Catherine

Macro Basic: the 3-equation model

Macroeconomics: Institutions, Instability, and the Financial System, Wendy Carlin & David Soskice, Chapter 1-3

IS Curve

(the Demand Side: Investment - Saving)

$$y^D = C + I + G = \underset{\text{animal spirit}}{C_0} + \underset{MPC}{C_1}\underset{\text{disposable income}}{(1-t)y} + \underset{\text{expected future post-tax profit}}{a_0} - a_1 r + G$$

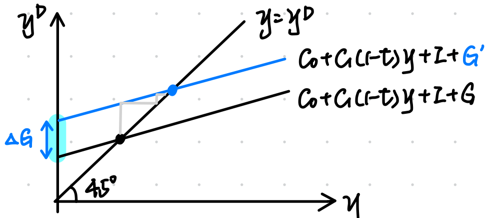
$$Y = a + \bar{b}(Y - T) + c - \bar{d}r + G \quad \text{(Tsinghua's Version)}$$

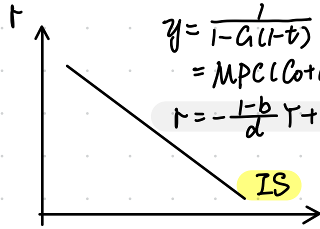
Keynesian consumption function: $C = C_0 + C_1(1-t)y$

Marginal Propensity to Consume: $MPC = \partial C / \partial \Delta y_{disp} = C_1$

Disposable Income $\Rightarrow \begin{cases} \text{consumption } C \\ \text{saving } S = y - C \end{cases}$, mp has $C_1 + S_1 = 1$

investment function: $I = a_0 - a_1 r$





$$y = \frac{1}{1 - C_1(1-t)}\left[C_0 + (a_0 - a_1 r) + G\right]$$

$$= MPC(C_0 + a_0 + G) - MPC \cdot a_1 r$$

$$r = -\frac{1-b}{d}Y + \frac{1}{d}(a + c + G - bT)$$

government-purchase multiplier:

$$\Delta y = \frac{1}{1 - C_1(1-t)}\Delta G$$

$$\Delta Y = -\frac{1}{1-b}\Delta G$$

tax multiplier: $\Delta Y = -\frac{1}{1-b}\Delta T$

interpretation: $r\uparrow \Rightarrow I\downarrow, y\downarrow$

Phillips Curve

(the Supply Side: Price Setting in labour market)

Efficiency Wages: ① incentive of work effort (↑ opportunity cost of unemployment)
② worker turnover cost

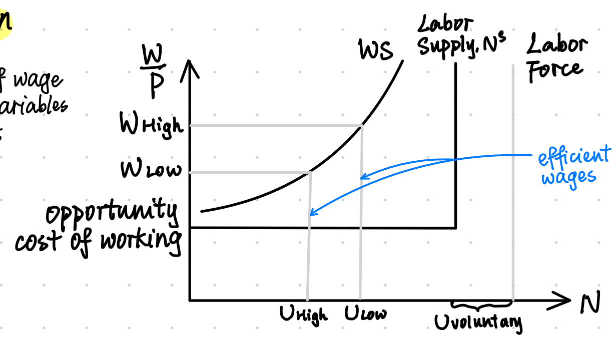
wage-setting real wage equation

$$W = P^E \cdot B(\underset{(+)}{N}, \underset{(+)}{Z_W})$$

- W: nomial wage
- P^E: expected price level
- N: level of employment
- Z_W: a set of wage-push variables

$$W^{WS} = \frac{W}{P^E} = B(N, Z_W)$$

(real wage)



price-setting real wage equation

perfect competition: $P = MC = \frac{W}{MPL} \Rightarrow \frac{W}{P} = MPL$

imperfect scenario: $P = (1+\mu)\frac{W}{MPL} \Rightarrow \frac{W}{P} = \frac{1}{1+\mu} MPL = (1-\mu) MPL$

(μ: price markup above the marginal cost)

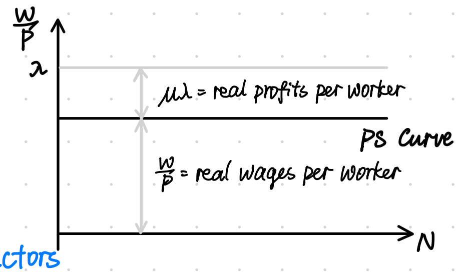
unit labor costs $= \frac{W \cdot N}{y}$

define output per labor $\frac{y}{N} = \lambda$ ($= MPL$)

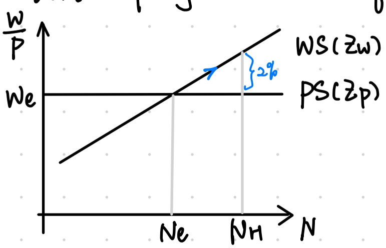
$\Rightarrow P = (1+\mu)\frac{W}{\lambda} \Rightarrow \frac{W}{P} = (1-\mu)\lambda$

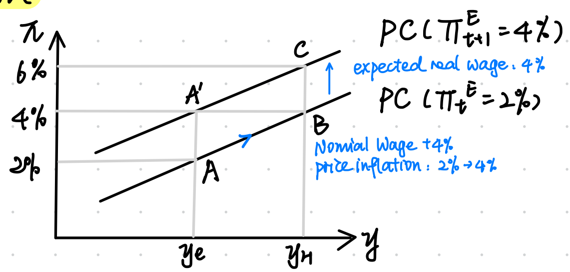
$\Rightarrow w^{PS} = \frac{W}{P} = \lambda(1-\mu) = \lambda F(\mu, z_p)$

PS curve including price-push factors (e.g. a fall in the tax wedge).



unemployment in equilibrium





$w^{WS}(y_t) = \left(\frac{W}{P}\right)^{WS} = B + \alpha(y_t - y_e) + z_w$ (WS curve, linear form) $y_t > y_e$!

$\left(\frac{\Delta W}{W}\right)_t \approx \left(\frac{\Delta P}{P}\right)_{t-1} + \alpha(y_t - y_e)$ (wage inflation) Nomial wage setter

$\left(\frac{\Delta P}{P}\right)_t \approx \left(\frac{\Delta W}{W}\right)_t - \left(\frac{\Delta \lambda}{\lambda}\right)_t$ (price inflation) price setter

$\Rightarrow \left(\frac{\Delta P}{P}\right)_t = \left(\frac{\Delta P}{P}\right)_{t-1} + \alpha(y_t - y_e)$

$\pi_t = \pi_{t-1} + \alpha(y_t - y_e)$ (Phillips Curve)

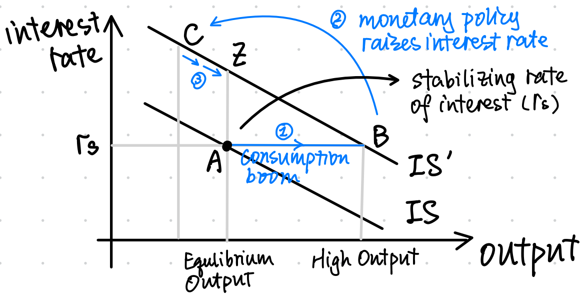
current inflation, lagged inflation, output gap

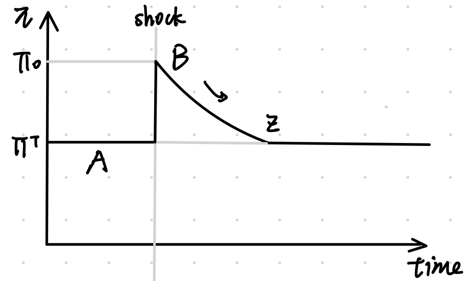
Key Assumption: adaptive expectations $\pi_t^E = \pi_{t-1}$

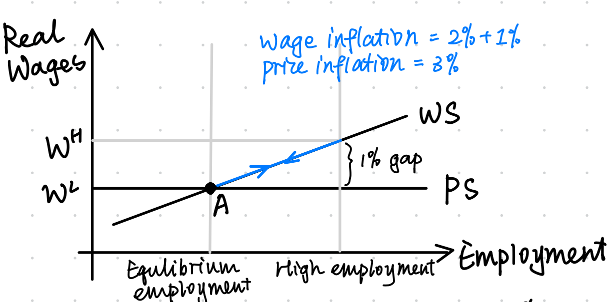
Monetary Rule Curve

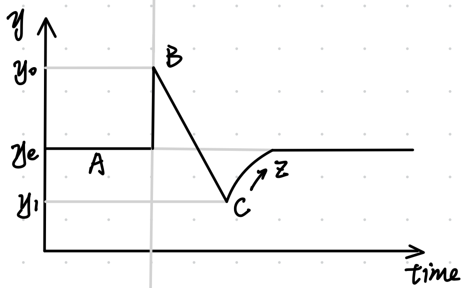
Central bank uses monetary policy to stabilize the economy

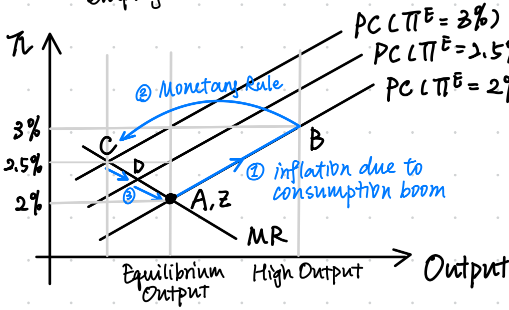
Example of positive demmand shock

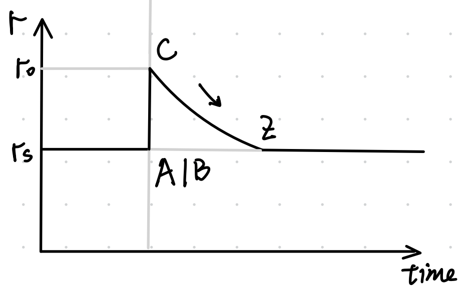










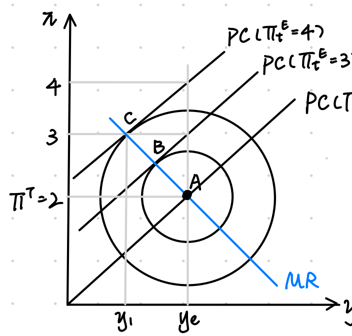


(central bank loss function)

