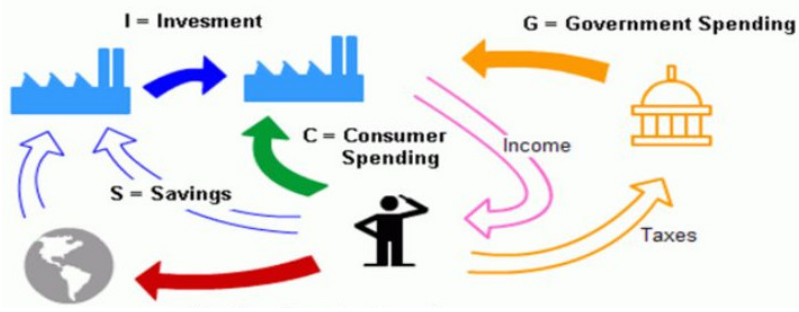
Macroeconomic Equilibrium in the Short-Run (Chapter 11)
Part II

Questions

How interest rates affect GDP?
How monetary policy affects the economy?

Recap: Short-Run Model



Summary of Short-Run Model

Desired demand $DD(Y)$

- components C, I, G, NX
- the link between real economy and asset & money markets is Tobin's q (recall $I(q)$); market value of capital/replacement value

Short-run equilibrium $Y = DD(Y)$

- supply adjusts to demand
- describes the real-side of the economy

What next: formulating a model with both real and monetary sectors

- monetary sector involves interest rate and money demand
- real sector build upon desired demand

IS Curve

What happens to the equilibrium output when interest rate i is changed?

- because prices are constant, real interest rate changes as much as nominal interest rate
- Tobin's q is affected; i decreases, q increases (i affects the discount rate of investments, higher the rate the higher the required returns)
- change of q affects investments and hence output

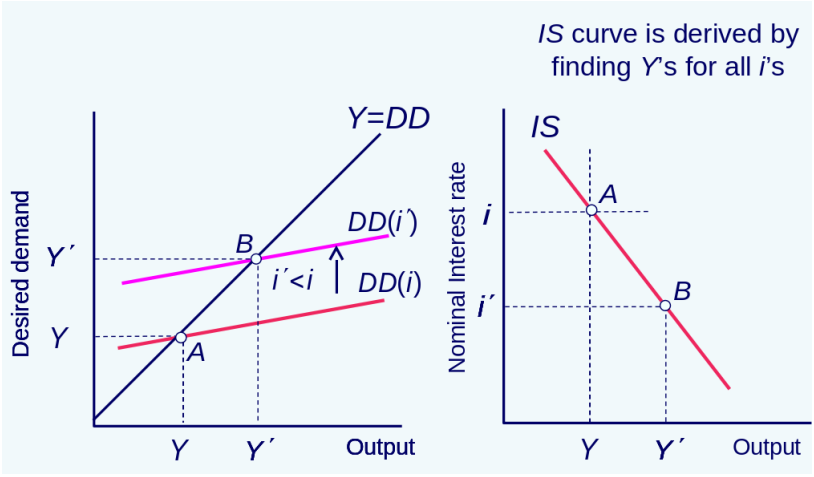
If i increases, equilibrium Y decreases

- negative relationship between interest rate and output, described by the IS-curve

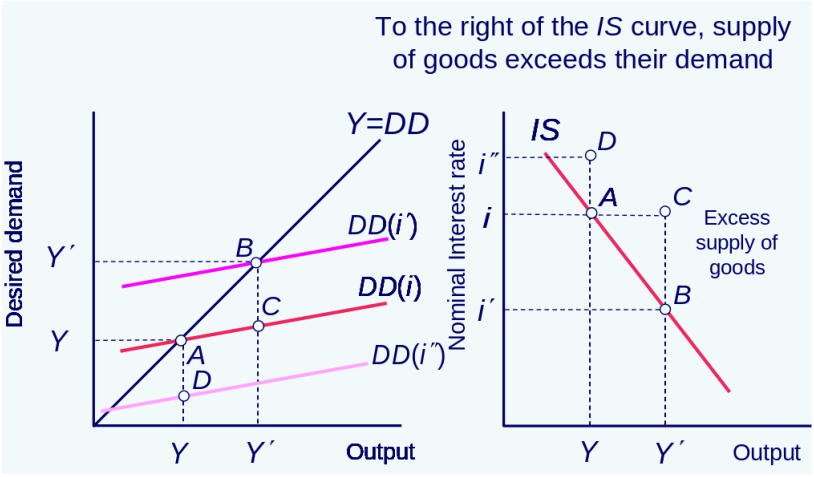
Example, ECB interest rates

- rate on main refinancing operations $\rightarrow$ Euribor rates $\rightarrow$ loan rates $\rightarrow$ investments/savings

