ECON0016: Macroeconomic Theory & Policy (21/22)
Term I Revision Notes

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Week 1: Introduction / The Demand Side I: Permanent Income Hypothesis (PIH) Basics

1. Notations

Upper case letters: Nominal

Lower case letters: Real

*Interest rates are always represented by lower case letters:

ι "iota": Nominal IR

r : Real IR

Superscript "e": Expected

2. Models, Theory, and Data

The macroeconomy is exceedingly complex both in cross-section and time-series.

The models we can build is extremely simple.

The data we have is always limited and noisy.

Dealing with this:

Models are not the truth, but simply a way of structuring out thoughts.

Distrust dogmatic statements about the macroeconomy.

3. The Demand Side

Approaches: Empirical / Theoretical (Micro-founded)

4. Modelling Households

Household spending consists of:

1. Non-durable consumption (Consumption)
2. Durable consumption (Investment)
3. Housing (Investment)

Heterogeneity: each household could make its consumption decision differently

The Representative Agent: assume that the decision of a single household can be used to represent the aggregate behaviour of all households in the economy (I.e. ignore heterogeneity)

5. The Permanent Income Hypothesis PIH

I. Descriptions

-Individuals optimally choose how much to consume by allocating their resources across their lifetimes

-Resources include: assets, current income, and future income

-This is a forward-looking decision and will depend on interest rates, asset values, expectations of future incomes, expectations of future taxes…

-The result is that optimal consumption is smooth compared with income

II. Assumptions

1. Representative Agent
2. Infinite Lifetime

   Actually not a crazy assumption as individuals' wealth can be inherited
3. Forward-looking Behaviour
4. Log Utility
5. Access to Borrowing and Saving (Not credit constrained)

   Note that access to borrowing and saving are not the same, and they have different effects on our analysis
6. Constant IR

   Generally, not reasonable.

   People need to forecast IRs in the future, which provides a channel for monetary policies such as forward guidance.
7. Computational Ability

   People have bounded rationality and reliable long-horizon forecasting of idiosyncratic incomes is not possible
8. …(See each specific section)

III. The Utility Function

$$U_t = \sum_{i=0}^{\infty} \frac{1}{(1+\rho)^i} \log c_{t+i}^e$$

c_{t+i}^e is the expected consumption at t+i

ρ is the discount factor

Points to note:

-The property of the utility function which means optimal consumption is smooth is Diminishing Marginal Utility

-Infinite lifetime

-Time-separable utility: Utilities on different days are independent

-$Expected\ marginal\ utility\ of\ consumption\ at\ t+i = \frac{1}{c_{t+i}^e}$

IV. The Budget Constraint

$$\sum_{i=0}^{\infty} \frac{1}{(1+r)^i} c_{t+i}^e = (1+r)a_{t-1} + \sum_{i=0}^{\infty} \frac{1}{(1+r)^i} y_{t+i}^e$$

LHS: Present Value of Expected Lifetime Consumption

= RHS: Present Value of Expected Lifetime Income

r is the real interest rate

a^{t-1} is the assets accumulated in the past

y_{t+i}^{e} is the expected after-tax income at t+i

V. Solving for Optimal Consumption

$$\max_{\{c_{t+i}\}_{i=0}^{\infty}} \sum_{i=0}^{\infty} \frac{1}{(1+\rho)^i} \log c_{t+i}^{e} \; s.t. \; \sum_{i=0}^{\infty} \frac{1}{(1+r)^i} c_{t+i}^{e} = \psi_t^e = (1+r)a_{t-1} + \sum_{i=0}^{\infty} \frac{1}{(1+r)^i} y_{t+i}^{e}$$

Households choose consumption to maximise their lifetime utility subject to the budget constraint.

Solving this, we get the Euler equation: $c_t = c_{t+1}^{e} = c_{t+1}^{e} = \cdots$ i.e. consumption is smoothed

(To get this we also assume that $\rho = r$)

Substituting the Euler equation into the budget constraint gives:

$$c_t = \frac{r}{1+r} \psi_t^e$$

$$\psi_t^e = (1+r)a_{t-1} + \sum_{i=0}^{\infty} \frac{1}{(1+r)^i} y_{t+i}^{e}$$

$$c_t = \frac{r}{1+r} [(1+r)a_{t-1} + \sum_{i=1}^{\infty} \frac{1}{(1+r)^i} y_{t+i}^{e}] + \frac{r}{1+r} y_t$$

Individuals choose their consumption to be the level at which they can keep it constant over time, given what they currently expect about their future income.

They save if current income > current PIH consumption

They borrow if current income < current PIH consumption

VI. Implications

Consumption is not affected by predictable changes in income.

What changes consumption? News, wrong expectations…

The Marginal Propensity to Consume (of temporary changes in income):

$MPC_{temp} = \frac{r}{1+r}$

If current income y_t increases unexpectedly by 1 unit, lifetime wealth ψ_t^e increases by 1 unit, and consumption increases by $\frac{r}{1+r}$

The Marginal Propensity to Consume (of permanent changes in income):

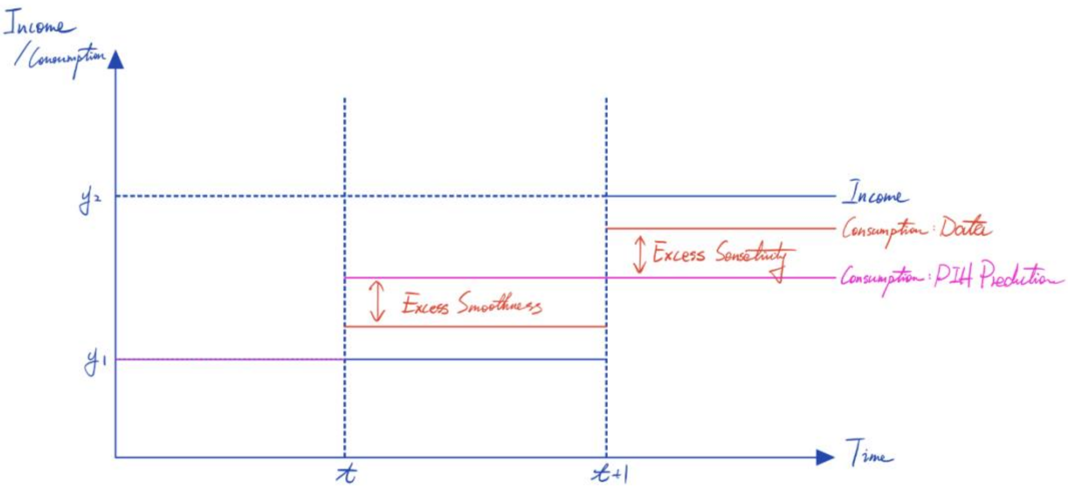
$MPC_{perm} = 1$

If all (current and future) incomes increase unexpectedly by 1 unit, lifetime wealth ψ_e^t increases by $\frac{1+r}{r}$ unit, and consumption increases by 1 unit.

VIII. Summary

(Some of) Assumptions: Representative agent, Infinite lifetime, Forward-looking behaviour, Log utility, Access to borrowing and saving…
Implications: Consumption smoothing, Expectations of future income determine consumption today, Temporary changes in income have a small impact on consumption, Permanent changes in income have a 1:1 impact on consumption, Implications for fiscal policy (Week 2 & 7)

6. Testing the PIH



News about an increase in income from y_1 to y_2 at time t.
Assume before the news arrives, $c_1 = y_1$ (Assume $a_0 = 0$)
Excess Smoothness:

PIH prediction: news about a change in future income should lead to an immediate shift in consumption.

Real data: consumption is sluggish in responding to news

Excess Sensitivity:

PIH prediction: predictable changes in income should have no effect on current consumption

Real data: consumption changes by around 30%

Week 2: The Demand Side II: the Investment-Saving Curve (IS)

1. "Hand-to-Mouth" Behaviour

There is evidence that some households simple consume their current income.
Reasons for HTM behaviour:

-Poor: Purchasing necessities

-Rich: "Wealthy HTM" – need to pay back existing debt and spend all their income

-Impatience

-Credit Constraints (Unable to borrow): want to consume more but cannot borrow, so look like HTM

Consumption of households who follow HTM: $c_t^{HTM} = y_t$

Consumption of households who follow PIH:

$$c_t^{PIH} = \frac{r}{1+r}[(1+r)a_{t-1} + \sum_{i=1}^{\infty} \frac{1}{(1+r)^i} y_{t+i}^e] + \frac{r}{1+r} y_t$$

Therefore, if a proportion of α households follow PIH, aggregate consumption is:

$$c_t = \alpha c_t^{PIH} + (1-\alpha) c_t^{HTM}$$

$$c_t = \alpha \widetilde{c_0} + \left[\alpha \cdot \frac{r}{1+r} + (1-\alpha)\right] y_t$$

This is consistent with the Keynesian consumption function: $c = c_0 + c_y y$, but we would like to use PIH to investigate the component of MPC.

If all people follow HTM, $MPC = 1$

If all people follow PIH, $MPC \approx 0$

Therefore, $Aggregate\ MPC \approx Fraction\ of\ people\ following\ HTM$

*Empirical positive correlation between inequality and MPC.

2. Pre-Tax and Post-Tax Income

In all discussions above, y represents disposable income / after-tax income.
If instead y represents pre-tax income, we need to replace y with $(1-t)y$ in all derivations where t is the proportional tax rate.

i.e. the Keynesian consumption function would be $c = c_0 + c_y(1-t)y$

$MPC = c_y(1-t)$

Lifetime wealth would be: $\psi_t^e = (1+r)a_{t-1} + \sum_{i=0}^{\infty} \frac{1}{(1+r)^i}(1-t_{t+i}^e) y_{t+i}^e$

When should we consider tax?

Unnecessary to consider tax: when considering consumption in isolation

Necessary to consider tax: when thinking about consumption in terms of macroeconomy

3. The Multiplier

Definition: $Multiplier = \frac{\Delta y}{\Delta z}$ where z is some exogenous variable

This measures "how much does output change as a result of an exogenous change in z"

e.g. Government spending multiplier $\frac{\Delta y}{\Delta g}$

This is hard to estimate because of reversed causation – government spendings both react and affect output

Data from different periods might not be comparable.

A rough rule of thumb is the government spending multiplier in normal times is between 0 and 1.5.

There are some evidence of negative multipliers – "expansionary fiscal contractions."

Application: Multiplier in Theory

Derivation:

We do not consider interest rate r here.

Take the consumption function: $c = c_0(\Lambda_c) + c_y(\Lambda_y)(1-t)y$

Substituting it into the aggregate demand equation:

$$AD = c + i + g = c_0 + c_y(1-t)y + i + g$$

Assume the goods market clears, so $y = AD$

Then, $y = c_0 + c_y(1-t)y + i + g$

$$[1 - c_y(1-t)]y = c_0 + i + g$$

$$y = \frac{c_0 + i + g}{[1 - c_y(1-t)]}$$

Therefore, theoretically, the government spending multiplier is:

$$\boldsymbol{\frac{\Delta y}{\Delta g} = \frac{1}{1 - c_y(1-t)}}$$

Another way to derive:

The sum to infinity of a geometric progression:

An initial 1 increase in government spending will incur a change in output:

$$1 + 1 \times c_y(1-t) + 1 \times [c_y(1-t)]^2 \ldots = \frac{1}{[1 - c_y(1-t)]}$$

If most agents follow HTM:

$c_y = 1 \rightarrow Multiplier \approx \frac{1}{t}$ The multiplier is large.

If all agents follow PIH:

$c_y = \frac{r}{1+r} \rightarrow Multiplier = \frac{1}{1 - \frac{r}{1+r}(1-t)} \approx 1$ The multiplier is small.

4. Firm's Investment

Definition: spending on goods that yield stream of future services.

Examples: Firms: machines, equipment, structures, inventory;

Households: housings, durable goods

I. Tobin's Q Theory

Firms choose the level of their capital stock to maximize their value:

$$\max V = \sum_{t=0}^{\infty} \frac{d_t^e}{(1+r)^t} \quad s.t. \quad d_t + i_t = af(k_t)$$

Here, the firm's value is the present value of shareholders' dividends.

d_t is the dividend at time t

i_t is the investment at time t

Capital depreciates overtime at rate δ

The marginal benefit of investing 1 unit of revenue is:

$$MB = \frac{\alpha f_k}{1+r} + \frac{1-\delta}{(1+r)^2} \alpha f_k + \cdots$$

This is defined as ***Tobin's q***. Simplifying this:

$$Tobin's\, q = MB = \frac{\alpha f_k}{r+\delta}$$

The marginal cost of investing 1 unit of revenue is:

$$MC = 1$$

Setting the MB=MC:

$$q = MB = \frac{\alpha f_k}{r+\delta} = 1$$

The value of q determines a firm's investment decision:

$q = 1$	MB = MC	$k = k^*,\ i = i^*$
$q > 1$	MB > MC	$k < k^*,\ i > i^*$
$q < 1$	MB <MC	$k > k^*,\ i < i^*$

At the steady state, $i = \delta k^*$.

**i is the investment in each period; $i > i^*$ implies the firms (optimally) invest more than in the steady state.

Determinants of investment:

	q or MB	Investment
$r \uparrow$	$\downarrow$	$\downarrow$
$\delta \uparrow$	$\downarrow$	$\downarrow$
$\alpha \uparrow$	$\uparrow$	$\uparrow$

Future values of these variables will have similar effects on $q = MB$ and investment decisions

	q or MB	Investment
$Future\ r \uparrow$	$\downarrow$	$\downarrow$
$Future\ \delta \uparrow$	$\downarrow$	$\downarrow$
$Future\ \alpha \uparrow$	$\uparrow$	$\uparrow$

Predictions of q theory:

1. Investment by firms is sensitive to the real IR

   In reality, the negative relationship is weak or there is no relationship.

This may subject to measurement issues since firms face different IRs.

2. Investment by firms is largely independent of current cashflow.
   In reality, investment is sensitive to cashflow because they are credit constrained.

**Investment decisions could also be simply based on "animal spirits."

Keynes, GT: "a large proportion of our positive activities depend on spontaneous optimism rather than on a mathematical expectation"

Firms do not have accurate expectations of the technology level or marginal product of capital.

II. Average Q

Tobin's q is hard to measure, so sometimes we use Average Q.

$Average\ Q = \frac{Stock\ Market\ Value\ of\ the\ Firm}{Replacement\ Cost\ of\ Capital}$

Under certain conditions (perfect competitions) $Tobin's\ q = Average\ Q$

Average Q can be used to judge whether the stock market is under/overvalued.

If $Q > 1$, possibilities are:

1. Overvaluation of stocks
2. Firms are irrational
3. Mis-measured capital

5. Household's Investment

1. Consumer durables
   -purchase produces a stream of utility in the form of future services
   -often funded with debt.
   -easily deferred if debt is hard to obtain
   -negatively related to interest rates
2. Housing
   -purchase produces a stream utility in the form of future housing services
   -usually funded with debt (mortgages); negatively related to interest rates
   -outside option is renting

Both are sensitive to IR.

