General equilibrium and monetary policy
Outline

- 1. Our general equilibrium model
  - the concept of equilibrium
  - process frequency
  - collecting partial equilibrium models
  - stability of the equilibrium
- 2. Monetary policy
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  - exchange rate targeting
- 3. GE model again
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  - reaction to shocks
- 4. AD-AS: a simple framework for policy analysis
  - model construction
  - reaction to shocks

Attention: the contents of this lecture differs from the textbook!!!
1. Our general equilibrium model
The concept of equilibrium

- Economic equilibrium refers to a situation where:
  - the market "clears": i.e. where the amount supplied of a certain product equals the quantity demanded.
  - all agents optimize their behavior
General equilibrium

- General equilibrium refers to a situation where all analysed markets clear simultaneously
- Markets interact with each other
- Example of partial vs. general equilibrium analysis: creation of Bus-lane
Process frequency (1)

- The model we will analyze tells about short to medium term behaviour of the economy.
- We ignore long term issues – economic growth.
- Standard way of preparing data to fit this class of models - detrending.
Process frequency (2)

Example of detrending GDP
Collecting partial equilibrium models

- Partial equilibria:
  - Goods market equilibrium (IS)
  - Market for monetary balances (LM)
  - Labour market ($L^D - L^S$)
- Links between markets
  - Phillips curve (PC)
  - Production function (PF)
  - Fisher equation (FE)
  - Monetary policy (MP)
Economy in long-run equilibrium

- \( Y^* \) - potential output
- \( r^* \) - natural rate of interest
- \( L^* \) - equilibrium employment
- \( U^* \) - natural rate of unemployment
Long-run equilibrium and deviations around it

- We think about the economy as being permanently hit by various shocks, e.g.
  - demand (IS) shock (e.g. fiscal policy)
  - monetary policy shock (e.g. CB raises \( i \))
  - productivity shock (innovations)
- Hence the economy fluctuates around equilibrium
- If the equilibrium is stable, the economy should return to it, after shocks die out
Is this equilibrium stable?
Assume positive demand shock – IS curve shifts out
Labour demand increases, inflation rises
Real interest rate decreases
Demand increases even further – model unstable

Who can stabilize the economy?
2. Monetary policy
Goals of monetary policy

- The final goal of most central banks: price stability
- Example: goal of the National Bank of Poland

THE ACT ON THE NATIONAL BANK OF POLAND of August 29, 1997

Article 3
1. The basic objective of NBP activity shall be to maintain price stability, and it shall at the same time act in support of Government economic policies, insofar as this does not constrain pursuit of the basic objective of the NBP.
Monetary policy strategies

- Central banks take various approaches (strategies) to achieve price stability
- 2 popular strategies:
  - inflation targeting
  - exchange rate targeting
Inflation targeting (simplified version)

- Central bank sets inflation target
  - NBP: 2.5%
  - Bank of England: 2%
- CB controls interest rates via open market operations
- Interest rates impact on consumption, investment, exchange rate
- Demand impacts on production and inflation
- Exchange rate influences inflation
Open market operations

- Commercial banks borrow monetary base from CB
- CB is monopolistic supplier of monetary base
- CB sets the price (interest rate)
- They meet during auctions (e.g. weekly)
- CB lends monetary base on short maturity (e.g. 1 week)
Transmission of interest rates (1)

- Open market operations influence short term interest rates at the money market (≠ market for money balances!!!)

Source: NBP

![Graph showing interest rates over time](chart.png)

**Stopy procentowe NBP oraz stawka POLONIA w 2011 r.**

**Stopy procentowe**: NBP oraz stawka POLONIA w 2011 r.

**Stopy procentowe**

- **POLONIA**
- **Stopa referencyjna NBP**
- **Stopa lombardowa NBP**
- **Stopa depozytowa NBP**

**Źródło**: Dane NBP.
Transmission of interest rates (2)

- Money market interest rates influence credit and deposit rates at commercial banks

Source: NBP & Eurostat
Interest rates and demand

- Real interest rates influence consumption and investment demand
- This is summarized in the IS curve
- Higher real rates reduce demand
- Lower real rates boost demand
- Demand influences production and inflation (see our model)
Interest rates and the exchange rate

- Interest rates influence the exchange rate
- Higher domestic interest rate attracts portfolio capital and leads to exchange rate appreciation
- Appreciation reduces the price of imported goods
Monetary policy as a stabilizing device

- The reaction of monetary policy to growing inflation should be increasing interest rates.
- This is summarized in the monetary policy reaction function:

\[ i_t = r^* + \pi^* + \Phi(\pi_t - \pi^*) \]

- where \( \pi^* \) - inflation target
- If inflation increases above target, CB raises interest rates.
- Stability principle: \( \Phi > 1 \)
Exchange rate targeting

- As discussed, ER influences import prices and domestic inflation
- Fixed exchange rate brings inflation (approximately) to the level of the country you peg to

![HICP inflation chart]

- Euro zone
- Denmark
Design of fixed ER system

- CB keeps exchange rate fixed vs. a stable and important currency (EUR or USD)
- General rule: CB sets central parity and (optionally) a fluctuation band around it
- The market exchange rate is allowed to fluctuate within the band
Fixed exchange rate framework

- Band may be wide (e.g. HUF +/- 15%) or narrow (e.g. DKK +/- 2.25%)
- Central bank uses foreign exchange interventions to prevent ER from leaving the band

The Danish exchange rate peg

Note: The DEM/DKK rate has been converted to an EUR/DKK rate before 1 January 1999. 1 euro = 1.95583 D-mark. Source: Bloomberg.
ER stability and monetary policy independence

- The more a CB stabilizes ER, the less independent its monetary policy becomes.

