Chapter 8
Monetary Policy
Transmission: IS-MP-PC-Analysis
Shortcomings of the IS-LM-Analysis

- Ultimate goal of the ECB: Price stability (formulated in terms of an inflation target)
  - no output targeting as in the IS-LM model
- Instruments of the ECB: Direct control over short-term money market rates (via open market operations) and indirect control over credit interest rates
  - no direct control over money as in the IS-LM model
- new model: IS-MP-PC
Monetary Transmission Process

Instruments of the ECB (e.g. main refinancing operations) → Money market rates, refinancing costs of banks → Credit interest rates of the private and public sector → Aggregate demand (prices and, inflation, real GDP, unemployment rates)

Operating targets

Intermediate targets

Final targets

“Money / credit supply process”
Chapter 7

“Transmission process”
Chapter 8

Instruments of the ECB (e.g. main refinancing operations)

Money market rates, refinancing costs of banks

Credit interest rates of the private and public sector

Aggregate demand (prices and, inflation, real GDP, unemployment rates)

“Money / credit supply process”
Chapter 7

“Transmission process”
Chapter 8
Monetary Transmission Process

- GDP
- Inflation (HICP)
- Inflation (Wages)
- Inflation (Commodities)
- 3M-Euribor
- Credit rates
- priv. Consumption
- Investment
Monetary Transmission Process

- Impulse responses show the reaction of a variable following a monetary shock:
  - prior to the shock all variables were at their equilibrium values (here: normalized to zero)
  - if time goes to infinity all variables will be at their equilibrium values (here: normalized to zero) → monetary neutrality

- The horizontal axis depicts time in quarters

- Inflation and interest rates are measured in percent
  - $3 \cdot 10^{-3} = 0.003 = 0.3$ percentage points = 30 base points (in case of interest rate) deviation from equilibrium

- GDP and its components are measured in levels (indices)
  - $-2 \cdot 10^{-3} = -0.002 = -0.2$ percent deviation from equilibrium
Monetary Transmission Process

- Interest rate channel
- Expectations channel
- (Exchange rate channel, asset price channel, quantity theory channel, ...)

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Interest Rate Channel

- Changes in money market rates have an impact on the interest rates set by banks on short-term loans and deposits.
- In addition, expectations of future official interest rate changes affect longer-term interest rates, since these reflect expectations of the future evolution of short-term interest rates.
- What are the macroeconomic effects of higher credit / deposit rates?
- Changes in interest rates affect the saving, spending and investment decisions of households and firms, and hence aggregate demand.
Interest Rate Channel

- Higher interest rates tend to make it less attractive for households or companies to take out loans in order to finance their consumption or investment.

- Other channels:
  - Higher interest rates make it more attractive for households to save their current income rather than spend it, since the return on their savings is increased.
  - Changes in official interest rates may also affect the supply of credit.
    - For example, following an increase in interest rates, the risk that some borrowers cannot safely pay back their loans may increase to a level such that banks will not grant a loan to these borrowers.
    - As a consequence, such borrowers, households or firms, would be forced to postpone their consumption or investment plans.
Interest Rate Channel

- Financial structure of the euro area
  - low debt securities issuance of the private sector
  - low stock market capitalization
  - important role of bank loans

Table 2.7 Amounts outstanding of debt securities denominated in national currency issued by residents in the euro area, the United States and Japan at end-2002

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Issued by financial corporations</th>
<th>Issued by non-financial corporations</th>
<th>Issued by general government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro area</td>
<td>105.4</td>
<td>44.7</td>
<td>6.6</td>
<td>54.1</td>
</tr>
<tr>
<td>United States</td>
<td>153.7</td>
<td>88.1</td>
<td>22.8</td>
<td>42.8</td>
</tr>
<tr>
<td>Japan</td>
<td>160.1</td>
<td>27.5</td>
<td>17.9</td>
<td>114.8</td>
</tr>
</tbody>
</table>

Table 2.8 Stock market capitalisation in the euro area, the United States and Japan

