Contents

[Lecture 2 Measuring macroeconomic variables 1](#_Toc125634288)

[Lecture 3 Production 2](#_Toc125634289)

[Lecture 4 Labor Market 2](#_Toc125634290)

[Lecture 5 Consumption 5](#_Toc125634291)

[Lecture 6 Investment 6](#_Toc125634292)

[Lecture 7 Goods Market 6](#_Toc125634293)

[Lecture 8-9 Economic Growth 7](#_Toc125634294)

[Lecture 10 Money 8](#_Toc125634295)

[Lecture 11-12 IS-LM 9](#_Toc125634296)

# Lecture 2 Measuring macroeconomic variables

1. GDP is the Market Value of all Final Goods and Services Newly Produced on Domestic Soil During a Given Time Period.
2. There are three ways of measuring GDP, namely production method, income method and expenditure method. They should return the same result. We will mainly use expenditure method.
3. Expenditure method:
4. Fundamental identity of national income account: total production = total income = total expenditure.
5. Impact of imports on GDP: as GDP measures domestic production, imports should have no impact on GDP. But why is Import subtracted in the expenditure method? This is because consumption of imported goods will be counted in (or similarly in ), so we need to subtract imports to correct it.
6. Components of GDP:
   1. Consumption (): the sum of durables, non-durables and services purchased domestically by non-business and non-government. Does not include purchase of new housing.
   2. Investment (: the sum of durables, non-durables and services purchased domestically by business. Includes business and residential structures, equipment and inventory investment. Does not include land purchases and stock purchase (difference between financial and economic investment).
   3. Government spending (): goods and services purchased by domestic government. Does not include welfare and social security, since it’s just transfer payment, and nothing is produced.
   4. Net Export (): Exports – Imports. Exports is the amount of goods produced domestically but sold on foreign soil; imports is the amount of goods produced on foreign soil but purchased domestically.
7. GDP only includes the expenditures for goods that are “produced”. If I give money to my friends, it is not counted in GDP.
8. . is aggregate supply, and is aggregate demand.
9. GDP does not measure well-being, and does not measure non-market activity (home production, black market, etc.).
10. Savings: current income minus current needs
    1. Deposable income: , where =tax, =transfers (welfare)
    2. Personal (household/private) saving

Personal savings rate =

* 1. Government (public) saving
  2. National savings

1. Inflation
   1. Price index : measures the cost of a fixed basket of goods over time. There are different types of price index, the most common ones are GDP deflator and CPI.
   2. Inflation rate [
   3. GDP deflator = . It is one prominent price index and includes all goods and services in GDP.
   4. CPI: another prominent price index. But only covers consumer goods.
   5. Nominal GDP: output valued at current price

Real GDP: output valued at price in a base year

GDP deflator = Nominal GDP/Real GDP

* 1. In this course, we mainly focus on real variables.

1. Inflation
   1. Denote as nominal interest rate between period 0 and 1, as expected and actual inflation rate between period 0 and 1, as expected and actual real interest rate between periods 0 and 1.
   2. The central banks sets , but they are trying to set .
2. Unemployment
   1. Labor force = #Employed + #Unemployed but looking
   2. Unemployment rate = #Unemployed but looking/Labor force
   3. Three types of unemployment:
      1. Frictional unemployment: matching between firms and workers
      2. Structural unemployment: mismatch of skills and employer needs + industry structural change
      3. Cyclical unemployment: result of output below full employment
   4. Frictional and Structural unemployment may be desirable and unavoidable.
3. AD/AS model

