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words, diagrams, equ.

THE LONG RUN (Michaelmas)

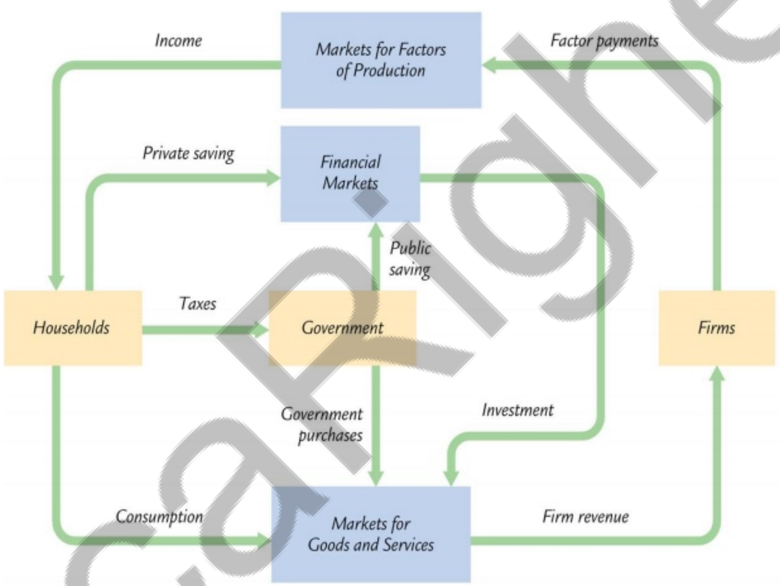
00. Economic Models

Endogenous: what models try to explain
Exogenous: what models take as given and changes
Parameter: what models take as given and is constant
Comparative Statistic: comparing two different equilibriums of the same model
Stock: quantity at a point in time | Flow: quantity per unity time
Market Clearing: prices respond quickly to stimulus so as to maintain equilibrium

01. Measuring Data

GDP

"Total expenditure on domestically produced final goods and services over a period" or
"Total income earned by domestically located factors of production over a period"



Can be calculated in several ways…

Production Approach: measures value of final goods produced
- Value of economies outputs minus value of intermediate goods used to produce that output (double-counting)
- Used goods are not counted (e.g. used car) but investment in inventory is

Expenditure Approach: measures value of total purchases: $Y = C + I + G + NX$
- C = value of all goods and services bought by households
- I = spending on capital and goods bought for future use aka
  = Gross Capital Formation = Gross Fixed Capital Formation + Inventory changes
- G = all government spending excluding transfer payments
- NX = exports – imports

Income Approach: measures value: $Y = wages + rent + profit + interest$
- Historically has fixed ratio of 2/3 Labour and 1/3 Capital

There are similar calculation variations…
- GNP = GDP + Net Factor Payments Abroad
- Net domestic product = GDP - depreciation
- Net national product = GNP - depreciation

There are several fundamental problems with GDP…
- Only includes market activity. Hence ignores the black economy (est. Italy 20% of GDP) and feminist argument ('If women counted')
- Doesn't measure changes in SOL (and leisure), depletion of environmental resources, distribution of output, and quality of goods (e.g. computers are better and cheaper)

There are many alternatives…
- Net Economic Welfare: adjusts for bads, non-market, leisure
- Human Development Index: includes education, life expectancy, GDP/c
- Genuine Savings: focus on natural resources, human capital, produced capital

To compare GDP across countries…
- Convert to common currency via exchange rates (e.g. £ => $)

Adjust for different price levels via GDP deflator ratio (e.g. $= Y^{UK,\$\,nom} \times \frac{P^{US}}{P^{UK}}$)

To compare GDP across time…

Price Changes

Market Prices: include indirect taxes. | Factor Prices: exclude indirect taxes

No 'perfect' index to compare data…
- Laspeyres: initial, fixed weight. Overstates as no measure of sub effect at all
- Paasche: final, variable weight. Understates as no measure of sub welfare effect
- Fisher: geometric mean of L. and P. over given period
- Chained-weighted: applies Fisher on a period-by-period basis

Inflation rate: rate at which prices change over time $\pi = \frac{\delta P}{P}$

GDP Deflator: $= \frac{nominal\ GDP\ 20xx}{real\ GDP\ 20yy}$ | PPP: $Y^{UK,\$\,PPP} = Y^{UK,\$\,nom} \times \frac{P^{US}}{P^{UK}}$

CPI: measures price of consumption basket of (~650) goods. Geometric mean.

CPIH: includes housing.

HICP: EU-wide standard

RPI: includes housing, council tax, mortgage; excludes top 4% and foreigner and state pensions. Hence tends to overstate inflation. Arithmetic mean.

	GDP Deflator	**CPI**
Capital Goods	Includes	Excludes
Imported Goods	Excludes	Includes
Basket	Variable (fixed price)	Fixed (variable price)

Prices can behave in two ways…
Sticky don't adjust completely (short run) or Flexible: adjust completely (long run)
Factors: market structure, Information, menu costs, brand, perishability

02. Production Model

Assumptions

- Single, closed economy; produces one good; markets clear (i.e. flexible prices)
- Fixed supply of Labour ($\bar{L}$) and Capital ($\bar{K}$)
- Constant Returns to Scale: $Y(\lambda K, \lambda L) = \lambda Y \text{ for } \lambda > 0$
- Diminishing Marginal Returns: if factor X increases, $MPX = \frac{\partial Y(X)}{\partial X}$ decreases
- Perfect Competition: firms are price takers (i.e. all hire at W and rent at R)
- Profit maximization: firms hire until $\Delta\pi = 0$, hence $0 = P \times MPX - C$ so $MPL = \frac{W}{P}, MPK = \frac{R}{P}$
- Cobb Douglas Production Function: $Y(K, L) = AK^a L^{1-a}$

Equations

Endo. Variables: Output (Y), Capital (K), Labour (L), real wage $\left(\frac{W}{P}\right)$, real rental rate $\left(\frac{R}{P}\right)$
Exo. Variables: Supply of Labour ($\bar{L}$) and Capital ($\bar{K}$)
Parameters: Productivity/TFP (A), production function (a)

Production Function: $Y(K, L) = AK^a L^{1-a}$
Rule for hiring K: keep hiring until $MPK = \frac{R}{P}$
Rule for hiring L: keep hiring until $MPL = \frac{W}{P}$
Supply equals demand for K: R^* such that $D_K(R) = S_K(R) = \bar{K}$
Supply equals demand for L: W^* such that $D_L(R) = S_L(R) = \bar{L}$

Solutions

- $K^* = \bar{K}$; $L^* = \bar{L}$; so $Y^* = A\bar{K}^a \bar{L}^{1-a}$
- so $\left(\frac{W}{P}\right)^* = MPL = \frac{\partial Y}{\partial L} = (1-a)A\bar{K}^a \bar{L}^{-a} = (1-a)\frac{Y^*}{L^*}$
- $\left(\frac{R}{P}\right)^* = MPK = \frac{\partial Y}{\partial K} = (1-a)A\bar{K}^{a-1}\bar{L}^{1-a} = a\frac{Y^*}{K^*}$

Implications

- More machines or people leads to more output
- Equilibrium real wage/rental-rate is proportional to output per worker/capital
    - a is the share of capital income as $\left(\frac{R}{P}\right)^* \times K^* = aY^*$
    - $1-a$ is the share of labour income as $\left(\frac{W}{P}\right)^* \times L^* = (1-a)Y^*$
- Economic profit = 0 as Euler's Theorem states $Y = MPL \times L + MPK \times K$ if CRS
- Can derive $y^* = A(k^*)^a$ so development determined by TFP and capital/person

In Real Life

- A explains ¾ and k^* ¼ of observed differences
- A (i.e. TFP) is a "measure of our ignorance" so that is unhelpful
- If we assume $A = 1$ (i.e. adjust for TFP) differences are much larger than predicted because IRL diminishing returns capital/person is not as strong as assumed

Notes: Growth

- Growth in Y: $\hat{Y}_t = g_Y$ (expect Y to double every $70/g_Y$ years)
- If constant growth then $Y_t = (1+g_Y)^t Y_0$
- For small values g_Y, $\ln(1+g_Y) \approx g_Y$
- Hence, $Y_t = (1+g_Y)^t Y_0 \rightarrow \ln(Y_t) = tg_Y + \ln(Y_0) \rightarrow g_Y = \frac{\ln(Y_t)-\ln(Y_0)}{t}$
- Can now use log rules

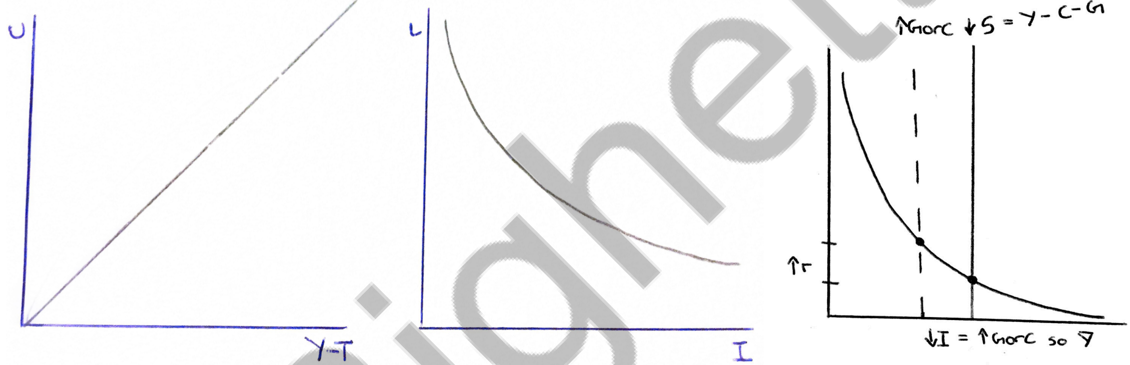
03. Demand in the Long Run

Assumptions

- Markets clear (demand=supply)
- Closed economy (i.e. not NX)
- Fixed supply side ($Y = \bar{Y}$)
- Same production function as before