6. Goods Market Equilibrium: The IS Curve

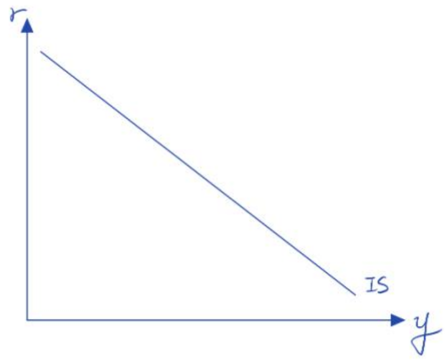
I. The IS Curve

In a closed economy, $ad = c + i + g$

The demand side is summarised by the IS curve, a relationship between current real IR and current income.

Consumption is influenced by real IR and current output: $c_t = c_p(\Lambda_c) + c_y(\Lambda_c)y_t + c_r(\Lambda_c)r_t$

where Λ_c are variables that determine non-durable consumption.
Similarly, Investment: $i_t = i_0(\Lambda_i) + i_y(\Lambda_i)y_t + i_r(\Lambda_i)r_t$
Assume goods market equilibrium: $y = ad$



A fall in IR causes IR sensitive components of consumption and investment to rise, therefore increase output directly.
The multiplier process will increase output further.

II. Good Market Equilibrium

On the curve: $y = Ad$
Above the curve: $y > AD$
Below the curve: $y < AD$
**Adjustment when not in equilibrium:

Channel 1: Through Firms: If the economy is above the IS curve, $y > AD$, which means firms are producing more than they are selling, piling up inventories. Realized this, firms will cut their production.

Channel 2: Through the Financial Market: Ignoring government spendings, $y = c + i$, which means $i = y - c$. i.e. Investment is equal to saving on the IS curve. Above the IS curve, investment will be less than saving, and IR will fall to clear the financial market.

III. Rotation and Shift of the IS Curve

Keep in mind that:

$$c_t = c_p(\Lambda_c) + c_y(\Lambda_c)y_t + c_r(\Lambda_c)r_t;\ i_t = i_0(\Lambda_i) + i_y(\Lambda_i)y_t + i_r(\Lambda_i)r_t$$

What determines the slope of the IS curve?

-The IR sensitivity of non-durable / durable consumption, and housing investment of households, and investment by firms.

-The size of the multipliers for consumption and investment.

What shifts the IS curve?

-Changes in Λ_c, Λ_i

-Changes in g (Exogenous government spendings)

**An increase in asset prices tend to increase consumption and investment, and there will be a multiplier effect (shift IS to the right) [More in lecture 8]

IV. The IS Curve and Policy

Monetary policy: change in IR -> movement along IS curve (effects depend on the slope) [More in lecture 6]
Fiscal Policy: change government spending g -> shifting IS curve (effects depend on the multiplier) [More in lecture 7]

***Algebra of IS Curve: (PS1Q2)*

Assumption: both consumption and investment depend on current income

$$c = c_0 + c_y y + c_r r; i = i_0 + i_y y + i_r y$$

$$ad = c + i + g = (c_0 + i_0) + (c_y + i_y)y + (c_r + i_r)r + g$$

Assume market clearing: $y = ad$

$$y = (c_0 + i_0) + (c_y + i_y)y + (c_r + i_r)r + g$$

Rearrange: $y = \frac{c_0+i_0+g}{1-(c_y+i_y)} + \frac{c_r+i_r}{1-(c_y+i_y)} \cdot r$

The intercept $\frac{c_0+i_0+g}{1-(c_y+i_y)}$ is positive as the MPC, MPI $c_0, i_0 > 0$ and $c_0 + i_0 < 1$. The slope $\frac{c_r+i_r}{1-(c_y+i_y)}$ is negative as $c_r, i_r < 0$.

Week 3: The Supply Side: the Wage Setting (WS), Price Setting (PS), and Phillips Curve (PC)

1. Introduction of the Supply Side

Production function: $y = \alpha f(k, n)$

Assume capital and aggregate productivity (a measure of the technological level) only change slowly, so we can neglect them for analysing the business cycle.

We ***assume away*** links between the demand and supply side:

-An increase in real IR -> increase in capital stock k, increase in technology α

-Tax on labour -> Labour supply decreases

…

2. Classical Model: Perfect Competition Labour Market

Assumptions

-No market power / Small agents -> i.e. everyone is a price taker

-Complete contracts with exact terms

-Complete information (perfectly symmetric information)

**Not likely to hold in real labour markets

Labour Demand

-Firms maximising profits

-The real wage paid = the marginal product of labour MPL

-Diminishing MPL -> downward sloping labour demand curve

Labour Supply

-Individuals maximizing utility

-Tradeoff between disutility of work and utility of income (-> consumption)

$u(c, l)$: $c \rightarrow consumption$; $l \rightarrow leisure$

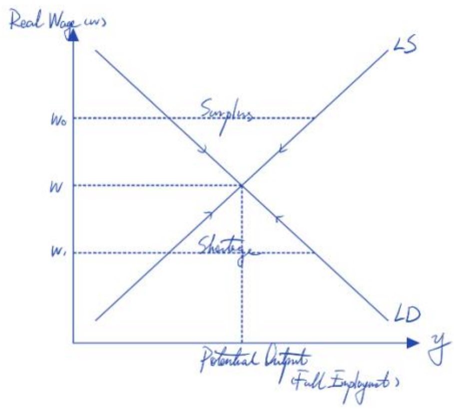
-A rise in the real wage will lead to:

-Income effect: l increases, quantity of labour supplied decreases

-Substitution effect: opportunity cost of leisure increases, quantity of labour supplied increases

-Assume substitution effects dominate income effects -> upward sloping labour supply curve

Equilibrium in the perfectly competitive labour market



Prices and wages are flexible, so the labour market always clears at the "full employment" and "potential output"

Unemployment at equilibrium is purely voluntary.

This level of output is optimal for the economy (maximized welfare). Therefore, policymakers can do nothing.

3. Imperfect Competition Labour Market: WS/PS

I. Features

Incomplete Contracts:

-Firms cannot observe workers' effort, so they have to pay workers a real wage higher than the reservation wage to encourage them to exert effort. (A real wage at which workers are indifferent between work and shirk)

-The lower the unemployment rate, the higher this wage must be, since workers will be less worried of being fired.

Workers with Market Power:

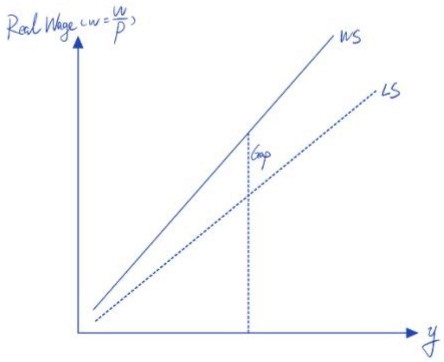
-Market power can either arise due to unions or differentiated skills

-Either of these will make it hard for employers to replace workers, and workers will ask for a wage higher than their reservation wage

-Unemployment is a measure of the bargaining power workers have

(When employment is low, workers have more bargaining power, hence able to obtain a higher real wage)

II. The Wage Setting Curve



$\boldsymbol{WS\ Curve: w = \frac{W}{P} = 1 - \alpha u + z}$

α is a constant

W is nominal wage

P is nominal price level

u is unemployment rate

z includes other factors (e.g. taxes)

In practice, although workers and firms care about the real wage, all wages are set in nominal terms.

The WS curve lies above LS curve, so there is always unvoluntary employment in a imperfectly competitive labour market.

The gap between WS and LS is a measure of the degree to which the assumptions of perfect competition fail to hold.

**2 Reasons why the WS curve always lies above LS curve:

-Bargaining power

-Efficiency wage

III. The Price Setting Curve

Price Setting Behaviour:

Under perfect competition, there is no markup: $P = MC$

Under imperfect competition, firms charge a markup: $P = (1 + \mu)MC$

μ is the markup of the firm

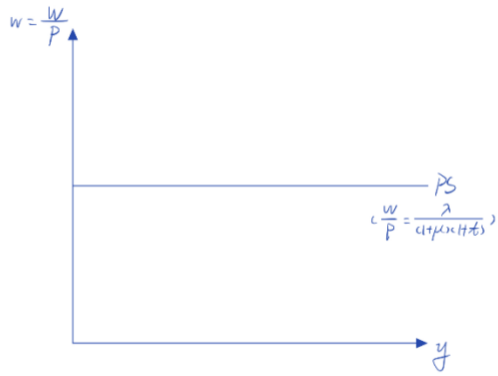
MC is the nominal marginal cost of labour: $MC = \frac{(1+t)W}{\lambda}$

t is the proportional tax rate paid by the firm

λ is marginal product of labour, assumed to be independent of output

Then, $\boldsymbol{PS\ Curve: w = \frac{W}{P} = \frac{\lambda}{[(1+\mu)(1+t)]}}$

WS Curve:



Properties:

-Horizontal by assumption (λ is independent of output)

-PS shifts if:

-The marginal product of labour λ changes

-The markup μ changes

-The tax rate t changes

-Anything else that takes a share of marginal product of labour changes

-PS always lies below LD, and the distance between PS and LD shows the degree of firms' market power.

IV. Aggregation

Wage Setting:

-Workers and firms agree on a specific nominal wage W^f

-The aggregate nominal wage can be calculated by summing over all firms

$W = \sum_f W^f$

Price Setting:

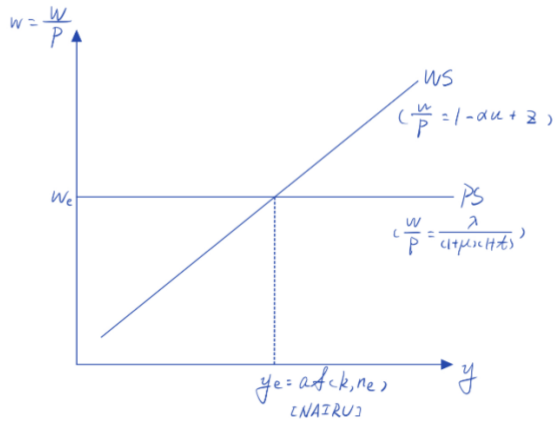
-Firms set the price of their own good P^f

-The aggregate nominal price level (corresponding to the CPI) can be calculated by summing over all firms

$P = \sum_f P^f$

**In terms of methodology, PS curve is micro-founded as it solves an optimisation problem facing every individual employer. We have not derived the micro foundation of the WS curve (one could in principle derive it). On the other hand, the classical model of perfectly competitive labour market is fully micro founded. [More about differences between classical and WS/PS --- see PS1 Q3]

V. Equilibrium



$$WS\ Curve: w = \frac{W}{P} = 1 - \alpha u + z$$

$$PS\ Curve: w = \frac{W}{P} = \frac{\lambda}{[(1 + \mu)(1 + t)]}$$

Properties:

-The equilibrium output is where PS and WS are consistent

-The equilibrium output corresponds to the Non-Accelerating Inflation Rate of Unemployment (NAIRU)

-At equilibrium, there is both voluntary and involuntary unemployment

-Changes in exogenous variables will shift the WS/PS curve, hence change the equilibrium output

-This is a stationary but unstable equilibrium: if the market is not in equilibrium, there will be no market force adjusting it back to equilibrium

Equilibrium Output y_e:

-Negatively related to tax rates: $t \uparrow PS \downarrow y_e \downarrow$

-Negative related to oil prices: $O_{oil} \uparrow PS \downarrow y_e \downarrow$

VI. More on Efficiency Wages

Higher wages firms benefits as well as costs

Reasons:

-Better nutrition of workers -> Higher productivity

-Fairness/Morale -> Gift exchange

-Less adverse selection

-Less moral hazard (shirk less)

4. Price and Wage ("Nominal") Stickiness

Sticky prices: prices are generally more flexible than wages. A rough estimate of the average time interval between price changes is 3 quarters or 1 year.

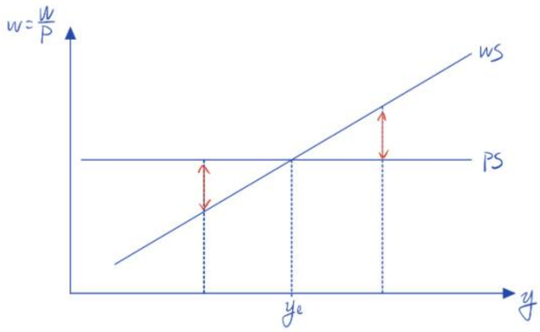
Sticky wages: most wages are specified by periodic contracts, either formally with annual union-bargaining rounds or informal bargains

Some ***further assumptions*** we made in the following discussion:

- "Sticky Wages": Wages are set for one period in advance and cannot be changed during the period.
  - Then the Wage Setting curve is: $W = P^e(1 - \alpha u + z)$

    Where P^e is the expected price level.
- "Flexible Prices": prices are flexible so firms can change prices whenever they want
  - This implies that the economy will always be on the PS Curve

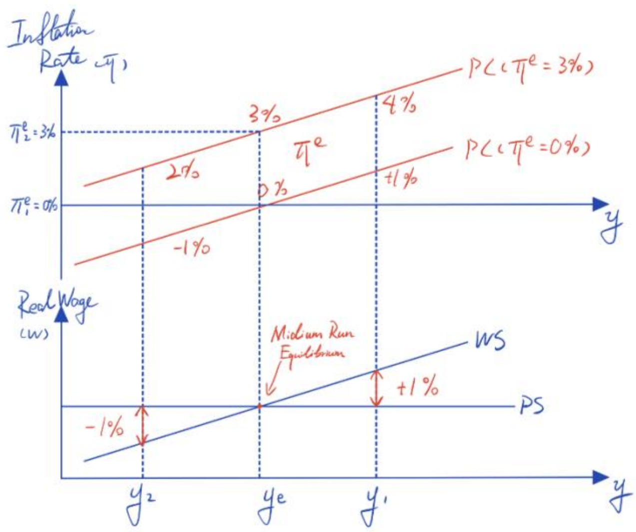
Therefore, unless the economy is at equilibrium, workers will get a real wage different from what they expect



5. The Philips Curve

I. Deriving the Phillips Curve: Relationship between y and π

Expected inflation is treated as exogenous



Expected inflation = 0%			
	y_e	$y_1 > y_e$	$y_2 < y_e$

Wages	0%	1%	-1%
Prices	0%	1%	-1%

Expected inflation = 3%			
	y_e	$y_1 > y_e$	$y_2 < y_e$
Wages	3%	4%	2%
Prices	3%	4%	2%

II. The Phillips Curve and Expected Inflation

The Phillips Curve can be written as:

$$\boldsymbol{Phillips\ Curve}: \boldsymbol{\pi = \pi^e + \alpha(y - y_e)}$$

There are a family of PCs, with each one corresponding to a particular level of expected inflation.

The only point where $Realized\ \pi = \pi^e$ is the equilibrium point where there is no output gap.

III. The Slope of the Phillips Curve

Period of Calculation

If the period over which inflation is calculated is the same as the period over which wages are set, the PC curve will be parallel to the WS curve.

If wages are set less frequently than inflation is calculated, the PC will be flatter than the WS curve.

If wages are set more frequently, the PC curve will be steeper than the WS curve.

The limiting/extreme case:

Perfectly flexible wages -> Vertical PC curve with output always at y_e

If prices are sticky as well as wages, the PC curve will be flatter than with only wage stickiness.