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro area</td>
<td>21</td>
<td>28</td>
<td>76</td>
<td>87</td>
<td>72</td>
<td>47</td>
</tr>
<tr>
<td>United States</td>
<td>53</td>
<td>92</td>
<td>141</td>
<td>153</td>
<td>136</td>
<td>104</td>
</tr>
<tr>
<td>Japan</td>
<td>90</td>
<td>73</td>
<td>54</td>
<td>67</td>
<td>56</td>
<td>58</td>
</tr>
</tbody>
</table>

Table 2.12 Bank deposits and loans in the euro area, the United States and Japan at end-2002

<table>
<thead>
<tr>
<th></th>
<th>Bank deposits</th>
<th>Bank loans</th>
<th>Bank loans to non-financial corporations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro area</td>
<td>81.3</td>
<td>107.9</td>
<td>42.1</td>
</tr>
<tr>
<td>United States</td>
<td>44.0</td>
<td>51.2</td>
<td>39.3</td>
</tr>
<tr>
<td>Japan</td>
<td>118.8</td>
<td>101.0</td>
<td>63.9</td>
</tr>
</tbody>
</table>

Source: ECB (2004), The monetary policy of the ECB
Interest Rate Channel

- The investment function assumes a direct impact of interest rates on investment demand
- If investment is mainly financed by credit
  - an increase in credit rates reduces the expected return on the investment project
  - investment therefore negatively depends on interest rates
Interest Rate Channel

IS-LM model
\[ \pi = 0, \ i = r \]

IS/MP/PC model
\[ \pi \neq 0, \ i \neq r \]

Investment demand depends on the real interest rate (r).
Nominal versus Real Interest Rates

- Interest Rates expressed in units of the national currency are called *nominal interest rates* \((i)\).
  - Borrowing one euro this year requires you to pay \(1 + i_t\) euros next year.

- Interest rates expressed in terms of a basket of goods are called *real interest rates* \((r)\).
  - Borrowing the equivalent of one basket of goods this year requires you to pay the equivalent of \(1 + r_t\) baskets of goods next year.
Nominal versus Real Interest Rates

**Definition and Derivation of the Real Interest Rate**

- $i_t =$ nominal interest rate for year $t$.
- $r_t =$ real interest rate for year $t$.
- $(1+i_t)$: Lending one dollar this year yields $(1+i_t)$ dollars next year. Alternatively, borrowing one dollar this year implies paying back $(1+i_t)$ dollars next year.
- $P_t =$ price this year.
- $P^e_{t+1} =$ expected price next year.

\[
(1 + r_t) = \frac{(1 + i_t) P_t}{P^e_{t+1}}
\]
Nominal versus Real Interest Rates

Given:
\[ 1 + r_t = (1 + i_t) \frac{P_t}{P_{t+1}^e} \quad \text{and} \quad \pi_e^t \equiv \frac{P_{t+1}^e - P_t}{P_t} \]

Then:
\[ \frac{P_t}{P_{t+1}^e} = \frac{1}{(1 + \pi_e^t)} \]

Consequently:
\[ (1 + r_t) = \frac{1 + i_t}{1 + \pi_e^t} \]

If the nominal interest rate and the expected rate of inflation are not too large, a simpler expression is:
\[ r_t \approx i_t - \pi_e^t \]

The real interest rate is (approximately) equal to the nominal interest rate minus the expected rate of inflation.
Nominal versus Real Interest Rates

- Present value of an investment $V_t$

$$V_t = \frac{P_{t+1}^e Y_{t+1}}{1+i_t} - P_t I_t \iff V_t = \frac{P_{t+1}^e Y_{t+1}}{(1+i_t)P_t} - I_t = \frac{Y_{t+1}}{1+r_t} - I_t$$

- The decision to realize an investment depends on its present value.
- On average it is reasonable to assume for all firms that the price of their goods increases with the overall price level.
- If the present value of the future return $Y_{t+1}$ from the investment $I_t$ exceeds today’s investment expenditure $P_t I_t$ the investment is realized.
- Firms evaluate the real value of their investment today.
Interest Rate Channel