Equations

Consumption: function of disposable income [$C = C(\bar{Y} - \bar{T})$] with slope MPC
Investment: function of real interest rate [$I = I(r)$] (usually negatively correlated)
Government: assumed exogenous, as are taxes [$G = \bar{G}; T = \bar{T}$]



Solutions

- Aggregate Demand: $C(\bar{Y}-\bar{T}) + I(r) + \bar{G}$ | Aggregate Supply: $\bar{Y} = F(\bar{K}, \bar{L})$
- Equilibrium: $\bar{Y} = C(\bar{Y}-\bar{T}) + I(r) + \bar{G}$

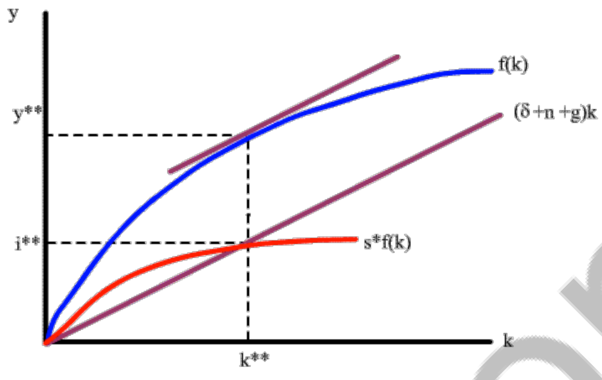
Implications

- Real interest rate adjusts to clear production market (only non-fixed variable)
- $S = \bar{Y} - C(\bar{Y}-\bar{T}) - \bar{G}$ which $= I(r)$ in equilibrium(by def!)
- Assume S is fixed [$S = \bar{S} = I(r^*)$] for now
- r equilibrates production- and loanable funds market!

  The savings curve shifts via…
- Change in public savings i.e. Fiscal Policy (increase $\bar{G}$ or decrease $\bar{T}$ lowers $\bar{S} = \bar{I}$)
- Change in private savings i.e. preferences/tech or tax law incentives

➢ In LR Demand does not affect Y (hermetically sealed; complete crowding out) and r ensures markets clear. Any $\uparrow GorC, \downarrow S, \uparrow r, \downarrow I$ so $\Delta Y = 0$ as shown by diagram

04. Solow Growth Model



Assumptions

- KEY: Diminishing Marginal Returns to k
- K is not fixed (dependent on investment)
- L is still fixed (for now); pop is workforce
- No G or T (to simplify presentation)
- National savings rate is constant

Equations

<u>Endo Variables</u>: $y\ k, c, i$
<u>Exo Variables</u>: $s, \delta, \bar{A}$

<u>Production Function</u>: $Y = F(K, \bar{L})$ so $\boldsymbol{y_t = f(k_t)}$ where $f(k) = F(K, 1)$
<u>Demand Function</u>: $Y = C + I$ so $\boldsymbol{y_t = c_t + i_t}$
<u>Investment Function</u>: $c = (1-s)y$ so $i = sy$ i.e. $\boldsymbol{i_t = sf(k_t)}$
<u>Change in capital</u> = investment – depreciation: $\boldsymbol{\Delta k_{t+1} = sf(k_t) - \delta k_t}$

Solutions

- $Y = F(K, \bar{L}) = \bar{A}K^a L^{1-a}$ so $y = f(k) = \bar{A}k^a$ so $s\bar{A}(k^*)^a = \delta k^*$ so…
- $k^* = \bar{A}^{\frac{1}{1-a}}\left(\frac{s}{\delta}\right)^{\frac{1}{1-a}}$ and $y^* = \bar{A}^{\frac{1}{1-a}}\left(\frac{s}{\delta}\right)^{\frac{a}{1-a}}$. Depends on $A, s, \delta,$ and a

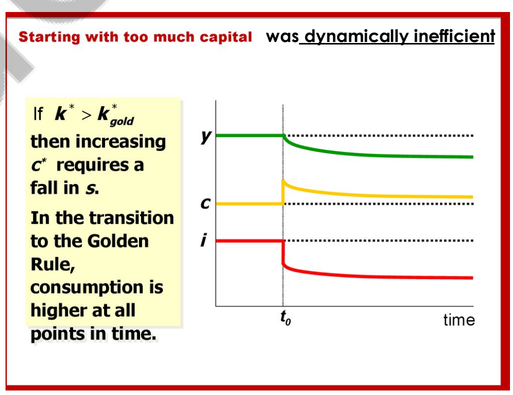
Implications

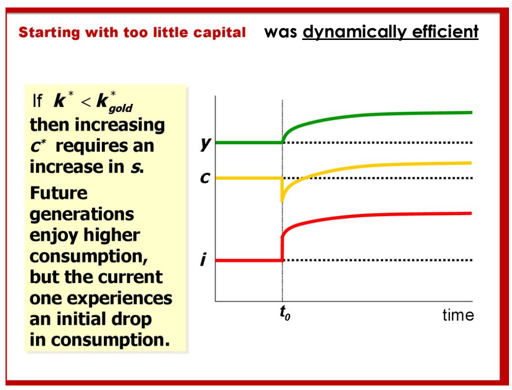
- Economy attains steady state because diminishing returns to investment
- No long-run economic growth if $L = \bar{L}$ and $A = \bar{A}$; capital accumulation is not the engine
- Log Growth Trick: $y = Ak^a \rightarrow g_y = g_A + ag_k = 0$ so $Y = yL \rightarrow 0 + +g_L = 0$

Variations

- <u>L is not fixed</u>: Population grows at rate n so $\boldsymbol{\Delta k_{t+1} = sf(k_t) - (\delta + n)k_t}$
- Log Growth Trick: $Y = yL \rightarrow g_Y = g_y + g_L = 0 + n$ but… does not improve SOL
- IRL n is not constant but depends on SOL (bell shaped curve)

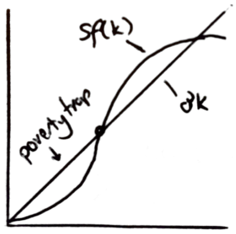
- <u>Golden Rule</u>: different values of s lead to different steady states, which $\max c$?
- $c^* = y^* - i^* = f(k^*) - (\delta + n)k^*$
- Graphically: k^*_{Gold} where slope of $f(k^*)$ is tangent to $(\delta + n)k^*$
- Mathematically: $k^*_{Gold} = \max f(k^*) - (\delta + n)k^*$ i.e. $f'^{(k^*)} = \delta + n\ (+g)$
- Note that Econ. does not tend to k^*_{Gold} and requires transition…

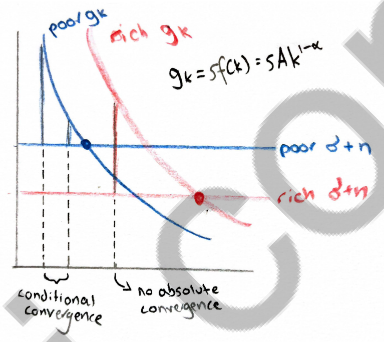




- <u>A is not fixed</u>: assume it grows at exogenous rate g
- Assume A is labour-augmenting so E = labour efficiency
- So $Y = F(K, LE) = E^{1-a}K^{a}L^{1-a}$
- Rewrite all equations in terms of LE (i.e. effective workers): $y = Y/LE$ and $k = K/LE$
- $\boldsymbol{\Delta k_{t+1} = sf(k_t) - (\delta + n + g)k_t}$ (δk for depreciation, nk for new L, gk for new "effective" L

Variable	Steady-state growth rate
$k = K/LE$	$g_k \to 0$
$y = Y/LE$	$g_y \to 0$
Y/L	$g_{Y/L} \to g$
Y	$g_Y \to n + g$





<u>Convergence:</u> Solow correctly predicts some IRL trends
- Solow predicts conditional convergence (i.e. all else being equal)
- But… Solow does not predict absolute convergence (if different s, δ, n, A, a

Notes: Solow

- If looking for Y find y and multiply by L
- As $k = K/L$ can increase via ↑ K and/or ↓ L. If same direction, magnitude matters!
- Always see if stimulus is 'one-off' or 'continuous' effect
- Solow's biggest weakness is reliance on ambiguous A (or E) and weak assumptions surrounding it e.g. firms have no incentive to invent A as there is perfect competition
- By contrast, AK model has no diminishing marginal returns to k so long-run growth

05. Unemployment

Fundamentals

<u>Unemployment Rate</u>: $(\#\text{-}Unemployed/Labour\text{-}Force) \times 100$
<u>Participation Rate</u>: $(Labour\text{-}Force/Adult\text{-}Population) \times 100$
<u>Okun's Law</u>: 1%-point rise Unemployment associated with a 2%-point fall in real GDP

