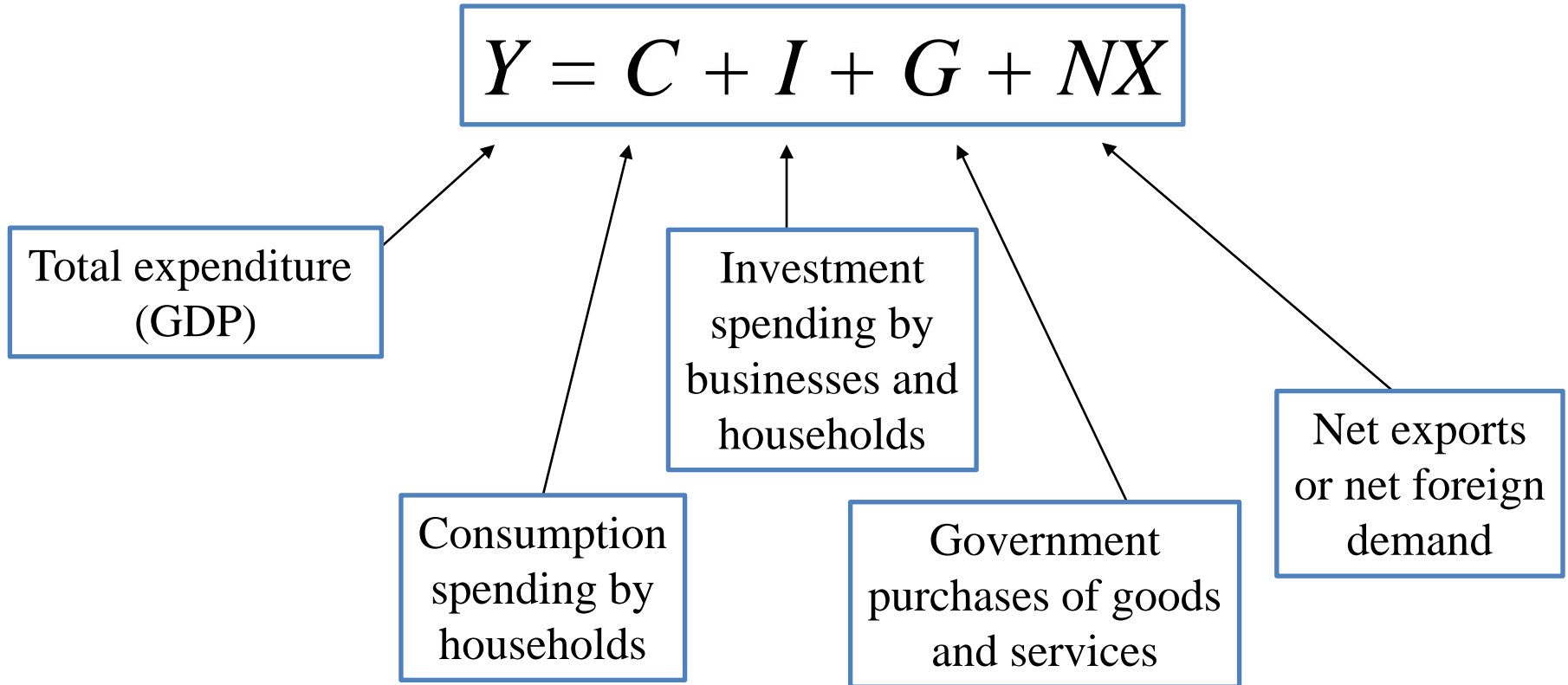
Real GDP Growth of China (Quarterly, 1992Q1-2019Q2)



Choice of Base Year

- One principle of calculating RGDP is that the base year should not be too far, so that prices will not be too out of date. For example, cell phone was a rare product 20 years ago.
- Since 1995, the US has been using chain-weighted measures of real GDP in the calculation of real GDP growth.
- The chain weight works as follows: Average prices in 2009 and 2010 are used to measure real growth from 2009 to 2010. Average prices in 2010 and 2011 are used to measure real growth from 2010 to 2011, and so on.
- In China, we change base-year every five years.

Components of Expenditure

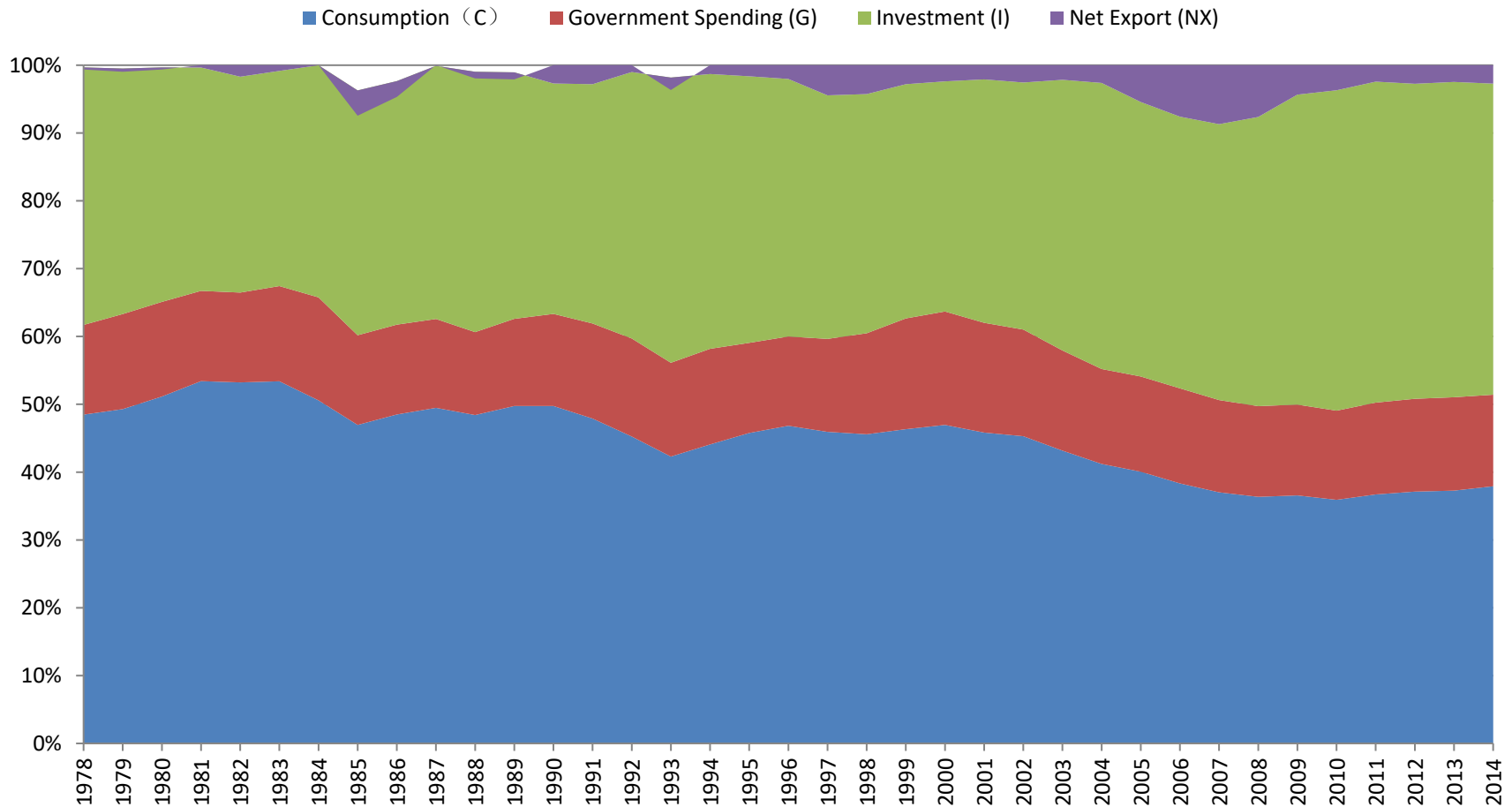


This is called the *national income accounts identity*.

