
- Building a Model of Aggregate Demand
- Money Market: The LM Curve
- Goods Market: The IS Curve
- A Graphical Representation of the Equilibrium: The IS/LM Model
- How to Use the Model? Examples.
- The Long-Run Equilibrium

Basic Markets

The Market for Goods and Services (Sessions 2 and 3)

Money (Session 5)

The Long Run

Economic growth (Session 4)

Labor Market (Session 7)

Demand side: determines the demand for goods and services by: households (C), firms (I), government (G) and foreigners (NX)

Supply side: determines the productive capacity of the economy (Capital, Labor, Productivity)

Aggregate Model of the Economy
Why a Model?

Models are small-scale versions of an economy. They combine theory (a set of equations that describe behavior of economic agents) and data (the equations are estimated with data from the economy in question).

Central banks, policy makers, or the private sector use models to forecast the evolution of the economy and to assess the likely impact of exogenous events:

- What would happen if the central bank raised interest rates by 50 basis points?
- What would be the consequences of the appreciation of the Euro vis-à-vis the US dollar?

The Basic Principles of Modelling: The Short Run and the Long Run

The long run

1. Prices are flexible
2. Output is determined by factors of production and technology (Session 4)
3. Unemployment is equal to its natural rate (Session 7)
4. All nominal variables are determined by money growth (Session 5)

The short run

1. Prices are fixed (or sticky)
2. Output is determined by Aggregate Demand (Consumption, Investment, Government Spending, Net Exports)
3. Unemployment is negatively related to output
4. Money growth (i.e. monetary policy) can affect real variables (real GDP)
Building a Model of Aggregate Demand

- **Aggregate demand** consists of four components: consumption, investment, government expenditures and net exports (current account).

\[ Y = C + I + G + NX \]

- To understand demand we need to understand the determinants of
  - Consumption: income (+), taxes (-), r (-), wealth,
  - Investment: real interest rate (-), profitability/future productivity (+)
  - Government Spending: exogenous
  - Net Exports: real exchange rate (-), foreign income (+), domestic income (-)

- **Assumption**: The economy is closed (NX = 0, exchange rate is irrelevant)

\[ Y = C (Y, Y^*, T, r, wealth) + I (r, profitability) + G \]

- We have two unknowns (endogenous variables): Y (output, income, GDP) and r (the real interest rate), we are missing one equation...

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Money Market: Supply and Demand

- **Money** is the stock of assets used for transactions.

- **Money supply** is controlled by the central bank. But the central bank only controls the monetary base. Commercial banks can also create some liquidity by holding long-term assets against short term liabilities – deposits.

- We can calculate the factor by which commercial banks and the public multiply the currency issued by the central bank in the process of money creation.
The Creation of Money

Central Bank Balance Sheet

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loans to Commercial Banks</td>
<td>Currency (Banknotes)</td>
</tr>
<tr>
<td>Securities</td>
<td>Reserves (Deposits of Commercial Banks)</td>
</tr>
<tr>
<td>Other assets (Gold, Foreign)</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td>Capital</td>
</tr>
</tbody>
</table>

Commercial Banks Balance sheet

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserves (Deposits at Central Bank)</td>
<td>Deposits</td>
</tr>
<tr>
<td>Loans</td>
<td>Loans from Central Bank</td>
</tr>
<tr>
<td>Securities</td>
<td>Other sources of funding (Bonds)</td>
</tr>
<tr>
<td>Other assets</td>
<td>Capital</td>
</tr>
</tbody>
</table>

Monetary Base = Currency (C) + Reserves (R)
Money Supply = Currency (C) + Deposits (D)

The Money Multiplier

The Money Supply is higher than the Monetary Base because commercial banks can magnify the liquidity introduced by the central bank. This is what we call the Money Multiplier.

We can calculate the factor by which commercial banks and the public multiply the currency issued by the central bank in the process of money creation.

\[
\frac{\text{Money Supply}}{\text{Monetary Base}} = \frac{C + D}{C + R} = \frac{C/D + 1}{C/D + R/D}
\]

As Long as the ratio R/D is smaller than one, the multiplier is larger than 1. The multiplier increases when C/D or R/D are smaller.
The Demand for Money

- The demand for money, i.e. how much money to keep is determined by the need to do transactions, by the interest rate on alternative financial instruments, and by the risk and liquidity of alternative assets (e.g. bonds).

- It is convenient to express the demand for money in real terms. This rearrangement removes the effect of price changes on money demand (because this effect is straightforward – an increase in the price level requires the same increase in money in order to conduct the same transactions).

\[
\frac{M^d}{P} = L(i, Y)
\]

- In equilibrium, Money Demand has to be equal to Money Supply, which is set by the central bank:

\[
\frac{M^s}{P} = \frac{M^d}{P} = L(i, Y)
\]

Equilibrium on the Money Market and an Increase in Money Supply

When there is an increase in money supply, the nominal interest rate decreases, leading to an increase in money demand. The new equilibrium is found at a lower nominal interest rate and a higher money demand.
Building a Model of Aggregate Demand

- Add the money market equation to the GDP determination equation:

\[
\frac{M}{P} = L(i, Y)
\]

\[
Y = C(Y, Y^e, T, r, \text{wealth}) + I(r, \text{Profitability}) + G
\]

- But we have added two new variables: \(P\) (the price level) and \(i\) (the nominal interest rate). We need more equations… or assumptions.