Natural Rate of Unemployment

<u>NRU</u>: unemployment rate if econ were in neither boom nor bust i.e. "equilibrium level of unemployment, embedding the actual characteristics of the goods and labour markets";
<u>Cyclical unemployment</u>: actual – natural rate (short run fluctuations in output)

- Let $L = \# - labour\ force$; $E = \# - employed\ workers$; $U = \# - unemployed\ workers$
- Assume exog. labour force (L), rate of job separations (s), rate of job finding (f)
- Equilibrium when $s \times E = f \times U$ so **NRU**$= \frac{U}{L} = \frac{s}{s+f} = \frac{1}{1+f/s}$
- Lower unemployment by decreasing s and increasing f. $s > 0$ due to creative destruction

Causes of Unemployment (a European Case Study)

Short Run

- Cyclical factors: insufficient demand i.e. 'bust' economy. EU has inherent macro problems such as sovereign debt crisis, deflationary bias, and lack fiscal transfers that accentuate both
- Hysteresis: turns this into long run unemployment especially amongst young

Long Run (i.e. NRU)

Frictional unemployment

- $\downarrow f$: Geographical mobility: EU has 24 languages and different cultures; higher 'cost' moving countries than [US] states
- $\downarrow f$: Welfare State: lowers opportunity cost of unemployment and embedded in Europe (SD, CD, Communism). Also, restrictive "hiring and firing" laws.
    - UK replacement ratio is ½ of Fra and U is ½ too
    - Germany 'job miracle' (U fell even during FC) due to Hartz IV
    - Norway 90s: 40-60% increase in job finding in last months of benefit eligbity
    - But… Denmark U/L is 5.8%. What matter is incentives, not generosity. Nordic "flexicurity" model has good agencies (imperfect info) and job training schemes
- Preferences: EU more leisure and less work (1,800h/y in US vs 1,450h/y in Ger). Partly tastes, partly higher income tax rates than US
- Structure: Black economy skews figures e.g. Italy's est. 20% of GDP so not 11% U/L

Structural unemployment

Real Wage rigidity causes job rationing if above equilibrium

Tech and trade: decreased demand for unskilled labour: US absorbed via wages (inequality: EU 0.31 vs US 0.47), EU via unemployment (EU 4% vs US 8%)

- Minimum wage: Especially effect unskilled workers e.g. 10% rise in min wage leads to 1-3% increase in teenage U/L
    - Ger 10% lower than France and U is 2/3 lower
    - Purchasing power: Czechia 2.86€ without and 4.27€ with
- Labour Unions: benefit insiders at cost of outsiders, can also $\downarrow f$ but… Austria 99% unionised but 5.4% U/L
- Efficiency wages: attract higher quality applicants, increase effort (shirk theory), reduce costly turnover and improve health e.g. Ford \$5 -75 absenteeism

06. Money Supply

Fundamentals

$\text{Money Supply} = \text{Currency} + \text{Demand Deposits}$

Function: Medium of Exchange (coincidence of wants), Store of Value (intertemporal optimisation but… inflation), Unit of Account;

Types: Commodity, Fiat

Assets = Liabilities + Equity (aka Net Worth); Leverage Ratio = Assets / Equity

M0: currency and reserves
M1: M0 + demand deposits
M2: M1 + small time deposits
M3: M2 + large time deposits
M4: M3 + least liquid assets

Model

- $M = C + D$; $Base = C + Reserves$; $rr = R/D$; $cr = C/D$ by definition. Assume all exo.
- $M = C + D = \frac{(C+D)B}{B} = \left(\frac{C+D}{C+R}\right)B = \left(\frac{C+D}{C+R}\right)B \times \frac{D}{D} = \left(\frac{cr+1}{cr+rr}\right)B$
- So $\text{money multiplier} = \left(\frac{cr+1}{cr+rr}\right)$; if $rr < 1$, then $m > 1$ so $\Delta M = m \times \Delta B > \Delta B$

Notes: Central Bank

Predominantly controls the money supply via monetary policy…
- Repo lending rate: interest the CB charges for loans to banks
- Reserve requirements: Fractional Reserve Banking
- Interest on Excess Reserves: charged to 'current accounts' have with CB
- Open market operations: buy/sell gov. short-term securities

Recently via more unusual monetary policy…
- Quantitative Easing: sell/buy gov. long-term securities
- Credit Easing: sell/buy commercial securities
- Seignorage: printing money aka 'inflation tax'

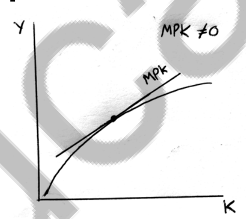
Different banks have different goals… Inflation Target (2% BoE), Money Growth Target (ECB), U/L and stable prices (Fed), and/or politics

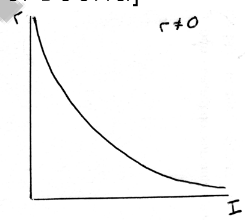
Notes: Interest Rates (i.e. Fisher Equation)

- $(1+i) = (1+r)(1+\pi)$ can be approximated as $i \approx r + \pi$
- Long Run: $i \approx r + \pi$ with r determined by loanable funds market.
- Short Run: $r \approx i - \pi^e$ with i being set by CB

  Negative Rates
- SR r can be negative when $\pi_{t+k} > r_t$ (i.e. $\pi > \pi^e$).
- SR i can be negative if CB sets it so, but commercial can't pass on due to 'liquidity trap' (unless forced savings or preferences). Encourages risky behaviour as it squeezes profits.
- LR r cannot be negative as $r = MCofK$ which in equ. $= MBofK = MPK > 0$. In loanable funds market, I tends to $x\text{-}axis$ as r decreases but never crosses it.
- LR i can be negative when $|\pi| > r$ and $\pi < 0$

  [Also see Zero Lower Bound]





07. Quantitative Theory of Money

Assumptions & Equations

- KEY: V is constant
- Prices are flexible and markets clear (i.e. medium/long-run)
- Exo: Velocity (V), Transaction Value (T) or Output (Y) [i.e. classical dichotomy]
- Endo: Price Level (P), Money Supply (M) [with CB having some control over it]

Solutions

- By definition: $V = \frac{T}{M} \approx \frac{P \times Y}{M}$ giving $\boldsymbol{M \times \overline{V} = P \times Y}$
- So, Real Money Demand = $\left(\frac{M}{P}\right)_d = \frac{1}{v} Y$ in equilibirum
- Via growth rate rules: $g_M + g_{\overline{V}} = g_P + g_Y \rightarrow \text{Infaltio}\boldsymbol{\pi} = \boldsymbol{g_M - g_Y}$

Implications

- For given values Y and V, a change in M causes equal magnitude change in P
- Economic growth requires growing the money supply to facilitate growth in transactions
- Excess money supply growth leads to inflation
- IRL V is not constant (hyperinflation panic), a very big weakness
- NOTE: Always distinguish between change in $g(M)$ and one-off effect

08. Money Demand

Assumptions

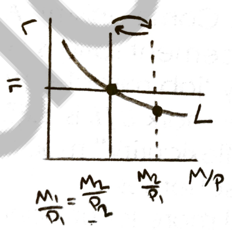
- <u>Variables</u>: Real Interest Rate (r), Nominal Interest Rate (i), Inflation Rate (π), Expected Inflation Rate (π^e), plus 06. And 07.
- No transaction costs;

Equations

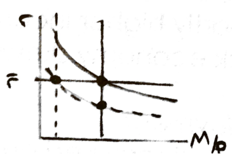
- $(M/P)_d = L(i, Y)$; Md depends ve⁻ on i (opp. Cost) and ve⁺ on Y (function)
- People don't know what inflation will be so $i = r + \pi^e$; so use $L(r + \pi^e, Y)$
- So, in equilibrium $\boldsymbol{(M/P)_s = (M/P) = (M/P)_d = L(r + \pi^e, Y)}$ where…
  - M is exogenous (determined by CB)
  - r is exogenous (adjusts to make $S = I$)
  - Y is exogenous ($= F(K, L)$)
  - P is endogenous (adjusts to make equation true)

Implications

- Real Money Supply deceases in P; Real Money Demand increases in P $\left[L\left(r + \frac{P^e}{P} - 1, Y\right)\right]$
- For given values r, Y, π^e a change in M causes equal magnitude change in P
- If all variable, an increase in M has a double effect…
  - Channel 1: $\uparrow M, \uparrow \left(\frac{M}{P}\right)_s, \uparrow P^*, \downarrow M/P$ [current monetary policy]
  - Channel 2: $\uparrow g_M, \uparrow \pi^e, \uparrow i, \downarrow (M/P)_d, \uparrow P^*, \downarrow M/P$ [future monetary policy]
  - Note that, in long term, $\pi \approx \pi^e$



$\uparrow M$: $M_1 \rightarrow M_2$
need to stay at $\bar{r}$
$\uparrow P$: $P_1 \rightarrow P_2$



$\uparrow P^e$ ∴ higher i for every r ∴ $\downarrow L$
$L_1 \rightarrow L_2$
need to stay at $\bar{r}$
$\uparrow P$: $P_1 \rightarrow P_2$

Notes: Classical Dichotomy

- Assumption/theory that nominal variables don't affect real variables.
- Neutrality of Money: ΔM doesn't affect real variables. IRL approx. true in long run
- **Pigou Effect**: If $C = f\left(\frac{M}{P}\right)$ [wealth effect] then $\uparrow g_M, \uparrow \pi, \uparrow i, \downarrow L, \downarrow \left(\frac{M}{P^*}\right), \downarrow C, \uparrow S, \downarrow r$
- **Mundell-Tobin Effect:** Note $\uparrow i = \downarrow r + \uparrow \pi$. Note there is a break down!