A More Detailed Decomposition

- Let C^d be the consumption of domestic goods and services, and let C^f be the consumption of imported goods and services.
- Similarly, we have I^d and I^f , and G^d and G^f .
- Then we have $Y = (C^d + C^f) + (I^d + I^f) + (G^d + G^f) + X - (C^f + I^f + G^f)$, where X is export.

Decomposition of Chinese GDP (Expenditure)



Consumption (C)

- Consumption (C) measures the value of all goods and services bought by households.
- It includes
 - durable goods
last a long time
e.g., cars, home appliances
 - non-durable goods
last a short time
e.g., food, clothing
 - services
work done for consumers
e.g., dry cleaning, air travel.

Investment (I)

- Definition: spending on goods bought for future use.
- It includes:
 - business fixed investment
spending on plant and equipment that firms will use to produce other goods & services
 - residential fixed investment
spending on housing units by consumers and landlords
 - inventory investment
the change in the value of all firms' inventories

Investment and Capital

- Capital is one of the factors of production.
At any given moment, the economy has a certain overall stock of capital.
- Investment is spending on new capital.
- Example:
 Suppose that on 1/1/2002:
 An economy has an amount of capital: 500
 during 2002:
 investment = 100, depreciation = -20
 1/1/2003:
 The economy will have capital: $500 + 100 - 20 = 580$
- In a word, investment is “flow”, capital is “stock”.

Housing Issue

- A house is a piece of capital which is used to produce a consumer service, which we may call “housing services”.
- A consumer’s spending on a new house counts under investment, not consumption.
- A tenant’s spending on rent counts under services -- rent is considered spending on “housing services.”
- In national income accounting, (the services category of) consumption includes the imputed rental value of owner-occupied housing.
- So what happens if a renter buys the house she had been renting?
Conceptually, consumption should remain unchanged: she is no longer paying rent, but she is still consuming the same housing services as before.

Inventory issue

- Unsold output goes into inventory, and is counted as “inventory investment”, *whether the inventory buildup was intentional or not*.
- If total inventories are \$10 billion at the beginning of the year, and \$12 billion at the end, then inventory investment equals \$2 billion for the year.
- Note that inventory investment can be negative (which means inventories fell over the year).

Government Spending (G)

- Government Spending includes all government spending on goods and services.
- To avoid double-counting, G excludes transfer payments (转移支付) (e.g. unemployment insurance payments), because they do not represent spending on goods and services.
- Transfer payments are included in “government outlays,” but not in government spending.

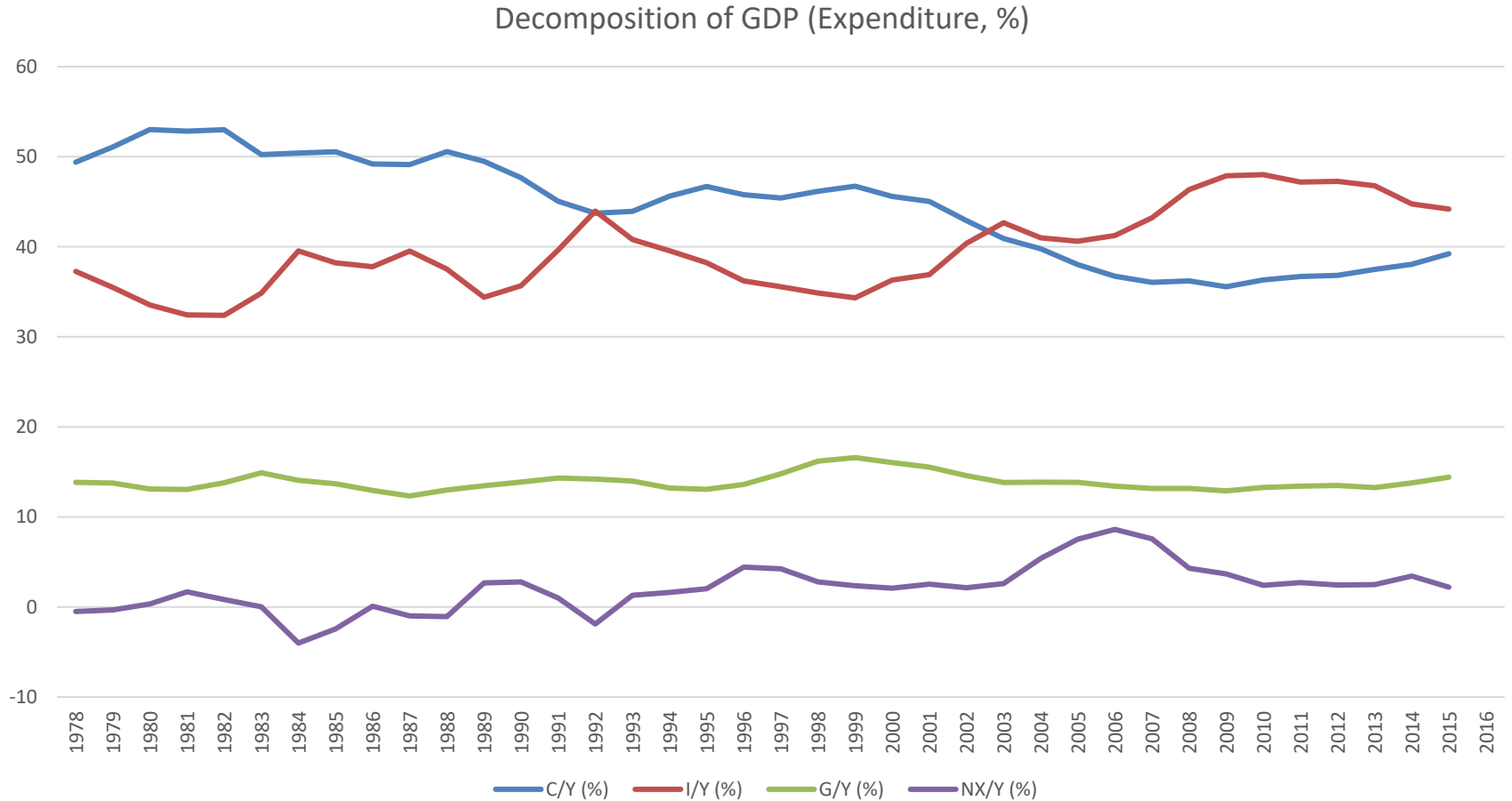
Chinese GDP at 2018

- In 2018, the total GDP of China is 90.0 trillion Yuan. The population is 1.4 billion. So GDP per capita is $90/1.4 \times 1000 \approx 64286$ Yuan.
- Using market exchange rate, the GDP per cap. is around \$9600. Using PPP exchange rate, the GDP per cap. is around \$19559 (2019 est).
- In comparison, the estimated US GDP per capita is \$65062 in 2019.

