Macroeconomic Data

1 Introduction

We know about our economy through the measurement of some key macroeconomic variables such as GDP (Gross Domestic Product), CPI (Consumer Price Index), unemployment rate, and so on. Each of these variables measures one dimension of the economy. For example, GDP measures the total size of the economy, CPI measures the overall price level, and the unemployment rate measures the extent of labor underuse.

On each dimension of our economy, there may be more than one relevant variable. For example, GNI (Gross National Income) is also a good measurement of the total size of the economy. Often these variables complement each other in describing a certain dimension of the economy. For example, GDP emphasizes geographic boundaries, while GNI emphasizes national ownership. The output of foreign enterprises located inside the country is counted in GDP, but not in GNI. Looking at both GDP and GNI (or equivalently, GNP (Gross National Product)) may give us a better picture of the size of the economy.

To each variable, there is also a time dimension. So macroeconomic data are invariably time series, or "realizations" of stochastic processes. Variation of a macroeconomic variable on the time dimension characterizes the dynamics of the economy. For example, the percentage change in GDP characterizes the speed at which the economy grows in size. For another example, the percentage change in CPI characterizes inflation or the speed at which money loses purchasing power.

Macroeconomic data are often systematically collected and compiled by national statistical bureaus, central banks, and other government agencies. In particular, GDP is a direct product of national accounting, which is to measure the economic activity of a nation using a consistent system of accounting technique. From 1952 to 1992, China used the Material Product System (MPS) that was prevailing in socialist countries back then. In 1992 China formally adopted the SNA (System of National Accounting) that was prevailing in western countries. There are two major differences between MPS and SNA. First, as the name suggests, MPS counts only goods output, exclusive of service. Second, SNA uses market prices in the valuation of goods and services, while MPS has to rely on administered prices.

Macroeconomic data can be very general in scope. Any data that help us gauge the state of the economy can be called macroeconomic data. In addition to data from government agencies, market prices for interest rates, exchange rates, stock market valuations, and so on, are of course macroeconomic data. Indices that are based on surveys, such as Purchasing Managers' Indexes (PMI), are also macroeconomic data. It is also well known that output data from key industries can be reliable indicators

for the state of the economy. In China, electricity consumption, the volume of rail cargo, and the total bank loan are well-known indicators for the economy.

In this chapter, we focus on the principles and rules for computing three of the most important macroeconomic variables: GDP, CPI, and unemployment rate. We also show time-series dynamics and cross-country comparisons of these data. These data would help us to gain some basic knowledge of the economy of our country and the world.

2 National Income Accounting

National income accounting is a set of principles and procedures for the measurement of total income and output in an economy. GDP (Gross Domestic Product) and its components are arguably the most important statistics in national income accounting. Other well-known statistics include GNP (Gross National Product) or GNI (Gross National Income), disposable income, etc.. The national income accounting also produces a flow-of-funds table and a balance-of-payments table. Here we focus on GDP and its components.

2.1 Nominal GDP

GDP is a measure of the size of the economy. There are three ways to view and calculate GDP:

(i) the production view: the total market value of final goods and services produced in the economy;

(ii) the income view: the total income generated from all transactions involving final goods and services produced in the economy;

(iii) the expenditure view: the total expenditure on the economy's output of final goods and services.

Note that, in theory, GDP derived from the above views (namely, production-based GDP, income-based GDP, and expenditure-based GDP) should be the same number. The income-based GDP is also called gross domestic income (GDI). In practice, however, they are different from each other since they involve different data sources and statistical procedures. Their differences are called *statistical discrepancies*.[1] Generally speaking, GDP based on production and expenditure is more reliable and timely.

Using the production approach, we formally define (nominal) GDP as the market value of all final goods and services produced within an economy in a given

period (e.g., a year). Mathematically, we have

$$GDP_t = \sum_{i=1}^{M} q_{it} p_{it}, \tag{1}$$

where $q_i t$ and $p_i t$ are quantity and price, respectively, of the i-th item produced period t. Note that $p_i t$ in (1) are current prices that change with time. We call the GDP calculated as in (1) nominal GDP, in contrast to "real GDP" that we will introduce later.

Example: An Economy of Two Trees

Consider an economy of two trees, one apple tree, and the other orange tree. If the apple tree produces 20 apples and the orange tree produces 10 oranges, with their market prices 0.5 and 1.0 RMB, respectively, then the GDP of the twin-tree economy is

$$20 \times 0.5 + 10 \times 1.0 = 20RMB.$$

Note that Equation (1) only counts final goods and services. Intermediate goods, which are parts of final goods, are not individually counted, to avoid double accounting. It is clear that

$$\begin{aligned} \text{GDP} &= \text{value of final goods and services produced} \\ &= \text{sum of value added at all stages of production.} \end{aligned}$$

To avoid double accounting, transactions of used goods are also not counted in GDP. Note that the "used" goods can be new goods to consumers. For example, suppose that Shanghai Motors produces a car in China but does not manage to sell it this year. Instead, Shanghai Motors puts the car into inventory and plans to sell it next year. The national accounting considers the unsold car as an "investment" in this year. When Shanghai Motors sells the car next year, the national accounting will treat the car as "used" and will not count it in next year's GDP.