Notes: Cost of Inflation

Expected Inflation

- Shoe leather Cost (more trips to bank to withdraw)
- Menu Cost (having to physically change price sings)
- Relative Price Distortions (causing micro inefficiencies in allocating resources)
- Unfair taxes (taxing nominal, not real activity)
- Hard to compare data from different time periods

Unexpected Inflation

- Arbitrary redistribution (e.g. fixed pensions get hurt)
- Increased uncertainty (distorts inter-temporal decisions)
- Hyperinflation: $\pi > 50\%/month$; almost always because gov. prints money

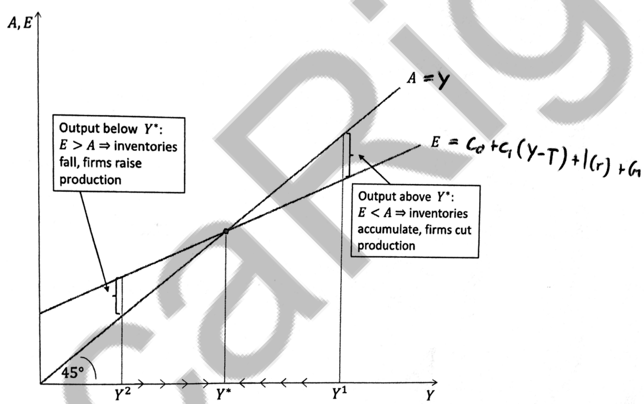
Reinforcing mechanisms

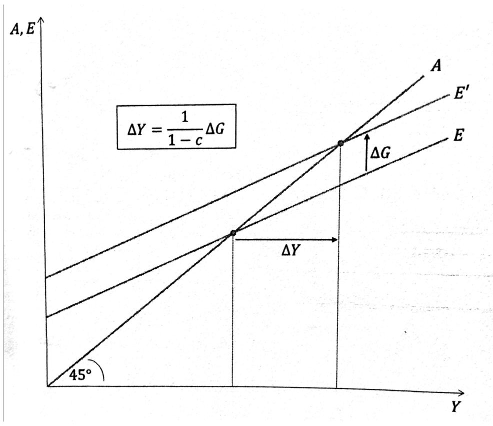
- Inflation erodes tax revenue and bond holders reluctant so need to print more; $\bar{\varepsilon} = e\frac{P}{P^*}$ means $\uparrow P, \downarrow e, \uparrow P\text{-of-Imports}$

THE SHORT RUN (Lent)

09. Investment-Savings ($r \to Y$)

Keynesian Cross

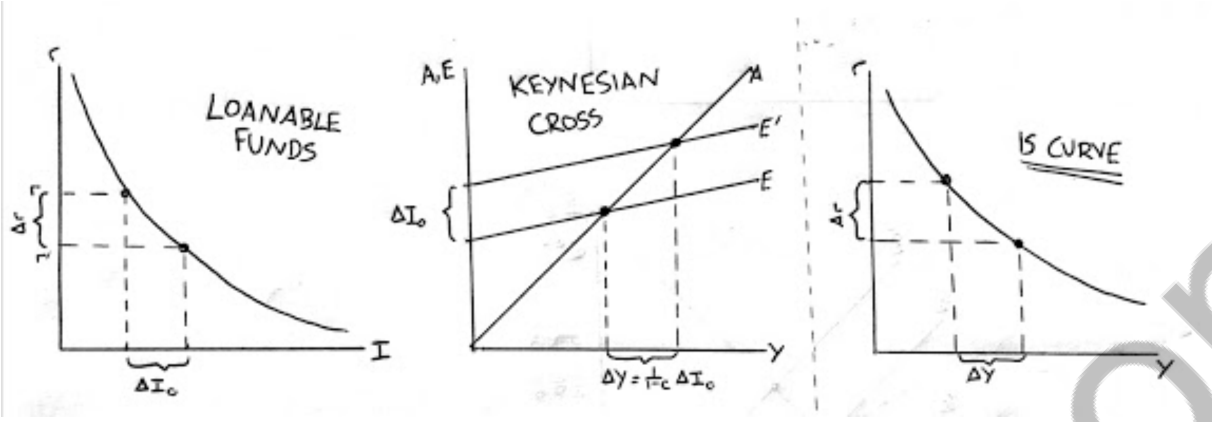




- Planned: $E = \mathrm{C} + \mathrm{I} + \mathrm{G} = c_0 + c_1(Y - T) + I_0(r) + G$ | Actual: $A = Y$
  - E Shifts: $\Delta c_0/c_1 T/I_0/G$
  - E Slope: $= c_1$, pivot around intercept with Y-axis
- In equilibrium $A = E$ so $Y = c_0 + c_1(Y - T) + I_0(r) + G = \frac{1}{1-c_1}(c_0 - c_1 T + I_0(r) + G)$
- Intuition: Changing inventories signal firms to change production
- Keynesian Multiplier: $\boldsymbol{\Delta Y = \frac{1}{1-c_1}\Delta G/c_0/I_0}$ [Note: When $\frac{\partial Y}{\partial G}, \frac{\partial T}{\partial G}$ matters!]

Basics of IS Curve

IS Curve: Plots points where good market is in equilibrium (i.e. Y given r)
e.g. $Y = \frac{1}{1-c_1}(c_0 - c_1 T + I(r) + G)$ or $= \frac{1}{1-c_1}(c_0 - c_1 T + I_0 + I_1 R + G)$

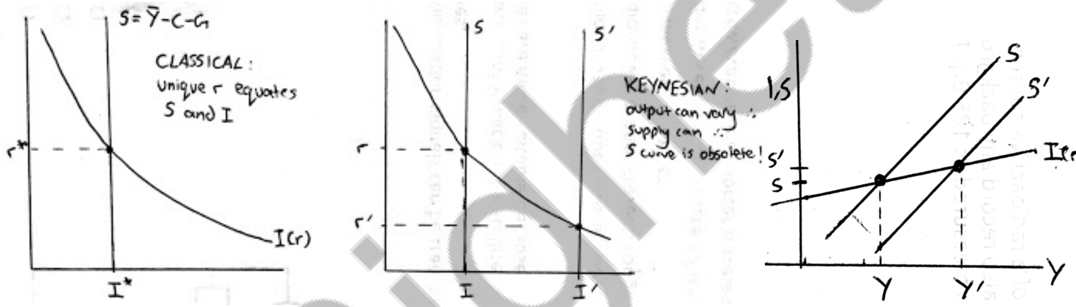


$\Delta \boldsymbol{r}$ → [loanable funds] → $\Delta \boldsymbol{i_0}$ → [Keynesian multiplier] → $\Delta \boldsymbol{Y}$

Interpretation

- $E = A$ so $Y = C + I(r) + G$ rearrange to $I(r) = [(Y - T) - C] + (T - G) = S_{pr} + S_{pub} = S$

  $\boldsymbol{E = A}$ implies $\boldsymbol{I = S}$!
- Intuition: A fall in r causes a rise in Y. Some of this is spent, some is saved.
- Output continues to rise until $I = S$
  - AD equilibrates goods market! (contra classical r)
  - Investment generates its own savings! (contra classical crowding out)
  - **Paradox of Thrift**: raising S_{SR} lowers S_{LR} and Y



Changes in IS Curve

Shifts: $\Delta G/c_o/i_0$ shift the IS curve by $\frac{1}{1-c_1}\Delta G/c_o/i_0$ (Intuition: higher Y for any given r)

Slope: Two cases (Intuition: change in r leads to larger change in Y). Show w/ shift

- I more sensitive to r => flatter $I(r)$ curve => flatter IS
- Larger Keynesian multiplier => steeper E curve => flatter IS curve

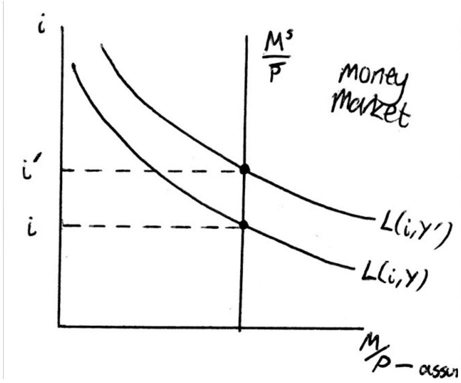
10. Liquidity-Money/Monetary-Policy $(Y \rightarrow i)$

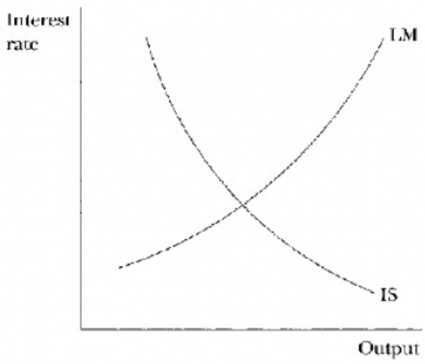
- In Classical P adjusts and Y fixed; in Keynesian Y adjusts and P fixed!
- Central Bank has monopoly over issuing currency, therefore can set either the quantity M (i.e. LM) or price P (i.e. MP) of money supply.
- Note money market has y-axis i, goods market has r. To combine the two we assume sticky inflation expectations ($\bar{\pi}^e$) so $r = i - \bar{\pi}^e$. Now just change y-axis.

