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

THE TAYLOR'S PRINCIPLE

- We have assumed $\beta_\pi > 1$.
- This which means the central bank reacts to a change in inflation by implementing a bigger change in interest rates.
- This means that real interest rates go up when inflation rises and go down when inflation falls. This is why the IS-MP curve slopes downwards: Along this curve, Higher inflation means lower output.
- Because Taylor's original proposed rule had the feature that $\beta_\pi > 1$, the idea that monetary policy rules should have this feature has become known as *the Taylor Principle*.
- We now discuss why policy rules should satisfy the Taylor principle.

WHEN $\beta_\pi > 1$

- Inflation in the IS-MP-PC model is given by

$$\pi_t = \theta \pi_t^e + (1-\theta)\,\pi^* + \theta\left(\gamma \epsilon_t^y + \epsilon_t^\pi\right)$$

where

$$\theta = \left(\frac{1}{1+\alpha\gamma\left(\beta_\pi - 1\right)}\right)$$

- Under adaptive expectations, $\pi_t^e = \pi_{t-1}$ and the model can be re-written as

$$\pi_t = \theta \pi_{t-1} + (1-\theta)\,\pi^* + \theta\left(\gamma \epsilon_t^y + \epsilon_t^\pi\right)$$

- Three different cases depending on different values of β_π.

1. $\beta_\pi > 1$
   - ★ $\beta_\pi > 1 \Rightarrow \alpha\gamma\left(\beta_\pi - 1\right) > 0$
   - ★ $\beta_\pi > 1 \Rightarrow 1 + \alpha\gamma\left(\beta_\pi - 1\right) > 1$
   - ★ $\beta_\pi > 1 \Rightarrow 0 < \theta < 1$

WHEN $\beta_\pi < 1$

- Recall from our last set of notes that inflation in the IS-MP-PC model is given by
$$\pi_t = \theta \pi_t^e + (1-\theta)\pi^* + \theta\left(\gamma \epsilon_t^y + \epsilon_t^\pi\right)$$
where
$$\theta = \left(\frac{1}{1+\alpha\gamma\left(\beta_\pi - 1\right)}\right)$$
- Under adaptive expectations, $\pi_t^e = \pi_{t-1}$ and the model can be re-written as
$$\pi_t = \theta \pi_{t-1} + (1-\theta)\pi^* + \theta\left(\gamma \epsilon_t^y + \epsilon_t^\pi\right)$$
- Three different cases depending on different values of β_π.

  2. $\left(1 - \frac{1}{\alpha\gamma}\right) < \beta_\pi < 1$:
     - ★ $\beta_\pi < 1 \Rightarrow \alpha\gamma\left(\beta_\pi - 1\right) < 0 \Rightarrow 1 + \alpha\gamma\left(\beta_\pi - 1\right) < 1$
     - ★ $\beta_\pi > \left(1 - \frac{1}{\alpha\gamma}\right) \Rightarrow 1 + \alpha\gamma\left(\beta_\pi - 1\right) > 0.$
     - ★ $\theta > 1$

WHEN β_π IS WELL BELOW ONE

- Recall from our last set of notes that inflation in the IS-MP-PC model is given by

$$\pi_t = \theta \pi_t^e + (1 - \theta)\, \pi^* + \theta \left(\gamma \epsilon_t^y + \epsilon_t^\pi \right)$$

where

$$\theta = \left(\frac{1}{1 + \alpha\gamma\left(\beta_\pi - 1\right)} \right)$$

- Under adaptive expectations, $\pi_t^e = \pi_{t-1}$ and the model can be re-written as

$$\pi_t = \theta \pi_{t-1} + (1 - \theta)\, \pi^* + \theta \left(\gamma \epsilon_t^y + \epsilon_t^\pi \right)$$

- Three different cases depending on different values of β_π.

3. $\beta_\pi < \left(1 - \frac{1}{\alpha\gamma}\right)$:
   - ★ $\beta_\pi < \left(1 - \frac{1}{\alpha\gamma}\right) \Rightarrow 1 + \alpha\gamma\left(\beta_\pi - 1\right) < 0.$
   - ★ $\beta_\pi < \left(1 - \frac{1}{\alpha\gamma}\right) \Rightarrow \theta < 0$

MACROECONOMY DYNAMIC AND DIFFERENCE EQUATION

- So the value of β_π determines the value of θ – so what?
- To explain why this matters, we need to explain something about difference equation
- A difference equation is a formula that generates a sequence of numbers. In economics, these sequences can be understood as a pattern over time for a variable of interest.
- After supplying some starting values, the difference equation provides a sequence explaining how the variable changes over time.
- For example, consider a case in which the first value for a series is $z_1 = 1$ and then z_t follows a difference equation

  $$z_t = z_{t-1} + 2$$

  This will give $z_2 = 3$, $z_3 = 5$, $z_4 = 7$ and so on.
- So the sequence of numbers generated is $1, 3, 5, 7, \ldots$.