Investment in China

- In 2018, total investment in China（固定资本形成+存货增加）is 39.7万亿元，约占GDP的44%。
- In 1980, the I/Y ratio was 35%.
- In US, I/Y has been between 15% and 20% in recent history.

Decomposition of GDP



Other measures of income

- GNI (Gross National Income) or GNP (Gross National Product)

$\text{GNI} = \text{GDP} + \text{net factor payments from abroad}$

- NNP (Net National Product)

$\text{NNP} = \text{GNP} - \text{Depreciation}$

- In the national income accounts, depreciation is called the consumption of fixed capital. In US, it equals about 10% of GNP. Because depreciation of capital is a cost of producing the output of the economy, subtracting depreciation shows the net result of economic activity.

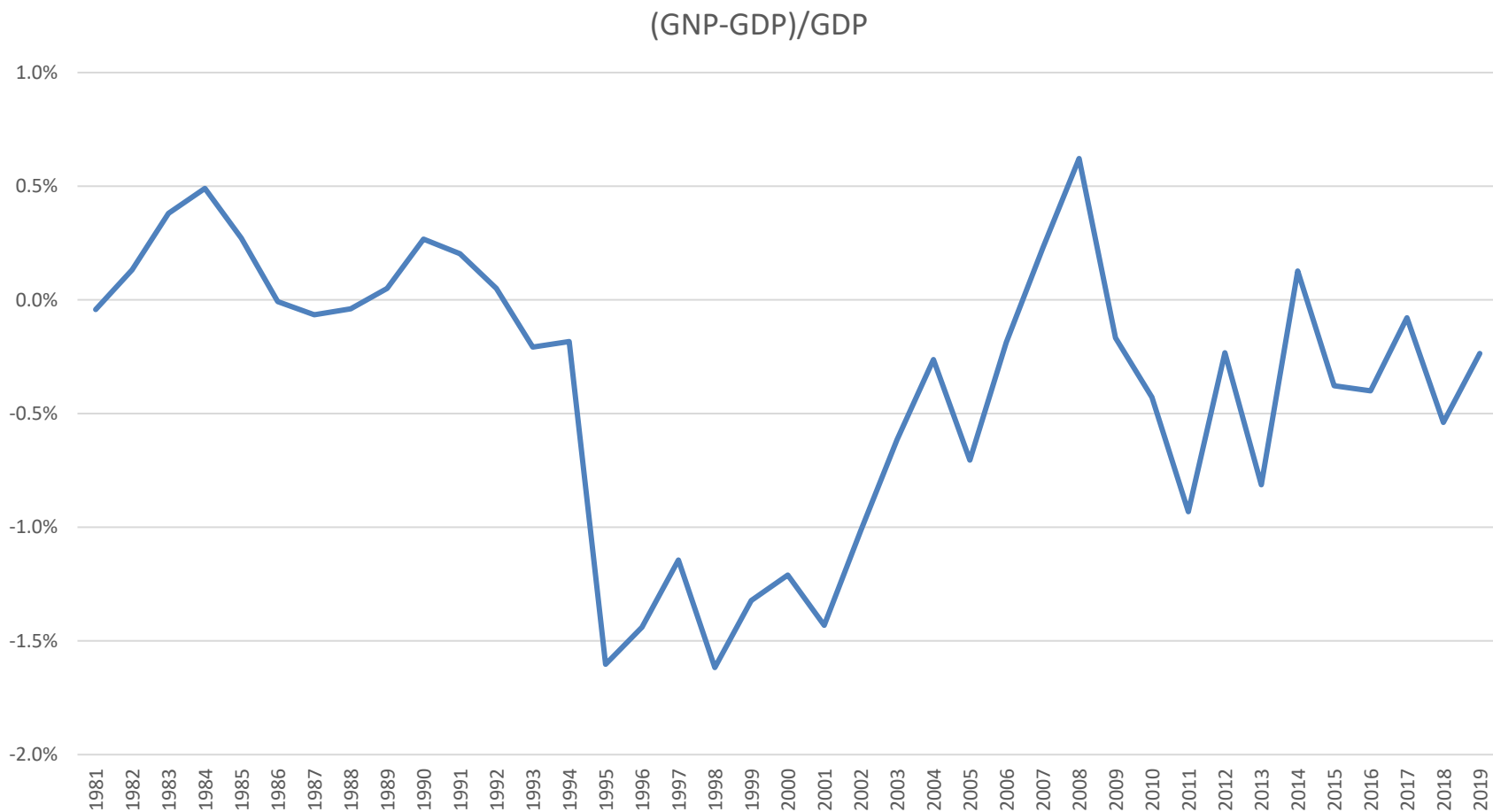
- NI (National Income)

- NI differs from NNP by a small correction called statistical discrepancy.

Difference between GNP and GDP (as percentage of GDP, 1997)

Country	$(\text{GNP}/\text{GDP}-1)*100\%$
U.S.A.	0.1%
Bangladesh	3.3%
Brazil	-2.0%
Canada	-3.2%
Chile	-8.8%
Ireland	-16.2%
Kuwait	20.8%
Mexico	-3.2%
Saudi Arabia	3.3%
Singapore	4.2%

Case of China



Personal Income

- Personal Income = National Income
 - Indirect Business Tax
 - Corporate Profits
 - Social Insurance Contributions
 - Net Interest
 - + Dividends
 - + Government Transfers to Individuals
 - + Personal Interest Income.
- Disposable Personal Income =
Personal Income – Personal Taxes

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- **Inflation**
 - **CPI**
 - **GDP Deflator**
- Unemployment

CPI

- CPI (Consumer Price Index) is an index that measures the overall level of prices for consumers.
- A government agency (统计局 in China, Bureau of Labor Statistics in US) determines a basket of goods and services consumed by a typical customer. Using this basket, the agency then computes an index,

$$\text{CPI}_t = c_0 \frac{\sum_i q_{i,t_0} p_{it}}{\sum_i q_{i,t_0} p_{i,t_0}},$$

where p_{it} is the price of the i -th item at time t , p_{i,t_0} is the price of the i -th item at some base time t_0 , q_{i,t_0} is the quantity of the i -th item in the consumption basket at t_0 , and c_0 is a constant.

- For example, we may choose $c_0 = 100$, implying that the level of CPI at time t_0 is 100.

