

# GRA 4159: Trends, cycles and signal extraction

**Monetary policy: Inflation targeting in a closed economy**

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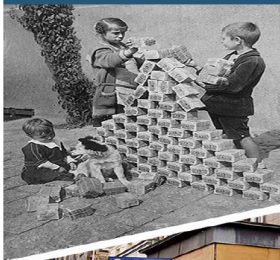
# Introduction

## About me

- Master of Business and Economics (Siviløkonom) from BI (1993) and Dr. Oecon from NHH (2001).
- Professor in macroeconomics at BI and adjunct professor at NHH.
- Worked in Norges Bank for 9 years.

# Central bank duties

Price stability



Payment systems



Financial stability



# Central bank duties



# Central bank duties

## Regulation on Monetary Policy (of March 2, 2018)

- § 1. Monetary policy shall maintain monetary stability by keeping **inflation low and stable**.
- § 2. **Norges Bank is responsible** for the implementation of monetary policy.
- § 3. The operational target of monetary policy shall be **annual consumer price inflation of close to 2 percent over time**. Inflation targeting shall be **forward-looking and flexible** so that it can **contribute to high and stable output and employment** and to **counteracting the build-up of financial imbalances**.
- § 4. Norges Bank shall regularly **publish the assessments** that form the basis of the implementation of monetary policy.

# Central bank duties

## Inflation targeting

- Norway adopted inflation targeting in March 2001.
- New Zealand adopted inflation targeting in 1989, followed by Canada (1991), the UK (1992), Sweden (1993) og Australia (1993).
- Implies delegation of power to the central bank.
  - ▶ Instrument independence.
  - ▶ Goal independence.
- The central bank is responsible for achieving the target. This demands more openness.

# How does monetary policy work?

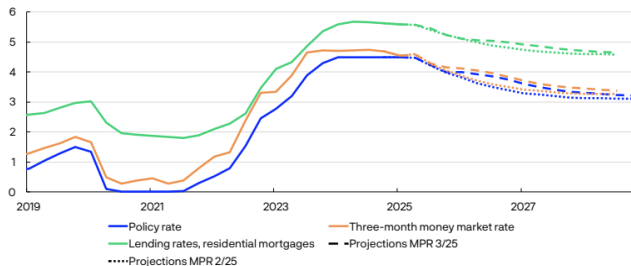
**The policy rate is the most important tool for the central bank**

- In Norway: the interest rate on large banks overnight deposits at Norges Bank (up to a quota).
- Creates the floor for market interest rates.
- Affects the rate of inflation and other key macroeconomic variables through different channels.

# How does monetary policy work?

## 3.8 Household lending rates

Percent



Sources: LSEG Datastream, Statistics Norway and Norges Bank

# How does monetary policy work?

## The key policy rate works through several channels



# Monetary policy trade offs

## Criteria for an appropriate interest rate path (MPR 1/2012)

- 1 **The inflation target is achieved:** The interest rate path should stabilise inflation at target or bring inflation back to target after a deviation has occurred.
- 2 **The inflation targeting regime is flexible:** The interest rate path should provide a reasonable balance between the path for inflation and the path for capacity utilisation in the economy.
- 3 **Monetary policy is robust:** The interest rate should be set so that monetary policy mitigates the risk of a buildup of financial imbalances, and so that acceptable developments in inflation and output are also the likely outcome under alternative assumptions about the functioning of the economy.

# Monetary policy trade offs

(MPR 1/2012, page 15)

## Response pattern of monetary policy and criteria for an appropriate interest rate path

Since 2005, Norges Bank has published forecasts for the key policy rate. As a guideline for the forecasts, Norges Bank has established a set of criteria for an appropriate interest rate path (see, for example, *Monetary Policy Report 3/11*).

The conduct of monetary policy is based on empirical observations of the functioning of the Norwegian economy and how the key policy rate works. New insights provide a basis for further development of monetary policy, in terms of the criteria that may be useful and how to apply them when forecasting the interest rate path.

There is a discussion internationally about whether monetary policy should take into account the risk of financial imbalances.<sup>1</sup> An emerging view is that in certain situations, persistently low interest rates may give rise to financial imbalances in the longer term, with wide fluctuations in output and employment. Norges Bank has previously stated that low interest rates over time entail the risk of a buildup of imbalances.<sup>2</sup> Technically this consideration has been expressed as a supplementary assessment of the changes to the Bank's interest rate forecast.<sup>3</sup> To clarify Norges Bank's response pattern, the criteria for an appropriate interest rate path have now been adjusted accordingly, as described below.

