European Macroeconomics

V. The monetary policy of the ECB

Lecture 7

The IS/MP/PC model

IS	**IS curve**	$y = a - b \cdot r + \varepsilon_1$
PC	**New Keynesian Phillips curve**	$\pi = \pi^e + d \cdot y + \varepsilon_2$
MP	**Central bank loss function**	$L = (\pi - \pi^*)^2 + \lambda \cdot y^2$

- This is a relatively simple model which is based on the Keynesian paradigm as it is based on the Phillips curve and as it assumes that the central bank can perfectly control the real interest rate.
- In contrast to other textbook models, it systematically introduces **shocks** and the **loss function of the central bank**
- It helps to understand the effects of demand and supply shocks on the economy and the optimum response of monetary policy to these shocks

The IS-Curve

$$y = a - b \cdot r + \varepsilon_1$$

y: Output gap, i.e. percentage deviation of output from the full employment value

a: Autonomous demand component

b: (Real) interest rate elasticity

r: Real interest rate

ε_1**:** Exogenous demand shock

- The model assumes that the central bank can control the real interest rate (r)
- The IS-curve is compatible with the classical and the Keynesian model. In the classical model the interest rate has a direct effect on consumption/saving, in the Keynesian model on investment only

The Phillips curve

$$\pi = \pi^e + d \cdot y + \varepsilon_2$$

π: Inflation rate

π^e : Expected inflation rate

d: Slope of the Phillips curve

y: Output gap

ε_2: Supply shock

The Phillips curve is an expected augmented Phillips curve: Inflation depends on the output gap (as a proxy for cyclical unemployment) and the expected inflation. For simplicity we assume in the following that the central bank is credible so that the inflation expectations equal the inflation target of the central bank (π^*)

The loss function of the central bank

$$L = (\pi - \pi^*)^2 + \lambda \cdot y^2$$

L: Welfare loss for the society due to inflation and output gaps

π : Inflation rate

π^*: The central bank's inflation target

λ: Preference parameter reflecting the relative weighting of the inflation and the output gap

y: Output gap

- Minimization of the loss function represents "optimal" policy.
- As an alternative, monetary policy can also be described by a so-called **Taylor rule**: $r = r^* + 0{,}5\ (\pi - \pi^*) + 0{,}5y$.
- In this rule, the central bank sets ist real rate equal to a natural real rate (r^*) adjusted upwards or downwards according to the inflation gap and output gap

The optimum real interest rate for a credible central bank ($\pi^e = \pi^*$)

- Substituting the Phillips curve (binding restriction) into "L" and deriving according to the optimal (loss minimizing) output gap, yields

$$y^{opt} = -\frac{d}{(d^2 + \lambda)}\varepsilon_2$$

- Substituting the optimal output gap into the Phillips curve yields

$$\pi^{opt} = \pi_0 + \frac{\lambda}{(d^2 + \lambda)}\varepsilon_2$$

- Solving to and substituting for the real interest gives the optimal real interest rate

$$r^{opt} = \frac{a}{b} + \frac{1}{b}\varepsilon_1 + \frac{d}{b(d^2 + \lambda)}\varepsilon_2$$

