Introduction to Macroeconomics

TOPIC 5: The IS-LM Model in an Open Economy

Annaïg Morin
CBS - Department of Economics

August 2013
The IS-LM Model in an Open Economy

Road map:

- Two concepts to better understand openness
- The goods market in an open economy
- IS-LM in an open economy
1. Two concepts to better understand openness

1.1. Balance of payments
1.2. Real exchange rate
1.1. The balance of payments

**Balance of payments:**
summary of all the transactions between a country and the rest of the world

- trade flows
- financial flows
1.1. The balance of payments

Two primary components of the balance of payments

- **Current account**
  - Trade balance: exports - imports
  - Net income: income received - income paid
    (salaries, income from asset holdings -dividends-, ...)
  - Net transfers received
    (aids, donations, workers’ remittances...)

- **Capital account**
  - Capital account balance:
    Purchases of foreign holdings by foreigners - purchases of foreign assets by the country
  - Statistical discrepancy
1.1. The balance of payments

<table>
<thead>
<tr>
<th>Current Account</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>1838</td>
</tr>
<tr>
<td>Imports</td>
<td>2338</td>
</tr>
<tr>
<td>Trade balance (deficit = -) (1)</td>
<td>-500</td>
</tr>
<tr>
<td>Income received</td>
<td>663</td>
</tr>
<tr>
<td>Income paid</td>
<td>498</td>
</tr>
<tr>
<td>Net income (2)</td>
<td></td>
</tr>
<tr>
<td>Net transfers received (3)</td>
<td>-136</td>
</tr>
<tr>
<td>Current account balance (deficit = -) (1) + (2) + (3)</td>
<td>-471</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capital Account</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in foreign holdings of U.S. assets (4)</td>
<td>1260</td>
</tr>
<tr>
<td>Increase in U.S. holdings of foreign assets (5)</td>
<td>1005</td>
</tr>
<tr>
<td>Capital account balance (deficit = -) (4) - (5)</td>
<td>255</td>
</tr>
<tr>
<td>Statistical discrepancy</td>
<td>216</td>
</tr>
</tbody>
</table>

*Source: Survey of Current Business, August 2011, Table F2*

Figure: The US balance of payments, 2010, in billions of US dollars.
1.1. The balance of payments

A country which runs a current account deficit is generally buying from the rest of the world more than what it is selling to the rest of the world. In order to finance this overspending, the country must borrow from the rest of the world by selling more assets to foreigners than domestic citizens buy foreign assets. In this case, the country is a net debtor to the rest of the world.

Symmetrically, a country running a current account surplus is a net creditor to the rest of the world.
1.1. The balance of payments

Remember: \( Y = C + I + G + X - M \)

\( Y - T - C \) is private saving and \( T - G \) is public saving. The sum is denoted \( S^T \) (total saving). Reorganizing the equation, we get:

\[ S^T - I = X - M \]

- Current account surplus = the country is saving more than it invests, providing an abundance of resources to other economies.
- Current account deficit = the country is investing more than it saves, using resources from other economies (borrowing).
1.2. Nominal and real exchange rate

Nominal exchange rate:

- price of the domestic currency in terms of the foreign currency
- price of the foreign currency in terms of the domestic currency

Convention I will be using (same as in the book):
price of the domestic currency in terms of the foreign currency, denoted by $E$. If we say that Denmark is the domestic country, we have: $E = 0.13 \ (1\text{DKK} = €0.13)$
1.2. Nominal and real exchange rate

Exchange rate regimes:

- **Flexible exchange rates**: the central bank lets the exchange rate adjust freely on the foreign exchange market.

- **Fixed exchange rates**: the central bank has an explicit exchange rate target and uses monetary policy to achieve this target.
1.2. Nominal and real exchange rate

Vocabulary:

- **Appreciation** of the domestic currency: increase in the nominal exchange rate
- **Depreciation** of the domestic currency: decrease in the nominal exchange rate
- **Revaluation** of the domestic currency: increase in the nominal exchange rate, under fixed exchange rates
- **Devaluation** of the domestic currency: decrease in the nominal exchange rate, under fixed exchange rates
1.2. Nominal and real exchange rate

Nominal exchange rate:

- price of the domestic currency in terms of the foreign currency, denoted by $E$

Real exchange rate:

- price of domestic goods in terms of the foreign goods, denoted by $\epsilon$

$\epsilon = \frac{EP}{P^*}$

- changes in $\epsilon$ are called real appreciations and real depreciations.
2. The goods market in open economy
2. The goods market in open economy

