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)

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

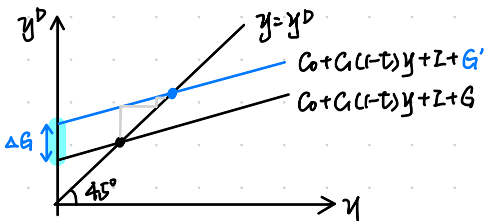
$$Y = a + \bar{b}(Y - T) + c - \bar{d} r + G \quad \text{(Tsinghua's Version)}$$

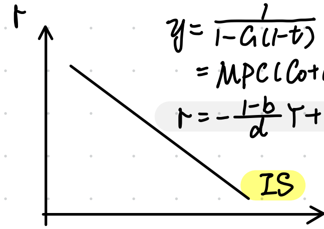
Keynesian consumption function: $C = C_0 + C_1(1-t)y$

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: $I = a_0 - a_1 r$





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

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

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

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 ($\uparrow$ opportunity cost of unemployment)
② worker turnover cost

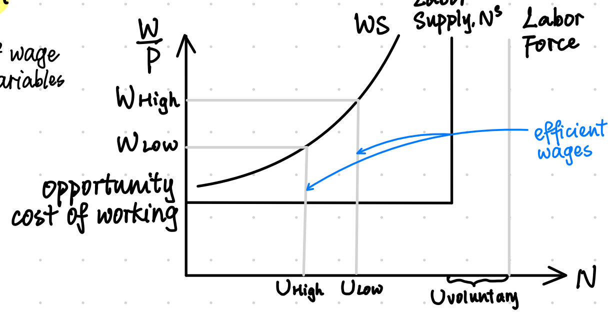
wage-setting real wage equation

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

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)

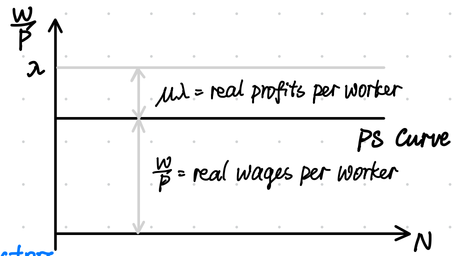
unit labor costs $= \frac{W \cdot N}{y}$

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

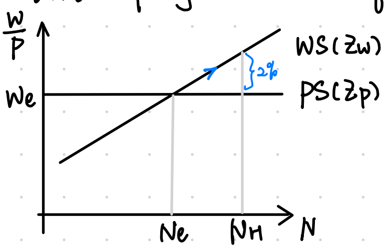
$\Rightarrow P = (1+\mu)\frac{W}{\lambda} \Rightarrow \frac{W}{P} = (1-\mu)\lambda$

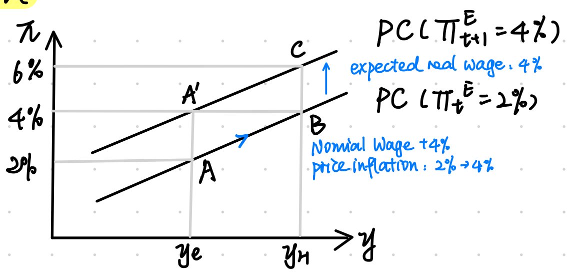
$\Rightarrow w^{PS} = \frac{W}{P} = \lambda(1-\mu) = \lambda F(\mu, z_p)$

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)

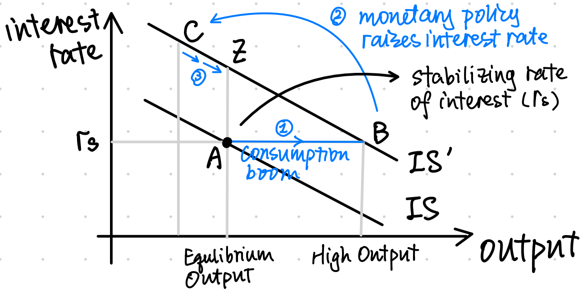
current inflation, lagged inflation, output gap

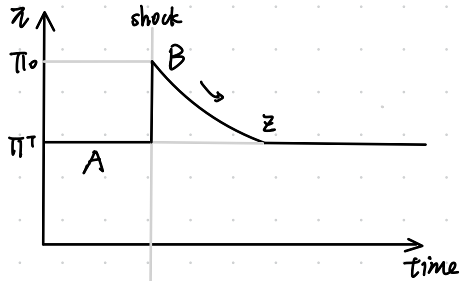
Key Assumption: adaptive expectations $\pi_t^E = \pi_{t-1}$