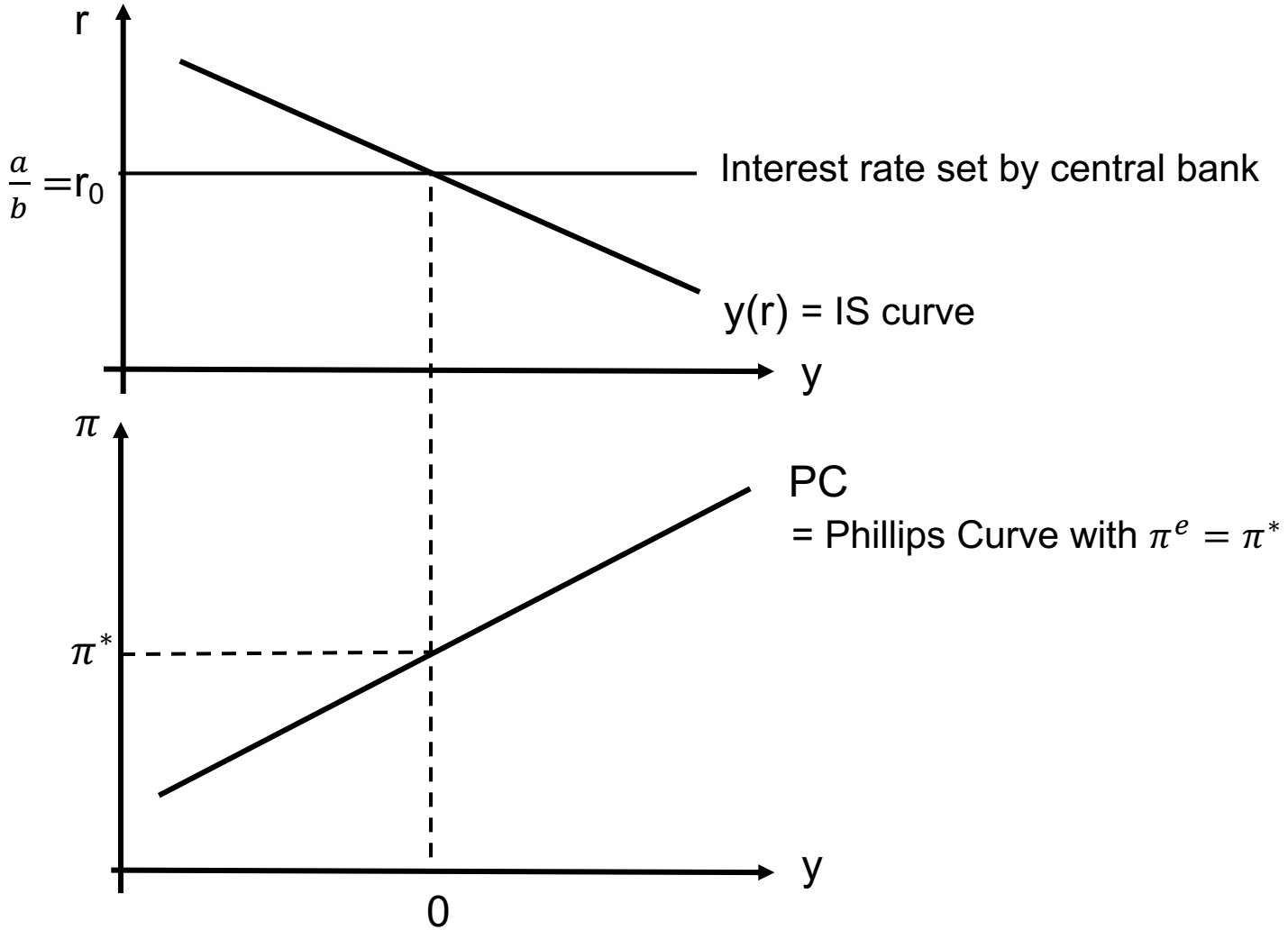
- The **optimum real interest rate** equals a neutral rate $\frac{a}{b}$ adjusted upwards or downwards according to a demand shock (ε_1) or a supply shock (ε_2)

The model in two graphs

The starting position is characterized by an **optimum** with a zero output gap and a zero inflation gap. The welfare loss is zero.