If, however, a company produces, but fails to sell, a spoilable good (e.g., vegetables), then the good is not counted in GDP at all.

Note also that in computing GDP, we use market prices, when available, to calculate the value of goods and services. When market prices are not available, we use imputed prices, which are estimates of market prices. For example, to calculate the value of housing service, it is common to impute the rent people have to pay to their landlords, who may be themselves if they own their homes. The value of government services, such as police and firefighting, also requires imputation. Typically, the national accounts value these government services in GDP by the wages paid to the public servants.

What GDP Does NOT Include One may argue that "services" of durable goods, such as cars and refrigerators, should also be valued in GDP. But these are omitted for convenience. There are also good reasons to include the value of domestic work performed by house-wives and husbands, such as cooking and washing, into GDP. Typically, however, these are also omitted in practice.

GDP calculation also omits goods and services in the underground economy. The underground economic activity can be substantial. People have incentives to "hide" transactions either because these transactions are illegal, or for tax-avoidance purposes. Illegal transactions include illegal drug trade, human trafficking, and so on. For minor services such as babysitting, the tax administration has little incentive to enforce taxation.

As can be seen, GDP is an inaccurate measure of the size of the economy. Besides, although the general framework for GDP computation is the same across countries, substantial differences exist in detail. As a consequence, comparing GDP across countries can be misleading. However, if the rules of calculation do not change over time, comparisons along the time dimension are meaningful.

2.2 Real GDP

Recall that in equation (1), we calculate GDP using current prices and obtain a nominal GDP. The nominal GDP changes over time because either there is a change in the amount (real value) of goods and services, or there are changes in the prices of those goods and services.

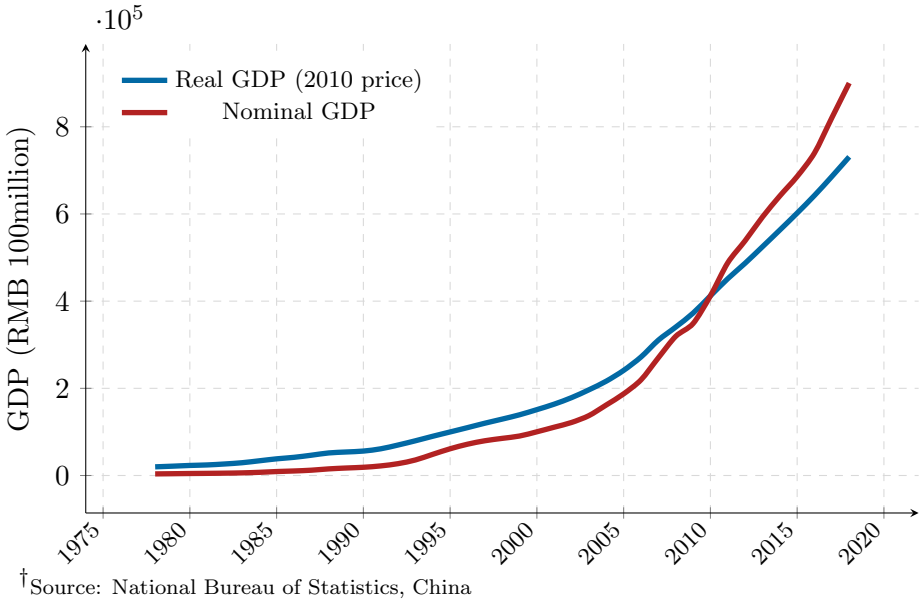
In contrast, real GDP measures the value of final goods and services at constant prices,

$$RGDP_t = \sum_{i=1}^{M} q_{it} p_{i,t_0} \tag{2}$$

where t_0 stands for the base year and p_{i,t_0} is a constant for each i. Taking real measurements is essential for gauging growth or improvement in living quality (e.g., real wage). Using nominal and real GDP, we can define GDP deflator (or implicit price deflator for GDP) as follows, $P_t \equiv GDP_t/RGDP_t$. As we will see later in the chapter, the GDP deflator is a measure of the general price level.

One principle of calculating real GDP is that the base year should not be too distant, ensuring that prices are not too out of date. For example, the cell phone was a rare product 30 years ago. It would be absurd to use the price of cell phones 30 years ago to calculate today's GDP. 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.

