BIEM

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B.LAB

HANDOUTS

MACROECONOMICS

-FIRST PARTIAL-

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This handout is written by students with no intention of replacing university materials.

It is a useful tool for studying the subject, but does not guarantee preparation as exhaustive and complete as the material recommended by the University.

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Chapter 2

GDP

GDP: **Gross Domestic Product**. It's the measure of aggregate output or income produced by an economy in a given period.

There are 3 more specific definitions: it can be computed in 3 ways which give the same result.

Def 1 and 2 are on the **production side**.

1. **GDP is the market value (at current/market prices) of all final goods and services (the opposite is intermediate goods which are used in the production of another good) produced in an economy in a given period**.

   However a good can be both final and intermediate. For example flour is a final good for consumers but an intermediate good to produce bread.

   We **don't** consider intermediate goods sold domestically to avoid double counting.

   We include:

   - Final goods sold domestically
   - Final goods sold abroad
   - Intermediate goods sold abroad that become final goods abroad

   EX 1.1

2. **GDP is the sum of the value added (value of production(revenue) - value of intermediate goods used in production) by all firms in the economy in a given period**.

   EX 1.2

3. **Income Side Def**: **GDP is the sum of all incomes produced in an economy in a given period**.

   We consider 4 kinds of incomes:

   - **Labour income**: revenues that go to workers, basically **wages**. The more people work in the company, the higher the GDP.
   - **Capital income / Profit income**: revenues that go to firms. All revenues-all costs (intermediate goods, wages, taxes)
   - **Rent income**: you own a building.
   - **Tax income**: revenues that go to the government.

   GDP=wages+profit+rent+tax

   EX 1.3

EX 2 HW

Ch 1 EX 1 pag 4-5

Nominal and Real GDP

- **Nominal GDP**, GDP at current prices, Dollar GDP, Euro GDP, GDP in current dollars, GDP in current euros

  It's the sum of quantities of final goods and services produced times their current price.

  $GDP_{NOM}^{2019}=P_A^{2019}*Q_A^{2019}+P_B^{2019}*Q_B^{2019}+\ldots$

  Macroeconomists do not use it much because it doesn't distinguish between the price and the quantity effects. That's why we use:

- **Real GDP**, GDP in terms of goods, GDP in constant dollars, GDP in constant euros, GDP adjusted for inflation.

  We choose a base year and we use it to compute GDP in different years.

  I use 2005 as a base year

  $GDP_{REAL}^{2014}=P_A^{2005}*Q_A^{2014}+P_B^{2005}*Q_B^{2014}+\ldots$

  $GDP_{REAL}^{2015}=P_A^{2005}*Q_A^{2015}+P_B^{2005}*Q_B^{2015}+\ldots$

  If it increases its because the quantity has increased: **I get rid of the price effect**.

  In the base year Nominal GDP=Real GDP

Notation:

Real GDP in Year t: $\mathbf{Y_t}$

Nominal GDP: $\mathbf{\$Y_t}$ or $\mathbf{€Y_t}$

GDP Growth Rate

$$\boxed{g = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}} = \frac{\Delta GDP}{GDP_{t-1}}}$$

g>0 expansion

g<0 recession

EX 3 HW

GDP per Capita

$$\boxed{GDP_{per\ capita} = \frac{GDP}{Total\ population}}$$

Problems with GDP:

- It gives the same value to bad and good

- It doesn't account for neg/pos externalities
- It doesn't account for inequalities
- It doesn't account for household work
- Underground economy (recently has been included)

Despite these problems, GDP is an essential economic variable. It is supported by other measures such as the Green GDP, HDI.

Unemployment Rate

Employment = N = number of people who have a job in a country.

Unemployment = U = number of people who do not have a job but are searching (it's not easy to assess: in the US there is CPS (current population survey) and in the EU LFS (labour force survey))

Unemployed: no job but you've been looking for one in the last 4 weeks and you have to prove it in some ways.

Labour force=$L = N + U$

Unemployment rate=$u = \frac{U}{L}$

October 2023 EU 6%, Germany 2.9%, Italy 7.8%, Spain 12%, US 3.4%

People who aren't in L are not employed and are not looking for a job.

Discouraged workers: when you were unemployed but now you've stopped looking for a job.

Participation rate = $\frac{L}{Total\ Population\ working\ age\ (15-64)}$

- If u ↑, participation rate will ↓.
- If u is high: the economy is not using some of its resources efficiently.
- If u is too low: there is labour shortage

Inflation Rate

Inflation: sustained rise in the price level

Inflation rate: rate at which the general level of price increases overtime

To compute inflation we have 2 price indexes:

1. **GDP deflator (Pt)**: compares the price of all currently produced domestic final goods and services to the price of the same goods and services in the base year.

$$\boxed{P_t = \frac{€Y_t}{Y_t}}$$

If nominal GDP ↑ faster than real GDP, then the increase must be due to prices.

If 2014 base year => $P_{2014}=1$

P_t is an index number. Its level has no economic meaning. Its **rate of change** is meaningful: it's called

Rate of inflation = $\pi_t = \dfrac{P_t - P_{t-1}}{P_{t-1}}$

$\pi t > 0$ inflation

$\pi t < 0$ deflation

πt is the rate of change P_t, or the rate at which the general level of prices increases over time.

It gives the average change in the price of final goods and services produced in the economy.

Page 564 prop 7

$$€Y_t = P_t * Y_t$$

$$g€Y_t = gP_t + gY_t$$

Growth rate of nominal GDP=inflation rate (ΔP_t) * growth rate of real GDP

2. **Consumer Price Index (CPI)**: consumers care about the average price of consumption of the goods they consume. The set of goods produced in the economy is different usually from the set of goods actually bought by consumers.

$$\boxed{\pi t = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}}}$$

CPI is an index and **its rate of change is meaningful**.

In EU: CPI is measured by **HICP** (Harmonized Index of Consumption Prices).

It's the measure of the average changes in the price paid by consumers for a specific and updated (annually) basket of goods and services typically consumed by consumers

$HICP_{2014}=100$

$HICP_{2015}=117$

It costs 17% more to buy the same basket as in 2014.

Problems with CPI:

- Consumers tend to substitute goods during the year

- New goods and quality improvement do not wait for one year
- Composition and Comparability of the basket

GDP deflator vs CPI

- **GDP deflator** considers all final goods and services produced **domestically** in an economy. It reflects the prices of final goods and services **produced** domestically.
- **CPI** considers "only" the final goods and services typically consumed **domestically independently of the country of production**. It reflects the price of final goods and services typically **consumed**.

Usually the P_t and CPI tend to move together, usually they differ by less than 1%.

If CPI significantly larger than GDP deflator => this is usually due to the fact that the price of imported goods increases more relatively to the price of goods produced domestically.

Pure inflation: only a theoretically concept: a proportional increase in prices and wages. If this happens it's not a good thing.

Problems caused by **inflation**:

- Purchasing power
- Issue for foreign trade: you might be less competitive
- Income distribution inequality
- Uncertainty increases in the economy and consumption decreases.
- Tax distortion becomes even more serious

High deflation is a problem too because it causes uncertainty.

The short run, medium run and long run

The **level of aggregate output** in an economy is determined by:

- **Movements in the demand for goods** (**SHORT RUN**): changes in demand, perhaps as a result of changes in consumer confidence or other factors, can lead to a ↓ in output (a **recession**) or an ↑ in output (an **expansion**)
- **How much the economy can produce** (**MEDIUM RUN**): the economy tends to return to the level of output determined by supply factors: the capital stock, the level of technology and the size of the labour force.
- **A country's education system, saving rate, quality of its government** (**LONG RUN**): to understand why China has been able to achieve such a high growth rate since 1980, we must understand why both the capital stock and the level of technology in China are increasing so fast. To do so, we must look at those 3 factors.

Ch 1 EX 2 pag 6-7, PS 1, multiple choice questions

EX 4 HW T/F/U

Alternatives measures to GDP:

SWB: subjective wellbeing index

$$GNI\ (Gross\ National\ Income) = GDP + money\ flowing\ from\ abroad - money\ to\ foreign\ countries$$

$$HDI\ (Human\ Development\ Index) = GNI + income\ distribution + life\ expectancy\ at\ birth + education$$

The maximum of the HDI is 1 or 100.

The Goods Market in the Short Run

Composition of GDP

Its main components are:

- **Consumption (C)**: goods and services bought by consumers. Usually the largest component
- **(Fixed) Investments (I)**: purchase of capital goods. It's divided between:
  - **non residential investments**: made by firms (plants, machinery)
  - **residential investments**: made by people (houses, buildings)
- **Government spending (G)**: purchase of goods and services by the government (no transfers, no pensions)
- **Net Exports**: $NX\ (Net\ Exports) = X\ (Exports) - IM\ (Imports)$

  >0 trade surplus

  =0 trade balance

  <0 trade deficit
- **Inventory investment**=**goods produced - goods sold**.

  >0

  =0

  <0

  It's not easy to compute it because a high inventory represents a cost so you pay lower taxes. Moreover it's a minor component of GDP in the end, so **we DON'T consider it**.

Demand for Goods (Z)

$Z = C + I + G + NX$

We develop a model (**Standard Model**) to understand Z based on these **assumptions**:

- Firms produce the **same good**: one market
- Firms are willing to **supply any amount** of the good at a certain price level. (We don't have limits in the production by the availability of national resources for ex)
- The **economy is closed** (no foreign trade). NX is 0.

So $\boxed{Z = C + I + G}$

Let's analyze the components of Z

- **Consumption**:

  It mainly depends on **disposable income** (Y_d), the income left after receiving transfers and paying taxes.

The writing **C=C(Y_d)** means "C is a function of Yd". If Yd increases, C increases.

We express C using a **behavioral equation**

$$\boxed{C = C_0 + C_1 * Y_d}$$

- C_0=**autonomous consumption**. It's what people consume if their Y_d were zero (you need to eat). C0 is **always positive**.

  P65 BOX => C_0 changes independently of Y_d.

- C_1=**marginal propensity to consume**: it is the effect of one additional dollar of Y_d on consumption.

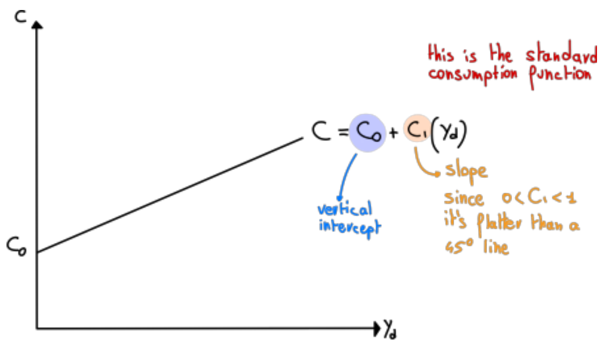
  0<C_1<1

  If C_1=0.2 on average if Y_d increases by 1$, C increases by 20cents.

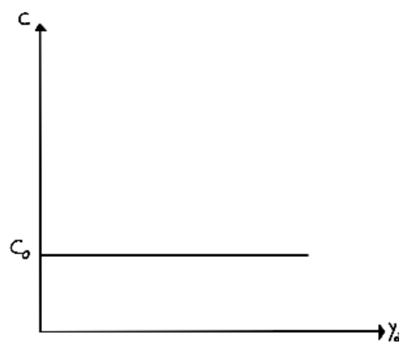
  You consume a part of the additional disposable income and you save the rest.

- $Y_d = Y - T$

Graph of consumption function



If you have C=C_0 it's a horizontal line.



GO BACK TO THE STD CONSUMPTION FUNCTION

- If Y ↑ and T (taxes) stays the same what is the effect on consumption?

  Y ↑, Yd ↑, C ↑ but less than 1:1 because part of the increase in Y is saved

- If T ↓ and Y stays the same. C?

  T ↓, Yd ↑ and C ↑ but less than 1:1 because part of the increase in Y is saved

  C is an **endogenous** variable because it depends on other variables such as Y, T, C_0, C_1.

- **Investments**:

  In our first standard model I is taken as **exogenous**. $I = \overline{I}$

- **Government spending**:

  G, together with T, it describes the **fiscal policy**.

  G has irregular behaviour in data so we take it as **exogenous**

  $G = \overline{G}$

  T are **exogenous** as well

  $T = \overline{T}$

Equilibrium output in this standard model

$C = C_0 + C_1(Y - \overline{T})$

$G = \overline{G}$

$T = \overline{T}$

$I = \overline{I}$

$Z = C + I + G$

$\boxed{Z = C_0 + C_1(Y - \overline{T}) + \overline{I} + \overline{G}}$ **Demand Function for the Standard Model**

We assume no inventories

Production Y = Demand Z

$Y = C_0 + C_1(Y - \overline{T}) + \overline{I} + \overline{G}$

$Y = C_0 + C_1 Y - C_1\overline{T} + \overline{I} + \overline{G}$

$Y - C_1 Y = C_0 - C_1\overline{T} + \overline{I} + \overline{G}$

$Y(1 - C_1) = C_0 - C_1\overline{T} + \overline{I} + \overline{G}$

Equilibrium Output $= Y^* = \hat{Y} = \underbrace{\boxed{\frac{1}{1 - C_1}}}_{\text{Multiplier of the standard case}} \underbrace{\boxed{(C_0 - C_1\overline{T} + \overline{I} + \overline{G})}}_{\text{Autonomous spending=A}}$

Multiplier of the standard case:

- $0 < C_1 < 1$
- $\dfrac{1}{1 - C_1} > 1$
- The closer C_1 to 1, the larger the multiplier
- Suppose $C_0 \uparrow$ by 2 billion, then Y $\uparrow$ by more than 2 billion because of the multiplier

$C_0 \uparrow, C \uparrow$, Z $\uparrow$, Y $\uparrow$, C $\uparrow$, Z $\uparrow$, Y $\uparrow$.

Autonomous spending = A

- It's the demand for goods that doesn't depend on output
- A is positive because:

$A = C_0 - C_1\overline{T} + \overline{I} + \overline{G}$

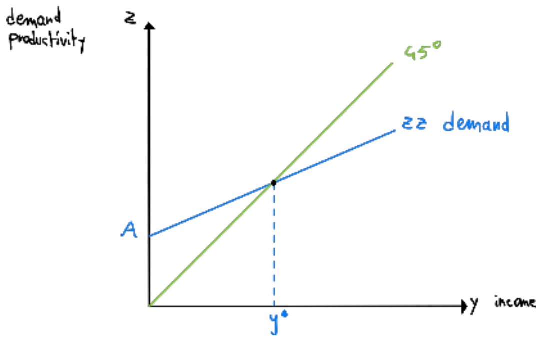
C_0, $\overline{I}$ positive

$\overline{G} - C_1\overline{T}$

- If government budget is balanced $G = T, \overline{G} - C_1\overline{T} > 0$
- If $G > T, \overline{G} - C_1\overline{T} > 0$
- Only If the government has a large surplus, A can be negative. This is not realistically.

EX 5 HW

Graphical analysis of the standard model



1. I represent Z

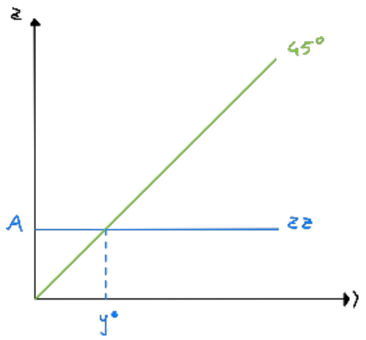
Z in the standard model

$Z = C_0 + C_1(Y - \overline{T}) + \overline{I} + \overline{G}$

$Z = (C_0 - C_1 + \overline{T} + \overline{I} + \overline{G}) + C_1 Y$

A=vertical intercept Slope<1

Example of a no standard case



$C = C_0$

$I = \bar{I}$

$G = \overline{G}$

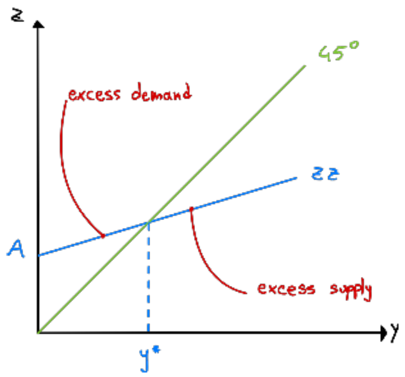
$T = \overline{T} + tY$

$Z = C + I + G$

- $Z = C_0 + \bar{I} + \overline{G}$
- Multiplier=1

  $A = (C_0 + \bar{I} + \overline{G})$
- $\hat{Y} = C_0 + \bar{I} + \overline{G}$

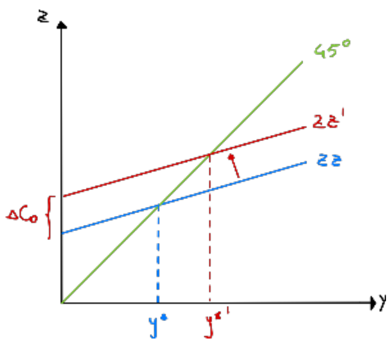
GO BACK TO STD CASE: **Excess Demand & Excess Supply**



EX 6 HW

Let's reason using the model

$C_0\uparrow$



ZZ is affected by $\uparrow C_0$

Slope unchanged. It's C_1!

Vertical Intercept $\uparrow$: it's a parallel shift

$C_0\uparrow$, $C\uparrow$, $Z\uparrow$

$Z\uparrow$ by ΔC_0 => $\hat{Y}\uparrow$

$C_0\uparrow$ by 100 ΔC_0=100

C $\uparrow$ by 100, Z $\uparrow$ by 100, Y $\uparrow$ by 100,

Now C $\uparrow$ by C_1*100, Z $\uparrow$ by C_1*100, Y $\uparrow$ by C_1*100, Now C ↑ by $C_1 * C_1 * 100\ldots$

The total ↑ in Y is $\Delta C_0(1 + C_1 + C_1^2 + \ldots + C_1^n)$

This sum is called geometric series. If n is large enough it approaches the limit $\frac{1}{1 - C_1}$

In the end the ↑in Y will be $\Delta C_0 * \frac{1}{1 - C_1}$

Investment and Saving

Private Saving: $S = S_{priv}$

Public Saving: $S_{pub} = T - G$

$T > G \;=>\; S_{pub} > 0$ Budget **SURPLUS**

$T < G \;=>\; S_{pub} < 0$ Budget **DEFICIT**

$T = G \;=>\; S_{pub} = 0$ **BALANCED** Budget

National Saving: $S_{nat} = S + S_{pub}$

Deficit: $Def = G - T$

Private Saving:

1. $\boxed{S_{priv} = Y - C - T} = Y_d - C$

   If you have to **derive the $\mathbf{S_{priv}}$ Function** you substitute into $S_{priv} = Y - C - T$ the expression you're given.