Over time, Norges Bank seeks to maintain inflation close to 2.5%. An appropriate interest rate path should meet the following criteria:

### 1. The inflation target is achieved:

*The interest rate should be set with a view to stabilising inflation at target or bringing it back to target after a deviation has occurred.*

### 2. The inflation targeting regime is flexible:

*The interest rate path should provide a reasonable balance between the path for inflation and the path for overall capacity utilisation in the economy.*

### 3. Monetary policy is robust:

*The interest rate should be set so that monetary policy mitigates the risk of a buildup of financial imbalances, and so that acceptable developments in inflation and output are also the likely outcome under alternative assumptions about the functioning of the economy.*

The various considerations taken into account in the criteria must be weighed against each other. The specific time horizon for stabilising inflation at target will depend on the type of disturbances to which the economy is exposed and their effect on the outlook for inflation and the real economy. Mathematically, these assessments can be represented in somewhat simplified terms by a loss function, where the parameters  $\lambda$ ,  $\tau$  and  $\gamma$  represent relative weights<sup>4</sup>:

$$L_t = (\pi_t - \pi)^2 + \lambda(y_t - y_t^e)^2 + \tau(u_t - u_{t-1})^2 + \gamma(u_t - u^e)^2$$

Criterion 1, which states that the inflation target is reached, is covered by the first segment. The loss  $L_t$  will be greater, the more actual inflation  $\pi_t$  deviates from the target  $\pi$ .

Criterion 2, which states that the inflation targeting regime is flexible, is covered by the first and second segments. For given inflation developments, the loss  $L_t$  will increase with fluctuations in economic activity, measured as the deviation between actual output  $y_t$  and the normal output level  $y_t^e$ . Often, a reasonable balance will imply opposite signs for the projected inflation gap  $(\pi_t - \pi)$  and output gap  $(y_t - y_t^e)$  some time ahead.

Criterion 3, which states that monetary policy is robust, is covered by the second, third and fourth segments.<sup>5</sup> Experience shows that financial imbalances often build up in periods of high capacity utilisation. For that reason, increasing the weight  $\lambda$  of the output gap in

# Monetary policy trade offs

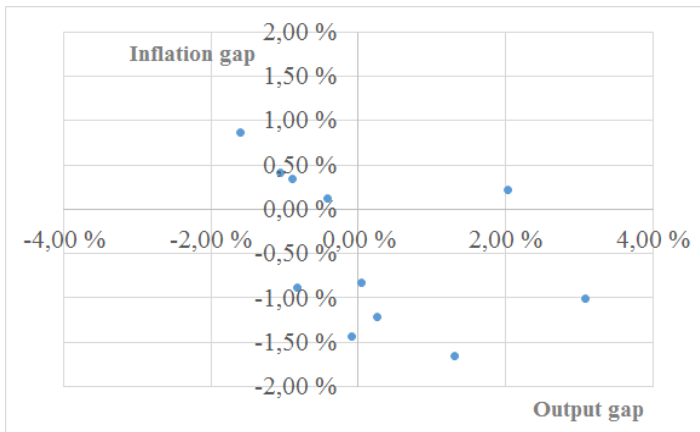
(MPR 1/2012, page 15)

inflation and the real economy. Mathematically, these assessments can be represented in somewhat simplified terms by a loss function, where the parameters  $\lambda$ ,  $\tau$  and  $\gamma$  represent relative weights<sup>4</sup>:

The diagram shows the loss function  $L = (\pi_t - \pi^*)^2 + \lambda(y_t - y_t^*)^2 + \gamma(i_t - i_{t-1})^2 + \tau(i_t - i_t^*)^2$  enclosed in a red rectangular border. Annotations with brackets identify parts of the function: 'Criterion 1' is above the first term  $(\pi_t - \pi^*)^2$ ; 'Criterion 2' is above a bracket spanning the first two terms  $(\pi_t - \pi^*)^2 + \lambda(y_t - y_t^*)^2$ ; and 'Criterion 3' is below a bracket spanning the last two terms  $\gamma(i_t - i_{t-1})^2 + \tau(i_t - i_t^*)^2$ .