Deriving the IS Curve



Deriving the IS Curve

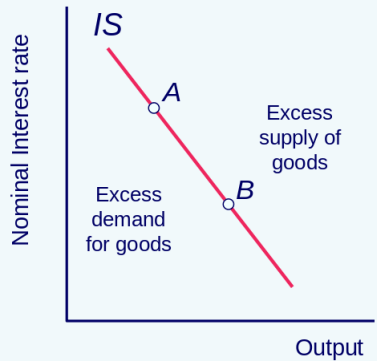


Deriving the IS Curve

To the left of the *IS* curve, demand for goods exceeds their supply

Convince yourself that this is true!

Hint: interest rates are lower than along the *IS* curve where $Y = DD(i)$



Example

$C(Y-T) = a + b(Y-T)$, $I(i) = c - di$

- $a, c, d > 0$, $b \in (0,1)$

Desired demand: $DD(Y;i) = a + b(Y-T) + c - di + G$

- here $NX = 0$

Equilibrium: $Y = DD(Y;i)$

- $Y = a + b(Y-T) + c - di + G$ which yields $Y = (a + c - di - bT + G)/(1-b)$ (IS-Curve)
- or $i = [a + (b-1)Y + c + G]/d$

Why the Name?

IS = investment saving

- investment=saving
- $Y = C + I + G + X - Z$ can be written as $Y - C - G + (Z - X) = I$
- adding and subtracting taxes: $(Y - T - C) + (T - G) + (Z - X) = I$ reads as "private saving"+"govt saving"+"foreign saving"= investments

Origins

- Harrod, Hicks, Meade 1936 in an effort to summarize Keynes' work

Shifts of the IS Curve

When exogenous variables change, the IS curve shifts

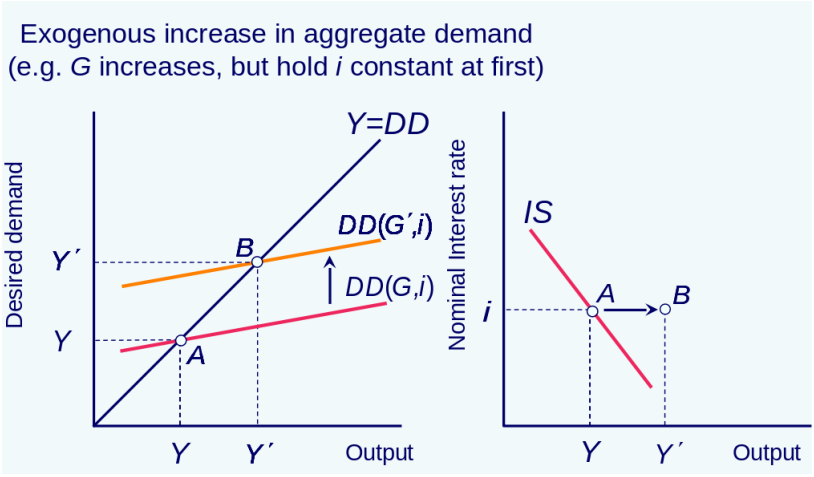
Examples

- foreign demand increases, demand increases, short run equilibrium demand is higher for all levels of interest rate
- expectations change (Tobin's q)
- collapse of wealth level (crisis, e.g. housing crisis)

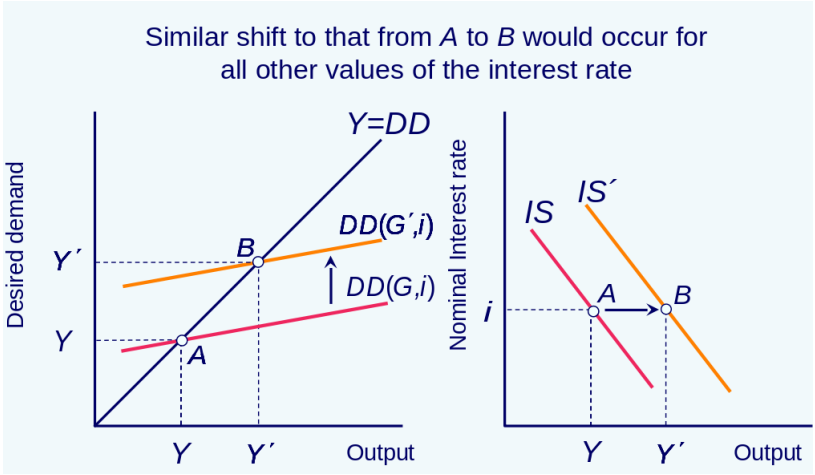
Note:

- changing the interest rate does NOT shift the curve!