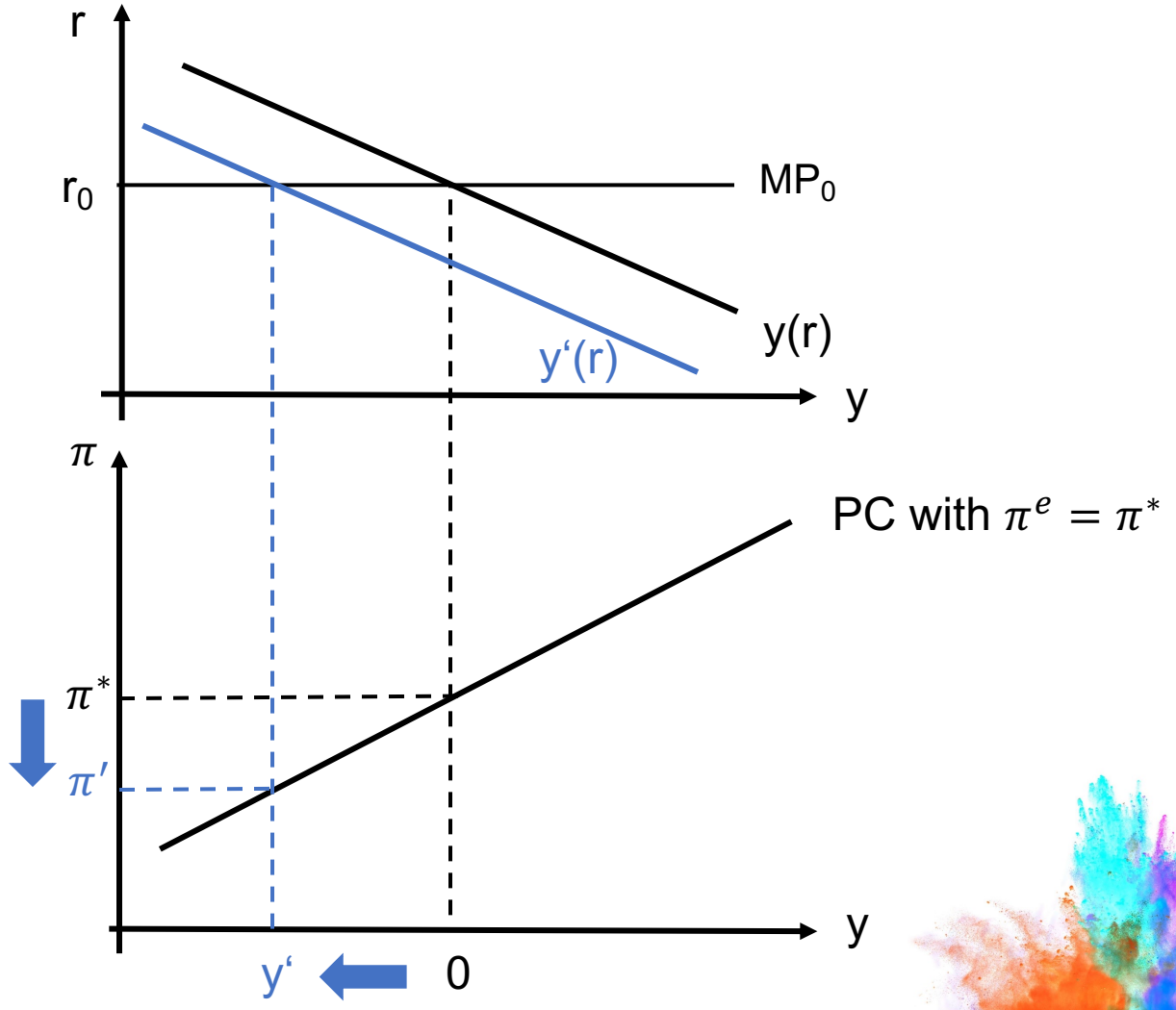
The real interest rate is at its **neutral level**: $\frac{a}{b}$

We assume that the central bank is **credible**: Inflation expectations are In line with the central banks inflation target



The effects of a negative demand shock

- A negative shock ($\varepsilon_1 < 0$) shifts the IS curve downwards. E.g. investment demand declines because of a pandemic
- With an unchanged real interest rate, the output (y‘) is below equilibrium (=negative output gap)
- In the lower diagram, the negative output gap reduces the inflation rate below the inflation target of π^*



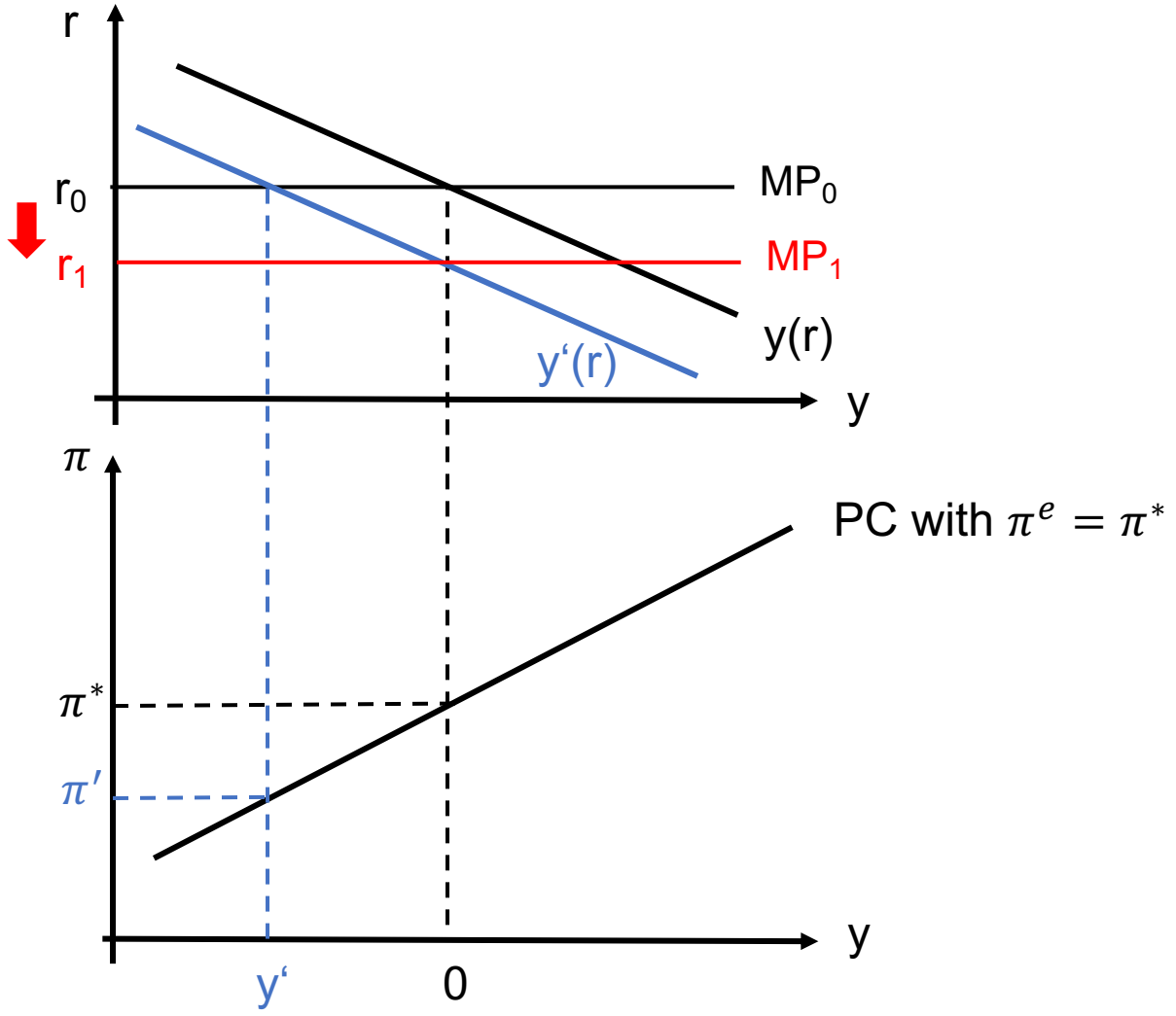
The central bank reacts to demand shock by lowering rates

- In reaction the demand shock, the central bank reduces the real interest rate from r_0 to r_1.

- With lower interest rate, the output can be increased so that the negative output gap is removed

- The inflation rate returns to the inflation target of central bank

- Thus, if the economy is affected by a demand shock there is **no trade-off** between the stabilisation of output and the stabiliziation of inflation



N. Gregory Mankiw, Principles of Economics

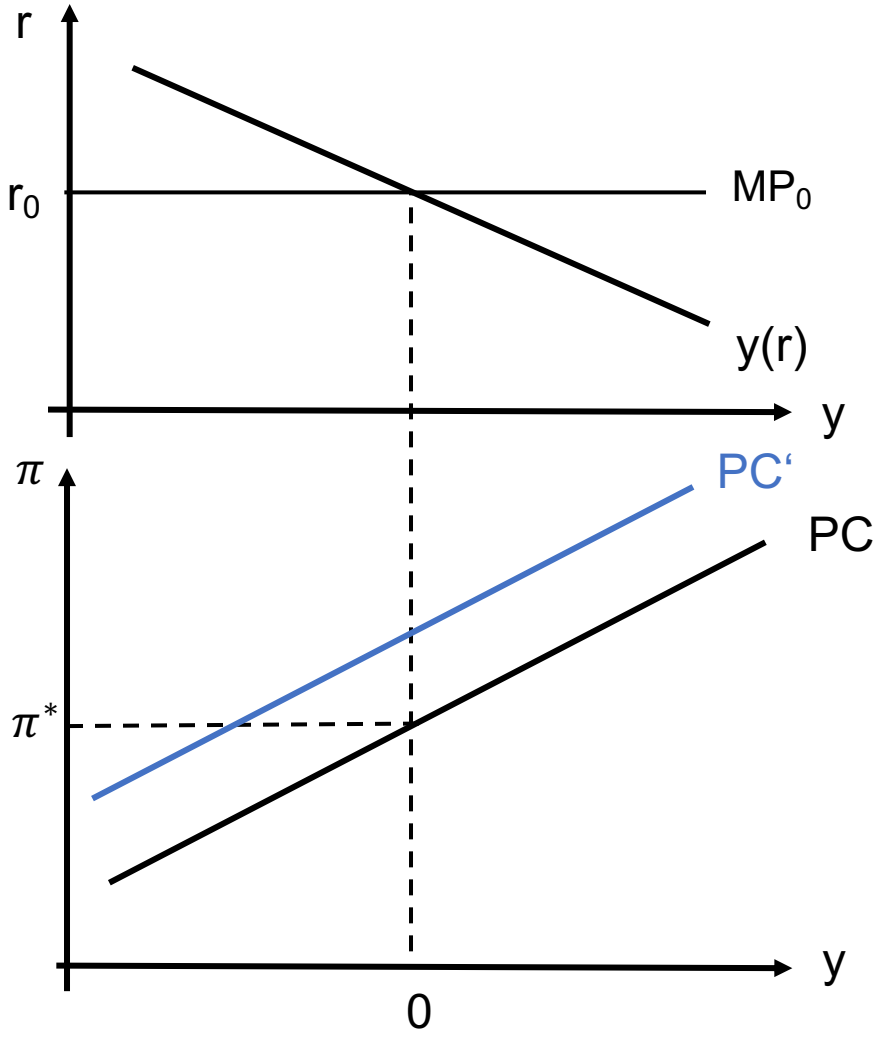
- „**Principle 10: Society Faces a Short-Run Trade-Off between Inflation and Unemployment**“
- „Increasing the amount of money in the economy stimulates the overall level of spending and thus the demand for goods and services.
- Higher demand may over time cause firms to raise their prices, but in the meantime, it alos encourages them to hire more workers and produce a larger quantity of goods and services.
- More hiring means lower unemployment.“

Mankiw‘s mistake: He starts the argument from a full employment situation where a monetary stimulus is inadequate.