Figure 1: China's Real and Nominal GDP



†Source: National Bureau of Statistics, China

Figure 1 shows the real and nominal GDP of China from 1978 to 2012. Since the base year of real GDP is 2010, the lines of real and nominal GDPs cross in the year 2010. We can see in the graph that China experiences rapid growth during the over 30-year period. The growth of nominal GDP is, of course, higher than that of real GDP, reflecting a rising price level. Figure 2 shows the quarterly year-over-year (YoY) growth rate of real GDP from 1992 to 2019. GDP is typically reported every quarter. The quarterly YoY growth rate is calculated as

$$R_t = \log\left(\frac{RGDP_t}{RGDP_{t-4}}\right),$$

where t denotes quarter. The YoY growth rate naturally filters out seasonality.

2.3 Components of GDP

From the expenditure view, we can decompose GDP into four components: consumption, investment, government spending, and net export,

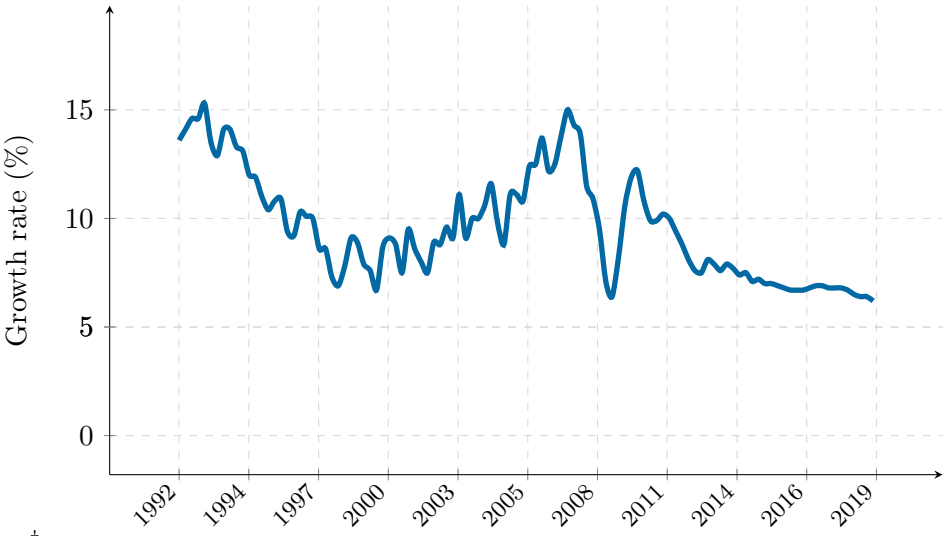
(1) Consumption expenditure by households (C)

(2) Investment expenditure by businesses and households (I)

(3) Government expenditure on goods and services (G)

(4) Net exports (or net foreign expenditure on domestically produced goods) (X)

Figure 2: Real GDP Growth of China (Quarterly)



†Source: National Bureau of Statistics, China

Let Y denote GDP. By definition we have

$$Y = C + I + G + X. \tag{3}$$

We call this equation the national income accounts identity.

Note that C, I, and G include the value of both imported and domestically produced goods and services. Let C^d be the consumption of domestic goods and services, and let C^f be the consumption of imported goods and services. We have $C = C^d + C^f$. Similarly, we have $I = I^d + I^f$ and $G = G^d + G^f$. Now we can have a more detailed decomposition of GDP:

$$Y = (C^d + C^f) + (I^d + I^f) + (G^d + G^f) + EX - (C^f + I^f + G^f),$$

where EX denotes export and obviously, $X = EX - (C^f + I^f + G^f)$. For example, if I buy an imported car, then this purchase should be included in the calculation of C. However, this purchase does not affect GDP since the calculation of X removes the value of the car.

Consumption (C) The consumption component measures the value of all goods and services bought by households. It includes the value of durable goods, non-durable goods, and consumer service. Durable goods are those that last a long time, such as cars, refrigerators, and so on. Non-durable goods last a relatively short time, e.g., food and clothing. Consumer service refers to the work done for consumers by individuals and firms, such as housing, dry cleaning, air travel, and so on.

Chinese consumption data is probably underestimated. First, the consumption of "housing service" is measured in China by multiplying the building cost of

the houses by a depreciation rate (2% for urban houses and 3% for rural houses). This method underestimates the consumption of housing since the building cost is sometimes only a fraction of market value, and the depreciation rate may also be lower than the rental rate of houses. Second, the official statistics do not account for private consumptions that are paid for by company accounts and thus treated as either business costs or investment in the case of durable goods.

Investment (I) The investment component measures the value of total spending on goods bought for future use. There are two types of investment: one is the fixed investment, which adds to the capital stock; the other is inventory investment, which adds to the inventory. The fixed investment conducted by firms is called business fixed investment, which is spending on plants and equipment that firms will use to produce goods and services. The fixed investment conducted by individuals and families is called residential fixed investment, which mainly consists of spending on apartments and houses. The inventory investment measures the change in the value of all firms' inventories.