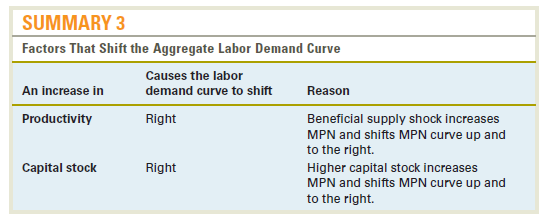
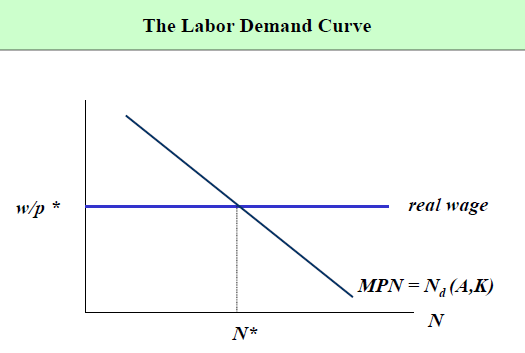
# Lecture 3 Production

1. Production function , where is real GDP, is constant, is capital, is number of workers, is a function.
   1. The commonly used production function (from empirical result) is
   2. Labor productivity =
   3. Total factor productivity

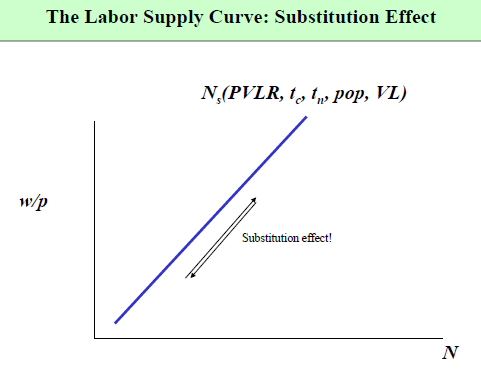
# Lecture 4 Labor Market

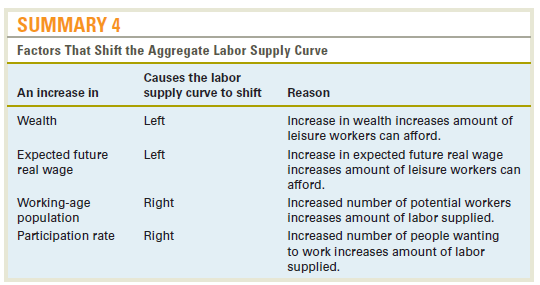
1. Labor demand in competitive market: given wage and price , the profit maximizing firm will hire at . Here MPN is the marginal product of hiring one more labor (note it is in terms of real variable), and is the real wage. can be derived from production function, and is given.

Labor demand curve shows the relationship of real wage and the demand of labor. It slopes downwards.



1. Labor supply: labor supply results from individual utility optimization.
   1. Substitution effect: higher real wage makes you want to work more (with original leisure time).
   2. Income effect: Higher real wage makes you richer, and you will work less given the same wage.
   3. Research on labor supply generally shows that the aggregate amount of labor supplied rises in response to a temporary increase in the real wage but falls in response to a permanent increase in the real wage.
   4. If we use to represent current real wage, and PVLR to represent wealth, then represents substitution effect and PVLR represents income effect.
   5. The labor supply curve shows the relationship between current real wage and hours worked, holding other factors (PVLR, tax, population, etc.) constant. It slopes upwards due to substitution effect.