Shifts of the IS Curve



Shifts of the IS Curve



Financial Crisis in US

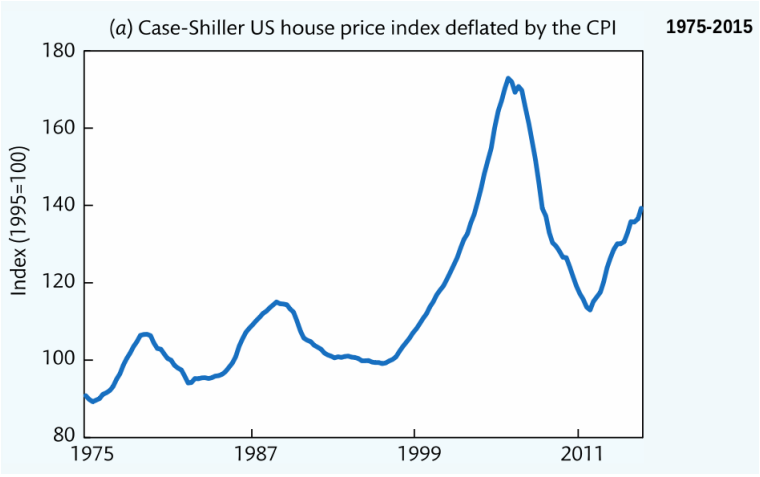
Low interest rates in early 2000's

- excessive borrowing $\rightarrow$ housing bubble
- when the bubble bursted, prices decreased and lending freezed (wealth shock)

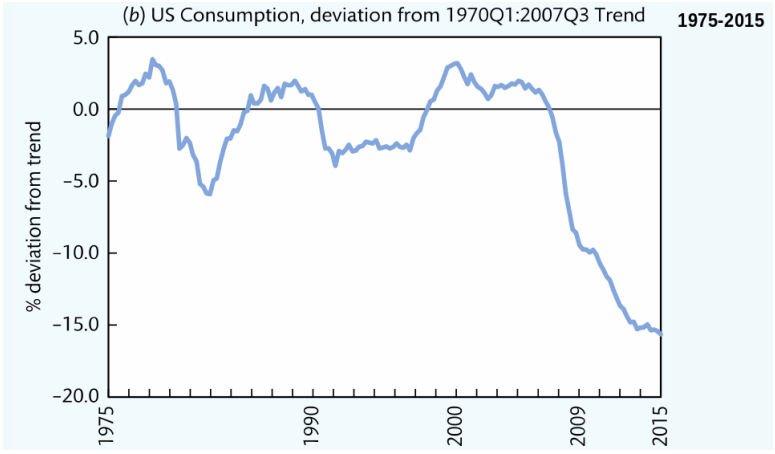
$\rightarrow$ demand decreased

$\rightarrow$ IS curve shifted

Financial Crisis in US



Financial Crisis in US



Taylor Rule

Central bank decision rule for setting the interest rate

- describes the behavior of a modern central bank

Money markets

- in equilibrium money demand equals its supply; $M = M^d$, where demand is $M^d = k(i)\,Y$
- old fashioned alternative to TR curve is the LM (liquidity preference - money supply) curve, central bank that does not directly set the rate but controls the rate through money supply

Recap on Money Demand

Desired holdings of money = money demand

- transaction motive and precautionary motive

Real money demand $L(i, Y)$

- also known as liquidity preference function
- nominal demand is $P \cdot L(i, Y)$

Quantity theory of money: $L(i, Y) = Y / V(i)$

- $V(i) = 1/k(i)$ is the velocity of money
- higher i, higher velocity (lower demand)

Taylor Rule

Interest rate reacts to inflation and output gap

$$i = \bar{i} + a \underbrace{(\pi - \bar{\pi})}_{\text{inflation gap}} + b \underbrace{\left(\frac{Y - \bar{Y}}{\bar{Y}} \right)}_{\text{output gap}}$$