The fixed investment would increase the stock of capital. For firms, capital is one of the most important factors of production. The more capital a firm has, the higher the capacity the firm has for future production. In aggregate, this is also true: the more capital we have in the country, the higher the potential we have for future production and consumption. Capital, however, depreciates. For example, machines wear and break down eventually. So investment in new capital is essential for maintaining and increasing the stock of capital.

For example, suppose that on 1/1/2016, an economy has a capital stock worth 500. During 2016, there is a fixed investment worth 100 with depreciation worth 20. Then at the end of 2016, the economy has a capital stock worth: 500+100-20=580.

Concepts: Stock and Flow

In economics and accounting, it is important to distinguish the "stock" variables and the "flow" variables. The stock variable measures the quantity at particular time points, while the flow variable measures the change in a given period. We also call stock variables "level variables."

In business accounting, the balance sheet tabulates stock variables such as debt, equity, and so on. And both the income statement and the cash flow statement tabulate flow variables such as revenue, profit, cash inflow, wage layout, and so on.

In national accounting, GDP is a flow variable, since it measures the domestic output in a given period. The unit of annual GDP is Yuan/Year. In contrast, the capital stock in a country is a stock variable with the unit Yuan.

We can meaningfully compare a stock variable with another stock variable, a flow variable with another flow variable. However, it would be meaningless to compare a stock variable with a flow variable, since the stock variable and the flow variable have different units. Nonetheless, it sometimes makes sense to calculate the ratio of a stock variable to a flow variable. For example, we often compare the ratio of total national debt to GDP. Since the unit of the ratio is "Year," the ratio can be understood as the number of years the country would take to pay off the debt, if all income (GDP) is devoted to debt payoff.

An apartment or house is a special piece of capital. We purchase houses for future consumption of "housing service." Spending on new houses is thus investment, not consumption. The housing service the house provides, however, is consumption. Note that it is not double accounting that both we count both the spending on new houses and rents in GDP. All fixed investments are supposed to generate future returns. Business fixed investments generate future profits, and residential fixed investments generate rent incomes.

Unsold output goes into inventory, and is counted as "inventory investment," whether the inventory buildup was intentional or not. If total inventories are 10 at the beginning of the year, and 12 at the end, then inventory investment equals 2 for the year. Note that inventory investment can be negative, which means that inventories fall over the year.

Figure 3 shows the ratio of inventory investment to GDP in China. In the 1980s and the early 1990s, the ratio of inventory investment was high, implying that a substantial amount of factory output ended up unsold. We may understand this phenomenon by noting that the economy was still dominated by the state-

Figure 3: Share of Inventory Investment in GDP

†Source: National Bureau of Statistics, China

owned enterprises (SOEs), which produced goods not to satisfy consumer demand, but to fulfill "plans." As a result, a large-scale mismatch between production and demand persisted in the economy. From the mid-1990s, the inventory ratio declined sharply. To explain the dramatic turnaround, note that China reformed its state-owned enterprises (SOEs) in the latter half of the 1990s. During the reform, the government privatized many small SOEs, and reformed and consolidated large SOEs into modern corporations. As a result, the managerial efficiency of corporate China improved dramatically. Even the remaining SOEs started to behave like business enterprises, constantly adjusting production according to market demand. Thus the share of inventory investment in GDP declined to a healthy level.

Government Spending (G) Government spending includes all government spending on goods and services. To avoid double-counting, G excludes "transfer payments" such as unemployment insurance payments. Transfer payments are, however, included in "government outlays" in the government budget.

Net Export (X) Net export, or balance of trade, equals the total value of export minus that of import in a given period. It represents the net foreign expenditures on goods and services produced in our country. If the net export is positive, we say that the country has a trade surplus. Otherwise, we say that the country has a trade deficit.

Generally speaking, the trade surplus is good, implying that the tradable sector of the country is competitive. A moderate trade deficit, however, is not necessarily bad. The United States, for example, enjoys a special privilege in that other

countries want to hold the US treasury bonds as reserve assets. As a result, the US persistently runs a trade deficit with the world. If the trade deficit becomes excessive (say, over five percent of GDP) and persistent, then some adjustment would have to occur, say, the exchange rate would have to depreciate.

In 2018, China's expenditure-based GDP is RMB 88.4 trillion,

$$88.4\ (Y) = 34.8\ (C) + 39.7\ (I) + 13.2\ (G) + 0.7\ (X).$$

Within investment, there is around RMB 1.6 trillion of inventory investment. In terms of percentages, China's consumption share of GDP is around 39%. And the fixed-asset investment, with a share of 43%, is the largest component in expenditures. In contrast, the US consumption share of GDP is around 2/3, the largest expenditure component in GDP.