Basics of LM Curve

<u>LM Curve:</u> Plots points where money market is in equilibrium (i.e. Y given r)

e.g. $\frac{M}{P}$[money supply] $= L_1Y - L_2R$[money demand] $\Rightarrow R = \frac{L_1}{L_2}Y - \frac{M}{PL_2}$



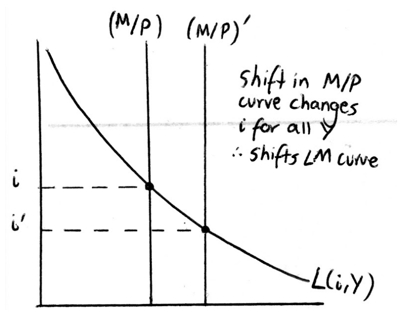


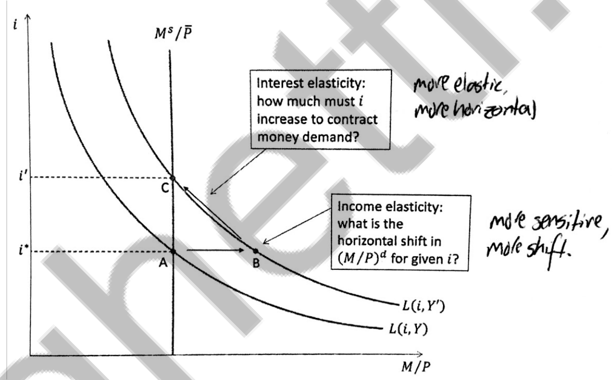
$$\boldsymbol{\Delta Y} \rightarrow [\boldsymbol{L_1} \text{ Income elasticity of Md}] \rightarrow \boldsymbol{L(i,Y)} \rightarrow [\boldsymbol{L_2} \text{ Interest elasticity of Md}] \rightarrow \boldsymbol{\Delta i}$$

Changes in LM Curve

Shifts: ΔM (i.e. CB buys/sells bonds), ΔP, and exog. $\Delta L(i, Y)$. See diagram
Slope: Two cases (Intuition: change in Y leads to larger change in i). Show w/ shift

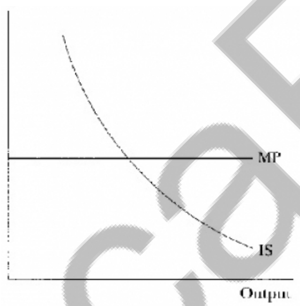
- Income elasticity of money demand: L more sensitive to Y => steeper LM
- Interest elasticity of money demand: L more sensitive to i => flatter LM

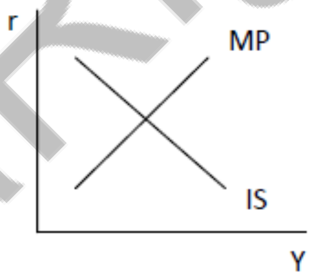




Basics of MP Curve

<u>MP Curve:</u> Plots points where money market is in equilibrium (i.e. Y given r)
CB sets horizontal line so $i = R + \bar{\pi}^e$ where normally $R = r_{LR}$





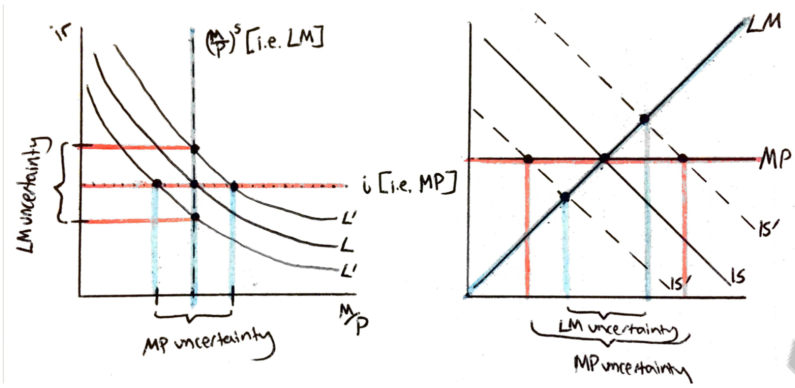
Taylor Rule

Taylor Rule: endogenises CB action via equation $R = \bar{r} + m_\pi(\pi - \pi^T) + m_Y(Y - \bar{Y})$
Friedman's case for passive CB policy

- There are "long and variable lags" between effect, response, and counter effect. Christiano et al. see peak monetary effect 18 months afterwards!
- Instead it is better to target something independent of current outcomes
    - Recall $M\bar{V} = PY \Longrightarrow g_M = \pi + g_Y$. Assuming g_Y exog, g_M chooses π
    - What is optimal π? Recall $i = r + \pi$ and i is a (distortionary) tax on cash
    - Should target $i = 0$ so $g_M = \pi = -r$. CB should actively try to hit ZLB!
    - But… M is hard to define and measure; deflation as a goal?

LM vs. MP (i.e. quantity setting vs. price setting)

- In theory, with perfect information of L, there is no difference. In practice, both M/P [LM] and i [MP] are set via open-market-operations
- But… in practice it harder to measure and target M/P than it is i
- Also depends if money-demand shocks are more common than good market:
    - L-shocks: under LM results in Δr (affects econ), under MP $\Delta M/P$ (doesn't)
    - IS-shocks: under LM results in less ΔY than under MP

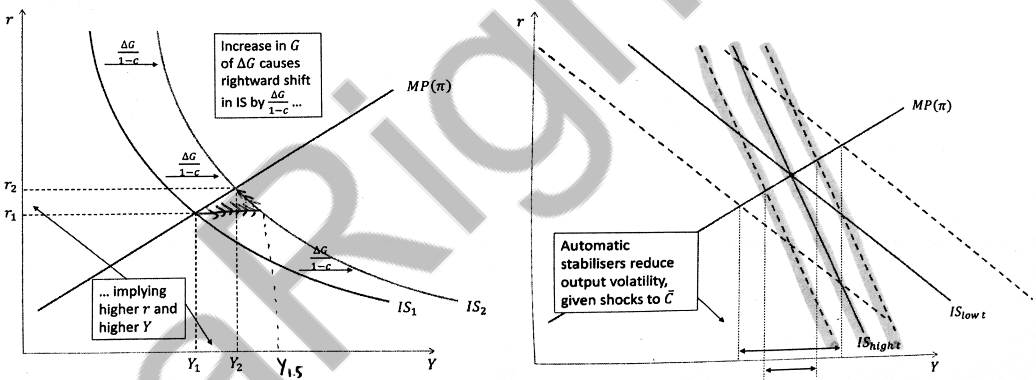


11. IS-LM/MP Model

IS: $Y = \frac{1}{1-c}(c_o - c_1 T + I_0 - I_1 R + G)$

LM: $R = \frac{L_1}{L_2} Y - \frac{M}{PL_2}$ | MP: $R = \bar{r} + m_\pi(\pi - \pi^T) + m_Y(Y - \bar{Y})$

Substitute LM/MP into IS and solve for Y e.g. $Y = \frac{c_0 + I_0 + I_1 \frac{M}{PL_2} + G}{1 - c_1(1-t) + I_1(\frac{L_1}{L_2})}$



$\uparrow G, \uparrow Y$ [shifts IS], $\uparrow r$ [via m_Y], $\downarrow I, \downarrow Y$[move along MP]

$\uparrow G, \uparrow Y$ [shifts IS], $\uparrow r$ [via $(M/P)^d$], $\downarrow I, \downarrow Y$[move along MP]

Not crowding out as CB actively chooses to raise rates or fix M

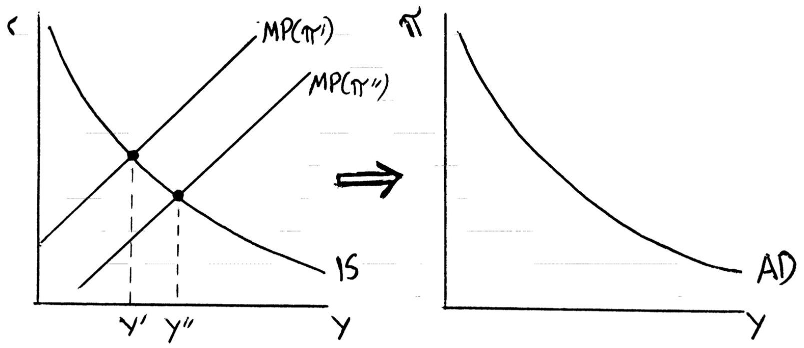
Equilibrium Multiplier: $0 \leq \frac{\partial Y}{\partial G} \leq \frac{1}{1-c}$ determined by m_Y.

Automatic Stabilisers: reduce the Keynesian multiplier, making IS curve steeper and hence it will shift less for a given shock.

12. Aggregate Demand Curve

Basics of AD Curve

<u>AD Curve:</u> Traces all IS-LM/MP equilibria for any given π. See equation above.



Interpretations of the downwards slope

- If the price for one good falls, demand for it falls. If the price of all goods falls, why should demand fall?