- **Key assumption:** in the short run, prices are fixed. This makes \(P\) a constant and it makes the nominal and real interest rate be the same because inflation is equal to zero

\[
r = i
\]

Building a Model of Aggregate Demand

- We are done, we have two equations and two unknowns

\[
Y = C(Y, Y^e, T, r, \text{wealth}) + I(r, \text{Profitability}, \text{other}) + G
\]

\[
\frac{M}{P} = L(r, Y)
\]

- Need to solve for:
  - \(Y\): output, GDP
  - \(r\): the real interest rate

- Given the values for the exogenous variables:
  - Government Spending (\(G\)) and taxes (\(T\))
  - Money (\(M\))
  - Expectations (of consumers and companies) that affect the consumption and investment functions, wealth, productivity….
Strategy: represent these two equations in a graph where we put in the axis the two endogenous variables: $r$ and $Y$.

The trick is to think about the relationship between $r$ and $Y$, holding constant all other variables (we will be moving along the line).

What we end up with are lines that represent equilibriums either on the money market or on the market for goods and services. When we combine the two schedules, we can solve for the equilibrium in the whole economy.

**First equation: money market equilibrium**

$$\frac{M}{P} = L(r,Y)$$

For a given money supply, the level of income determines the (real) interest rate that makes money demand equal to money supply.

The outcome is an upward-sloping curve that we call the *LM curve*.

Suppose output goes up. Keeping money supply fixed requires that the real interest rate increases as consumers and firms need more money to match the increase in the number of transactions.
Building a Model of Aggregate Demand

Second equation

\[ Y = C(Y, Y^*, T, r, \text{wealth}) + I(r, \text{Profitability}) + G \]

- Start with a level for the real interest rate and solve for output.
- Pick a lower level for the real interest rate and ask: What is the level of aggregate demand for this (lower) interest rate?
- Because investment and consumption of durable goods depend negatively on the interest rate, aggregate demand increases.

The outcome is a downward-sloping curve that we call the IS curve.

Model is completed: IS-LM model

- Equilibrium real interest rate
- Equilibrium output

Macroeconomics in the Global Economy
Antonio Fatás
How to Use the Model of Aggregate Demand

- What makes the equilibrium change? **Exogenous variables**

- IS curve shifts to the right whenever **the demand for goods goes up**:
  1. Government spending goes up
  2. Taxes go down (including taxes on capital)
  3. Investment or consumer confidence go up
  4. Other factors

- LM curve shifts to the right whenever **the liquidity in the economy increases**:
  1. Money supply increases
  2. Prices decrease
  3. Financial markets innovation reduces the need to hold money (velocity goes up)

- Following a shift of one of the curves, there is always a **movement along** the other curve to reach the new equilibrium.

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Examples of Changes in Aggregate Demand: Monetary Contraction


Aug 1979-April 1980: Fed reduces M/P by 8.0% (Jan 1983, inflation is down to 3.7%)

What was happening to interest rates and output?

- **Real interest rate**
  - April 1980: $i = 15.8\%$
  - August 1979: $i = 10.4\%$

- **Real Growth**
  - Real Growth 1980 = -0.33\%
  - Real Growth 1979 = 3.18\%
Fiscal Expansion (Increase in G)

An increase in government spending will raise the demand in the economy at any given interest rate. This is represented as an outward shift in the IS curve:

What happened to the interest rate? To output? Why?

Examples of Changes in Aggregate Demand: Fiscal Expansion

Fiscal expansion: Germany's reunification

<table>
<thead>
<tr>
<th>Year</th>
<th>Budget deficit (% of GDP)</th>
<th>Real GDP (1989 = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>108.0</td>
<td>109.0</td>
</tr>
<tr>
<td>1990</td>
<td>107.0</td>
<td>108.0</td>
</tr>
<tr>
<td>1991</td>
<td>106.0</td>
<td>107.0</td>
</tr>
<tr>
<td>1992</td>
<td>105.0</td>
<td>106.0</td>
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</table>

Interest Rate, Germany

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>6.28</td>
<td>8.13</td>
<td>8.27</td>
<td>8.32</td>
<td>9.31</td>
</tr>
</tbody>
</table>
The Long-Run Equilibrium
(Closed Economy)

We start with the two equations describing the equilibrium on money market and on the goods market:

\[
\frac{M}{P} = L(r, Y)
\]

In the long-run prices are flexible. We have now three endogenous variables – interest rates (r), output (Y), and prices (P).

To solve this model we claim that in the long run output is determined by the factors of production (labor, capital) and their productivity.

General Equilibrium
Summing up the Model

Changes in the economic environment lead to changes in demand. In the short run, demand determines output. If demand is below potential, the economy is in a recession, if demand is above potential, the economy is in an expansion.

In April 2012, CPI inflation (measured as the annual change in the consumer price index) stood at 1.3 per cent (1.1 per cent in March 2012).

Riksbank (Swedish Central Bank)
Session 8. Summary

- The IS/LM model is a model of aggregate demand.
- The IS curve represents the demand for goods in the economy (this is the link between demand and interest rates).
- The LM curve represents the liquidity in the system.
- In the short run prices are fixed and aggregate demand determine the level of output. Firms produce to meet the demand at the given price.
- The long-run equilibrium of the economy is captured by the potential level of output. In the short-run output is determined by aggregate demand. Without any policy intervention the economy returns to the long-run equilibrium by changes in the price level: High demand raises prices and chokes off excess demand. Low demand forces producers to lower prices, which then boosts demand in the economy.

Appendix: Output Growth and the Money Market

Increase in output => Increase in transactions => Increase in money demand

To produce more, firms need cash to conduct transactions (buy intermediate goods, etc). They will take a loan and with the higher demand for credit interest rates will increase.
Appendix: Goods Market: The IS curve

Here is a second interpretation of the IS curve:

\[ Y = C(Y, Y^*, T, r, \text{wealth}) + I(r, \text{Profitability}) + G \]

\[ Y - C(Y, Y^*, T, r, \text{wealth}) - G = I(r, \text{Profitability}) \]

(National Saving = Investment)