IV. Further Assumptions on Timing and Expectations

Timing:

We assume events happen in the following order in each period:

-Expectations are updated

-Nominal wages are set

-Knowing this wage, firms set their prices

-The economy stays on the PS curve and (generally) off the WS curve

Expectations:

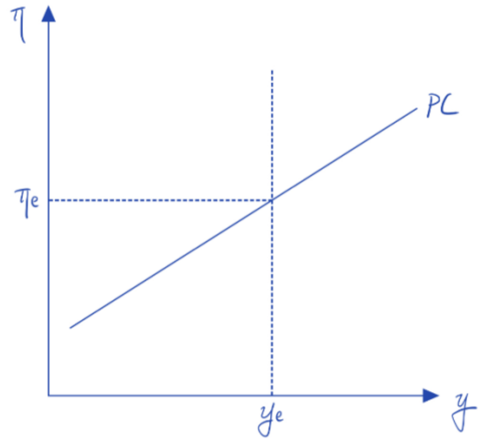
We only consider the case where there are "adaptive expectations": expected inflation in the next period will be equal to current inflation.

$\pi_{t+1}^e = \pi_t$

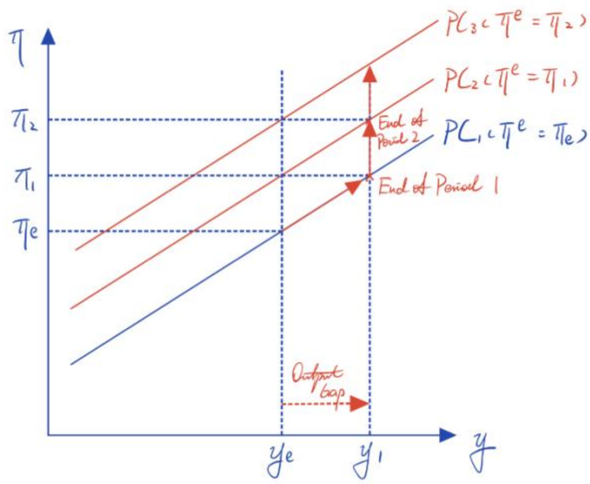
[More types of expectations will be discussed in Lect. 5]

V. The Economy without Policy

At equilibrium output:



Away from the equilibrium output:



6. Is the Economy Unstable without Policy?

Perfect Competition:

"Classical mechanisms" / price mechanisms will always adjust the economy to the equilibrium point.

**Supported by Hayek

Imperfect Competition (WS/PS model):

Potential auto stabilizing mechanisms:

-High expected real wages could lead to entry into the labour force

-Expectations: if workers consistently get a lower real wage, they may change their way of forming expectations [More in lect. 5]

Week 4: Macroeconomic Dynamic: Monetary Rule (MR) Curve and the 3-Equation Model

1. What Do Central Banks Do?

Bank of England (BoE): price stability (defined by the government's inflation target) and support the government's economic policy, including its objectives for growth and employment.
Federal Reserve (Fed): maximum employment, stable prices, and moderate long-term IR… an average 2% inflation
European Central bank: "a high level of employment" and "sustainable and non-inflationary growth"

2. The Tools of Monetary Policy

Before 1980s: Controlling money supply
Today: Controlling overnight nominal interest rate
"Exotic" / Unconventional instruments: Quantitative easing (QE)
Other things central banks do: hold gold & reserves, keep financial stability, etc.

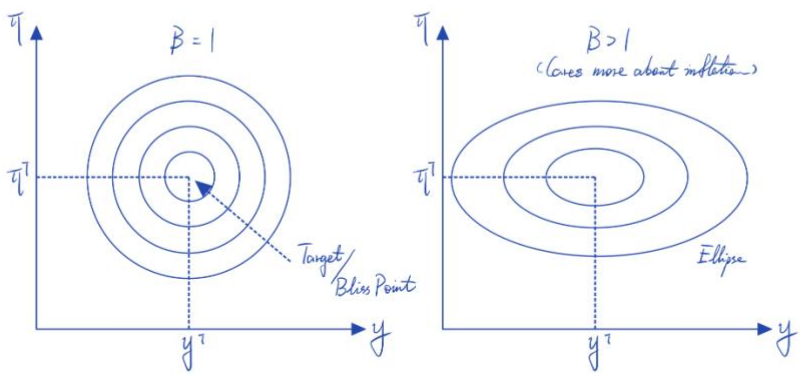
3. Modelling a Central Bank

I. Central Bank's Loss Function & Indifference Curve

Inflation and output targets given by the government: π^T, y^T
The central bank cares about deviations from these targets, so we can write its loss function as:

$$Central\ Bank's\ Loss\ Function: L = (y - y^T)^2 + \beta(\pi - \pi^T)^2$$

where B is the Weight on Inflation.
The central bank prefers small L.
The central bank's indifference curves: $L = (y - y^T)^2 + \beta(\pi - \pi^T)^2$



II. What Constraints Policy Choices?

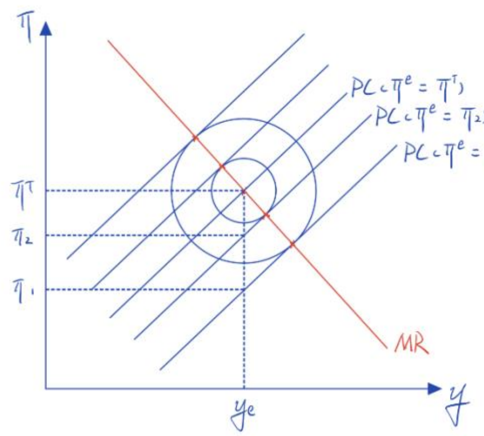
In general: the zero lower bound, the structure of the economy
In the model: the Phillips curves, the target inflation & output
Now assume the central bank's target output is equal to the equilibrium level of output [will be justified in Lect. 5]

$$y^T = y_e$$

The central bank's problem is then to minimise its loss function subject to the trade-off between inflation and output.

III. Deriving the Monetary Rule (MR) Curve

For each Phillips curve, the tangent point with the indifference curves is the optimal point for the central bank:



Properties of the MR curve:
The MR curve shows the path along which the central bank will guide the economy to reach the point of medium-run equilibrium. $y^T = y_e, \pi^T$
MR curve always passes through the target/bliss point.
Slope:

If β is higher, which means the central bank cares more about inflation (more averse to inflation), the MR curve will be flatter.

If β is lower, which means the central bank cares more about inflation (less averse to inflation), the MR curve will be steeper.

If β is zero, which means the central bank only cares about growth, the MR curve will be vertical.

Shift:

Only changes in inflation & output targets will shift the MR curve.

4. Tools, Lags, and Forecasting

I. Central Bank's Influence on Output

The CB sets the nominal IR ι

$\Downarrow$ Real IR r is determined by the Fisher's equation: $\iota = r + \pi^e$

$\Rightarrow$ Influences consumption c

$\Rightarrow$ Influences investment i

$\Downarrow$ Influence aggregate demand ad

$\Downarrow$ $y = ad$ (IS curve)

II. Lag & Forecasting

It takes time for a change in IR to affect aggregate demand and hence output.
To model this, we assume that the central bank can only affect aggregate demand in the next period. (1 period lag) Therefore, the central bank must forecast where the economy will be in the next period, specifically the PC and IS curves.

5. The Three-Equation Model

I. Introduction: IS/PC/MR

Investment-Spending (IS) Curves: the Demand Side

$$(If\ both\ c, i\ are\ function\ of\ y, r:)y = \frac{c_0 + i_0 + g}{1 - (c_y + i_y)} + \frac{c_r + i_r}{1 - (c_y + i_y)} \cdot r$$

$y = ad = c + i + g$

$c \rightarrow$ consumption

$i \rightarrow$ investment by firms

$g \rightarrow$ government spending

**Wage-Setting / Price-Setting (WS/PS) Curve: the Supply Side

Wage setting behaviour by firms & workers: $WS\ Curve: w = \frac{W}{P} = 1 - \alpha u + z$

Price setting behaviour by firms: $PS\ Curve: w = \frac{W}{P} = \frac{\lambda}{[(1+\mu)(1+t)]}$

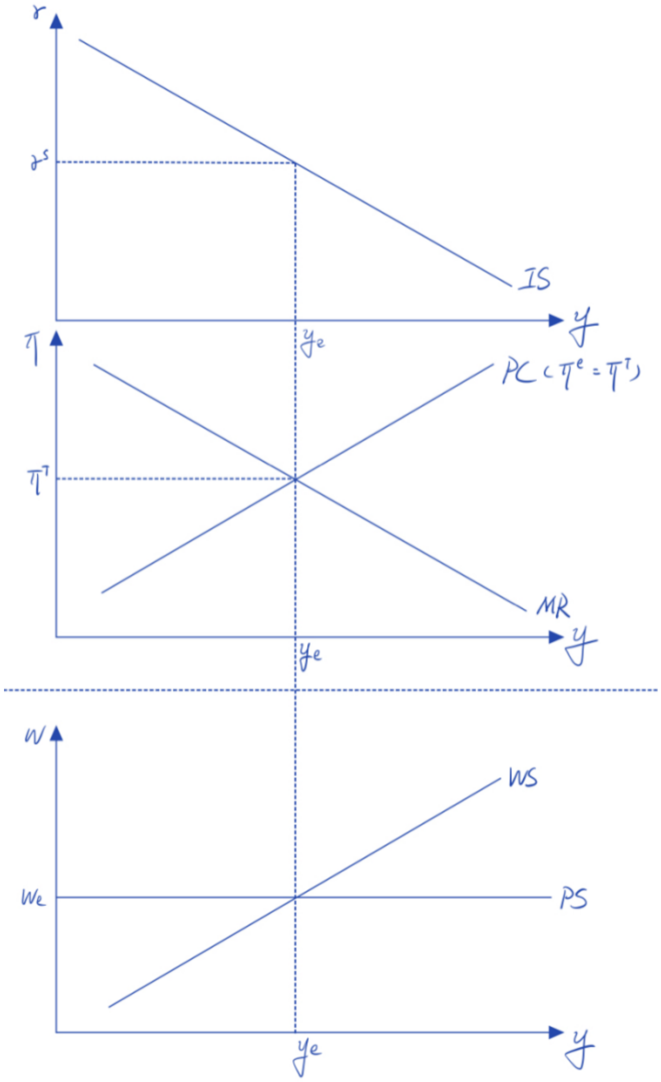
(Imperfectly competitive labour market)

Phillips Curve (PC): A Summary of the Supply Side

$$\pi = \pi^e + \alpha(y - y_e)$$

Summarising the supply side with nominal stickiness

Monetary Rule (MR) Curve: Optimal Monetary Policy



II. The Medium-Run Equilibrium (MRE)

At the Medium-run Equilibrium:
$y = y_e; \pi = \pi^T; r = r^s (Stabilizing\ Rate\ of\ Interest);$
$\iota \approx r^s + \pi^T (Fisher's\ Equiation)$

$\Delta W = \pi^T; w = \frac{W}{P} = \frac{\lambda}{(1+\mu)(1+t)}\ (Constant)$

** We continue to assume adaptive expectations here. i.e. $\pi_t^e = \pi_{t-1}$

III. Timeline

Period starts
⇓ The pervious period's IR r changes affect output y
⇓ Shocks happen
⇓ Expectations of inflation for this period π_t^e are updated (PC shifts)
⇓ Nominal wages W are set (WS Curve)

⇓ Firms set nominal prices P as a markup over the nominal wage (PS Curve)

⇓ The economy is on the IS and PC curve

⇓ If the economy is not on the medium-run equilibrium:

↓ The CB forecasts the PC in the next period by working out the inflation expectation of the next period π_{t+1}^{e}.

↓ This implies the level of output y it must choose to get on its MR curve in the next period

↓ The CB then forecast the IS curve in the next period

↓ Using the forecasted IS curve, the CB find the IR r it must set to achieve output y

↓ The CB sets nominal IR ι with the Fisher's equation (ι, r respond instantly with the shock, but can only influence the output in the next period)

******Some Notes about Answering Questions with the 3-Equation Model:***

-Always start from the MRE

-Closely follow the timeline

-Draw the time paths of y, π, r

Week 5: Expectations and the Effectiveness of Policy

1. Where Do We Use Expectations?

Phillips Curve: Expected Inflation π^e

WS/PS curve

IS Curve: PIH / Q theory: Expected $r, y\ldots$

MR Curve: Expected PC, IS

2. Different Ways of Forming Expectations

Three ways of forming expectations:

-Static: $\pi_t^e = \bar{\pi}\ (constant)$

-Adaptive: $\pi_t^e = \pi_{t-1}$

-Rational: agents use all information at their disposal, not making systematic errors

How to choose?

-Benefits: accurate decisions -> better decisions

-Costs: time / effort / monetary spendings

I.a Static Expectations

$\pi_t^e = \bar{\pi}$

This implies that the Phillips curve is: $\pi_t = \bar{\pi} + \alpha(y - y_e)$

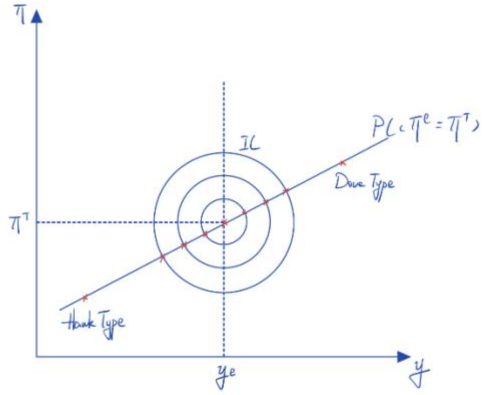
And there is long run trade-off between inflation and output.

Eg. UK inflation 1914-1940

During this period, inflation generally had a mean of 0 and there are random "white noise shocks."

** Philips (1958) *Economica*: "The Relationship between Unemployment and the Rate of Change of Money Wages in the United Kingdom 1861-1957" (Single PC)

I.b Policy Implications of Static Expectations



The MR curve does not exist since deriving it requires a family of PCs.
Policymakers can choose any point on the single PC, and their choice depends on their preferences over output and inflation.
Even in the long run, PC will not shift.

II.a Adaptive Expectations

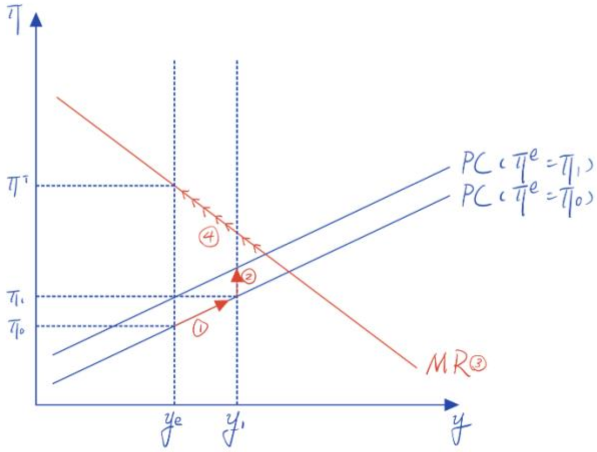
$\pi_t^e = \pi_{t-1}$
PC can shift and there will be a family of PCs.
MR curve exists.
There is inflation-output trade-off only in the short run.
This has no effect on the medium-run equilibrium as it is only determined by the supply side.
Eg. UK inflation 1950-1980

During this period, inflation was always positive, and, from the mid-60s, persistent. As static expectations perform poorly, people switched to adaptive expectations.