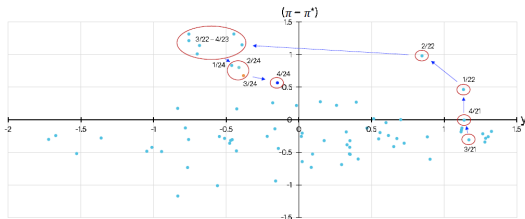
$$L = (\pi_t - \pi^*)^2 + \lambda(y_t - y_t^*)^2 + \gamma(i_t - i_{t-1})^2 + \tau(i_t - i_t^*)^2$$

# Monetary policy trade offs



# Monetary policy trade offs

**Chart 4.6 Somewhat improved monetary policy performance**  
Inflation gap and output gap. Average 1–3 years ahead



Source: Norges Bank

target, and output could approach potential with a lower policy rate. In

Period: 2005 Q4 – 2024 Q4.

The chart shows combinations of forecasts for the output gap ( $y$ ) and inflation ( $\pi$ ) deviation from the target ( $\pi^*$ ) on average one to three years ahead. Each point represents the forecasts in a specific Monetary Policy Report. **Forecasting improves the closer the points are to origin,** although the points will normally lie further from the origin following larger shocks. Their location in the diagram depends on the monetary policy stance. **Often, but not always, an appropriate trade-off will entail a policy rate path that implies that the forecasts for the inflation gap and the output gap have opposite signs.**

The trade-offs in the monetary policy reports between September 2021 and December 2024 are circled in red.

# Monetary policy under inflation targeting

Røisland, Ø. og T. Sveen (2018), “Monetary Policy under Inflation Targeting”, Norges Bank Occasional Papers No. 55.

- **Inflation targeting in a closed economy**
- Inflation targeting and financial stability
- Inflation targeting in an open economy

# Monetary policy under inflation targeting

## Transmission mechanism

- The output gap:

$$y = -\alpha (i - \pi^e - \rho) + v, \quad (1)$$

where  $y = \frac{Y - \bar{Y}}{\bar{Y}}$  denotes the output gap and the real interest rate is  $r = i - \pi^e$ .

- Alternatively, we can write the IS-equation as:

$$y = -\alpha (r - \bar{r}), \quad (2)$$

where  $\bar{r} = \rho + \frac{1}{\alpha}v$  (3) is the short-run neutral real rate.

# Monetary policy under inflation targeting

## Transmission mechanism (cont'd)

- Inflation equation:

$$\pi = \pi^e + \gamma y + u \quad (4)$$

where  $u$  is a cost-push shock (or inflation shock).

# The Monetary Policy Transmission Mechanism

A reduction in the key policy rate

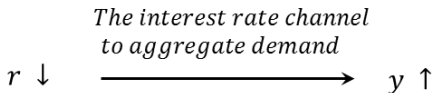
# The Monetary Policy Transmission Mechanism

A reduction in the key policy rate

$r \downarrow$

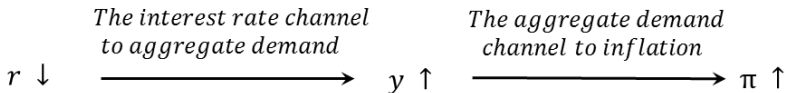
# The Monetary Policy Transmission Mechanism

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# The Monetary Policy Transmission Mechanism

