

MONETARY THEORY AND POLICY

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AGENDA

- Money and real economic activities?
- Why does money affect output?
- **Modern monetary policy model**
 - **Basic framework**
 - Analysis
 - Extension

MONETARY POLICY MODEL

- Old-version monetary policy model (in EE312)
 - IS-LM / AD-AS model
 - Phillips curve: inflation and unemployment
- Two problems:
 - Inflation v.s. Price
 - Monetary policy variable

PROBLEM I

- Concerns over the monetary policy conduct have nowadays shifted towards controlling inflation.
 - Central bank adopts the inflation targeting!
- Theoretical treatment in textbook and Practical conduct do not fall in line
 - Textbook focuses on the determination of “price”
 - Central bank focuses on the determination of “inflation” – i.e. rate of change in price.

PROBLEM 2

- Central banks have nowadays controlled “very short-term interest rate”
- Theoretical treatment in most standard textbooks focus on controlling money supply.

NEW GENERATION OF MONETARY POLICY MODEL

- This development owes a great deal to David Romer, who proposed the first version of monetary policy model usable for the undergraduate teaching
 - Romer (2003) “The Keynesian economics with LM curve”
- The model is called **“IS / PC / MP”** model
 - Also know as the “three” equation model, but two curves.
 - Also known as the **augmented “AD-AS” model**

IS / MP / PC MODEL

- IS = IS relation (capture aggregate demand)
 - Link between (real) interest rate and aggregate output
 - Capture the transmission of monetary policy
- MP = Monetary policy equation (capture behavior of central bank)
 - The equation describes a prescriptive plan for **the adjustment of policy rate**
 - Represent how central bank “**control**” the **aggregate demand**
- PC = Phillips curve (capture the aggregate supply)
 - How inflation is determined by the course of economic activities.