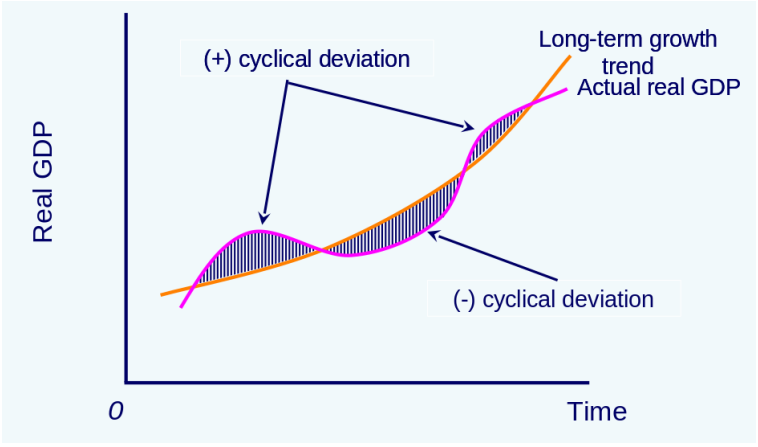
- $\bar{\pi}$ is the target inflation rate, $a > 0$ weight of the inflation target
- $\bar{Y}$ is the trend GDP, $b > 0$ weight of the output gap target

Short-run TR curve

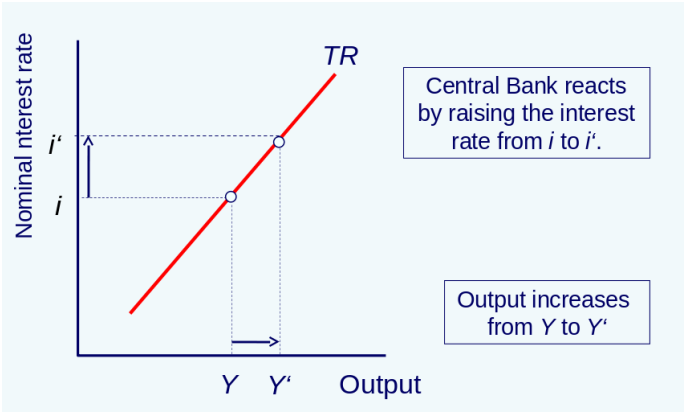
$$i = \bar{i} + b \left(\frac{Y - \bar{Y}}{\bar{Y}} \right)$$

- the objective is stable growth
- there is inflation pressure if $Y > \bar{Y}$
- note: estimating $\bar{Y}$ can be hard, e.g. affected by productivity

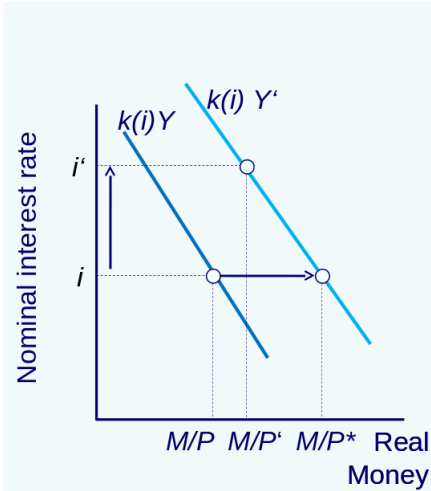
Output Gap and Cyclical Deviations



Taylor Rule


Nominal interest rate
TR
i‘
i
Central Bank reacts by raising the interest rate from i to i‘.
Output increases from Y to Y‘
Y
Y‘
Output

Money Market Equilibrium



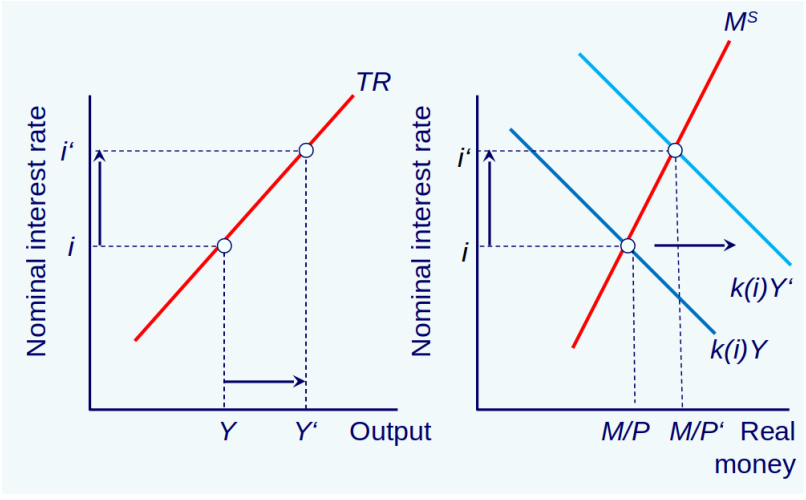
Output increase from Y to Y' increases money demand from $k(i)Y$ to $k(i)Y'$