Central Bank Response: Taylor Rule for MP; Keynes Effect for LM
  - MP: Increase in π causes CB to raise R, lowering Y
  - LM: CB fixes M so increase in P lowers M/P raising R, which lowers Y

Pigou Effect: $\uparrow \pi, \uparrow i, \downarrow Md, \downarrow M$ (to keep $\overline{\mathrm{R}}$), $\downarrow M/P, \downarrow C, \downarrow Y$

Mundell Fleming Effect: see Open Economy

Changes in AD Curve

Shifts: Anything that affects IS-LM/MP equilibria e.g. $c_0, G, \bar{r}, \pi^T$ etc.
Slope: Two stages (Intuition: change in π leads to larger change in Y). Show w/ shift
  - How much does R respond to π? => higher m_π
  - How much does Y respond to R => steeper IS curve

13. Aggregate Supply Curve

Basics of AS Curve

<u>SRAS Curve:</u> e.g. $\pi = \pi^e + v(Y - \bar{Y})$ | <u>LRAS Curve:</u> $Y = \bar{Y}$) | Intersect at $(\bar{Y}, \pi^e)$
  - If $v = 0$ we are back at Keynesian model ($\pi = \pi^e$ and exogenous)
  - If $v = \infty$ we are back at Keynesian model ($Y = \bar{Y}$ and exogenous)

Interpretations of the upwards slope

Sticky prices:
- s firms have sticky prices avg. p^s; $(1-s)$ have flexible prices p^f
- Average price $P = sp^s + (1-s)p^f$
- Firms want $p = P$ [general price level] $+ a(Y - \bar{Y})$[marginal cost pressure]
- Sticky price firms assume $Y = \bar{Y}$ and $P = P^e$. Flexible price firms don't worry…
- $P = sP^e + (1-s)[\mathrm{P} + a(Y - \bar{Y})] = P^e + a\frac{1-s}{s}(Y - \bar{Y})$
- Using log rules $\pi = \pi^e + a\frac{1-s}{s}(Y - \bar{Y}) = \pi^e + v(Y - \bar{Y})$. Share sticky firms ($s$) matters.

Criticisms
- Theory: needs to assume bounded rationality (menu costs)
- Practice: Evidence that firms adjust nominal prices every 8-11 months but sales!

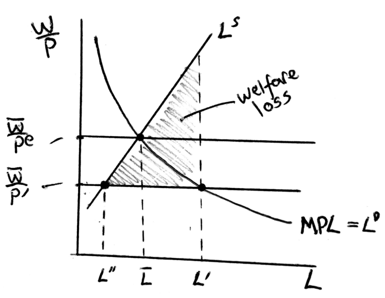
Sticky wages: Workers agree to a fixed nominal wage, but real wage matters.
- Workers agree to nominal wage W in advance, based on P^e and target rw ω
- $W = \omega P^e \Rightarrow \frac{W}{P} = \omega\frac{P^e}{P}$

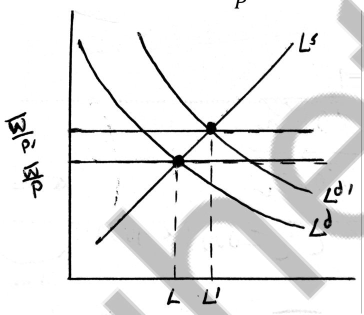
- Firms have CD production function $Y = A\bar{K}^{a}L^{1-a}$
- Workers are hired until $w = MPL$: $\omega\frac{P^e}{P} = (1-a)\frac{Y}{L}$ so $L = \frac{1-a}{\omega}Y\frac{P^e}{P}$
- "If $\bar{Y}$ is output when $P = P^e$ then $Y = \bar{Y}\left(\frac{P^e}{P}\right)^{\frac{1-a}{a}}$" [No clue why]
- Rewriting in logs: $Y = \bar{Y} + \frac{1-a}{a}(P - P^e)$
- Using log rules: $\pi = \pi^e + \frac{1-a}{a}(Y - \bar{Y}) = \pi^e + v(Y - \bar{Y})$. Share of L (a) matters.

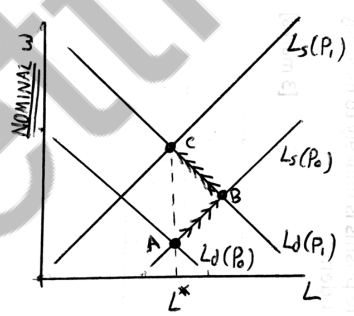
Criticisms

- Theory: Need to assume bounded rationality (workers have to supply unlimited L^s). If this weren't the case they would be behaving irrationally (see diagram)

- Practice: Evidence that real wages are not strongly counter-cyclical but slightly pro cyclical with $Corr\left(Y, \frac{W}{P}\right) \approx 0.1$. Can be explained by Real Business Cycle:
  - AS shock reduces cost of production ($\downarrow P$) and hence raises real wage $\left(\uparrow \frac{W}{P}\right)$. But also increases L-demand, labour and hence output rise ($\uparrow L, \uparrow Y$).
  - If prices are sticky a firm can only adjust to decrease in demand via lower y (not p). This reduces L_d and thus $\frac{W}{P}$ as well.







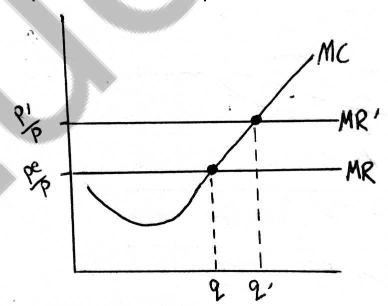
Worker Misperception: Workers don't know P so can't distinguish nominal from real w

- $\uparrow P \Rightarrow \downarrow \frac{W}{P} \Rightarrow \uparrow L^d$. L^s only adjusts accordingly in LR, via higher nominal wage

Imperfect information: Prices carry information in nominal not real terms

- Under perfect competition $MR = \frac{p[\text{firm}]}{P} = MC(y)$
- When a firm sees $p > p^e$ it needs to ask whether it's because demand for its product (prob=θ) has risen or the value of money has fallen (prob=$1-\theta$)
- For an individual firm we get $y = y^e + \theta(p - p^e)$, for econ $Y = \bar{Y} + \theta(P - P^e)$
- Rearrange and use logs rules: $\pi = \pi^e + \theta(Y - \bar{Y}) = \pi^e + v(Y - \bar{Y})$. What matters is perceived probability that CB has raised $P(\theta)$.

Criticisms: Would expect Internet (open information) and forward guidance to have impact. None perceived so far.

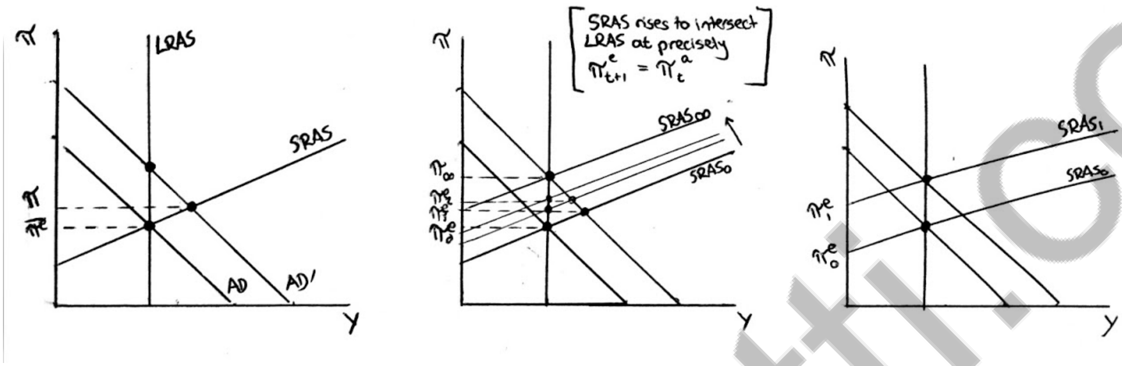


	Labour	*Firms*
Market clearing	L misperception (Price level bounds rationality)	Imperfect info (CB bounds rationality)
Non-Market clearing	Sticky w (contracts bounds rationality)	Sticky p (menu costs bounds rationality)

14. Inflation Expectations

- $\pi = \pi^e + v(Y - \bar{Y}) + \epsilon$ where ϵ is an AS/cost-push shock

Exogenous expectations: $\pi^e = \bar{\pi}$ always holds. There is a permanent inflation-output trade-off. LRAS becomes meaningless. CB can permanently set $Y^* > \bar{Y}$.
Adaptive expectations: $\pi^e = \pi_{-1}$. There is a temporary inflation-output trade-off. SRAS eventually moves back to LRAS equ. CB can set $Y^* > \bar{Y}$ only at increasing π, i
Rational expectations: $\pi^e = \pi^T$. There is no inflation-output trade-off. SRAS immediately moves back to LRAS equ. CB can never set $Y^* > \bar{Y}$.