2.1. Determination of the equilibrium
   2.1.1. The demand for domestic goods
   2.1.2. The equilibrium

2.2. Changes in demand

2.3. Depreciation
2.1.1. The goods market in open economy - The demand

Remember Topic 2 the goods market, the demand for domestic goods is:

\[ Z = C + I + G + X - IM \]

This would be if \( IM \) would denote the value of imports in terms of domestic goods. But if \( IM \) denotes the value of imports in terms of foreign goods, then we have to write:

\[ Z = C + I + G + X - IM/\epsilon \]

- \( C \) is function of the disposable income \( Y - T \)
- \( I \) is function of the level of output \( Y \) and the interest rate \( r \)
- \( G \) is exogenous
- **What about \( X \) and \( IM \)?**
2.1.1. The goods market in open economy - The demand

Determinants of imports: \( IM = IM(Y, \epsilon) \)

- Domestic income \( Y \): the higher the domestic income, the higher the demand of goods, domestic and foreign.
- Real exchange rate \( \epsilon \): the higher the price of domestic goods in terms of foreign goods, the higher the level of imports

Determinants of exports: \( X = X(Y^*, \epsilon) \)

- Domestic income \( Y^* \): the higher the foreign income, the higher the demand of goods, domestic and foreign.
- Real exchange rate \( \epsilon \): the higher the price of domestic goods in terms of foreign goods, the lower the level of exports
Demand for domestic goods:

\[ Z = C(Y - T) + I(Y, i) + G + X(Y^*, \epsilon) - IM(Y, \epsilon) \]

Assumption: \( E \) and \( \epsilon \) are exogenous. (We will relax this later.)
2.1.1. The goods market in open economy - The demand

Figure: The IS relation in open economy
The goods market in open economy - The demand

NB1:
- The difference between $DD$ and $AA$ is imports. Given that imports increase with the level of income, the difference gets larger as $Y$ increases. The $AA$ line is flatter than the $DD$ line.

NB2:
- The difference between $ZZ$ and $AA$ is exports. Given that exports do not vary with the level of income, the difference remains the same as $Y$ increases. The $AA$ line and the $ZZ$ line have the same slope.

NB3:
- Net exports are decreasing with $Y$ because imports increase with $Y$ (while exports are unaffected).

NB4:
- Net exports are equal to zero at the level of output for which $DD$ crosses $ZZ$. Why?
2.1.2. The goods market in open economy - The equilibrium

- The demand is:
  \[ Z = C(Y - T) + I(Y, i) + G + X(Y^*, \epsilon) - IM(Y, \epsilon) \]
- The offer is: \( Y \)

The **IS relation** in open economy is:

\[ Y = C(Y - T) + I(Y, i) + G + X(Y^*, \epsilon) - IM(Y, \epsilon) \]
2.1.2. The goods market in open economy - The equilibrium

Figure: The equilibrium on the goods market
What happens when government spending increases?
2.2. The goods market in open economy - Changes in demand

Figure: Fiscal policy: increase in government spending
2.2. The goods market in open economy - Changes in demand

**Fiscal policy**: government spending increases:

- Demand is higher, the demand relation shifts up.
- Output increases (more than the initial increase in $G$: multiplier effect)
- Increase in output leads to an increase in imports (keeping the level of exports unaffected): trade deficit
Is the multiplier larger or smaller in open economy than in closed economy?
An increase in $G$ leads to an increase in demand and then in supply. Output increases. Therefore consumption increases too but the increase in consumption falls not only on domestic goods but also on foreign goods. The effect on the demand for domestic goods is smaller than it would be in a closed economy. The multiplier is smaller.

Graphically: the slope of the demand relation is smaller in open economy $\Rightarrow$ the multiplier is smaller.
What happens when foreign demand increases?
2.2. The goods market in open economy - Changes in demand

Figure: Effects of an increase in foreign demand
2.2. The goods market in open economy - Changes in demand

**Increase in foreign demand**

- Increase in the demand of domestic goods, shift of the $ZZ$ curve. Output increases, pushing up income and demand, etc (multiplier)
- Upward shift of the net export line: now the country runs a trade surplus

NB: At the initial point, the total demand for domestic goods was equal to the domestic demand for domestic goods. At the new equilibrium point, the total demand is larger than the domestic demand which means that the trade balance shows a surplus. Exports increase (initial change), imports increase due to the increase in income (multiplier effect), but the increase in imports is smaller than the increase in exports.
Importance of taking openness into account