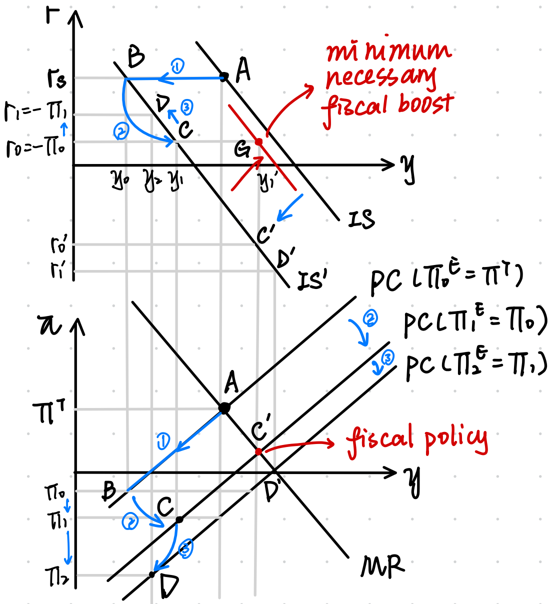
$$L = (y_t - y_e)^2 + \beta(\pi_t - \pi^T)^2$$

- $\beta > 1$: inflation adverse
- $\beta < 1$: unemployment adverse

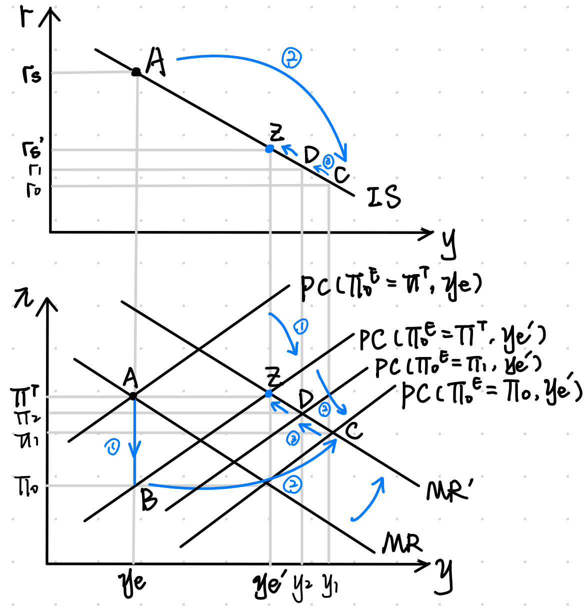
MR curve : $(y_t - y_e) = -\alpha\beta(\pi_t - \pi^T)$



the deflation trap



a supply shock

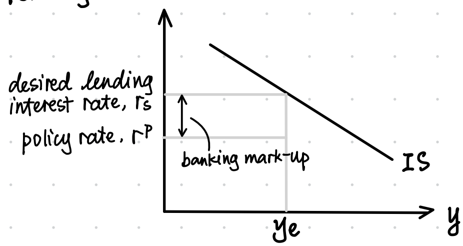


Banking Basic: financial system & balance sheet

Macroeconomics: Institutions, Instability, and the Financial System, Wendy Carlin & David Soskice, Chapter 5

Lecture notes - Basic Knowledge (P5)

Money and Interest Rate



Money
- **Narrow money** (M_0): cash and reserve balances held at CB
- **Broad money** (M_2 / retail M_4): central bank money + commercial bank money

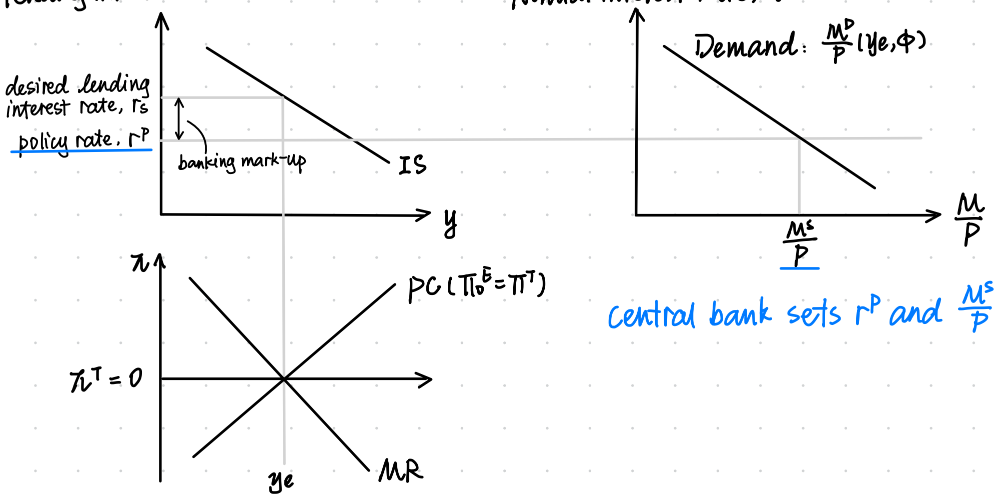
demand for money:

$$\frac{M^D}{P} = f(y, i; \phi)$$

- y: output (+)
- i: nominal interest rate (Fisher: $i = r + \pi^E$), (−)
- ϕ: structural changes: confidence (+), payment technology (−), new financial instruments

The Benchmark Model

- the lending rate (e.g. 5-year fixed rate mortgage): r
- Money market rate
  - short / medium-term interbank lending rates $\sim r^P$
  - short / medium-term government bond yields $\sim r^P$
- the policy rate ($\sim$ Official Bank Rate / CB deposit rate): r^P



central bank sets r^P and $\frac{M^S}{P}$

interest rate margin (banking mark-up equation):

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

banking mark-up μ^B:
- riskiness of loans (+)
- risk tolerance (−)
- bank equity / capital cushion (−)

* see more in Monetary Transmission Mechanism

Bank's Balance Sheet

monetary policy interest rate
(is a short-term rate, e.g. 14-day)

A very simplified bank balance sheet

ASSETS	=	LIABILITIES
Loans e.g. Mortgage return = retail lending rate		**Deposits** {longer-term, instant access} cost = retail deposit rate — cheapest funding (insured)
Securities gov bond, asset-backed securities, wholesale reverse repo lending ... return typically gov bond yield → collateral for repo borrowing (lately also, yield on asset backed securities) ↳ default risk → 0, capital risk > 0.		**Debt (bank bonds)** e.g. wholesale repo borrowing secured with collateral cost = yield paid on bonds
Reserves / Cash return = central bank deposit rate		**Equity capital (s'holder funds)** robust when > 10% cost ≈ dividend/share price (roughly)

less risky, lower return (↓ from Loans to Reserves)

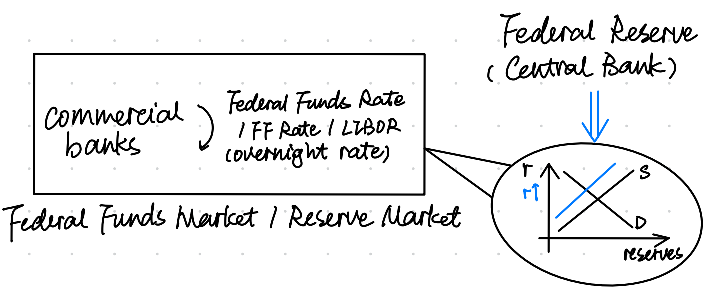
external obligation (Deposits and Debt)

⇓ EFP (External Funding Premium)

Regulating the banks (key risks)

- Maturity mis-match (short liabilities vs long assets) implies cash flow shocks — cash-flow risk
  (short liabilities: deposits; long assets: mortgage loan)
  - so target min reserve or liquidity ratio, **reserves/deposits**
    previous: dictation
    recently: government competes by lower reserve rates
- Risky assets (principally loans, to some extent securities) may go bad and cause insolvency — solvency risk
  - so target min capital ratio, **equity capital/risk weighted assets**
    UK: 70%

Financial System



target: mon pol rate

① "reserve ratio" ↑
② Sell government bonds (drain cash / liquidity)
③ CB deposit rate ↑

interbank overnight interest rate
official bank rate / CB deposit rate } mon pol rate ⇒ lending rate

Monetary Transmission Mechanism: Credit Rationing

Monetary Theory and Policies (third edition), Walsh, Chapter 10.5 and 10.6

Walsh, chapter 7 in the second edition (less emphasis on the more advanced material in 7.3), or 10.5 and 10.6 in the third edition (less emphasis on 10.5.5). This provides a good overview of the impact of imperfect information on credit markets, but is less good in relating this material to the aggregate bank lending channel and other parts of the monetary transmission. If you are comfortable with the coverage of moral hazard and adverse selection in the lecture notes, then I would not focus on the Walsh textbook this week and instead proceed to the articles, which concentrate on why credit market imperfections give rise to various theories of monetary policy transmission via the banking system.

Credit rationing by definition is limiting the lenders of the supply of additional credit to borrowers who demand funds at a set quoted rate by the financial institution.[1] It is an example of market failure, as the price mechanism fails to bring about equilibrium in the market. It should not be confused with cases where credit is simply "too expensive" for some borrowers, that is, situations where the interest rate is deemed too high. With credit rationing, the borrower would like to acquire the funds at the current rates, and the imperfection is the absence of supply from the financial institutions, despite willing borrowers. In other words, at the prevailing market interest rate, demand exceeds supply, but lenders are willing neither to lend enough additional funds to satisfy demand, nor to raise the interest rate they charge borrowers because they are already maximising profits, or are using a cautious approach to continuing to meet their capital reserve requirements.[2]

Adverse Selection

borrowers $\begin{cases} \text{Type G} & q_g \to \text{borrowing rate } \frac{r}{q_g} \\ \text{Type B} & q_b \to \text{borrowing rate } \frac{r}{q_b} \end{cases}$

loan interest rate ↑ ⇒ more Type B borrowers

⇒ expected return to lender ↓

$q q_g r_l + (1-q) q_b r_l = r \quad | \quad r_l = \frac{r}{q q_g + (1-q) q_b}$

since $\frac{r}{q_g} < r_l < \frac{r}{q_b}$, lenders attract more Type B borrowers

⇒ E(return to lender) < r

For the borrower: $E(\pi^B) = \frac{1}{2}[R' + \underset{(+)}{x} - (1+r_l)L] - \frac{1}{2}C$

the critical cutoff: $x^*(r_l, L, C) \equiv (1+r_l)L + C - R'$

For lenders: $E(\pi^L) = \frac{1}{2}[(1+r_l)L] + \frac{1}{2}[C + R' - \underset{(-)}{x}] - (1+r)L$

borrowers $\begin{cases} \text{Type G}, & x = x_g \\ \text{Type B}, & x = x_b \end{cases}$, $x_g < x_b$