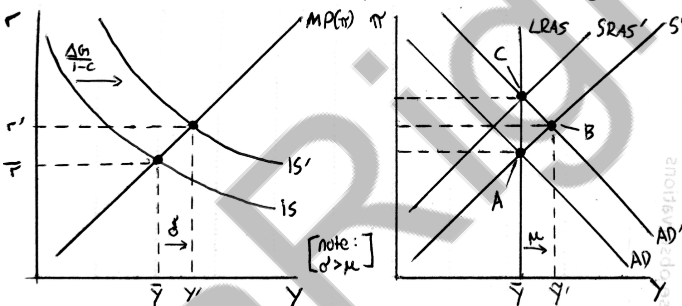


15. AS-AD Model

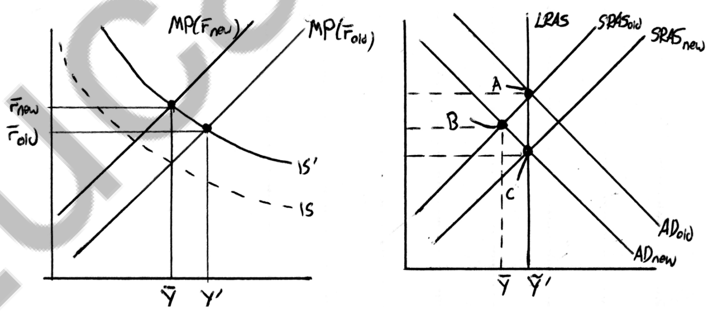
AD Shock

Example

- SR: ΔG shifts IS by $\frac{\Delta G}{1-c}$, raising Y by δ. True for all π so AD shifts by δ, raising Y by μ
- LR: $\Delta \pi^e$ so SRAS shifts upwards until long run equilibrium is reached

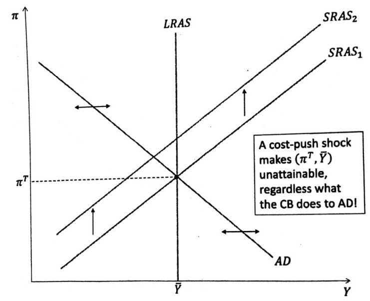


- But… will CB accept permanent $\pi > \pi^T$ in long run? NO!
- vLR: Classical Model tells us $\Delta G \Longrightarrow \Delta S \Longrightarrow \Delta \bar{r}$. CB realises this, shifting MP∴AD returns



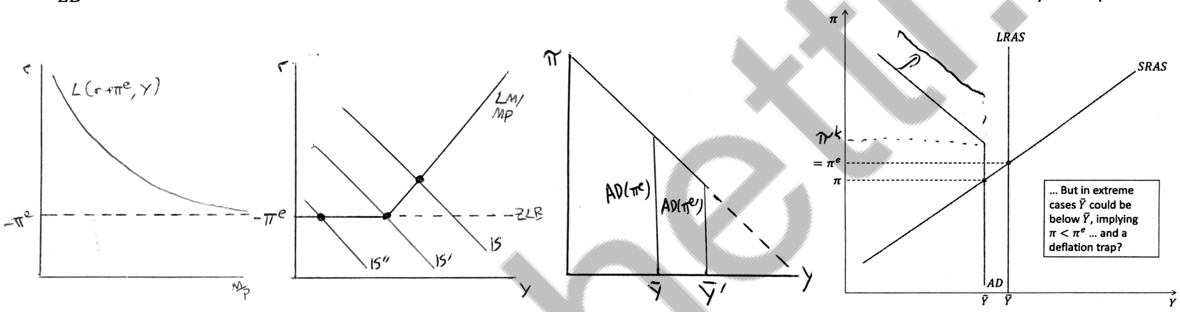
AS Shock

- Whilst an AD shock can be, in theory, remedied immediate, an AS shock cannot as it requires the CB to engage in inflation-output trade-off



16. Zero Lower Bound

- $i \geq 0 \Longrightarrow r + \pi^e \geq 0 \Longrightarrow r \geq -\pi^e$
- Lower π^e means constraint more binding. Hence some propose higher π^T
- $R = \max\{\bar{r} + m_\pi(\pi - \pi^T) + m_Y(Y - \bar{Y}),\ r_{LB} = -\pi^e\}$
- Monetary policy becomes ineffective, fiscal policy its most powerful
- Normally, a fall in R shifts down IS and MP curve equally. But as it can't fall below r_{LB}, Y can't exceed $\tilde{Y}$. This in turn affects AD curve. If $\tilde{Y} < \bar{Y}$ deflationary trap!



17. Open Economy in the Long Run

Basics of Trade

- $Y = C + I + G + NX \Longrightarrow Y - C - I - G = NX \Longrightarrow \boldsymbol{S - I(r^*) = NX(\epsilon)}$
- CA [current account] $= NX + NIA$ [net income assets] $+ NT$ [net transfers] | $CA \approx NX$
- $\boldsymbol{NCF}$: Net Capital Flows are changes in net wealth stock
- $\boldsymbol{CA + NCF}$ **[net capital flows]** $\boldsymbol{= 0}$ | $\boldsymbol{\sum CA_i = 0}$
- $\boldsymbol{\epsilon}$**[real]** $= \dfrac{\boldsymbol{e}\textbf{[nominal]}\boldsymbol{P}\textbf{[domestic]}}{\boldsymbol{P^*}\ \textbf{[world]}}$

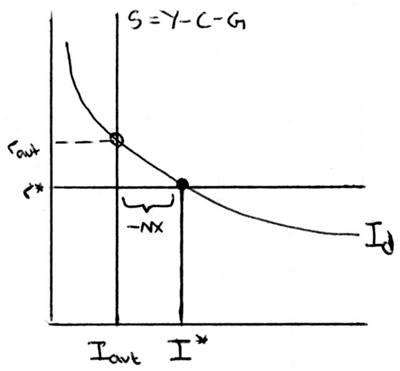
Marshall Lerner Condition

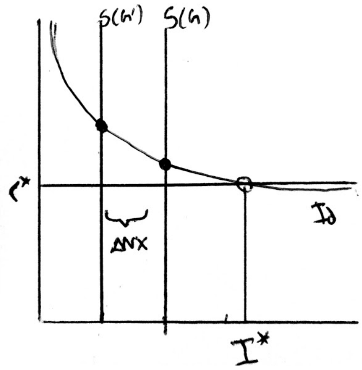
- If there is a real appreciation ($\uparrow \epsilon$) there are two effects. Which will dominate?
  - Subsitute Effect: Domestic goods more expensive so volume X falls, M rise
  - Income Effect: Real price of M falls so value of M falls

1. $NX = X - \frac{1}{\epsilon}M < 0$
2. $\frac{\partial NX}{\partial \epsilon} = \frac{\partial X}{\partial \epsilon} - \frac{1}{\epsilon}\frac{\partial M}{\partial \epsilon} + \frac{M}{\epsilon^2} < 0$
3. $\frac{\epsilon^2}{M}\frac{\partial X}{\partial \epsilon} - \frac{\epsilon}{M}\frac{\partial M}{\partial \epsilon} + 1 < 0$ [divide by $\frac{M}{\epsilon^2}$]
4. $-\frac{\epsilon}{X}\frac{\partial X}{\partial \epsilon} + \frac{\epsilon}{M}\frac{\partial M}{\partial \epsilon} > 1$ [small NX $X \approx \frac{M}{\epsilon}$]
5. $\eta^X + \eta^M > 1$ [η= ϵ-elasticitiy]
6. $\uparrow \epsilon \Longrightarrow \downarrow NX$

Open Classical Model

- Perfect capital mobility dictates that r^*[world] $= r$[domestic]. I^* independent of S
- If there is upward pressure on r, capital flows in appreciating ϵ, reducing NX
- Hence government spending crowds out NX not I





Solow Revisited

$r = MPK = \alpha A\left(\frac{K}{L}\right)^{\frac{1}{1-\alpha}}$. Capital should flow from where $\frac{K}{L}$ is high (rich) to low (poor).

Criticisms

- Would imply that $MPK_{India} = 50 \times MPK_{USA}$. Clearly absurd. Why?
    - Human Capital (i.e. augmented labour) differs
    - Technology differs
    - Capital market imperfections

Law of One Price

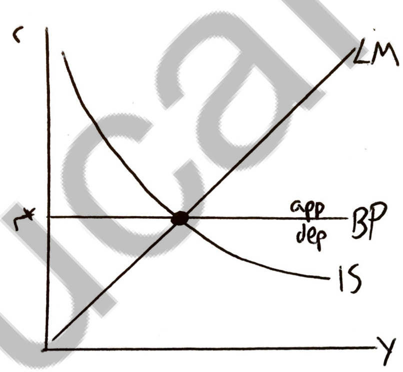
- The logic of arbitrage states that in long run $\epsilon_i = 1$. But IRL $\epsilon_{\text{rich}} > \epsilon_{\text{poor}}$. Why?

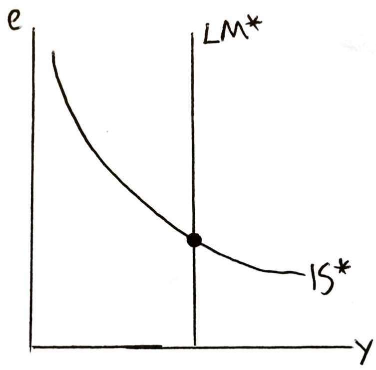
Balassa-Samuelson Effect

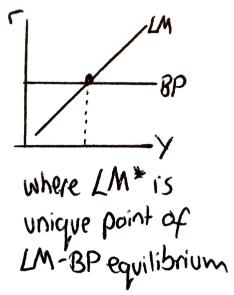
- In practice we can generalise that manufacturing are tradeable, services aren't
- $P = tp_m + (1-t)p_s$
- Growth reduces costs of manufacturing goods much quicker so $\frac{p_s}{p_m}$ higher in rich
- Let's suppose the LoOP only holds for manufacturing goods: $1 = \frac{ep_m}{p^*{}_m}$
- $\epsilon = \frac{e[tp_m+(1-t)p_s]}{tp_m^*+(1-t)p_m^*} = \frac{t+(1-t)\frac{p_s}{p_m}}{t+(1-t)\frac{p_s^*}{p_m^*}}$ | This could explain why!