   If you have to find a **C function**: $C = Y - T - S$ and you substitute.

2. In a closed economy $Y = C + I + G$

   $Y - T = C + I + G - T$

   $Y - T - C = I + G - T$

   $$\left.\begin{aligned} &\boxed{S = I + G - T} \\ &I = S + (T - G) \\ &I = S + S_{pub} \\ &I = S_{nat} \\ &I = (Y - T - C) + (T - G) \end{aligned}\right\}$$

   They are called the **Goods Market Equilibrium Condition**.

   It can be used to obtain $\hat{Y}$.

3. $S = Y - T - C$

$$S = Y - T - C_0 - C_1(Y - T)$$

$$S = Y - T - C_0 - C_1Y + C_1T$$

$$S = -C_0 + Y(1 - C_1) - T(1 - C_1)$$

$$\boxed{S = -C_0 + (Y - T)(1 - C_1)}$$

Marginal Propensity to Save $(1 - C_1)$: how much of an additional unit of Y people on average will save.

If Y↑, S↑, but less than one-to-one.

Why is n.2 a Goods Market Equilibrium Condition?

$$I = S + T - G$$

$$I = -C_0 + (Y - T)(1 - C_1) + (T - G)$$

$$I = -C_0 + Y - C_1Y + C_1 - G$$

$$Y(1 - C_1) = C_0 + I - C_1T + G$$

$$\hat{Y} = Y^* = \frac{1}{1 - C_1}(C_0 + I - C_1T + G)$$

Paradox of Saving

Suppose in an economy, consumers, all of a sudden, decide to save more. For us, considering our standard model, this might mean: C_0↓ C_1↓ $(1 - C_1)$↑.

C_0↓ C↓ Z↓ Y↓

What is the effect on S?

1. $S = Y - C - T$

   If Y↓, **S↓**

   BUT

3. $S = -C_0 + (Y - T)(1 - C_1)$

   C_0 is less negative. **S↑**

   Is the net effect ambiguous? Yes. SO

2. $I = S + (T - G)$

I unchanged, T-G unchanged. So S is unchanged.

In the end **the 2 effects they cancel out**. Only the formula 2) can tell me this.

This paradox is true only if **G**, **T** and **I** are **exogenous** and in the **short run** because in the long run you accumulate capital.

Is the Government omnipotent?

$$Y = \frac{1}{1 - C_1}[C_0 + \bar{I} + G - C_1 T]$$

This equation implies that the government, by choosing the level of spending (G) or the level of taxes (T), **can choose the level of output it wants**. If it wants output to be higher by €1 billion, all it needs to do is to increase G by €$(1 - C_1)$ billion. This increase in government spending, in theory, will lead to an output increase of €$(1 - C_1)$ billion times the multiplier $\frac{1}{1 - C_1}$, or €1 billion.

In reality governments cannot achieve any level of output they want. If they could, and it was as easy as it sounds in the previous paragraph, why would a government have allowed a growth to stall in 2008 and output to actually fall in 2009? Why wouldn't the government increase the growth rate now, so as to decrease unemployment more rapidly? There are many aspects of reality that we have not yet incorporated in our model, and all of them complicate the government's task. We shall introduce them in due time. But it is useful to list them briefly here:

- **Changing government spending or taxes is not easy**: Getting any parliament to pass bills always takes time. Implementing what is in the bills takes even more time.
- **We have assumed that I remained constant**: But investment is also likely to respond in a variety of ways. So are imports: some of the increased demand by consumers and firms will not be for domestic goods but for foreign goods. The exchange rate may change. All these responses are likely to be associated with complex, dynamic effects, making it hard for governments to assess the effects of their policies with much certainty.
- **Expectations are likely to matter**: For example, the reaction of consumers to a tax cut is likely to depend on whether they think of the tax cut as transitory or permanent. The more they perceive the tax cut as permanent, the larger will be their consumption response. Similarly, the reaction of consumers to an increase in spending is likely to depend on when they think the government will raise taxes to pay for the spending.
- **Achieving a given level of output can come with unpleasant side effects**: Trying to achieve too high a level of output can, for example, lead to increasing inflation and, for that reason, be unsustainable in the medium run.

- **Cutting T or increasing G**, as attractive as it may seem in the short run, **can lead to large budget deficits and an accumulation of public debt**. A large debt has adverse effects in the long run. This is a hot issue today in almost every advanced country in the world.

In short, the proposition that, **by using fiscal policy**, **the government can affect demand and output** in the **SHORT RUN** is an important and correct proposition.

But, as we refine our analysis, we will see that **the role of the government in general**, and the successful use of fiscal policy in particular, **become increasingly difficult**: governments will never have it so good as they have had it in this chapter.

EX 13 iPAD

EX 14 VIDEO

EX 7,8,9,10, 11 VIDEO

Question 1, Question 2 SHEET.

Multiple Choice 3, PS

Chapter 3 Ex 12 Solutions on BB

EX PP8-25 CH1

Financial Markets

1. **Some definitions**:

   - **Money**: an asset that people use to buy goods and services from other people. It is the most liquid asset and pays no interest. There are two types of money:
     - **currency** (coins and bills supplied by the Central Bank)
     - **account deposits** (bank deposits) at private banks.
   - **Financial markets**: refer broadly to any marketplace where securities trading occurs, including the stock market, bond market, forex market, and derivatives market.
   - **Bonds**: an asset too, but, unlike money, they pay a positive interest rate. However, you cannot use them for transactions. Bonds are investment securities where an investor lends money to a company or a government for a set period of time, in exchange for regular interest payments. Once the bond reaches maturity, the bond issuer returns the investor's money. Companies sell bonds to finance ongoing operations, new projects or acquisitions. Governments sell bonds for funding purposes, and also to supplement revenue from taxes. When you invest in a bond, you are a debtholder for the entity that is issuing the bond.
   - **Shares**: the capital of a company is divided into shares. Each share forms a unit of ownership of a company. Therefore, shares represent units of ownership in a corporation or financial asset owned by investors who exchange capital in return for these units.**Demand for money**: is it convenient to hold all of your wealth just in money or bonds? The mixture is the best. Remind that **BONDS** are one of the most important tools to let an economy works fine.

2. **Money demand ($M^D = M^d$)**: sum of all individual demands for money by firms and people in an economy. It depends on:

   - **Level of Transactions**: the more you want to spend, the more money you need.
   - **Interest Rate (i)**: the higher the i, the lower the money demand because people shift to bonds.

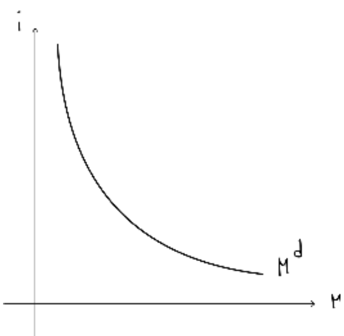
   It's hard to measure. We say that it is proportional to nominal income.

   $$\boxed{M^d = €Y * L(i)}$$

   If $€Y \uparrow M^d \uparrow$ $€Y$ represents the level of transactions

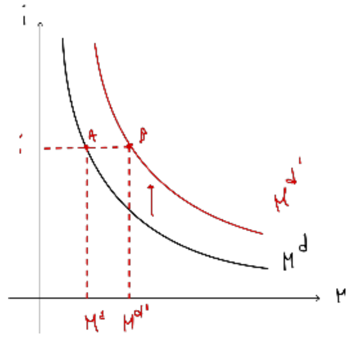
   If $i \uparrow M^d \downarrow$ because it's more convenient to hold bonds.

   Graph for M^D.



M^D is downward sloping because the higher i, the lower M^D (Bonds are more convenient).

Suppose ↑ €Y



$$M^d = €Y * L(i)$$

€Y ↑ M^d ↑

3. **Money Supply**: M^s

There are 2 types of money:

- **Currency**: supplied by the **Central Bank** (CB).
- **Deposit accounts**: supplied by **(Private) Banks**.

We assume that the only type of money in the economy is currency supplied by the **CB**.

Suppose the CB supplies an amount of money equal to M, so:

$$\boxed{M^S = M}$$

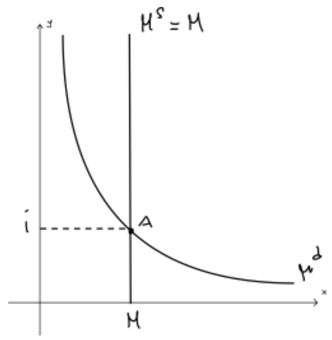
4. **Equilibrium in Financial Markets**:

Money Supply = Money Demand

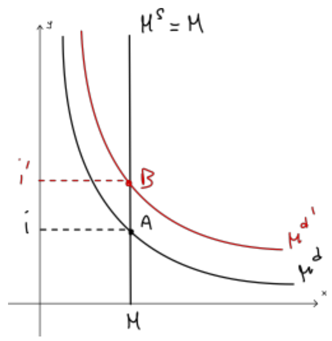
$\boxed{M^s = M^d}$ **Equilibrium condition in the money market / Money Market Equilibrium Condition.**

For us $M^s = M^d$ => $M = M^d$ => $M = €Y * L(i)$

Graph the Equilibrium Condition:



- Now suppose €Y ↑, What is the effect on i?



€Y ↑ level of transaction ↑

People demand more money

M^d ↑ to $M^{d'}$ => economy moves from A to B

From the graph we see that the i increases

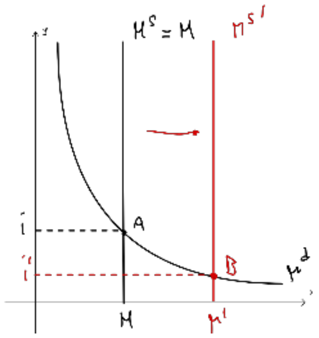
Intuition:

€Y ↑ M^d ↑ but M^s=

d is equilibrium and excess money demand.

In order to go back to the equilibrium and discourage people from demanding more money, so i↑ because bonds become more convenient and M^d ↓. B is the new equilibrium.

- Now suppose M^s ↑. What is the effect on i?



Intuition (2 are possible):

1. M^s ↑ but M^d= which means I have **excess of money supplied**.

   To restore the equilibrium M^d must ↑, this is why i ↓ so bonds become less convenient and M^d ↑ and the **equilibrium** is **restored**. => point **B**.

2. M^s ↑, there is more money in the economy and i, that can be considered as the **price of money,** falls.

5. **Open Market Operations (OMO)**

In reality CB targets a certain i. To obtain it, it changes M^s.

- Suppose CB wants to ↑ M^s: **Expansionary Monetary Policy**

  CB ***BUY*** bonds: by paying them, ***the amount of money in the economy increases***.

  M^s is expanded and i ↓.

- Suppose CB wants to ↓ M^s. **Contractionary Monetary Policy**

  CB ***SELLS*** bonds: it receives money in exchange for bonds and ***the amount of money in the economy decreases***.

  M^s is contracted and i ↑.

  So if inflation π ↑, CB ↑ i by selling bonds.

6. **CB's Balance Sheet**:

- Its **assets** are the **bonds** it holds in its **portfolio**.
- Its **liabilities** are the **stock of money** in the **economy**.

Open market operations lead to **equal changes in assets and liabilities**.

- If the **CB buys €1 million** worth of **bonds:**
  - the amount of bonds it holds is higher by €1 million
  - and so is the amount of money in the economy.

  This operation is an **expansionary open market operation**: the CB ↑ the supply of money.

- If the **CB sells €1 million worth of bonds**:
  - both the amount of bonds held by the CB
  - and the amount of money in the economy are lower by €1 million.

  This operation is a **contractionary open market operation**: the CB ↓ the supply of money.

7. **The Bond Prices**: suppose that in an economy there are only ***1 year bonds*** and they promise a payment of 100$ (Future Promised Payment) one year from now.

   (If in the exam you don't have any FPP, by convention we give it for granted that is 100$)

   Notation:

   $\$P_B$: price in $ of the bond today.

   You buy the bond today and you hold it for one year. What is the interest year on the bond?

$$\boxed{i = \frac{\$100 - \$P_B}{\$P_B}}$$

   Let's work on this:

$$i\$P_B = \$100 - \$P_B$$

$$i\$P_B + \$P_B = \$100$$

$$\$P_B(i+1) = \$100$$

$$\boxed{\$P_B = \frac{\$100}{1+i}}$$

   If i ↑ $\$P_B$ ↓

   Intuition:

   Suppose you buy a bond, $i = 2\,\%$

   The next day the European Central Bank intervenes and I decreases to 1.5%. So the I dec.

   People are willing to pay a higher price for your bond.

$i \downarrow \$P_B \uparrow$

8. **The Role of Banks**:

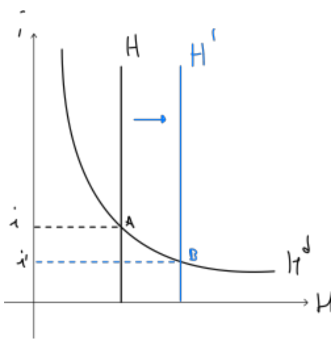
Private Banks receive funds from people and firms and buy with them financial assets (bonds and shares) and make with them loans.

Reserves: % of bank deposits that banks cannot use. They are partly in cash and partly in an account banks have at the Central Bank. Reserves are kept because banks must be ready to satisfy people who want to withdraw money and who wants to write a check.

Equilibrium in the market for CB money or monetary base

Demand for CB money comes from 2 different sources:

- **Currency demanded by people**:



- **Reserves demanded by banks**:

First Model:

- People want to hold money only as checkable deposits. Basically **people have 0 currency**.
- The demand for CB money $\boxed{H^d = R^d}$

R^d : demand for reserves by banks. This demand depends on demand for deposits (D^d).

- Since there is no demand for currency basically your M^d is made up only of checkable deposits. $M^d = D^d$ but since $M^d = €Y * L(i)$ => $D^d = €Y * L(i)$
- **Reserve (deposit) ratio (θ)**: proportion of checkable deposit banks have to keep as reserves.

θ is decide by CB.

During **recession θ decreases**.

Banks can apply a higher θ for precautionary reasons.

- $R^d = \theta D^d = \theta M^d = \theta \$Y * L(i)$

$D^d \uparrow \qquad R^d \uparrow$

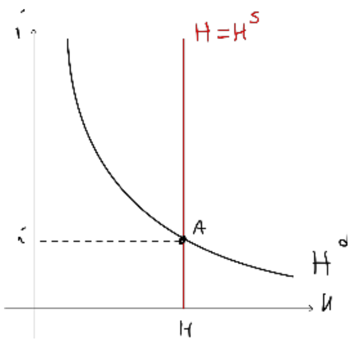
- Since $R^d = H^d = \theta \$ YL(i)$
- $H = H^s$: **supply of CB Money**=**Monetary Base**=High Powered Money. It's the total amount of CB money in the economy, managed through open market operations.
- At equilibrium

$H = H^s = H^d$

$H = R$

$\boxed{H = \theta \$ Y * L(i)}$

Graph of the equilibrium



H^d is decreasing.

Here $H^d = R^d$

$i\uparrow D^d\downarrow R^d\downarrow H^d\downarrow$

Suppose H ↑. What about i?

Intuition: $i\downarrow$

H has ↑ but $H^d =$ excess supply of CB money

H^d must ↑ to bring again the equilibrium. Since here H^d depends only on R^d, then R^d should ↑ and D^d↑ so $i\downarrow$ (bonds are less convenient).

Fed Rate and the Refi rate:

You may wonder whether there is an actual market in which the demand and the supply of reserves determine the interest rate. And, indeed, in the US, there is an actual market for bank reserves. This market is called the federal funds market. The interest rate determined in this market is called the federal funds rate. Because the Fed can, in effect, choose the federal funds rate by changing the supply of CB money, H, the federal funds rate is typically thought of as the main indicator of US monetary policy. This is why so much attention is focused on it, and why changes in the federal funds rate typically make front page news.

In the eurozone, the ECB implements monetary policy in a somewhat more complicated way than the Fed. There are several interest rates directly controlled by the ECB, but the most important one is the "main refinancing rate" or, more simply, "refinancing rate" (Refi Rate). It is the cost of the loans that the banks obtain from the ECB and is closely linked to the money supply of the CB: the higher this rate, the lower the amount of reserves that the banking system borrows from the ECB and the lower the money supply. In other words, this rate determines both the supply of reserves and the interest rate at which banks exchange reserves in the interbank market. By increasing or decreasing the refinancing rate, the ECB can, therefore, exert an indirect influence on all interest rates in the economy: first of all, on those banks demand on interbank transactions and then, in cascade, on interest rates on loans to businesses, real estate and so on.

Second Model:

Demand for money is:

- **Demand for currency**: CU^d
- **Demand for checkable deposits**: D^d, so demand for reserves by banks R^d

Together CU^d and D^d determine the demand for CB money H^d.

Now people hold checkable deposits and currency.

$$\boxed{H^d = CU^d + R^d}$$

Now people decide how much to hold in currency and how much in the checkable deposits.

$$M^d = CU^d + D^d$$

$$M^d = \$Y * L(i)$$

=> $\quad \$Y * L(i) = CU^d + D^d$

Currency/Money ratio or Cash/Money ratio (c): fixed proportion of money people hold in currency.