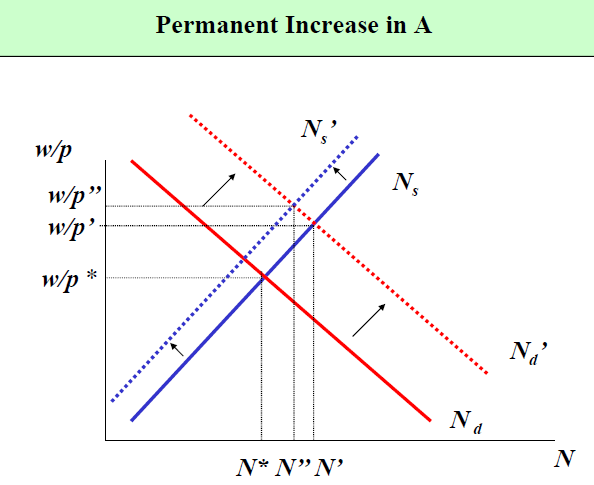
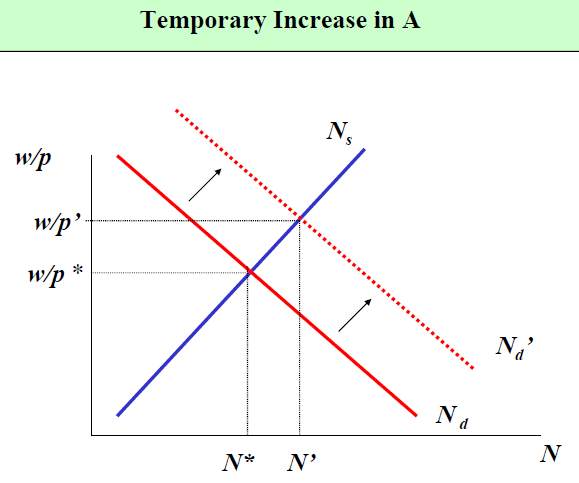


1. Labor market equilibrium
   1. Impact of A:

Temporary increase of A will impact the production function and thus the demand curve, and demand will be shifted larger. However, there is no direct impact on PVLR, thus supply will be the same.

Permanent increase of shifts demand curve larger but shifts supply smaller. An example is technological progress.

Technological progress will increase wage inequality between skilled and unskilled workers, because the demand for skilled workers are larger.

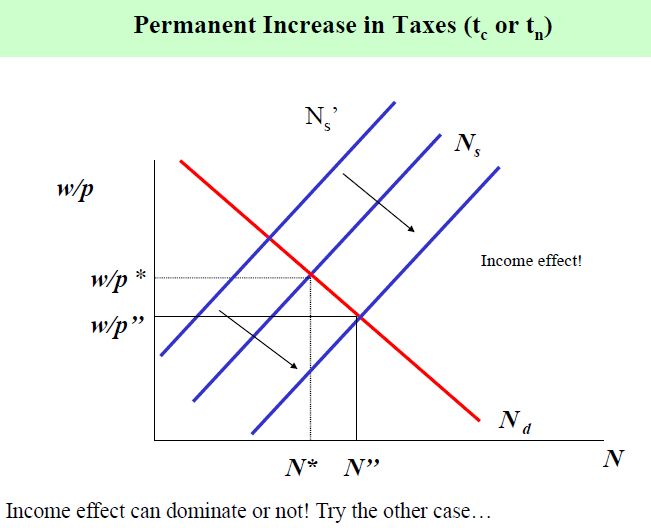
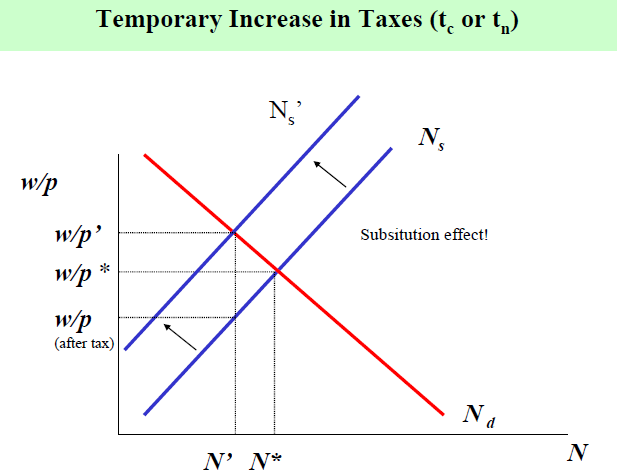


* 1. Impact of tax (on income or consumption):

Temporary increase of tax will make after-tax real wage lower, thus shifts the supply curve smaller due to substitution effect.