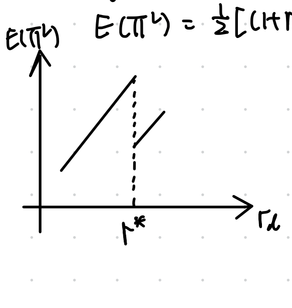
1° $x^*(r_l, L, C) \le x_g < x_b$

$$E(\pi^L) = \frac{1}{4}[(1+r_l)L + C + R' - x_g] + \frac{1}{4}[(1+r_l)L + C + R' - x_b] - (1+r)L$$
$$= \frac{1}{2}[(1+\underset{(+)}{r_l})L + C + R'] - \frac{1}{4}(x_g + x_b) - (1+r)L$$

2° $x_g \le x^*(r_l, L, C) \le x_b$

$$E(\pi^L) = \frac{1}{2}[(1+r_l)L + C + R'] - \frac{1}{2}x_b - (1+r)L$$

↓ fall discretely at $1 + r_l = \frac{x_g - C + R'}{L}$



credit rationing

$$r^* = \frac{x_g - C + R'}{L} - 1$$

Moral Hazard

Now, the borrowers can choose between several projects of different risks
Following Stiglitz and Weiss (1981)

borrower : $\begin{cases} \text{project A}, & \begin{cases} R^a, & \text{good state } (p^a) \\ 0, & \text{bad state} \end{cases} \\ \text{project B}, & R^b\ (p^b)\ /\ 0 \end{cases}$, $R^b > R^a$, $p^a > p^b$, $p^aR^a > p^bR^b$

$E(\Pi^A) = p^a[R^a - (1+r_L)L] - (1-p^a)C$
$E(\Pi^B) = p^b[R^b - (1+r_L)L] - (1-p^b)C$
$\Rightarrow E(\Pi^A) > E(\Pi^B)$ iff. $\frac{p^aR^a - p^bR^b}{p^a - p^b} > (1+r_L)L - C$ (+)

$r^* \Rightarrow \frac{p^aR^a - p^bR^b}{p^a - p^b} = (1+r^*)L - C$

$\Rightarrow \begin{cases} r_L < r^* : \text{take project A} \\ r_L > r^* : \text{take project B} \end{cases}$

Payment to lenders : $p^a(1+r_L)L + (1-p^a)C > p^b(1+r_L)L + (1-p^b)C$
The lender's profits are not monotonic in the loan rate

Monitoring Costs

Lenders have to monitor borrower who always has an incentive to underreport the success of the project
Following Williamson (1987a)

risky project : payoff $x \in [0, \bar{x}]$ (some distribution)

lenders monitoring a cost of c ↗ ; ↘ borrower reports : $x^s \in [0, \bar{x}]$
assumption : monitoring $\Leftrightarrow x^s \in S \subset [0, \bar{x}]$

$\Rightarrow E(\Pi^L) = \begin{cases} R(x) - c, & x^s \in S \\ K(x^s), & x^s \notin S \end{cases} \Rightarrow$ constant $\bar{K}$

monitoring : $x - R(x) > x - \bar{K}$, or $\bar{K} > R(x)$ for all $x^s \in S$

$E(R^b) \equiv E[x - R(x) \mid R(x) < \bar{K}]\Pr[R(x) < \bar{K}] + E[x - \bar{K} \mid R(x) \geq \bar{K}]\Pr[R(x) \geq \bar{K}]$
lenders' expected return $\geq r$ (opportunity cost).

s.t. $E[R(x) - c \mid R(x) < \bar{K}]\Pr[R(x) < \bar{K}] + \bar{K}\Pr[R(x) \geq \bar{K}] \geq r$

Notice that monitoring takes place when a loan default happens, i.e. $R(x) = x$

$E(\Pi^L) = \begin{cases} x - c, & x < \bar{K} \\ \bar{K}, & x \geq \bar{K} \end{cases}$

proof: $E[R^b] = E[x - R(x) \mid R(x) < \bar{K}]\Pr[R(x)<\bar{K}] + (E[x \mid R(x) \geq \bar{K}] - \bar{K})\Pr[R(x) \geq \bar{K}]$

$= E[x-R(x) \mid R(x)<\bar{K}]\Pr[R(x)<\bar{K}] + E[x \mid R(x)\geq\bar{K}]\Pr[R(x)\geq\bar{K}]$

$- (r - E[R(x)-c \mid R(x)<\bar{K}]\Pr[R(x)<\bar{K}])$

(given that $E[R(x)-c \mid R(x)<\bar{K}]\Pr[R(x)<\bar{K}] + \bar{K}\Pr[R(x)\geq\bar{K}] = r$)

$= E[x-c \mid R(x)<\bar{K}]\Pr[R(x)<\bar{K}] + E[x \mid R(x)\geq\bar{K}]\Pr[R(x)\geq\bar{K}] - r$

$= E[x] - c\underbrace{\Pr[R(x)<\bar{K}]}_{\text{probability that monitoring occurs}} - r$

probability that monitoring occurs, $\bar{K}\uparrow \Rightarrow E[R^b]\downarrow$

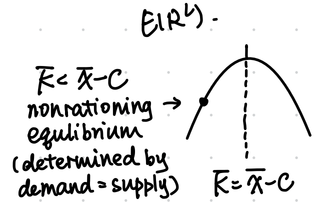
assumption: x is uniformly distributed on $[0, \bar{x}]$

$E(R^L) = \int_0^{\bar{K}} (x-c)\frac{1}{\bar{x}}dx + \int_{\bar{K}}^{\bar{x}} \bar{K}\frac{1}{\bar{x}}dx$

$= \left[\frac{1}{2}\left(\frac{\bar{K}^2}{\bar{x}}\right) - c\left(\frac{\bar{K}}{\bar{x}}\right)\right] + \bar{K}\left[1-\left(\frac{\bar{K}}{\bar{x}}\right)\right] = r$

$\Rightarrow -\frac{1}{2\bar{x}}\bar{K}^2 + \left(1-\frac{c}{\bar{x}}\right)\bar{K} - r = 0$

$\Delta = \frac{1}{\bar{x}^2}(\bar{x}-c)^2 - \frac{2\bar{x}r}{\bar{x}^2} = \frac{1}{\bar{x}^2}[(\bar{x}-c)^2 - 2\bar{x}r]$



$\Rightarrow \bar{K} = \bar{x} - c \pm \sqrt{(\bar{x}-c)^2 - 2\bar{x}r}$

$\bar{K} > \bar{x}-c$ is NOT an equilibrium, as smaller $\bar{K}$ yields higher $E(R^L)$.

$\Rightarrow$ credit rationing equilibrium: $\bar{K} = \bar{x} - c$

Agency Costs

efficiency type $w \in [0,1]$, $w\downarrow \Rightarrow$ fewer inputs needed

project requires inputs of $x(w)$,

yields gross payoff $\begin{cases} K_1, & p=\pi_1 \quad \text{(bad)} \\ K_2, & p=\pi_2=1-\pi_1 \quad \text{(good)} \end{cases}$

$E(\pi) = \pi_1 K_1 + \pi_2 K_2$, denoted K

monitoring costs $= c$ by others (except for the firm)

internal sources of financing $= S$ ($S < x(0)$)

opportunity cost r

If observation costs $= 0$: $K > r x(w)$ iff. receive loans

$\therefore$ borrow $B = x(w) - S$ ($w < w^*$, where $r x(w^*) = K$).

payment:
(to the firm)

	audited	not audited
K_1 is announced	P_1^a	P_1
K_2 is announced	/	P_2

(with probability $= p$).

$$\max\ \pi_1[p P_1^a + (1-p)P_1] + \pi_2 P_2 \quad \text{s.t.}$$

$$\begin{cases} \pi_1[K_1 - p(P_1^a + C) - (1-p)P_1] + \pi_2[K_2 - P_2] \geq rB \\ P_2 \geq (1-p)(K_2 - K_1 + P_1) \\ P_1^a \geq 0,\ P_1 \geq 0,\ 0 \leq p \leq 1 \end{cases}$$

Lagrangian multipliers ⇒ minimize E(audited costs) = $\pi_1 pC$

⇒ no-agency-cost condition: $S \geq x(w) - \frac{K_1}{r} \equiv S^*(w)$

$$p = \frac{r[x(w) - S] - K_1}{\pi_2(K_2 - K_1) - \pi_1 C} \quad \text{(s.t. lender's required return condition)}.$$

$\pi_1 pC$: the agency costs of due to asymmetric information (Bernanke and Gertler).

Lecture 1:
Monetary Transmission Mechanism

Lecture notes - lecture1_2

the Naive 'Pass-Through' Model

1% ↑ mon pol rate ⇒ 1% ↑ in { deposit, debt, capital } arbitrage } Walsh Model

$$E\pi^{BANK} = \frac{1}{2}(R' + x - (1+r_l)L) - \frac{1}{2}C$$ $x \uparrow \Rightarrow E(\pi^{BANK}) \uparrow$

$$E\pi^{INV} = \frac{1}{2}((1+r_l)L) + \frac{1}{2}(C + R' - x) - (1+r)L$$ $x \uparrow \Rightarrow E(\pi^{INV}) \downarrow$

EFP (External Finance Premium) $= r_l - r = f\left(\underset{(+)}{\frac{x}{L}}, \underset{(-)}{\frac{C}{L}}, \underset{(-)}{\frac{R'}{L}}\right)$

For deposit insured by states, $x = 0$;
$x(\text{debt}) < x(\text{equity})$

Distortion to the One-for-One Effect (Example: Adverse Selection)

Types of Banks { G : x_g, B : x_b }, where $x_g < x_b$

$$E\pi^{BANK} = \frac{1}{2}(R' + x - (1+r_l)L) - \frac{1}{2}C$$

$$E\pi^{INV} = \frac{1}{4}((1+r_l)L + C + R' - x_g) + \frac{1}{4}((1+r_l)L + C + R' - x_b) - (1+r)L$$

When $r \uparrow \Rightarrow r_l \uparrow$, Good Banks withdraw the market

$$E\pi^{INV} = \frac{1}{2}((1+r_l)L + C + R' - x_b) - (1+r)L$$ ⇒ EFP ↑

Narrow Lending Channel (NLC)

CB tightens monetary policy ⇒ reserve supply ↓

⇒ bank risks violating $\frac{\text{reserve}}{\text{deposit}} \downarrow$

⇒ { method 1. deposit lending ↓
method 2. switch to debt / equity funding }

⇒ average cost of bank funding ⇑ (> 1%)