At interest rate i, money market equilibrium holds if the central bank supplies $(M/P)^*$

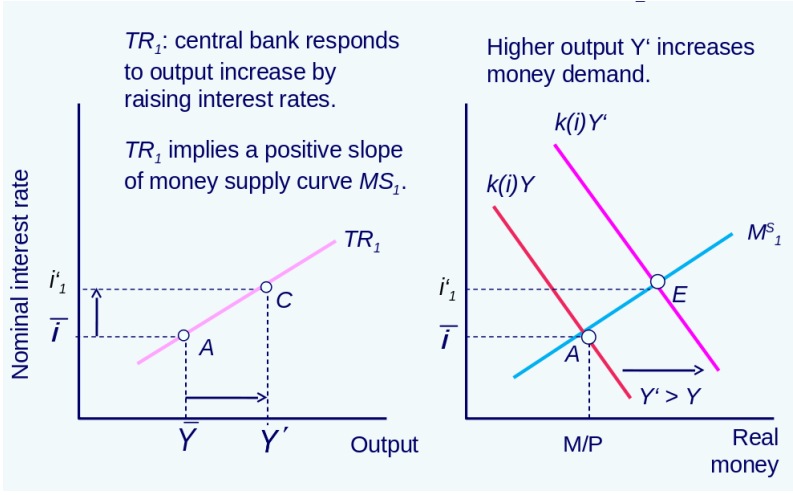
The central bank raises the interest rate from i to i' in reaction to the output increase

The higher interest rate i' reduces money demand. Money market equilibrium holds for money supply $(M/P)'$

Taylor Rule and Money Markets



Slope of the Taylor Rule



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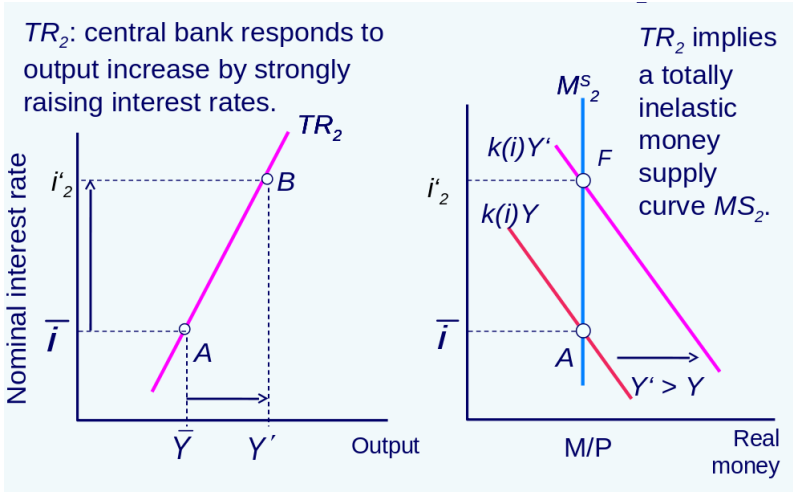
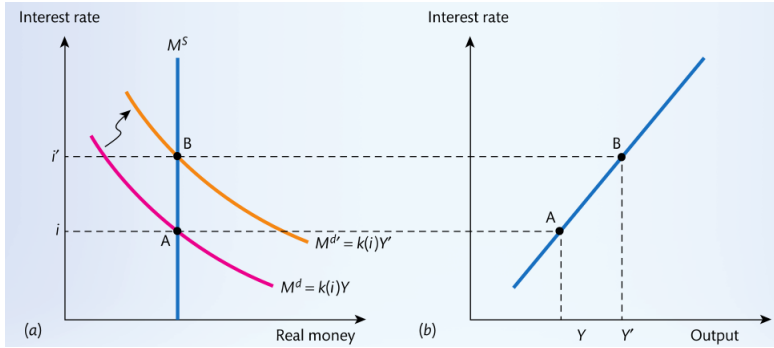


LM Curve


Interest rate
M^S
B
i'
i
A
$M^{d\prime} = k(i)Y'$
$M^d = k(i)Y$
(a)
Real money
Interest rate
B
A
(b)
Y
Y'
Output

LM Curve: Example

Money demand $M^d/P = Y - 20i$, $P = 2$

Money supply: $M^s/P = 600$

What is the LM curve?