Permanent increase of tax not only has the substitution effect, but also the income effect, so the shift of supply curve depends on which effect is larger.

No impact on labor demand because income/consumption tax has no effect on production function.



1. Long run equilibrium: labor market clears, .
2. Suppose price changes. It has no effect on labor demand since production function does not change; it has no effect on labor supply, since population, tax, wealth do not change as long as real wage does not change. Therefore, in the long run, price changes have no effect on , as long as is constant.
3. Change in price will have no effect on real output , therefore long run aggregate supply curve is a vertical curve.
4. In the long run, supply side of economy (labor, etc.) determines output, and demand side of economy determines price. In the short run, demand and supply jointly determines price and output.

# Lecture 5 Consumption

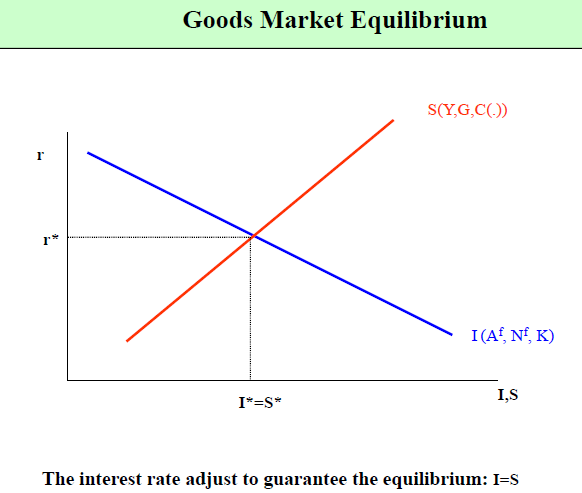
1. Keynesian consumers: , assumes consumption is a linear function of disposable income. However, this model does not fit data well (it matches long-run/country-level data, but does not match short-run/household-level data), and does not consider some important factor like expectation, interest rate, etc.
2. Permanent income hypothesis (PIH): maximize the utility of current consumption and future consumption. The result of PIH shows that consumption does not vary a lot with temporary income changes. PIH also shows the relationship between consumption and interest rate.
   1. Substitution effect: if interest rate increases, substitution effect will make you save more and consume less today; income effect implies net savers will consume more today, and net borrowers will consume less today.
   2. income effect: if interest rate increases, net savers get higher income, and will consume more both today and tomorrow, and savings fall. Net borrowers will consume less both today and tomorrow, and savings increase.
3. According to PIH, temporary income changes should not have a large impact on consumption: households will consume the extra income smoothly. However, in reality consumption is sensitive to temporary income changes. Therefore, economists need to think of new theories to refine PIH, including liquidity constraints.
4. Liquidity constraint: sometimes a household wants to borrow to smooth consumption, but lenders are not willing the lend money. This will lead consumption behavior different from theoretical result.
5. Factors affect consumption:
   1. Current income
   2. Expectation of future income
   3. Wealth
   4. Tax
   5. Interest rate

# Lecture 6 Investment

1. Investment fluctuates most sharply over the business cycle in the GDP components.
2. Capital is increased by investment minus depreciation:
3. The optimal capital is cost of an additional unit of capital.
4. When interest rate increases, the investment decreases, because higher interest rate make the cost of capital higher.

# Lecture 7 Goods Market

1. Goods aggregate demand =
2. Goods aggregate supply
3. The good market is in equilibrium when AD=AS.
4. Recall that notional saving (assume no other countries), then the equilibrium is represented by . While increases with r, decreases with r, the interest rate will adjust to bring the market in equilibrium.



1. Factors shifting savings curve: , or factors that change
2. Factors shifting investment curve: depreciation, or factors that change such as

# Lecture 8-9 Economic Growth

1. Source of growth: , growth could be from increase of (TFP),(capital), (labor). We can measure the growth of from macroeconomics data, and given a production function, we can calculate the growth of .
2. Growth accounting equation:
3. Solow model: define =population at time t, =growth rate of , =output produced at time t, =capital stock at time t, =gross investment at time t, =consumption at time t. Assume not government(G) and foreign (NX) sector, so .