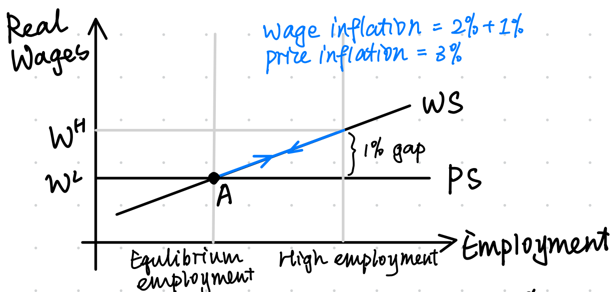
Monetary Rule Curve

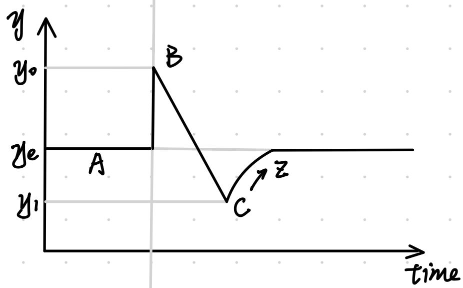
Central bank uses monetary policy to stabilize the economy

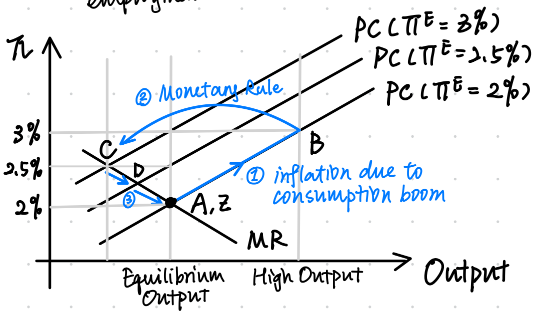
Example of positive demmand shock

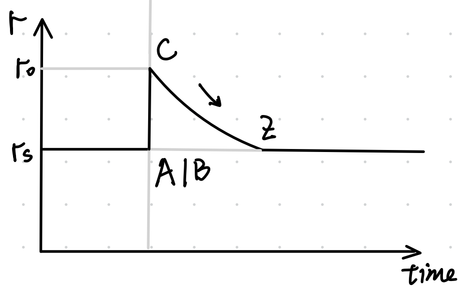


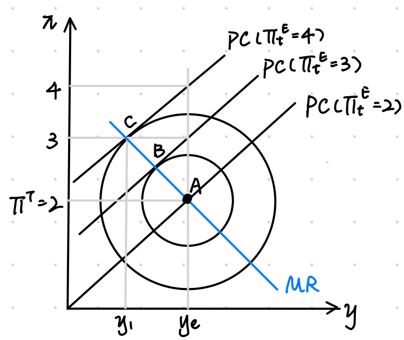












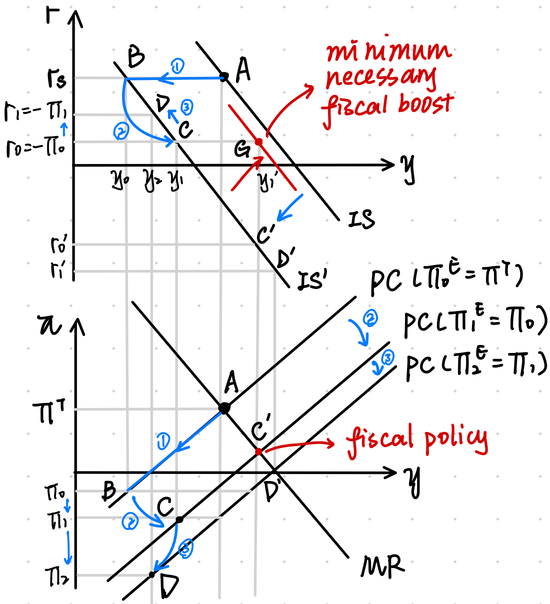
(central bank loss function)