A reduction in the key policy rate



# Monetary policy under inflation targeting

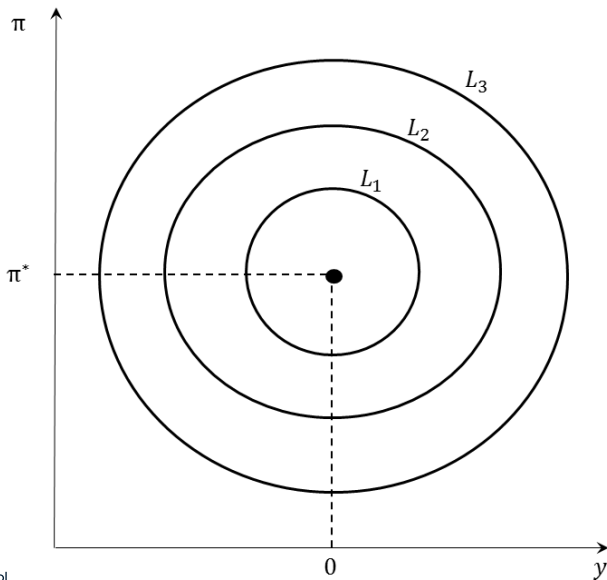
## Monetary policy

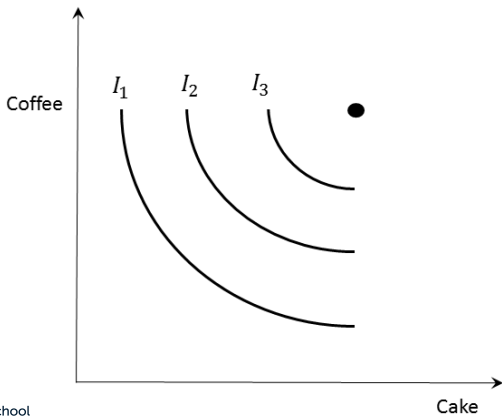
- Loss function:

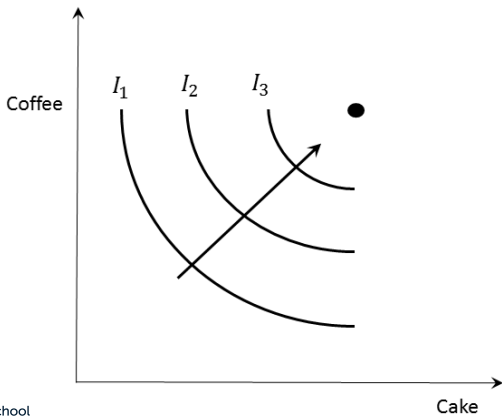
$$L = \frac{1}{2} \left[ (\pi - \pi^*)^2 + \lambda y^2 \right] \quad (5)$$

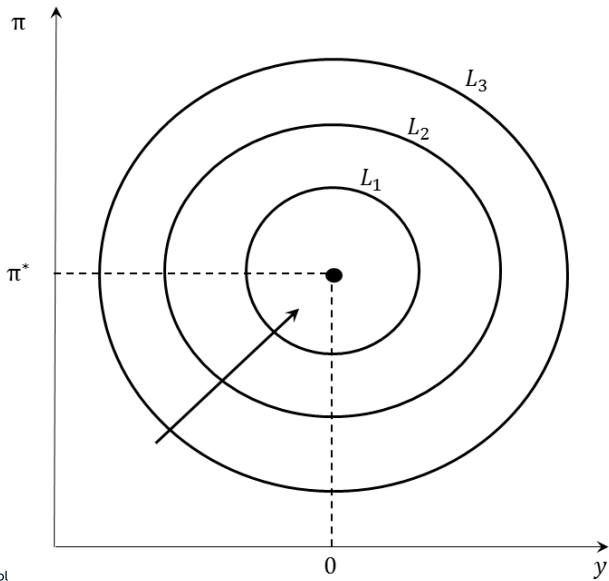
- Parameter  $\lambda$  measures how much weight the central bank (CB) assigns to production stability relative to price stability.
  - ▶  $\lambda = 0$  : strict inflation targeting
  - ▶  $\lambda > 0$  : flexible inflation targeting
  - ▶  $\lambda = \infty$  : output gap targeting