$(\mathbf{1-c})$: Fixed proportion of money people hold in deposits

$$CU^d = c * M^d$$

$$D^d = (1-c) * M^d$$

- At equilibrium

  $$M = M^s = M^d = CU + D$$

  $$CU = cM$$

  $$D = (1-c)M$$

  Now we find c

  $M = \dfrac{D}{1-c}$ and we substitute this M in the $CU = cM$ equation we just found.

$$CU = c\frac{D}{1-c}$$

$$CU(1-c) = cD$$

$$CU - cCU = cD$$

$$c(CU + D) = CU$$

$$\boxed{c = \frac{CU}{CU + D}}$$

- **Reserve ratio (θ)**. At equilibrium $R = \theta D$ because

  $R^d = \theta D^d$, then we substitute D^d

  $R^d = \theta(1-c)M^d$

In this second model $H^d = CU^d + R^d$

$H^d = cM^d + \theta(1-c)M^d$

We factorise M^d

$$\boxed{\begin{aligned} H^d &= [c + \theta(1-c)]M^d \\ H^d &= [c + \theta(1-c)]\$Y * L(i) \end{aligned}}$$

Demand for CB money

In equilibrium: the supply of CB money (or monetary base) = demand for CB money

$H = H^d$

$H = CU + D$

At equilibrium this expression $H^d = [c + \theta(1-c)]M^d$ becomes

$$\boxed{\begin{aligned} H &= [c + \theta(1-c)]M^d \\ H &= [c + \theta(1-c)]\$Y * L(i) \end{aligned}}$$

Equilibrium Condition in the Market for the CB money (monetary base)

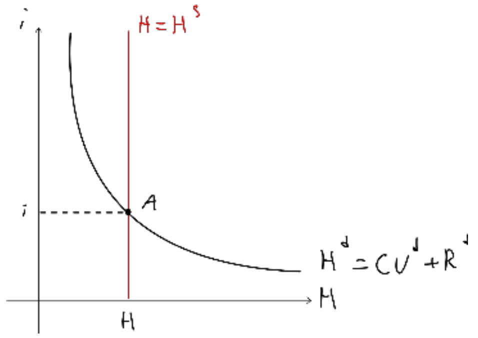
- If $c = 1$ => zero deposits.

  $H = \$YL(i)$

- If $c = 0$ => first model.

  $H = \theta\$YL(i)$

Graph of the equilibrium in the market for the monetary base:



- **If $H\downarrow$ what happens to i?**

  In the equilibrium graph H shifts to the left, $i\uparrow$.

  H^d= disequilibrium. There is excess demand for CB money

  H^d must $\downarrow$

  $H^d = CU^d + R^d$

  So $H^d\downarrow$ if $CU^d\downarrow$ and $D^d\downarrow$. $M^d\downarrow$ so $i\uparrow$ (because bonds become more convenient).

The **relation** between the **money supply** and the **monetary base**.

- If in an economy there are **no private banks**, then

  $M^s = H^s = H$

- If there are **private banks**, then

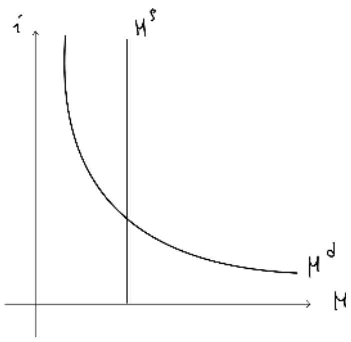
  $M^s = H^s + (money\ supplied\ by\ private\ banks)$

Now, we want to derive a **relation between M^s and H**

1. **Money Market**:

   $M = M^s = M^d$ monetary market equilibrium condition

   Graph:



2. **Market for the Monetary Base** (based on the 2nd model):

   The market is in equilibrium when:

   $$H = [c + \theta(1-c)]M^d$$

3. We put the 2 equilibrium conditions together.

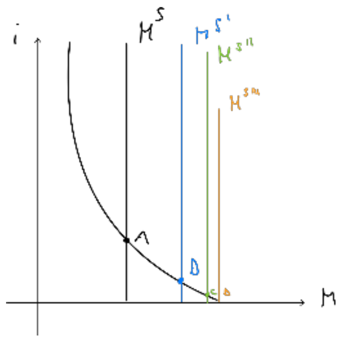
$$\boxed{\begin{aligned} H &= [c + \theta(1-c)]M \\ M &= \frac{1}{[c+\theta(1-c)]}H \end{aligned}}$$

Relation between money supply and monetary base (CB money)

   When the market for the monetary base in equilibrium, then the money market is in equilibrium too.

Liquidity Trap:

Reality: the CB targets a certain i and achieves it through **open market operations (OMO)** (buy/sell bonds).



The economy is at A => equilibrium

- Suppose there is a recession: CB should move M^s to the right (expansionary monetary policy).

  => $i\downarrow$ $\quad$ $I\uparrow$

- Suppose NOT enough, again M^s to the right.

  Suppose NOT enough, again M^s to the right since $i = 0$

  The economy is in a **liquidity trap,** because if M^s keeps on ↑ ↑ ↑ i is still 0, and at $i = 0$ people becomes indifferent between money and bonds.

Ways out of liquidity trap:

- **Contractionary monetary policy**: $i\uparrow$ but economy must be ready to afford the increase in i
- **Quantitive leasing**: it's an unconventional monetary policy, a huge purchase of bonds by the CB. i becomes negative.

EX 14 P26

EX 15 P28 IPAD

EX SLIDES 15,16 T/F

EX PP26-35 CH1

IS-LM Model

We put Ch3 and Ch4 together.

1. **Goods Market** (Ch3)

$Z = C + I + G$

At eq $Y = Z$

$Y = C + I + G$

Now I is no longer equal to $\bar{I}$

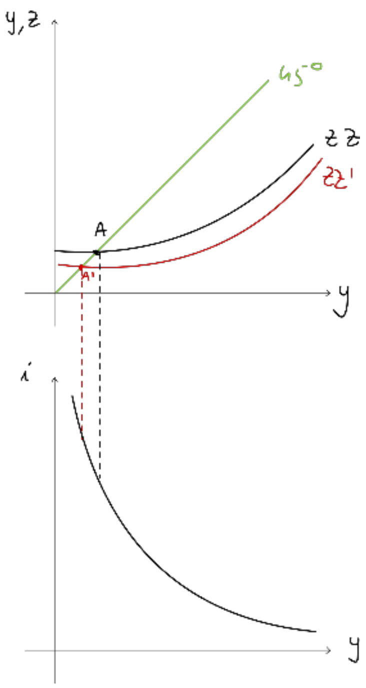
Now I depends on Y (+) and i (-).

$I = I(Y, i)$ (I is a function of Y and i)

$\boxed{Y = C(Y - T) + I(Y, i) + G}$ **IS relation (implicit formula)**

C and I are functions respectively of Y-T and Y,i.

Graph of the IS



- Ch3 but now ZZ includes I that depends on Y, i
- ZZ is ↑ If Y ↑

  $Y^d\uparrow$ $C\uparrow$ $Z\uparrow$ $I\uparrow$, $Y\uparrow$ now with a double effect: C and I
- When $Y\uparrow$ by 1\$, $Z\uparrow$ by less
- Empirical evidence: C and I are not linear, ZZ is a curve.

Now suppose i ↑.

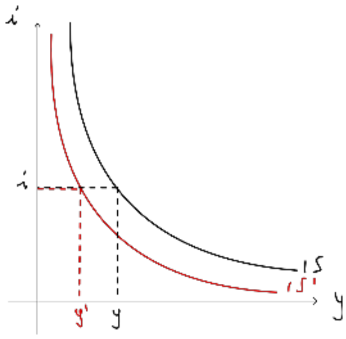
$I\downarrow$ $Z\downarrow$ $Y\downarrow$ $ZZ\downarrow$

I obtain the graph of the IS => downward sloping:

$i\uparrow$ $I\downarrow$ $Z\downarrow$ $Y\downarrow$

The **IS** is the **locus of all pairs $(\mathbf{Y}, \mathbf{i})$ for which the goods market is in equilibrium**.

Let's reason on the IS



$IS: Y = C(Y - T) + I(Y, i) + G$

- Suppose $T\uparrow$

  $T\uparrow\ Y^d\downarrow\ C\downarrow\ Z\downarrow\ Y\downarrow$ => IS to the left.

- The same when $G\downarrow$

  $G\downarrow\ Z\downarrow\ Y\downarrow$

- The same when $C_0\downarrow$

- The same when $\bar{I}$ (exogenous component of I) $\downarrow$

$G\uparrow\ T\downarrow\ C_0\uparrow\ C_1\uparrow\ IS$ to the right.

Let's obtain an explicit expression for the IS

$C = C_0 + C_1(Y - \bar{T})$

$I = \bar{I} + d_1 Y - d_2 i$

d_1 sensitivity of I to Y

d_2 sensitivity of I to i.

Computation: $Y = C + I + G$

$$\boxed{Y = \boxed{\frac{1}{1 - c_1 - d_1}}\boxed{(C_0 - C_1\bar{T} + \bar{I} + \bar{G})} - \frac{d_2}{1 - C_1 - d_1} i}$$

IS **relation (explicit formula)**

- **Demand or Fiscal Multiplier**:

  $0 < C_1 + d_1 < 1$

  $C_1 + d_1$ is the **Marginal propensity to spend/expenditure**.

- A**= autonomous spending**: The sum of all component of the demand for goods and services that doesn't depend on Y and i.

To represent the explicit IS I need to write it as $i = \ldots$

$$\boxed{i = \boxed{\frac{1}{d_2}(C_0 - C_1\bar{T} + \bar{I} + \bar{G})} - \boxed{\frac{1 - C_1 - d_1}{d_2}} Y}$$

Vertical Intercept **Slope**

IS **relation (explicit formula)**

Horizontal Intercept: $i = 0$

$$0 = \frac{1}{d_2}(C_0 - C_1\overline{T} + \bar{I} + \overline{G}) - \frac{1 - C_1 - d_1}{d_2}Y$$

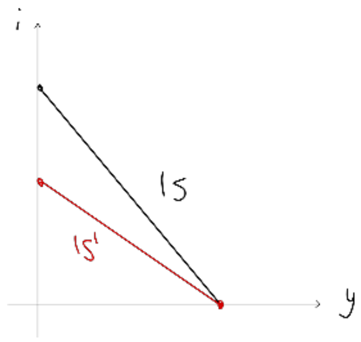
$$\frac{1 - C_1 - d_1}{d_2}Y = \frac{1}{d_2}A$$

$$Y = \frac{1}{d_2}A\frac{d2}{1 - C_1 - d_1} = \boxed{\frac{A}{1 - C_1 - d_1}}$$ **Horizontal Intercept**

Reasoning on the IS

1) $d_2\uparrow$ **or it's very high**

d_2 is the sensitivity of I to i



If d_2 is high, the IS

- Slope: lower, flatter
- V. Int: lower
- H. Int: unchanged

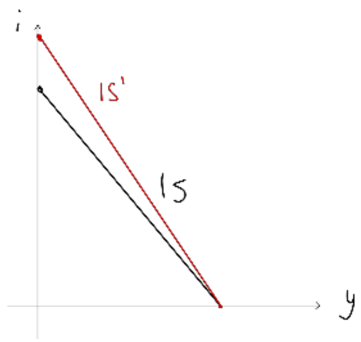
Intuition:

Suppose CB changes i

This has more effect than when d_2 is low.

(The same effect is when C_1or d_1 is large)

2) $d_2\downarrow$ **or it's very low**



If d_2 is low, the IS

- Slope: higher, steeper
- V. Int: higher
- H. Int: unchanged

Intuition:

Suppose CB changes i

This has less effect than when d_2 is low.

(The same effect is when C_1or d_1 is small)

3) d_2**=0**

I doesn't depend on i

Slope=∞ => vertical line

The IS is VERTICAL ONLY if NO component depends on i.

Suppose you have $I = \bar{I} d_2 = 0$ but

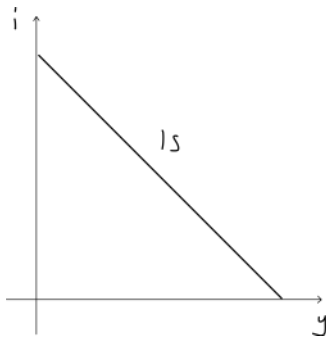
$C = C_0 + C_1(Y - \overline{T}) - h_2 i$

$i\uparrow\ C\downarrow$

Negative relation between i and C which makes sense: $i\uparrow$ you save more: $C\downarrow$

So $i\uparrow\ C\downarrow\ Z\downarrow\ Y\downarrow$

In this case IS is not vertical, it has the usual negative slope because C depends negatively on i.



If $d_2 \neq 0$ when $i\downarrow\ I\uparrow\ Z\uparrow\ Y\uparrow$.

$d_2 = 0$ when $i\uparrow$ or $\downarrow$ I=.

The smaller d_2, the smaller the $\uparrow$ in Y when $i\downarrow$.

EX 5a Ch2: When IS is vertical, expansionary fiscal policy ($T\downarrow$ and/or $G\uparrow$) haas its maximum effect.

4) $d_2 = \infty$

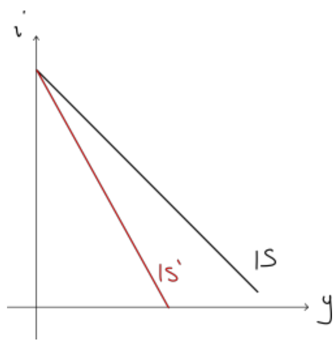
slope=0 IS horizontal

5) $d_1\downarrow$ **(sensitivity of I to Y)**

Slope: greater/steeper

V. Int: unchanged

H. Int: lower



<u>Intuition</u>:

Suppose $C_0\uparrow$ $C\uparrow$ $Z\uparrow$ $Y\uparrow$ $I\uparrow$ but less.

6) $d_1\uparrow$

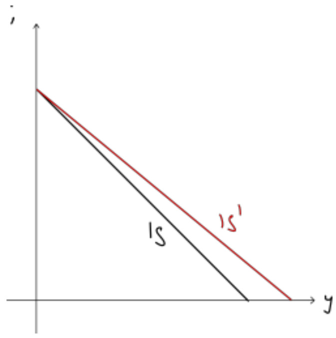
Slope: lower

V. int: unchanged

H. Int: greater

<u>Intuition</u>:

Suppose d_1 large, $Y\uparrow$ $I\uparrow\uparrow\uparrow$



EX 1a Ch2

2. **Financial Markets**: Ch 4

LM=Liquidity Money

- Equilibrium on the Money Market

$$M = M^s = M^d = \$YL(i)$$

In real terms

$$\boxed{\boxed{\frac{M}{P}} = \boxed{YL(i)}}$$

LM relation (implicit formula)

Real money stock

Real money demand YL(i)

LM is the locus of all pairs (Y, i) for which the money market is in equilibrium ($M = M^s = M^d$).

We have 2 versions of the $IS - LM$ model; for both of them the IS is the same, the LM changes.

- **Standard $IS - LM$ model**: The CB **targets the** i, so M^s is **endogenous**. More realistic.
- **NON-Standard $IS - LM$ model**: The CB **targets** M^s, so M^s is **exogenous**.

Standard IS-LM Model

The IS is the same (see above).

The LM

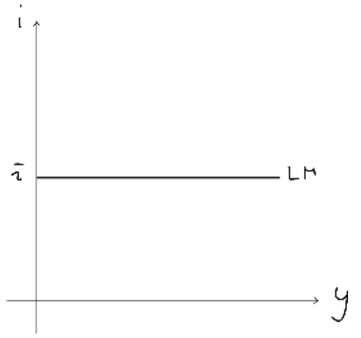
$$M^d = P(f_1Y - f_2i)$$

$$M = P(f_1Y - f_2\bar{i})$$ the $\bar{i}$ is the one targeted by the CB

Eq: $M^d = M$

$P(f_1 Y - f_2 i) = P(f_1 Y - f_2 \bar{i})$

$\boxed{i = \bar{i}}$ LM **in the standard model**

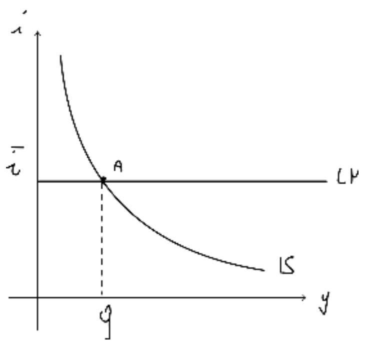


The LM will move up or down according to ↑ or ↓ in $\bar{i}$ chosen by the CB.

EX Ch 2 Question 1 point b.

The equilibrium in the $IS - LM$ Standard Model:

Graph:



Computation of $\hat{Y}$:

$$\begin{cases} IS \\ LM \end{cases} \qquad \begin{cases} i = \frac{A}{d_2} - \frac{1 - C_1 - d_1}{d_2} Y \\ i = \bar{i} \end{cases}$$

$$\bar{i} = \frac{A}{d_2} - \frac{1 - C_1 - d_1}{d_2} Y$$

I can get $\hat{Y}$

$$\hat{Y} = Y^* = \frac{1}{1 - C_1 - d_1} A - \frac{d_2}{1 - C_1 - d_1} \bar{i}$$

$$i^* = \hat{i} = \bar{i}$$

- By how much $\hat{Y}$ will change if A changes by ΔA?

$$\Delta Y = \boxed{\frac{1}{1 - C_1 - d_1}} \Delta A$$

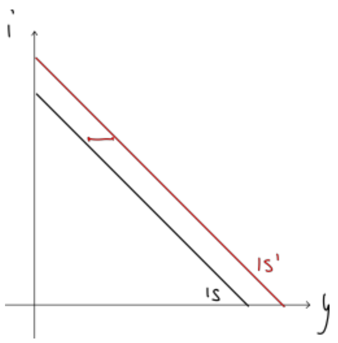
Fiscal policy multiplier of the standard case

(Because T & G are the most important changes in A)

If $G\uparrow$ by ΔG, what is the effect on Y?

$$\Delta Y = \frac{1}{1 - C_1 - d_1} \Delta G$$

Graph



$C\uparrow \; Z\uparrow \; Y\uparrow$

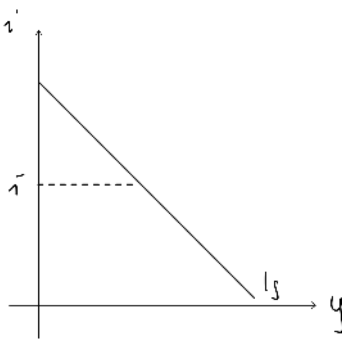
The fiscal policy multiplier measures how much Y will change following a change in A and $A = C_0 - C_1\overline{T} + \overline{I} + \overline{G}$

- By how much will $\hat{Y}$ change following a change in $\bar{i}$ equal to $\Delta\bar{i}$?

$$\Delta \hat{Y} = \boxed{\frac{-d_2}{1 - C_1 - d_1}} \Delta \bar{i}$$

Monetary policy multiplier of the standard case

(It gives the corresponding change in $\hat{Y}$ due to a change in $\bar{i}$



$i\uparrow$ you move LM up and you move along the IS

EX 1c Ch2

Example 1:

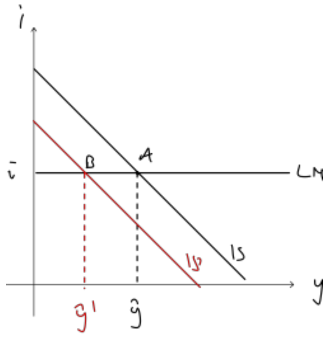
Government wants to $\downarrow Def$ => The government will $\uparrow T$ and/or $\downarrow G$

Suppose the government $\uparrow T$ and G=

When $T\uparrow$ and/or $G\downarrow$ => **contractionary fiscal policy/fiscal contraction**.