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

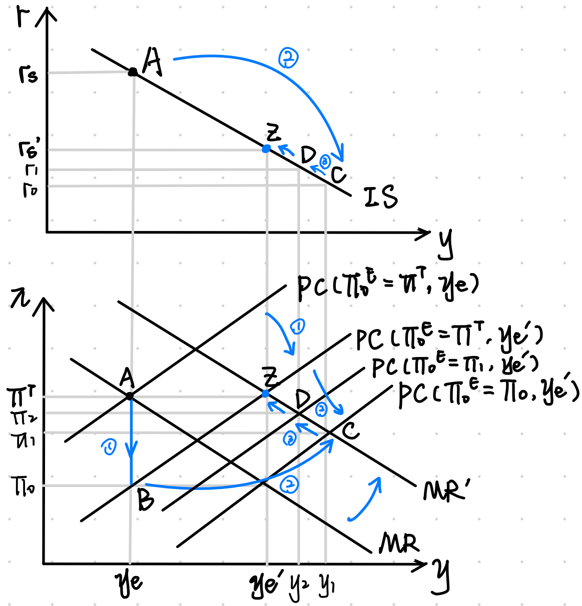
- $\beta > 1$: inflation adverse
- $\beta < 1$: unemployment adverse

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

the deflation trap



a supply shock

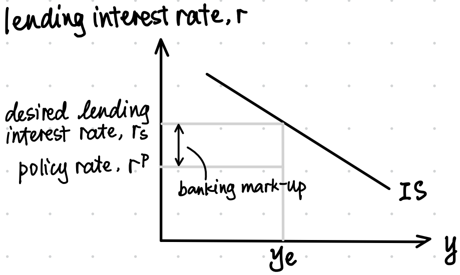


Banking Basic: financial system & balance sheet

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

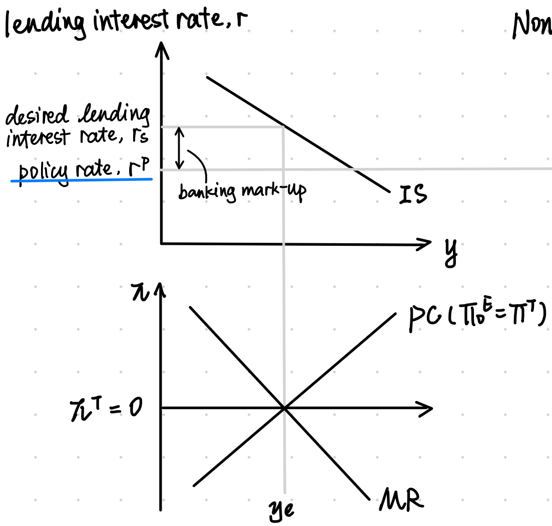
demand for money:

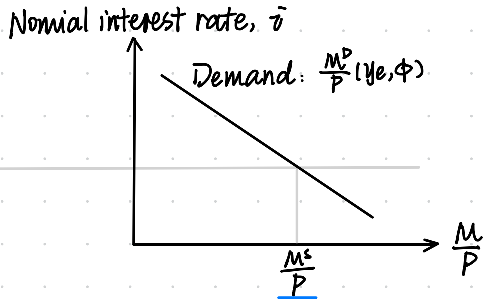
$$\frac{M^D}{P} = f(y, i; \phi)$$

- y: output (+)
- i: nomial 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

A very simplified bank balance sheet

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

ASSETS = LIABILITIES

less risky
lower return

Loans e.g. Mortgage
return = retail lending rate

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.

Reserves / Cash
return = central bank deposit rate

external obligation

Deposits { longer-term / instant access
cost = retail deposit rate   cheapest funding (insured)

Debt (bank bonds) e.g. wholesale repo borrowing secured with collateral
cost = yield paid on bonds

⇓ EFP (External Funding Premium)

Equity capital (s'holder funds) robust when > 10%
cost ≈ dividend/share price (roughly)

Regulating the banks (key risks)

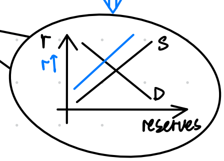
- Maturity mis-match (short liabilities vs long assets) implies cash flow shocks   cash-flow risk
  (short liabilities: deposits; long assets: mortgage loan)
  - so target min reserve or liquidity ratio, **reserves/deposits**
  previous: dictation
  recently: government competes by lower reserve rates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

Financial System

Federal Reserve
(Central Bank)   ⟨ target: mon pol rate

Commercial banks } Federal Funds Rate / FF Rate / LIBOR (overnight rate)

Federal Funds Market / Reserve Market



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

loan interest rate $\uparrow$ $\Rightarrow$ more Type B borrowers

$\Rightarrow$ expected return to lender $\downarrow$

$g q_g r_L + (1-g) q_b r_L = r$ | $r_L = \frac{r}{g q_g + (1-g) q_b}$

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

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

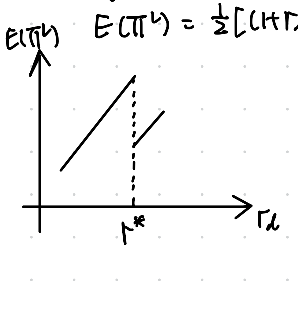
1° $x^*(r_L, L, C) \le x_g < x_b$

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

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)

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

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

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

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

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 $\Leftrightarrow x^s \in S \subset [0, \bar{x}]$

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

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).

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

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

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

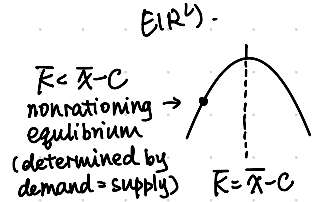
(given that $E[R(x) - c \mid R(x) < \bar{K}]\Pr[R(x) < \bar{K}] + \bar{K}\Pr[R(x) \geq \bar{K}] = r$)

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

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 equlibrium, as smaller $\bar{K}$ yields higher $E(R^L)$.

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

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 $= p$).

$$\max\ \pi_1[pP_1^a+(1-p)P_1]+\pi_2P_2 \quad \text{s.t.}$$

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

Lagrangian multipliers $\Rightarrow$ minimize $E(\text{audited costs})=\pi_1 pC$

$\Rightarrow$ 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 $\begin{cases} \text{deposit} \\ \text{debt} \\ \text{capital} \end{cases}$ arbitrage

} Walsh Model

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

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

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 $\begin{cases} G : x_g \\ B : x_b \end{cases}$, 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

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

Narrow Lending Channel (NLC)

CB tightens monetary policy ⇒ reserve supply ↓

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

⇒ $\begin{cases} \text{method 1. deposit lending} \downarrow \\ \text{method 2. switch to debt / equity funding} \end{cases}$

⇒ 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 ⇒ α↓
- 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)

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

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

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 $C + R' - \alpha - (1+r)L$
- 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 $\downarrow$

tight policy erodes bank capital:

1. narrow / broad channels slow the real economy, loan defaults $\uparrow$, equity $\downarrow$
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 $\uparrow$

Lecture 2:
Tools and Targets for mon pol

Lecture notes - lecture3_4

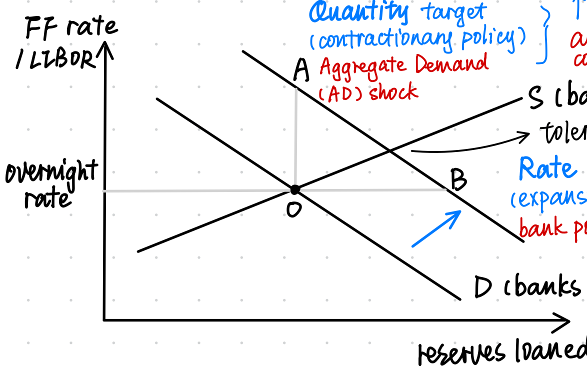
Lecture Overview

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)



Quantity target (contractionary policy) } ↑output ⇒ ↑deposits ⇒ ↑reserves
automatic stabilization of AD shocks
con: unwanted output volatility (quick $r_p \to r_L$)

→ tolerate flunctuations (England Bank)

Rate target (expansionary policy) } e.g. rising risk perceptions or declining risk appetite ⇒ R^D↑
bank portfolio shock
prevent portfolio shocks propagating to the real economy

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
(theory) changes in velocity — foreign holdings of \$ ⇏ expenditure
⇒ 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)

$$\underbrace{i_t}_{\text{nomial}} = (\underbrace{r^*}_{\text{target}} + \underbrace{\pi^*}_{\text{target}}) + 0.5\,(\underbrace{y_t}_{\text{actual}} - \underbrace{y_t^*}_{\text{potential}}) + 1.5\,(\underbrace{\pi_t}_{\text{current inflation}} - \pi^*)$$