- $Y - 20i = 600$, which gives $i = Y/20 - 30$

Background of Taylor Rule

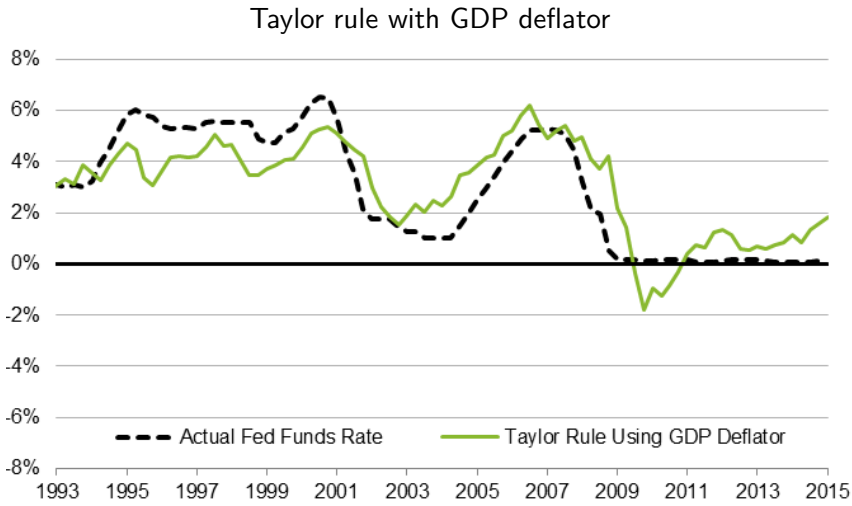
Debate: policy rules versus discretion

- CB policy should guarantee long-term price stability
- from money targets to inflation targets
- Taylor rule proposed in 1993 by John Taylor

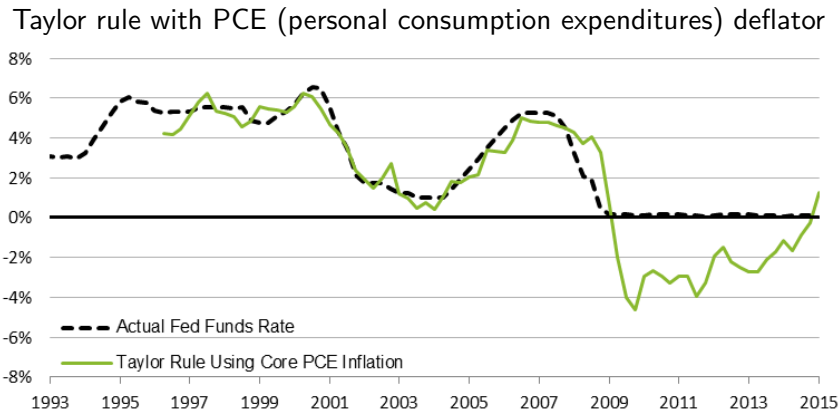
Do CBs follow mechanistic policy rules?

- in their own words no, but they utilize different policy rules
- policy rules are oversimplifications but for macroeconomic analysis they provide good approximations
- in estimated TR's parameter b is typically about 0.5
- it has been observed that CBs conduct interest rate smoothing