- IS curve

goods market equilibrium:

\[ Y = C(Y - T) + I(Y, r) + G \]

\[ = c_0 + c_1(Y - T) + b_0 + b_1Y - b_2r + G \]

\[ \Rightarrow Y = \frac{c_0 + b_0}{1 - c_1 - b_1} - \frac{b_2}{1 - c_1 - b_1} r + \frac{G - c_1 T}{1 - c_1 - b_1} \]

natural level:

\[ Y_n = \frac{c_0 + b_0}{1 - c_1 - b_1} - \frac{b_2}{1 - c_1 - b_1} r_n + \frac{G_n - c_1 T_n}{1 - c_1 - b_1} \]
Interest Rate Channel

- IS curve

expressed as percent deviation from the natural level:

\[ y = \frac{Y - Y_n}{Y_n} = a - br + \varepsilon_1 \]  

where \( \varepsilon_1 \sim N(0, \sigma_{\varepsilon_1}) \)

in the medium run the output gap is closed:

\( G = G_n \) and \( T = T_n \)

\[ \Rightarrow \varepsilon_1 = 0 \]  (thus, changes in government spending and taxes are interpreted as demand shocks)

the natural level of the interest rate is given by:

\[ y = 0 = a - br_n \]

\[ \Leftrightarrow r_n = \frac{a}{b} \]
Expectations Channel

- Through the expectations channels monetary policy can influence price developments by influencing the private sector’s longer-term expectations.
- Central banks have a medium-term inflation objective:
  - If a central bank enjoys a high degree of credibility in pursuing its objective, monetary policy can exert a powerful direct influence on price developments by guiding economic agents’ expectations of future inflation and thereby influencing their wage and price-setting behavior.
  - The credibility of a central bank to maintain price stability in a lasting manner is crucial in this respect.
  - Only if economic agents believe in the central bank’s ability and commitment to maintain price stability, inflation expectations will remain firmly anchored to price stability.
Expectations Channel

- According to the Phillips curve inflation expectations have a direct impact on current inflation.
  - wage-price mechanism (AS-AD analysis)
- If inflation expectations are firmly anchored at the level of the inflation target, then the inflation target enters the wage bargaining process.
Expectations Channel

- most general formulation of the Phillips curve
  \[ \pi_t = \pi^e_t - d \left( u_t - u_n \right) \]  
  note: now \( d \) instead of \( \alpha \)

- introduction of the output gap \( y_t \)
  \[ y_t = \frac{Y_t - Y_n}{Y_n} = \frac{(1-u_t)L - (1-u_n)L}{(1-u_n)L} = -\frac{u_t - u_n}{1-u_n} \approx -(u_t - u_n) \]

- inflation expectations are anchored at the level of the central bank’s inflation target \( \pi_0 \)
  \[ \pi^e_t = \pi_0 \]

- new formulation of the Phillips curve
  \[ \pi_t = \pi_0 + d \, y_t \]
Expectations Channel

- Given the inflation expectations anchored at the level of the central bank’s inflation target, short run deviations of production from its natural level following a temporary shock lead to changes in the current rate of inflation.

- Credibility of the inflation target means,
  - that inflation expectations are firmly anchored.
  - that the private sectors assumes that the central bank will make every effort to return to the natural level of output as soon as possible after a shock has hit the economy.

- Phillips curve (PC)

\[ \pi = \pi_0 + dy + \varepsilon_2 \] where \( \varepsilon_2 \sim N\left(0, \sigma_{\varepsilon_2}\right) \)
Graphical Representation in a $y-r/\pi$ Diagram

$y = a - br + \varepsilon_1$

$\Leftrightarrow r = \frac{a}{b} - \frac{1}{b} y + \frac{1}{b} \varepsilon_1$

$\pi = \pi_0 + dy + \varepsilon_2$
Monetary Policy in the IS-MP-PC Model

Monetary policy stabilizes the economy

Economy without monetary policy

$L$ is the social welfare loss, that results from fluctuations of production around its natural level and the inflation rate around the inflation target.
Monetary Policy in the IS-MP-PC Model