18. Mundell-Fleming Model [see Bateman's A3 sheet]

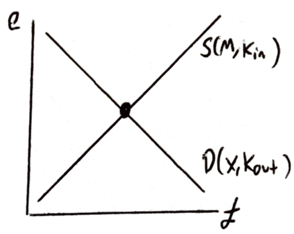
- In IS-LM analysis assume fixed price/inflation ($\bar{P}$ or $\bar{\pi}$). Hence $i^* = r^* + \bar{\pi}$ and $\epsilon = ke$
- Now have three markets: Goods (IS), Money (LM/MP), and BP (r^*). Two ways to draw





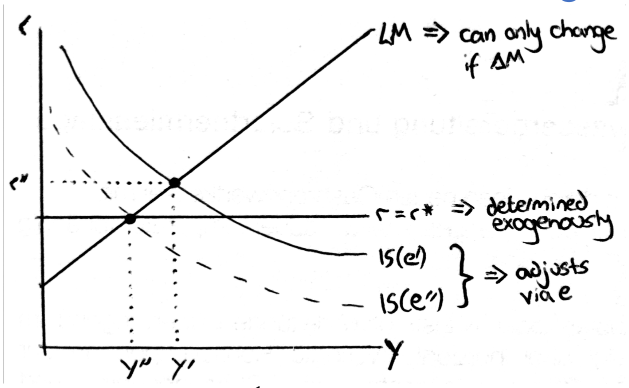


- In r, Y space Δe shifts in IS; Δr moves along IS
- In e, Y space Δe moves along IS*; Δr shift IS* and LM*



- $\downarrow r, \downarrow K_{net\ in}, \downarrow$ ε, goods more comp., £ more dd. and less ss.
- Distinguish between $\Delta X, M$ because of Δe or Δ at every level of e

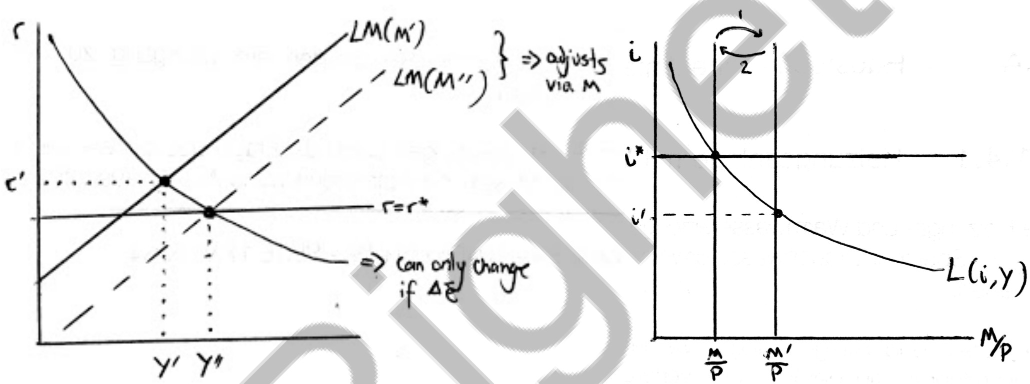
IS and LM shifts: Fixed M, floating e



- Recall IS: $Y = \frac{1}{1-c}[c_o + I_0(r^*) + G + NX(\bar{e})]$. Note it is flexible as e is flexible.
- Recall LM: $L(i, Y) = \frac{M}{P}$. Note it is not flexible as i, M, P are not flexible
- Y entirely determined by money market! Intuition: Foreign capital attracted to upwards pressure on r. Inflow appreciates e, so $NX(e)$ falls and thus IS shifts down.

Monetary Policy is very effective with no crowding out (e.g. UK 1930s recovery) as e adjusts. Fiscal policy only has compositional effects, being offset by fall in NX.

IS and LM shifts: Fixed e, variable M



- Recall IS: $Y = \frac{1}{1-c}[c_o + I_0(r^*) + G + NX(\bar{e})]$. Note it is not flexible as e is not flexible.
- Recall LM: $L(i, Y) = \frac{M}{P}$. Note it is flexible as M is flexible
- Y is entirely determined by goods market. CB has to fight exchange rate pressures by <u>intervening in the ForEx market and thereby increasing the money supply</u>…
  - Appreciative Pressure: floods ForEx with £-supply, gaining foreign reserves in exchange. This increases the monetary base and thus money supply.
  - Depreciative Pressure: floods ForEx with £-demand, buying with its 'war chest' and 'burning' the £ it gets. This decreases the monetary base and thus money supply.

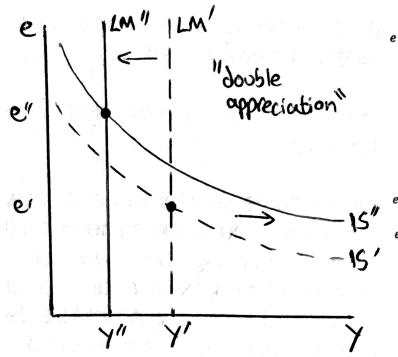
Fiscal Policy is very effective with no crowding out as M adjusts (explains Greece € overspending). Note only C and G can vary. Monetary policy is impotent (explains why inflation plagued Greece joined €).

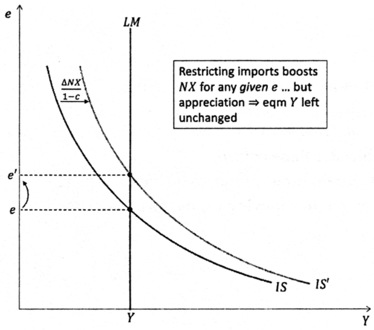
Dangers of a Fixed Exchange Rate

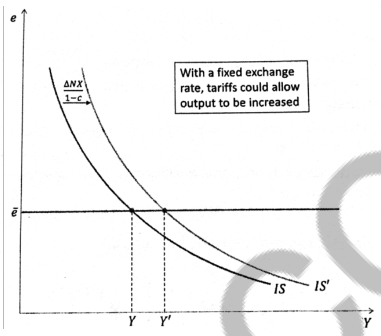
- If currency is overvalued ($\bar{e} > e_{FE}$) output is depressed ($Y < Y_{FE}$). Monetary policy is powerless and fiscal policy requires deficit (internal or external balance)
- Sustained CA deficit requires NCF surplus. Also fear of devaluation can worsen a negative output gap as investors demand compensation for extra risk: $r = r^* + \theta$

Special Case: Δr^* / Large Economy

- In r, Y space Δr^* shifts BP. If floating e IS responds; if fixed $\bar{e}$ LM responds
- In e, Y space Δr^* shifts IS* (ΔI for all e) <u>and</u> LM* (new LM-BP equilibrium). If floating e IS responds; if fixed $\bar{e}$ LM responds (relevant for GD deflation spreading)







Special Case: Trade Policy

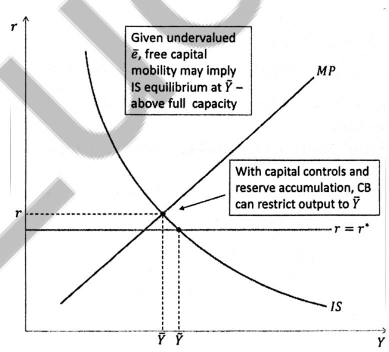
- $NX(e, \phi)$ where ϕ is import restrictions. Will trigger $\downarrow iM, \uparrow NX, \uparrow IS/IS^*$
- If floating e: A boost in NX for any given e is offset by appreciation Recall Y is determined by money market (unless CB accommodates by expanding M)
    - Intuition: imports and exports are lowered so net position unchanged.
- If fixed $\bar{e}$: A boost in NX is accompanied by an increase in M. Can allow Y to be increased (especially if $\bar{e}$ overvalued).
- In US/Large-Econ case this will also raise BP and therefor create some stimulus even when floating!
- In all cases, mention that may result in foreign response ϕ^* and damage long-term supply side (don't need to elaborate).

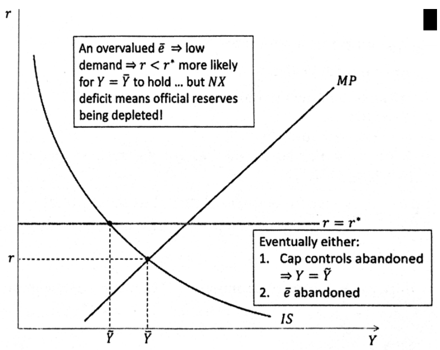
Special Case: Capital Controls / Imperfect Capital Flows

- Can restrict capital mobility (NCF) so $r \neq r^*$ by controlling official sector flows.
- Recall, $NCF + CA \equiv 0$. If $NCF = 0$ then $NX(\bar{e}) \approx CA = 0$. That is the country can control r as desired but only if e is pegged at right choice. BP is vertical. Possible to do more?

Official Flows

- A-symmetry as a CB can save forever but it can't borrow forever. $NCF \leq 0$ so $NX(\bar{e}) \geq 0$ and not every country can run a trade surplus!
- Suppose $\bar{e}$ undervalued so NX surplus attained CB sets $r > r^*$ suppressing Y. Reserves accumulate at the cost of unrealised investment.
- Suppose $\bar{e}$ overvalued => NX deficit. CB sets $r < r^*$ boosting Y. Reserves diminish overtime until exhausted. Something has to give.





NX(e, Y) Case

Suppose $M = \bar{M} + mY$ and $X = \bar{X}$. Now only one level of Y that avoids BoP crisis: