Targets, Instruments, Indicators, and Goals of Monetary Policy

I. What the Central Bank Does and Does Not Control

A. Does control

1. Composition of its own balance sheet
2. Interest rate on borrowed reserves
3. Reserve requirements for bank deposits

B. Does not control

1. Money supply
2. Monetary base
3. Most interest rates

II. A Simple Money Multiplier Model

A. Definitions

MB	monetary base
RR	required reserves
ER	excess reserves
TR	total reserves (currency held by banks)
C	currency held by nonbank public
D	demand deposits
M1	money supply
rr	required reserve ratio, = RR/D
ex	excess reserve ratio, = ER/D
c	currency-to-deposit ratio, = C/D

B. Model

1. Individual households hold currency C and demand deposits D (checkable accounts). Ratio of currency to demand deposits:

$$c = C/D$$

determined by the households.

$$\Rightarrow \quad C = cD$$

2. Banks hold *reserves*, currency in their vaults.

a. *Required reserves* RR are required by law to be some fraction rr of deposits:

$$RR = rrD$$

where rr is determined by the central bank.

b. *Excess reserves* ER are any extra reserves the bank chooses to hold:

$$ER = erD$$

where er is determined by the bank.

3. The *monetary base* is

$$\begin{aligned} MB &= TR + C \\ &= RR + ER + C \\ &= (rr + er + c)D \end{aligned}$$

4. The *money supply* (using the M1 definition) is

$$\begin{aligned} M1 &= D + C \\ &= \frac{1 + c}{rr + er + c} MB \end{aligned}$$

III. Policy Instruments

A. Money supply - not a policy instrument

The central bank

1. does not control er or c

2. therefore does not control the money supply M1

B. Available instruments

1. rr

2. MB (if there are no major flows of currency out of the country)

3. short-term interest rate, which affects demands for money and reserves.

Note that central banks do *not* control interest rates directly. Instead they influence them by changing the money supply. The difference between a money instrument and an interest rate instrument is

a. with a money instrument, the central bank adjusts the money supply (or the money growth rate) to a specific value

b. with an interest rate instrument, the central bank adjusts the money supply (or the money growth rate) to whatever value is necessary to make the interest rate equal to a specific value

IV. Targets, Indicators, and Goals

A. What is to be controlled

1. Ultimate *goals* - level of output, inflation rate, etc.

a. want to control them immediately

b. however, are affected by policy only with a long lag

i. 9 to 12 months for real output in the US

ii. 12 to 18 months for inflation in the US

2. Practical short-run goals are *intermediate targets*

a. are related to the ultimate goal variables (e.g., money growth and inflation rates)

b. can be controlled with short lags

c. include interest rates, money supply, exchange rates

B. What provides information

1. Ultimate goal variables usually are observable only with long lags

2. Indicators

a. observed more frequently than goal variables

b. are related to goal variables

c. examples include

i. new orders, housing starts, unemployment rate

ii. interest rates, money supply, exchange rates

→ NOTICE that interest rates, money supply, and exchange rates can be instruments, targets, or indicators. However, they cannot function as all three or even as any two. Once one of these variables m is designated for one use, it cannot have any other use. For example, if the central bank decides to use the interest rate as an indicator of the state of the economy, it cannot set its value as a target or use it as an instrument for carrying out monetary policy. We will see examples below where the interest rate is used in different roles.

V. Short-run stabilization

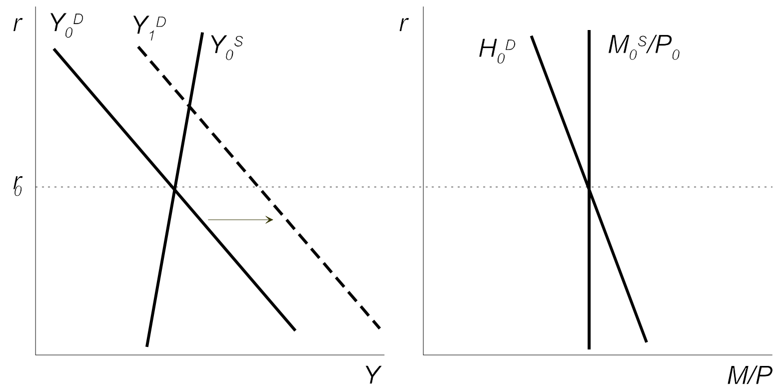
The central bank would like to use monetary policy to offset shocks quickly, before they cause economic harm.

The problem is that many variables that the central bank would like to stabilize can be observed only with a considerable lag.

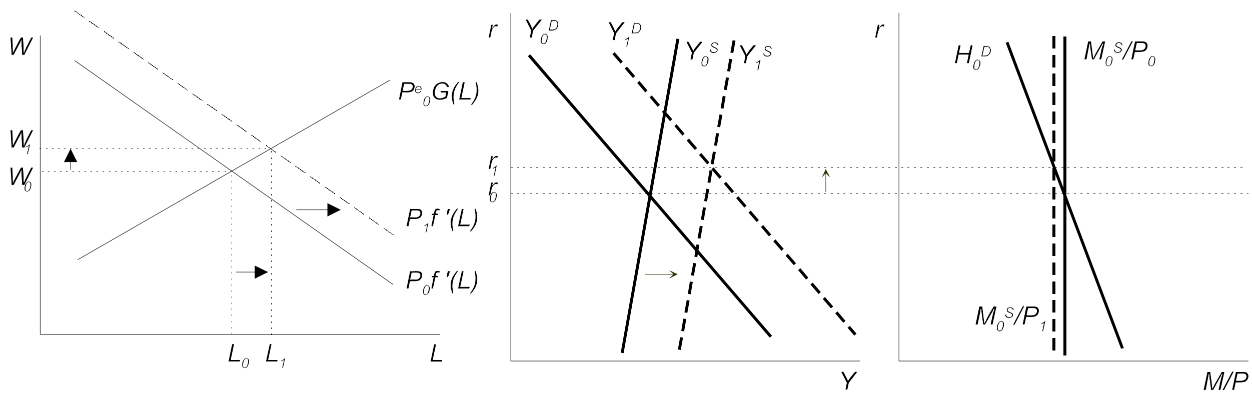
One possible approach is to make an optimal guess about the nature of any shock that occurs and then change the money supply appropriately.

A. A shock accompanied by an increase in the interest rate

1. Shock: Increase in government purchases



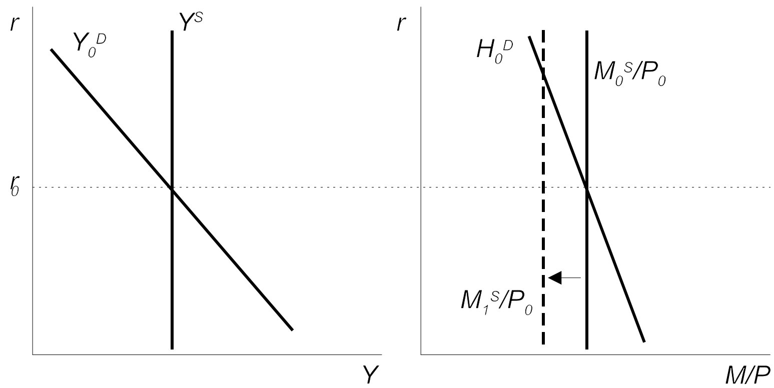
The economy’s short-run response:



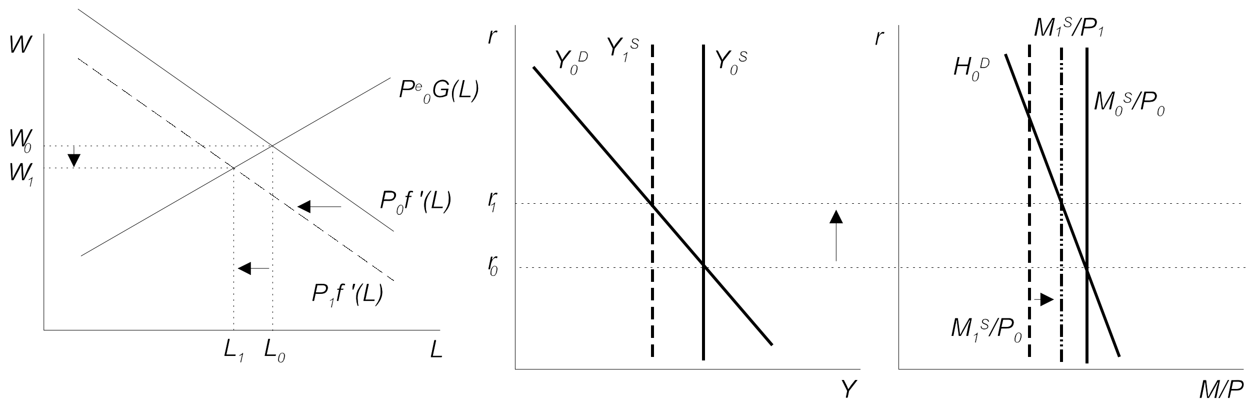
2. Policy response: reduce M to offset the output effect of the original shock

a. First, consider the effect of a reduction in M.

The change in M looks like this:



It has the following effects on the economy:



b. Clearly, it is possible to offset the effects of the original shock (increase in government purchases) with an appropriate decrease in M.

3. Observables and policy response

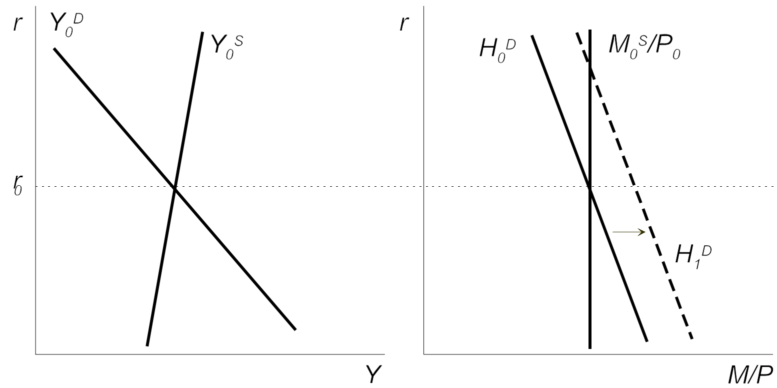
a. Interest rate but not Y is observable in short run

b. Shock makes interest rate rise

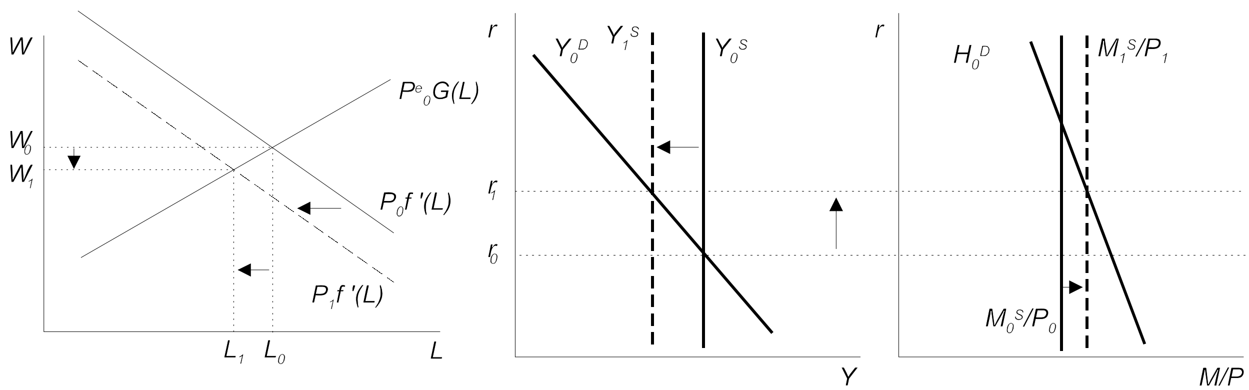
c. Optimal response by central bank is to reduce M (assuming the central bank's goal is to stabilize Y)

B. A different shock accompanied by an increase in the interest rate

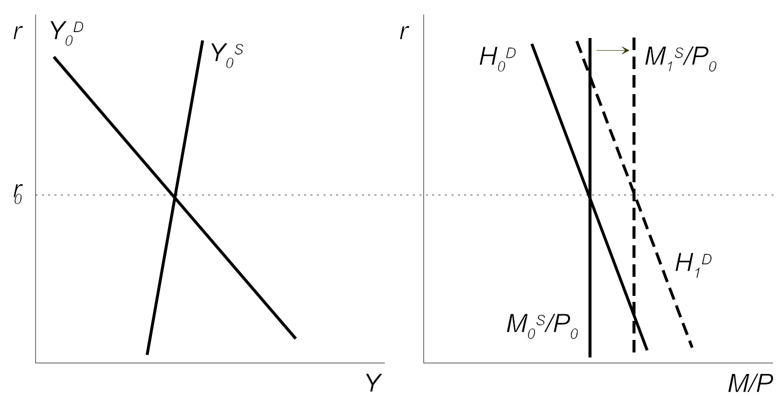
1. Money demand rises



and has the following effect on the economy in the short run



2. Optimal policy response: *increase* M to make P rise and induce output to rise. All change in Y can be prevented by increasing M enough to accommodate the increase in M^D. Notice that such a response keeps R constant.



3. Observables and policy response

a. Interest rate is observable in short run

b. Shock makes interest rate rise

c. Optimal response by central bank is to *increase* M

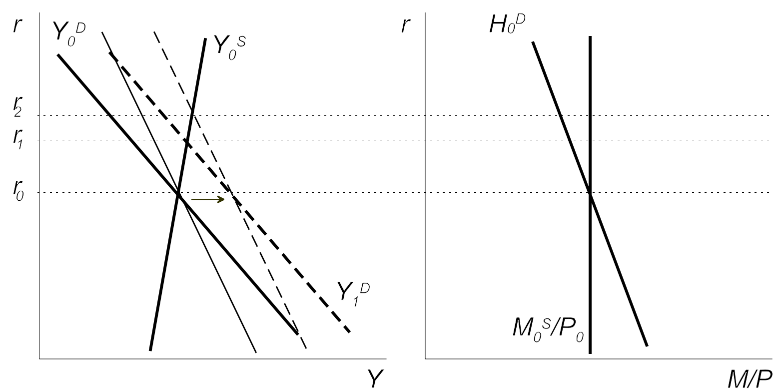
C. Another way to describe the optimal policy response:

1. If the shock is a shift in Y^S, the central bank should use the interest rate as an indicator and make no attempt to control it.

2. If the shock is a shift in M^D, the central bank should use the interest rate as a target and keep it constant.

D. Problem: the central bank does not what the shock is. How should it respond to changes in the interest rate?

E. An additional complication: slopes



The same size shift in Y^D causes different amounts of excess money supply (and therefore different amounts of price change and consequent shifts in Y^S) depending on the slope of Y^D. The effect on the economy also depends on the slopes of Y^D and H^D.

F. William Poole's approach to optimal policy

The following simple model illustrates a way to extract information from observed changes in the interest rate and then respond optimally.

1. Economic structure

$$Y^S = A\left(\frac{P}{P^e}\right)^\alpha$$

$$Y^D = B(1+r)^{-\gamma}U$$

$$M^D = \Omega(1+r)^{-\delta}V$$

$$M^S = \frac{\Lambda(1+r)^\eta}{P}$$

where η is a constant to be chosen by the central bank. It determines how responsive M will be to changes in r.

2. Log-linearize

Take natural logarithms to linearize the model.

Lower case letters represent the logs of the corresponding upper case letters. E.g.,

x = ln X

Also, we use the approximation

ln (1+X) ≈ X

when X is small.

We have

$$y^D = b - \gamma r + u$$

$$y^S = a + \alpha(p - p^e)$$

$$m^D = \omega - \delta r + v$$

$$m^S = \lambda + \eta r - p$$

3. Solve the model

a. $m^D = m^S \quad \Rightarrow \quad \omega - \delta r + v = \lambda + \eta r - p$

Solving for r gives

$$r = \frac{\omega - \lambda + p + v}{\eta + \delta}$$

b. $y^D = y^S \quad \Rightarrow \quad b - \gamma r + u = a + \alpha(p - p^e)$

Solving for p gives

$$p = \left[b - a + \alpha p^e - \gamma \frac{\omega - \lambda}{\eta + \delta}\right]\left[\frac{\eta + \delta}{\alpha(\eta + \delta) + \gamma}\right] - \frac{\gamma}{\alpha(\eta + \delta) + \gamma} v + \frac{\eta + \delta}{\alpha(\eta + \delta) + \gamma} u$$

c. Substitute the solution for p into the equation for y^S to get

$$y^S = a + \alpha\left[b - a + \alpha p^e - \gamma \frac{\omega - \lambda}{\eta + \delta}\right]\left[\frac{\eta + \delta}{\alpha(\eta + \delta) + \gamma}\right] - \frac{\alpha\gamma}{\alpha(\eta + \delta) + \gamma} v + \frac{\alpha(\eta + \delta)}{\alpha(\eta + \delta) + \gamma} u - \alpha p^e$$

$$= C_0 - C_1 v + C_2 u$$

where C_0, C_1, and C_2 are constants.

d. The coefficients C_1 and C_2 depend on η

⇒ the responsiveness of y^S to v and u depends on η, chosen by the central bank.