2.4 The Income Side of the National Accounts

An important measure of aggregate income is the gross national income (GNI), which is the sum of household income in a given period. The relationship between GNI and GDP is as follows,

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

GNI is conceptually the same as the gross national output (GNP). In international statistics, GNI has gradually replaced GNP. For large countries with diversified industries, GDP and GNI should be similar. Small countries with one or two dominant industries (e.g., oil), GDP and GNI can differ substantially from each other.

Recall that the income-based GDP is also called gross domestic income (GDI). In theory, GDI should equal GDP, but they usually yield different results. The difference between GDI and GDP is called *statistical discrepancy*,

$$\text{GDI} = \text{GDP} - \text{statistical discrepancy}.$$

The national income (NI) is defined as

$$\begin{aligned} \text{NI} &= \text{GDI} + \text{net factor payment from abroad} - \text{depreciation} \\ &= \text{GNI} - \text{depreciation} - \text{statistical discrepancy} \end{aligned}$$

Personal income is defined as the income received by all individuals or households from all sources (e.g., wage, dividend, interest, etc.) in a given period (say, a year). Disposable personable income (or simply, disposable income) is defined as the personal income minus personal tax and nontax payments.

3 Price and Inflation

In macroeconomics, price is often a shorthand for the general price level for an economy as a whole. And inflation is a sustained increase in the general price level of goods and services in an economy over a time interval, say, a year. In this section, we discuss two popular measures of the general price level, CPI (Consumer Price Index) and GDP deflator.

3.1 CPI

CPI is an index that measures the overall level of prices for consumers. A government agency (Bureau of Statistics in China, Bureau of Labor Statistics in the US) determines a vector of weights that reflect the proportions of each item in a basket of goods and services consumed by a typical customer. Using this weight vector, the agency then computes an index,

$$CPI_t = c_0 \frac{\sum_i q_{i,t_0} p_{it}}{\sum_i q_{i,t_0} p_{i,t_0}}, \tag{4}$$

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. Note that we may define

$$w_i = \frac{q_{i,t_0} p_{i,t_0}}{\sum_i q_{i,t_0} p_{i,t_0}},$$

which is the fraction of expenditure on the i-th item in the consumption basket. Then the equation (4) can be written as

$$CPI_t = c_0 \sum_i w_i \frac{p_{it}}{p_{i,t_0}}. \tag{5}$$

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 listed in the following table:

Year	Apple	Orange
2016	6	3
2015	5	2

Now we calculate CPI using 2015 as the base year. According to the consumption of 2015, we can calculate the weights for the consumption basket,

$$w_{apple} = \frac{5 \times 20}{5 \times 20 + 2 \times 10} = \frac{5}{6}, \quad w_{orange} = \frac{2 \times 10}{5 \times 20 + 2 \times 10} = \frac{1}{6}$$

If $c_0 = 100$, then the CPI for 2016, using the consumption basket of 2015 as weights, is given by

$$CPI_{2016} = 100 \cdot \left(w_{apple} \cdot \frac{6}{5} + w_{orange} \cdot \frac{3}{2} \right) = 125.$$

The CPI for 2015, the base year, is obviously 100. Since the rate of change in CPI is inflation, we have that the inflation in 2016 is 125/100-1=25%.

The government typically reports inflation data every month. Within each year, inflation exhibits strong seasonality. In China, for example, the price level reaches the high point during the Spring Festival every year. As a result, seasonal adjustment is often necessary before any analysis of inflation based on CPI.

To deal with the seasonality, China's National Bureau of Statistics reports the following monthly CPI:

$$CPI_t = \sum_i w_i \left(\frac{p_{it}}{p_{i,t-12}} \right) \times 100\%. \tag{6}$$

Here the subscript t represents the month. The above CPI_t gives us, essentially, the year-on-year inflation rate. For example, if we obtain $CPI_{2018-10} = 103$ from (5), then it means that the year-on-year inflation rate of 2018-10 is 3%. This statistic does not eradicate, only mitigates, the seasonality problem, because the Spring Festival may fall in different months. Furthermore, it loses information on month-to-month variation.

The so-called "core inflation" measures the increase in the price of a consumer basket that excludes food and energy products. The food and energy prices are largely dependent on some key commodities (e.g., corn, oil, etc.) and thus often very volatile. China's National Bureau of Statistics does not report core inflation.

The statistics bureau determines the composition of the consumption basket and the weights assigned to each item by conducting household surveys. The composition of the basket has to change over time, as consumer behavior changes over time. For example, as income per capita increases, the proportion of income spent on food would fall (i.e., Engel's law). As a result, the share of food in the basket should decrease during economic growth. Even within the category of food, the share of grain would decrease, and that of meat would increase, as people's lives improve. In China, the statistics bureau adjusts the CPI basket every five years.