A MORE RELEVANT EXAMPLE

- More relevant to our case is the multiplicative model

$$z_t = bz_{t-1}$$

- For a starting value of $z_1 = x$, this difference equation delivers a sequence of values $x, xb, xb^2, xb^3, xb^4.....$ If b is between zero and one, the sequence converges to zero but if $b > 1$ it explodes to either plus or minus infinity depending on whether x is positive or negative.
- The same logic prevails if we add a constant term

$$z_t = a + bz_{t-1}$$

  If b is between zero and one, the sequence converges over time to $\frac{a}{1-b}$ but if $b > 1$, the sequence explodes towards infinity.
- Add random shocks to the model

$$z_t = a + bz_{t-1} + \epsilon_t$$

  where ϵ_t is a series of zero-mean random shocks. Then if $0 < b < 1$ the series tends to oscillate above and below the average value of $\frac{a}{1-b}$ while if $b > 1$ the series will tend to explode over time.

MACROECONOMIC STABILITY AND β_π

- These considerations explain why the Taylor principle is so important.
- If $\beta_\pi > 1$ then inflation dynamics

$$\pi_t = \theta\pi_{t-1} + (1-\theta)\,\pi^* + \theta\,(\gamma\epsilon_t^y + \epsilon_t^\pi)$$

  are described by an AR(1) model with $0 < \theta < 1$. Inflation and output will be stable around long-run average values.
- If $\left(1 - \frac{1}{\alpha\gamma}\right) < \beta_\pi < 1$, then $\theta > 1$ and inflation ends up exploding off to either plus or minus infinity. Output either collapses or explodes.
- Why does β_π matter so much for macroeconomic stability? Obeying the Taylor principle means that shocks that boost inflation raise real interest rates and thus reduce output, which contains the increase in inflation.
- In contrast, when the β_π falls below 1, shocks that raise inflation result in lower real interest rates and higher output which further fuels the initial increase in inflation.