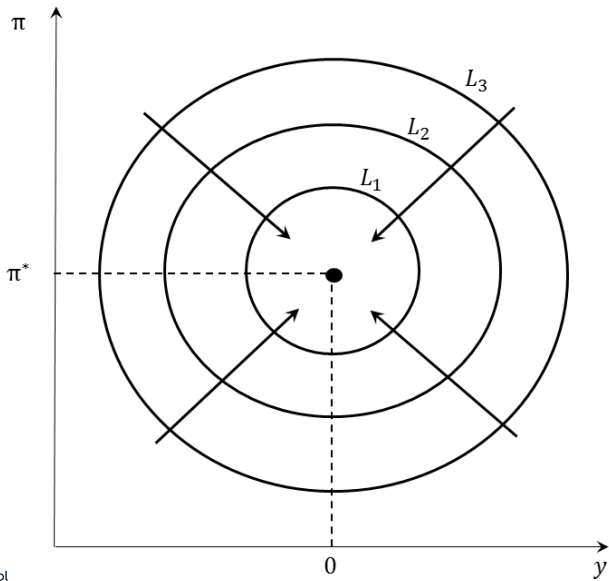
## The loss function



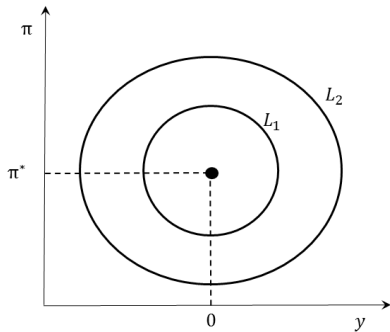




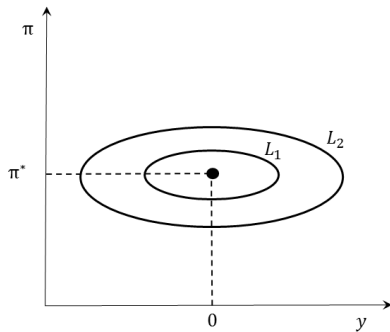




a)



b)



# Monetary policy under inflation targeting

## Optimal monetary policy

- Minimize the loss function, given the economic mechanisms described above:

$$\min_r \frac{1}{2} [(\pi - \pi^*)^2 + \lambda y^2]$$

- The first-order condition can be written as:

$$\pi - \pi^* = -\frac{\lambda}{\gamma} y \Leftrightarrow y = -\frac{\gamma}{\lambda} (\pi - \pi^*) \quad (7 \text{ and } 8)$$

The latter shows the extent to which the CB is willing to drive the economy into a recession when inflation is above the target.

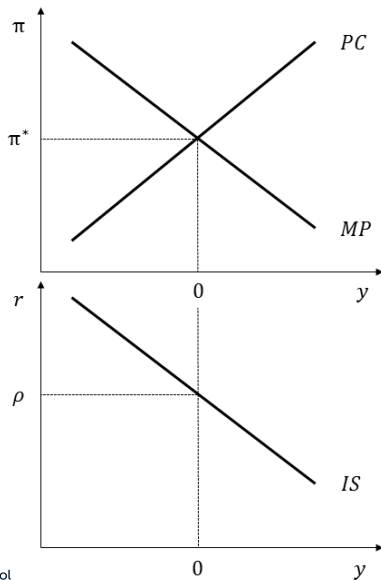
# Monetary policy under inflation targeting

## Graphical analysis

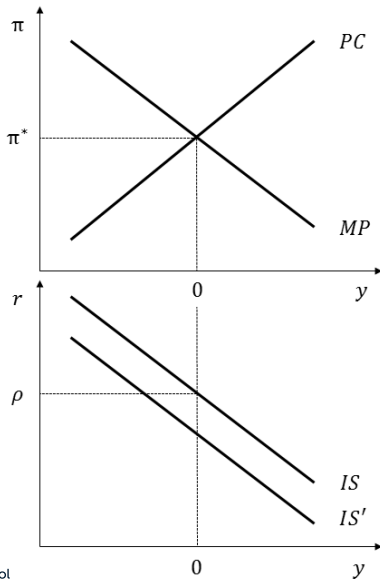
- To simplify, we assume  $\pi^e = \pi^*$ .
- We will use two diagrams:
  - 1  $(y, \pi)$ -diagram with two equations:
    - ★ The Phillips curve (PC) – with positive slope  $\gamma$ .
    - ★ Monetary policy (MP) – with negative slope  $-\frac{\lambda}{\gamma}$ .
  - 2  $(y, r)$ -diagram with one equation:
    - ★ IS-equation solved with respect to the real interest rate.