CPI

- Let w_i denote the fraction of expenditure on the i -th item in the consumption basket at time t_0 ,

$$w_i = q_{i,t_0} p_{i,t_0} / \sum_{i=1}^M q_{i,t_0} p_{i,t_0}$$

Then the equation (4) can be written as

$$\text{CPI}_t = c_0 \sum_{i=1}^N w_i \left(\frac{p_{it}}{p_{i,t_0}} \right).$$

Apple and orange economy

- For example, in our twin-tree economy, the apple tree produces 20 apples and the orange tree produces 10 oranges. All these fruits are consumed every year. Their prices are

Year	Apple	Orange
2016	0.5	1
2015	0.4	0.8

- Then the CPI for 2016 is given by

$$CPI_{2016} = \frac{0.5 * 20 + 1 * 10}{0.4 * 20 + 0.8 * 10} = \frac{20}{16}.$$

Inflation and Core Inflation

- Change in CPI is inflation.
- Core CPI is the price index of a consumer basket that excludes food and energy products.
- Core inflation measures the increase in the core CPI.
- CPI exhibits strong seasonality, hence seasonal adjustment is necessary before any analysis of inflation based on CPI.

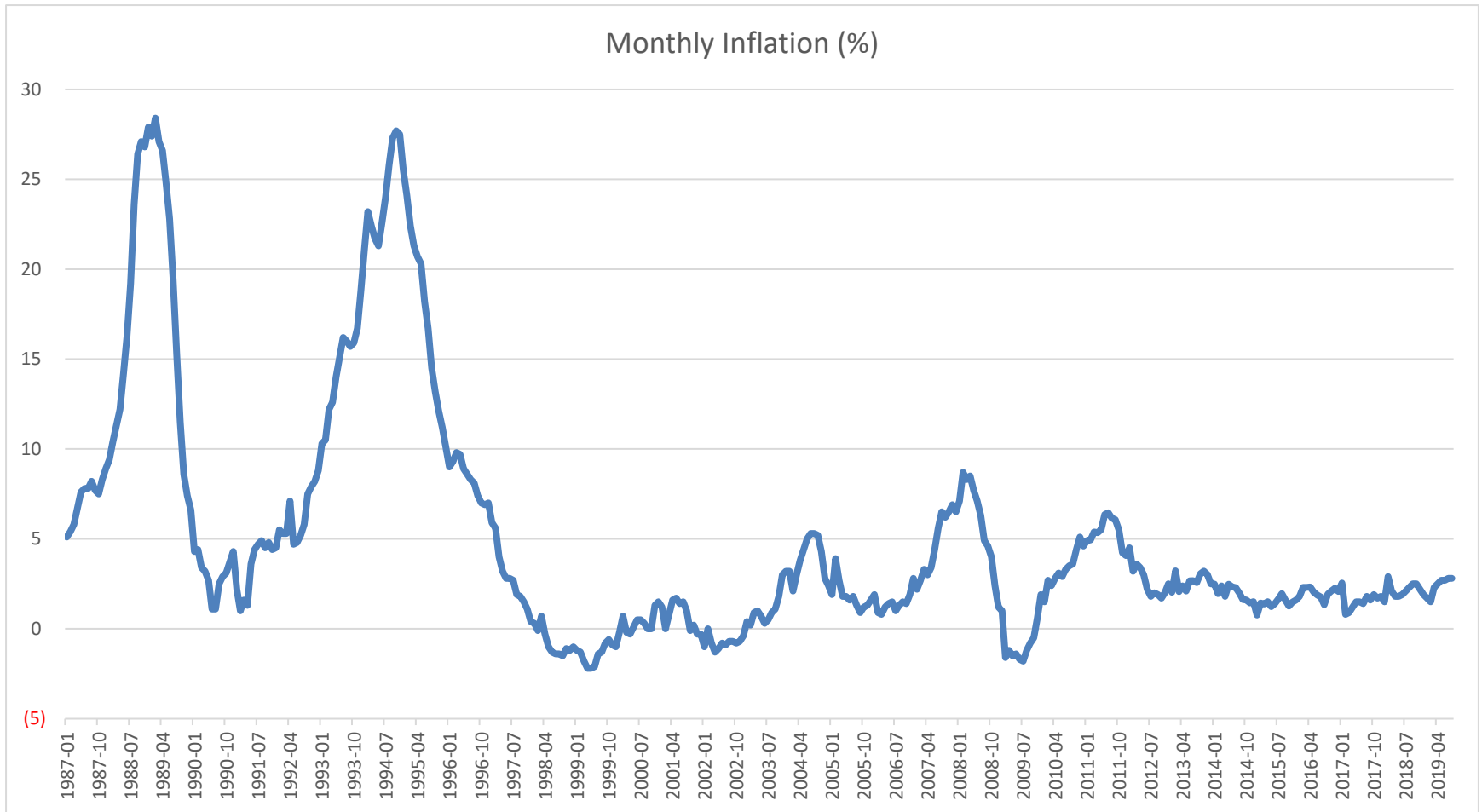
How Chinese Statistics Bureau Calculates inflation

- Conduct a survey to determine the composition of a typical consumer's "basket" of goods. ($\rightarrow w_i$)
- Every month, collect data on prices of all items in the basket. ($\rightarrow p_{it}$)
- Publish Year-to-Year CPI change in any month:

$$\sum_i w_i \left(\frac{p_{it}}{p_{i,t-12}} \right) \times 100\%$$

This statistics avoids, largely, seasonality. But it loses both chain (环比) and level (水平) information.

Inflation in CPI



(5)

Composition of the CPI's “basket” (US)

Food and bev.