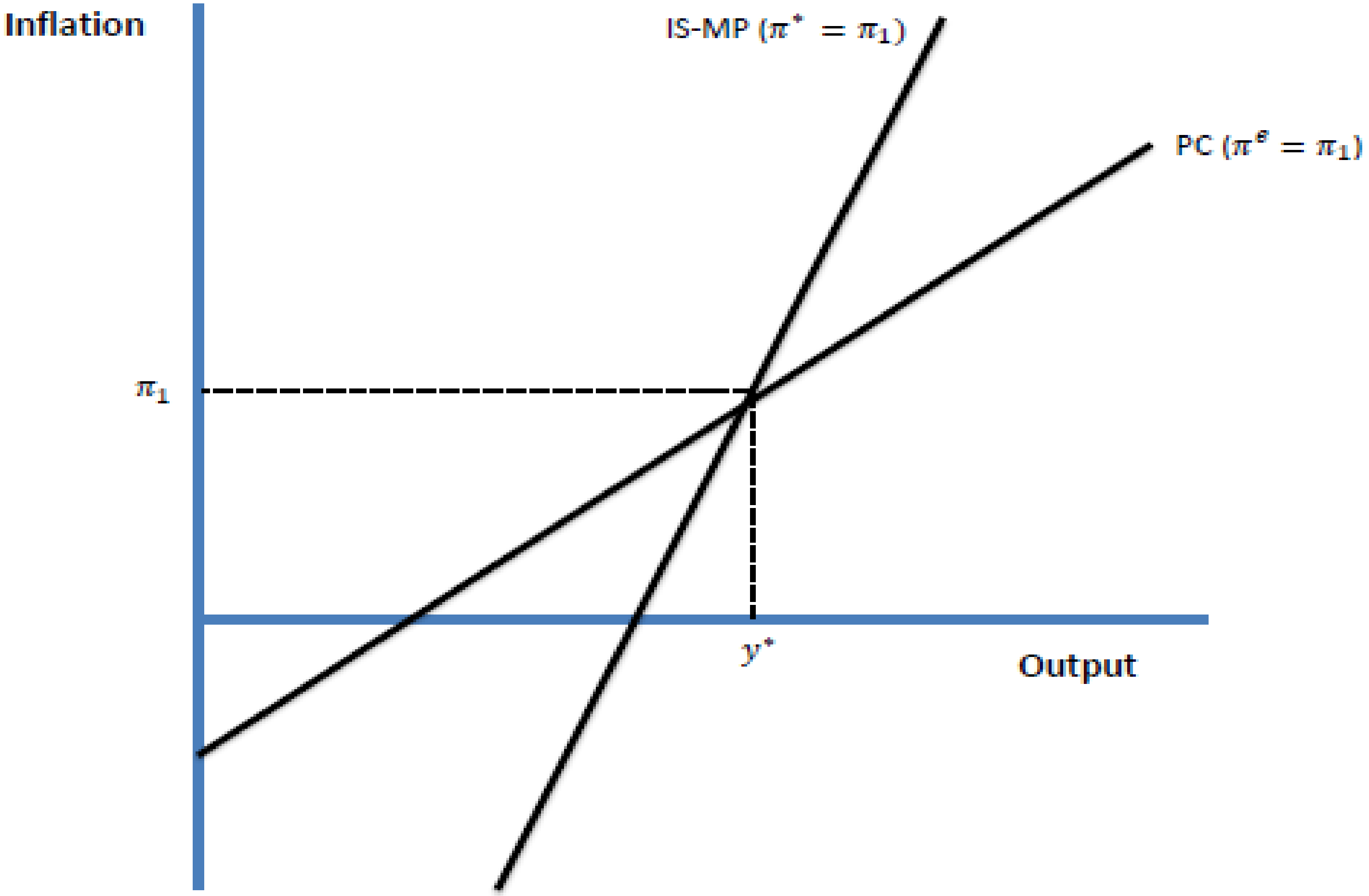
GRAPHICAL REPRESENTATION

- We can use graphs to illustrate the properties of the IS-MP-PC model when the Taylor principle is not obeyed.
- The IS-MP curve is given by

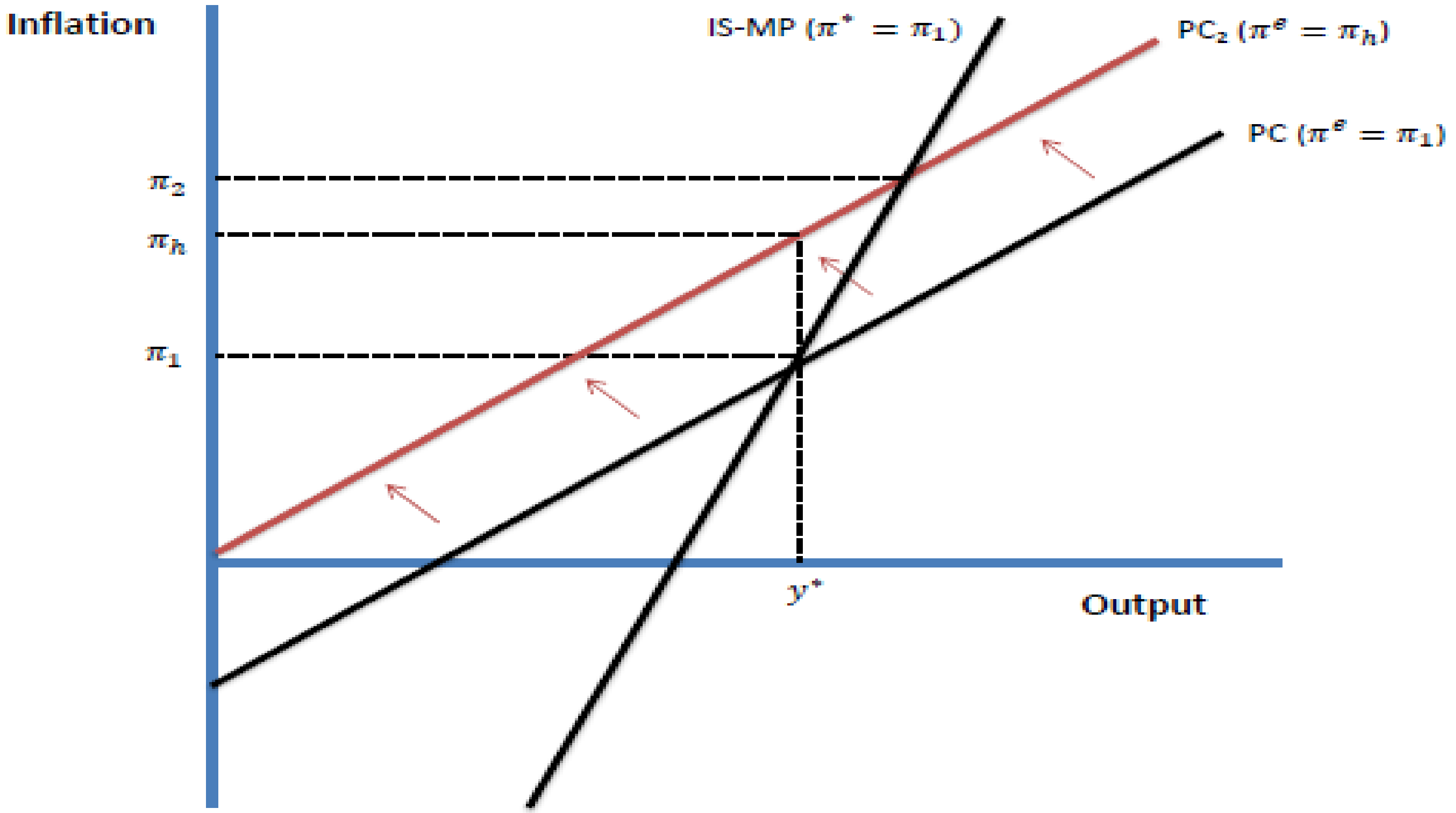
$$y_t = y_t^* - \alpha(\beta_\pi - 1)(\pi_t - \pi^*) + \epsilon_t^y$$