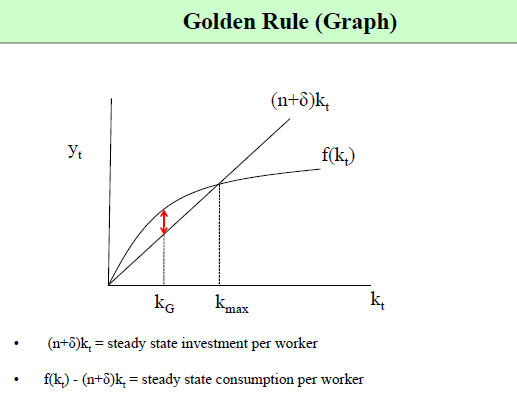
Define per-worker variable: . Assume we have . is an increasing and concave function.

In steady state, are constant and do not change over time. Then we can know, have to increase at rate , and . Then we know , and thus We can see that when increases, increases but decreases. Therefore, there is some that maximizes .

However, in steady state, may not be at . The steady state is given by saving = investment, , where is saving rate. The steady state is determined by the production function, saving rate, population growth and depreciation rate, but not related to initial state.

In Solow model, output is spent in two parts: (1) consumption , which represents the living standard of people; (2) investment , which can further increase in the future. There is a tradeoff between “now” (consumption) and “future” (investment) in how to use .

Solow model implies that a higher saving rate leads to higher capital-labor ratio, and thus higher output. Output (and thus consumption) will increase in the long run, but consumption will decrease in the short run due to higher saving.



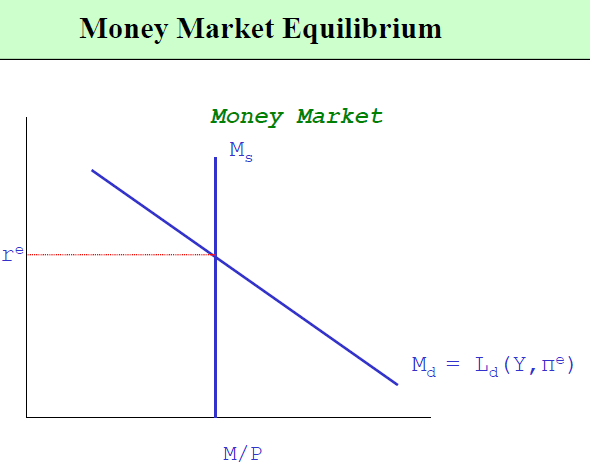
1. Sustained growth can be from (1) increase the steady state capital-labor ratio . is determined by , so can keep growing only if keeps increasing or keeps decreasing, which is limited (2) increase . Therefore, the only source of sustained growth is from
2. Endogenous growth model: it assumes that when increases, R&D and human capital will also increase, making MPK constant.

# Lecture 10 Money

1. Functions of money
   1. Medium of exchange
   2. Unit of account
   3. Store of value
2. M1 = currencies + checking account balance