** Long-run trade-off represented by a single PC breaks down.
**Prediction of switch in expectation by Milton Friedman, 1968, "The Role of Monetary Policy": "People have been expecting prices to be stable…"; "But the decline ex post in real wages will soon come to affect anticipations."

II.b Policy Implication of Adaptive Expectations

[See discussions in previous weeks, as we all assume expectations to be adaptive before.]
What if policymakers think expectations are static when they are actually adaptive?



Step1: The policymaker recognizes static expectation, targeting $y_1 > y_e$

Step2: This results in inflation $\pi_1 > \pi_0$, causing welfare loss for individuals

Individuals switch to adaptive expectations, shifting PC upwards

(Inflation accelerates if the CB does not react)

Step3: MR curve will appear if CB realizes the adaptive expectation

**Correlation between output and inflation change sign (PC->MR)

The CB will react according to the MR curve and gradually bring the economy towards equilibrium

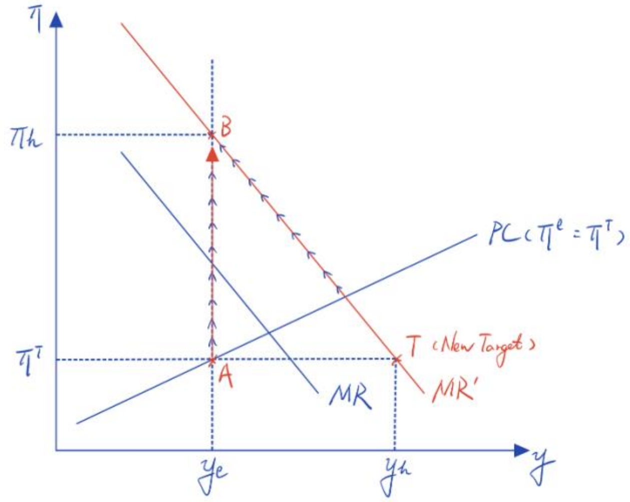
III.a Rational Expectations

Agents forecast using all information at their disposal to minimise errors, not making systematic errors/mistakes. (Rational Expectation Hypothesis)

**Example of Systematic mistakes/errors: People use adaptive expectations when inflation is accelerating

Year	Actual Inflation	Adaptive Expected Inflation	Forecast Error
1	2%	2%	0
2	2%	2%	0
3	3%	2%	-1%
4	4%	3%	-1%
5	5%	4%	-1%
6	6%	5%	-1%

III.b Policy Implication (Ineffectiveness) of Adaptive Expectations



The policymaker announces a higher target output: $(y_e, \pi^T) \rightarrow (y_h, \pi^T)$

*If individuals are having adaptive expectations: PC will shift upwards year by year until point C is reached, and there will be welfare loss during this process as realized inflation will always be higher than expected inflation.

If people have rational expectations, the economy will change from (y_e, π^T) to (y_e, π_h) immediately. There will be no change in output and inflation will be higher.

The policy has no real effects on output.

There is no welfare loss is the change is instant.

**Fisher, 1978, JPE: "…policy can only affect (real) output by doing the unexpected" -> New Classical Economics (focus on expectations)

IV. Inflation Bias

A change in target $(y_e, \pi^T) \rightarrow (y_h, \pi^T)$ implies that CB needs to:

$$\min L = (y_t - y_h)^2 + \beta(\pi_t - \pi^T)^2 \quad s.t. \quad PC: \pi_t = \pi_{t-1} + \alpha(y_t - y_e)$$

Solving this problem yields a shift in the MR curve:

$$y_t - y_h = -\alpha\beta[\pi_{t-1} + \alpha(y_t - y_e) - \pi^T]$$

Solving this for $(y_1, \pi_1), (y_2, \pi_2), (y_3, \pi_3)$ …:

$$y_1 = \frac{y_h + \alpha^2\beta y_e}{1 + \alpha^2\beta}; y_e < y_1 < y_h$$

$$\pi_1 = \pi^T + \frac{\alpha(y_h - y_e)}{1 + \alpha^2\beta}; \pi_1 > \pi^T$$

…

Outcome: new MRE:

$$\pi_t = \pi_{t-1} = \pi^T + \frac{y_h - y_e}{\alpha\beta}$$

And the Inflation Bias is:

$$\boldsymbol{Inflation\ Bias} = \frac{\boldsymbol{y_h - y_e}}{\boldsymbol{\alpha\beta}}$$

$$y_h > y_e \Rightarrow Pisitive\ Inflation\ Bias;\ y_h < y_e \Rightarrow Negative\ Inflation\ Bias$$

This applies to both adaptive expectation and rational expectation: the change is year by year $(y_1, \pi_1), (y_2, \pi_2), (y_3, \pi_3) \ldots$ with adaptive expectations while the change is instant with rational expectations.

Policies can do nothing about expanding output eventually but change inflation.

3. Expectations in the Model & Reality

I. Expectations in the Model

To capture the observed persistence in inflation, we put a lagged term in the Phillips Curve:

$$\pi_t = \pi_{t-1} + \alpha(t_t - y_e)$$

This partly represents adaptive expectations, which is the best way of forming expectations if the inflation is persistent. However, there are also other things which may make inflation adjust slowly, such as further nominal stickiness, sticky information, cognitive limitations…

There are also evidence that there is a rational component of expectation. Some announcements of CBs can have immediate effects, so it is better to think the Phillips curve as a mixture of adaptive and rational expectations:

$$\pi_t = \lambda\pi_{t-1} + (1-\lambda)\pi_t^{Rational} + \alpha(y_t - y_e)$$

II. Difficulties of Forming Expectations

The sheer difficulties of forming good expectation in practice:

-Lack of data

**Need repeated experiments, which is not possible in reality

-Constant structural change

-“Deep” uncertainty

**”Black Swans”

III. How Do Individuals Deal with This?

People usually simply use the “rule of thumb”

4. Is Policy Effective in Practice?

I. Why Might Stabilisation Policies Not Work?

Classical Economics: free markets are self-stabilising, so policy interventions can only worsen the economy

New Classical Economics: rational expectations imply that ***anticipated*** policies are ineffective
**Political Economy: question how likely policymakers will: work out what has happened -> decide the correct policy to respond to it -> implement the policy in a timely fashion -> not use policy for short-term ends such as re-election?

II. Destabilising Policies

Most policies effect the economy with time lags. The shock may be very different form period to period. (e.g. IS shifts left in period t, then to the right in period t+1. The government design a fiscal expansion to offset the decrease in AD, while makes the economy overheating in period t+1) Then, the supposedly stabilising policies may be actually destabilising.
Also, policymakers may not be able to distinguish between temporary and permanent shocks.

III. Boltho's Test

5. (Discussion point 2) Transmission of Policies

I. Mechanism by which the central bank announcing an inflation target translates into an actual inflation rate:
CB announces π_T -> If it is credible -> Expectations will be updated to $\pi^e = \pi_T$ -> Employees bargain a higher nominal wage according to the WS curve (with an adjustment for the output gap)-> Firms increase the price level, keeping the economy on the PS curve -> Actual inflation -> If $y = y_e$, $\pi = \pi_T$.
If people have rational expectations and CB has perfect credibility, there will not be a deflationary/inflationary gap as expectations will always be fixed at the target. If the credibility is not perfect, there will be a process in which households gradually change their expectations when they try to work out what is going on… There is possibility of expectation becoming "unanchored" and inflation getting out of control (though vert unlikely in a modern institutional setting).

Week 6: Monetary Policy: Costs of Inflation/Deflation, New Classical Policies, and Monetarism

1. Costs of Inflation/Deflation

I. Costs of Inflation

Inflation is like a tax on holding money, making people less willing hold their assets as money.
Costs:

-Wage and price stickiness -> Menu costs: time and resources used to adjust prices and wages

-Nominal stickiness in general -> Redistribution (between lenders and borrowers, etc.)

-High inflations tend to be more volatile, making it hard for planning (empirical, not theoretical)

-Under hyperinflation, some basic market mechanisms stop working. Switch to other currencies.

II. Costs of Deflation

Costs of deflation $\Leftrightarrow$ Benefit of inflation
Costs:

-Zero-Lower Bound (ZLB) on nominal interest rates & Deflationary Trap 1

People will simply hold cash if nominal IR is below 0

**Abolish cash?

Fisher's Equation: $\iota = r + \pi^e \Rightarrow r = \iota - \pi^e$

Deflationary Trap:

If $\iota = 0$, then $r = -\pi^e$. There will be a positive feedback loop for deflation:

$$\pi^e \downarrow \Rightarrow r \uparrow \Rightarrow y \downarrow, \pi \downarrow$$

Conventional monetary policies can do nothing after hitting the ZLB.

-The Risk of "Debt-Deflation" & Deflationary Trap 2

Deflation increase the value of debt.

Insolvency issues

Deflationary Trap 2:

Deflation $\Rightarrow$ Default on mortgages $\Rightarrow P \downarrow \Rightarrow Real\ Debt\ d = \frac{D}{P} \uparrow \Rightarrow AD \downarrow \Rightarrow y \downarrow, \pi \downarrow$

III. Why Not Target Zero Inflation?

Downward Nominal Wage Rigidities
Individuals are very reluctant to accept a decrease in nominal wage. Hence, the only way to reduce real wages is through positive inflation.

Reduce the Risk of Hitting ZLB

$\iota = e + \pi^e$

For any given real IR, higher inflation means nominal IRs can be cut further before hitting the ZLB.

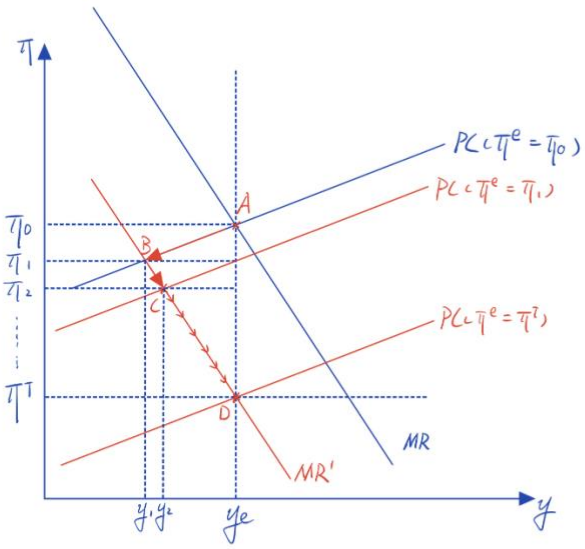
2. Monetary Policy: Disinflation

The Phillips curve with adaptive expectations is $\pi_t = \pi_{t-1} + \alpha(y_t - y_e)$ Therefore, to reduce inflation, policymakers must decrease output. i.e. create a recession. The question is, how deep and how long should this recession be?

Two ends of the spectrum of possibilities: A long shallow recession "Gradualism" or a quick and deep recession "Cold Turkey"

2.1. Gradualist Approach

I. Adaptive Expectation

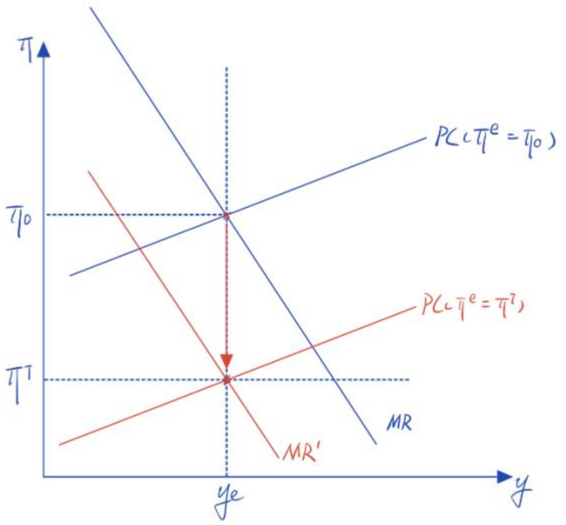


The economy is at point A (y_e, π_0). The CB now targets a lower inflation π^T and would like to use graduate disinflation policies. The MR curve is shifted from MR to MR'. In the first period, the CB creates a recession $y_e \rightarrow y_1$, the economy reacts $A \rightarrow B$. With adaptive expectation, PC shifts downwards. In the next period, $B \rightarrow C$. The process continues until the economy reaches the target point $D: (y_e, \pi^T)$.

With adaptive expectations, credibility of CB is not a problem.

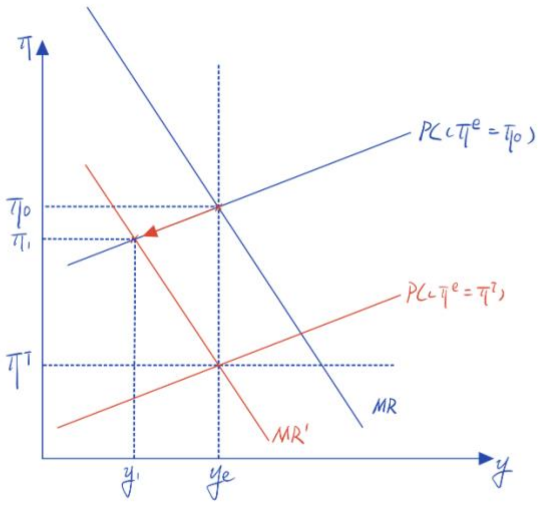
II. Rational Expectation

Gradualist with Perfect Credibility:



If the policy is perfectly credible, with rational expectations, after the CB changes its target, individuals immediately update their expectations. The economy moves to the new target point instantly even if the policymaker takes the gradualist approach. Hence, the disinflation will be costless.

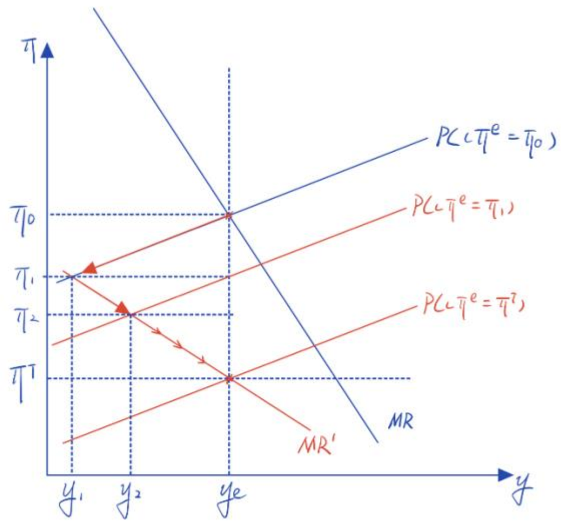
Gradualist with Incredibility:



If the policy is not credible, with rational expectations, after the CB changes its target, individuals will not update their expectations. Consequently, PC will not shift, and the economy will move to (y_1, π_1).

The incredibility may relate to worries about politics (policymakers may not stick to the initial policy).

2.2. "Cold Turkey" Approach



Besides a lower target inflation π^T, the CB also becomes more averse to inflation (β increases). Therefore, MR curve shifts left and becomes flatter. With adaptive expectations, the inflation will be reduced and the target will be reached quicklier. However, there will be a larger recession $y_e \rightarrow y_1$ and unemployment.