We have the derivatives:

$$\frac{\partial C_1}{\partial \eta} = -\frac{\alpha^2\gamma}{[\alpha(\eta + \delta) + \gamma]^2} < 0$$

$$\frac{\partial C_2}{\partial \eta} = \frac{\alpha\gamma}{[\alpha(\eta + \delta) + \gamma]^2} > 0$$

⇒ the central bank faces a trade-off in choosing η. Changing the value of η makes the economy more responsive to one shock and less responsive to the other.

4. Minimizing the variance of y^S

Poole suggested choosing η to minimize the variance of y^S.

$$\sigma^2_{y^S} = \left[\frac{\alpha\gamma}{\alpha(\eta+\delta)+\gamma}\right]^2 \sigma_v^2 + \left[\frac{\alpha(\eta+\delta)}{\alpha(\eta+\delta)+\gamma}\right]^2 \sigma_u^2$$

Taking the derivative with respect to η and setting it equal to zero gives

$$\eta = \frac{-(2\alpha\delta+\gamma-1)\,\sigma_u^2 \pm \sqrt{[(2\alpha\delta+\gamma-1)\,\sigma_u^2]^2 - 4\alpha\,\sigma_u^2[(\alpha\delta^2+\gamma-1)\,\sigma_u^2 - \alpha\gamma^2\,\sigma_v^2}}{2\alpha\,\sigma_u^2}$$

One solution will be a local maximum and the other a local minimum, depending on the second derivative. The sign of the second derivative in turn depends on the magnitudes of the slopes γ, α, and δ and the magnitudes of σ_u^2 and σ_v^2.

Not worth working out the details here.

6. Real world more complicated because

a. there are also money supply shocks(money multiplier is random) and output supply shocks

b. slopes γ, α, and δ are random (at the very least because they are not know but only estimated econometrically and perhaps because they change over time)

c. Central bank may want to stabilize more than just output (e.g., inflation)

d. ➥ These complications have led most central banks to abandon short-run stabilization.

VI. Long-run stabilization, targeting, and instrument rules

A. Economic growth, money growth

1. Technical progress

Suppose the production function is

$$Y_t = A_t F(K_t, L_t)$$

Growth in the coefficient A captures technical progress. Even if K and L are constant, growth in A causes growth in Y.

2. Implications for money demand

a. Money demand is

$$H_t^D = H(C_t, ...)$$

b. Growth in Y ⇒ growth in C [in fact, in equilibrium, Y and C grow at the same rate]

c. Growth in Y therefore ⇒ growth in H^D

3. Implications for price stability and money growth

a. Money market equilibrium

$$H^D = \frac{M^S}{P}$$

b. Growth in H ⇒ negative growth in P if M^S is held constant

c. To avoid deflation, must have M^S grow at the same rate as H^D

4. For this reason, monetary policy generally is discussed in terms of the growth rate of M^S rather than the level of M^S

[Note that any desired one-time change in the level of M^S can be achieved by first changing the growth rate of M^S in the same direction as the desired change in M^S and then returning the growth rate of M^S to 0 once M^S has reached its desired level. So we can discuss any change in M^S in terms of the growth rate of M^S.]

B. Inflation targeting

1. Central bank objective function

$$\min_{\pi, u} E_t \sum_{i=0}^{\infty} \left(\frac{1}{1+\rho} \right)^i [(\pi_{t+i} - \pi_{t+i}^T)^2 + \omega (u_{t+i} - u^*)^2]$$

where ρ is the central bank's rate of time preference, π is inflation, π^T is the desired (or *target* level of inflation), u is the unemployment rate, and u* is the equilibrium unemployment rate.

2. Timing:

The central bank must choose its policy before it knows the complete state of the economy.

3. Preliminaries

a. Notation and dating.

Recall that we have defined

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

The price that maintains final equilibrium during period t is P_t (see the notes on *Money, Prices, and General Equilibrium*). That means that the price that prevails at the end of period t is P_t. Therefore, the inflation that occurs between the beginning and end of period t is

$$\pi_{t-1} \equiv \frac{P_t - P_{t-1}}{P_{t-1}}$$

b. Phillips curve

Recall that the relation between inflation and unemployment is

$$\pi_{t-1} = \pi^e_{t-1} + \phi(u^* - u_t) , \qquad \phi > 0$$

c. Expectations

For simplicity, suppose expectations are formed by the adaptive process

$$\pi^e_t = \pi^e_{t-1} + \lambda(\pi_{t-1} - \pi^e_{t-1}) \qquad 0 < \lambda < 1$$