M2 = M1 + saving deposits + small time deposits + MMMFs + MMDAs

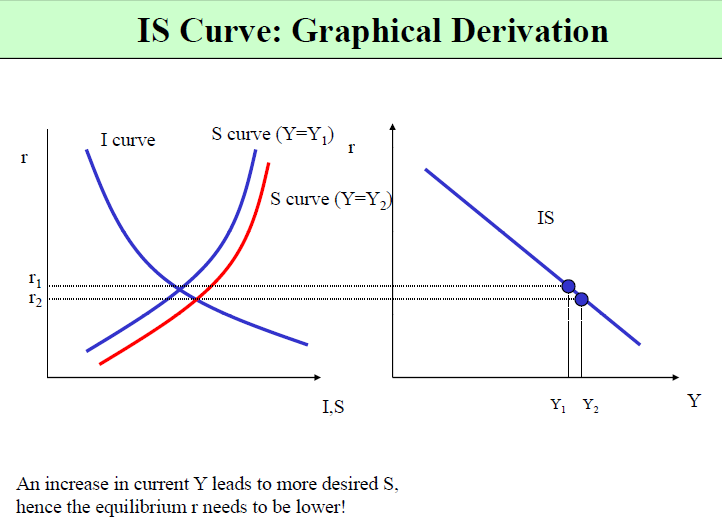
1. Money supply is affected by: (1) central bank (2) banks (3) the public
   1. The fed targets fed funds rate, and carries out open market operations to keep actual rate near the target rate. If the Fed conducts an open market purchase, then it injects money in the system, and money supply increases; if the Fed conducts an open market sale, then money supply decrease
   2. Banks and the public: in later lectures.
2. Money demand: . It reveals factors impacting money demand:
   1. Price level
   2. Output
   3. Real interest rate
   4. Inflation
3. Money market equilibrium: real money demand = real money supply
   1. Real money supply = , which does not change with interest rates, affected by money supply and price level .
   2. Real money demand = , which decreases with . Affected by
   3. Equilibrium:



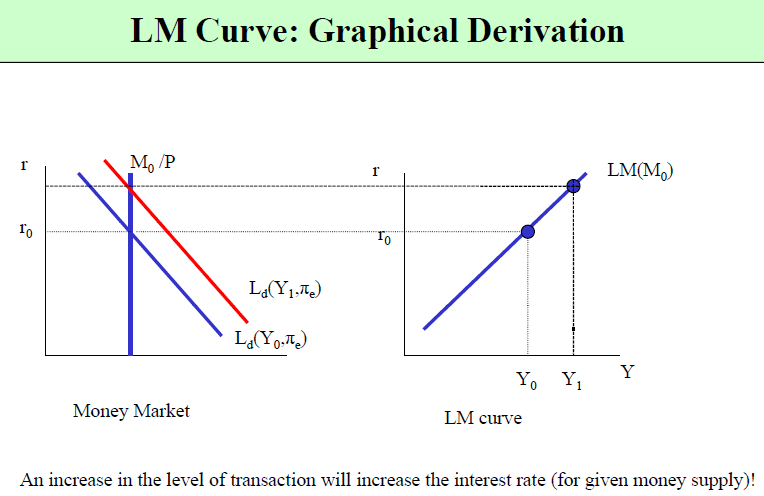
1. Velocity . In reality, is not fixed, and rises with inflation. When M growth is high it generates inflation, which raises V, which in turn raises inflation further.
2. correlation between M growth and inflation is above 0.95.

# Lecture 11-12 IS-LM

1. IS curve represents the equilibrium in the goods market: .
2. The IS curve relate to . When falls, investment increases, consumption also increases due to substation effect dominates. Therefore, IS curve is downward sloping in space.



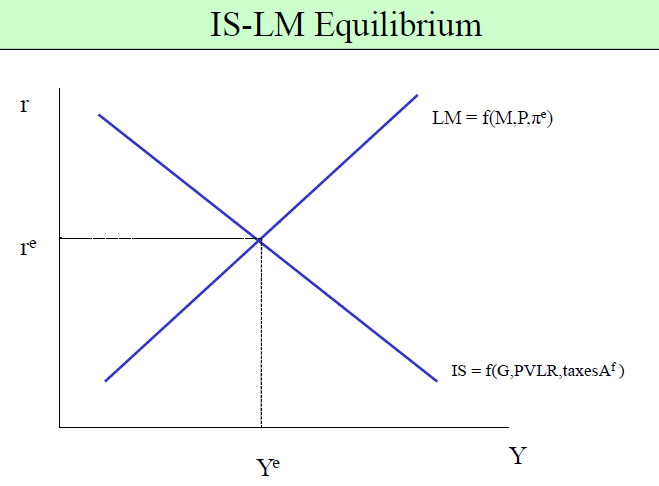
1. What shifts IS curve: anything that increases C, I or G (or NX when we model it).
2. Change in will cause movement along IS curve.
3. LM curve represents the equilibrium in the money market: . Every point on the LM curve represents an intersection between the real money supply and real money demand.
4. LM curve is named as it is because it documents the relationship between Liquidity and Money.
5. Derivation of LM curve: holding money supply fixed, an increase in will shift money demand to the right, and thus the interest rate at equilibrium will increase. Therefore, LM curve is upward sloping.