PHILLIPS CURVE: THE SUPPLY SIDE

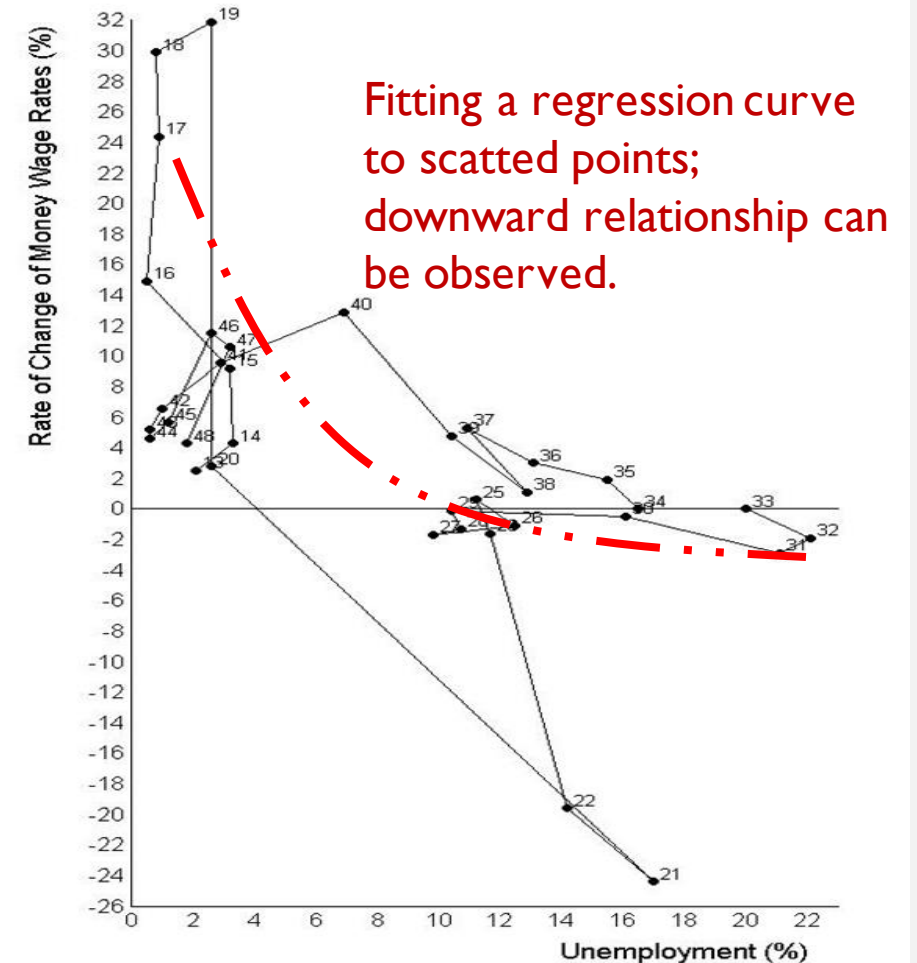


- Origin of the Phillips curve (By A.W. Phillips)
 - 1958 **A.W. Phillips** discovered the inverse relation between the rate of unemployment and the rate of increase in money wages.
 - **Wage inflation** decreases with **unemployment rate**.
 - Studies based on the UK data for 1861-1957.
 - The relation has been highly stable.

PHILLIPS CURVE: THE SUPPLY SIDE

➤ The relation between wage inflation and unemployment rate for the UK during 1913-1948.

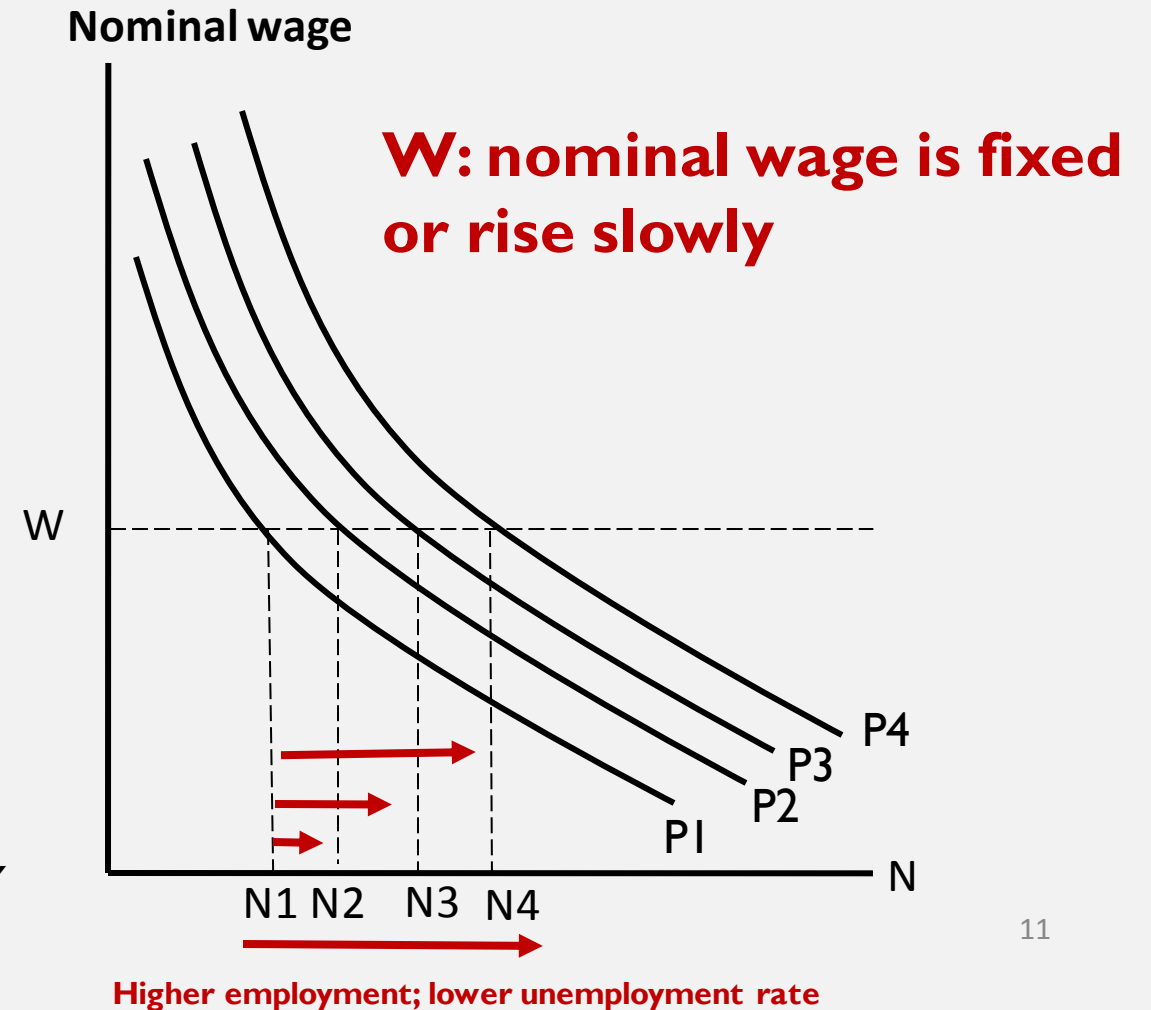
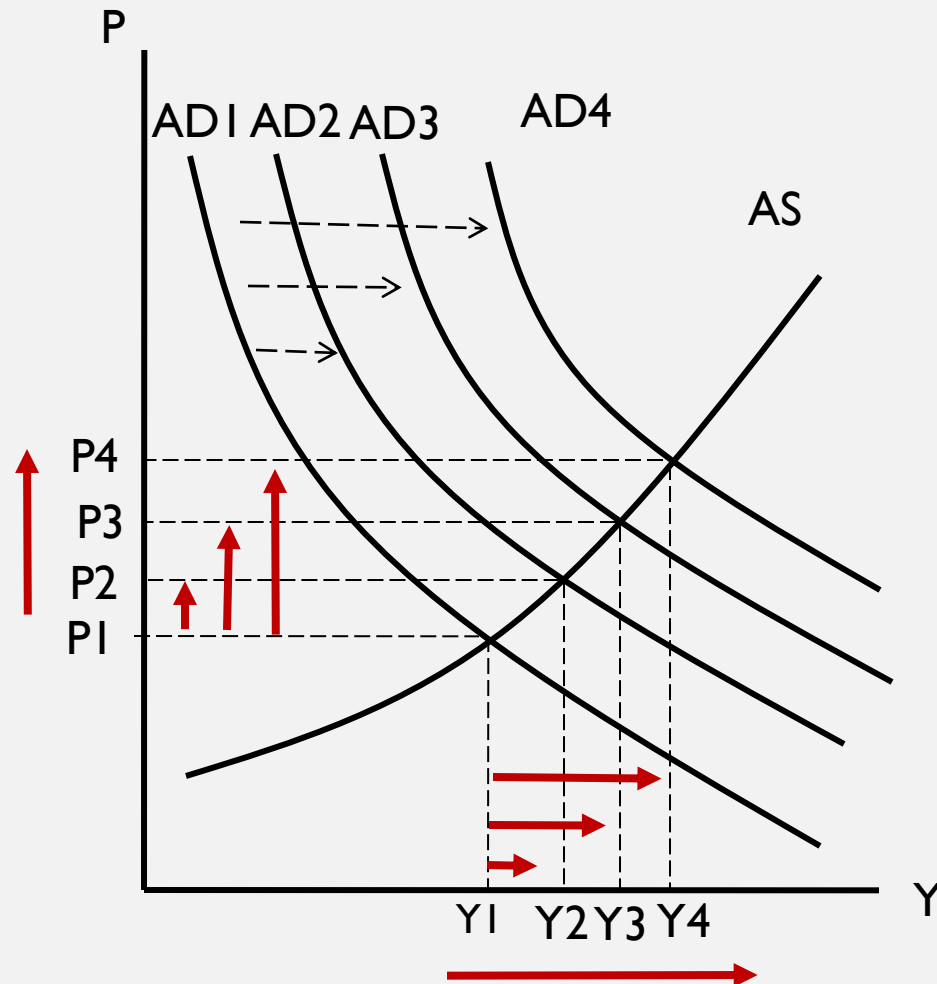
- 1960 Paul Samuelson and Robert Solow found a similar relation in the US data for 1900-1960.
 - The relation is dubbed '**the Phillips curve**'.



PHILLIPS CURVE: THE SUPPLY SIDE

- Subsequently, economists uncovered a similar relation when looking into the comovement between the **CPI inflation** and the **unemployment rate**.
- **Why do we have a negative relationship?**

PHILLIPS CURVE: THE SUPPLY SIDE (KEYNESIAN INTERPRETATION)



PHILLIPS CURVE: THE SUPPLY SIDE

- Original doctrine of Phillips curve and its Implications
 - Policymaker faced a trade-off: Central bank can push for a low unemployment rate if they are willing to accept the high inflation
 - The trade-off is thought to be a permanent one!
- However, Milton Friedman's 1968 presidential address to the American Economic Association produced a well-timed and influential critique of the thinking **underlying the Phillips Curve**.

PHILLIPS CURVE: THE SUPPLY SIDE

- Keeping unemployment low in a persistent manner is not feasible in the long-run.
 - If low unemployment means workers have strong bargaining position, then high nominal wage inflation on its own is not good enough; They want nominal wage inflation greater than price inflation.
- Friedman argued that if policy-makers tried to exploit an apparent Phillips curve trade-off, then the public would get used to high inflation and come to expect it.
- Inflation expectations would move up and the previously-existing trade-off between inflation and output would disappear.

PHILLIPS CURVE: THE SUPPLY SIDE

- In particular, he put forward the idea that there was a natural rate of unemployment and that attempts to keep unemployment below this level could not work in the long run.
- He proposed another augmented version of the Phillips curve.

$$\pi_t = \pi_t^e + \kappa(u_t - u_t^n) + \varepsilon_t^\pi$$

π_t^e = expected inflation

u_t^n = natural rate of unemployment

u_t = unemployment rate

ε_t^π = inflation shock

PHILLIPS CURVE: THE SUPPLY SIDE

- How can the augmented version explain the storyline that Friedman argued – i.e. no permanent trade-off?
 - Given that $(u_t - u_t^n) > 0$, resulting outcome would be that $\pi_t > \pi_t^e$
 - Worker will revise the inflation expectation; demanding for higher nominal wage growth.
 - Previous existing trade-off is then eliminated as firm will start to realize that it would no longer be good to increase the employment; employment will be back to the natural rate.