(based on a constant growth assumption)

close to 2 when estimated using real time data

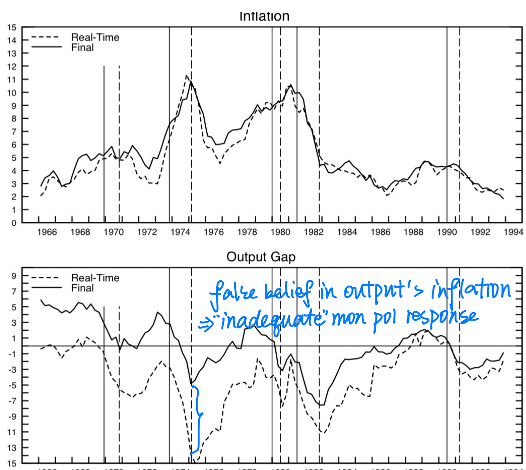
Monetary Policy Rules in Real Time (Orphanides, 2003)

(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.

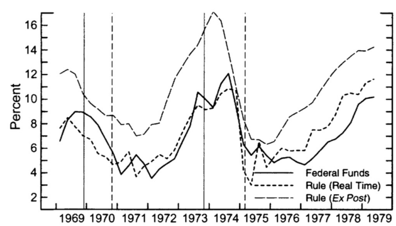


FIGURE 3. REAL-TIME AND *EX POST* TAYLOR RULES

(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

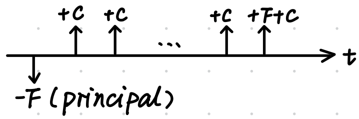
—— QE + supply shock: long inflation

Lecture 3: the Yield Curve

Lecture notes - lecture5

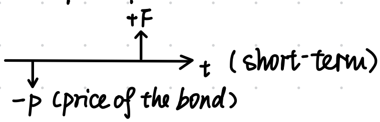
Term Structure of Interest Rate

Coupon Bond



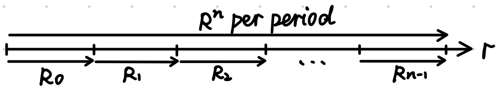
e.g. UK government gilts, US treasury bonds

Discount Bond (zero coupon)



$\begin{cases} \text{discount rate} = \frac{F-P}{F} \\ \text{implicit interest rate} = \frac{F-P}{P} \end{cases}$

e.g. treasury bills



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

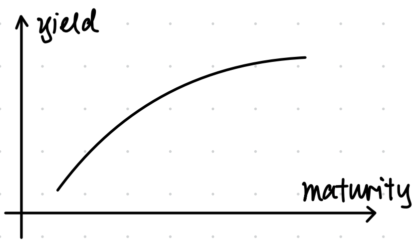
denote $i_t^n = \ln(1+R_t^n)$, $i_{t+i} = \ln(1+R_{t+i})$

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

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"

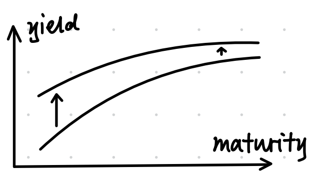
if y/c inverted: $\begin{cases} \text{sign markets expecting recession} \\ \text{CB cut short rates} \end{cases}$

y/c indicates credibility of monetary policy

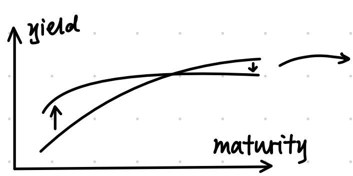
Ellingsen and Soderstrom

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:

$\begin{cases} \text{endogenous: forecast higher } \pi \text{ than target} \Rightarrow \text{short rates} \uparrow \\ \text{exogenous: unrelated to } E(\pi)\text{, e.g. change in committee} \Rightarrow \pi^T \downarrow \text{ (greater aversion)} \end{cases}$



(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: $fut^{0}_{s,t}$

$$fut^{0}_{s,t} = E_t \underbrace{\frac{1}{m}}_{\text{number of days}} \sum_{i \in s} \underbrace{ff_i}_{\text{fed fund rate}} + \underbrace{\mu^{0}_{s,t}}_{\text{risk premium}}$$

a measure of the unanticipated component of policy intervention:

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

Regression specification:

$$\Delta i^{n}_{t} = b^{n}_{3} + b^{n}_{4} \Delta ff^{exp}_{t} + b^{n}_{5} \Delta ff^{unexp}_{t} + V^{n}_{t}$$