FED Funds Rate vs. Taylor Rule

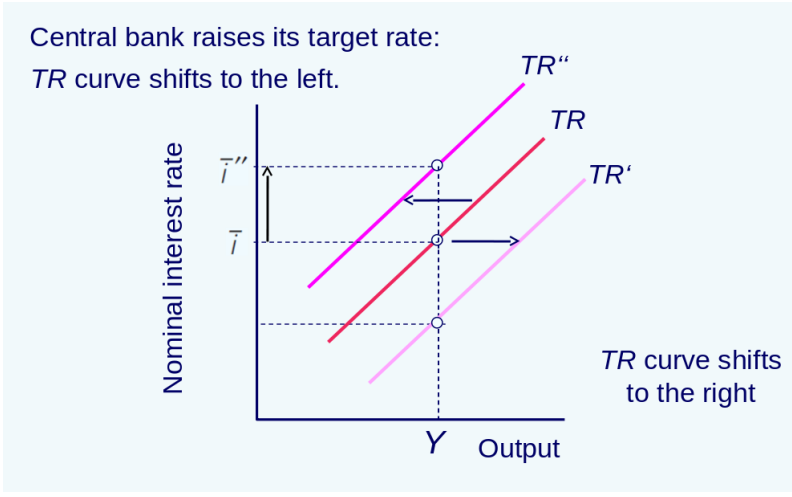


FED Funds Rate vs. Taylor Rule



Source: Ben Bernanke's blog post from 2015

Shifts of TR Curve



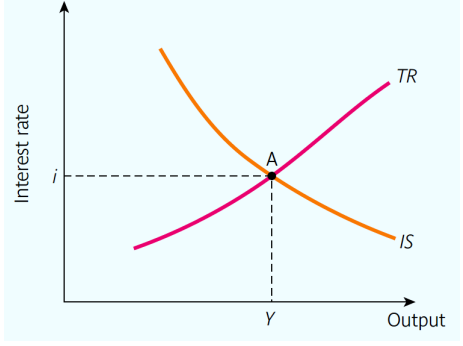
IS-TR Model

IS-curve: the relationship between the interest rate and output through demand

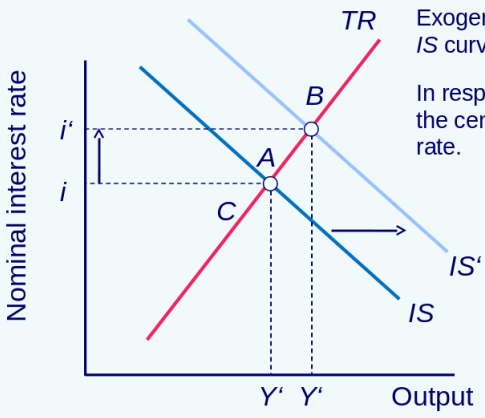
TR-curve: the relationship between interest rate and short run output through monetary policy

IS-TR-model: describes how changes in monetary policy and demand factors affect output and interest rate in the short-run

IS-TR Model



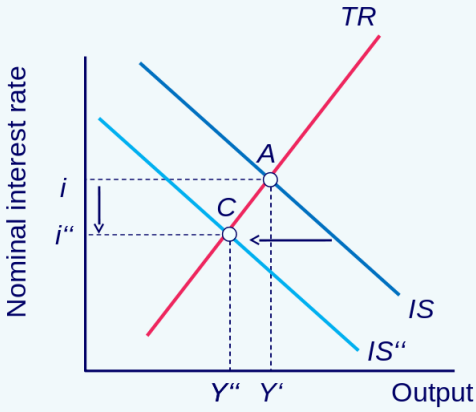
Real (IS) Shocks



Exogenous increase in demand: *IS* curve shifts to the right.

In response to output expansion, the central bank raises the interest rate.

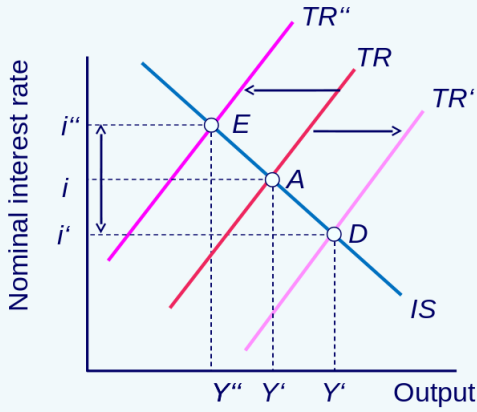
Real (IS) Shocks



Exogenous decrease in demand: *IS* curve shifts to the left.

In response to output contraction, the central bank lowers the interest rate.

Monetary Policy (TR) Shocks



Central bank lowers its target interest rate:

TR curve shifts to the right

Central bank raises its target interest rate:

TR curve shifts to the left

Monetary Policy and Zero Lower Bound

Interest rates cannot be set (significantly) below zero

- when 0 is reached, CB cannot provide stimulus via interest rates (liquidity trap) $\rightarrow$ quantitative easing (asset purchases programs)
- J. Hicks: "So long as rates of interest are positive, the decision to hold money rather than lend it, or use it to pay off old debts, is apparently an unprofitable one"
- holding cash guarantees zero nominal interest rate

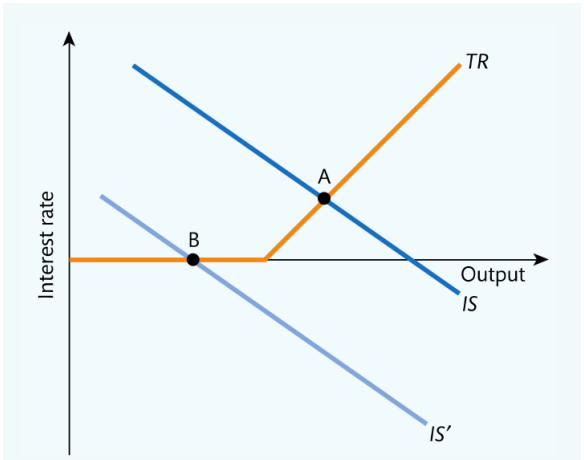
Taylor rule

$$i = \max\left\{ \bar{i} + a \underbrace{(\pi - \bar{\pi})}_{\text{inflation gap}} + b \underbrace{\left(\frac{Y - \bar{Y}}{\bar{Y}} \right)}_{\text{output gap}}, 0 \right\}$$

