IS-LM model for macro policy analysis

(in an international context)

Assume:
- two countries: home and foreign (∗)
- focus on short run: prices are fixed \( (P=P^*) \) \( (Π^e=0) \)
- government spending and taxes are exogenous \( (G=G^*, T=T^*) \)
- foreign variables as given
- for simplicity: \( KA=0, NUT=0 \)
  \( NFI\Delta=0 \) \Rightarrow implies \( CA=IB \)

First goal: understand determination of output (or income) \( Y \).
Insight: output is driven by demand in the short run.

\[ \text{Demand} = C + I + G + \text{Imports} \]

1) Consumption \( (C) \): assume \( C \) is a function of current income net of taxes.

\[ C = C(Y-I) \]  "disposable income"
The slope of the consumption function is called the "marginal propensity to consume" (MPC)

\[ 0 < MPC < 1 \]

"marginal propensity to save" (MPS)

\[ MPS = 1 - MPC \]

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2) \underline{Investment} is assumed to be a negative function of the interest rate \( i \)

\[ I = I(i) \]

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3) \underline{Government spending and taxes} are assumed to be exogenous:

\[ G = \bar{G}, \quad T = \bar{T} \]
(4) trade balance: \[ T_B = EX - IM \]

\[ \text{exports} \quad \text{imports} \]

\( a) \) real exchange rate \( (E^* \quad \rho) = q \)

- rise in \( P^* \) (imported goods become more expensive) \( \rightarrow \) imports \( \downarrow \), exports \( \uparrow \)
- fall in \( P \) (home goods cheaper) \( \rightarrow \) \( \downarrow \) \( IM \), \( \uparrow \) \( EX \)
- rise in nominal exchange rate \( (\uparrow E \quad \rho) \) \( \rightarrow \) more expensive to buy foreign currency \( \rightarrow \) buy foreign goods: \( \downarrow \) \( IM \), \( \uparrow \) \( EX \)

In summary, a rise in the real exchange rate \( (q = E^* \quad \rho) \) leads to a rise in trade balance.

\( b) \) income: a rise in income raises consumption (as saw earlier) by MPC, some of which is consumption of goods produced abroad

\[ \uparrow Y \rightarrow \uparrow C \rightarrow \downarrow IM \rightarrow \uparrow TB \]
MPC: marginal propensity to consume foreign goods (imports)
MPC_H: " " home goods
MPC_F + MPC_H = MPC
Also true for foreign country;
\( \Delta Y^* \rightarrow \Delta IM^* = EX \rightarrow ATB \)
\[ TB = TB \left( \frac{E_p^*}{p}, Y-T, Y^*-T^* \right) \]
\[ (+) \quad (-) \quad (+) \]

\[ \text{Demand (D)} = C(Y-T) + I(i) + G \]
\[ + TB \left( \frac{E_p^*}{p}, Y-T, Y^*-T^* \right) \]
\[ = D(Y-T, i, \frac{E_p^*}{p}, Y^*-T^*, G) \]

Equilibrium concept: all goods produced must be willingly demanded and purchased.
Equilibrium condition: \( Y = D \) output = demand
\[ D = D \left( y - T, i, \frac{E}{P}, ... \right) \]
recall: IS-LM model basics

Demand \( (D) = C(Y - T) + I(i) + G + TB\left(\frac{E_{p}^{o}, Y - T, Y^*, T^*}{P, Y - T, Y^*, T^*}\right) \)

Equilibrium condition: all goods produced must be willingly purchased

output = demand
\[ Y = D \]

Suppose a rise in government purchases \( \Delta G \) from \( G_1 \) to \( G_2 \), \( \Delta G = G_2 - G_1 \)

→ shifts up D line

→ rise in equilibrium output from \( Y_1 \) to \( Y_2 \)
Things that shift up the demand line:

1) rise in G
2) cut in taxes: \( JT \rightarrow \uparrow Y-T \rightarrow \uparrow C (Y-T) \)
3) fall in interest rate: \( \downarrow i \rightarrow \uparrow I(i) \)
4) rise in real exchange rate (\( \Rightarrow \uparrow TB \))
5) exogenous shocks to demand consumption: a rise in household wealth or consumer confidence
   \( \Rightarrow \) rise in consumption for any given income level.

Investment: optimism about investment opportunities: rise in \( I \) for any given \( i \).

Trade balance: taste shift between home and foreign goods.
**IS curve**

*Def*: shows combinations of output ($Y$) and interest rate ($i$), where the goods market and foreign exchange market are in equilibrium.

**goods market**

\[
D_i = C(Y-T) + I(i) + G + TB(EP) \quad (Y-T, +T)
\]

**foreign exchange market**

Suppose a fall in interest rate from $i_1$ to $i_2$

\[
\downarrow i \rightarrow F \rightarrow \uparrow E \rightarrow \uparrow TB \rightarrow \uparrow ND \rightarrow \uparrow Y
\]

So output rises from $Y_1$ to $Y_2$.