When $T\downarrow$ and/or $G\uparrow$ => **expansionary fiscal policy/fiscal expansion**.

What is the effect on $\hat{Y}$, $\bar{i}$, composition of demand?



A initial equilibrium

$T\uparrow\ Y_d\downarrow\ C\downarrow\ Z\downarrow\ Y\downarrow$

IS to the left

$\bar{i}$ unchanged => CB no intervention

Composition of output/demand:

C		I		G
$Y\downarrow$	$=> C\downarrow$	$Y\downarrow$	$=> I\downarrow$	Unchanged
$T\uparrow$		$i =$		

What happens to S?

$$I = S + (T - G)$$
$$\downarrow \quad \downarrow \quad \quad \uparrow$$

S will decrease.

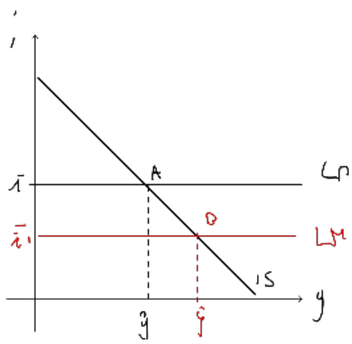
$T\uparrow\ Y_d\downarrow\ C\downarrow\ Z\downarrow\ Y\downarrow\ S\downarrow$

The $\downarrow Y$ prevails over the $\downarrow$C

Example 2:

Suppose the CB $\downarrow i$ (expansionary monetary policy): BUYS bonds.

What's the effect on $\hat{Y}$, i, composition of output?



$\bar{i}\downarrow\ I\uparrow\ Z\uparrow\ Y\uparrow$

$\hat{Y}' > \hat{Y}$

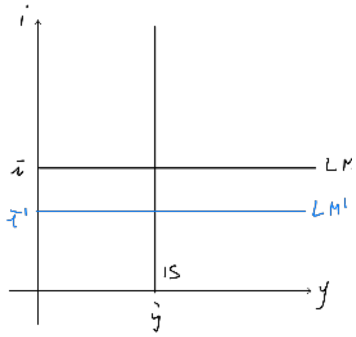
Composition of output/demand:

C		I		G
$Y\uparrow$	$=> C\uparrow$	$Y\uparrow$	$=> I\uparrow$	Unchanged
$T=$		$i\downarrow$		

$C\uparrow$ $I\uparrow$ G= the $\uparrow Y$ is due both to $\uparrow$C and $\uparrow I$

A special case

$I = \bar{I}$ and the component of IS depends on I

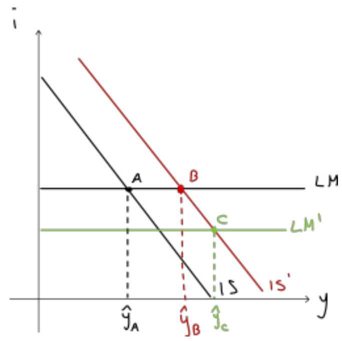


Suppose $i\downarrow$

Since the IS is fully insensitive to i, no change in Y => no effect on the market but only on financial market.

3. **Policy Mix**.

Suppose the economy is in a recession. Expansionary fiscal policy, for ex: $G\uparrow$ $Z\uparrow$ $Y\uparrow$



A initial equilibrium.

$G\uparrow$ point B => $\hat{Y}_B > \hat{Y}_A$

Suppose the CB would like to support the $\uparrow$ in Y further. Expansionary monetary policy:

$\bar{i}\downarrow$ => point C $\hat{Y}_C > \hat{Y}_B > \hat{Y}_A$

Sometimes, the right mix is to use fiscal and monetary policy in the same direction.

Suppose that the economy is in a recession and output is too low. Then, both fiscal and monetary policies can be used to increase output:

- Expansionary fiscal policy, say through a decrease in taxes, shifts the IS curve to the right to IS'.
- Expansionary monetary policy shifts the LM down to LM'.

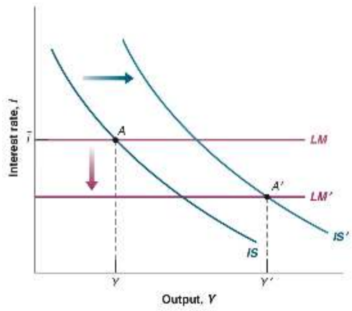


Figure 5.8
The effects of a combined fiscal and monetary expansion
Fiscal expansion shifts the IS curve to the right. Monetary expansion shifts the LM curve down. Both lead to higher output.

$T\downarrow$ so $C\uparrow$ $Z\uparrow$ $Y\uparrow$ and since $i\downarrow, I\uparrow$.

Such a combination is typically used to fight recessions.

An increase in Y could be achieved just by using fiscal policy ($\uparrow$ in G or $\downarrow$ in T) or just by using monetary policy ($\downarrow$ in i). However there are a number of reasons why policymakers may want to use a policy mix:

- **A fiscal expansion means either an $\uparrow$ in G or a $\downarrow$ in T or both**. This means an increase in Def and running a large deficit and increasing government debt could be dangerous later. In this case it's better to rely on monetary policy

- **A monetary expansion means a $\downarrow$ in i**. If the interest rate is very low, then the room for using monetary policy may be limited. In this case, fiscal policy has to do more of the job. If i is already equal to zero because of the zero lower bound, fiscal policy has to do all the work. If demand were to decrease soon, the room for monetary policy to $\downarrow$ i would be limited, and fiscal policy would have to play the main role.

- **Fiscal and monetary policies have different effects on the composition of output**. A $\downarrow$ in T tends to $\uparrow$ C relative to I. A $\downarrow$ in i affects I more than C. Thus, depending on the initial composition of output, policymakers may want to rely more on fiscal or more on monetary policy.

- **Finally, neither fiscal policy nor monetary policy works perfectly**. A $\downarrow$ in T may fail to $\uparrow$ C. A $\downarrow$ in i may fail to $\uparrow$ I. Thus, in case one policy doesn't work as well as hoped for, it is better to use both.

Sometimes, the right policy mix is instead to use the 2 policies in opposite directions, for example, combining a fiscal consolidation with a monetary expansion.

Suppose that the government is running a large Def and would like to reduce it, but doesn't want to trigger a recession. If the government reduces the Def, say by $\uparrow T$ or $\downarrow G$ (or both) the IS curve will shift to the left to IS'. At a given i, higher T or lower G will $\downarrow Z$, and through the multiplier $\downarrow Y$. Thus, the reduction in the Def will lead to a recession.

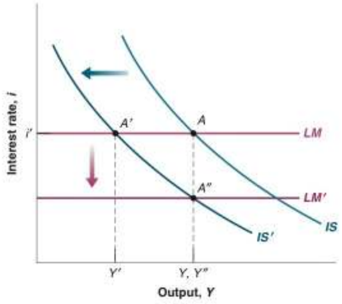


Figure 5.9
The effects of a combined fiscal consolidation and a monetary expansion
The fiscal consolidation shifts the IS curve to the left. A monetary expansion shifts the LM curve down. Together, they leave output unchanged while the budget deficit is reduced.

The recession can be avoided, however, if monetary policy is also used. If the CB reduces the i to i'. The combination of both policies thus allows for the reduction in the Def, but without a recession.

What happens to C and I in this case?

- What happens to C depends on how the Def is reduced.
  - If $G\downarrow$, Y=, Y_d=, C=
  - If $T\uparrow$ $Y_d\downarrow$ $C\downarrow$
- What happens to I is unambiguous: Y=, $i\downarrow$, $I\uparrow$

Ex 4 HW: a government is running a large budget deficit, it wants to decrease it but leave Y unchanged. How will $\hat{Y}$, i and composition of demand change? What about S?.

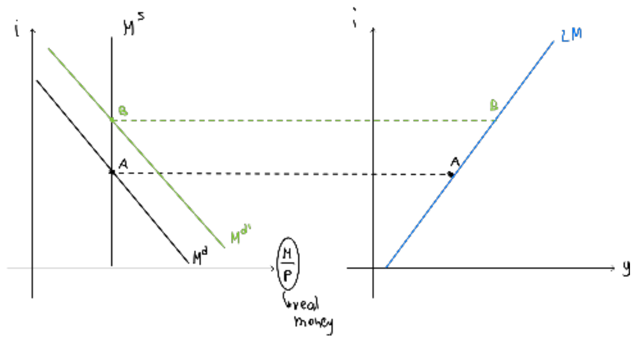
Book read p106-109

BB Ex 17-18-19

Ex 20-21 iPad.

Non-standard IS-LM Model

- CB chooses M^s
- IS is the same
- LM changes



A initial equilibrium

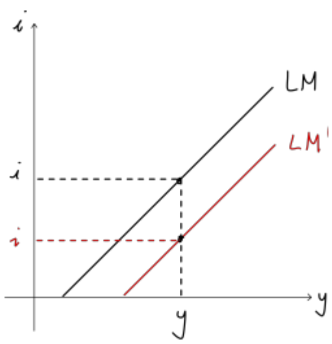
Suppose ↑ Y, M^d↑ i↑ because M^s hasn't changed.

LM is now upward sloping Y↑ i↑

$$\boxed{\frac{M}{P} = YL(i)}$$

LM **equation (implicit)**

When Y↑ i↑



If M↑ i↓ LM shifts down.

Same when the P↓

$\frac{M}{P}$↑ so i↓

(If M↓ or P↑ => LM shifts to the left)

Functional form for the LM:

$$\boxed{\frac{\overline{M}}{P} = f_1 Y - f_2 i}$$

LM **equation (explicit)**

$\frac{\overline{M}}{P}$ is real money stock real money demand.

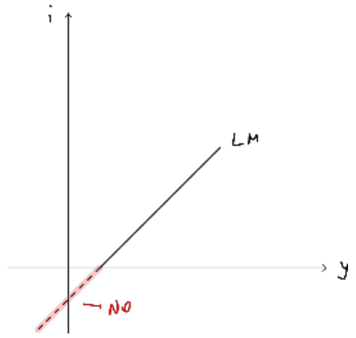
$$\boxed{Y = \frac{1}{f_1}\frac{\overline{M}}{P} + \frac{f_2}{f_1}i}$$ **To compute Y**

$$\boxed{i = \boxed{-\frac{1}{f_2}\frac{\overline{M}}{P}} + \boxed{\frac{f_1}{f_2}}Y}$$ **To compute I**

For exercises

V. int<0 Slope>0

We assume that i has no negative values. We ignore the portion of the LM lying in the 3rd and 4th quadrant.



H. Int $i = 0$

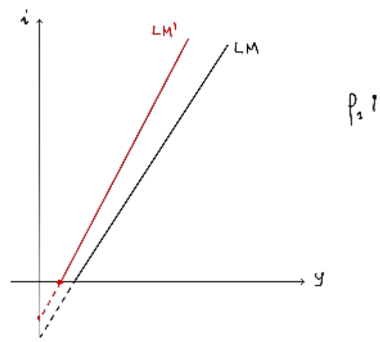
$$0 = -\frac{1}{f_2}\frac{\overline{M}}{P} + \frac{f_1}{f_2}Y$$

$$\frac{f_1}{f_2}Y = \frac{1}{f_2}\frac{\overline{M}}{P}$$

$$Y = \frac{1}{f_1}\frac{\overline{M}}{P}$$ <= Horizontal Intercept

EB Q2 a) Ch2

1. $f_1 \uparrow$



   It's the sensitivity of real M^d to income.

   Slope: ↑, steeper LM

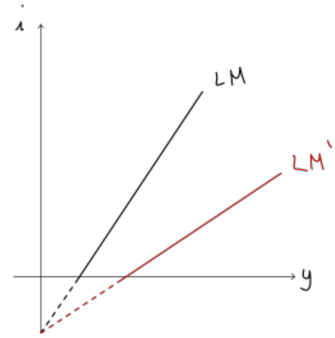
   V. Int: =

   H. Int: ↓

   Intuition:

   If f_1 is large, when $Y\uparrow$, $M^d \uparrow\uparrow\uparrow$, so i will ↑ ↑ ↑ to restore equilibrium.

2. $f_1 \downarrow$



Slope: down, flatter LM

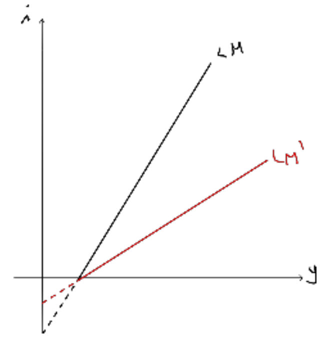
V. Int: =

H. Int: ↑

Intuition:

---

3. $f_2 \uparrow$



It's the sensitivity of M^d to i

Slope: decreases, M^d flatter

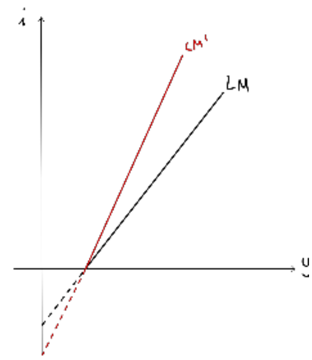
V. Int: ↑

H.int: =

Intuition:

If f_2↑ ↑ ↑, a small ↑ in the interest rate is sufficient to lead to a large drop in M^d.

4. $f_2 \downarrow$



Slope: ↑, steeper M^d

V. Int: ↓

H. Int: =

Intuition:

---

5. When will the LM be vertical?

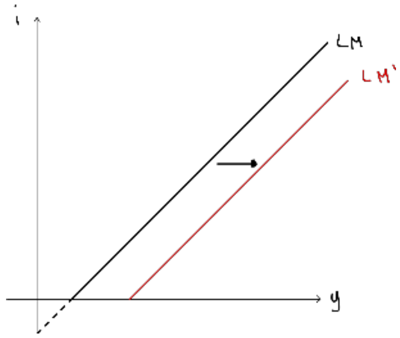
Slope=∞ $\quad \dfrac{f_1}{f_2} = \infty$ → $f_1 = \infty$; → $f_2 = 0$

Suppose ↑ $\overline{M}$

$$LM: \quad Y = \frac{1}{f_1}\frac{\overline{M}}{P} + \frac{f_2}{f_1} i$$

LM shifts to the right. But how much?

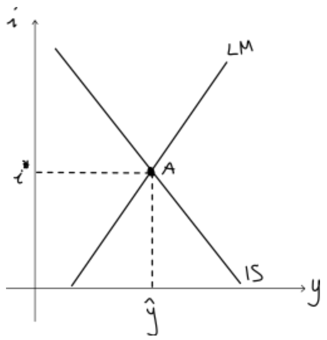
$$\Delta Y = \frac{1}{f_1}\frac{\Delta \overline{M}}{P}$$



If f_1 is low, M^d is little sensitive to Y, in order to have a change in M^d, Y needs to change a lot.

EB Q2 b) Ch2

Equilibrium of the non standard $IS - LM$ model



To compute $\hat{Y}, i*$

$$\begin{cases} IS \\ LM \ of \ the \ non-standard \ model \end{cases}$$

$$\begin{cases} i = \frac{1}{d_2}(C_0 - C_1\overline{T} + \overline{I} + \overline{G}) - \frac{1 - C_1 - d_1}{d_2}Y \\ i = -\frac{1}{f_2}\frac{\overline{M}}{P} + \frac{f_1}{f_2}Y \end{cases}$$

Lots of computations to get to these results:

$$Y = \frac{1}{(\frac{f_1 d_2}{f_2}) + (1 - C_1 - d_1)}A + \frac{d_2}{f_1 d_2 + f_2(1 - C_1 - d_1)}\frac{M}{P}$$

We don't need to learn these formulas by heart

$$i = \frac{\frac{f_1}{f_2}}{\frac{f_1 d_2}{f_2} + (1 - C_1 - d_1)}A - \frac{1 - C_1 - d_1}{f_1 d_2 + f_2(1 - C_1 - d_1)}\frac{M}{P}$$

Referring to $\hat{Y}, i*$, how much will $\hat{Y}$ change if autonomous demand changes by ΔA?

$$\Delta\hat{Y} = \boxed{\frac{1}{\frac{f_1 d_2}{f_2} + (1 - C_1 - d_1)}}\Delta A$$

Fiscal policy multiplier of the NON-standard case

(Because T & G are the most important changes in A)

1. d_2 is low

   It's the sensitivity of I to i

   If $Y\uparrow$ $M^d\uparrow$ $i\uparrow$ $I\downarrow$ (small decrease)

2. f_1 is small

   it's the sensitivity of M^d to Y

   If $Y\uparrow$ $M^d\uparrow$ (small increase) $i\uparrow$ (little increase) $I\downarrow$ (little decrease)

3. f_2 is large

   It's the sensitivity of M^d to i

   If $Y\uparrow$ $M^d\uparrow$ $i\uparrow$ (little increase is enough)

By how much will Y change following a change in nominal money supply M?

I refer to the "blue formula" above

$$\Delta Y = \boxed{\frac{d_2}{f_1 d_2 + f_2(1 - C_1 - d_1}}\frac{\Delta\overline{M}}{P}$$

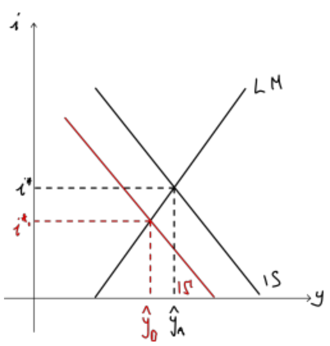
Monetary policy multiplier of the NON- standard case

(It measures the response of Y to changes in M)

EB Q2 c) Ch2

Reasoning on the NON-standard $IS - LM$ model

Example 1: Suppose $T\uparrow$. What happens to $\hat{Y}$, i^*, composition of demand.



$T\uparrow$ $Y_d\downarrow$ $C\downarrow$ $Z\downarrow$ $Y\downarrow$

IS to the left.

$i\downarrow$ why?

