1 Measuring GDP

GDP:Market value of domestically produced final goods and services. within a year or a quarter.

1.1 The Product Approach

We will calculate the value of the *final goods and services* excluding the intermediate ones which are used up in the production of other goods and services in the same period that themselves are produced.

Capital goods which are used to produce goods are included. *Inventory investment* which is the amount that inventories of unsold finished goods, goods in process and raw material *have changed* in this period. It's can also be done to add up *value-added*. Tax is another form of adding value on the product from the government.

$$Value - added = Total\ Revenue - value\ of\ intermediate\ goods.$$

1.2 The Expenditure Approach

It's the standard approach for calculating GPD in most countries. It's consists of several aspects:

Consumption: spending by domestic households on final goods and services including Consumer durables, nondurable goods and services.

Investment: spending for new capital goods (fixed investment) plus inventory investment(the change in the quantity of goods that firms hold in storage, including materials and supplies, work progress and finished goods. *Raw material* is not counted as investment as they will be turned in to product ultimately.

Government purchases of goods and services: Not all government expenditure are purchases of goods and services like interest rate of debt, transfers, and exchange not counted in current goods and services. Some spending is for capital goods to add nation's capital stock.

Net exports: $Net\ Exports = Exports - Import$

$$\begin{aligned} GDP &= (C - C_M) + (I - I_M) + (G - G_M) + X \\ &= C + I + G + NX \end{aligned}$$

1.3 The Income Approach

Private sector:

$$Private\ sector = Y(GDP) + NPF + TR + INT - T$$

Government sector:

$$Government\ sector = T - TR - INT$$

$$
\begin{aligned}
GDP = & \, After\text{-}tax\ Wage\ Income \\
& + After\text{-}tax\ Profit \\
& + Interest\ Income \\
& + Taxes
\end{aligned}
$$

Income forms the basis for Expenditure(demand), Disposition of Expenditure determined Production(supply), and Revenue of Supply becomes Income. Three approach will get identical GDP.

1.4 Example

Example1: Consumption outside of home country.$\Delta C = +6, \Delta NX = -6$

Investment means that the good will generate new revenue, while consumption will not generate new revenue.

Inventory investment;

1.4.1 GDP and GDP per capita

Gini coefficient – income inequality, the welfare of the economy Poverty line – the number of people below the line to evaluate

Gross national product(GNP): Total income earned by the *nation's* factors of production, regardless of where located. This is used to estimate the completely national production.

GNP - GPD = net factor payments(NFP). Factor payments such as profits(by capital), wages(by labour), rent, interest, etc. When NFP < 0, it means that the country receives foreign economic factors.

1.5 Which market price to use

Nominal GDP uses the values of goods and services at current prices.

Real GDP uses the the values of goods and services at constant years. It is used to observe the real development concentrating on quantity rather than price. The gap of real GDP and Nominal GDP symbolizes inflation.

1.6 Inflation

Inflation Rate:

$$\frac{P_t - P_{t-1}}{P_{t-1}}$$

How to measure overall price level: *GDP deflator* and *CPI(consumer price index)*, PPI, PMI, housing price, etc.

1.6.1 GDP deflator and CPI

The GDP deflator is defined as:

$$100 \times \frac{Nominal\ GDP}{Real\ GDP}$$

GDP delator: a weighted sum of prices. Every year GDP is contributed by different goods, and the changing baskets of goods are described by *paasche index*

Consumer Price Index(CPI): tracking changes in the typical household's cost of living. The cost will be calculated among the typical consumer's baskets of goods. The baskets are described by *Laspeyres index*

$$CPI = 100 \times \frac{cost\ of\ basket\ in\ that\ month}{cost\ of\ basket\ in\ base\ period}$$

Head Inflation: describe the total inflation from all areas and may experience sudden inflationary spikes like food and energy.

Core inflation: exclude certain items that faces volatile price movements, notably food and energy. This is commonly used. CPI is also a weighted sum of prices, while the weights remain fixed as the baskets are fixed.

The overstating of inflation rate by CPI:

a. Situation bias

b. Introduction of new goods

c. Quality bias

Differences between CPI and GPD Deflator:

a. Prices of capital goods (exclude / included)

b. Prices of imported consumer goods (included / excluded)

c. The baskets of goods (fixed / changing)

d. Different frequencies (monthly / qtrly)

1.6.2 PPI & PMI & House Price

Producer Price Index(PPI): a weighted index of prices measured at the wholesale, or producer level. It's also based on survey.