Housing

Apparel

Transportation

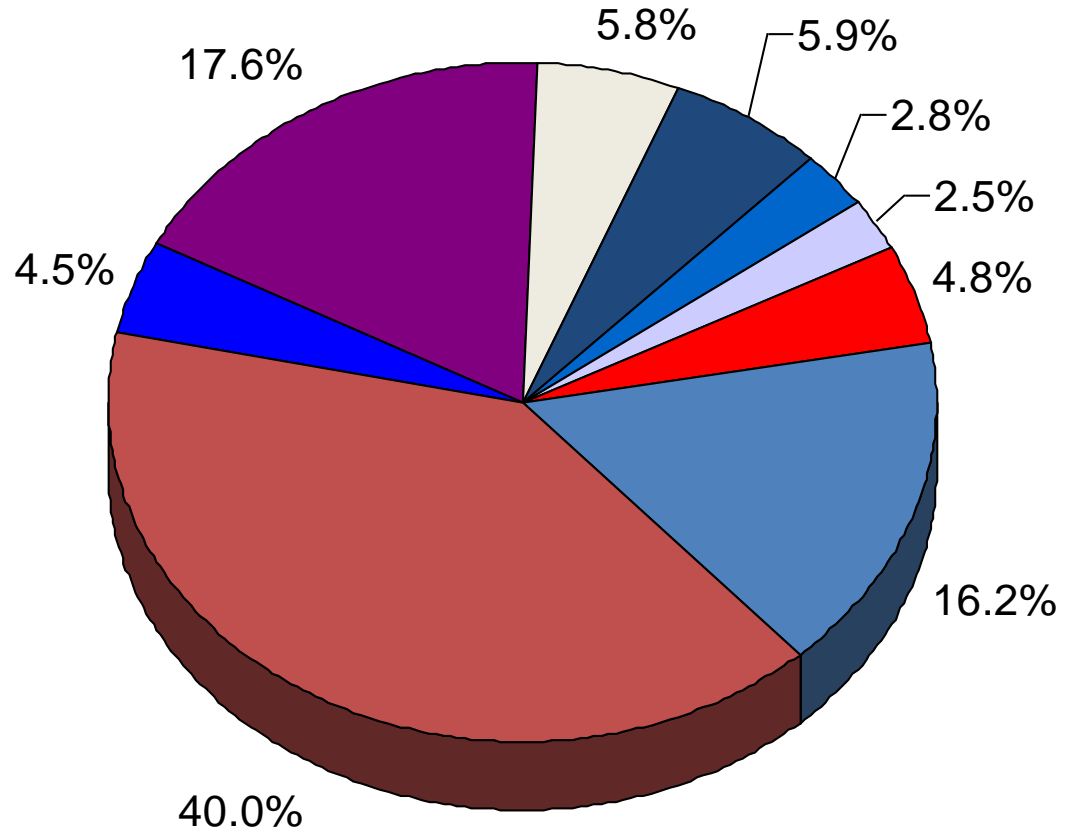
Medical care

Recreation

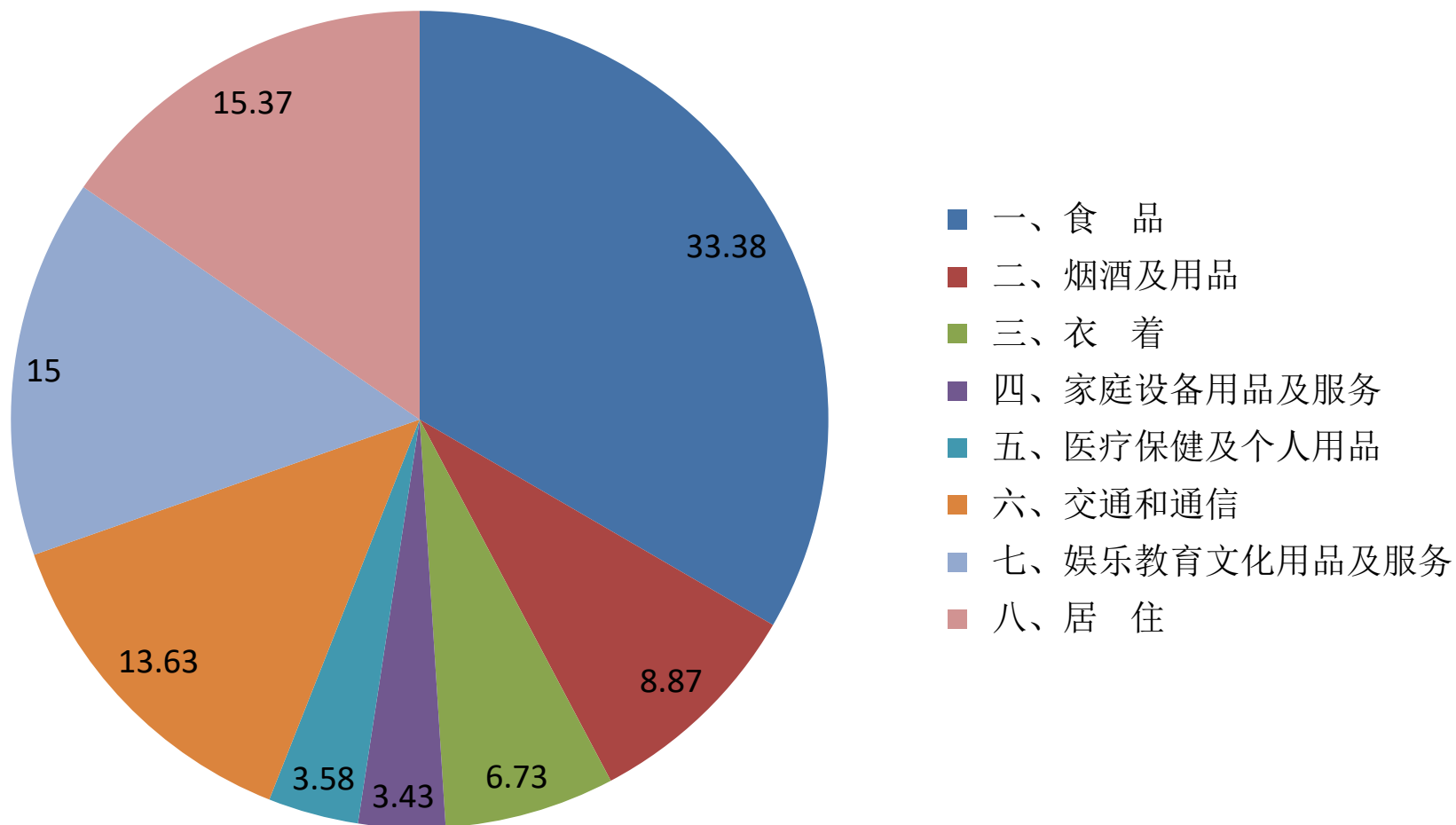
Education

Communication

Other goods and
services



中国CPI权重（2006-2010，估计）



GDP Deflator

- We define GDP deflator by

$$P_t = \frac{Y_t}{y_t} = \frac{\sum_{i=1}^M q_{it} p_{it}}{\sum_{i=1}^M q_{it} p_{i,t_0}}$$

where y_t is the value of output at price level of the year t_0 (base year), q_{it} is the output of i^{th} item in year t .