Plausibility: ① regulatory / voluntary $\frac{R}{D}$ floor (?) (EFP↓)
② large, internationally diversed bank groups
⇒ less precautionary (EFP↓)
③ deposit not so special (EFP↓)
{ Globalization ⇒ cut r_e↓, TBTF / SIFI ⇒ x↓
money market displaces deposit
[?] 1. global systematic downturn risk
2. complicated instruments ⇒ opaque BS ⇒ adverse selection

Ashcraft's work

the aggregate level of NLC does not add up too much
- banks with spare cash draw customers from banks facing liquidity drain ⇐ systematic liqudity drain
⇐ information asymmetry when customers move across banks

{ deposit-dependent
non deposit-dependent : BHC (Bank Holding Companies)

$$L_{it} = \alpha L_{it-1} + \beta \triangle r_{it} + \gamma \triangle r_t * BHC_{it} + \text{other controls}$$

$\hat{\beta} = -0.84$ $\hat{\gamma} = 0.96$

where L_{it} denotes lending growth, $\triangle r_t$ is the change in the federal funds rate and BHC_{it} is 1 if a bank belongs to a bank holding company and 0 otherwise

Broad Lending Channel (Financial Accelerator)

Policy tightening ⇒ risk free rate (r)↑, banks pass it on to economy
⇒ decline in asset prices↓
⇒ lower collateral banks offer for debt / equity: C↓
⇒ worsen C+R′−X−(1+r)L
{ commercial banks are great investors in gov bond↓
property market: default rate↑
⇒ EFP for non-deposit funding
⇒ banks pass on to customers an Δ(interest rate)
> Δ(risk free risk)

the same reasoning applies to firms: $r\uparrow \Rightarrow$ asset $\downarrow \Rightarrow$ collateral to bank $\downarrow \Rightarrow r_e\uparrow$

Distribution: ① Flight-to-Quality Effect (tightening disproportionately more to banks with insufficient collateral)

② limit monetary effacy: $r\downarrow$, but { liquidity / cash preference, risk perception, asset price $\downarrow$ (offset) }

Other Perspectives

1. the Bank Capital Channel

$$\frac{\text{Equity Capital}}{\text{risk weighted asset}}$$

→ hard to extract: add profits to retained earnings (?)

→ smaller loan book ↓

tight policy erodes bank capital:

1. narrow / broad channels slow the real economy, loan defaults↑, equity↓
2. majority-mismatch ⇒ bank accepts lower margin on loans for a period
3. risk weightings may be adjusted up in the long-run

2. the Risk Taking Channel

investors more risk averse ⇒ EFP ↑

Lecture 2:
Tools and Targets for mon pol

Lecture notes - lecture3_4

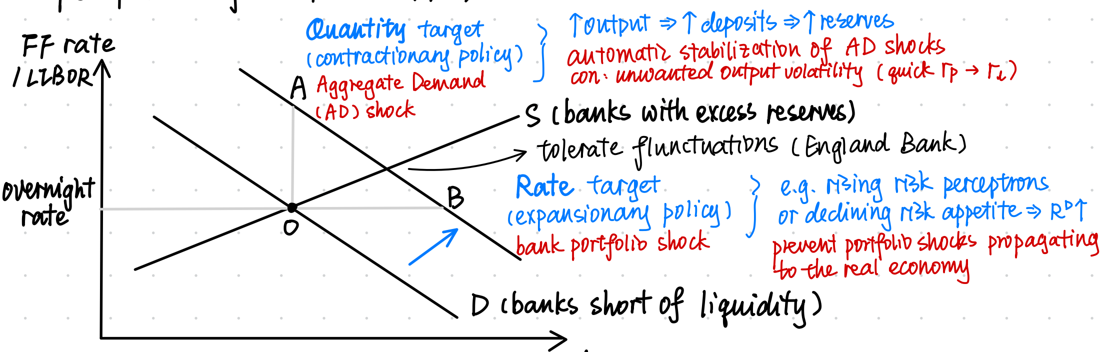
Lecture Overview

1. operating target { the overnight interest rate (~2009)
   the amount of liquidity / reserves traded (1980s)
2. in response to { loss function variables (e.g. inflation) 1970s, 1980s
   intermediate target (e.g. money supply) since 1990
   ⇒ inflation stability
3. Taylor rule

1. Operating Target

central bank ⇒ instruments of mon pol { open market operations, CB deposit rate } ⇒ overnight rate target / reserves target

Perspective from Poole (1970)



Other determinants

1. transparency : interest rate easier to interpret
2. QE / quantitative easy : deep recession policy rate → 0

2. Predictor

Money Supply (intermediate variable)

– Mechanism

Money ⇒ potential for expenditure ⇒ future output and inflation
⇒ may signal macroeconomic imbalances not reflected in π and Δy

(identity of exchange: $MV = PY$)

Assumption: stable velocity V (more likely with M = broad money)
prices are sticky relative to quantities

Con: narrow money more easily controlled by central banks

– Opposition

1. (empirical) positive correlation in Eurozone, weaker evidence in US (foreign holdings of \$ ⇏ expenditure)
(theory) changes in velocity
⇒ domestically held money: a better predictor

2. bank lending to financial institutions ($M\uparrow$, but not ⇒ expenditure)
⇒ money measures that omit loans between financial institutions

3. credit creation via overdrafts (透支) ⇒ counter-cyclical

However, high broad money growth in the US during 2020-2021 successfully predicts the inflation surge of 2022

Inflation (direct focus)

Empirical study: can lead to excessively loose monetary policy when inflation is surpressed for extended periods by exceptional factors

⇒ cross-checking via reference to broad money growth

Doubt for cross-checking: Lucas Critique

"any attempt to exploit a statistical correlation (e.g. broad money growth and macro imbalances) for policy purposes will simply result in the correlation breaking down and police effect ↓"

Pro: easier interpretation, guide expectations (2% in UK) / transparency
(the closer is $E(\pi)$ to target, the more rapidly hit the target)

Debate on transparency

1. beliefs / objectives can be circulated more rapidly
2. prevent inefficient coordination failures between fiscal (gov) and monetary policy (CB)
3. publishing inflation forecasts brings forward in time penalty from excess inflation → different forecasts

1. noisy CB signal ⇒ raise aggregate volatility
2. minority views be surpressed, deteriorate the quality of decisions
3. (currency union, e.g. EU) vote in the interest of Eurozone or German national interest?

3. the Taylor Rule

(Taylor characterize US monetary policy for 1987q1 – 92q4)

$$i_t = (r^* + \pi^*) + 0.5(y_t - y_t^*) + 1.5(\pi_t - \pi^*)$$

i_t: nomial; r^*: target; π^*: target; y_t: actual; y_t^*: potential (based on a constant growth assumption); π_t: current inflation

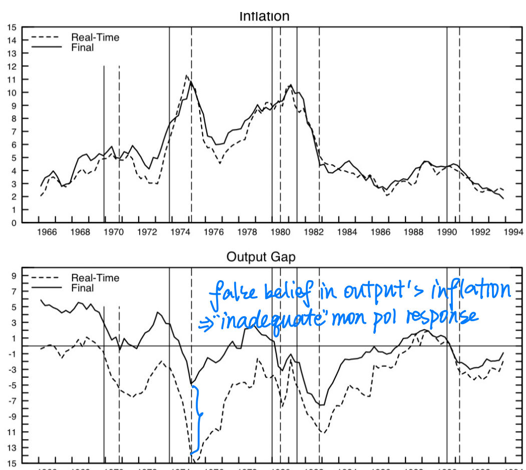
1.5 → close to 2 when estimated using real time data

Monetary Policy Rules in Real Time (Orphanides, 2003)

(Great inflation in 1970s: $\pi\uparrow$ 10% in many countries)

CGG: failure in Taylor rules (only except post-1992)

Orphanides: information constraints for CB
—— potential output is a latent variable



Taylor rule can only be used to evaluate policy if estimated using real time data.

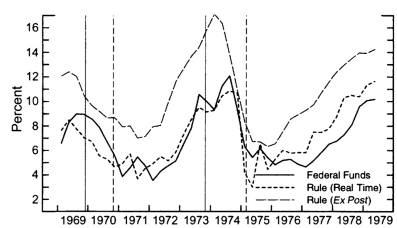


FIGURE 3. REAL-TIME AND *EX POST* TAYLOR RULES

(Another Great Inflation? 2022/23 inflation ↑ in UK (11% / 7%) and US

2020s: oil and gas shortages (from international conflicts)

(not as much as 1970s: oil price hike half as big, energy intensity of economy ↓)

belief: slow rates of economic growth will contain price inflation

2023: low expectation of inflation (peek at late 2022: 6%, 2023: 4%)

{ trade unions less control over real wages
, firms harder to preserve profit margins (global competition)

interest rate 15 years at the ZLB

historically high rates of narrow money creation by CBs via QE

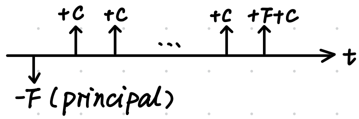
—— QE + supply shock: long inflation

Lecture 3: the Yield Curve

Lecture notes - lecture 5

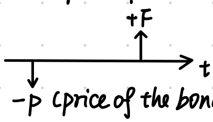
Term Structure of Interest Rate

Coupon Bond



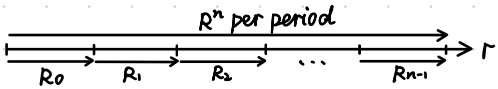
e.g. UK government gilts, US treasury bonds

Discount Bond (zero coupon)



{ discount rate = $\frac{F-P}{F}$
implicit interest rate = $\frac{F-P}{P}$

e.g. treasury bills



no arbitrage: $(1+R_t^n)^n = \prod_{i=0}^{n-1}(1+R_{t+i})$

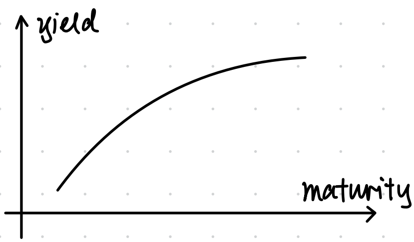
denote $i_t^n = \ln(1+R_t^n)$, $i_{t+i} = \ln(1+R_{t+i})$

$\Rightarrow i_t^n = \frac{i_t + i_{t+1} + \cdots i_{t+n-1}}{n}$ ($\ln(1+R_{t+i}) \approx R_{t+i}$)