Asset Price Inflation: The rise of asset price. Inflation often refer to the consumer side.

Purchasing Managers' Index(PMI): is based on data compiled from monthly replies to questionnaires sent to purchasing executives. A reading above 50 indicates an expansion of the sector while blow 50 represents a contraction.

There are two different types of PMI. *Official PMI* is based on data collected by the NBS on State-owned companies. *Private PMI* is derived rin a survey of private companies.

1.7 Categories of the population

Employed: Working at a paid job

Unemployed: not employed but looking for a job

Labor forces: the amount of labor available for producing goods and services; all employed plus unemployed persons.

no in the labor force: not employed, not looking for work, such as distressed worker.

$$Unemployment\ rate = \frac{Number\ unemployed}{Labor\ force}$$

$$Labor\ force\ participation\ rate = \frac{Labor\ force}{Total\ working\ age\ population}$$

2 The Labor Market: Productivity, Output, and Employment

2.1 The production function: $Y = A \cdot F(K, L)$

2.1.1 Factors of production

K = capitals: tools, machines, and structures used in production.

L = labor: the physical and mental efforts of workers. (also commonly denoted as N in macro)

A = other: Total Factor Productivity[TFP](Management, Weather, Policy, Technology, etc)

Potential GDP: the GDP with full-employment output

2.1.2 Property

Slopes Upward: More of any input produces more output.

Diminishing marginal products: Slope becomes

Marginal Product of Capital: The extra output the firm can produce from an additional unit of capital.

$$MPK = F(K+1, L) - F(K, L) = \frac{\partial F}{\partial K}$$

Marginal Product of Labor: The extra output the firm can produce from an additional unit of labor.

$$MPL = F(K, L+1) - F(K, L) = \frac{\partial F}{\partial L}$$

MPK and MPL, as the property, are always positive and has a diminishing rate. Their units are in *goods* per unit of labor.

Diminishing Marginal Returns: As only one input is increased, its marginal product falls.

Returns to scale: scale all inputs by the same factor, $Y_1 = F(K_1, L_1)$, $Y_2 = F(zK_1, zK_2)$:

Constant returns to scale: $Y_2 = zY_1$

Increasing returns to scale: $Y_2 > zY_1$

Decreasing returns to scale: $Y_2 < zY_1$

2.1.3 Cobb-Douglas Production Function

$$Y = AK^{\alpha}L^{1-\alpha}$$

Each factor's marginal product is proportional to its average product.

$$MPK = \frac{\alpha Y}{K}, \quad MPL = \frac{(1-\alpha)Y}{L}$$

α is the capital share of total income, with a constant returns to scale.

$$Capital\ income = MPK \times K = \alpha Y$$
$$Labor\ income = MPL \times L = (1-\alpha)Y$$

2.1.4 Supply shock

Supply shocks are derived from the influence of supply side without control. It has *positive* shock and *adverse(negative)* shock.

2.2 The Demand for Labor

Assumptions: Short-run analysis, workers are indifferent, markets are competitive, Profit maximization. The cost is real wage $w = \frac{W}{P}$(P is average product, like CPI, GDP deflator); benefit = MPL; The maximization is $w = MPL$.

Labor demand curve is exactly the MPL curve as $w = MPL$. So the labor demand curve is downward sloping.

The difference of Move Along the Curve and Shift the Curve. Move Along the Curve describe the relationship between the elements along the fixed curve. Shift the Curve is move the curve as some circumstances change, so with a given element another element change.

Factors that shift the labor demand curve(depend on the factors of MPL): Productivity, Capital stock.

Aggregate demand for labor is the sum of the labor demands of all firms in the economy.

2.3 The Supply of Labor

The Income-leisure tradeoff: $U(C, L)$ is judged. The income and substitution effects are also included.

Substitution effect: Higher real wage encourages work, since reward for working is higher, relying on short-turn.

Income effect: Higher real wage increases income for same amount of work time, so person can afford more leisure, soo will supply less labor, relying on long-run or permanent change.

The factor that shift the labor supply curve: Wealth and Expected future real wage.