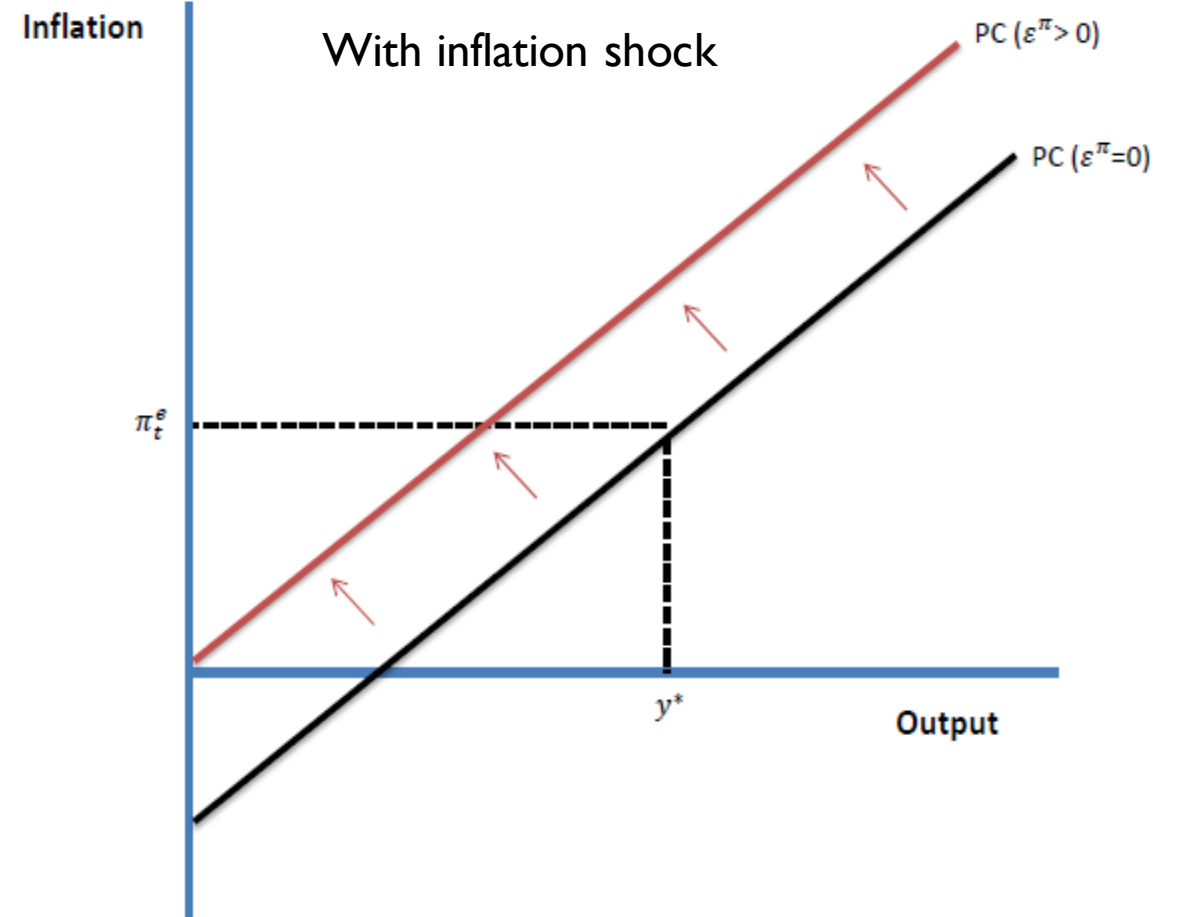
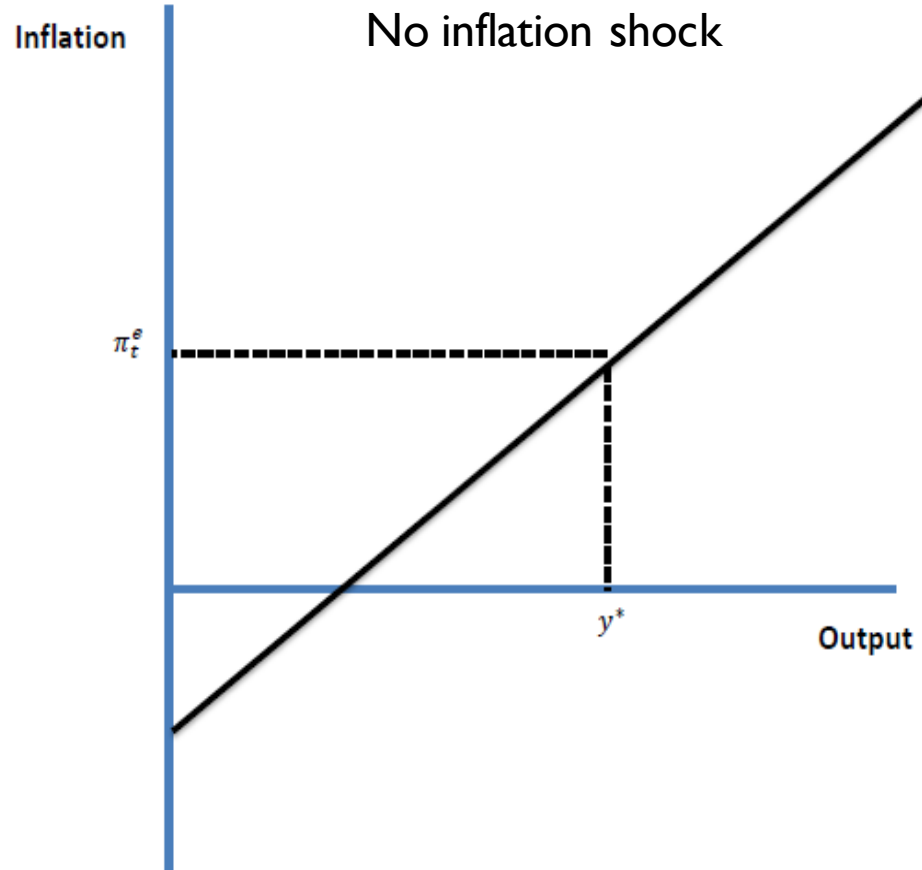
PHILLIPS CURVE: THE SUPPLY SIDE

- Current generation of Phillips curve is to express the relationship between “inflation” and “output gap” (rather than unemployment gap)

$$\pi_t = \pi_t^e + \gamma (y_t - y_t^*) + \epsilon_t^\pi$$

- This owes the relationship uncovered by Arthur Okun; **output gap is positively related to unemployment gap.**
 - Output gap = actual output – potential output (y^*)

PHILLIPS CURVE: THE SUPPLY SIDE



IS RELATION

- The second element of the model is an IS curve relating output to interest rates. The **higher interest rates are, the lower output is.**
- What type of interest rate are we talking about?
 - The IS relationship is between **output and real interest rates**, not nominal rates. Real interest rates adjust the nominal interest rate by subtracting the inflation.
- Why does higher (real) interest rate negatively affect output?