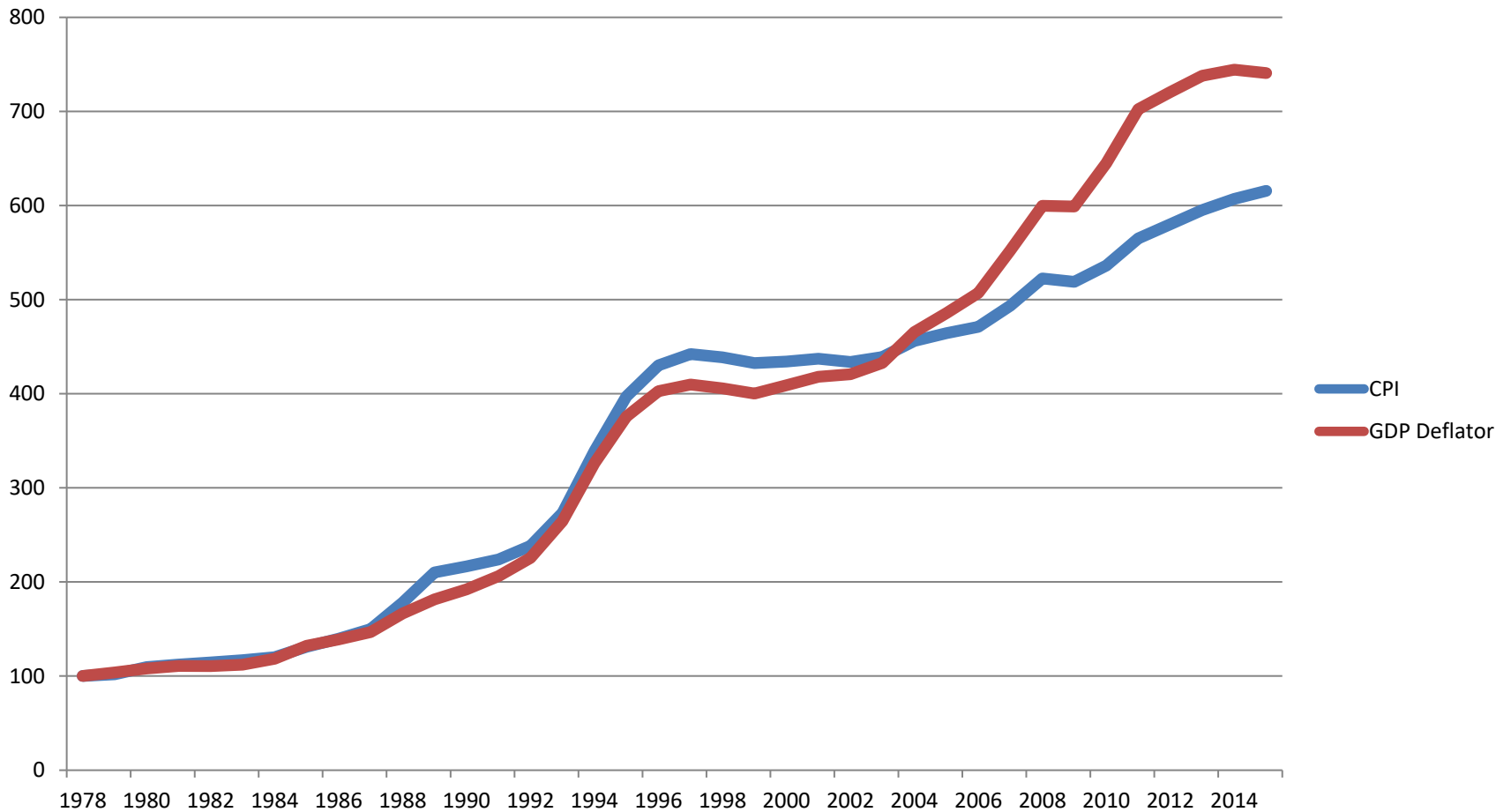
- Obviously, the GDP deflator also measures general price level.
- Let $w_{it} = q_{it} p_{i,t_0} / \sum_{i=1}^M q_{it} p_{i,t_0}$, then we obtain

$$P_t = \sum_{i=1}^M w_{it} \cdot \left(\frac{p_{it}}{p_{i,t_0}} \right)$$

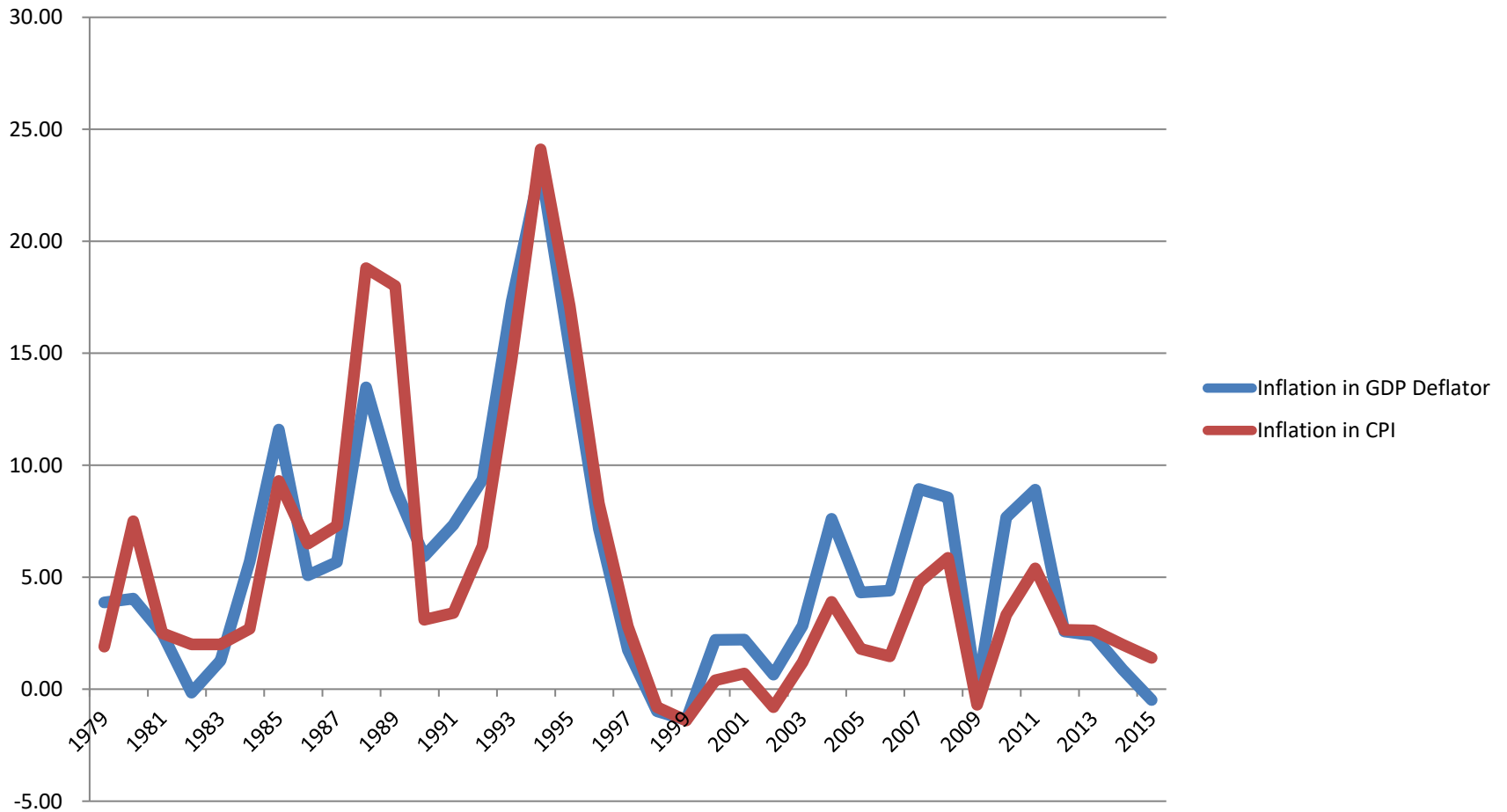
GDP Deflator v.s. CPI

- The GDP deflator measures the prices of all goods and services produced, whereas the CPI measures prices of only the goods and services bought by consumers. Thus, an increase in the price of goods bought only by firms or the government will show up in the GDP deflator, but not in the CPI.
- Also, another difference is that the GDP deflator includes only those goods and services produced domestically. Imported goods are not a part of GDP and therefore don't show up in the GDP deflator.
- The final difference is the way the two weight the prices in the economy. The CPI assigns fixed weights to the prices of different goods (Laspeyres index), whereas the GDP deflator assigns changing weights (Paasche index).