We discuss monetary policy **after a shock has occurred**

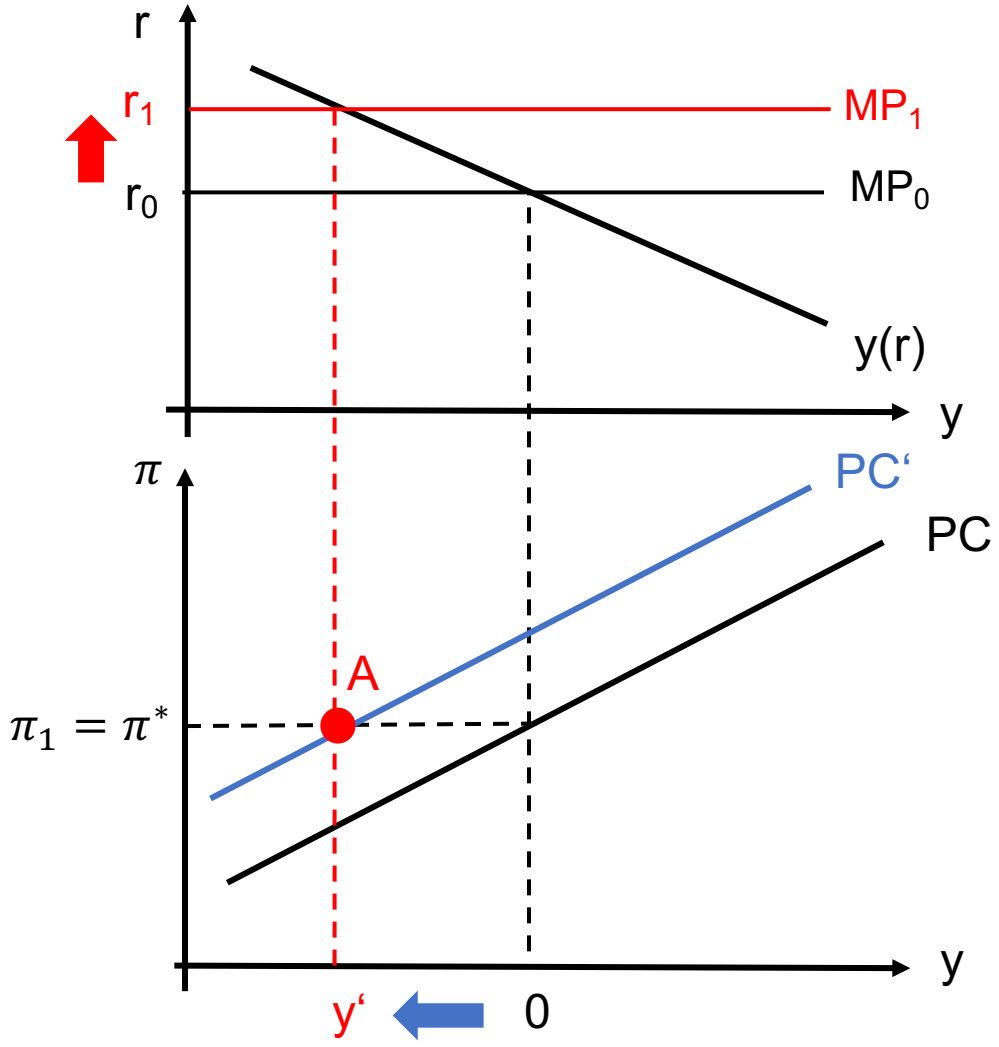
The effects of a positive supply shock

- A positive supply shock ($\varepsilon_2 > 0$) shifts the PC curve upwards. E.g. higher oil prices increase the production costs of firms.
- With an **unchanged real interest rate**, the output (y‘) remains constant, but the inflation rate is above the inflation target of the central bank (=**positive inflation gap**)
- In the lower diagram, the negative output gap reduces the inflation rate below the inflation target of the central ($\pi' > \pi^*$)
- The situation is not an optimum



How can the central bank react?
Stabilizing the inflation rate by raising the real interest rate