IS RELATION

- What's new for the IS relation in modern monetary policy.
- **Traditional IS equation:** represent the relationship in terms of output and (real) interest rate
- **Augmented version:** represent the relationship in terms of **output gap** and (real) interest rate gap

IS RELATION

- The augmented version of IS relation is given by

$$y_t = y_t^* - \alpha (i_t - \pi_t - r^*) + \epsilon_t^y$$

y_t = Actual output

y_t^* = potential output

i_t = nominal interest rate

r_t^* = Natural rate of interest rate

ϵ_t^y = **IS shock**

MONETARY POLICY BEHAVIOR

- Inflation depends on output, and output depend on interest rate
- How interest rate is determined?
- Traditional approach to the determination of interest rate is built upon the concept of LM relation
 - Model the behavior of money demand and LM relation

money demand

$$\frac{m_t}{p_t} = \delta - \mu i_t + \theta y_t$$

LM relation

$$y_t = \frac{1}{\theta} \left(\frac{m_t}{p_t} - \delta + \mu i_t \right)$$

MONETARY POLICY BEHAVIOR

- Traditional approach focuses on controlling money supply.
- Taking the level of money supply as given, “interest rate” and “output” are “simultaneously determined; the intersection point between IS curve and LM curve

MONETARY POLICY BEHAVIOR

- To make the structure more consistent to practical conduct, we assume that central bank directly sets the nominal interest rate.
 - Very short-term interest rate; monetary policy operating procedures.
- We capture the behavior of interest rate setting by the so called “monetary policy rule” or “interest rate rule”

MONETARY POLICY BEHAVIOR

- We first consider a monetary policy rule of the form:

$$i_t = r^* + \pi^* + \beta_\pi (\pi_t - \pi^*)$$

We assume $\beta_\pi > 0$.

- Features of this rule:
 - ▶ Central bank adjusts i_t up when inflation, π_t , goes up and down when inflation goes down.
 - ▶ When $\pi_t = \pi^*$ real interest rates equal their natural level.
- Why is a rule like this a good idea?
 - ▶ If the public understands the central bank's target inflation rate, then on average we get $\pi_t^e = \pi^*$.
 - ▶ In this case, the Phillips curve tells us that, on average, inflation will equal π^* provided we have $y_t = y_t^*$.
 - ▶ And IS curve tells us that, on average, we will have $y_t = y_t^*$ when $i_t - \pi_t = r^*$.

THE COMPLETE THREE-EQUATION MODEL

- 1 The Phillips curve:

$$\pi_t = \pi_t^e + \gamma (y_t - y_t^*) + \epsilon_t^\pi$$

- 2 The IS curve:

$$y_t = y_t^* - \alpha (i_t - \pi_t - r^*) + \epsilon_t^y$$

- 3 The monetary policy rule:

$$i_t = r^* + \pi^* + \beta_\pi (\pi_t - \pi^*)$$

THE COMPLETE THREE-EQUATION MODEL

- The version of three-equation model can be analyzed by mathematical approach
- We will be representing the three equations using graphical illustration
- This is not feasible because we have three variables!
 - Let try to get the graphical illustration that describe the relationship between “inflation” and “output”

THE IS-MP CURVE

- If we replace the term i_t in the IS curve with the formula from the monetary policy rule, we get

$$y_t = y_t^* - \alpha [r^* + \pi^* + \beta_\pi (\pi_t - \pi^*)] + \alpha (\pi_t + r^*) + \epsilon_t^y$$

- Now multiply out the terms in this equation to get

$$y_t = y_t^* - \alpha r^* - \alpha \pi^* - \alpha \beta_\pi (\pi_t - \pi^*) + \alpha \pi_t + \alpha r^* + \epsilon_t^y$$

- Canceling terms and re-arranging, this simplifies to

$$y_t = y_t^* - \alpha (\beta_\pi - 1) (\pi_t - \pi^*) + \epsilon_t^y$$

- This is the IS-MP curve. It combines the information in the IS curve and the MP curve into one relationship.