Term premium (account for risk): $i_t^n = \frac{i_t + E(i_{t+1}) + \cdots E(i_{t+n-1})}{n} + \theta_t^n$

(though $E(i_t) \neq \ln(1+E(R_t))$)

Expectations Hypothesis of the Term Structures (EHTS): θ_t^n varies with n but not t



"the yield curve steepened on market expectations of a tightening of monetary policy"

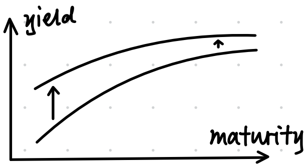
if y/c inverted: { sign markets expecting recession
CB cut short rates

y/c indicates credibility of monetary policy

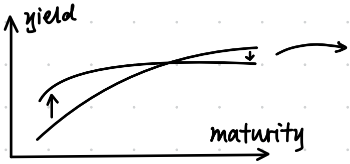
Ellingsen and Soderstrom

1. mon pol changes elicit reactions only when unexpected
   anticipated policy changes shift y/c at the time they become anticipated
2. 2 cases of unexpected mon pol shocks:

   { endogenous: forecast higher π than target $\Rightarrow$ short rates ↑
   exogenous: unrelated to $E(\pi)$, e.g. change in committee $\Rightarrow \pi^T$↓ (greater aversion)



(endogenous shock)



(exogenous shock)

→ if current policy rate is sufficiently large

Kuttner (2001): measures of unanticipated policy changes

spot month futures contract rate on day t of month s : $fut^{0}_{s,t}$

$$fut^{0}_{s,t} = E_t \frac{1}{m} \sum_{i \in s} ff_i + \mu^{0}_{s,t}$$

number of days　fed fund rate　risk premium

a measure of the unanticipated component of policy intervention:

$$\frac{m}{m-t}(fut^{0}_{s,t} - fut^{0}_{s,t-1})$$

Regression specification:

$$\Delta i^n_t = b^n_3 + b^n_4 \Delta ff^{exp}_t + b^n_5 \Delta ff^{unexp}_t + V^n_t$$

$\Rightarrow b^n_5 >> b^n_4$, more significant

Ellingsen and Soderstrom (2005):

$$\Delta i^n_t = \alpha_n + (\beta^{NP}_n d^{NP}_n + \beta^{End}_n d^{End}_n + \beta^{Ex}_n d^{Ex}_t) \Delta i^{-3m}_t + V^n_t$$

a non-policy day　endogenous　exogenous

QE: the change to short-term interest rate is uncertain
- Supply curve shifts to the right
- Demand curve shifts to the left

normal monetary policy: the effect on the long-term interest rate

the tern premium (the residual) cannot be measured accurately
- proxy: upheaval in the political scenario as a measure of the term premium
- AI perceptrons: to sense the public risk aversion (traders, not the general public, some natural language processing method)

Time-varying term premium

Should the monetary policy reaction function include long-term interest rates?
- Japanese Yield Curve Control: unlimited QE, currency depreciation
- reverse yield curve signal: changing policy decreases government credibility
- reasons for the reverse yield curve is not certain: public emotion? Chinese investors preferring long-term bond

Lecture 4 :
Pwblic Finance (seigniorage)

Lecture notes - lecture 6

Each time a central bank creates money, the value of existing money is diluted.

Inflation as a source of public finance

$$G_t + i_{t-1}B_{t-1} = T_t + (B_t - B_{t-1}) + (H_t - H_{t-1})$$

government expenditure; stock of debts (inc. consol bonds); tax revenue; monetary base = nonbank public + reserves (high powered money, narrow money) non-interest bearing asset

in nomial income units:

$$\frac{G_t}{P_tY_t} + i_{t-1}\left(\frac{B_{t-1}}{P_tY_t}\right) = \frac{T_t}{P_tY_t} + \frac{B_t - B_{t-1}}{P_tY_t} + \frac{H_t - H_{t-1}}{P_tY_t}$$

$$\frac{B_{t-1}}{P_tY_t} = \frac{B_{t-1}}{P_{t-1}Y_{t-1}} \cdot \frac{P_{t-1}Y_{t-1}}{P_tY_t} = b_{t-1}\left[\frac{1}{(1+\pi_t)(1+\mu_t)}\right]$$

$$\Rightarrow \quad g_t + \bar{r}_{t-1} b_{t-1} = t_t + (b_t - b_{t-1}) + h_t - \frac{h_{t-1}}{(1+\pi_t)(1+\mu_t)}$$

$\left(\frac{1+i_{t-1}}{(1+\pi_t)(1+\mu_t)} - 1\right)$ the ex-post real return from t-1 to t

set $\mu=0$. denote π_t^e as the expected inflation, r_t as the ex-ante real rate, i.e., $1+i_{t-1} = (1+r_{t-1})(1+\pi_t^e)$, adding $(r_{t-1} - \bar{r}_{t-1})b_{t-1} = \frac{(\pi_t - \pi_t^e)(1+r_{t-1})b_{t-1}}{1+\pi_t}$:

$$\Rightarrow \quad g_t + r_{t-1}b_{t-1} = t_t + (b_t - b_{t-1}) + \frac{\pi_t - \pi_t^e}{1+\pi_t}(1+r_{t-1})b_{t-1} + \left[h_t - \frac{h_{t-1}}{1+\pi_t}\right]$$

(1) ex-ante real interest rate; income from deflating debt interest payment via surprize inflation

anticipated inflation doesn't deflate interest payment, as the effects will be compensated by an increase in i.

(2) **seigniorage:** $S_t = h_t - \frac{h_{t-1}}{1+\pi_t} = (h_t - h_{t-1}) + \left(\frac{\pi_t}{1+\pi_t}\right)h_{t-1}$ → "the tax base"

(2-1) private portfolios adjust in favour of non-interest bearing government liability (e.g. liquidity)
in equilibrium: $h_t - h_{t-1} = 0$

(2-2) ↳ can be collected in steady-state "the tax rate"

limits to revenue creation via seigniorage tax:

h (tax base) endogenous to anticipated inflation ⇒ lower h

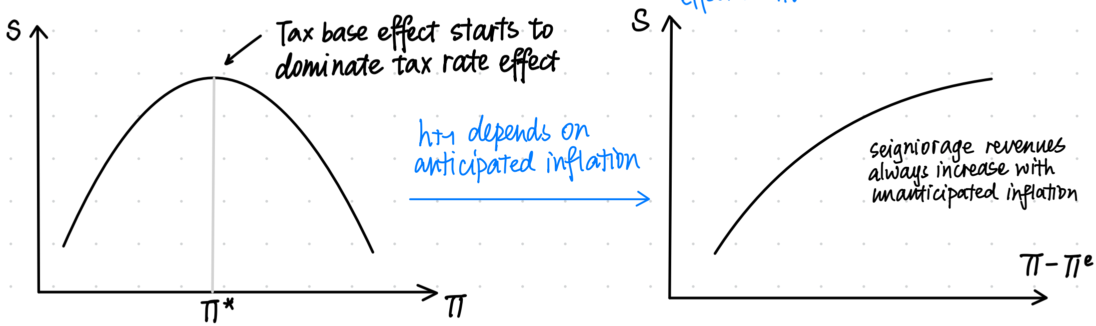
⟶ Laffer Curve

the Inflation Tax Laffer Curve

seigniorage: $S_t = h_t - \frac{h_{t-1}}{1+\pi_t} = (h_t - h_{t-1}) + \left(\frac{\pi_t}{1+\pi_t}\right) h_{t-1}$ → "the tax base"

2   2-1   2-2 real money holding

- $(h_t - h_{t-1})$: private portfolios adjust in favour of non-interest bearing government liability (e.g. liquidity)
  - in equilibrium: $h_t - h_{t-1} = 0$
- $\left(\frac{\pi_t}{1+\pi_t}\right)$: ↳ can be collected in steady-state "the tax rate"
  - decreasing marginal effect on π_t



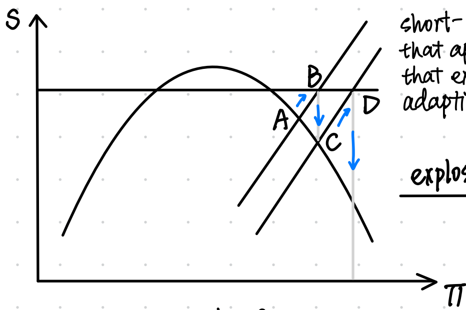
Cagan (1956): a model of seigniorage and hyperinflation

estimated turning point: $\pi^* \in (200\%, 300\%)$ per annum

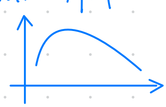
cannot explain hyperinflation: Zimbabwe (>600%)

Cagan's key assumption: (adaptive inflation expectation) $\pi_t^e = \pi_{t-1}$

↳ portfolio adjustment frictions, preference



short-run revenue functions that apply under the assumption that expectations are updated adaptively



explosive θ and π →

until:
lowered expected inflation
(× first reduction in money)

Evaluation of the Cagan model:

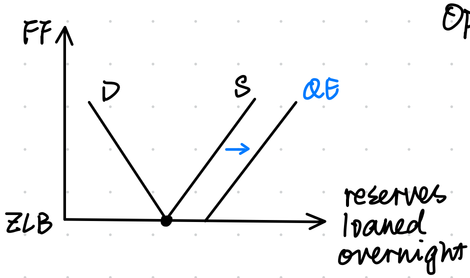
1. high π ⇒ adaptive inf expectation ×, large error
2. constraints on portfolio adjustment ⇒ violate $E(\pi) = \pi_{t-1}$
3. why government ↑π if it knows it'll reduce future revenues

Lecture 5 :
Quantitative Easing

Lecture notes - lecture 7

Limit to Conventional Politics

Negative nomial interest rates can be avoided by hoarding cash
(*) small negative rates: Riksbank, Swiss National Bank
(storage of vault cash costly)

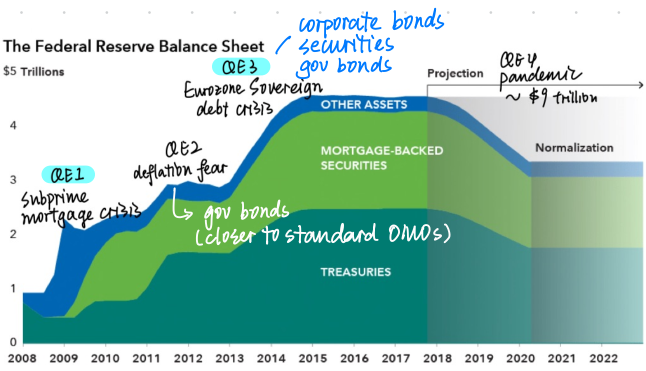


Options:
- forward guidance for r (extend low rate period by linking rates to numerical targets for u, π)
- CB vary balance sheet composition
  (2007/8 (Fed): sell treasury bonds, buy ABS
  2012 (Fed): sell short gov bills, buy long bonds / twist the yield curve)
  ECB's Long-Term Refinancing Operations (LTRO)

Quantitative Easing (QE) to raise inflation

Central Bank creates electronic accounts credited with new cash balances (addition to monetary base), and purchases assets from financial institutions, so private sector cash balances are increased

(*) new liabilities (cash reserves) + assets ⇒ balance sheet expansion



Sources: Federal Reserve, U.S. Treasury. As of 6/30/2017.