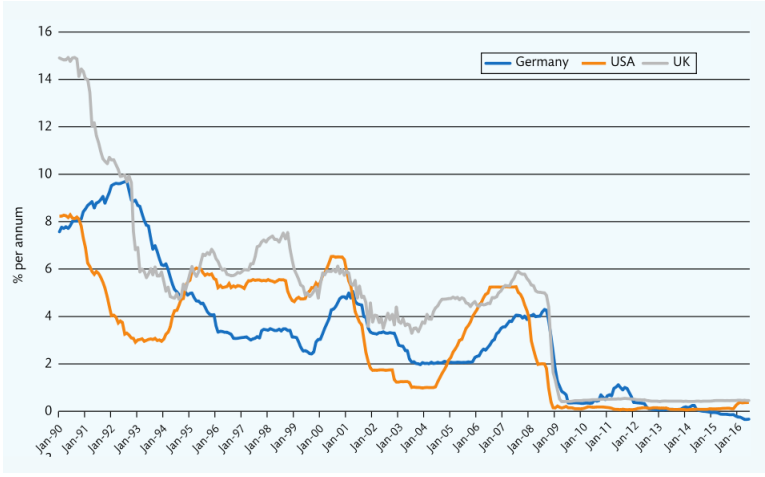
Negative interest rates in Eurozone

- since 2014

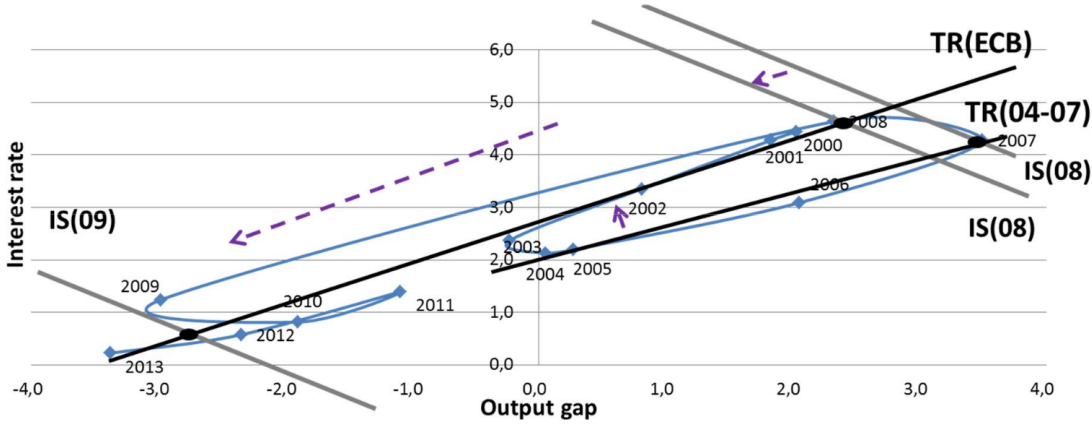
Monetary Policy and Zero Lower Bound



Monetary Policy and Zero Lower Bound



Example: IS-TR and Euro Area 2000–2013



Source J. Tervala 2014

Example: Finding the Equilibrium

TR curve: $i = Y/20 - 30$

Consumption: $C = 120 + 0.5(Y - T)$

Investment: $I = 100 - 10i$

$G = 100$ and $T = 40$

IS curve

- solve $Y = 120 + 0.5(Y - 40) + 100 - 10i + 100$ to obtain $Y = 600 - 20i$

Equilibrium: $i = Y/20 - 30$ and $Y = 600 - 20i$

- $Y = 600 - Y + 600$ and $Y = 600$ (and $i = 0$)

Questions: Analyzing Macroeconomic Events

Explain the short-run effect of the following events on GDP, how the central bank should response to stabilize output?

1. The government offers a temporary investment tax credit: for each euro of investment that firms undertake, they get a credit that reduces the taxes they pay on corporate income.
2. A housing bubble bursts, so that housing prices fall by 20% and new home sales drop sharply.
3. A resurgence of growth in Japan leads to an unexpected increase in the demand by Japanese consumers for European goods.