$Y\downarrow$ $M^d\downarrow$ but M^s is = so to restore the equilibrium and make $M^d\uparrow$, i will $\downarrow$

Composition of output/demand:

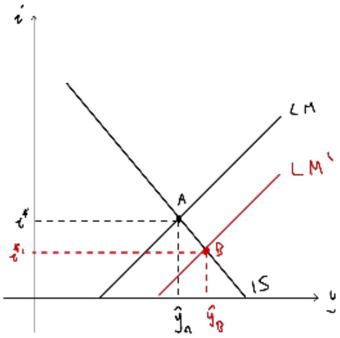
C		I		G
$Y\downarrow$	$=> C\downarrow$	$Y\downarrow$	$=> I$ ambiguous	Unchanged
$T\uparrow$		$i\downarrow$		

$Y\downarrow\ I\downarrow$

$i\downarrow\ I\uparrow$

$$\underset{\downarrow}{Y} = \underset{\downarrow}{C} + \underset{?}{I} + \underset{=}{G}$$

Example 2: Suppose $M\uparrow$, Explain the effect on $\hat{Y}$, i^*, composition of demand.



$M\uparrow$, but M^d= so to restore equilibrium $i\downarrow$ so that $M^d\uparrow$. Then $I\uparrow$ and $Y\uparrow$

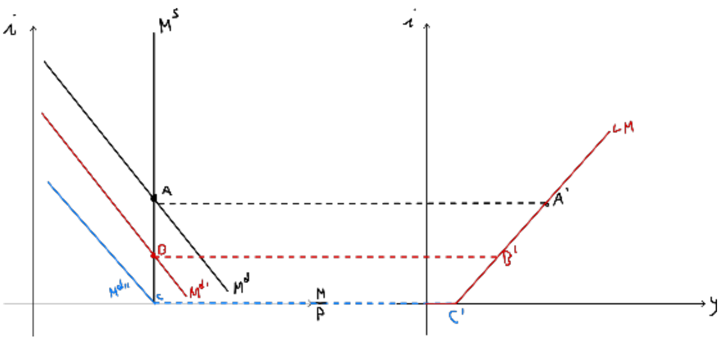
Composition of output/demand:

C		I		G
$Y\uparrow$	$=> C\uparrow$	$Y\uparrow$	$=> I\uparrow$	Unchanged
T=		$i\downarrow$		

Liquidity Trap in the NON standard IS-LM Model

$i = 0$ or $i -> 0$

The LM is:

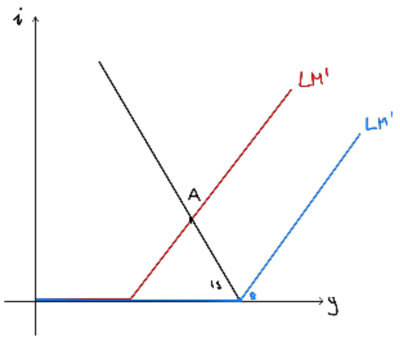


Suppose $Y\downarrow, M^d\downarrow$ $M^{d'}$ =>point B where $i\downarrow$

Suppose Y keeps on ↓, M^{d}" => point C where $i = 0$

The LM is in a liquidity trap ($i = 0$): it's flat and then upward sloping.

So:



A initial equilibrium

If M^s↑ LM shifts to the right => the economy is at point B where $i = 0$ => liquidity trap.

If CB keeps on ↑ M^s, the intersection is still at B => expansionary monetary policy has no effect.

Ex 22 iPad

EB: p38-59

Extended IS-LM Model

1. **Nominal interest rate (i_t): interest rate in terms of $**

If I borrow 1 dollar today, then next year I will repay $(1+i_t)\$$

Real interest rate (r_t): interest rate in terms of a basket of goods.

If I borrow the equivalent of 1 basket of goods today, then next year I'll repay the equivalent of $(1+r_t)$ basket of goods.

Suppose you can buy only bread.

In nominal terms you borrow $P_t\$$. The next year your repay $(1+i_t)P_t\$$.

In real terms, you care about the amount you have to repay in terms of bread

P^e_{t+1}: Expected price of bread next year

I expect to repay next year: $\dfrac{(1+i_t)P_t}{P^e_{t+1}}$

$$(1+r_t)=\frac{(1+i_t)P_t}{P^e_{t+1}}$$

Now we introduce inflation

Expected Inflation (π^e_{t+1})

Definition of Inflation $\left(\pi^e_{t+1}=\dfrac{P^e_{t+1}-P^e_t}{P_t}\right)$

$$1+\pi^e_{t+1}=\frac{P^e_{t+1}-P^e_t}{P_t}+1$$

$$1+\pi^e_{t+1}=\frac{P^e_{t+1}}{P_t}$$

$$\frac{1}{1+\pi^e_{t+1}}=\frac{P_t}{P^e_{t+1}}$$

$$\boxed{(1+r_t)=\frac{1+i_t}{1+\pi^e_{t+1}}}$$

This gives the exact relationship between $i_t,\ r_t,\ \pi^e_{t+1}$

If $i_t,\ \pi^e_{t+1}$ aren't too large (<20%) then it can be approximated as:

$r_t = i_t - \pi^e_{t+1}$

We usually see that: $\pi^e_{t+1} > 0 \quad => \quad r_t < i_t$

The higher π^e_{t+1}, the lower r_t

Ex ante real interest rate ($1 - \pi^e$)

Ex post real interest rate ($1 - \pi$)

- CB chooses i_t but in reality it cares about r_t.
  - If the CB wants $r = 4\%$ and know that $\pi^e = 2\%$, then it will set $i = 6\%$
  - If the zero-lower bound holds: $i \geq 0$, then $\boxed{r = i - \pi^e}$

    The lowest value for i is 0, r cannot be smaller than $-\pi^e$
  - If π^e is positive, r_t might also be negative.

2. **Bonds**: they differ in terms of:
   - **Maturity**:
   - **Risk**: to compensate for risk, bond holders require a **RISK PREMIUM (x)** that depends on:
     - **The probability of default**: the higher it is, the higher the x. You demand $i + x$ (i=nominal interest rate on riskless bonds)
     - **The degree of risk aversion of bond holders**: the more risk averse, the higher x

   Nominal interest rate on a risky bond with probability p of default: $i + x$

$$\underbrace{\boxed{(1+i)}}_{\text{Return on a riskless bond}} = \underbrace{\boxed{(1-p)(1+i+x) + p * 0}}_{\text{Return on a risky bond}}$$

   If > => I would buy the riskless bonds.

   You can compute $\boxed{x = \dfrac{p(1+i)}{1-p}}$

3. **The extended $IS - LM$ model (standard model)**

   This version is more realistic.

   We distinguish between

   - Real and nominal interest rates
   - Policy rate set by CB and borrowing rate

- **1st version**:

$$\begin{cases} IS: \ Y = C(Y-T) + I(Y, i - \pi^e + x) + G \\ LM: \ i = \bar{i} \end{cases}$$

$$\boxed{\begin{cases} IS: \ Y = C(Y-T) + I(Y, r + x) + G \\ LM: \ i = \bar{i} \end{cases}}$$

If x↑ => it means that lenders perceive a higher risk that borrowers will not repay.

Lenders become more risk averse

The amount of loans in the economy ↓

We call:

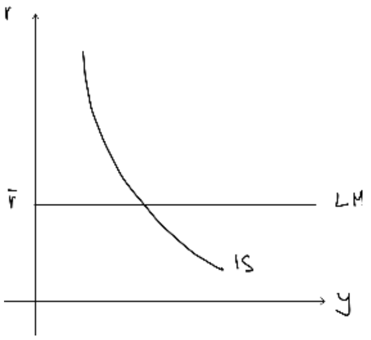
- i the **nominal policy rate determined** by the **CBs monetary policy**
- $r + x$ the **real borrowing rate** for **firms** and **people**

- **2nd version**:

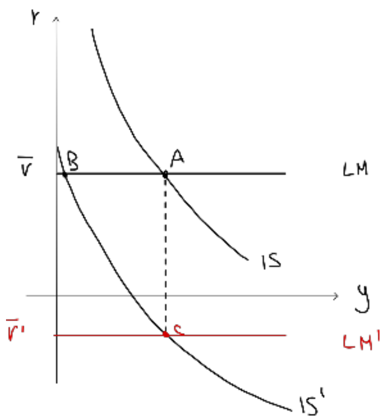
The CB targets the real policy rate = r

$$\boxed{\begin{cases} IS: \ Y = C(Y-T) + I(Y, r + x) + G \\ LM: \ r = \bar{r} \end{cases}}$$

Graph:



Suppose investors become more risk averse: x↑



A= initial equilibrium

x↑ $(r + x)$↑ I↓ Z↓ Y↓ => IS to the left

The economy moves at B where Y is low. There is danger of recession.

The government can ↓ T and/or ↑G but this hurts public debt

We can use monetary policy.

Suppose CB steps in and wants to achieve the initial Y so Y must ↑.

LM' ↓ but in this case r↓ ↓ ↓ because x↑ and I depends on $r + x$

If the zero lower bounds holds: i cannot be negative. The lowest possible r is $r = -\pi^e$

If π^e is low or negative, then the CB will not be able to achieve the initial Y.

EB p 60-65

PS

MC

Ex 23 iPad

Ex 24 HW: The zero lower bound for the nominal interest rate implies that if $\pi^e = -3\,\%$, r cannot be <3%.

Labour Market - Medium Run

WAGE determination

- Wages depend on
  - **labour market conditions**: $u\uparrow W\downarrow$
  - **Workers' bargaining power** depends on:
    - **Labour market conditions**: $u\uparrow barg.power\downarrow$
    - **Nature of the job**: if the job requires lots of skills, $barg.power\uparrow$
- **Efficiency Wage Theories** claim that firms are **willing to pay a wage higher than reservation wage** because:
  - **productivity** $\uparrow$
  - you attract **talents**
  - you $\downarrow$ **turnover**.

Read BOX p 141-142. (**NOT FOUND**).

W = **Aggregate Nominal Wage** in the economy

$\boxed{W = P^e * F(u, z)}$ **WAGE Determination Equation**

P^e = **expected price level**. => Wages must have a future outlook.

$F(u, z) =$ => by convention z is a catch-all variable that includes all other factors that affect wages in a positive way.

- +

z stands for:

- **Unemployment benefits**: if it $\uparrow$, $z\uparrow barg.power\uparrow W\uparrow$
- **Minimum Wage**: if it $\uparrow$, $z\uparrow barg.power\uparrow W\uparrow$
- **Citizen Income**: if it $\uparrow$, $z\uparrow$
- **Power of unions**: if it $\uparrow$, $z\uparrow barg.power\uparrow W\uparrow$
- **The degree of centralization in the wage bargaining process** $\uparrow$: it's the same as power of unions $\uparrow$, $barg.power\uparrow W\uparrow$
- **Firing becomes less easy**: if it $\uparrow$, $z\uparrow barg.power\uparrow W\uparrow$

PRICE determination

Firms set prices. We assume that they use only labour.

Their production function is: $\boxed{Y = AN}$

Y = Output and Income

A = Labour Productivity

N = Employment

$\boxed{A = \frac{Y}{N}}$ **output per worker**. We DON'T assume it equal to 1.

- To produce 1 unit, you need:

  $1 = AN$ so you need $N = \frac{1}{A}$ workers.

- To produce output Y, firms need $N = \frac{1}{A}Y = \frac{Y}{A}$

- **Total Cost** function: $\boxed{TC = W * N = W * \frac{Y}{A}}$

- We assume **no perfect competition**: firms set prices using a **MARKUP (m)** over MC.

$MC = \frac{W}{A}$ **partial derivative w/r to Y**

$\boxed{P = (1+m)\frac{W}{A}}$ **PRICE determination equation**

m depends on:

- **Competition**
- **Demand**
- **Barriers to entry**
- **Elasticity**

Equilibrium in the Labour Market

1. **WAGE SETTING** (WS): represents the workers' side and it comes from the W determination equation.

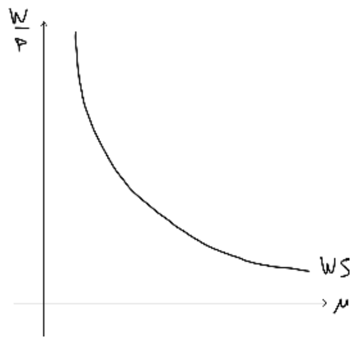
   BUT

   We assume that W depends on the **actual price level** P and not on the P^e because it is hard for people to guess it and, moreover in the medium run $P^e = P$.

   $W = P * F(u, z)$

   $\boxed{\frac{W}{P} = F(u, z)}$ **WAGE SETTING Relation**

This relations says that the **real wage** ($\frac{M}{P}$) depends on u and on all the z variables.



If $u\uparrow \frac{W}{P}\downarrow$

The higher u, the lower the real wage chosen by wage setters (workers) because their bargaining power is low.

WS is downward sloping

- If u changes you move along the WS curve.
- If $z\uparrow WS\uparrow$ ($z\uparrow$ when $barg.power\uparrow$)

2. **PRICE SETTING (PS)**: represents firms. It comes from the P determination equation.

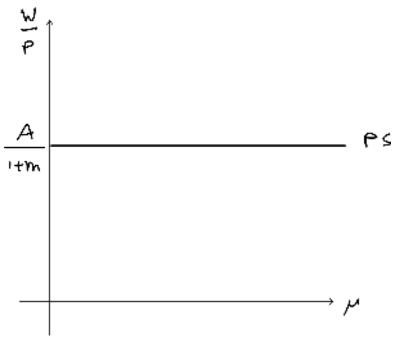
$$P = (1+m)\frac{W}{A}$$

$$\frac{P}{W} = \frac{1+m}{A}$$

$$\boxed{\frac{W}{P} = \frac{A}{1+m}}$$

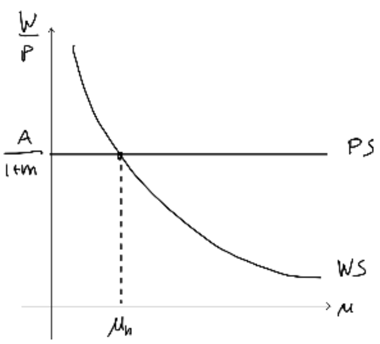
PRICE SETTING Relation

that determines the real wage (W/P) firms are willing to pay



Suppose competition $\downarrow$, $m\uparrow$, prices of product $\uparrow$, $\frac{W}{P}\downarrow$, $PS\downarrow$

Graph of equilibrium:



To compute the equilibrium:

$$\begin{cases} WS \\ PS \end{cases} \qquad \begin{cases} \frac{W}{P} = F(u, z) \\ \frac{W}{P} = \frac{A}{1+m} \end{cases} \qquad => F(u_n, z) = \frac{A}{1+m}$$

u_n **(natural (structural) rate of unemployment)** is the **unemployment rate** at which the real wage ($\frac{W}{P}$) chosen by wage setters (workers, WS) is exactly the same as the real wage chosen by price setters (firms, PS).

- In the **short run**: u_n depends mostly on z.
- In the **medium run**: u_n depends mostly on labour market conditions

We have a functional form for $F(u, z)$

$$\boxed{F(u, z) = 1 - \alpha u + z}$$

α = **sensitivity of real wage to unemployment**

If we assume $A = 1$

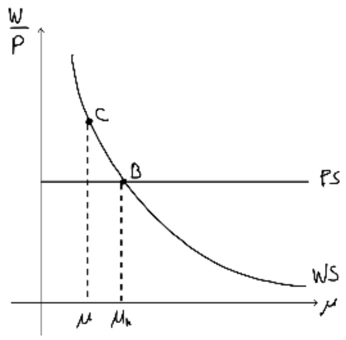
$$F(u_n, z) = \frac{1}{1+m}$$

$$1 - \alpha u_n + z = \frac{1}{1+m}$$

$$\boxed{u_n = \frac{1}{\alpha}[1 + z - \frac{1}{1+m}]}$$

Reasoning on the WS-PS model

- $u < u_n$

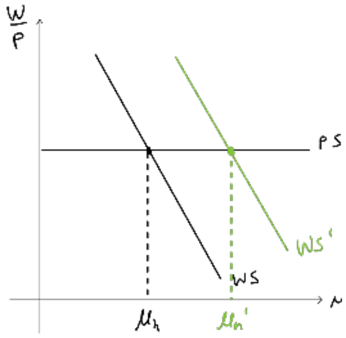


At C: $u < u_n$ $WS > PS$

Wage setters (workers) demand a real wage $\frac{W}{P}$ that is higher than the real wage price setters (firms) are willing to pay.

u will ↑ up to u_n because in this way $\frac{W}{P}$ requested by workers will ↓ back to equilibrium.

- **Unemployment benefits ↑**

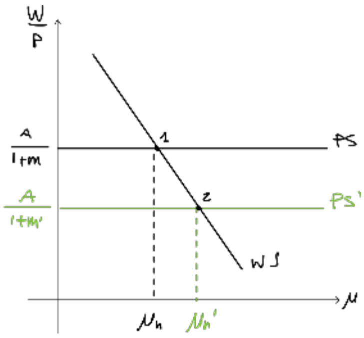


z↑ $barg.power$↑ $\frac{W}{P}$ requested↑ u_n↑ Why?

A higher u_n is needed to bring $\frac{W}{P}$ demanded by workers down to the $\frac{W}{P}$ firms are willing to pay

- **Less stringent antitrust legislation**:

  firms can collude more easily. Firms have more power, competition ↓, m ↑, price of product ↑, $\frac{W}{P}$ ↓



$\frac{W}{P}$ ↓, to convince workers to accept this ↓, u_n will ↑.

- **Oil price ↑**

  Firms' costs ↑, prices ↑ (as if m ↑) so PS ↓

- **Labour productivity ↑**

  Positive technological shock

  A↑, firms' efficiency ↑, firm ↓ prices so that it sells more, $\frac{W}{P}$ ↑ and PS↑

Natural Level of Output

$$u = \frac{U}{L} = \frac{L-N}{L} = 1 - \frac{N}{L}$$

$$\boxed{u = 1 - \frac{N}{L}}$$

$\boxed{uL = L - N}$

$N = L(1-u)$

If $u = u_n$, then $N = N_n$

$\boxed{N_n = L(1-u_n)}$

- Suppose that $Y = AN$ and $A = 1$ so that $Y = N$

  If $u = u_n$, then $N = N_n$, then $Y = Y_n$ and this is **natural level of output**.