CPI vs GDP Deflator (China)



Inflation in CPI and GDP Deflator



Why CPI tends to overstates inflation

- 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 money. But it does not reduce the CPI, because the CPI uses fixed weights.
- Unmeasured changes in quality
 - Quality improvements increase the value of the dollar, but are often not fully measured.

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- (Un)employment

Measuring Unemployment

- Unemployment Rate = $\frac{\text{Number of Unemployed}}{\text{Labor Force}}$
- Labor Force Participation = $\frac{\text{Labor Force}}{\text{Adult Population}}$
- The labor force is defined as the sum of the employed and unemployed, and the unemployment rate is defined as the percentage of the labor force that is unemployed.
- The labor-force participation rate is the percentage of the adult population who are in the labor force.

Labor Market in China and the US

- In 2018, China's population and labor statistics are as follows (millions):

$$\text{Population} = 248.6 \text{ (Children, Age 0-15)} + 1148.6 \text{ (Adults)} = 1395.4$$

$$\text{Labor force} = 775.9 \text{ (Employed)} + 29.8 \text{ (Unemployed)} = 805.7$$

$$\text{Unemployment rate} = 29.8/805.7 = 3.7\%$$

$$\text{Labor-force participation rate} = 805.7/1148.6 = 70.3\%$$

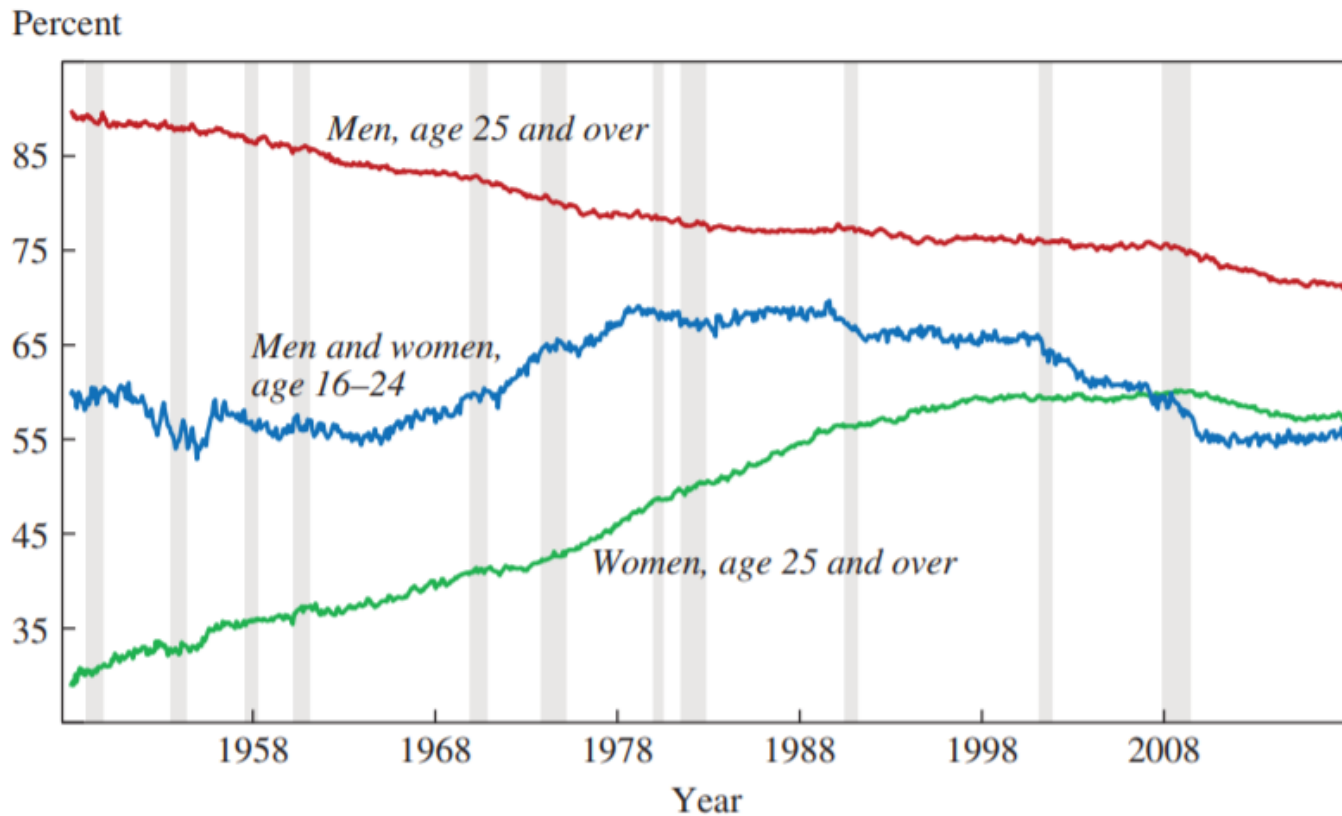
- In Sep 2019, the US labor statistics broke down as follows (millions):

$$\text{Labor Force} = 158.3 \text{ (Employed)} + 5.8 \text{ (Unemployed)} = 164.1$$