3. Monetarism (Pre 3-Equation Model)

I. Framework

During most historical periods, monetary policies focus on setting IR. However, monetarism (popular before the 3-equation model) proposes that there is a direct link between inflation rate and rate of growth of money supply.

Derivation:

$MV = Py$

Where M is money supply; V is the velocity of money circulation; P is the price level; y is output

Taking logs: note $p = \log P$; $m = \log M$; $v = \log V$;

$\Rightarrow p + logy = m + v$

Subtracting last period's value: $\Delta p + \Delta \log y = \Delta m + \Delta v$

Monetarism assumes velocity and output to be constant, so: $\Delta p = \Delta m$

i.e. inflation is always and everywhere a monetary phenomenon.

II. Measures of Money Supply Target

M0 (Narrow Money): $M0 = Currency + Central\ Bank\ Reserves$

M3/M4 (Broad Money): $M3/M4 = M0 + Demand\ Deposits + Saving\ Deposits +$

$Time\ Deposits$

The CB can directly control narrow money M0, but broad money M3/M4 matters for the economy.

III. Monetarism in Practice: UK in the 1980s

Observe the empirical relation between different measures and inflation -> Pick the one that is most closely related -> Use quantity restrictions (credit rationing) to control that

Practice:

1979: Thatcher government was elected with a commitment to reduce inflation: Medium Term Financial Strategy (MTFS) set strict targets for growth of broad money (M3) because it had the strongest relationship with inflation. (The main instrument used is still controlling M1.) This had strong credibility.

The result is a successful disinflation, but it is very costly in terms of unemployment. Besides, M3 target was missed for most of the time and there was not strong relationship between M3 and inflation.

IV. What Went Wrong with Monetarism?

Goodhart's Law: any observed regularity between monetary aggregate and inflation will break down once a central bank tries to exploit it. (Related with Lucas critique)

Reasons:

- -Bank's reaction changed after policy changes: creating new financial products, offering different IRs, etc.
- -Velocity of money circulation could be different
- -Expectations changed

Disinflation was still achieved since controlling money supply is similar to controlling IR.

**There are important open-economy aspects and interactions between fiscal/monetary policies.

4. Pre-Crisis (Pre-2008) Monetary Policy Framework

I. The Instrument: Short-Term Nominal Interest Rate

As monetarism's control over money supply performed poorly, CBs switched to the short-term nominal interest rate (usually the overnight interbank lending rate), and set an inflation forecast as the intermediate target.

II. Taylor Rules

The Taylor Rule is an empirical description of monetary policy:

$$\iota_t = \bar{\iota} + \gamma_1(\pi_t - \pi^T) + \gamma_2(y_t - y_e)$$

Where: $\bar{\iota} = r^s + \pi^T$ is the nominal IR at targets

$(\pi_t - \pi^T)$ is the inflation gap

$(y_t - y_e)$ is the output gap

III. Taylor Principle

The Taylor Principle is a simplified version of the Taylor Rule. We only consider nominal IR's correlation with inflation here.

**Under Taylor rule, for each 1% increase in inflation, the CB tends to raise the nominal IR by more than 1%.

Taylor principle can be derived by using the 3-equiation model:

3 Equations:

$PC: \pi_1 = \pi_0 + \alpha(y_1 - y_e)$

$MR: y_1 - y_e = -\alpha\beta(\pi_1 - \pi^T)$

$IS: y_1 - y_e = -a(r_0 - r^s)$

Suppose an inflationary shock hits the economy at time 0:

Use PC to obtain π_1 and then use MR:

$\pi_0 - \pi^T = (\alpha + \alpha^{-1}\beta^{-1})(y_1 - y_e)$

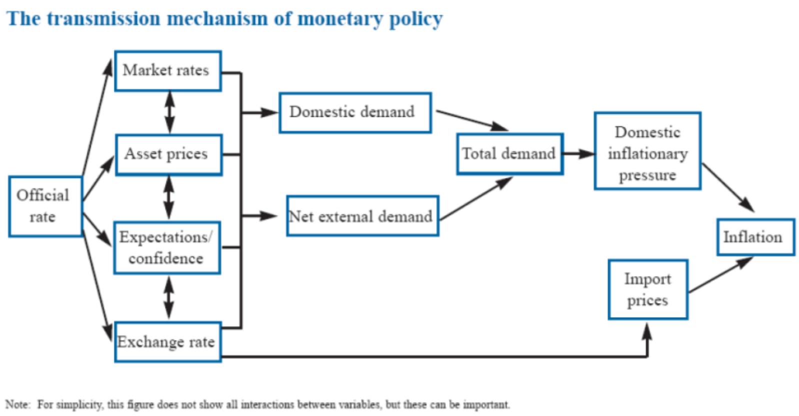
Use IS to relace $(y_1 - y_e)$:

$$r_0 - r^s = \frac{1}{a(\alpha + \alpha^{-1}\beta^{-1})}(\pi_0 - \pi^T)$$

If $a = \alpha = \beta = 1 \Rightarrow r_0 - r^s = 0.5(\pi_0 - \pi^T)$

This implies if inflation π_0 is increased by 1%, the real IR r_0 should be increased by 0.5%, so the nominal IR $\iota = r + \pi^e$ should be increased by 1.5%.

**In reality, the transmission of IR is much more complicated:



Week 7: Fiscal Policy & Government Debt

1. Automatic Stabilizers

Tax

-As the unemployment rate increases, the tax base shrinks, decreasing the tax receipts.

-If the tax rate t is high, the multiplier is small. Therefore, a demand shock will have a small effect on output.

Transfers

-Transfer payments (e.g. unemployment benefits) are inversely proportional to output: transfers will be higher if unemployment is high

Both stabilizers above are automatic, which means they react to shocks without time lags. However, their effect in stabilizing the economy is empirically small.

Reasons

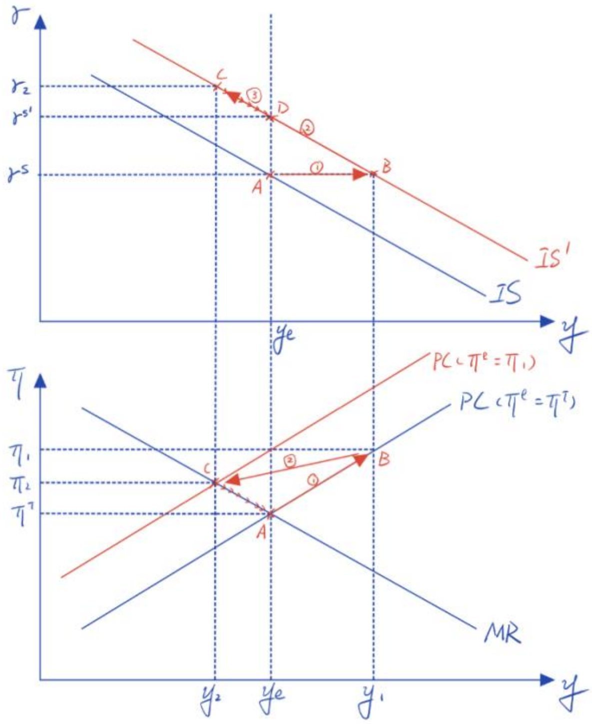
-By definition, automatic stabilizers are temporary. PIH implies temporary income changes can only have a small effect on permanent income and hence on consumption ($\frac{r}{1+r}$). *On the other hand, credit constrained households will react more.

2. Active Stabilisation Policy

Active stabilisation policies include both ***monetary (discussed in Lect. 5) and fiscal policies***. Active stabilisation policies have time lag problems.

“Conventional Assignment” of two types of policies: Use monetary policies for stabilisation while fiscal policies should focus on sustainable government spending. Fiscal policies should be used for stabilisation only in deep crisis and when monetary policies are ineffective. (e.g. post-2007: temporary VAT cut in UK and massive increase in government spending in the US.)

I. Fiscal Policy in the 3-Equation Model



In period 1, the government increases its spending. Experiencing full multiplier effect, the IS curve shifts rightwards $IS \rightarrow IS'$ and the economy moves from $A \rightarrow B$. Output increases $y_e \rightarrow y_1$ and inflation increases $\pi^T \rightarrow \pi^1$.

In the next period, the CB responds to the fiscal policy. As inflation is higher, PC shifts upwards (assume adaptive expectation). If there is no change in MR, the CB sets monetary policy at point C. Specifically, the real IR moves $r^S \rightarrow r_2$, decreasing the output $y_1 \rightarrow y_2$ and decreasing the inflation $\pi_1 \rightarrow \pi_2$. Such process will continue until the output is y_e again.

Medium-Run Crowding Out: Eventually, there will be no change in output, which mean the multiplier is 0.

In between, the effect will depend on the response of monetary policy.

Assumptions behind this Model:

-CB does not change its target

-Increase in government spendings increases AD through the multiplier process. However, under PIH, the response of consumption can offset the increase in government spending. Therefore, we have to assume that the time path of taxes is irrelevant to consumption for a positive multiplier in period 1. [See later sections for detail]

3. Ricardian Equivalence: Fiscal Policy, Government's Debt, and the Permanent Income Hypothesis

I. The Government's Budget Constraint

The government's budget constraint (includes both fiscal authority and the CB) is:

$$G_t + iB_{t-1} = T_t + (B_t - B_{t-1}) + \Delta M_t$$

LHS: $G_t \rightarrow$ Government Spending; $iB_{t-1} \rightarrow$ Interest of Bonds

RHS: $T_t \rightarrow$ Tax; $(B_t - B_{t-1}) \rightarrow$ Net Increase in Government Bonds; $\Delta M_t \rightarrow$ Money Printed

This implies that government spending can be financed in three ways: taxes, issuing new debt, and print money (inflation tax).

Define the ***Primary Budget Deficit*** as the difference between government spendings and taxes:

$$D_t = G_t - T_t$$

Now, we focus on the fiscal authority only (ignoring money financing), we can write down the budget constraint as:

$$\frac{G_t}{P_t} + \frac{(1+i)B_{t-1}}{P_{t-1}} \cdot \frac{P_{t-1}}{P_t} = \frac{T_t}{P_t} + \frac{B_t}{P_t}$$

Using $\frac{(1+i)P_{t-1}}{P_t} = \frac{1+i}{1+\pi_t} = 1 + r_t$ (from Fisher's Equation), we can write the budget constraint in real terms:

$$g_t + (1 + r_t)b_{t-1} = t_t + b_t$$

which implies that:

$$\begin{aligned} &Real\ Government\ Spending + (1 + Real\ IR) \times Real\ Debt\ of\ Last\ Period \\ &= Real\ Tax + Real\ Debt \end{aligned}$$

Assuming constant real IR and solving this forward, we can get the ***Intertemporal Budget Constraint***:

$$(1 + r)b_{t-1} = \sum_{i=0}^{\infty} \frac{1}{(1 + r)^i}(t_{t+i} - g_{t+i})$$

which implies that the present value of future primary surpluses must be sufficient to repay the stock of debt.

II. Fiscal Policy and PIH & Ricardian Equivalence

Considering tax, under PIH, consumption is:

$$c_t = \frac{r}{1 + r}\psi_t^e$$

$$where\ \psi_t^e = (1 + r)a_{t-1} + \sum_{i=0}^{\infty} \frac{1}{(1 + r)^i}(y_{t+i}^e - t_{t+i})$$

If households understand the government constraint, they will know that the path of future government spending is given:

$$(1+r)b_{t-1} = \sum_{i=0}^{\infty} \frac{1}{(1+r)^i}(t_{t+i} - g_{t+i})$$

Regarding to Tax Cuts:

A tax cut today means higher taxes in the future. i.e. PV of taxes will be unchanged. Therefore, there will be no change in lifetime wealth and hence no change in consumption.

Regarding to Increasing Government Spending:

An increase in government spending today means higher taxes in the future. Households will expect their lifetime income to be lower, reducing their consumption. This will offset the impact of increase in government spending. If the increase in government spending is permanent, it will be fully offset. If the increase in government spending is temporary, it will be partially offset.

Time Path of Tax and Consumption

The time path of taxes cannot affect consumption.

*****Discussions here are all based on Lump-Sum taxes, proportional income tax will influence after-tax income hence influence MPC, as discussed in the beginning chapters.

An example:

There are 2 periods. Assume $r = 0$ and no change in price levels.

	Period 1	Period 2
Pre-Tax Income	y_1	y_2
Government Spending	g_1	g_2
Taxes	t_1	t_2

Under PIH, consumption is $c_1 = c_2 = \frac{y_1 - t_1 + y_2 - t_2}{2}$

The government's budget constraint is $g_1 + g_2 = t_1 + t_2$

Combining these we can get $c_1 = c_2 = \frac{y_1 - g_1 + y_2 - g_2}{2}$ which is irrelevant of t_1, t_2

Ricardian Equivalence

How to fund government spending does not matter. Under PIH, private saving will always offset government spending.

Permanent and Temporary Increase in Government Spending

Although how to fund government spending (time path) does not matter, temporary increase in government spending can increase AD (with multiplier < 1) will permanent increase cannot.

	A Permanent Increase in Government Spending by 1000	A Temporary (1-Period) Increase in Government Spending by 1000
$\Delta PV\ of\ Taxes$	$1000 \cdot \frac{1+r}{r}$	1000
$\Delta PV\ of\ Lifetime\ Wealth$	$-1000 \cdot \frac{1+r}{r}$	-1000

$\Delta Consumption$	$\frac{r}{1+r}\left(-1000 \cdot \frac{1+r}{r}\right)$ $= -1000$	$-1000 \cdot \frac{r}{1+r}$
$\Delta y = \Delta c + \Delta \text{y} + \Delta \text{g}$	0	$1000 - 1000 \cdot \frac{r}{1+r}$ $= \frac{1000}{1+r}$

Fiscal Policy & PIH: Summary

If (Assumptions):

-PIH holds and individuals do not suffer from credit constraints

-Households understand the government's budget constraint

-Households behave as if their lifetime is infinite

-Households and the government face the same IR

Then (Outcome):

-The time path of taxes is irrelevant to consumption and hence output (Ricardian Equivalence)

-Permanent changes in government spending will have no effect on output

-Temporary changes in government spending can affect output with a multiplier < 1

The effectiveness of government spending therefore depends on the degree of crowding out and the extent to which PIH holds.

**Those stabilization policies may also have supply-side effects, such as influencing long-term unemployment. [Some Examples of Such Interaction See Section 3.1]

***The Great Multiplier Debate: Fiscal Austerity*

There are certain evidence of negative multipliers. i.e. "Expansionary Fiscal Contractions"

Mechanisms that could cause this:

-Expansionary fiscal policies affect the expectation of output (the government is trying to solve some big and serious issues) / expectation of taxes (taxes will be much higher in the future).

-There is high value attached to government debt (bonds), especially in financial markets. The financial markets can be affected with those policies.

4. Government Debt Dynamics

I. The Time Path of Government Debt

Ignoring money finance, the government's budget constraint is:

$$G + iB_{t-1} = T + \Delta B$$

(See previous sections for details of this formulae)

Represent this in ratios o GDP:

$$\frac{\Delta B}{Py}=\frac{G-T}{py}+\frac{iB_{t-1}}{Py}=d+i\tilde{b}$$

Where $\tilde{b}=\frac{B_{t-1}}{Py}$ (Debt-to-GDP Ratio in the previous period) and $G-T$ is the Primary Deficit.