A temporary rise of real wage(Substitution effect) will increases labor supply, while a permanent increase in the real wage will make the labor supply falls.

Aggregate supply of labor is the total amount of labor supplied by everyone in the economy. Other factors for Aggregate supply are Working-age population and Participation rate.

2.4 Labor market equilibrium

Aggregate quantity of labor demanded = aggregate quantity of labor supplied. However wage is sticky and may be above the equilibrium which leads to unemployment.

Example of changes: government policy to production / retirement age.

3 Goods Markets

Assume it is in closed economy with $NX = 0$, $GDP = GNP$,

$$NFP = 0$$

.

Aggregate demand(spending) represents equilibrium of goods and services:

$$Y = C + I + G + NX = C + I + G$$

The conversion of this equation means the *national savings* and represent equilibrium of loanable funds.

$$I = Y - C - G$$

3.1 Consumption and Saving

Household(disposable income $Y - T$):

$$S = (Y - T) - C$$

C^d is the aggregation of consumption amount desired by households. The C^d can be perceived as:

$$C^d = \sum_{i=1}^{N} C_i$$

The household will finally sum together and translate to the aggregate level.

Desired national saving(which is the planned saving and investment to find the equilibrium):

$$S^d = Y - C^d - G$$

The consumption and savings lead to savior and borrower which is two faces of one thing. The savings introduce tradeoff between current consumption versus future consumption, measuring by real rate.

3.1.1 Interest Rate

Interest Rate: a rate of return promised by a borrower to a lender.

Real Interest Rate: rate at which the real value f an asset increases over time, representing real purchasing power.

Nominal Interest Rate: rate at which the nominal value of an asset increases over time on the normal contrast, affected by the inflation rate.

Fisher effect:

$$(1 + i) = (1 + r)(1 + \pi)$$

$$i = r + \pi + r\pi$$

As $r\pi$ is very small and it can be neglected.

$$r = i - \pi$$

r is derived from goods market equilibrium and π can be observed. As π needs to be expected to introduce ex-ante rate(prior, before realization):

$$i^e = r + E\pi$$

We also have a after realization we will have a ex-pose i similar to the above. This equation can be used to represent inflation rate's feature. The expected interest rate is usually used. The price of 1 unit of current consumption is $1 + r$ units of future consumption.

3.1.2 Consumption-smoothing Motive

It's the desire to have a relatively even pattern of consumption over time.

Permanent Income Hypothesis: Focuses in what consumers do with stochastic income receipts, which is not very suitable for China.

Life-cycle Hypothesis: Focuses on predictable changes in income over the life cycle.

The hypothesis tries to explain the consumption-smoothing motive.

3.2 Consumption function

Marginal Propensity to Consume: the change in C when disposable income increase by one dollar. MPC is in the range of $(0, 1)$ due to consumer-smoothing motive. MPC is actually the slope of consumption function in household level, which can be used to evaluate aggregate level C^d.

$$MPC = \frac{\Delta C}{\Delta(Y - T)}$$

Factors will affect consumption will present as followed.

3.2.1 Current Income Y_t

As $Y_t \uparrow$, both consumption and savings $\uparrow$ as $0 < |\Delta C| < |\Delta(Y_t - T_t)|$ (consumption-smoothing motive). The aggregate level has a similar change.

$$\Delta C_{t+1} = \Delta Y_t \times MPC \times (1 + r)$$

3.2.2 Expected Future Income

Higher expected future income leads to more consumption today with saving falls like deflation. Deflation will discourage consumption.

3.2.3 Changes in Wealth

$$Wealth = Asset - Liability$$

$$Savings = Current\ Income - Current\ Expenditure$$

Savings can contribute to wealth. Wealth is not a part of saving. When wealth $\uparrow$, consumption $\uparrow$, savings $\downarrow$, which is similar to mechanism of future income.

3.2.4 Changes in Real Interest Rate

Increased real interest rate has two opposing effects. For saver, interest rate is benefit of saving:

Substitution effect: positive effect on saving, since rate of return is higher.

Income effect: negative effect on saving, since it's easier to save to obtain a given amount in the future.

For borrower, interest rate is the cost of borrowing.

Substitution effect: positive effect on savings, since the cost is higher.

Income effect: Positive effect on saving, since the higher real interest rate means a loss of wealth.

The mixed result will result in a slightly positive slope between r and S^d

3.2.5 Changes in Tax

Interest earning are taxed: t is the rate at which nominal interest income is taxed. Expected after-tax real interest rate:

$$r_{a\text{-}t} = (1-t)i - E\pi$$

The tax will affect interest rate, which influence consumption.

3.2.6 Fiscal Policy

The fiscal policy is under balanced Gov Budget:

$$Gov\ Budget = T - G - 0$$

Affects desired consumption through changes in current and expected future income. it will directly affect desired national saving.

There are two channels:

An increase in current government purchases (G)

Adjusting the timing of taxes to change consumption behavior.

Government purchases(temporary increase): There two approaches to compensate $G\uparrow$: $T_t\uparrow$ or $T_{t+1}\uparrow$:

$$T_t \uparrow \Rightarrow\ 0 < |\Delta C| < |\Delta(Y_t - T_t)|$$
$$S = (Y_t - T_t) - C_t,\ MPC < 1, \quad S\downarrow$$
$$S^d = Y_t - C_d - G,\ |\Delta C| < |\Delta G| = |\Delta T_t|, \quad S^d\downarrow$$

$$T_{t+1}\uparrow \Rightarrow (Y^e_{t+1} - T_{t+1})\downarrow \Rightarrow C_t\downarrow$$
$$S = (Y_t - T_t) - C_t,\ \Delta C < 0,\ \Delta T_t = 0, \quad S\uparrow$$
$$S^d = Y_t - C_d - G,\ |\Delta C| < |\Delta G| = |\Delta PV(T_{t+1})|, \quad S^d\downarrow$$

Adjusting of the timing of taxes:

Assumption(Ricardian equivalence proposition): If future income loss exactly offsets current income gain, no change in consumption as people are rational. $T_t\uparrow$ and $T_{t+1}\downarrow$

$$S = (Y_t - T_t) - C_t,\ \Delta C_t = 0,\ \Delta T_t \uparrow, \quad S \downarrow$$
$$S^d = Y_t - C_d - G,\ \Delta C^d = 0,\ \Delta G = 0, \quad \Delta S^d = 0$$

Assumption(Myopic): In practice, people may not see that future taxes will rise if taxes are cut today. $T_t \uparrow$ and $T_{t+1} \downarrow$

$$S = (Y_t - T_t) - C_t,\ |\Delta C_t| < |\Delta(Y - T_t), \quad S \downarrow$$
$$S^d = Y_t - C_d - G,\ \Delta C^d < 0,\ \Delta G = 0, \quad S^d \uparrow$$

3.3 Investment

Investment refers to the purchase or construction of capital goods, including residential and nonresidential buildings, equipment and software used un production, and additions to inventory stock. Investment intends to fluctuate over the business cycle. Investment decision has a time delay differing from labor markets.

3.3.1 desired capital stock

Desired Capital Stock is the amount of capital that allows firms to *earn the largest expected profit*($Max\ E_t(profit_{t+1})$. Desired capital stock depends on costs and benefits of additional capital, similar to labor market with expected profit. For each unit of investment, the balance is seeked similar to labor market:

$$MPK^f = E_t(\frac{\Delta Y_{t+1}}{\Delta K_{t+1}}) \ = uc \ \Rightarrow E_t(benefit_{t+1}) = E_t(cost_{t+1})$$

The benefit of this can be using the Expected production function.

$$p_k = \text{real price of capital goods per unit}$$
$$d = \text{depreciation rate}$$
$$e = \text{expected real interest rate}$$

To get expected cost per unit, we define user cost as two parts include depreciation rate and expected real interest rate:

$$uc = p_k \times (r + d)$$

uc is a horizontal line and doesn't vary with K, like the cost w for per-unit labor. The factors are changes in the real interest rate, depreciation rate , price of capital, or technology factor that will affect MPK^f.

With taxes, the return to capital is only $(1 - \tau)MPK^f$). It can be also be considered the increase in uc. This is the tax-adjusted user cost of capital is $\frac{uc}{1-\tau}$

3.3.2 Investment and capital stock

The capital stock changes from two opposing channels: New capital increases the capital stock; The capital depreciates.

$$K_{t+1} - K_t = I_t - d_{K_t}$$

Rewrite the equation to get the Investment:

$$I_t = K_{t+1} - Kt + d_{K_t}$$

$-K_t + dK_t$ is fixed in the decision to the investment. The investment decision relies solely on the desired capital stock in one-on-one relationship. This also means investment covers the net increase in capital stock and depreciation.