1. QE → ZLB
   (unlike Open Market Operations / OMO)
   target a quantity, not price
   larger balance sheet expansion
2. New risks
   assets may lose value
   unlimited BS expansion
   Treasury underwrite losses

More into QE

the QE procedure

The ultimate sellers of assets are typically the non-bank private sector, for example insurance companies and pension funds.[3] By selling assets such as long-dated government bonds (gilt-edged securities, or gilts), the non-bank private sector's holdings of gilts falls (Figure 1). To pay for these gilts, rather than printing currency, the central bank credits the bank accounts of the ultimate sellers of these assets. QE thereby increases their holdings of bank deposits, and so broad money (Figure 1). The central bank finances its purchases by issuing base money in the form of reserves held by commercial banks. It therefore expands its own balance sheet, with the holdings of gilts matched by reserves (Figure 2). The banking sector's balance sheet also expands as the increased holdings of deposits by the non-bank private sector are matched against the newly created central bank reserves (Figure 3). It is this set of perturbations to balance sheets, precipitated by central bank asset purchases, that leads to portfolio rebalancing and so marks the start of the transmission mechanism of QE that is discussed in section III.

Figure 1:

Assets	Liabilities
– Gilts + Deposits	

Open in new tab | Download slide

Non-bank private sector (e.g. pension funds)

Figure 2:

Assets	Liabilities
+ Gilts	+ Reserves

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Central bank

Figure 3:

Assets	Liabilities
+ Reserves	+ Deposits

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Private bank

pure QE: private sector indifferent between holding gilts and money

As a result, the money created by purchases of one-period bonds may be passively absorbed by the private sector. In these circumstances, attempts at this sort of expansionary monetary policy have no impact as the economy is in a liquidity trap.

Otherwise: portfolio rebalancing

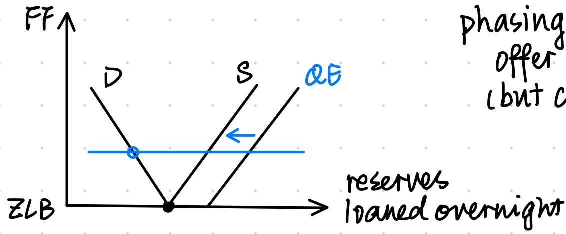
QE different from conventional monetary policy:

1. direct injection of a specified quantity of broad money
   rather than influence its price through variations in the price of base money
2. target longer-dated gilts and private-sector assets
   including: corporate bonds, MBS ...

QE Transmission Channels

1. Portfolio Rebalancing and the Shadow Banking System

QE ⇒ private investors long in cash with a low return, maturity mismatched
⇒ rebalance portfolios towards corporate bonds and equities (shadow banking)
⇒ drive up prices for corporate bonds and equities, r↓ (long-term yield)
(relatively cheaper than government bonds, however)
⇒ corporations better hiring, investing; aggregate demand ↑
(also: QE ⇒ purchase of long-term assets ⇒ long-term risk premia ↓)



phasing out of QE (aftermath):
offer good deposit rate in the CB
(but costly, loss making)

* Signalling Channel: reveal about the likely path of future monetary policy (expect policy rates to remain lower for longer ⇒ remain credibility, keep π^E anchored)
* Liquidity Channel: liquidity in long-term assets

2. Exchange Rate Channel

QE ⇒ portfolio rebalancing, diversify into foreign assets
⇒ boost supply of domestic currency on foreign exchange market
⇒ depreciates real exchange rate and boosts net exports
⇒ US$ depreciates, China's foreign exchange reserves declines

3. Fiscal Channel

QE ⇒ prices of gov bonds ↑, interest rate payable ↓
⇒ gov debt ↓, more gradual fiscal consolidation implementation

(*) flow of QE / stock of QE ?? matters for interest rates on government debt

– if it is the flow of QE then expect US government to face higher interest rates in second half of 2011
– but central banks argue it is the stock of QE that matters, e.g. (i) re-investment of maturing assets necessitates some further asset purchases even when QE formally over; (ii) through having absorbed so much government debt, central banks have reduced default probabilities and therefore the risk premia investors require on bonds

(*) long-term rate ↓ ⇒ income of pension funds ↓ (adverse-imome effect)
(retired people have a large propensity to consume)

QE and Bank financing costs

1. lower EFPs: banks (biggest holders of sovereign's bonds) ⇒ collateral ↑ when value of bonds rise
   improved fiscal position limits future tax liability, sovereign is better placed to launch a bank bail-out
2. support bank lending and private expenditure (but banks must be willing to pass on lower costs)

Has QE worked?

On the plus side:

1. shadow banking system has boomed (UK stock market up 22% in 2009. firms accessed corporate bond markets on record scale due to low cost of funds)
2. avoid deflation (US: 1% and falling ⇒ 2% since QE II)
3. currency weakened post-QE
   government bond yields low despite acceleration of gov debt

On the negative side:

1. bank lending to consumers and small firms remain weak
   ⇒ consumer spending sluggish, service sector weak
   (QE cannot directly help the small guy)
   - rising capital ratios (to reverse effects of crisis)
     (thus banks can only increase loans using equity. however low EFP gets)
   - corporations more willing to hold cash than spend it (reduced risk appetite)
2. savings are used to retire expensive debt and build corporate cash reserves

[risks]

3. QE and inflation risks
   (QE IV: £800bn UK, 30% ~ 40% nominal GDP) ⇒ price ↑ → Y(GDP) ↑
   especially when velocity ↓ (MV=PY), but when V recovers ...

CB options

1. automatic exit of QE
   reverse asset purchases through allowing gilts to mature and recouping cash (But long maturity debt ...)
2. sell devalued assets ⇒ fiscal deficit, above target inflation, hurt holders
3. raise bank rate to constrain lending (costly)

Foundations for the next crisis:

(1) pump liquidity into failing financial institutions
(2) 'zomby firms' kept alive but fundamentally unproductive
(3) drive next asset price bubble (waiting to burst)

Fiscal losses:

CB takes losses ⇒ treasury absorbs such losses ⇒ fiscal problems
(customers forward-looking: higher future tax ⇒ saving ↑ today)

Institutional Structures:

CB allocates money via QE, but not elected to do this
Gov audit CB ⇒ excess inflation for political gain

Undermining CB transparency:

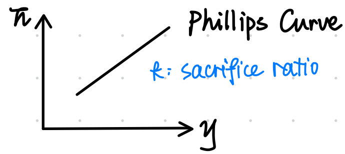
hard to predict more / less QE on the way
unwanted volitility (expect price ↓, sell, gov do nothing, buy ↑)

Lecture 6 :
the Phillips Curve

Lecture notes - lecture (Richard Mash) 1+2

What predictions regarding price and output dynamics can be obtained given different assumptions about:

(i) the flexibility of nomial variables
(ii) the formation of expectations
(iii) the nature of information

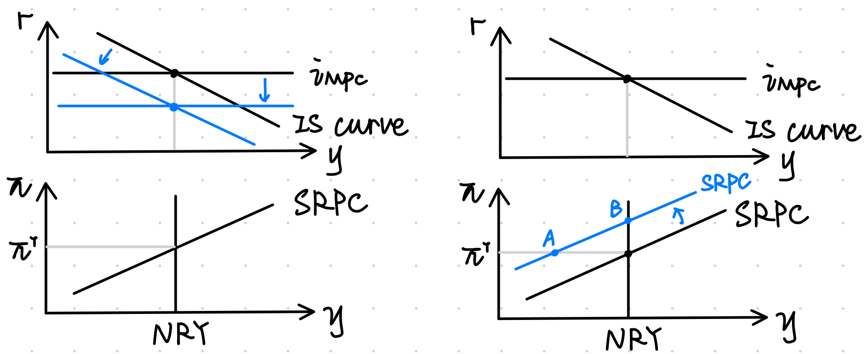


Terminology

the Phillips Curve: wage inflation = F(unemployment)
price inflation = F(output)

the Aggregate Supply Curve: causation runs from prices to outputs

"the" Phillips Curve in this part refers to the short run Phillips Curve



Key Data Features

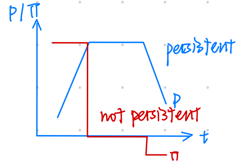
1. A positive sacrifice ratio

the sacrifice ratio as the cumulative percentage loss of annual GDP relative to trend required for a 1 percentage point reduction in the underlying inflation rate

	Maximum sacrifice ratio	Minimum sacrifice ratio
Canada	8.90%	1.53%
France	4.32%	-2.71%
Germany	15.67%	6.25%
Italy	9.14%	2.04%
Japan	1.85%	-2.50%
United Kingdom	7.09%	-0.27%
United States	13.47%	6.42%

2. **Price level persistence**

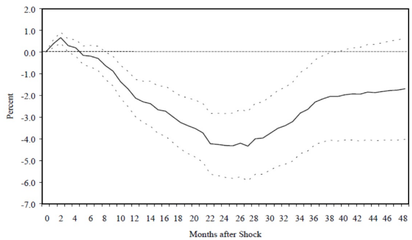
price level persistence does not necessarily imply inflation persistence



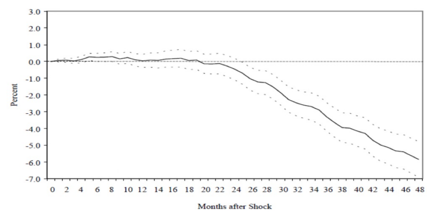
3. **Inflation and output persistence**

models of aggregate fluctuations must be capable of generating endogenous persistence (exogenous persistence in policy process accounts only a small fraction)

i. The response of output to a monetary contraction is U-shaped.



ii. The response of the price level to a monetary contraction is delayed, leading to considerable inertia in the inflation rate.