$$\text{Unemployment Rate} = (5.8/164.1) \times 100 = 3.5\%$$

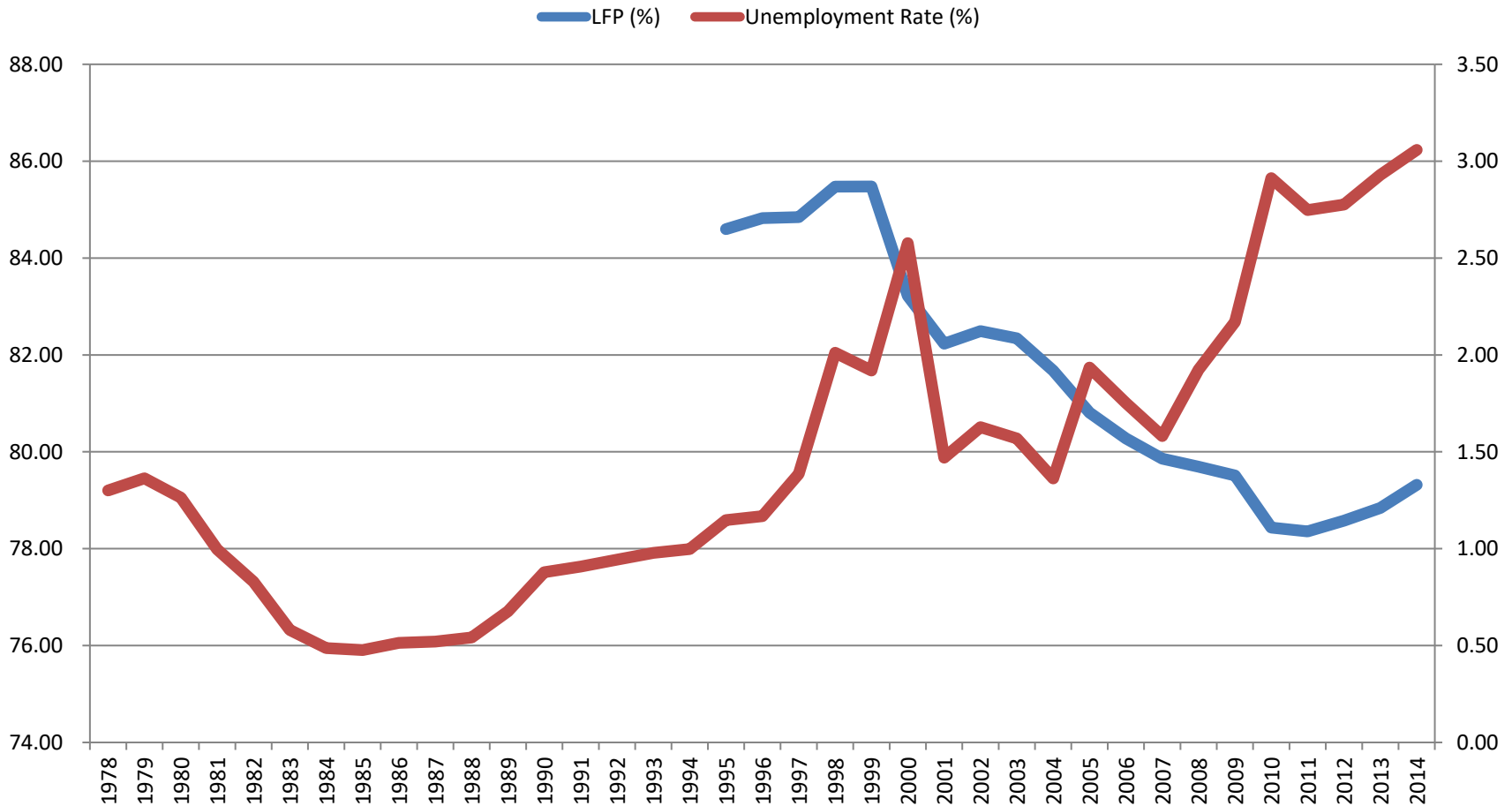
$$\text{Labor-Force Participation Rate} = (164.1/259.6) \times 100 = 63.1\%$$

Case Study I: Trends in US LFP

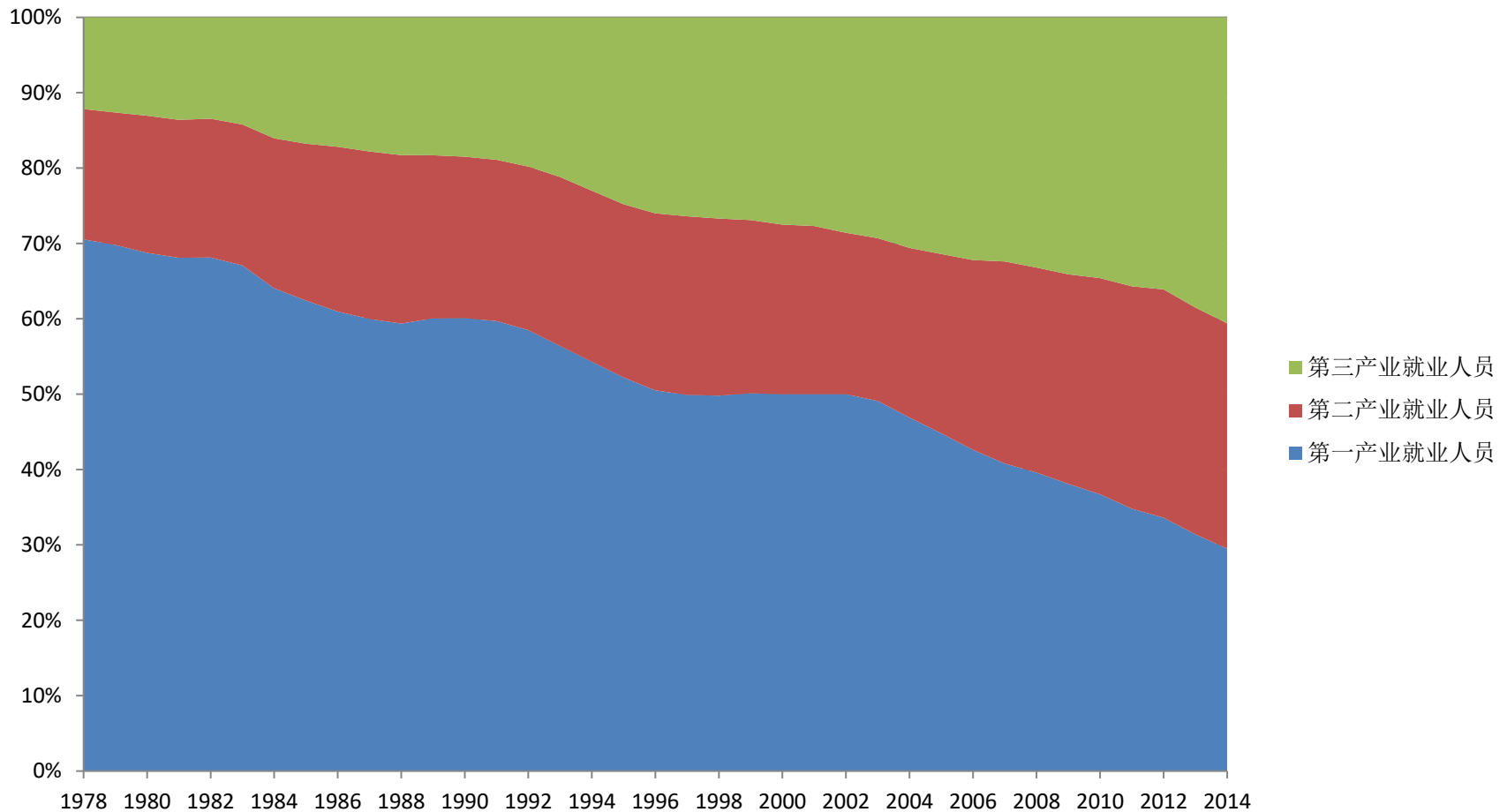


Sources: U.S. Bureau of Labor Statistics; National Bureau of Economic Research.
a. Shading denotes recessions. The data are seasonally adjusted.

Case Study II: LFP and Unemployment Rate in China



Case Study III: The Structural Change in Labor Force



Summary

- Gross Domestic Product (GDP) measures both total income and total expenditure on the economy's output of goods & services.
- Nominal GDP values output at current prices; real GDP values output at constant prices. Changes in output affect both measures, but changes in prices only affect nominal GDP.
- GDP is the sum of consumption, investment, government purchases, and net exports.
- The overall level of prices can be measured by either
 - the Consumer Price Index (CPI),
the price of a fixed basket of goods purchased by the typical consumer
 - the GDP deflator,
the ratio of nominal to real GDP
- The unemployment rate is the fraction of the labor force that is not employed.