The fact that a country calculates its CPI using one basket implies that the CPI reflects the price level facing an "average consumer." For a diverse country like China and the US, this average consumer is elusive. Naturally, many people would feel that the CPI gives a biased measure of the living cost. In most cases, since price increases are more infuriating and news-worthy, people would feel that the CPI understates inflation systematically.

There are, however, good reasons to argue that CPI tends to overstate inflation. First, there is the so-called substitution bias. Since the CPI uses fixed weights, it

cannot reflect consumers' ability to substitute toward goods whose relative prices have fallen. In other words, when one item in the consumption basket becomes more expensive, the weight of this item should decrease. But the CPI calculation ignores this possibility. Second, the introduction of new goods makes consumers better off and, in effect, increases the value of the money. But this does not reduce the CPI, also due to the fixed weights. Third, quality improvements increase the value of the money, but they are also conveniently ignored.

The National Bureau of Statistics of China also publishes a PPI (producer price index) that measures the average price changes of the industrial goods from domestic producers. The rules of calculating PPI is the same as CPI, with a different basket that contains a representative list of wholesale goods. For historical reasons, China's PPI basket does not contain agricultural goods and services. Because many industrial goods are inputs to the production of consumption goods, PPI is widely believed to be a leading indicator for CPI.

3.2 GDP Deflator

There is another statistic that can be used to measure inflation, the GDP deflator. Recall that we define GDP deflator by

$$P_t = \frac{Y_t}{y_t} = \frac{\sum_i q_{it} p_{it}}{\sum_i q_{it} p_{i,t_0}}, \tag{7}$$

where y_t is the value of output at the price level of the year t_0 (base year), q_{it} is the output of i-th item in year t. If we define $w_{it} = \frac{q_{it} p_{i,t_0}}{\sum_i q_{it} p_{i,t_0}}$, then we obtain $P_t = \sum_i w_{it} \cdot \left(\frac{p_{it}}{p_{i,t_0}} \right)$, which is a weighted average of price increases just like CPI.

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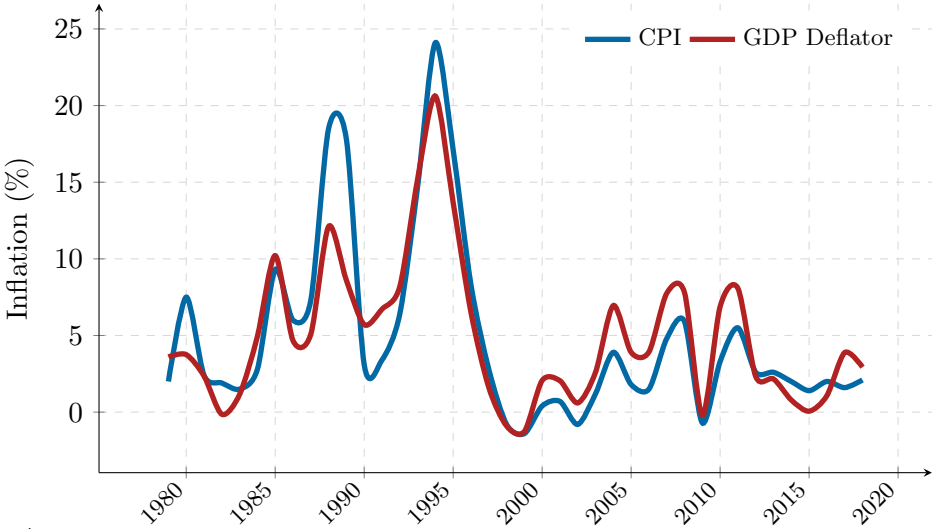
However, there are two major differences between CPI and GDP deflator. First, the baskets of goods and services are different. The basket for GDP deflator contains all final goods and services produced domestically. The weight of each item is proportional to the total output of each item. But the CPI basket contains only those goods and services consumed by an "average consumer." The weight of each item is proportional to the consumption of the item by the average consumer. For example, 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. For another example, imported consumer goods are not a part of GDP and therefore don't show up in the GDP deflator, but they are in the CPI basket. Second, GDP deflator is available at the frequency as GDP, which is typically quarterly data. But CPI is typically monthly data. Third, the weight for GDP deflator changes every quarter since the composition of output changes every time, while that for CPI changes much more slowly (roughly every five years in China).