Taking full derivatives of this equation:

$$\partial B_{t-1}=Py\partial\tilde{b}+\tilde{b}y\partial P+\tilde{b}P\partial y$$

Divided by Py on both sides:

$$\frac{\partial B_{t-1}}{Py}=\frac{Py\partial\tilde{b}}{Py}+\frac{\tilde{b}y\partial P}{Py}+\frac{\tilde{b}P\partial y}{Py}$$

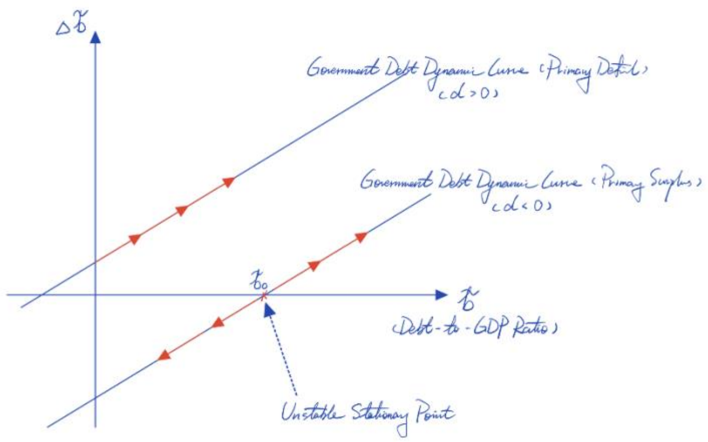
Finally, we take an approximation:

$$\Delta\tilde{b}\approx\partial\tilde{b}\approx d+(i-\pi-\gamma_y)\tilde{b}=d+(r-\gamma_y)\tilde{b}$$
$$\boldsymbol{\Delta\tilde{b}=d+(r-\gamma_y)\tilde{b}}$$

which means that:

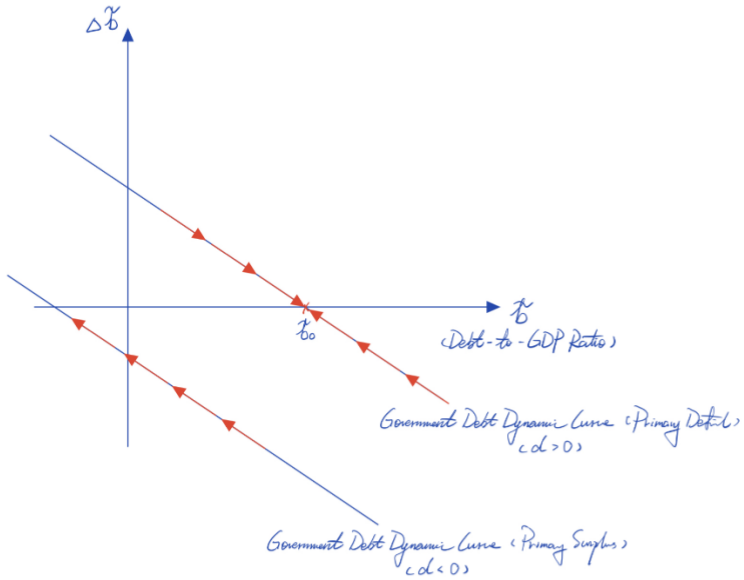
$$\begin{aligned}&\mathit{Change\ in\ Debt\ to\ GDP\ Ratio}\\&\qquad=\mathit{Primary\ Deficit\ to\ GDP\ Ratio}\\&\qquad+(\mathit{Real\ IR}-\mathit{Output\ Growth\ Rate})\times\mathit{Previous\ Debt\ to\ GDP\ Ratio}\end{aligned}$$

II. Case 1: Real IR > Output Growth Rate



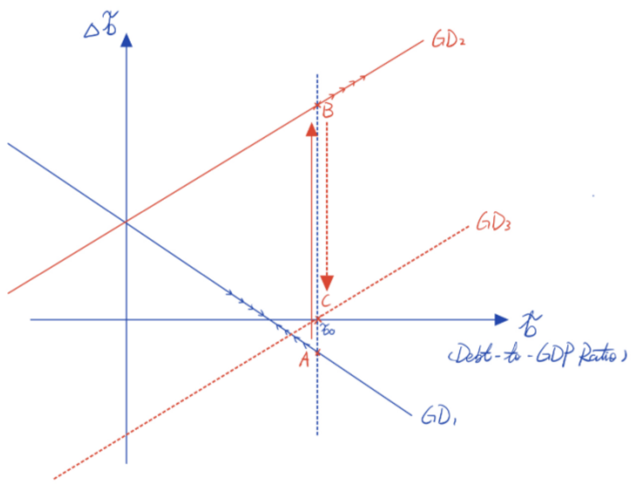
In this situation, real IR > Output growth rate, which means interest payments grow faster than GDP. i.e. The debt servicing cost will be higher than the growth in tax revenue. Government debt dynamics curves are upward sloping. With primary deficit $\Delta\tilde{b}>0$, the government debt-to GDP ratio will increase without bound. With primary surplus $\Delta\tilde{b}<0$, there will be a stationary but unstable point at $\tilde{b}_0$.

II. Case 2: Real IR < Output Growth Rate



In this situation, real IR < Output growth rate, which means interest payments grow slower than GDP. i.e. The debt servicing cost will be lower than the growth in tax revenue. Government debt dynamics curves are downward sloping. With primary deficit $\Delta\tilde{b} > 0$, the government debt-to GDP ratio will converge to a stationary and stable point such as $\tilde{b}_0$. With primary surplus $\Delta\tilde{b} < 0$, the government debt-to-GDP ratio will shrink without positive bound but can be stable at a negative debt-to-GDP ratio (i.e. government's asset position is positive).

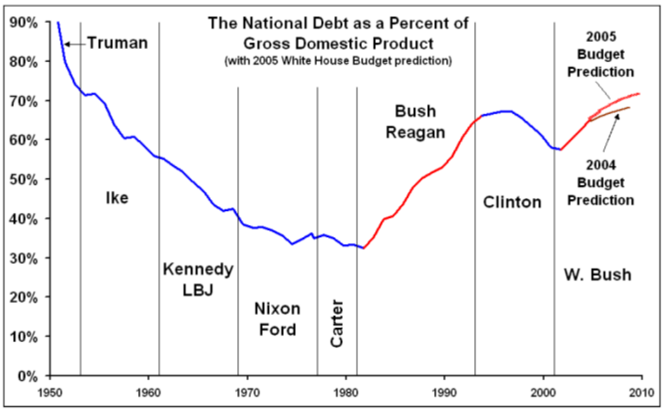
II. Case 3: Switching from $r < \gamma_y$ to $r > \gamma_y$



Originally, the real IR is smaller than the growth rate of output, and the government debt dynamic curve is downward sloping (GD_1). The economy is performing at point A with primary deficit. Then, a sudden increase in real IR takes place, push the economy from point $A \rightarrow B$. With the same primary deficit, we will have a upward government debt dynamic curve

GD_2, and the government debt-to-GDP ratio will grow without bound. The government will need to have a considerable amount of primary surplus to push the economy to point C to stop this.

*****Government Debt in History***



There were primary deficits in most of the time in the US.

1950s/60s: high growth rate and low IR (Keynesian policies)

1970s: low growth rates and low IR

1980s: low growth rates and high IR (Disinflation policies)

1990s: high growth rates and high IR

****When government accumulates high level of debt, the risk of default is also higher, and, taking this risk into consideration, higher IR will be needed.

Week 8: Finance & the Macroeconomy

1. Interest Rates, Monetary Transmission, and the Modern Banking System

I. IR & Monetary Transmission

Many IRs in the economy vary according to the following factors:

-Term Structure: Term period / Term of the loan (Longer term -> Higher uncertainty)

-Risk Structure: The default risk of the loan which depend on the type of borrowers and type of loans

The central bank only controls the overnight rate for commercial banks to lend and borrow.

The transmission from base rate to other interest rates (and hence demand) will depend on specific term structure, risk structure, and banks' lending decisions.

Term Structure:

A full list of (annualized) interest rates for a given default risk is known a "Yield Curve." It represents the term structure of interest rates.

II. Policy Rates and the Modern Banking System

The CB controls the policy rate of interest (e.g. by Monetary Policy Committee at BoE or FOMC at the Federal Reserve).

The policy rate is the rate the CB lends to financial institutions and pays on reserves. It is the same as interbank overnight lending rate (in normal times).

$$Policy\ Rate = Interbank\ Overnight\ Lending\ Rate$$

The CB acts like a monopoly supplier of money.

Given a target policy rate, there is no need to target quantities, which is very hard because commercial banks may create various financial products in response to CB's attempt to control quantity.

There is a mark-up (assumed to be constant) earned by commercial banks between the policy rate and the rate at which commercial banks lend to households and firms, which affects the AD in the economy.

$$Policy\ Rate \xrightarrow{+markup} Rate\ at\ Which\ Commercial\ Banks\ Lend\ to\ Individuals\ and\ Companies \rightarrow ad$$

III. Lending Rates and Policy Rates

Specifically, actual IRs differ from the policy rate because of:

-Term structure of IR

-Bank's expected return on their loans taking default into account

-Banks' attitudes towards risks and abilities to bear risk

-Opportunity cost of capital

-Degree of competition in the banking market

Capture this simply is :

$$r = (1 + \mu^B) r^P$$

where r^p is the Policy Rate and μ^b is the banking markup

**The Basle Agreement asks for controlling the μ^B

The CB needs to choose the policy rate to get the actual IR at the desired level. Therefore, the CB needs to estimate the banking markup, which is complicated. Given a constant actual IR target, changes in the banking markup will require changes in the policy rate even if nothing else in the economy has changed.

2. Credit Constraints & Policy

I. Credit Constraints

Credit constraints exist because of Asymmetric Information: lenders will not know whether failures are due to unlucky events or lack of efforts

-Moral Hazard (Hidden Action): Incentives to repay are not aligned

-Adverse Selection (Hidden Characteristics): Low risk borrowers self-select away

Banks charge high IR to protect their profit, and the high IR filers out borrowers with low risks.

Collateral is one way of mitigating these issues, ensuring that borrowers have some stakes in the project.

-Mortgages (Housing Loans) are usually collateralised by the property itself.

If credit constraint binds, households / firms will be in situations where they would like to borrow (to consume or invest) more but they cannot.

II. Credit Constraints and Policy Effects

Monetary Policy:

The consumption of credit constrained consumers are more likely to respond to a policy change, because they are unable to smooth their consumption. A lot of them act similarly to HTM instead of PIH.

Fiscal Policy:

If the government borrows to fund a tax cut, unconstrained households will increase consumption by the annuity value of the change, or not increase consumption at all if Ricardian Equivalence holds. However, credit constrained households will be very likely to increase consumption as many of them follow HTM.

3. Asset Price Bubbles

Definition: a persistent deviation of the value of an asset from its fundamental value.

Fundamental Value of an asset: the present value of the stream of income/services the asset entitles its owner to.

e.g. for a stock: $p_t^* = \sum_{s=0}^{\infty} \frac{div_{t+s}^e}{(1+r)^s}$

e.g. for a house: $p_t^* = \sum_{s=0}^{\infty} \frac{rent_{t+s}^e}{(1+r)^s}$

In general, the price of an asset can be written as its fundamental value + bubbles:

$$p_t = p_t^* + z_t$$

I. Rational Bubbles

Assume there is no arbitrage (i.e. no riskless profit). This no arbitrage assumption implies:

$$p_{t+1} = (1+r)p_t - (1+r)d_t$$

Therefore, the current price should be equal to the dividend in current period + PV of its expected price in the next period:

$$p_t = d_t + \frac{p_{t+1}^e}{1+r}$$

One form of bubble satisfies this is a Deterministic Bubble:

$$p_t^* + z_t = d_t + \frac{p_{t+1}^* + z_{t+1}^e}{1+r}$$

The price of such a stock will increase exponentially even though dividends are constant, and individuals will be willing to pay a higher price for the stock due to the Expected Capital Gain:

$$p_t^* + z_t = d_t + \frac{p_{t+1}^* + z_{t+1}^e}{1+r} \xrightarrow{Minus\ p_t^* = d_t + \frac{p_{t+1}^*}{1+r}} z_t = \frac{z_{t+1}^e}{1+r} \xrightarrow{Rearrange} z_{t+1}^e = (1+r)z_t$$

**We can even show that rational bubbles can still exist even if investors know there is a non-zero probability where bubbles may burst in the future.

II. Price Dynamics Equations

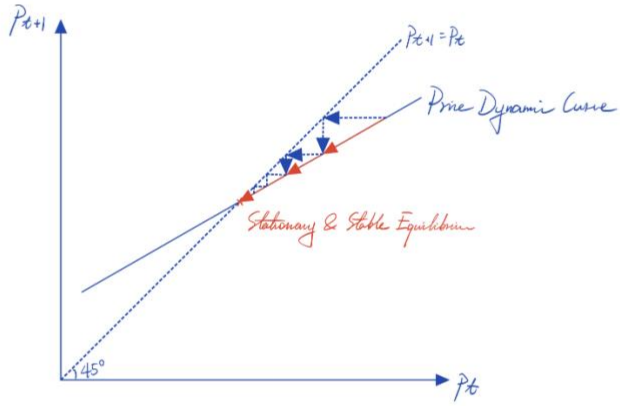
Setting $p_{t+1} = p_{t+1}^e$, we can look at the price dynamics:

$$p_{t=1} = f(p_t)$$

The no arbitrage condition implies:

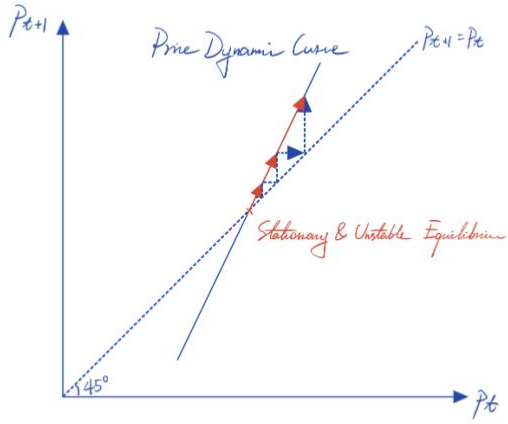
$$Price\ Dynamics\ Equation: p_{t+1} = (1+r)p_t - (1+r)d_t$$

Case 1: Market for Fish ($r < 0$)



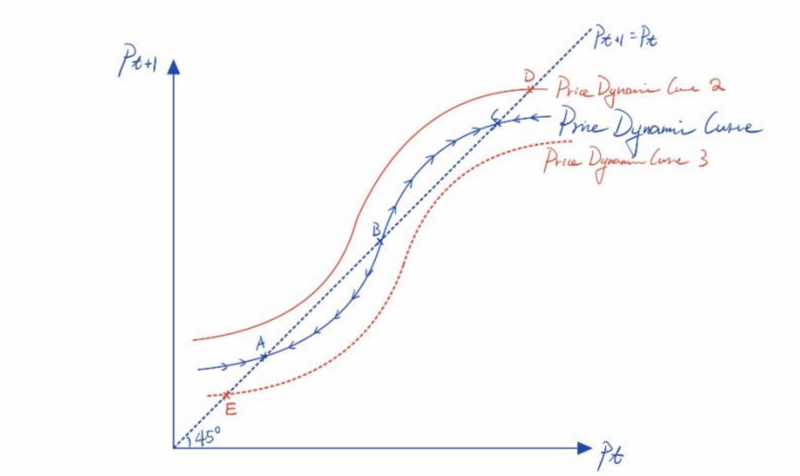
In this market where $r < 0$, prices will fall with time, converging to a stationary and stable point.