$\Rightarrow b^{n}_{5} \gg b^{n}_{4}$, more significant

Ellingsen and Soderstrom (2005):

$$\Delta i^{n}_{t} = \alpha_n + \left(\beta^{NP}_{n} \underbrace{d^{NP}_{n}}_{\text{a non-policy day}} + \beta^{End}_{n} \underbrace{d^{End}_{n}}_{\text{endogenous}} + \beta^{Ex}_{n} \underbrace{d^{Ex}_{t}}_{\text{exogenous}}\right) \Delta i^{-3m}_{t} + V^{n}_{t}$$

Lecture 4 :
Public 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

$$\underbrace{G_t}_{\text{government expenditure}} + i_{t-1}\underbrace{B_{t-1}}_{\text{stock of debts (inc. consol bonds)}} = \underbrace{T_t}_{\text{tax revenue}} + (B_t - B_{t-1}) + (\underbrace{H_t}_{\text{monetary base}} - H_{t-1})$$

monetary base = nonbank public + reserves (high powered money, narrow money)

in nomial income units:

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

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

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

$\left(\frac{1+i_{t-1}}{(1+\pi_t)(1+\mu_t)} - 1\right)$ 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 $(r_{t-1} - \bar{r}_{t-1})b_{t-1} = \frac{(\pi_t - \pi_t^e)(1+r_{t-1})b_{t-1}}{1+\pi_t}$:

$$\Rightarrow \quad g_t + \underbrace{r_{t-1}}_{\text{ex-ante real interest rate}} b_{t-1} = t_t + (b_t - b_{t-1}) + \underbrace{\frac{\pi_t - \pi_t^e}{1+\pi_t}(1+r_{t-1})b_{t-1}}_{\text{income from deflating debt interest payment via surprise inflation}}{}^{1} + \left[h_t - \frac{h_{t-1}}{1+\pi_t}\right]$$

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

$$\text{seigniorage: } S_t = h_t - \frac{h_{t-1}}{1+\pi_t}{}^{2} = \underbrace{(h_t - h_{t-1})}_{2\text{-}1} + \underbrace{\left(\frac{\pi_t}{1+\pi_t}\right)}_{\text{"the tax rate"}} \underbrace{h_{t-1}}_{2\text{-}2} \rightarrow \text{"the tax base"}$$

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

limits to revenue creation via seigniorage tax:

h (tax base) endogenous to anticipated inflation $\Rightarrow$ lower h

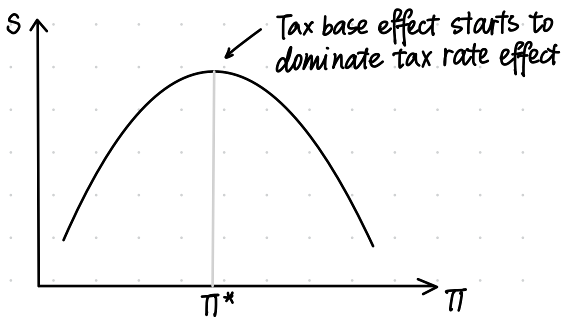
$\longrightarrow$ Laffer Curve

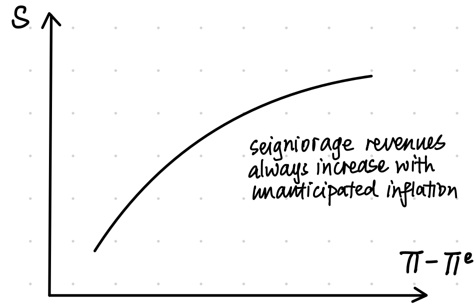
the Inflation Tax Laffer Curve

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

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

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

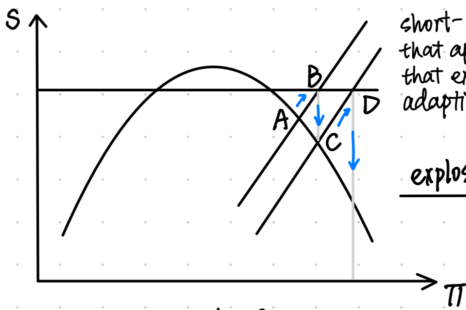




Cagan (1956): a model of seigniorage and hyperinflation

estimated turning point: $\pi^* \in (200\%, 300\%)$ per annum
cannot explain hyperinflation: Zimbabwe (1600%)

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



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