$$r = \rho + \frac{1}{\alpha}v - \frac{1}{\alpha}y$$

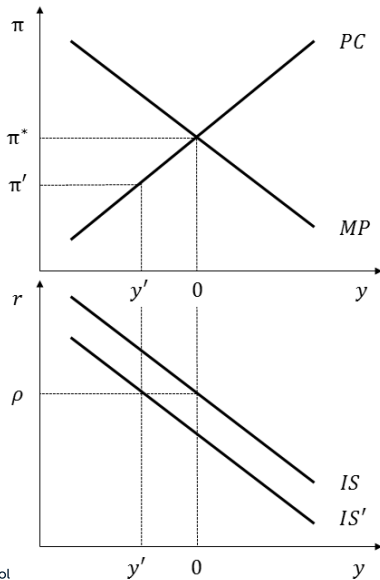
## The MP-PC-IS chart



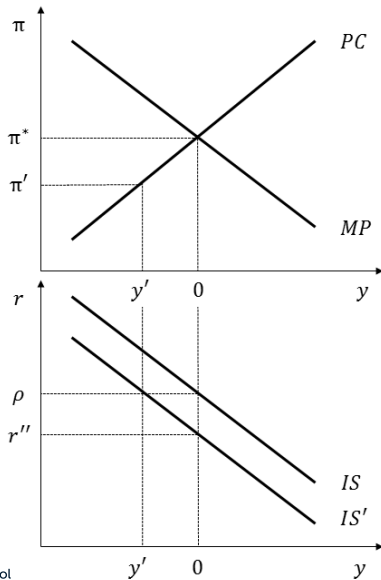
## Negative demand shock



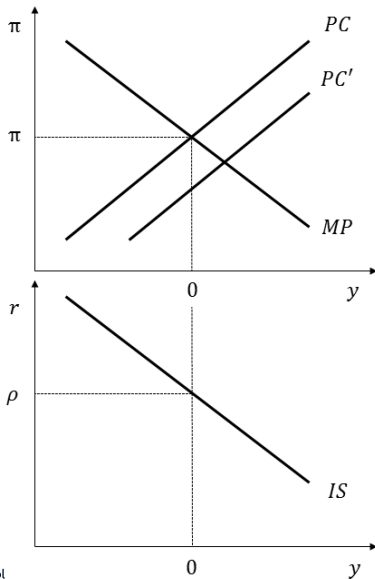
## Negative demand shock



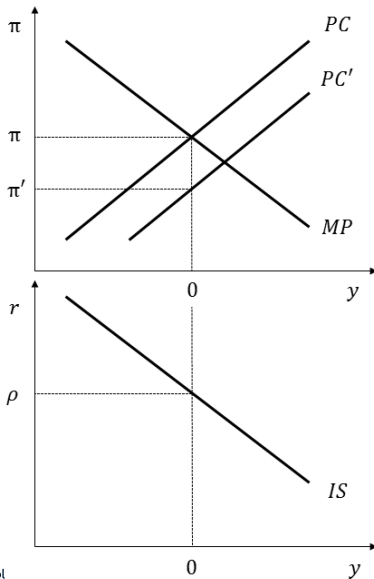
## Negative demand shock



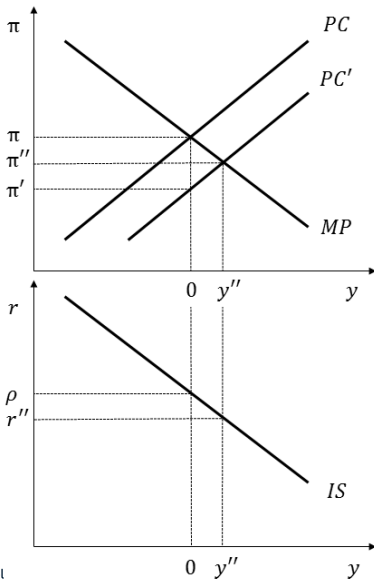
## Negative inflation shock



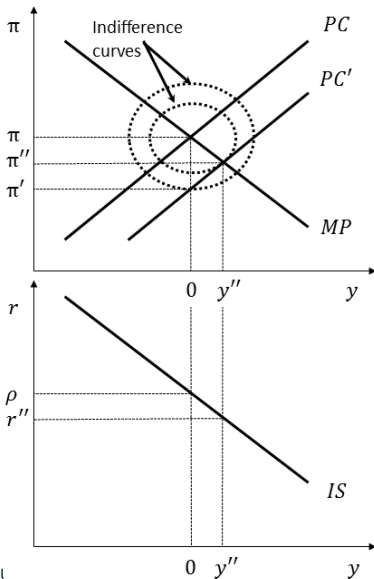
## Negative inflation shock



## Negative inflation shock



## Negative inflation shock



## Lower inflation target