  The slope of the curve depends on whether or not $\beta_\pi > 1$.
- When $\beta_\pi > 1$ the slope $-\alpha(\beta_\pi - 1) < 0$. The IS-MP curve slopes down.
- When $\beta_\pi < 1$ the slope $-\alpha(\beta_\pi - 1) > 0$. The IS-MP curve slopes up.
- But when is the upward-sloping IS-MP curve steeper than the Phillips curve and when is it not?
- I won't show it here but the condition for IS-MP curve to slope up and be steeper than the Phillips curve is $\left(1 - \frac{1}{\alpha\gamma}\right) < \beta_\pi < 1$. In other words, this graph corresponds to the second case considered above. This is the case we will show in graphs here.

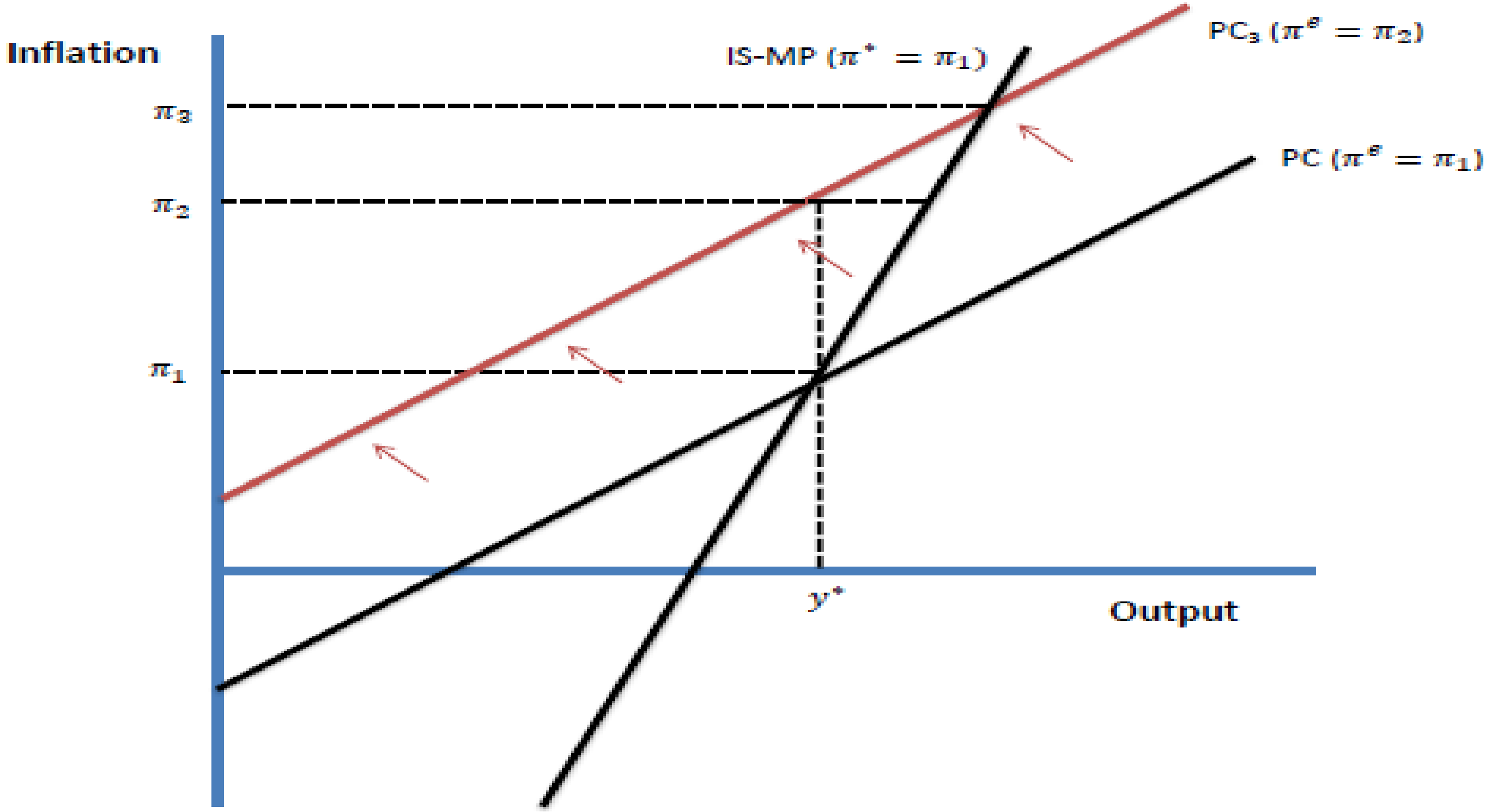
The IS-MP-PC Model when $\left(1 - \frac{1}{\alpha\gamma}\right) < \beta_\pi < 1$



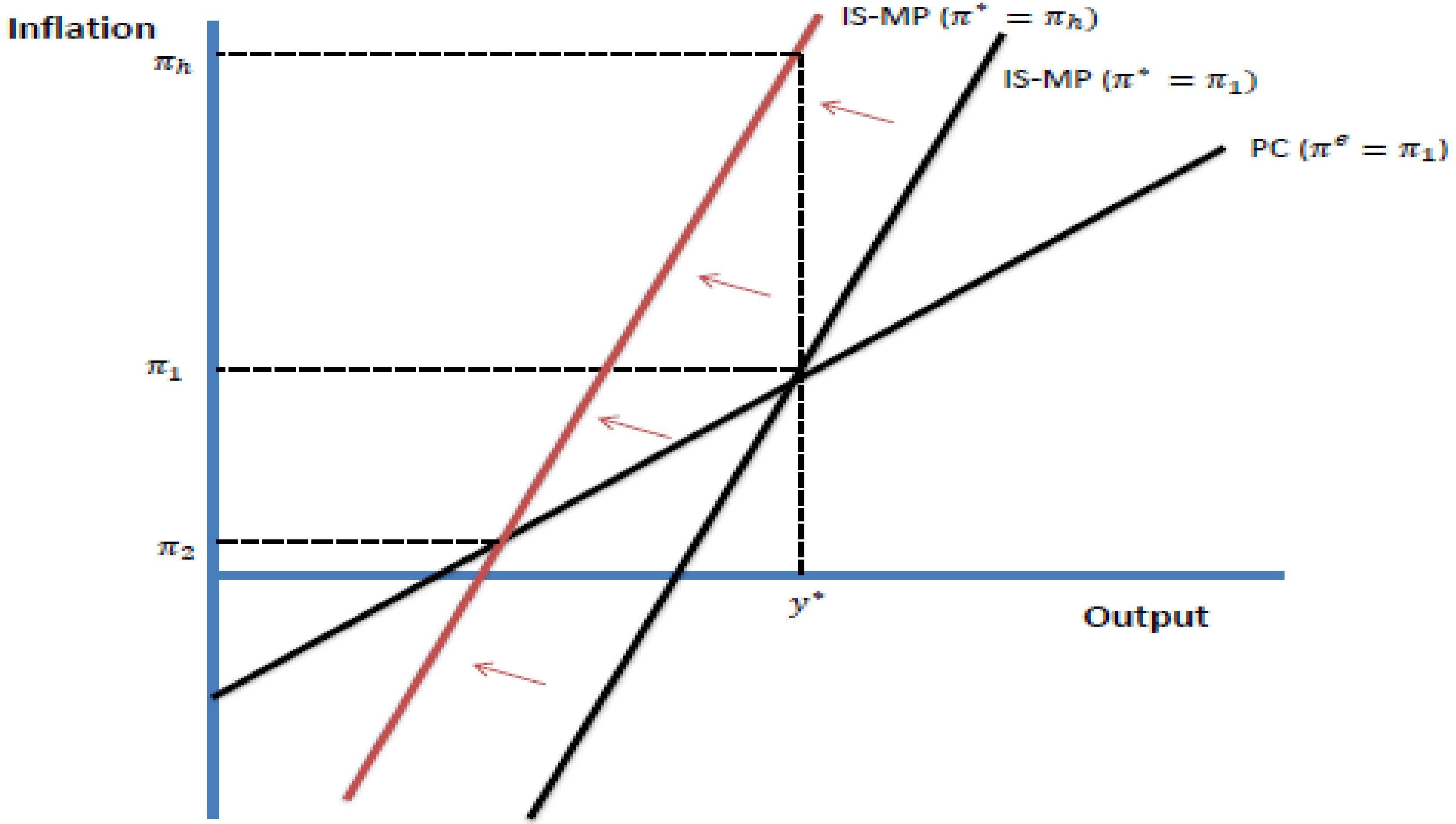
An Increase in π_t^e when $\left(1 - \frac{1}{\alpha\gamma}\right) < \beta_\pi < 1$