Given a measure of the general price level, say P_t, we may calculate inflation

Figure 4: China's Annual Inflation in CPI and GDP Deflator



†Source: National Bureau of Statistics, China

by taking percentage change of P_t,

$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1.$$

Or, we may take logarithm difference of P_t,

$$\pi'_t = \log\left(P_t/P_{t-1}\right),$$

Where $\log(\cdot)$ is natural logarithm. Note that π is an approximation to π'_t since

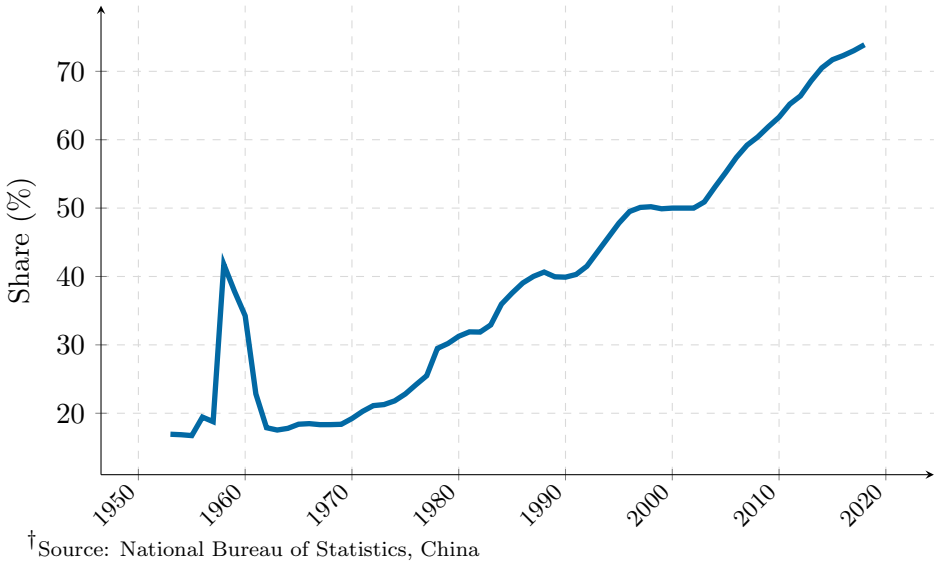
$$\log\left(P_t/P_{t-1}\right) = \log\left(1 + \frac{P_t - P_{t-1}}{P_{t-1}}\right) \approx \frac{P_t - P_{t-1}}{P_{t-1}}.$$

Figure 4 shows the annual inflation measured by CPI and GDP deflator. From 1979 to 2018, there are about eight cycles of inflation. The four inflation cycles before the mid-1990s are more volatile, while those after the mid-1990s are moderate. While CPI inflation and GDP deflator inflation generally move together in each cycle, there are substantial quantitative differences.

4 Employment

In macroeconomics, employment is shorthand for total employment, which is the number of employees in the economy. The measure of employment typically excludes business owners, household employees, unpaid volunteers, and the unincorporated self-employed. Total employment is a measure of the utilization of human resources.

Figure 5: Share of Nonfarm Employment in China



†Source: National Bureau of Statistics, China

Nonfarm Employment Sometimes it is helpful to focus on nonfarm employment, the measure of employment that excludes farmers and farm employees. Changes in nonfarm employment give us valuable information on business cycles. For example, the monthly Total Nonfarm employment data of the US is a popular indicator of the US business cycles. The ADP national employment report of the US, which tracks the US nonfarm private-sector employment, is also closely scrutinized by the capital market.

For developing countries like China, changes in the share of nonfarm employment in total employment also reflect the pace of economic development. Economic development is almost synonymous with industrialization. As an agricultural economy develops, more and more people would leave the agricultural sector for the industrial and service sector. Consequently, the share of nonfarm employment may exhibit a secular upward trend, as we can see in Chinese data since the 1970s (Figure 5).

Unemployment Rate We may define unemployment as the situation of someone above a specified age (usually above 15) who wants to work but cannot find a job. If someone neither has a job nor is looking for one, then he is not considered unemployed. Instead, we say that he has withdrawn from the labor force. We define the unemployment rate as the percentage of the labor force that is unemployed:

$$\text{Unemployment rate} = \frac{\text{Number of the unemployed}}{\text{Labor force}}, \tag{8}$$

where the *labor force* is the sum of the employed and the unemployed. The unemployment rate is a measure of how difficult one can find a job. It is also a measure of

how *tight* the labor market is. A high unemployment rate means that it is difficult for an unemployed to find a job. But it also means that it is easy for employers to find workers.

Labor-Force Participation Rate A related ratio is the labor-force participation (LFP) rate, which is the percentage of the adult population (say, above age 15) who are in the labor force:

$$\text{Labor force participation rate} = \frac{\text{Labor force}}{\text{Adult population}}. \tag{9}$$

China's Population and Labor Statistics

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

$$\begin{aligned} 1395.4(\text{Population}) &= 235.2(\text{Children, Age 0-14}) + 1160.2(\text{Adults}) \\ 806.7(\text{Labor force}) &= 775.9(\text{Employed}) + 29.8(\text{Unemployed}) \end{aligned}$$

Then,

$$\begin{aligned} \text{Unemployment rate} &= \frac{29.8}{806.7} = 3.7\% \\ \text{Labor-force participation rate} &= \frac{806.7}{1160.2} = 69.5\% \end{aligned}$$

5 Money Supply

Money in a modern economy may include cash, demand deposits, saving deposits, money market funds, and so on. The supply of money is ultimately controlled by the monetary authority (the central bank), which also records and publishes money supply data.