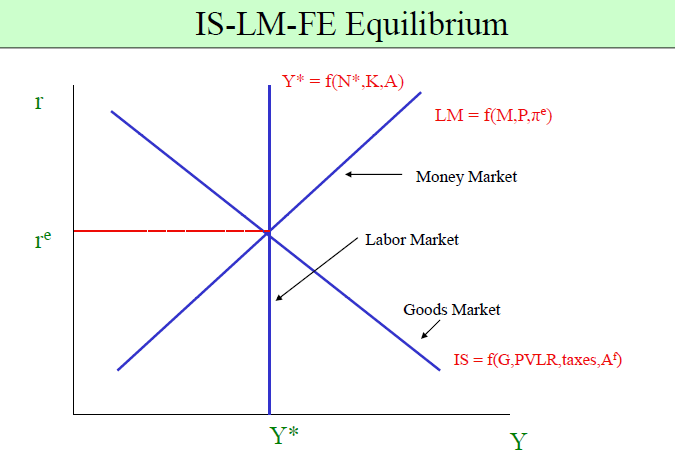
1. What shifts LM curve:
   1. higher real money supply (or higher nominal money supply or lower price ) shifts LM to down and right
   2. higher expected inflation shifts LM to down and right
2. Short run: prices are sticky

Long run: prices adjust

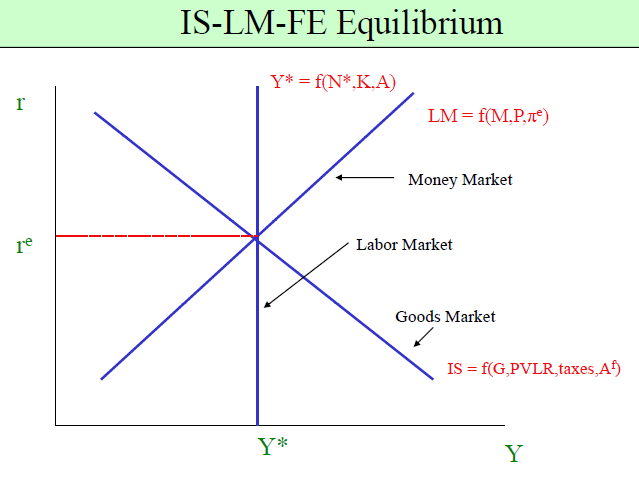
1. IS-LM equilibrium
   1. Short run: intersection of IS and LM



* 1. Long run: labor is also in equilibrium. Add FE (full employment) curve. Labor market is not sensitive to , so it is a vertical line.



1. Monetary policy: in the short run, increasing money supply will shift LM to right; in the long run, prices adjust and go back to the equilibrium, and monetary policy has no long run effect.
2. Fiscal policy: in the short run, increasing will shift IS to the right; in the long run, since fiscal policy does not affect , will be the same but price will rise, leading to higher .
3. When monetary policy does not work:
   1. Vertical IS curve: firms don’t respond to interest rate change if they think banking system is frozen. Shifting in LM curve won’t increase Y.
   2. Horizontal LM curve: nominal interest rate is bounded at 0, so when reaches the bound, the Fed cannot make it lower. This is called “liquidity trap”.



# Lecture 13 AS-AD