The investment is derived from desired capital stock, and desired capital stock is derived from MPK^f and uc.

3.4 Goods

For goods market equilibrium: Aggregate quantity of goods supplied = aggregate quantity of goods demanded(desired).

$$Y = C^d + I^d + G$$

The real interest rate adjusts to bring the goods market to equilibrium.

Goods market equilibrium is changed to loanable funds.

$$S^d = I^d$$

Both of them are a function is dependent on interest rate, forming Saving curve S and Investment curve.

Factors for S^d: Y, Y^e, W, $G \uparrow T \uparrow$, $T_t \uparrow T_t \downarrow$.

Factors for I^d: d, uc, τ, MPK^f

the interest rate here is the representation of all rates for the structure of interest rate.

4 Asset Market: the Monetary System and the Quantity Theory of Money

4.1 Asset Market

4.1.1 Money

Money is the stock of assets can be readily used to make transactions;

Functions :

a). medium of exchange;

b). store of value;

c). unit of account;

Types:

a). Fiat money: has no intrinsic value

b). Commodity money: has intrinsic value, e.g. gold coins;

The *money supply* is the quantity of money available in the economy. *Monetary policy* is the control over the money supply. Monetary policy is conducted by a country's *central bank*.

measurements: C, $M1$, $M2$

$$M = C + D$$

Reserves(R): the portion of the deposits that banks have not lent

A bank's liabilities include deposits and Asset include reserves and outstanding loans. Due to the Reserves, there are 100-percent-reserve banking and fractional-reserve banking.

When all money deposited in the bank:

$$\text{Money Supply} = \frac{1}{rr} * C$$

rr is the proportion of the reserves. This doesn't increase wealth but increase liquidity.

Bank Capital: the equity a bank's owners have put into bank.

Leverage: the use of borrowed money to supplement existing funds purposes of investment;

$$\text{Leverage ratio} = \frac{\text{Asset}}{\text{Equity}}$$

Monetary base, controlled bt the central bank:

$$B = C + R$$

Reserve-deposit ratio, depends on regulations & bank polices:

$$rr = \frac{R}{D}$$

Currency-deposit ratio, depends on household's preferences

$$cr = \frac{C}{D}$$

$$M = C + D = m \times B$$

$$m = \frac{C + D}{B} = \frac{C + D}{C + R} = \frac{cr + 1}{cr + rr}$$

We can find the relationship between monetary base which is controlled by money policy and money supply. The central bank can just have partial influence on the money supply. The monetary multiplier describes the influence as government cam directly influence of monetary base.

4.1.2 The instruments of monetary policy

The Reserves are the point that is partially influenced.They can be ineffected. They can use:

(a). Open Market operations: to increase bases, PBOC will buy government bonds or repo by reserves from commercial banks, resulting the reserves increased in the market.

(b). Discount Rate: the interest rate PBOC charges on loans to bank. To increase the base, PBOC will lower the discount rate encouraging banks to borrow more reserves.

(c). Reserve requirement ratio(RRR). In common day, $rr \approx RRR$. In the crisis, $rr > RRR$ as they feel unsafe, resulting excess reserves $(rr - RRR) \times D$. In the crisis, RRR is not an active instrument.

(d): interest on reserve.

Decline in money supply mainly depends on monetary multiplier.

4.1.3 The Demand for money

The demand or money is the quantity of monetary assets people want to hold. The nominal money demand is affeced by the following factors.

Price Level: the higher the price level, the more money you need for transaction. Nominal money demand is thus proportional to the price factor. It's an one-to-one relationship.

Real Income: The more transactions you conduct, the more money you need.

Interest rate: An increase in the interest rate or return on non-monetary asset decrease the demand for money(i). Another interest form is monetary interest rate(always deposit); increase in the interest rate on money increases money demand (i^m). However, the monetary interest is low and constant so is sometimes not considered.

$$M^d = PL(Y, i, i^m)$$

$$\frac{\partial M^d}{\partial Y} \in (0,1) \times P, \quad \frac{\partial M^d}{\partial i} < 0, \quad \frac{\partial M^d}{\partial i^m} > 0$$