4. Example

a. Start in general equilibrium with $\pi = \pi^e = \pi^T$ and u = u*.

b. In period t, an unexpected shock causes u to fall and π to rise above π^e and π^T.

c. ⇒ π_t^e also rises by $\lambda(\pi_{t-1} - \pi_{t-1}^e)$

d. ⇒ next period, π will exceed π^T even if u rises back to u* because of the Phillips curve:

$$\pi_t = \pi_t^e + \phi(u^* - u_{t+1})$$

$$= \pi_{t-1}^e + \lambda(\pi_{t-1} - \pi_{t-1}^e) + \phi(u^* - u_{t+1})$$

$$= \pi_{t-1}^T + \lambda(\pi_{t-1} - \pi_{t-1}^T) + \phi(u^* - u_{t+1})$$

where the term $\lambda(\pi_{t-1} - \pi_{t-1}^T)$ is positive.

e. The central bank cannot do anything to offset the effects of the shock in the initial period because it does not learn about them quickly enough. However, it can respond to the change in future inflation that the shock causes.

⇒ the central bank should raise u_{t+1} to reduce future inflation.

⇒ a reduction in the money growth rate in period t+1

The magnitude of the reduction depends on the magnitudes of

i. the original shock
ii. the parameter ϕ
iii. the parameter λ (because that will determine how much π^e changes)
iv. the parameter ω
v. the parameter ρ
vi. the response of u to changes in the money growth rate

C. Instrument Rules (Taylor Rules)

1. Inflation targeting requires less information than short-run stabilization, but it still requires a great deal of information about the structure of the economy

2. An even simpler policy rule that requires no information at all about the structure of

the economy is an instrument rule, usually called Taylor rules

3. Procedure

a. The central bank watches its indicator variables (such as the unemployment gap or inflation gap).

b. If they deviate from the target levels, the central bank changes the money growth rate until the interest rate reaches the desired level.

c. The desired level of the interest rate is given by a formula such as

$$R_{t+1} = r^* + \pi_{t-1}^T + \alpha_u (u^* - u_t) + \alpha_\pi (\pi_{t-1} - \pi^T)$$

where R is the nominal interest rate and $0 < \alpha_u$, α_π are parameters chosen by the central bank.

According to this formula, the central bank should raise the nominal interest rate (equivalent to reducing the money growth rate and so tending to slow the pace of economic activity) if u is below u* or π is above π^T. The parameters α_u and α_π determine the importance given to each of the deviations.

d. For the formula to stabilize the economy, it is necessary that $1 < \alpha_\pi$. The reason can be seen by considering a counterexample. Suppose that $\alpha_\pi = 1$. Then the central bank allows R to rise by exactly the excess of π over π^T. Doing that would require no change in the money growth rate. To counteract the extra inflation, the money growth rate must fall, which in turn will cause R to rise by more than the gap π-π^T. That in turn requires that $1 < \alpha_\pi$.

e. Many central banks in the world now use some type of Taylor rule in making monetary policy.

4. A problem with Taylor rules

If the central bank does not know the current values of π and u, then Taylor rules are difficult to use and can destabilize the economy.

D. Choosing the inflation target

1. In principle, the desired inflation rate should be 0.

2. The problem with setting $\pi^T = 0$ is that unexpected negative shocks to π can have serious consequences in financial markets.

3. Recall that the nominal interest rate is given by the formula

$$R_t = r_t + \pi_t^e$$

4. In fact, this formula is correct only for *non-negative* nominal interest rates. The nominal interest rate cannot be negative. If the nominal interest rate were negative, people would do better holding cash than lending. To see why, suppose $R < 0$ (which means that $\pi < 0$ with $r < |\pi|$.

a. If a loan is made, the real rate of return will be r.

b. If cash is held, the real rate of return will be $-\pi > r$ because cash always pays a nominal interest rate of 0.

⇒ the right formula for the nominal interest rate is

$$R_t = \max(r+\pi, 0)$$

5. ⇒ If $\pi < 0$ with $r < |\pi|$, people would take their money out of the banking system and also would attempt to sell their bonds. Financial markets would collapse.

6. If the central bank set $\pi^T = 0$, then a small negative shock to π could cause R to fall to zero and financial markets to collapse. The 1-year real interest rate is about 0.01 (i.e., 1% per year), so the shock to π would not have to be large.

7. For this reason, central banks usual choose $0 < \pi^T$, usually about 0.01.