- the central banks tries to minimize the social welfare loss (= objective function)
- its instrument is the short-term nominal interest rate $i$ (the central bank has perfect control over the refinancing costs of banks)
  - given the expected rate of inflation $\pi^e_t = \pi_0$ the central bank can also influence the real interest rate $r$
- the objective function is given by

$$L = \left( \pi - \pi_0 \right)^2 + \lambda y^2$$

where $0 < \lambda < \infty$

This is a quadratic loss function, which has the important property of being symmetric: a deviation above the target causes the same loss as the same magnitude of deviation below the target.
Flexible Inflation Targeting

- **optimal monetary policy**
  \[
  \min \quad L = (\pi - \pi_0)^2 + \lambda y^2
  \]

- **subject to the structure of the economy**
  \[
  \pi = \pi_0 + dy + \varepsilon_2
  \]
  \[
  y = a - br + \varepsilon_1
  \]

- **optimal interest rate**
  \[
  r^{opt} = \frac{a}{b} + \frac{1}{b} \varepsilon_1 + \frac{d}{b \left( d^2 + \lambda \right)} \varepsilon_2
  \]
Flexible Inflation Targeting

\[ L = (\pi - \pi_0)^2 + \lambda y^2 = (dy + \varepsilon_2)^2 + \lambda y^2 \]

\[ y = a - br + \varepsilon_1 \]

\[ \mathcal{L} = \left\{ (dy + \varepsilon_2)^2 + \lambda y^2 \right\} - \psi \{ y - a + br - \varepsilon_1 \} \]

\[ (1) \frac{\partial \mathcal{L}}{\partial y} = 2d(dy + \varepsilon_2) + 2\lambda y - \psi = 0 \]

\[ (2) \frac{\partial \mathcal{L}}{\partial r} = -\psi b = 0 \]

\[ (3) \frac{\partial \mathcal{L}}{\partial \psi} = y - a + br - \varepsilon_1 = 0 \]

from (2): \( \psi = 0 \) in (1)

then (1'): \( y = \frac{-d}{d^2 + \lambda} \varepsilon_2 \) in (3)

then (3'): \( r = \frac{a}{b} + \frac{1}{b} \varepsilon_1 + \frac{d}{b(d^2 + \lambda)} \varepsilon_2 \)
Flexible Inflation Targeting

\[ y = a - b r + \varepsilon_1 \]

\[ \Leftrightarrow r = \frac{a}{b} - \frac{1}{b} y + \frac{1}{b} \varepsilon_1 \]

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

\[ \pi = \pi_0 + dy + \varepsilon_2 \]
Flexible Inflation Targeting

demand shock ($\varepsilon_1 < 0$)
Flexible Inflation Targeting

demand shock ($\varepsilon_1 < 0$)
Flexible Inflation Targeting

demand shock ($\varepsilon_1 < 0$)
Flexible Inflation Targeting

demand shock ($\varepsilon_1 < 0$)
Flexible Inflation Targeting

- the central bank can perfectly compensate the demand shock
- central bank faces no “trade-off” between inflation and employment (output)
  - If there was a trade-off between objectives, then a choice between the different goals would have to be made.
  - A trade-off involves a sacrifice that must be made to reach one objective, rather than the other.
Flexible Inflation Targeting

supply shock \((\varepsilon_2 > 0)\)

\[
L = (\pi - \pi_0)^2 + \lambda y^2
\]

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

\(h = \sqrt{L}, \ g = \sqrt{L/\lambda}\)

\(\lambda \rightarrow \infty\) … output junkie (vertical line)

\(\lambda = 0\) … inflation nutter (horizontal line)

\(\lambda = 1\) … "flexible" IT (circle)

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Flexible Inflation Targeting

supply shock \((\varepsilon_2 > 0)\)
Flexible Inflation Targeting

supply shock ($\varepsilon_2 > 0$)
Flexible Inflation Targeting

supply shock ($\varepsilon_2 > 0$)
Flexible Inflation Targeting

- central bank faces a “trade-off” between inflation and output stabilization
- optimal policy depends on the objective function – and hence the preferences – of the central bank