- Central rule: interest rate parity:

\[
i_t = i_t^* + \frac{E_{t+1} - E_t}{E_t} + \rho_t
\]

- With firmly fixed ER we have:

\[
i_t = i_t^* + \rho_t
\]
ER stability and monetary policy independence

National Bank of Denmark mimics the monetary policy of the ECB – no independent monetary policy

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**MONETARY-POLICY INTEREST-RATE SPREAD AND SPREAD IMPLIED BY 3-MONTH FORWARD FOREIGN-EXCHANGE TRANSACTIONS**

<table>
<thead>
<tr>
<th>Percentage points</th>
</tr>
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<tbody>
<tr>
<td>2.0</td>
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Chart 7

- **Blue line**: Danmarks Nationalbank's lending rate less the ECB's marginal rate
- **Orange line**: Implied interest-rate spread based on 3-month forward transactions between kroner and euro

**Note**: For the ECB's marginal rate, the variable tender rate is applied until 14 October 2008, after which the fixed tender rate is applied. The most recent observations are from 4 December 2008.

**Source**: Danmarks Nationalbank and ECB.
ER targeting – final remarks

- ER targeting is better designed for small open economies with one important trading partner
  - high impact of import prices on domestic inflation
  - fixed ER stabilizes conditions for foreign traded
- Fixed ER regimes have been prone to currency crises
- Less prone option: currency board
3. GE model again
Stability of the equilibrium

- Independent monetary policy (e.g. inflation targeting) reacts to shocks in order to stabilize the economy
- We will assume simple reaction function (Taylor rule)

\[ i_t = r^* + \pi^* + \Phi(\pi_t - \pi^*) \quad \Phi > 1 \]
Taylor Rule: Euro Area

Sources: OECD, Econ. Outlook; IMF, Int. Fin. Statistics
Is the equilibrium stable now?

Assume again positive demand shock – IS curve shifts out

Labour demand increases, inflation rises

Central bank reacts – raises interest rate

Real rate goes up

Demand falls – economy returns to equilibrium
Reaction of the economy to various shocks

- Our GE model is a convenient (and standard in mainstream economics) way to track the consequences of various shocks hitting the economy.

- Examples:
  - demand (IS) shock
  - monetary policy shock
  - money demand (LM) shock
  - productivity shock

- Do not forget: this is a short to medium term model. Does not explain growth.
Monetary policy shock – reaction function shifts up. Nominal and real interest rates increase.

Economy contracts: output and inflation fall.

Central bank lowers interest rates.

The economy converges slowly back to equilibrium (star-variables). This is called monetary policy neutrality.
Reaction to monetary policy shock – Polish economy

Response of GDPYOY to Cholesky
One S.D. RWIB1MEXP Innovation

Response of CORENETYOY to Cholesky
One S.D. RWIB1MEXP Innovation
Money demand shock - LM curve shifts out

At the given interest rate money demand increases

No further adjustment takes place

Money demand plays no role in contemporaneous monetary policy
Cost shock – Phillips curve shifts out

Inflation rises

CB raises interest rates

Demand falls (move along IS curve)

Inflation falls

Model stable – but to return to GE cost shock must die out or wages must fall (PC moves back)
4. AD-AS: A simple framework for policy analysis
Our GE and the AD-AS models

- Our GE model describes in detail behaviour of the economy
- This is nice but complicated
- Sometimes a simpler framework can be more useful
- Aggregate supply – aggregate demand model provides such framework
Aggregate supply

- Start with Phillips curve (with adaptive expectations)
  \[ \pi_t = \pi_{t-1} - \alpha(u_t - u^*) \]
- Take Okun’s law
  \[ y_t - y^* = -\beta(u_t - u^*) \]
- And substitute
  \[ \pi_t = \pi_{t-1} + \alpha\beta(y_t - y^*) \]
Aggregate supply

- In the long run output is at the equilibrium (potential level)
- Inflation is stable
Aggregate supply

- In the short run output can deviate from potential
- Inflation rises when output exceeds potential
- And declines when output is below potential

\[ \pi(t) = \pi(t-1) \]
Aggregate demand

- Take IS curve (simplified, ignore future y)
  \[ y_t = -\sigma r_t \]
- Use Taylor rule
  \[ i_t = \delta \pi_t \]
- And Fisher equation (with adaptive exp.)
  \[ r_t = i_t - \pi_t \]
Aggregate demand

- And substitute
  \[ y_t = -\sigma(i_t - \pi_t) \]
  \[ y_t = -(\delta \pi_t - \pi_t) \]

- Finally we get
  \[ y_t = -\sigma(\delta - 1)\pi_t \]
AD-AS

- AD-AS framework in the short (AD-SAS) and long (AD-LAS) run
Demand shock

- After a positive demand shock inflation and output rise
- If MP counteracts, inflation returns to target
- If MP accommodates, inflation rises
- Real economy returns to potential
Supply shock

- After a negative supply shock (e.g. bad weather, higher oil prices) output falls, inflation rises.
- If monetary policy accommodates, inflation rises further (1970’s case).
- If MP counteracts it can cause a recession.
- Supply shocks are a bigger challenge for monetary policy than demand shocks.

\[ \pi \]
\[ \pi^* \]
\[ y^* \]
\[ y \]
\[ AD \]
\[ SAS \]
Take-aways

- We studied a complete model of business-cycle fluctuations
- With passive monetary policy the model is not stable (explodes after shocks)
- The goal of monetary policy is to provide low and stable inflation
- Active monetary policy adjusts interest rates to fight inflation
- When Taylor principle is fulfilled ( $\Phi > 1$ ) the economy is stable
Exercises

- Analytic approach to the GE model
- Analysis of various shocks in the GE and AD-AS models