Different types of money differ mainly in liquidity. Cash is the most liquid money while saving deposits are much less liquid. The fact that there are different types of money poses a problem for the measurement of the total money supply in the economy. Central banks use several measures (M0, M1, M2, etc.), classified along a spectrum between the narrowest and the broadest measurements. Narrow measures include the most liquid types of money, while broad measures include illiquid money.

Typically, narrow measures of money supply are largely in agreement in different countries. For example, M0 typically measures all physical currency including

Table 1: The Definitions of Money Supply

	China	US
M0	physical currency	physical currency
M1	M0 + demand deposits	M0 + demand deposits + travelers checks + other checkable deposits
M2	M1 + saving deposits	M1 + saving deposits (including money market deposits) + retail money market mutual fund balances + small time deposits.

coinage. For another example, the base money (MB) is the value of all physical currency plus bank reserves at the central bank (including required reserve and excess reserve). However, each central bank may use different names. For example, the Bank of England's "narrow money (M0)" roughly corresponds to MB in the US and China.

However, broader measures of the money supply may differ substantially in each country. We can see this in Table 1, which tabulates the defintion of M0, M1, and M2 in the US and China. As a result of different definitions, it may be misleading to compare broad money supply across countries.

Notes

[1]In China's Statistical Year Book, GDP calculated from the production view is listed in Table 3-1 (Gross Demostic Product, 国内生产总值), GDP calculated from the expenditure view is listed in Table 3-11 (Gross Domestic Product by Expenditure Approac, 支出法国内生产总值). The National Bureau of Statistics does not directly report income-based GDP. But there three ways to calculate it from other data: (i) aggregation of province data; (ii) the non-financial flow-of-funds table (非金融资金流量表); (iii) the input-output table (intermediate use) (投入产出基本流量表, 中间使用部分). The quality of province data is poor. The quality of the other two is good, but they are available only with a significant delay.

Exercises:

1. Categorize each of the following transactions into one of four components of GDP: (household) consumption, investment, government consumption, and net export.

(a) Huawei sells a computer to the army.

(b) Huawei sells a computer to Taobao.

(c) Huawei sells a computer to a Chinese resident in Shanghai named Junhui Qian.

(d) Huawei sells a computer to a local government in Japan.

(e) Huawei produces a computer but fails to sell it this year (hopefully sell it next year).

2. A farmer grows a ton of wheat and sells it to a miller for 500 RMB. The miller uses the wheat (the only input) to produce flour and sells the flour to a baker for 1000 RMB. The baker uses the flour to make bread. Consumers buy these bread for 3000 RMB.

(a) What is the value-added in each stage of the production of bread?

(b) If the farmer, miller, baker, and the consumers constitute an economy, what is the GDP for this economy?

3. Find Chinese GDP data and list the shares of consumption, investment, government consumption, and net export in 1980, 1995, and 2010. (Note: Data are available on: http://www.stats.gov.cn)

4. In the twin-tree economy, the production and consumption of apples and oranges are as follows,

	Apple		Orange	
Year	Production	Consumption	Production	Consumption
2016	25	20	15	12
2015	15	10	10	8

Note that the differences between "Production" and "Consumption" are exported. And the market prices for apples and oranges are:

Year	Apple	Orange
2016	6	3
2015	5	2

(a) Compute the nominal GDP of the twin-tree economy for both 2015 and 2016.

(b) Compute the real GDP of 2016 using the 2015 price.

(c) Compute the CPI for 2016 using 2015 as the base year. (Let the CPI of 2015 be 100.)

(d) Compute the GDP deflator for 2016, using the 2015 price. (Let the GDP Deflator of 2015 be 100.)

(e) Compute the GDP deflator for 2015, using the 2016 price. (Let the GDP Deflator of 2016 be 100.)

5. Find the nominal and real GDP of China, calculate and plot the annual GDP deflator from 1978 to 2016. Compare the inflations of CPI and GDP deflator.

6. Suppose that an economy has 100 people, divided into 9 groups:

Group	Description	Number of people
1	Have full-time jobs	30
2	Have one part-time job	10
3	Have two part-time jobs	5
4	Would like to work and are looking for jobs	10
5	Would like to work, but have given up looking.	5
6	Running their own business	10
7	Retired	15
8	University students	5
9	Small children	10

(a) Compute the labor force and the labor force participation rate.

(b) Compute the unemployment rate.