Case 2: Market for Tulip Bulbs (Rational Bubbles, $r > 0$)



In this market where $r > 0$, prices will rise without bound with time. There is a stationary point, but not a stable one.

Case 3: Market with Multiple Equilibria



This is a market with multiple equilibria. With the original price dynamic curve, there are 3 stationary points: A, B, C. Point A, C are stable equilibria while B is unstable. A shift of PDC in this market could shift the type of equilibrium as shown, and could lead to the burst of a bubble: $PDC\ 1 \rightarrow PDC\ 3$ with $C \rightarrow E$.

4. Burst of Bubbles

Trigger the burst: something occurs to the "rationale" of the bubble to be reassessed such as some "scary bad news" or "Minsky Moment."

This will make some investors start to sell, and asset prices will begin to fall.

Consequently, more investors will start to question the rationale behind the bubble, forming a positive feedback loop for falling prices.

Effects of A Bursting Bubble

-Falling asset prices causes consumption and investment to fall, which hit the economy as a negative demand shock

-Interaction with Lending: Financial Accelerator [Next Section]

-Interaction with the Banking System [Next Section & Lect. 9]

Financial Accelerator

Financial Accelerator is a positive feedback process: a change in the prices of assets will affect the macroeconomy.

This applies to an economy with credit constrained households. Without credit constraints, agents can smooth their consumption and investment (following the PIH / Tobin's Q Theory), and the asset price shock will be temporary.

Banks usually demand collaterals for loans to households, and there is a loan-to-value ratio. The finance accelerator operates in the following steps:

Use prices of houses as an example:

-Net worth = Market price of the house – Mortgage (Equity = Asset – Liability)

Nominal / Market price of houses $p_t \uparrow \Rightarrow$ Net worth $\uparrow \Rightarrow$ Credit constraints relaxed $\Rightarrow$ Borrow more by re-mortgaging $\Rightarrow$ Consumption and investment in housing $\uparrow \Rightarrow$ Demand for housing $\uparrow \Rightarrow$ Further increase in nominal / market prices of houses …

****Bubble & Increase in Demand for Houses***

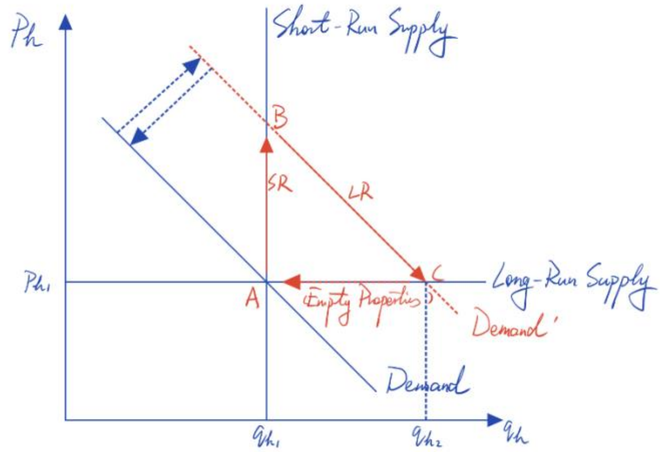
Increase housing demand can arise from:

-Rising population

-Falling size of households

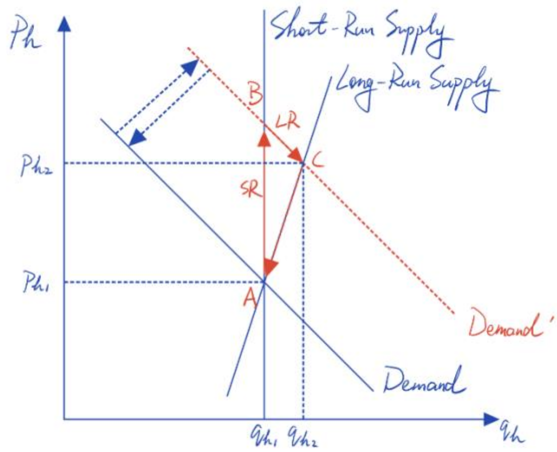
-Rising wealth

Case 1: There is no LR supply constraints (eg. Texas)



An increase in demand will in LR cause small change in prices. On the other hand, after the demand shrinks back, there will be plenty of empty properties.

Case 2: LR supply constraints (Physical/Planning) are tight (eg. London, NYC)



Asset price can rise without a bubble, and when asset price falls, there will not be lots of empty properties. ** The CB should refrain from using its monetary policy tools (such as IR) to intervene this market.

5. A Plain Vanilla Financial Crisis

(From banks' perspective)

Assume there is a bubble.

When the housing bubble bursts, house prices fall, and the net worth of households decreases

⇓ Households are unable to pay mortgages

⇓ Houses are repossessed by banks and liquidated (sold) at a loss (→Supply increases, further decreasing prices)

⇓ On the bank side, losses from mortgages make bank insolvent

⇓ Capital cushion falls and there will be lower levels of lending

⇓ Banks raise IR to protect themselves, further worsening households' net worth

In the 3-equation model, this is represented by a dramatic left shift of the IS curve (and an increase of IR).

6. Macroprudential Monetary Policy

Use other instruments other than IR.
Pre-2007 consensus: given the difficulty in identifying a bubble, policymakers should focus on bubbles' effect on the real economy, not trying to identify and control bubbles.
Traditional monetary policies (IRs) are blunt tool to address bubbles and may encourage risk-taking behaviours. e.g. Rational bubbles can grow even faster with higher IRs.
Post-2008: Macroprudential policies (Pro-cyclical Capital Ratios, Direct Lending Restrictions, etc.)

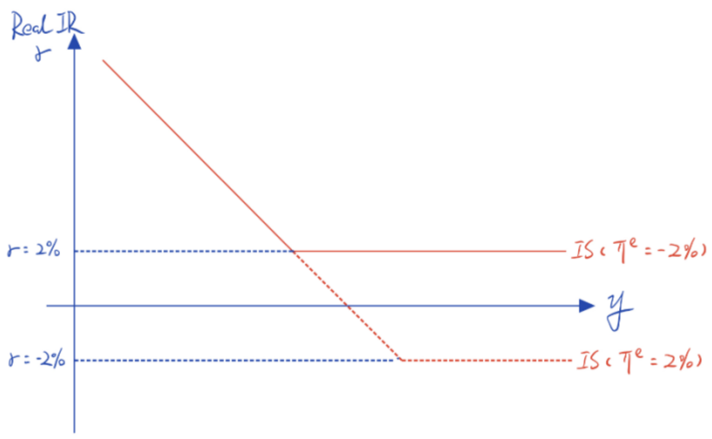
Week 9: Global Financial Crisis

1. The Zero-Lower Bound (ZLB) on Nominal Interest Rates

Nominal IRs cannot fall below zero because, otherwise, lenders will rather hold something earning a zero return (cash) than pay borrowers for the privilege of borrowing.
**One simple solution: Abolish cash [more in Buiter blow, FT article]
In reality, nominal IR can be a bit lower than 0, but certainly with a lower bound.
ZLB on nominal IRs implies a lower bound on real IRs:

$$\iota = r + \pi^e \geq 0$$
$$r = \iota - \pi^e \geq -\pi^e$$

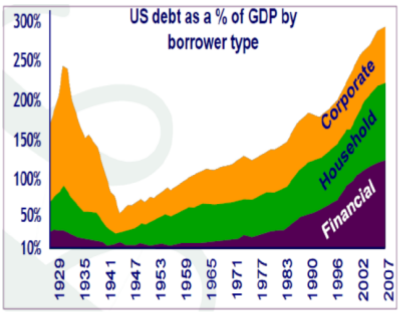
Hence, it also implies a restriction on the IS curve:



2. 2008 Global Financial Crisis

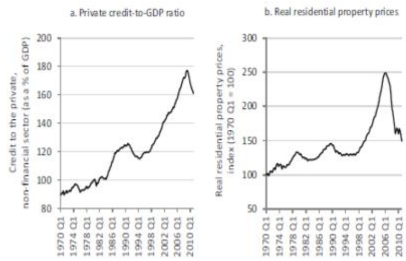
I. Background

Leverage of the financial sector dramatically increased.



Interaction between rising house prices and credit constraints:

-Higher residential property prices and private credit-to-GDP ratio



II. Traditional Mortgage Markets

Traditionally, mortgage lenders (e.g. banks) fund their loan book with deposits:

Assets	Liabilities
Mortgages (Long Term): 900	Deposits (Short Term): 1000
Cash / Reserve: 100	

If a lender wants to expand its loan book, it will need to absorb more deposits or borrow in the short-term money market (interbank lending market):

Assets	Liabilities
Mortgages (Long Term): 1900	Deposits (Short Term): 1000
Cash / Reserve: 100	*Borrowing (e.g. 3 Months): 1000*

Debt Roll Over: The borrowing needs to be repaid usually every 3 months, so the bank will have to "roll over" it (i.e. replace with new loans) every 3 months to maintain the size of its loan book.

III. Mortgage Markets with Securitisation & Tranching

Securitisation:

There are n mortgages all with return of $mean\ \mu = 1$ and $standard\ deviation\ \sigma = 1$

Package them into a bond (i.e. the coupon on the bond is the sum of all the mortgage repayments). The return on this bond will have $mean\ \mu_{sec} = n$ and $standard\ deviation\ \sigma_{sec} = \frac{\sigma}{\sqrt{n}}$. i.e. This bond will be less risky.

This subject to a key assumption: Return on the individual mortgages are independent.

Tranching:

The lender could then split this bond into different parts. For example, splitting it into 2 parts:

-A "safe" bond (with mean return of $\frac{n}{2}$) which has the first claim on the returns from the mortgages

-A "risky" bond (with mean return of $\frac{n}{2}$) which gets what is left over after the "safe" bond has been paid out

The return of the "safe" bond is extremely unlikely to fall below 50, which means it is effectively risk-free. This allocates risk to those who want to hold it, thus making financial markets perform more efficiently. (All under the key assumption above)

IV. Quick Expansion Using Securitisation

After securitisation and tranching, the bank finds a ratings agency to agree with the mortgage lender's calculation and rate the bonds.
In practice, many different tranches from "investment grade" to "toxic waste" were sold to different participants in the financial market as "Mortgage Backed Securities (MBS)."
Mortgage lenders then remove those mortgages from their books, making a profit (increase in equity) and allowing them to lend more:
e.g. selling mortgage for 1000

Assets	Liabilities, Equities
Cash: 1100	Deposits: 1000
	Equity: 100

Then lend more:

Assets	Liabilities, Equities
Cash: 100	Deposits: 1000
Mortgage Loans: 1000	Equity: 100

Then redo this process of securitisation, tranching, selling, re-mortgaging…

Problems:

Since the lender no longer holds the loans, they have less incentive to make good lending decisions and monitor borrows' effort. Buyers may even repack and resell MBS again. All these worsening the adverse selection and moral hazard problems in the financial market.

V. Sub-Prime Lending

Lending to individuals with poor credit records increased from the mid-1990s, particularly in the US. Reasons:

-A social policy objective: to reduce inequality
-A hunt for profit opportunities
-Securitisation gives less incentive to make good lending decisions

Structure of Sub-Prime Mortgages:

-These mortgages do not require equity, offered to NINJA (No Income No Job and No Asset)
-These mortgages are offered with low IR in the first few years and no amortisation of principal, making repayments affordable.
-At reset date, if house prices have increased, borrowers will have higher equities, so they can re-mortgage at a lower IR. Sub-prime borrowers become prime borrowers as long as house prices keep increasing.
-However, if house prices fall, borrowers will start to default, and particular features of the US mortgage market make default much more likely. (Limited liability and little punishment)

VI. Situations around 2005 & Federal Reserve

Market:

Some lenders were financing their book through short-term borrowing, making them vulnerable to liquidity in the short-term money market.

Quality of lending decisions kept decreasing and sub-prime lending kept increasing due to reasons addressed above, especially because securitisation and tranching.

Tranching were complicated: assets with many different risk / return profiles were packed in to MBS. Then, they were sometimes re-tranched, forming “alphabet soup” of securitisations. The real risks became very hard to determine.

These are spread throughout the financial system.

House prices in the US kept rising, and everyone was making profits. There was also strong expectations of further increase in prices.

Fed Reserve:

Started from mid-2004, the Federal Reserve started to raise IR, considering the economy as overheating. House prices ceased to rise after that, and later started to fall.

VII. Burst of A Bubble: A Minsky Moment & Credit Crunch

Falling house prices led to higher default rates on sub-prime mortgages, causing an aggregate shock affecting many mortgages.

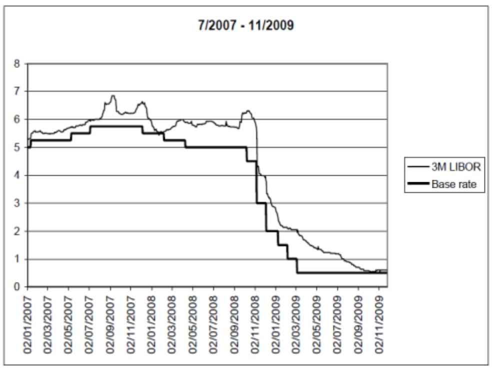
Recall the key assumption behind securitisation: defaults are idiosyncratic and independent. This assumption became invalid as falling house prices had caused widespread defaults.

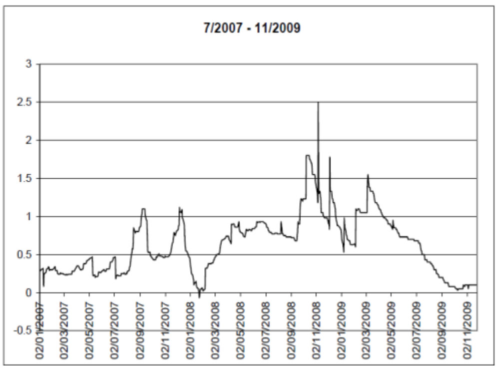
Widespread defaults made MBS lose value dramatically, reducing banks’ assets and putting them under the risk of insolvency.

Then, interbank lending collapsed because:

> -No one knew who was holding MBS or the value of MBS held by others, so risk of counterparty default became unquantifiable.
>
> -Banks want to preserve their capital

Consequently, a ***credit crunch*** happened. Mortgage lenders were unable to rollover their short-term borrowings anymore and became insolvent, which formed a ***self-enforcing cycle***.