Explosive Dynamics when $\left(1 - \frac{1}{\alpha\gamma}\right) < \beta_\pi < 1$



An Increase in π^* when $\left(1 - \frac{1}{\alpha\gamma}\right) < \beta_\pi < 1$



An Increase in π^* when $\beta_\pi < 1$

- This last result is consistent with our basic equation for inflation:

$$\pi_t = \theta\pi_t^e + (1-\theta)\,\pi^* + \theta\left(\gamma\epsilon_t^y + \epsilon_t^\pi\right)$$

  because we are considering the case where $\theta > 1$ so the coefficient on π^* is negative.

- Still, it seems odd. Shouldn't a higher inflation target lead to higher inflation?
- The explanation is that this doesn't happen with our monetary policy rule:

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

- A higher inflation target lowers i_t because it reduces the "inflation gap" $\pi_t - \pi^*$ but it increases i_t because of the first term $r^* + \pi^*$ which is required to maintain the natural real rate in the long term, a reduction in inflation must be matched by a reduction in nominal interest rates.
- When $\beta_\pi < 1$ this second effect is bigger than the first effect. A higher inflation target leads to higher interest rates and lower inflation.

EVIDENCE OF MONETARY POLICY RULES AND MACROECONOMIC STABILITY

TABLE I
AGGREGATE VOLATILITY INDICATORS

	Standard Deviation of:			
	Inflation		Output	
	Level	*hp*	*Gap*	*hp*
Pre-Volcker	2.77	1.48	2.71	1.83
Volcker-Greenspan	2.18	0.96	2.36	1.49
post–82	1.00	0.79	2.06	1.34

Clarida, Gali and Gertler (2000), \Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory“ QJE

EVIDENCE OF MONETARY POLICY RULES AND MACROECONOMIC STABILITY

$$r_t = (1 - \rho)\{rr^* - (\beta - 1)\pi^* + \beta\pi_{t,k} + \gamma x_{t,q}\} + \rho(L)r_{t-1} + \varepsilon_t$$

TABLE II
BASELINE ESTIMATES

	π^*	β	γ	ρ	p
Pre-Volcker	4.24	0.83	0.27	0.68	0.834
	(1.09)	(0.07)	(0.08)	(0.05)	
Volcker-Greenspan	3.58	2.15	0.93	0.79	0.316
	(0.50)	(0.40)	(0.42)	(0.04)	

Standard errors are reported in parentheses. The set of instruments includes four lags of inflation: output gap, the federal funds rate, the short-long spread, and commodity price inflation.