So since $Y = Y_n$ here

$\boxed{Y_n = N_n = L(1-u_n)}$

At equilibrium on the labour market (A=1)

$$F(u_n, z) = \frac{1}{1+m}$$

$$F(1 - \frac{N_n}{L}, z) = \frac{1}{1+m}$$

$$F(1 - \frac{\boxed{Y_n}}{L}, z) = \frac{1}{1+m}$$

It's the Y that corresponds to u_n and N_n

If $\left.\begin{aligned} u &= u_n \\ N &= N_n \\ Y &= Y_n \end{aligned}\right\}$ This is realized in the medium run when $P = P^e$

In the short run, usually:

$u \neq u_n$

$N \neq N_n$

$Y \neq Y_n$

$P \neq P^e$

APPENDIX: Labour Demand and Supply

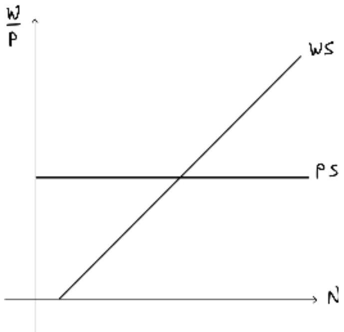
We can represent the labour market equilibrium in terms of labour demand and labour supply.

$$\frac{W}{P} = F(u, z)$$

$$\frac{W}{P} = F(1 - \frac{N}{L}, z)$$

We focus on the relationship between employment and $\frac{W}{P}$ that is POSITIVE.

If $N \uparrow \frac{W}{P} \uparrow$ because $barg.\ power \uparrow$



The WS relation looks like a **labour supply** relation.

The PS relation looks like a flat **labour demand** relation. It's flat because of our simplifying assumption of constant returns to labour in production. Had we assumed that there were decreasing returns to labour in production, our PS would be downward sloping.

- The **standard labour supply** relation gives the wage at which a given number of workers are willing to work. The higher the wage, the larger the number of workers who are willing to work.

  In **contrast**, the wage corresponding to a given level of employment in the WS relation is the result of a process of bargaining between workers and firms or unilateral wage setting by firms. Factors like the structure of collective bargaining or the use of wages to deter quits affect the wage-setting relation. In the real world, they seem to play an important role. Yet they play no role in the standard labour supply relation.

- The **standard labour demand** relation gives the level of employment chosen by firms at a given real wage. It is derived under the assumption that firms operate in competitive goods and labour markets and therefore take wages and prices – and by implication the real wage – as given.

  In **contrast**, the price-setting relation takes into account the fact that, in most markets, firms actually set prices. Factors such as the degree of competition in the goods market affect the price-setting relation by affecting the mark-up. But these factors aren't considered in the standard labour demand relation.

- In the l**abour supply–labour demand framework**, those who are unemployed are willingly unemployed. At the equilibrium real wage, they prefer to be unemployed rather than work.

  In **contrast**, in the $WS - PS$ framework, unemployment is likely to be involuntary. For example, if firms pay an efficiency wage, workers would rather be employed than unemployed. Yet, in equilibrium, there is still involuntary unemployment. This also seems to capture reality better than does the labour supply–labour demand framework.

These are the 3 reasons why we have relied on the WS and PS relations rather than on the labour supply–labour demand approach to characterize equilibrium in this chapter.

Final Remarks

- In the **short run** $P \neq P^e$ when nominal wages are set. Hence,
  - u **is not necessarily equal to** u_n
  - Y **is not necessarily equal to** Y_n.
  - Y **is determined by monetary and fiscal policy**.
- In the **medium run** $P = P^e$.
  - The economy will converge to the Y_n and **deviations** from this level of production are **transitory**.
  - Monetary policy affects the price level only
  - Fiscal policy affects the price level and the composition of aggregate demand.
- **Monetary and fiscal policies** have **no effect** on the Y_n. The policies that affect the u_n, and therefore the Y_n, are **supply-side policies**, which affect the degree of **competition** in the goods market or the degree of **flexibility** of the labour market.

EX 25 iPad

EB: p68-69 - PS 5 - MC5

SLIDES HW ex 26

Ex 27 iPad

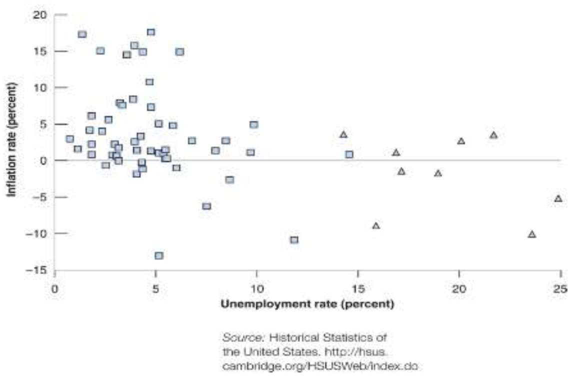
The Philipps Curve

In ***1958***, **Phillips** found a negative relation between inflation and unemployment (using data on UK, 1861-1957): he found out that when u was low, inflation was high.

In ***1960***, **Samuelson** and **Solow**, using 1900-1960 data on the US, confirmed the relation (apart from the period 1931-1939 that was characterized by high unemployment). They called this relation **Phillips curve.**

In the ***1970s***, this **relation broke down**: the US and most OECD countries experienced high u and high inflation at the same time. The relation was valid when considering u and the change in inflation rate, rather than inflation.

Inflation and unemployment in the US, 1900-1960



PC when $u\uparrow$ $\pi\downarrow$ and vice versa.

1st Formula

WAGE determination equation: $W = P^e * F(u, z)$

PRICE determination equation: $P = (1+m)W$ where $W = \dfrac{P}{1+m}$

$$=> \frac{P}{1+m} = P^e F(u, z)$$

$$P = P^e(1+m)F(u, z)$$

If $P^e \uparrow$, nominal wages $\uparrow$, firms' costs $\downarrow$, $P\downarrow$

We know that:

$$F(u, z) = 1 - \alpha u + z$$

$$P = P^e(1+m)(1 - \alpha u + z)$$

We introduce the inflation rate π

$$\frac{P_t}{P_{t-1}} = \frac{P_t^e}{P_{t-1}}(1+m)(1-\alpha u_t + z)$$

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

$$\frac{P_t^e}{P_{t-1}} = 1 + \pi_t^e$$

We substitute:

$$1 + \pi_t = (1+\pi_t^e)(1+m)(1-\alpha u_t + z)$$

$$\frac{1+\pi_t}{(1+\pi_t^e)(1+m)} = 1 - \alpha u_t + z$$

We can approximate this if π_t, π_t^e are not too large:

$$1 + \pi_t - \pi_t^e - m = 1 - \alpha u_t + z$$

1) $\boxed{\pi_t = \pi_t^e + (m+z) - \alpha u_t}$ **First Way in which the PC can be written**

If $m\downarrow P\downarrow \pi_t\downarrow$

2nd Formula

We assume that $\pi_t^e = \bar{\pi}$

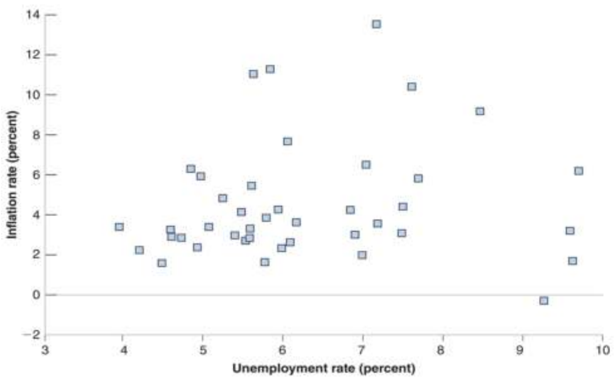
Current inflation is NOT used to predict future inflation.

Inflation expectations are **NOT PERSISTENT** and they're **ANCHORED**.

2) $\boxed{\pi_t = \bar{\pi}_t + (m+z) - \alpha u_t}$ **Original PC, valid for Philipps, Samuelson and Solow**

3rd Formula

In the 1970s the relation between u and π broke down.



Wage setters changed the way in which they formed expectations on inflation => expectations became **MORE PERSISTENT**, **DE-ANCHORED**.

Last year's inflation rate is now considered to form expectations.

Suppose that expectations are formed in this way:

$$\pi_t^e = (1-\theta)\boxed{\bar{\pi}} + \boxed{\theta}\pi_{t-1}$$

constant value The effect of last year's inflation on π_t^e

The higher θ, the more important past inflation to form expectations.

In the 1970s, $\theta\uparrow$.

Before $\theta -> 0$

Mid 1970s $\theta -> 1$

People expected this year's inflation to be almost the same as last year's

Inflation expectations became **VERY PERSISTENT**.

$$\pi_t = \pi_t^e + (m+z) - \alpha u_t$$

$$\pi_t = (1-\theta)\bar{\pi} + \theta\pi_{t-1} + (m+z) - \alpha u_t$$

If $\theta -> 0$ you get **2nd Formula**

If $\theta = 1$ you get $\pi_t = \pi_{t-1} + (m+z) - \alpha u_t$

3) $\boxed{\pi_t - \pi_{t-1} = (m+z) - \alpha u_t}$ **Modified PC, expectations-augmented PC, Accelerationist PC, Adaptive-Expectations PC**

4th Formula

In the 1990s the PC changes again.

In the 1980s, CBs started to commit to low π => **inflation expectations** became **RE-ANCHORED** (to the CB's inflation target).

We go back to 2nd Formula.

$$\pi_t = \bar{\pi}_t + (m+z) - \alpha u_t$$

Taking data for the US (1996-2018) an empirical PC can be estimated.

4) $\boxed{\pi_t = 2.8\% - 0.16u_t}$ **Empirical PC**

5^{th} Formula

u_n= natural rate of unemployment, achieved in the medium run.

$P = P^e$

$\pi = \pi^e$

1st Formula: $\pi_t = \pi_t^e + (m+z) - \alpha u$

$\pi_t - \pi_t^e = (m+z) - \alpha u$

Since we're in the medium run $\pi = \pi^e$

$0 = (m+z) - \alpha u_n$

$$u_n = \frac{(m+z)}{\alpha}$$

If m↑ and/or z↑, u_n↑

m↑, prices ↑, $\frac{W}{P}$ ↓, so u_n ↑ to make workers accept the lower $\frac{W}{P}$

$\pi_t - \pi_t^e = (m+z) - \alpha u_t$

$\pi_t - \pi_t^e = -\alpha[-\frac{m+z}{\alpha} + u_t]$

$\pi_t - \pi_t^e = -\alpha[-u_n + u_t]$

5) $\boxed{\pi_t - \pi_t^e = -\alpha[u_t - u_n]}$ **Another version of the Modified PC**

If $u_t z < u_n$ => from 5th Formula $\pi_t > \pi_t^e$.

Why?

If it is true that $\pi_t > \pi_t^e$

$P_t > P_t^e$

Prices are higher than what workers expect,

workers OVERESTIMATE the real wage paid by firms.

workers supply more labour than what they would do otherwise so

$u_t < u_n$ TRUE

If $\pi_t = \pi_t^e$

$P_t = P_t^e$

$u_t = u_n$ => you see it from 5th formula.

u_n is realized in the economy when inflation expectations are correct.

6th Formula

Now we assume that π_t^e= last year's inflation rate =π_{t-1}

6) $\boxed{\pi_t - \pi_{t-1} = -\alpha[u_t - u_n]}$ **Another version of the Modified PC**

The change in inflation depends on the difference between the actual u_t and the natural u_n unemployment rate.

In 6th Formula $\pi_t^e = \pi_{t-1}$

Suppose $u_t < u_n$ $\pi_t > \pi_{t-1}$ we see it from 6th Formula.

Inflation rate increases over time.

Intuition:

I can explain it as above starting from $\pi_t > \pi_{t-1}$ OR from $u_t < u_n$.

$u_t < u_n$

$work.barg.power \uparrow$

Workers demand higher nominal wage

Firms' costs ↑

$P\uparrow$

$\pi\uparrow$ so $\pi_t > \pi_{t-1}$ TRUE

Recap:

If

$$\left.\begin{array}{l} \pi_t = \pi_t^e \\ P_t = P_t^e \\ u = u_n \\ Y = Y_n \end{array}\right\}$$

Medium Run:

If inflation expectations are correct, monetary policy is neutral in the short run.

Since $Y = Y_n$, to change Y_n you need **structural or supply side policies** (↑ competition, ↑ technology, ↑ labour market flexibility)

Monetary and fiscal policies have no effect on Y_n but.

- monetary policy affects only the P level
- Fiscal policy affects the P level and the composition of demand

If $u = u_n,\ \pi_t = \pi_t^e,\ P_t = P_t^e$ => u_n can also be defined as the rate of unemployment needed to keep inflation rate constant. It is also called **NAIRU (non-accelerating inflation rate of unemployment)**.

Ex 28 iPad

7th Formula

Empirical Evidence: When π becomes high, it's also more variable.

This is Bad for workers: if $\pi_t > \pi_t^e$ $\quad \frac{W}{P}\downarrow$

To solve this issue we can do **WAGE INDEXATION**:

It it's complete, then wages are automatically ↑ in line with inflation.

Suppose we have 2 kinds of labour contracts:

- λ=proportion of **labour contracts** that are **indexed** (nominal wages move one-to-one with inflation rate)
- $(1-\lambda)$=proportion of **labour contracts** that are **not indexed**.

5th Formula:

$$\pi_t = \pi_t^e - \alpha[u_t - u_n]$$

$$\pi_t = [\lambda\pi_t + (1-\lambda)\pi_t^e] - \alpha[u_t - u_n]$$

$(1-\lambda)$ contracts respond to the expected inflation

λ contracts respond to actual inflation

Suppose $\pi_t^e = \pi_{t-1}$ last year's inflation rate

$$\pi_t = [\lambda\pi_t + (1-\lambda)\pi_{t-1}] - \alpha(u_t - u_n)$$

$$\frac{\pi_t - \lambda\pi_t - (1-\lambda)\pi_{t-1}}{(1-\lambda)} = -\frac{\alpha(u_t - u_n)}{(1-\lambda)}$$

$$\frac{\pi_t(1-\lambda) - \pi_{t-1}(1-\lambda)}{(1-\lambda)} = -\frac{\alpha(u_t - u_n)}{(1-\lambda)}$$

$$\frac{(\pi_t - \pi_{t-1})(1-\lambda)}{(1-\lambda)} = -\frac{\alpha(u_t - u_n)}{(1-\lambda)}$$

7) $\boxed{\pi_t - \pi_{t-1} = -\frac{\alpha}{1-\lambda}(u_t - u_n)}$ **Another version of the Modified PC (with Wage Indexation)**

EB: pp70-77.

$\frac{\alpha}{1-\lambda}$ = sensitivity of change in inflation to unemployment

If $\lambda \uparrow \frac{\alpha}{1-\lambda} \uparrow$ Why?

Intuition:

$\lambda \uparrow$ wage indexation $\uparrow$, the effect of u on the $\Delta\pi$ is higher.

- If λ=0 **no wage indexation**

  If $u_t \downarrow$ $work.barg.power \uparrow$ $W \uparrow$ firm's costs $\uparrow$ $P \uparrow$ $\pi \uparrow$

  But wages do not respond immediately because they're not indexed

- If λ=1 **all wages are indexed**

  If $P \uparrow$ $\pi \uparrow$ wages respond immediately firms costs $\uparrow$ $P \uparrow$

The larger λ the stronger the effect of u on inflation

Stagflation: stagnation (slow or low or no growth) and inflation (high)

Deflation and PC

We have just looked at what happens to the PC when inflation is high. Another issue is what happens when inflation is low and negative (deflation).

One motivation for asking this question is given by an aspect of Figure 8.1. Note that the points corresponding to the 1930s (triangles) lie to the right of the others. Not only was unemployment unusually high (this is no surprise because we are looking at the years corresponding to the Great Depression) but, **given the high unemployment rate**, the **inflation rate was surprisingly high**. In other words, given the high unemployment rate, we would have expected not merely deflation, but a large rate of deflation. In reality, deflation was limited, and from 1934 to 1937, despite high unemployment, inflation actually turned positive.

There are two potential explanations.

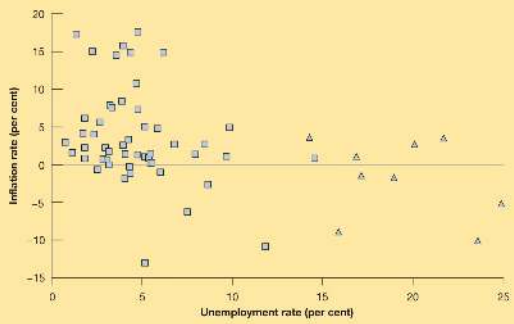


Figure 8.1(b)

Inflation versus unemployment in the United States, 1900–60

During the period 1900–1960 in the United States, a low unemployment rate was typically associated with a high inflation rate, and a high unemployment rate was typically associated with a low or negative inflation rate.

Source: Based on historical statistics of the United States, see http://hsus.cambridge.org/HSUSWeb/index.do

- The **Great Depression** was associated with an ↑ not only in the u_t but also in the u_n. This seems unlikely. Most economic historians see the Great Depression primarily as the result of a large adverse shift in demand (think of a large shift to the left of the IS curve) leading to an ↑ in u_t over the u_n, rather than an ↑ in the u_n itself.
- When the economy experiences **deflation**, the **PC relation breaks down**. One possible reason is the reluctance of workers to accept ↓ in their nominal wages. Workers may unwittingly accept a cut in their real wages that occurs when their nominal wages ↑ more slowly than inflation. However, they are likely to fight the same cut in their real wages if it results from an overt cut in their nominal wages. This mechanism was clearly at work in some countries during the financial crisis.

Figure 8.6, for example, plots the distribution of wage changes in Portugal in two different years:

- 1984 when the inflation rate was a high 27%
- 2012, when it was just 2.1%.

Note how the distribution of wage changes is roughly **symmetric** in 1984, but bunched at zero in 2012, with nearly no negative wage changes. To the extent that this mechanism is at work, this implies that the PC relation between π and u may disappear, or at least become weaker, when the economy is close to zero inflation.

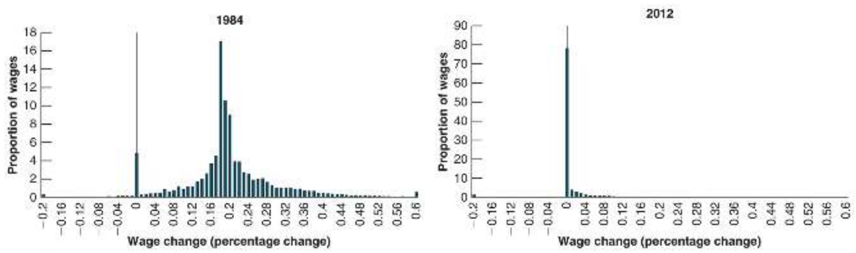


Figure 8.6

Distribution of wage changes in Portugal, in times of high and low inflation

Source: Pedro Portugal, based on Portuguese household survey.