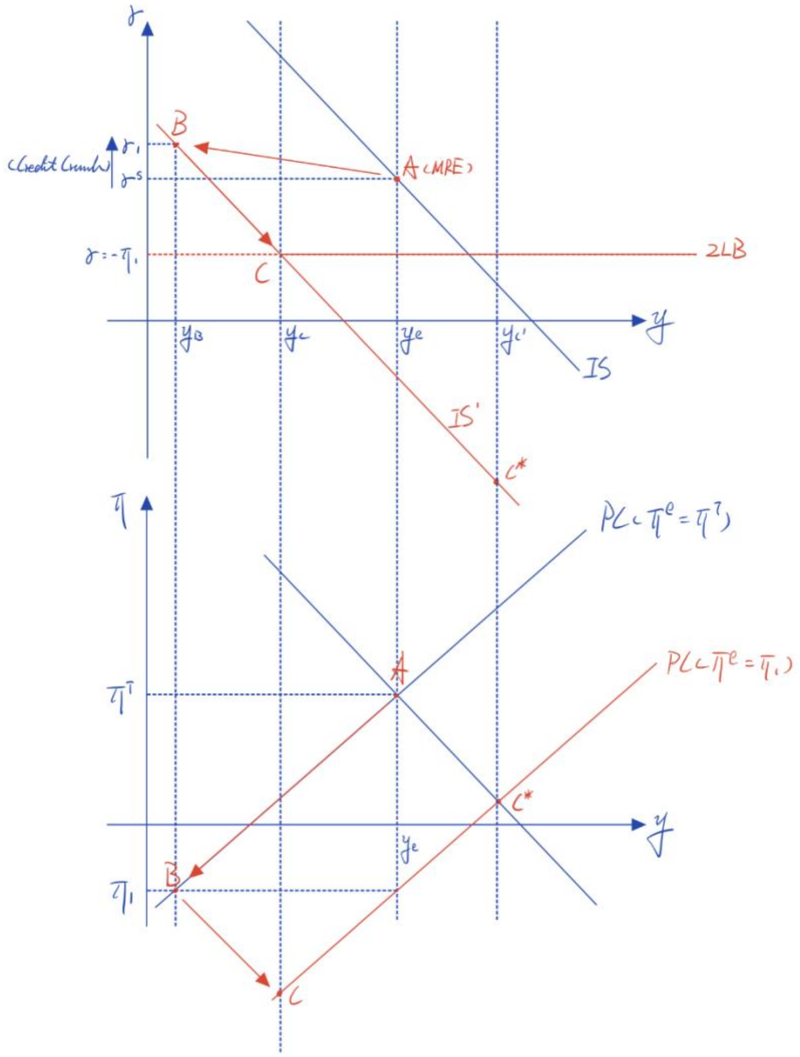


Gap between the base rate and the interbank lending rate enlarged.

VIII. Effects on the Macroeconomy

Households: mortgages were hard to get and house prices were falling.
Firms: need to roll-over debt → insolvencies
Self-enforcing cycle in the Macroeconomy:
Insolvency of firms -> Unemployment -> Lower expected future income -> PIH effects -> Lower demand -> Further insolvency of firms / Unemployment -> …

IX. Effects in the 3-Equation Model Part 1 (Conventional Monetary Policy Only)



Starting point: Medium-run equilibrium A
House prices started to fall, shifting $IS \rightarrow IS'$
Meanwhile, credit crunch caused a rise in IR $r^s \rightarrow r_1$
End of period 1: Point $A \rightarrow B$. Deflation appeared and output shrunk.
PC shifted, ZLB applied.
CB's desired point in period 2 should be C'. However, as ZLB restricted the range of IR the CB could set, the CB would set $r = -\pi_1$.

The outcome of period 2 became point C: there was a further deflation and the output was still below the equilibrium level.
In the next period, this cycle continues: $\pi \downarrow, ZLB \uparrow$, further restricting monetary policies
**Banking markup could add another layer of amplification as banks may lift their IR to securing their profit and avoid insolvency.

X. Monetary Policy Response in Reality

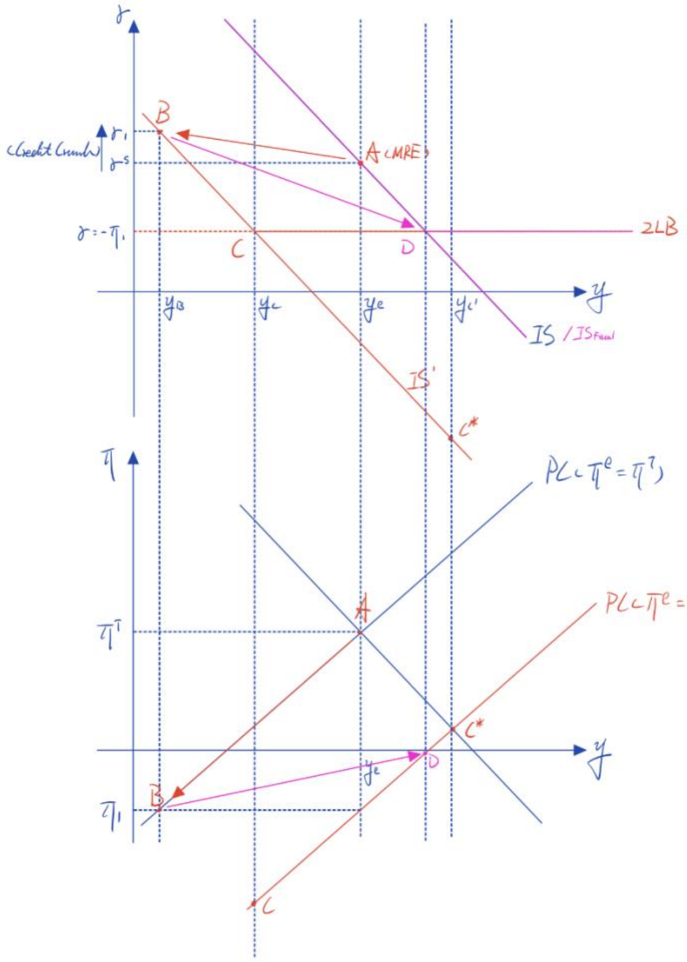
The Fed tries to encounter this with conventional monetary policies. The Fed funds rate was at ZLB by early 2009, but the optimum was to cut it further.
Therefore, ***Unconventional Monetary Policies*** were used:

1. Quantitative Easing (QE)
   - -Attempt to reduce longer-term IR directly by "printing money" to purchase targeted assets, including privately issued assets and (mostly) government bonds.
     - -Buying privately issued assets could boost AD directly
     - -Buying government bonds could reduce long-term IR and indirectly boost AD
2. Forward Guidance
   - -Attempt to influence the yield curve by promising to keep IR low for an expected period
     - -The expectations theory of the term structure
     - -However, people can infer from a strong promise from the CB as a signal that the economy is really in trouble.

XI. Fiscal Policy Response

Automatic Stabilisers (e.g. Unemployment benefits)
UK: VAT cuts
US: big increase in government spending (with no increase in IR from the CB)
Issues: Fiscal policy and the ZLB, constraints to fiscal policy, doubts over effectiveness, high debt-to-GDP ratio…

XII. Effects in the 3-Equation Model Part 2 (Monetary + Fiscal Policy)



Point $A \rightarrow B$ follow the same logic shown in the last section. With expansionary fiscal policies, the IS curve may be restored $IS \rightarrow IS_{Fiscal}$. Hence, the CB can now choose point D. Although the ZLB still binds, the inflation and output will be much closer to the optimum, preventing continuous fall of inflation expectation.

Week 10: Aftermath of the Global Financial Crisis

1. Balance Sheet Effects

I. Households' Balance Sheet

The years prior to the credit crunch witnessed the expansion of households' and banks' balance sheets:

Households (Prime Borrowers)

Assets	Liabilities + Equities
House: 1000	Debt: 800 Equity: 200

If house price increases:

Assets	Liabilities + Equities
House: 1200	Debt: 800 *Equity: 400*

Then, households can borrow more and perform mortgage equity withdrawal (refinance):

Assets	Liabilities + Equities
House: 1200	*Debt: 900* *Equity: 300*

Once house prices start to fall, households become very likely to default.

Self-enforcing Cycle: Falling property prices -> Household equities reduces -> Default of households -> Reduce consumption to repay debt (contractionary) -> Lower AD -> Further decreases in property prices …

This process is persistent because the stock of debt is usually multiple times of consumption.

II. Banks' Balance Sheet

Traditional Banking: post-war "Financial Repression" limits the activities of banks:

e.g. 20% Capital Ratio:

Assets	Liabilities + Equities
Loans: 1000	Long-term Debt: 400 Short-term Deposit: 400 Equity: 200

Equity can absorb losses: e.g. a 10% fall in value of assets:

Assets	Liabilities + Equities
Loans: 900	Long-term Debt: 400 Short-term Deposit: 400 *Equity: 100*

Capital ratio decreases from 20% to 11.11%, but the bank is still away from insolvency.

With MBS:

Deregulation of banks from 1980s onwards and financial "innovations" (MBS) enabled banks to expand their balance sheet rapidly with higher leverages.

Assets	Liabilities + Equities
Loans: 1000	Long-term Debt: 950
MBS: 1000	Short-term Deposit: 950
	Equity: 100

The high leverage / low capital ratio amplifies banks' profit from rising house prices while makes them vulnerable to a fall in house prices / MBS value: e.g. a 10% fall in value of MBS:

Assets	Liabilities + Equities
Loans: 1000	Long-term Debt: 950
MBS: 900	Short-term Deposit: 950
	Equity: 0

Then, the bank will be at the edge of insolvency / bankruptcy. With the risk of bankruptcy, banks increase their IR on loans to secure profits.

Self-enforcing Cycle: Falling property prices -> MBS value decreases -> Banks' equities decrease -> Closer to bankruptcy -> All banks respond by raising equity and (or) attempting to reduce the size of their balance sheets -> Reduce lending -> Lower investment -> Lower AD -> Further decreases in property prices …

**Equity of some banks was completely wiped out and, to protect the banking system, government nationalised those banks or guaranteed bank liabilities.

**Releasing macroprudential policies will not be effective in tackling with such situation as banks are not willing to lend at all.

**"Financialisaton":

-Great Depression: leveraging and deleveraging of corporates

-Global Financial Crisis: leveraging and deleveraging of the financial sector

III. Governments' Balance Sheet

Government debt increased dramatically due to:

-Recapitalisation of banks: the government provided equity to insolvent banks directly (Bailout)

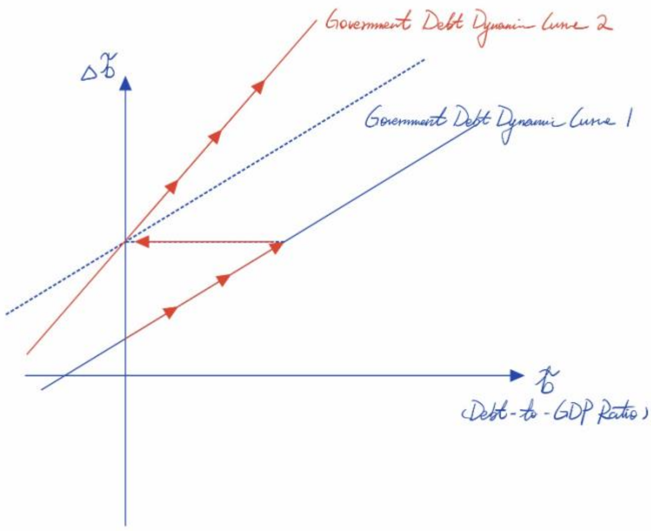
-Guarantees of bank liabilities

-Automatic stabilisers

-Discretionary fiscal policies

**For some countries (e.g. Greece), debt had already been very high due to past profligacy and difficulty to raise taxes.

Government Sovereign Debt Crisis:



After the global financial crisis, the real IR was low, and the growth rate was even lower (recession).

$$\Delta\tilde{b} = d + (r - \gamma_y)\tilde{b}; \quad r > \gamma_y$$

Then, government debt increased (bank bailouts + guarantees of bank liabilities) and deficit also increased (expansionary fiscal policy + automatic stabilisers). Meanwhile, real IR also increased (a risk premium). These made the gap between real IR and growth rate even larger $(r - \gamma_y) \uparrow$. Together with a higher primary deficit, the government debt dynamic curve shifted upwards and became steeper.

To prevent the government debt from accelerating increases, the government could:

1. Attempt to reduce the primary deficit by increasing tax revenue and cut fiscal spending – "Austerity"
2. Attempt to stimulate growth. This usually involves expansionary fiscal policy, which is in contradictory of austerity (if Ricardian equivalence does not hold).
3. Attempt to decrease the real IR. However, as government debt accumulating, lenders would perceive higher risk of default, hence require a higher IR to lend to the government.
4. Decrease the stock of debt directly by defaulting / partial defaulting (renegotiation)

2. How to Prevent It from Happening Again?

Try to avoid a financial crisis in advance.

Macroprudential policies (avoid bubbles).

How valuable is the financial sector?

-Much of what the financial sector does is "socially useless." – Adair Turner, Chairman of the FSA, 2009

-or even worse than useless

-Proper valuations and administration are needed

3. **Other Topics that we have no time to cover

Supply Side Policies

WS depends on government policies (e.g. minimum wages, tax)
PS depends on policies that affect competitions (e.g. anti-trust policies)
Growth and Business Cycles
Banks and the Macroeconomy
Financial sector is far more complicated
Macroeconomy and Development

4. **Beyond the Model: Dynamic New Keynesian Models

I. Real Business Cycles

The real business cycle theory suggests that an important source of shocks is the variation of technological progress:

$$y = af(k,n)$$

a captures many things in an economy, including demand, but mainly technological levels.
Then, the business cycle can be though as movements in (NOT around) potential / equilibrium output. (Fluctuations in the economy is caused by fluctuations in a)
Hence, the economy will operate as the optimum responses to the conjecture, and there is no necessity for the government to intervene.

II. Dynamics New Keynesian Models

IS Curve (from PIH):

$$\mathrm{X}_t = \eta_x \mathrm{X}_{t-1} + (1-\eta_x)E_t\mathrm{X}_{t+1} - \sigma r_t + \tau(E_t g_{t+1} - g_t) + \varepsilon_t^d$$

X_t is the output; $\eta_x \mathrm{X}_{t-1}$ captures the backward-looking component (e.g. habits); $(1-\eta_x)E_t\mathrm{X}_{t+1}$ captures the forward-looking component (e.g. to smooth consumption); $-\sigma r_t$ measures the effect of real IR; $\tau(E_t g_{t+1} - g_t)$ captures the effect of government spendings (and expectations about government spendings); ε_t^d measures exogenous shocks.

Phillips Curve (Imperfect Competition + Sticky Prices):

$$\pi_t = \eta_\pi \pi_{t-1} + (1-\eta_\pi)E_t\pi_{t+1} + \alpha x_t + \varepsilon_t^s$$

This could be seen as a combination of individuals with adaptive expectations and rational expectations.

Monetary Rule:

$$x_t = -\varphi \pi_t$$

where $x_t = y_t - y_t^e$ is the output gap.

This model is currently used by most CBs around the world.
**Drawback: this assumes that government budget constraint will always be satisfied by lump sum taxes, and there is lack of analysis of investments.
We can use econometrics tools like VAR to analysis current economic performance and make predictions.

5. Policy in a Wider Context

Fiscal Policies:

- -Institutions
- -Distributional Effects (Some fiscal policies aim at these effects)
- -Supply-Side Effects
- -Constraints on government debt

Monetary Policies:

- -Institutions (e.g. Complicated financial institutions)
- -Distributional & Welfare Effects (Debate on current QE)
- -Constraints (ZLB, and households' expectations and interpretations)
- -Credibility of Policy Makers

"All models are wrong, but some are useful." ----George Box