- The multiplier is smaller in open economy. Smaller efficiency of fiscal policies.
- An expansionary fiscal policy deteriorates the trade surplus. Accumulation of debt vis-à-vis the rest of the world.
- No control on an important determinant of output: foreign demand. Policy coordination?
2.3. The goods market in open economy - Depreciation

\[ NX = X(Y^*, \epsilon) - IM(Y, \epsilon) / \epsilon \text{ with } X(Y^*, \epsilon) \text{ and } IM(Y, \epsilon) \]

\(-,+)\\(+,-)\\(+,+)

**Direct effects of a depreciation:**

- Exports increase
- Imports decrease
- The relative price of foreign goods in terms of domestic goods, \(1/\epsilon\) increases, pushing the import bill up.

**Marshall-Lerner condition** (valid in reality): exports increase enough and imports decrease enough to compensate for the increase in the price of imports. A real depreciation leads to an increase in net exports.
Indirect effects of a depreciation:

- Net exports increase (Marshall-Lerner), the NX line shifts up, which leads to an increase in domestic output and an upward shift of the ZZ line.
- Same graph as in the case of an increase in foreign demand
- Improvement of the trade balance even if increase in imports
In the two previous slides, we assumed that quantities (exports and imports) adjust immediately to a change in the real exchange rate. In reality it is not the case.

**How will net exports change following a depreciation if quantities does not adjust immediately?**

- What would be the first effect of a depreciation on net exports?
- How would net exports be impacted by a change in quantities?
2.3. The goods market in open economy - Depreciation: dynamics

**Figure: the J-curve**

- **Net exports, NX**
  - **Time**
  - **Depreciation**
  - **Points:**
    - **A**
    - **B**
    - **C**

**Introduction to Macroeconomics**

**TOPIC 5: Open Economy**
The **J-curve** shows that the improvement of the trade balance following a depreciation (Marshall-Lerner condition) only comes with a delay. At the moment of the depreciation, a temporary deterioration of the trade balance might take place.
2.3. The goods market in open economy - Depreciation: dynamics

Figure: Showing the lag with which the trade balance reacts to changes in the real exchange rate.
3. IS-LM in an open economy
3. IS-LM in an open economy

- 3.1. The goods market
- 3.2. The financial market
- 3.3. The goods and financial markets together: the open IS-LM model
- 3.4. Effects of policy in a flexible exchange rate regime
- 3.5. Effects of policy in a fixed exchange rate regime
3.1. Open IS-LM - The goods market

Equilibrium in the goods market:

\[ Y = C (Y - T) + I (Y, i) + G + NX (Y, Y^*, E) \]

\( (+) \)

\( (+,-) \)

\( (-,+,-) \)

In the short run, prices do not change. Which means that changes in the nominal exchange rate impact the real exchange rate proportionally. Therefore, to simplify, we choose \( P \) and \( P^* \) so that \( P/P^* = 1 \), which is: \( E = \epsilon \).
3.2. Open IS-LM - The financial market

In a closed economy, the financial market has only one component:

- the money market (determining how much money vs. bonds people hold).

In an open economy, the financial market has two components:

- the **money market** (determining how much money vs. bonds people hold)
- the **bond market** (determining how much domestic bonds vs. foreign bonds people hold)
Equilibrium on the money market: \( \frac{M}{P} = YL(i) \)

The equilibrium is the same as in a close economy.
3.2. Open IS-LM - The financial market

Equilibrium on the bond market:

*How to choose between domestic and foreign assets?*
3.2. Open IS-LM - The financial market

Figure: Expected returns from holdings one-year US bonds vs. one-year UK bonds.
Arbitrage (investors will take advantage of a price difference and buy the bonds with highest expected rate of return):

\[ 1 + i_t = (1 + i^*_t) \frac{E_t}{E^{e\_t+1}} \]

This equation is called the **Interest Parity Condition**.

It can be rewritten so:

\[ i_t \approx i^*_t - \frac{E^{e\_t+1} - E_t}{E_t} \]

Because of arbitrage, the domestic interest rate must be equal to the foreign interest rate minus the expected appreciation rate of the domestic currency.
Investors have 100DKK and can choose between Danish and European bonds. Both type of bonds offer an interest rate of 2%. The current and future exchange rate is 0.13.

1. Is the interest parity condition respected?

Let's suppose that the Danish interest rate increase from 2 to 3%.

2. Is the interest parity condition respected?

Let's suppose that investors engage in arbitrage.