Modelling Themes

Source of Tradeoff

timing / information / behavioural frictions with flexible prices vs. sticky prices / wages

Baseline: if all prices / wages are flexible, the economy should be stable at the natural rate of output (NRY) and there's no sloping Phillips Curve

Keynesian: if prices / wages are sticky, a sloping Phillips Curve generally arise.

two pricing model: state dependent and time dependent pricing

1. **optimising microfoundations (Lucas Critique)**
   agents take sensible decisions to maximize their objectives
   the Lucas critique: "structural" microfoundations (not prone to change when policy changes)
2. **rational expectations (x adaptive expectations)**
   RE is the standard modeling assumption, however it's hard to replicate persistence under RE
3. **price level persistence**
4. **inflation and output persistence**
5. **positive sacrifice ratio**

Firms in monopolistic competition: $P_t^* = P_t + \alpha y_t + \varepsilon_t$

(P_t: log price, y_t: output gap, ε_t: cost push shock)

- flexible prices but time frictions: set $P_t = E_{t-j}[P_t^*]$
- sticky prices in Keynesian models: newly set prices last for >1 period
  the choice of price

Models

Phillips Curve Models: Summary of Key Features

Model	Optimising Microfoundations?	Rational Expectations?	Price Level Persistence?	Inflation and Output Persistence?	Positive Sacrifice Ratio?
FLEXIBLE PRICES & WAGES					
Phelps/Friedman	Yes	No	Yes	Yes	Yes
Lucas*	Yes?	Yes	No	No	Yes (unanticipated policy)
Kydland & Prescott/ Barro and Gordon	Yes?	Yes	No	No	Yes (unanticipated policy)
Mankiw & Reis*	Yes??	Yes	Yes	Yes	Yes (unanticipated policy)
Christiano, E'baum & Evans*	No?	Yes	Yes	Yes	Yes (but can be perverse)
STICKY PRICES AND/OR WAGES	nominal rigidity: constraints on resetting prices/wages				
Taylor*	Yes	Yes	Yes	No	Yes (but can be perverse)
Fuhrer & Moore	No	Yes	Yes	Yes	Yes (but can be perverse)
Roberts	Yes	No	Yes	Yes	Yes (but can be perverse)
Calvo*	Yes	Yes	Yes	No	Yes (but can be perverse)
Gali & Gertler*	No?	Yes	Yes	Yes	Yes (but can be perverse)

1. "Flexible Model 1": Phelps/Friedman

inflation ⇒ output

adaptive expectations: $y_t = k(\pi_t - \pi_{t-1})$

when inflation and nomial wages rise, workers underestimate inflation so overestimate the real wage and oversupply labour, hence a temporary output increase

however, more successful empirically

Lucas's Island (firm ≈ island) data published few days later

2. "Flexible Model 2": the Imperfect Information Model (Lucas, 1972)

inflation ⇒ output

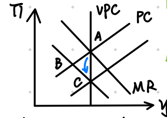
- competitive markets
- full price flexibility & rational expectations
- long-run Phillips Curve vertical at full employment output
- stable velocity in $PY = MV$, thus Δgrowth $P \propto \Delta$growth M

producers have imperfect information about the aggregate price level

↑price { aggregate price inflation ⇒ constant Y; a change in relative price ⇒ ↑Y profitable

$\Rightarrow y_t = c(p_t - E_{t-1}[p_t]) = c(\pi_t - E_{t-1}[\pi_t])$ Lucas surprise supply function

A→B shows persistence (but not too much)



persistence: { gov incredible / public unaware
However: Germany, Switzerland credible ⇒ persistence

Effects of anticipated policy

1. only unanticipated changes in the money supply affect output
2. price level and inflation behave as jump variables
3. pre-announced disinflation (provided credible) can be achieved without output loss ($k=0$)
4. stabilization policy cannot reduce output volatility if information is symmetric

Effects of unanticipated policy

Phillips curve relationship only observed contemporaneously, equilibrium restored next period once producers can observe aggregate prices for the period before

3. "Flexible" Model 3: Kydland & Prescott / Barro & Gordon

firms { set prices contemporaneously (ex post) ⇒ set ideal single period price / set prices one period in advance (ex ante) ⇒ set expectation ideal price

$\Rightarrow \pi_t = E_{t-1}[\pi_t] + ky_t + f(\varepsilon_t)$

Assessment: { ex ante price setting plausible / positive one-period sloping PC, but π and y lack persistence

proof for M&R: sectoral difference in persistence of inflation (service > good)

4. "Flexible" Model 4: Sticky Information (Mankiw and Reis)

output ⇒ inflation

time-dependent re-optimization rule (a constant probability of re-optimization each period given by λ)

justification for re-optimization rule: costly for gathering information, menu cost

$\Rightarrow \pi_t = \frac{\lambda}{1-\lambda} y_t + \lambda \sum_{j=1}^{\infty} (1-\lambda)^j E_{t-j}[\pi_t + \alpha \Delta y_t]$

proxy for: rational constraints / cognitive capacity (how to interpret data)

Assessment: { price plan v.s. re-optimization — which is reasonable? / price level persistence ✓ inflation and output persistence ✓

con: professionality

5. "Flexible" Model 5: Indexation (Christiano, Eichenbaum and Evans)

mix

Calvo probability structure + adjust price from the period before and partially indexing it to lagged inflation (Gali-Gertler model with $\theta \approx \frac{1}{2}$)

6. "Sticky" Model 1: Taylor (1979, 1980)

2-period wage contracts (50% of contracts negotiated each period)

X_t: contract wage set at time t ⇒ average wage is $W_t = \frac{X_t + X_{t-1}}{2}$

assume: a constant markup: $P_t' = W_t + \mu$ (log price) ⇒ $P_t = \frac{X_t + X_{t-1}}{2}$

$\frac{1}{2}[(X_t - P_t) + (X_t - E_t P_{t+1})] = ky_t \quad \Rightarrow \quad X_t = \frac{1}{2}(P_t + E_t P_{t+1}) + ky_t$

real wage today; future anticipated real wage; (the expected average real wage ∝ output gap)

$$P_t = \frac{1}{2}[\frac{1}{2}(P_t + E_t P_{t+1}) + ky_t + \frac{1}{2}(P_{t-1} + E_{t-1}P_t) + ky_{t-1}]$$

$$= \frac{1}{2}P_{t-1} + \frac{1}{2}E_t P_{t+1} + k(y_t + y_{t-1}) + \frac{1}{2}\eta_t, \quad \eta_t \equiv E_{t-1}P_t - P_t$$

$$\Rightarrow \pi_t = E_t \pi_{t+1} + 2k(y_t + y_{t-1}) + \eta_t$$

properties of the Taylor model

1. current inflation depends on today's expectation of inflation tomorrow (due to wage-setters looking ahead to future inflation during the second period of the contract)
2. credible disinflation can be costless so a positive sacrifice ratio is predicted only for non-credible or unanticipated reductions in inflation.
3. Some reductions in inflation can give rise to an output bloom! ($\pi_t > E_t\pi_{t+1}$) Ball booms
4. no lagged inflation ⇒ doesn't predict inflation or output persistence

7. "Sticky" Model 2: Fuhrer and Moore (1995) → relative wage concerns

$$x_t - p_t = \frac{1}{2}(x_{t-1} - p_{t-1} + E_t(x_{t+1} - p_{t+1})) + 2ky_t$$

some jealousy of other group of workers

nomial rigidity + real rigidity (benchmark effect)

critique: why x_{t-1} instead of a more rational x_t? (However, emprically justified)

$$\Rightarrow \pi_t = \frac{1}{2}(\pi_{t-1} + E_t\pi_{t+1}) + 2k(y_t + y_{t-1}) + \eta_t$$

thus persistence in inflation process, a positive sacrifice ratio even for anticipated reductions in inflation, longer-lived effects of disinflation

8. "Sticky" Model 3: Ad hoc departure from rational expectations (Robert)

$$\pi_t = \frac{1}{2}(\pi_{t-1} + E_t\pi_{t+1}) + 2k(y_t + y_{t-1}) + \eta_t$$

9. "Sticky" Model 4: Calvo (1983) Pricing

{ p_i: re-set prices; $1-p_i$: stablize prices

price/wage stickiness is introduced using a stochastic time dependent pricing rule which takes the form of an assuming a constant probability of the firm being able to change it's price each period

"the Phillips Curve" (the New Keynesian Phillips Curve):

$$\pi_t = \beta E_t[\pi_{t+1}] + \chi y_t + g(\varepsilon_t)$$

(don't have the term π_{t-1})

Assessment: hugely prominent from Taylor's model, but unable to replicate persistence in inflation and output

mix

about the growth rate of prices

10. "Sticky" Model 5. Gali and Gertler (1999)

the rule of thumb to set a new price: base on last period's newly set prices adjusted for lagged inflation

$$\pi_t = \beta(1-\theta) E_t[\pi_{t+1}] + \theta\pi_{t-1} + \chi y_t + g(\varepsilon_t)$$

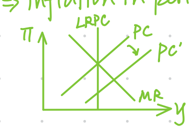
optimizing microfoundation; rule of thumb (dumb)

hybrid NKPC (New Keynesian Phillips Curve)

"disinflation boom"

in period t-1: CB announce in period (t+1): $\pi\downarrow$

⇒ inflation in period t: $\pi_t\downarrow$ ahead of time



$\pi\downarrow, y\uparrow$ ⇒ sacrifice ratio <0 ! (normally positive)

Lecture 6 :
Discretionary Policy

Lecture notes – lecture (Richard Mash) 3+4

Time Consistent / Inconsistent Policy

- Time consistent policy: period by period optimization
  ⇒ discretionary policy making
  (sub-game perfect equilibrium in game theory)
- Time inconsistent policy: commitment to stick to pre-made plan
  (could be sub-optimal at the time of implementation)

- Delegation
  independent CB: loss functions different from society
  ⇒ make the outcome closer to the ideal commitment outcome
- Constrained discretion
  standard discretion is constrained by an announced inflation target

Inflation Bias

Inflation Bias: a particular time inconsistency problem by which the average inflation rate is too high relative to social optimum

Reasons:
- i) economic fundamentals
  tax distortions, imperfect competition, excessive minimum wages / trade union
- ii) political motivations: can be solved by delegation

The Model (Barro and Gordon, 1983 with quadratic loss function)

AS: $y = y_n + a(\pi - \pi^e) + e$ (Keynesian form: $\pi = \pi^e + \frac{1}{a}(y - y^n - e)$)

y: log(output); y_n: log(natural output); e: random, zero mean supply shock / cost push / inflation shock