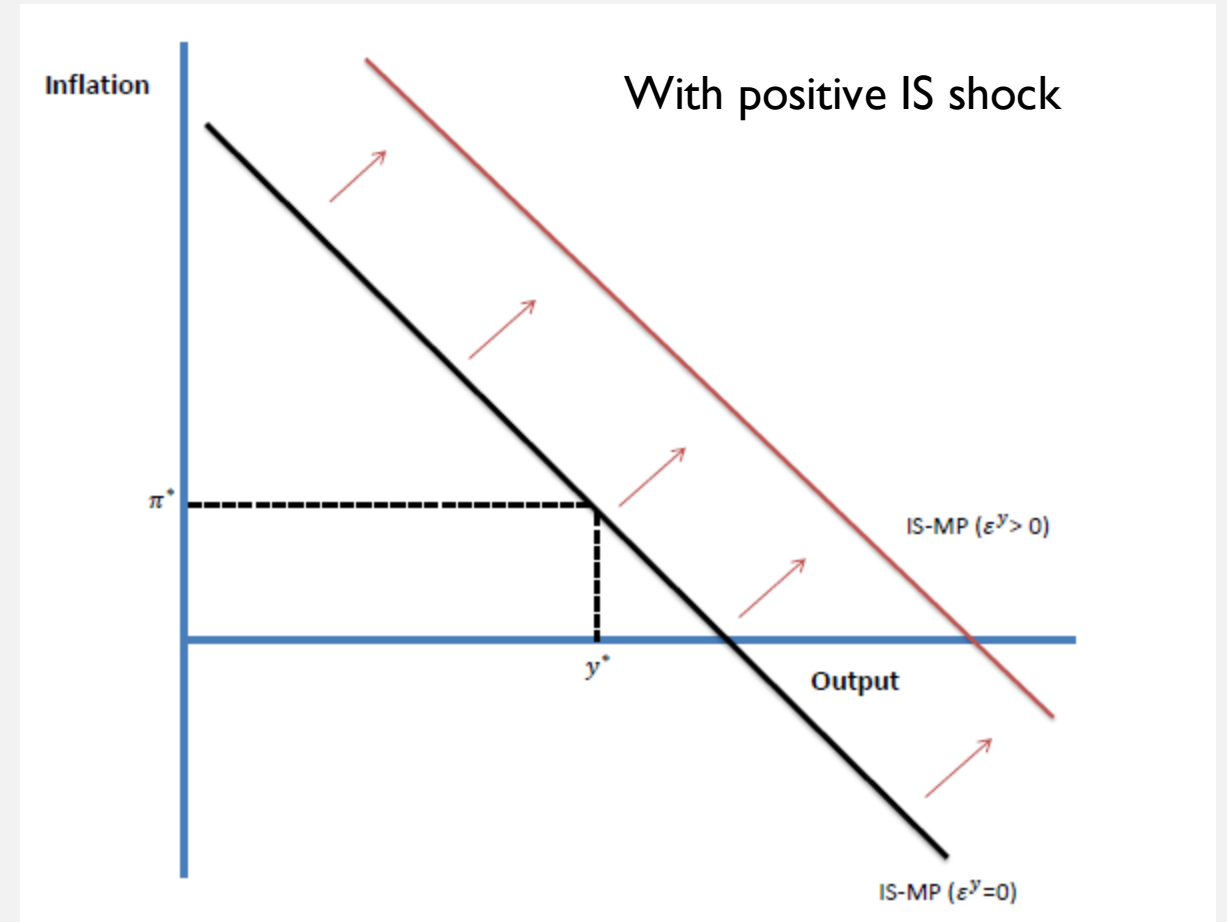
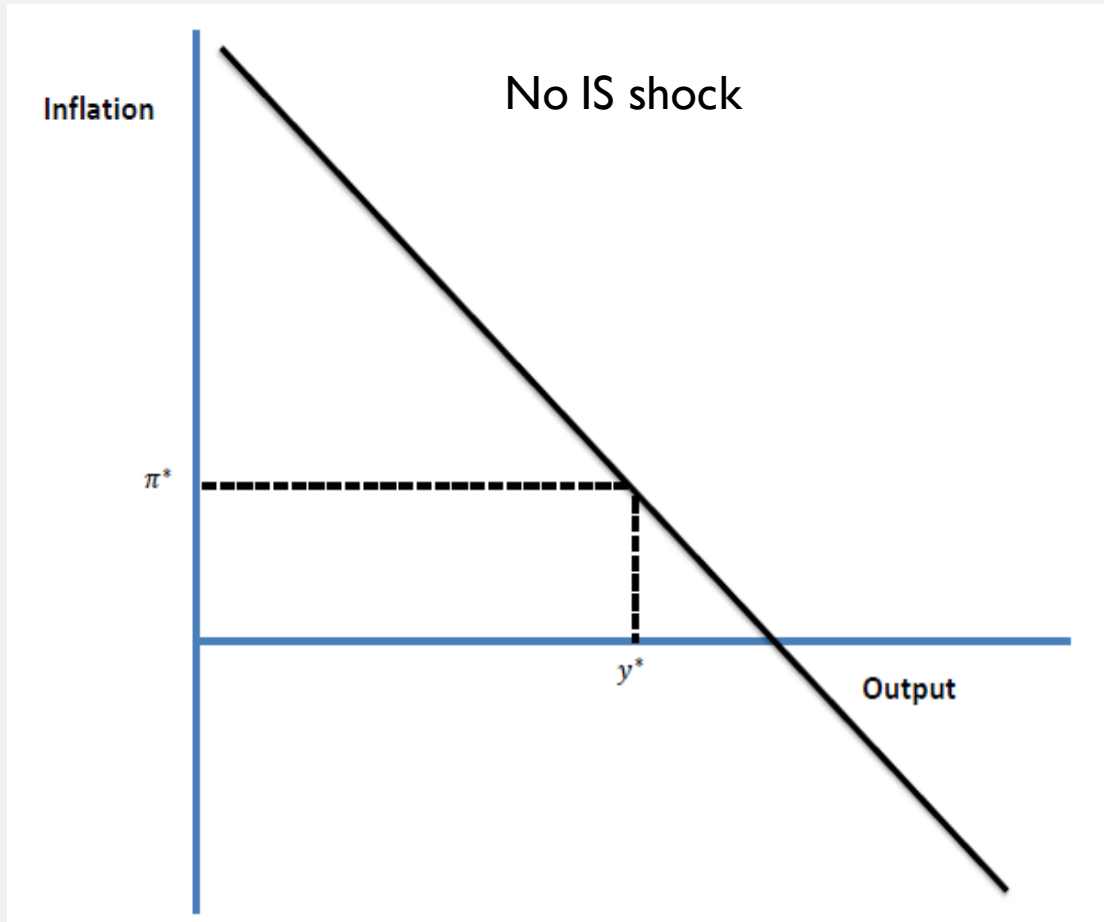
THE IS-MP CURVE

- The IS-MP curve is

$$y_t = y_t^* - \alpha (\beta_\pi - 1) (\pi_t - \pi^*) + \epsilon_t^y$$

- How this curve looks in a graph depends especially on the value of β_π .
- An extra unit of inflation implies a change of $-\alpha (\beta_\pi - 1)$ in output.
- Is this positive or negative? We are assuming that $\alpha > 0$ so this combined coefficient will be negative if $\beta_\pi - 1 > 0$, i.e. the IS-MP curve will slope downwards if $\beta_\pi > 1$ and upwards if $\beta_\pi < 1$.
- Explanation: Increase in inflation of x will lead to an increase in nominal interest rates of $\beta_\pi x$ so real interest rates change by $(\beta_\pi - 1)x$. If $\beta_\pi > 1$ then an increase in inflation leads to higher real interest rates and, via the IS curve relation, to lower output.
- For now, we will assume that $\beta_\pi > 1$ so that we have a downward-sloping IS-MP curve but we will revisit this later.

THE IS-MP CURVE



EQUILIBRIUM

- Suppose that “inflation expectation” is well anchored.
- Private sector uses the “target inflation rate” as the expected level of inflation.
- Suppose that there is no shock!

EQUILIBRIUM