3. How will the investors react?

4. What would be the impact on the current exchange rate?

5. After arbitrage, is the interest parity condition respected?
The Interest Parity Condition can also be rewritten as:

\[ E = \frac{1+i}{1+i^*} \bar{E}^e \]

with \[ E = E(i, i^*, \bar{E}^e) \]

\( (+, -, +) \)
3.2. Open IS-LM - The financial market

Figure: The relation between the interest rate and the exchange rate implied by the interest parity condition

**Figure**: The relation between the interest rate and the exchange rate implied by the interest parity condition.
3.3. Open IS-LM - The goods and financial markets together

The goods market:

\[ Y = C(Y - T) + I(Y, i) + G + NX(Y, Y^*, E) \]

The financial market (money market):

\[ \frac{M}{P} = YL(i) \]

The financial market (bonds market):

\[ E = \frac{1+i}{1+i^*} \overline{E}^e \]

In order to decrease the number of equations, we plug the interest parity equation into the goods market equation.
The IS-LM model in an open economy:

- **IS:** \( Y = C(Y - T) + I(Y, i) + G + NX(Y, Y^*, \frac{1+i}{1+i^*}E^e) \)

- **LM:** \( \frac{M}{P} = YL(i) \)

And we find the value of the exchange rate by using the interest parity condition.

This model is also called the **Mundell-Fleming model** (1960’s).
3.3. Open IS-LM - The goods and financial markets together

Figure: The IS-LM model in an open economy
3.3. Open IS-LM - The goods and financial markets together

*How to interpret the downward slope of the IS curve?*

- An increase in the interest rate leads to a drop in investment, in demand, and in output.
- New channel (open economy): An increase in the interest rate leads to an appreciation of the domestic currency, a decrease in exports, in demand, and in output.
What are the effects of an expansionary fiscal policy?
3.4. Open IS-LM - Effects of policy

Figure: The effects of an expansionary fiscal policy

Introduction to Macroeconomics
TOPIC 5: Open Economy
The effects of an expansionary fiscal policy:

- Increase in demand, leading to an increase in output
- The demand for money goes up due to the increase in output: upward pressure on the interest rate (to decrease the demand for money and maintain the equilibrium).
- The increase in the interest rate makes domestic bonds more attractive and lead to an appreciation.
- Both increases in the interest rate and in the exchange rate partly offset the increase in output.
3.4. Open IS-LM - Effects of policy

*How do the components of demand vary?*

- Consumption and government spending both increase
- Investment: ambiguous
- Net exports decrease due to both the increase in output and the appreciation
What are the effects of a contractionary monetary policy?
3.4. Open IS-LM - Effects of policy

Figure: The effects of a contractionary monetary policy
3.4. Open IS-LM - Effects of policy

The effects of a contractionary monetary policy:

- The monetary contraction leads to an increase in the interest rate.
- This increase in the interest rate leads to an appreciation.
- The increase in the interest rate and the appreciation both lead to a fall in demand and output.
- Money demand falls due to the output fall, leading to a lower interest rate, partly offsetting the initial increase in the interest rate and the initial appreciation.
Fixed exchange rate:

- Some countries peg their currency to another currency or to a basket of foreign currencies.
- How? By fixing $E$ and therefore setting $i$ equal to $i^*$.
- These countries use their money supply to maintain a certain interest rate and exchange rate.
What are the effects of an expansionary fiscal policy in a regime of fixed exchange rates?
3.5. Open IS-LM - Effects of policy in a regime of fixed exchange rates

**Figure:** The effects of an expansionary fiscal policy in a regime of fixed exchange rates

**Introduction to Macroeconomics**

**TOPIC 5: Open Economy**
The effects of an expansionary fiscal policy in a regime of fixed exchange rates:

- Increase in demand, leading to an increase in output
- The demand for money goes up due to the increase in output: upward pressure on the interest rate (to decrease the demand for money and maintain the equilibrium).
- The central bank must react otherwise there would be an appreciation of the currency.
- Increase in the money supply: shift of the LM curve.

The fiscal policy has to be accompanied by a monetary accommodation in order to keep the interest rate and the exchange rate at their initial levels.
In a regime of fixed exchange rate, the countries give up a precious tool for correcting imbalances or changing the level of economic activity: their monetary policy.
Conclusion

This course:
- Understanding of the functioning of the goods market and the financial market, and of the interactions between these two markets
- Understanding how openness affects the functioning of these markets
- Understanding the effects of economic policies

So much more to see:
- the labor market
- medium run and long run
- better understanding the financial market
  - exchange rate regimes
  - introducing risk in the bonds market
  - history of financial crisis