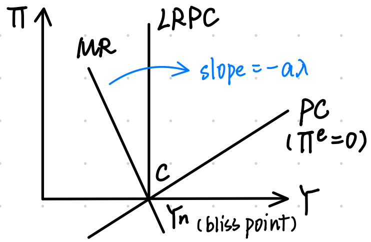
Assumption: policy maker can set inflation directly ($\pi = \Delta m + v$)
- Expectations formed prior to the monetary policy decision and e
- Supply shock realized, monetary policy determined; output and inflation determined

CB aims to min expected value of following loss function:

$$V = \frac{1}{2}\lambda(y - y_n - k)^2 + \frac{1}{2}\pi^2$$

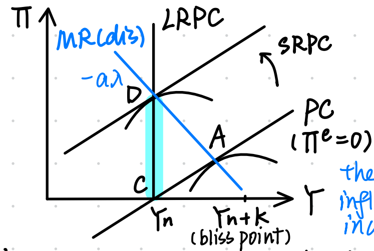
stabilize output around $y_n + k$; stabilize inflation around 0

If $k=0$:



shocks ⇒ policy along MR line

Adaptive Expectations ($k>0$):



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

myopic policy maker

the socially optimal inflation rate is time inconsistent

the attempt for higher output ⇒ move C to D

Rational Expectations Solution:

$$V = \frac{1}{2}\lambda\left(a(\pi-\pi^e)+e-k\right)^2 + \frac{1}{2}\pi^2$$

FOC: $\frac{\partial V}{\partial \pi} = a\lambda\left(a(\pi-\pi^e)+e-k\right)+\pi = 0$

$$\Rightarrow \pi = \frac{a^2\lambda\pi^e + a\lambda(k-e)}{1+a^2\lambda}$$

$$\therefore \pi^e = E(\pi) = \frac{a^2\lambda\pi^e + a\lambda k}{1+a^2\lambda} \Rightarrow \pi^e = a\lambda k \quad (\text{with } E(e)=0)$$

cost — marginal benefit of inflation

→ substitute back into FOC:

$$\pi^d = a\lambda k - \left(\frac{a\lambda}{1+a^2\lambda}\right)e$$

stabilization motive

→ substitute $\pi^d - \pi^e$ into the AS equation:

$$y = y_n + \frac{1}{1+a^2\lambda}e$$

notice there's no k in the equation

Solution to the Inflation Bias

Repetition of this Nash game ⇒ reputation building
(a possible escape from the inflation bias problem but tend to be fragile)

CBI (Central Bank Independence)

- instrument independence
- goal independence

— the Conservative Central Banker (Rogoff, 1985)

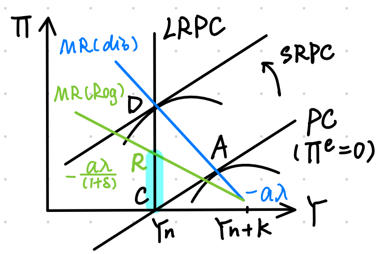
loss function: $V^R = \frac{1}{2}\lambda(y-y_n-k)^2 + \frac{1}{2}(1+\delta)\pi^2$

conservativeness (extra dislike of inflation)

$\Rightarrow (1+\delta)\pi = a\lambda k$

weight conservatism reduces the propensity for CB to dampen output shocks using counter-cyclical policy

(Delegation to an independent CB often interpreted as an attempt to achieve 'weight conservatism')



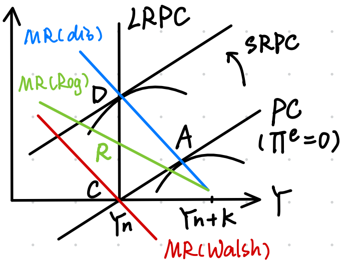
Contracts for central bankers (Walsh, 1995)

loss function: $V = \frac{1}{2}\lambda(y - y_n - k)^2 + \frac{1}{2}\pi^2 - t_0 + a\lambda k\pi$

$t_0 - a\lambda k\pi$: payment to CB by the government

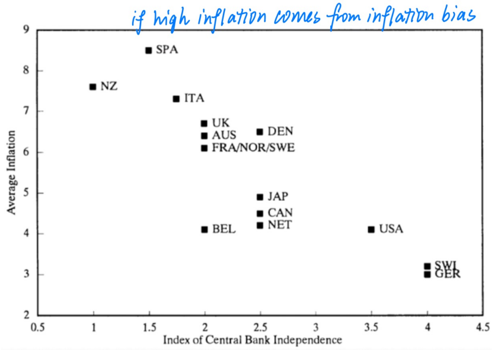
CB optimality condition: $\pi^d + a\lambda k = a\lambda k \Rightarrow \pi^d = 0$

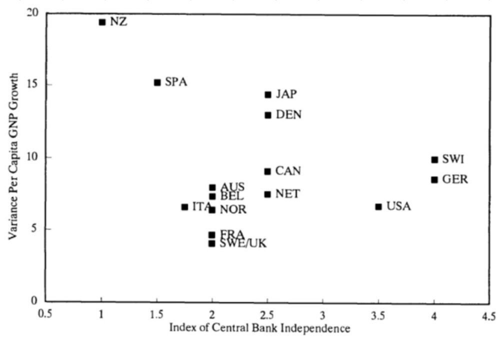
Limitations:
① implementation of the contract transfer in practice
② shocks do not change other model parameters, e.g., λ
③ displacement problem remains



Central Bank Independence and Inflation Performance

if high inflation comes from inflation bias





(who is represented on the board, for how long does a board member serve, is the CB obliged to lend to the government in all circumstances)

Alessina and Summers (1993): low π achieve by ↑CBI → no additional volatility in real variables

Further Perspectives ...

1. perhaps the inflation bias exists in theory but is extremely small in practice (Globalization ⇒ $k\downarrow$, $\lambda\downarrow$ in the BG model)
2. Cukierman (2002): even when $k=0$, a bias can arise due to preference asymmetries

Stabilization Bias

loss function (with k=0): $V = \frac{1}{2}\lambda(y-y_n)^2 + \frac{1}{2}\pi^2$

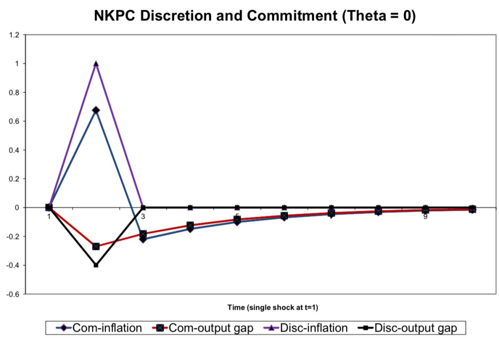
Stabilization Bias with NKPC

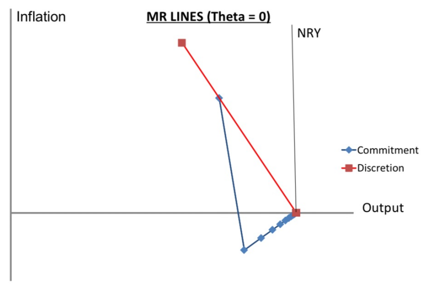
Calvo pricing "New Keynesian Phillips Curve" form:

$$\pi_t = \beta E_t[\pi_{t+1}] + \gamma(y_t - y_n) + \varepsilon_t$$

—— under discretion $E_t[\pi_{t+1}]$ not under control of the policy maker, so the best they can do if there is a cost push shock $\varepsilon_t > 0$ is to "share" its impact on π and y according to the optimal MR line.

credible commitment ⇒ manipulate $E_t[\pi_{t+1}]$



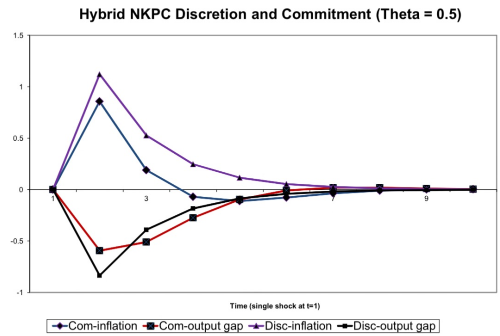


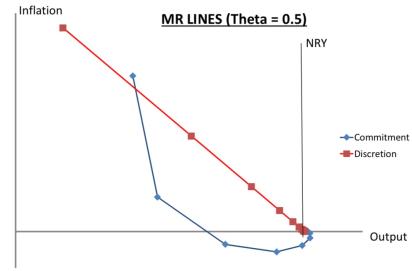
Hence under commitment Et[t+1] effectively becomes an additional policy instrument for dealing with the time t shock. This is not possible under discretion because once time t+1 arrives no earlier promise is binding (it is time inconsistent) and the _ policy maker will simply react to the time t+1 shock ignoring the past.
Thus commitment and discretion differ so there is a bias and its called stabilisation bias as it relates to stabilising the economy when shocks occur.

1. Price level targetting
   an effective delegation mechanism for achieving the commitment outcome ($\pi \uparrow\downarrow$ ⇒ offset in price)
2. Rogoffian central banker unhelpful
   ⇒ less inflation, more negative output gap
   but thereafter choose zeros for both rather than creating the dynamic profile of the commitment case
3. Walsh inflation penalty → also unhelpful
   ⇒ only change average inflation

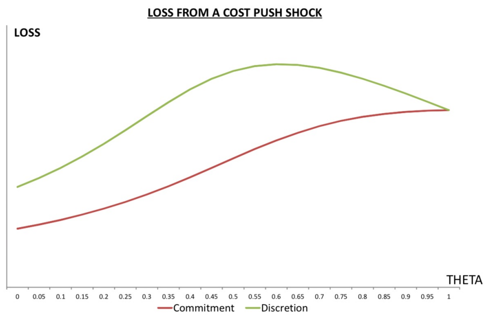
Stabilization Bias with the Hybrid NKPC

Hybrid form: $\pi_t = \beta(1-\theta)E_t[\pi_{t+1}] + \theta\pi_{t-1} + \gamma(y_t - y_n) + \varepsilon_t$





A credible promise to reduce inflation more next period helps to reduce it today.



1. Price level targetting no longer optimal (early increases in inflation > later negative values)
2. Rogoffian central banker: ✓

   while they will distort the initial "spikes" they will also subsequently reduce inflation to target more quickly and create a time path for inflation between the discretion and commitment cases above.
3. Walsh inflation penalty: ✗

Lecture 7 :
Central Bank Independence

Lecture notes - lecture (James Forder) 1