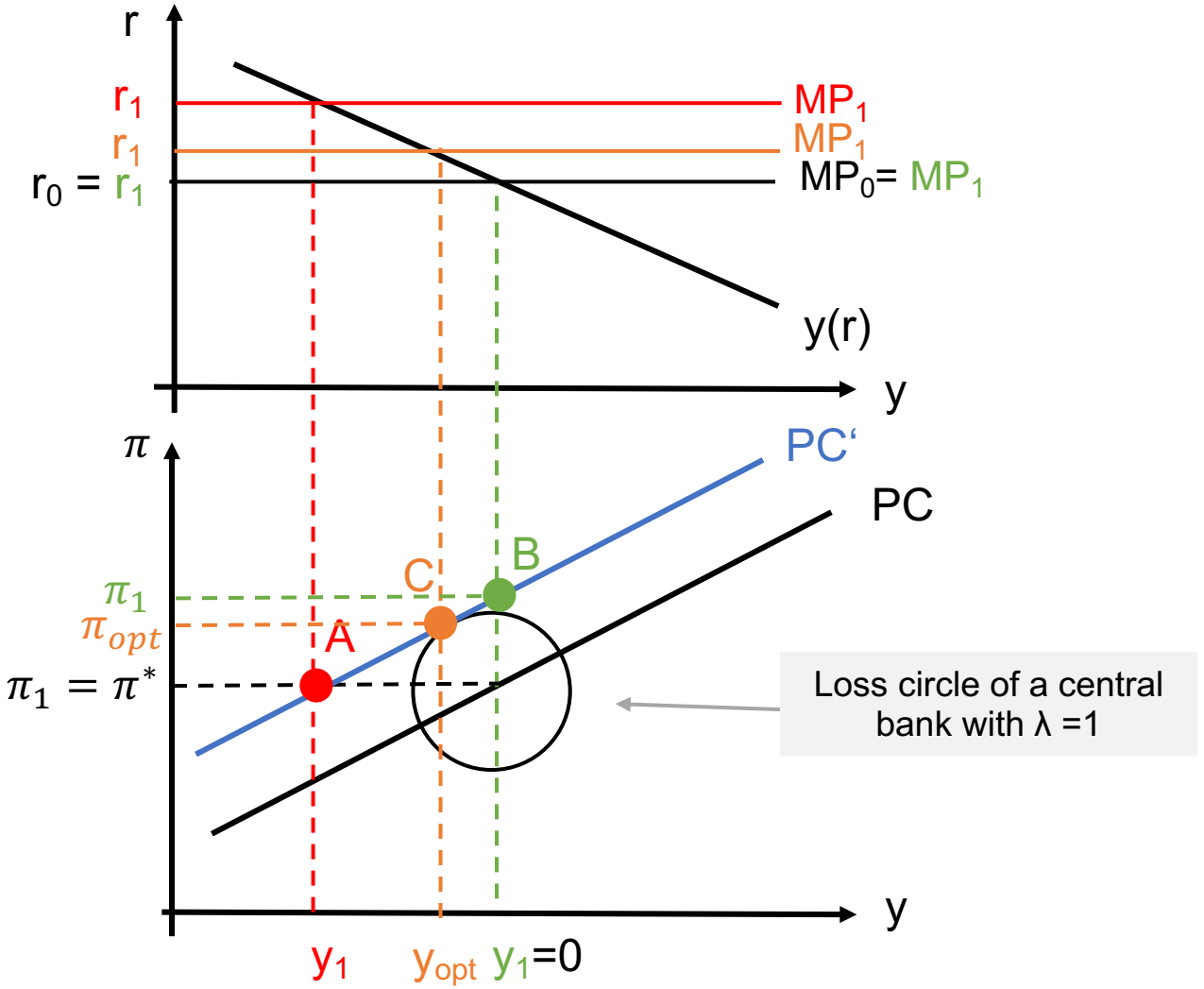
- The higher real interest brings the inflation rate back to the inflation target but this leads to a negative output gap.
- The situation is also not an optimum



How can the central bank react?
Stabilizing the inflation rate by raising the real interest rate

- With λ=0, the loss function of the central bank can be depicted by a circle with the optimum ($\pi = \pi^*$ and y=0) as center.
- The optimum combination of output and inflation interest can be determined graphically as tangent point between new Phillips curve and loss circle (C)
- The loss function as circle formula:

$$1 = \frac{(\pi - \pi_0)^2}{(\sqrt{L})^2} + \frac{(y-0)^2}{(\sqrt{L/\lambda})^2}$$



Comparison of demand and supply shock

Demand shock

- There is **no trade-off** between inflation and output (= cyclical unemployment) after a demand shock
- **Policy implications:** The central bank is a forceful actor in economic stabilization
- **Limit:** zero-lower bound of interest rates. In this case, fiscal policy becomes the dominant player. MMT is the relevant paradigm

Supply shock

- There is **a trade-off** between inflation and output (=cyclical unemployment) after a supply shock
- The decision of the central bank depends on its **preferences** for output stabilization versus inflation stabilization (λ)
- In a model with more periods, the impact on **inflation expectations** matters.
  - If they remain stable, the central bank can allow a temporary inflation gap.
  - If they drift upwards („second round effects“) the central bank will react with a more restrictive interest rate policy