IS-LM-PC Model

Short Run:

$Y \neq Y_n$ or $Y = Y_n$

$u \neq u_n$ or $u = u_n$

Medium Run:

$Y = Y_n$

$u = u_n$

Now we study the Short Run and the Medium Run dynamics.

Short Run

It's represented by the Extended IS-LM Model (2nd version).

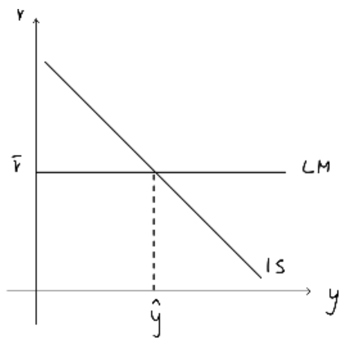
$IS: \ Y = C(Y - T) + I(Y, r + x) + \overline{G}$

$r =$ is the **Real Policy Rate**.

$i = r + x$ **Real Borrowing Rate**

$LM: \ r = \overline{r}$

CB chooses the r



IS downward sloping

$r\uparrow \ I\downarrow \ Z\downarrow \ Y\downarrow$

Medium Run

Defined by the PC (we use the 5th formula)

$\pi_t - \pi_t^e = -\alpha[u_t - u_n]$

$u < u_n \qquad \pi > \pi^e$

We write the PC in terms of output

Step 1:

$$u = \frac{U}{L} = \frac{L-N}{L} = 1 - \frac{N}{L}$$

$$u = 1 - \frac{N}{L}$$

$$\boxed{N = L(1-u)}$$

Since $Y = AN$

and (A=1 always in this chapter) $Y = N$

Then $\boxed{Y = N = L(1-u)}$

$$\boxed{u = 1 - \frac{Y}{L}}$$

Step 2:

If $u = u_n$ $N = N_n$ => $N_n = L(1-u_n)$

$Y = Y_n$ => $Y_n = L(1-u_n)$

OUTPUT GAP $(Y - Yn)$: difference between actual output and natural or potential level of output

$$Y - Y_n = L(1-u) - L(1-u_n)$$

$$Y - Y_n = L(1 - u - 1 + u_n)$$

$$Y - Y_n = L(-u + u_n)$$

- If $u = u_n$ $Y = Y_n$ 0 OUTPUT GAP
- If $u > u_n$ $Y < Y_n$ NEGATIVE OUTPUT GAP
- If $u < u_n$ $Y > Y_n$ POSITIVE OUTPUT GAP

Step 3:

$$Y - Y_n = L(-u + u_n)$$

$$(u - u_n) = -\frac{Y - Y_n}{L}$$

I substitute this in 5th PC formula.

$$\pi - \pi^e = -\alpha(u - u_n)$$

$$\pi - \pi^e = -\alpha\left(-\frac{Y - Y_n}{L}\right)$$

$$\boxed{\pi - \pi^e = \frac{\alpha}{L}(Y - Y_n)}$$ **General Equation of the PC in IS-LM Model**

Step 4:

We define how inflation expectations are built.

There are 2 main ways:

a) π^e are **ANCHORED** to ECB/FED $\overline{\pi}$ or to a fixed value $\overline{\pi}$

$$\pi^e = \overline{\pi}$$

1) $$\boxed{\pi - \overline{\pi} = \frac{\alpha}{L}(Y - Y_n)}$$

$Y > Y_n$ => $\pi > \overline{\pi}$ (inflation is higher than π)

b) $\pi^e = \pi_{t-1} = \pi_{-1} = \pi_{(-1)}$

People expect inflation this year to be the same as last year (**DE-ANCHORED**)

2) $$\boxed{\pi - \pi_{t-1} = \frac{\alpha}{L}(Y - Y_n)}$$

Let's take 1)

$$\pi - \overline{\pi} = \frac{\alpha}{L}(Y - Y_n)$$

If $Y > Y_n$ $\pi > \overline{\pi}$

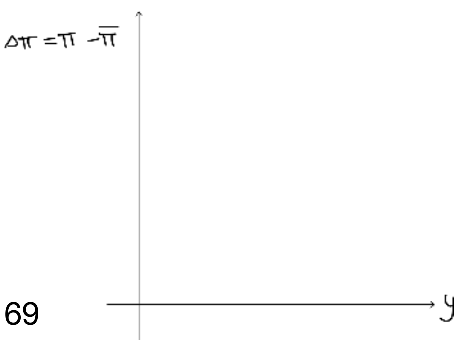
Intuition:

If $Y > Y_n$ $u < u_n$

work. barg. power ↑ W↑ firms' costs ↑ P↑ π↑ so

$\pi > \overline{\pi}$

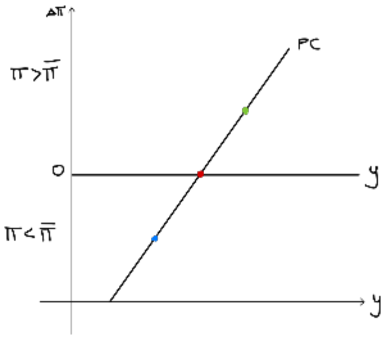
Graph:



$$\pi - \pi_{t-1} = \frac{\alpha}{L}(Y - Y_n)$$

We graph:

$$\pi - \overline{\pi} = \frac{\alpha}{L}(Y - Y_n)$$



- If $\pi = \overline{\pi}$
  $\pi - \overline{\pi} = 0$
  $Y = Y_n$
- If $\pi > \overline{\pi}$
  $Y > Y_n$
- If $\pi < \overline{\pi}$
  $Y < Y_n$

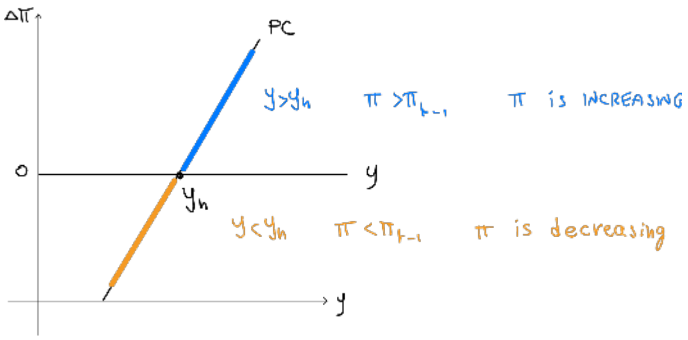
Output Gap=0

Output Gap<0

Output Gap>0.

Let's take 2)

$$\pi - \pi_{t-1} = \frac{\alpha}{L}(Y - Y_n)$$



Other ways in which π^e can be defined

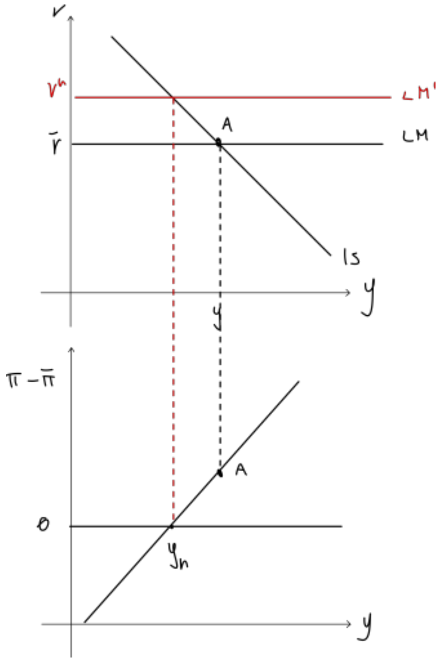
c) $\pi^e = 0$

$$\boxed{\pi = \frac{\alpha}{L}(Y - Y_n)}$$

d) $\pi^e = number$

$$\boxed{\pi - number = \frac{\alpha}{L}(Y - Y_n)}$$

IS-LM-PC Model



- **Short Run**

A initial equilibrium $Y > Y_n$

- **Medium Run**

At A $\pi > \overline{\pi}$ inflation is higher

A is only the short run run equilibrium because $Y \neq Y_n$

Medium Run Analysis:

- If NO policy change
  - Y remains above Y_n

    $Y > Y_n$

    Inflation remains above
  - Inflation remains above target inflation $\pi > \overline{\pi}$

    UNLIKELY because CB will step in to bring π close to $\overline{\pi}$. If we keep on with $\pi > \overline{\pi}$ people will start to DE-ANCHOR so

    $\pi^e = \pi_{t-1}$

    Since at A $Y > Y_n$ inflation starts increasing
- CB will intervene to bring the economy to $Y = Y_n$
  - Y must ↓
  - $\overline{r}$ will ↑ I↓ Z↓ Y↓ to Y_n
  - The economy moves along the PC and the IS to reach A' which is a medium run equilibrium.

- $\pi = \bar{\pi}$
- $Y = Y_n$
- $r = r_n$ (**Natural rate of interest**, **neutral rate of interest**, **Wicksellian rate of interest**) it's the real interest rate associated with Y_n which in turn is associated with u_n. It's the interest rate for which the goods market is in equilibrium in the medium run.

In reality it takes time for the economy to reach Y_n:

1. the role of the CB is not easy because it doesn't know where Y_n is, so it adjusts it slowly and see what happens.
2. Firms need time to adjust their I decisions when $\bar{r}$ ↑ or ↓

Real Borrowing Rate

$r_n + x$

$i = r + \pi^e$

At the medium run PC 1) with

$\pi = \bar{\pi}$

$i = r_n + \bar{\pi}$ the higher π, the higher i

$$\underbrace{\boxed{\frac{M}{P}}}_{\text{Real } M^s} = \underbrace{\boxed{YL(i)}}_{\text{Real } M^d}$$

At the medium run

$$\frac{M}{P} = \boxed{Y_n L(r_n + \bar{\pi})}$$

They are constant at medium run equilibrium. The economy reaches a steady state

Also $\frac{M}{P}$ must be constant as well

It means that P↑ at the same rate as M

$\boxed{\pi = g_M}$ **Rate of Nominal Money Growth**

so $i = r_n + \bar{\pi}$ but $\bar{\pi} = \pi$

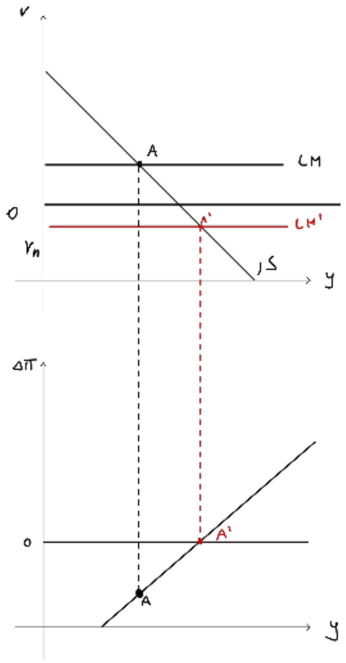
$i = r_n + \pi$

$\boxed{i = r_n + g_M}$

Neutrality of MONEY in the medium run: In the medium run real variables (like real Y, u, r_n, I, C) are independent of the monetary policy.

Changes in M^s affects only P, W, nominal variables. They don't affect Y_n

The zero lower bound and debt spiral



A initial equilibrium

The economy is in a recession

$Y < Y_n$

Negative output gap

$\pi < \bar{\pi}$

The CB will ↓ r until $Y = Y_n$

At A' $Y = Y_n$ $r = r_n$ inflation=target inflation

But r_n needed to move to A' is negative, the recession is very bad.

Suppose the CB cannot ↓ r to r_n

If the economy stays at A:

- Large output gap and deflation
- People will see that π is always lower than $\bar{\pi}$ so they will DE-ANCHOR:

$\pi^e = \pi_{t-1}$

People will start to anticipate deflation => Larger deflation => more and more deflation => **DEFLATION SPIRAL OR TRAP**

So the **CB will intervene** trying to do its best to bring the economy close to Y_n

If $\pi^e = \pi_{t-1}$ $Y < Y_n$ inflation ↓

If π^e remain anchored no deflation spiral

If the zero lower bound holds

$i = 0$ minimum value

$r = i - \pi$

$r = 0 - \pi$

$r = -\pi$

r becomes positive I↓ Y↓

Lower Y, more deflation so the CB needs to intervene

Fiscal Consolidation

An economy that is at its medium run equilibrium

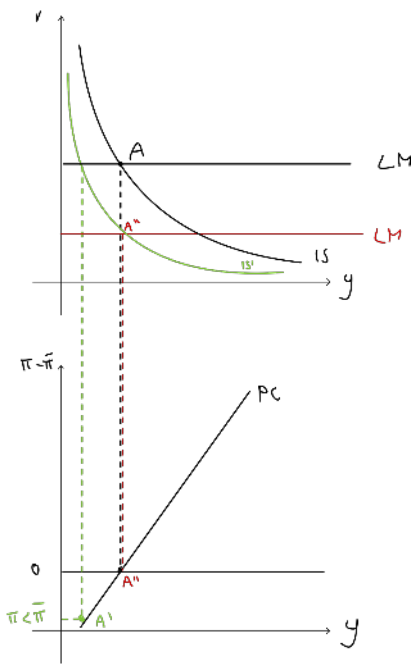
$Y = Y_n$

$u = u_n$

$\pi^e = \overline{\pi}$

Gov implements a **fiscal consolidation:** T↑ and/or G↓

What are the effects in the short and medium run?



- A initial equilibrium

  $Y = Y_n$ $r = r_n \pi = \overline{\pi}$

- ↑T

Short Run Analysis:

$\uparrow T \quad \downarrow Y_d \quad \downarrow C \quad \downarrow Z \quad \downarrow Y$ IS to the left

A' short Run

$Y\downarrow$

r_n=

$\pi < \bar{\pi}$ =>

since $Y < Y_n$ $u > u_n$ work power ↓ $W\downarrow$ $P\downarrow$ $\pi\downarrow$

Composition of demand:

C		I		G
$Y\downarrow$	$=> C\downarrow$	$Y\downarrow$	$=> I\downarrow$	Unchanged
$T\uparrow$		$r + x$ =		

the ↓ in Y depends both on the ↓ in C and I

Medium Run Analysis:

$Y < Y_n$ Y is low $\pi < \bar{\pi}$

The CB intervene: it will $\downarrow r$ $(r + x)\downarrow$ $I\uparrow$ $Y\uparrow$ up to Y_n

A''=medium run equilibrium

$Y = Y_n$

$r = r'_n$

$\pi = \bar{\pi}$

Composition of demand (A'' vs A):

C		I		G
Y=	$=> C\downarrow$	Y=	$=> I\uparrow$	Unchanged
$T\uparrow$		$r + x\downarrow$		

it's different from short run.

Since Y is = the ↓ in C and the ↑ I are of equal size.

In the medium run: **fiscal policy DOESN'T affect** Y_n, it affects P level and composition of demand but it's NEUTRAL w/r to Y_n.

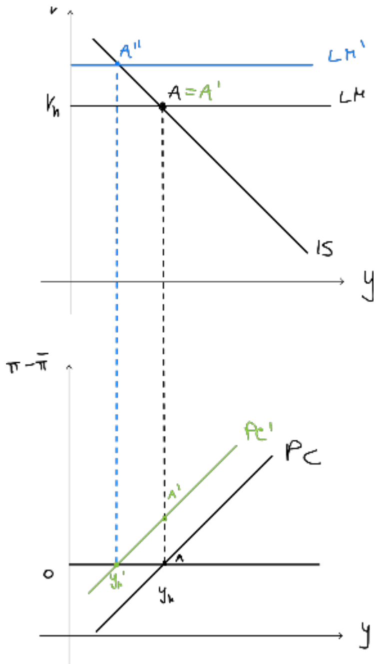
If in the **short run the CB and the Gov coordinate** then **medium run equilibrium can be achieved** in the **short run** => fiscal consolidation happen without a ↓ in Y

Supply Shocks

Suppose an economy is at medium run equilibrium

Price of oil ↑

What are the short and medium run effects ?



- A initial equilibrium

  P oil ↑

  Firms' costs ↑

  P ↑

  $\frac{W}{P}$ ↓, to make workers accept this ↓ in $\frac{W}{P}$ decided by price setters, then u_n will ↑

  Y_n↓ => PC to the left

A' short run equilibrium

$Y > Y_n$

r=

Inflation rate at A' is higher because oil price has ↑

Medium Run:

- The CB doesn't intervene

  r=

  $Y > Y_n'$

  Stays at A' but inflation is higher than $\bar{\pi}$

  Overtime inflation expectations will became DE-ANCHORED

  $\pi^e = \pi_{t-1}$ => inflation starts increasing

- The CB will intervene

  Since $Y > Y_n'$ the CB will ↑ r to get to Y_n'

  A'' is a medium run equilibrium.

Remarks:

1. In the short run IS could shift
   - Oil price ↑ I↓ IS shifts to the left
   - Oil price ↑ income is redistributed from oil buyers to oil producers.
     Oil producers tend to have a lower C_1 so C↓, IS to the left

2. The ↑ in oil price might be temporary

   If CB believes that it's temporary, it might not intervene and might tolerate $\pi > \bar{\pi}$

   BUT it's risky cause people can de-anchor.

EB: Complete Ch3 (skip 6-8).

Recap

- π^e:
  - $\bar{\pi}$: anchored
  - π_{t-1}: de-anchored
  - 0: anchored
  - Number: anchored
- **IS**:
  - To the right:
  - To the left:
    - C_0↓
    - T↑
    - Pessimism ↑
    - G & T ↓ by the same amount
    - The ↓ G prevails over the ↓ in T (multiplied by C_1)
    - $C = C_0 + C_1(Y - T) - h_2(r + x)$
      Financial markets degree of risk aversion ↑ x↑ IS to the left even if $I = \bar{I}$
    - C_0 & T↓ by the same amount: the ↓ in C_0 prevails => IS to the left

3. **LM**:
   - r_n↑ CB SELLS bonds
   - r_n↓ CB BUYS bonds

4. **PC** Shifts when you have a new Y_n to the:
   - **LEFT**:

- ↑ cost of production
- ↑ price of oil
- ↑ z
- ↑ m ↑ P
- ↑ unemployment insurance
- A ↓ (negative technological shock)

• **RIGHT**:

- ↑ competition
- ↓ m
- Liberalization programs
- ↓ unemployment benefits
- ↓ z
- A↑

Exercise 6 P78 EB (Important)

Consider an economy described by the following equations:

$$C = C(Y - \overline{T})$$

$$I = I(r + x, Y)$$

$$G = \overline{G}$$

$$Y = C + I + G$$

$$M^d = P * L(r + \pi^e, Y)$$

$$\frac{M}{P} = L(r + \pi^e, Y)$$

$$\pi - \pi^e = (\frac{\alpha}{L})(Y - Y_n)$$

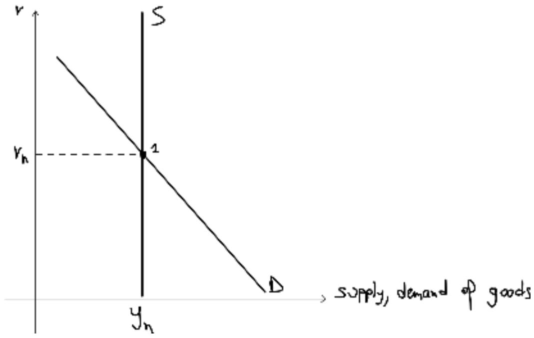
where M is nominal money supply, the term πe appearing in the Phillips curve (the last equation) is expected inflation, and the other symbols have the usual meaning.

A. Define r_n and discuss its determinants using a graph.

At the medium run

$$IS: \boxed{Y_n} = \boxed{C(Y_n - \overline{T}) + I(r_n + x, Y_n) + \overline{G}}$$

Supply of Goods — Demand of Goods



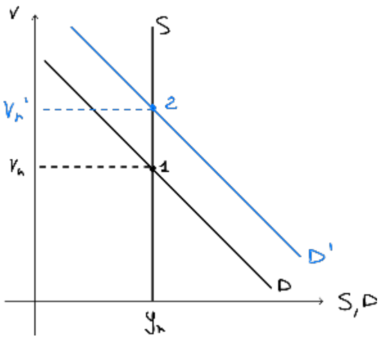
This is the **graph of supply-demand for goods**.

Supply: vertical line because it doesn't depend on r. It depends on technology, competition, labour market conditions.

Demand: downward sloping in r: $r\downarrow$ $(r+x)\downarrow$ $I\uparrow$ demand $\uparrow$

Some examples to understand the GRAPH:

1. $C_0 \uparrow$



Supply =

Demand shifts up

Y_n = (no supply shocks)

$r_n \uparrow$ Why?

S is unchanged, D $\uparrow$ to make it $\downarrow$ and go back to equilibrium, r_n will $\uparrow$ so that $I\downarrow$ and the effect of $\uparrow C_0$ is neutralized.

Composition of demand

C		I		G
Y=	$=> C\uparrow$	Y=	$=> I\downarrow$	Unchanged
T=		$r+x\uparrow$		
$C_0\uparrow$				

2. $I\uparrow$ same reasoning.

3. C_0 and $T\downarrow$ by the same amount

   Supply =

   Demand $\downarrow$ because the $\downarrow$ C_0 prevails

   Y_n=

   $r_n\downarrow$ S= Dec so to make D$\uparrow$, $r_n\downarrow$ so $I\uparrow$

   The effect of the $\downarrow$ in C_0 is neutralized.

4. $m\uparrow$

   $P\uparrow$

   $\frac{W}{P}\downarrow$ so $u_n\uparrow$ $Y_n\downarrow$

   Supply: to the left

   Demand: =

   $r_n\uparrow$ S$\downarrow$ D=, to make D $\downarrow$ $r_n\uparrow$ so $I\downarrow$

Composition of demand

C		I		G
$Y\downarrow$	$=> C\downarrow$	$Y\downarrow$	$=> I\downarrow$	Unchanged
T=		$r+x\uparrow$		

5. A new law is passed making hiring and firing easier/less costly

   $z\downarrow$ WS shifts to the left $u_n\downarrow$ $Y_n\uparrow$

   Supply: to the right

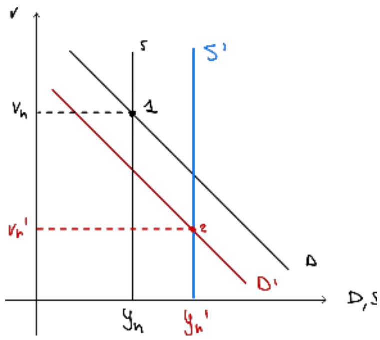
Demand: =

$r_n\downarrow$ S $\uparrow$ D=, so D must $\uparrow$, $r_n\downarrow$ $I\uparrow$ $D\uparrow$

6. $A\uparrow$ and $x\uparrow$

$A\uparrow$ PS $\uparrow$ $u_n\downarrow$ $Y_n\uparrow$ => supply to the right and PC to the right

$x\uparrow$ $(r+x)\uparrow$ $I\downarrow$ $Z\downarrow$ $Y\downarrow$ => IS to the left, demand down

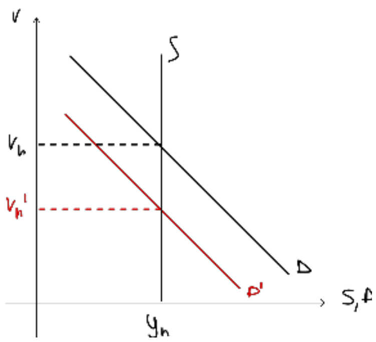


$r_n\downarrow$ S'>S excess supply, so D must $\uparrow$, so $r_n\downarrow$ so $I\uparrow$

7. $\Delta G = \Delta T < 0$

Supply=

Demand $\downarrow$ because G is stronger



$r_n\downarrow$ because S=

D $\downarrow$ so to make it $\uparrow$ $r_n\downarrow$ $I\uparrow$

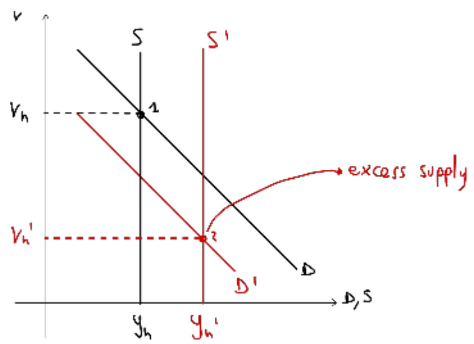
Composition of demand:

<table>
<tr><th colspan="2">C</th><th colspan="2">I</th><th>G</th></tr>
<tr><td>Y=</td><td rowspan="2">$=> C\uparrow$</td><td>Y=</td><td rowspan="2">$=> I\uparrow$</td><td rowspan="2">$G\downarrow$</td></tr>
<tr><td>$T\downarrow$</td><td>$r+x\downarrow$</td></tr>
</table>

8. $m\downarrow$ and $x\uparrow$

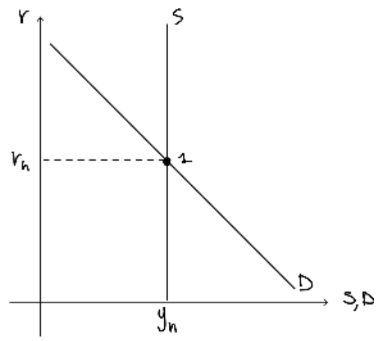
$m\downarrow$ PS $\uparrow$ $u_n\downarrow$ $Y_n\uparrow$ => Supply to the right

$x\uparrow$ $(r+x)\uparrow$ $I\downarrow Z\downarrow$ $Y\downarrow$ => demand down



S $\uparrow$ and D $\downarrow$ so D must $\uparrow\uparrow$ to go back to equilibrium. This is why $r_n\downarrow$ so $I\uparrow$

B. Explain the neutrality of money



The economy is at 1: it's medium-run equilibrium.

Suppose a Monetary Expansion or CB wants to $\downarrow$ the Policy Rate

Short Run:

- $r\downarrow$ $(r+x)\downarrow$ $I\uparrow$ $Z\uparrow$ $Y\uparrow$
- Assume $\pi^e = 0$
- $Y > Y_n$
- $\pi - \pi^e > 0$ $\pi - 0 > 0$ $\pi > 0$ inflation is positive

In the short run Monetary Policy is NOT neutral.

Medium Run:

Y_n doesn't change because it depends on supply-side factors. So supply is unchanged. So in the medium run we go back to Y_n and r_n=.

Neutrality of Money in the Medium Run.

Composition of Demand:

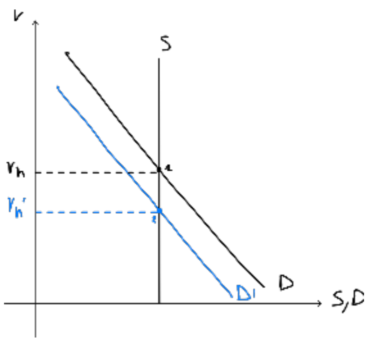
Compared to the initial level, only the Price level will change (higher).

C. Consider a ↓ in G

What's the effect on r_n, Y_n (Medium Run)?

Supply unchanged because it's effected by supply side factors only.

Demand: shifts ↓



Y_n=

$r_n' < r_n$ => S=, D ↓ to make D ↑ we need to ↓ r_n so that I↑ so the effect of the ↓ G us counterbalanced.

Composition of demand:

C		I		G
Y=	$=> C$=	Y=	$=> I\uparrow$	$G\downarrow$ by assumption
T=		$r+x\downarrow$		

$$\underset{=}{Y} = \underset{=}{C} + \underset{\uparrow}{I} + \underset{\downarrow}{G}$$

I↑ by the same amount G↓, so that Y is unchanged.

Recap:

Y_n=

r_n↓

Composition of demand changes

FISCAL POLICY is **NOT neutral in the medium run** BUT **it does NOT affect** Y_n.

Ex 8 p 84 (Important)

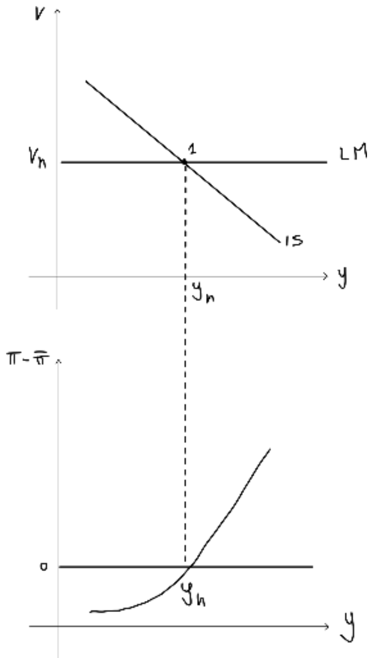
IS-LM-PC model

Wage setters form π^e in 2 ways:

1. $\pi^e = \overline{\pi}$
2. $\pi^e = \pi_{t-1} = \pi_{-1}$

A. Represent the medium-run equilibrium under scenario 1 and 2

1. $\pi - \overline{\pi} = \frac{\alpha}{L}(Y - Y_n)$



B. Why is the way in which π^e are formed important?

Suppose $r < r_n$

- $\pi = \overline{\pi}$ **(anchored)**

  $r < r_n$

  $\pi > \overline{\pi}$

  High inflation, higher than $\overline{\pi}$

- $\pi = \pi_{t-1}$ (de-anchored)

  Inflation will not only be high but also increasing overtime

- If $i = 0$ (zero lower bound holds), then when $\pi^e = \pi_{t-1}$ => you can end up in a DEFLATION SPIRAL

- If $\pi^e = \bar{\pi}$ you have NO deflation spiral because inflation expectations remain anchored.

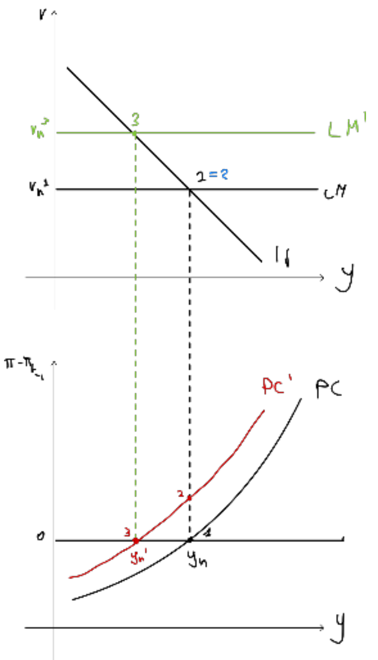
The ECB's inflation target is 2%. If inflation is persistently higher than 2%, then people de-anchor $\pi^e = \pi_{t-1}$

Ex 31

IS-LM-PC Model

$\pi^e = \pi_{t-1}$

The economy is at its medium run equilibrium. Denote it with 1.



P of oil ↑. Denote the new short run equilibrium by 2. The new medium run equilibrium by 3. Explain.

1=initial equilibrium.

Short Run:

P of oil ↑

Firms' costs ↑

P ↑

$\frac{W}{P}$↓, so to make accept this ↓, u_n will ↑. Y_n↓. => PC to the left

IS,LM do not move.

Recap:

$Y = Y_n$ unchanged

$r = r_n^1$ unchanged

Inflation is increasing because of P of oil ↑

Medium Run:

If NO intervention by CB, we stay at 2 but inflation keeps on increasing, so it's UNLIKELY

The CB steps in to bring the economy to Y_n', it will ↑ r_n

$Y = Y_n'$

$r_n = r_n^3$

Inflation: $\pi = \pi_{t-1}$

Composition of demand (3 vs 1)

C		I		G
$Y\downarrow$	$=> C\downarrow$	$Y\downarrow$	$=> I\downarrow$	Unchanged
$T=$		$r + x\uparrow$		

Both the ↓ C and in I contribute to the ↓ in Y

- Now, the Gov and the CB want the economy to go back to initial Y_n

Greta thinks: expansionary monetary policy

Adele thinks: fiscal expansion to avoid inflation issues

Who is right? Why?

None of them: to get to Y_n we need supply-side policies.

Ex 32

$C = C_0$

$G = \overline{G}$

$I = \bar{I} + d_1 Y$

$T = \overline{T} + tY$

$C_0 > 0$
$0 < d_1 < 1$
$0 < t < 1$
$t < d_1$

- Find **equilibrium output**

$Z = C_0 + \bar{I} + d_1 Y + \overline{G}$

$$Y = C_0 + \bar{I} + d_1 Y + \overline{G}$$

$$\hat{Y} = \frac{1}{1-d_1}(C_0 + \bar{I} + \overline{G})$$

- Derive the change in S and S_{nat} in the case of a $\downarrow C_0$

Private saving function

$$S = Y - T - C$$

$$S - \overline{T} - tY - C_0$$

$$S = (1-t)Y - \overline{T} - C_0$$

$$S = (1-t)(\frac{1}{1-d_1})(C_0 + \bar{I} + \overline{G}) - \overline{T} - C_0$$

$$\Delta S = \frac{1-t}{1-d_1}\Delta C_0 - \Delta C_0$$

$$\Delta S = \Delta C_0(\frac{1-t}{1-d_1} - 1)$$

$$\Delta S = \Delta C_0(\frac{1-t-1+d_1}{1-d_1})$$

$$\Delta S = \Delta C_0(\frac{d_1 - t}{1-d_1})$$

$$S_{pub} = \overline{T} + tY - \overline{G} = \overline{T} + t(\frac{1}{1-d_1})(C_0 + \bar{I} + \overline{G}) - \overline{G}$$

$$\Delta S_{pub} = \underbrace{\boxed{\frac{t}{1-d_1}}}_{>0}\underbrace{\Delta C_0}_{<0} \qquad \Delta S_{pub} < 0$$

$$\Delta S_{nat} = \Delta S + \Delta S_{pub} = (\frac{d_1 - t}{1-d_1} + \frac{t}{1-d_1})\Delta C_0$$

$$\Delta S_{nat} = \underbrace{\boxed{(\frac{d_1}{1-d_1})}}_{>0}\underbrace{\Delta C_0}_{<0} \qquad \Delta S_{nat} < 0$$

$S_{nat}\downarrow$, we can see this from:

$S_{nat} = I$

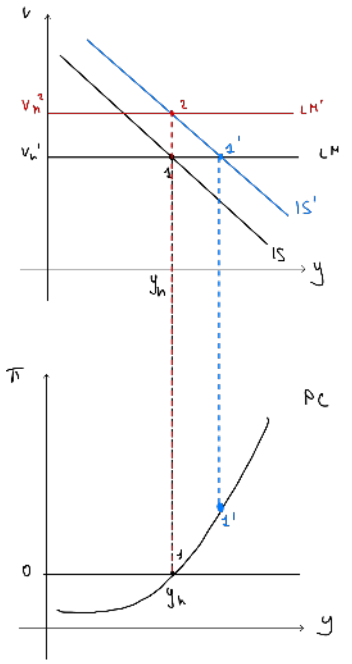
$I = \bar{I} + d_1 Y$
$\quad = \quad \downarrow$ So $I\downarrow, S_{nat}\downarrow$

Ex 33

$\pi^e = 0$

IS-LM-PC model

A. Represent the initial equilibrium and call it 1, assuming $r_n^1 > 0$



B. Show and discuss the short-run effects of a $\downarrow$ in financial markets participants' degree of risk aversion, assuming CB $r_n = r_n^1$

$x\downarrow$ $(r + x)\downarrow$ $I\uparrow$ $Z\uparrow$ $Y\uparrow$ => IS to the right

$Y' > Y_n$

$r_n^1 =$

$\pi > 0$

C. How will C and I change?

C		I		G
$Y\uparrow$	$=> C\uparrow$	$Y\uparrow$	$=> I\uparrow$	Unchanged
$T=$		$r+x\downarrow$		

D. The economy is at 1'. The CB wants it to return to initial Y_n but implementing open market operations.

$Y > Y_n$ so r_n must $\uparrow$ to bring up Y to Y_n

CB will SELL bonds: it will be paid, $M^s \downarrow$, $r_n\uparrow$

2 is the new medium run equilibrium where $Y = Y_n$

E. Discuss how the CB should act in order to return output not just to initial Y_n, but also the general price level to the value it had at the initial medium run equilibrium.

The CB wants to go back to Y_n and also to the initial price level.

It should bring r temporarily higher than r_n^2, so that the economy reaches $Y_2 < Y_n$. The inflation rate becomes negative and so the general level of prices falls.

Once the general level of prices is back to its initial level, the CB will decrease r down to $r_n^{2\prime}$.

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TEACHING DIVISION

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