This is a movement along an IS curve ($\downarrow i \rightarrow \uparrow Y$)
The following things shift the IS curve right (because they raise output for a given i):

- Rise in G
- Fall in taxes
- Exogenous shocks to C, I or TB
The LM curve is the combination of money supply and demand that satisfies equilibrium in the money market:

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

where \( \frac{M}{P} \) is real money supply and \( L(i)Y \) is real money demand.

Suppose a rise in income (from \( Y_1 \) to \( Y_2 \)):

- raises real money demand
- rises the interest rate \( (i^*) \) to keep the equilibrium value of real money demand equal to the constant money supply.

![Money Market Diagram](image)

![LM Curve Diagram](image)
What shifts the LM curve right:

1) rise in money supply:

\[ \frac{M_1}{P} \rightarrow \frac{M_2}{P} \]

\[ \downarrow \text{i from } i_1 \text{ to } i_2 \text{ for any given } Y \]

This is a shift right (or down) in the LM curve.

2) an exogenous fall in money demand (for a reason other than a change in income)

\[ \frac{M}{P} \rightarrow \text{real money} \]

Again, i falls for any given Y; shift LM curve right (down)
Combine IS & LM curves
recall

Is curve: equilibrium in goods and foreign exchange markets

- says ↓ i \implies \uparrow I \implies \downarrow d \implies \uparrow Y

- shifted right by → \text{fiscal policy}

Lm curve: equilibrium in money market

- says \uparrow Y \implies \uparrow i (to prevent a quantity money demand)

- shifted right by → \text{monetary policy}
Monetary policy (under flexible exchange rates)

IS-LM Graph

LM

IS

Y

Y1

Y2

i

i1

i2

Foreign exchange market

Foreign Rate

E1

E2

↑M: lowers interest rate for a given output level; rightward shift in LM curve,

⇒ move along IS curve; drop in interest rate stimulates investment spending, and a currency depreciation stimulates exports

⇒ rise in expenditure ⇒ rise in output.
monetary policy (under fixed exchange rate)

IS-LM Graph

foreign exchange market

\[ i \quad \frac{E}{E} \quad Y \quad Y \]

\[ \text{If } M \text{ increases, } \text{shifts LM curve right } \]
\[ \Rightarrow \text{pressure for interest rate to fall and currency to depreciate} \]

The central bank loses reserves in the foreign exchange market, and money supply in circulation returns to original level,

\[ \Rightarrow \text{shifts LM curve back to its original position} \]

\[ \Rightarrow \text{so no change in output.} \]
Fiscal policy expansion under a flexible exchange rate

IS-LM Graph

foreign exchange market

\[ \Delta G \rightarrow \text{shifts IS curve right} (\text{rise in } Y \text{ for a given } i) \]

\[ \rightarrow \text{higher interest rate and higher output, and domestic currency appreciates (WE)} \]

Why \( i \) rises: LM curve story: need a rise in interest rate to keep real money demand equal to constant real money supply, despite higher income.

Note that \( \Delta i \) has feedback effect on goods market. IS curve story in reverse.

\[ \Delta i \rightarrow \Delta I \rightarrow \Delta E \rightarrow \Delta J \text{ (investment crowding out)} \]

\[ \Delta E \rightarrow \Delta J \text{ (export crowding out)} \]

\[ \rightarrow \Delta Y \text{ somewhat} \]

So output rises less than it otherwise would have.
Fiscal policy expansion under a fixed exchange rate.

IS-LM Graph

foreign exchange market

$\uparrow S \rightarrow$ shift IS curve right

$\uparrow Y \&$ start $\uparrow i$

$\uparrow$ pressure for currency to appreciate (E)

so central bank will find itself gaining reserves and selling domestic currency

$\rightarrow \uparrow$ money supply in circulation to keep $E=E$

This is represented as a rightward shift in the LM curve.

so there is no change in $i$ or $E$ to crowd out investment or trade balance.

so output rises even more than under the flexible-exchange rate case.
<table>
<thead>
<tr>
<th>Exchange Rate Regime</th>
<th>Policy</th>
<th>Impact on:</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>$i$</td>
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<tr>
<td>Floating</td>
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<td>$\downarrow$</td>
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<tr>
<td>Fixed</td>
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<td></td>
<td>Fiscal Expansion</td>
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\[TB = TB \left( \frac{E^{p^*}}{P}, \bar{X}, Y^{x^*} \right)\]

just a function of the real exchange rate
(a) Nominal Exchange Rates

- Large depreciation of zloty against the euro.
- Lat fixed against the euro.
- Poland (left scale)
- Latvia (right scale)

(b) Real Government Spending

- Continued spending growth in Poland.
- Austerity in Latvia.

(c) Output per Person

- No recession in Poland.
- Deep depression in Latvia.

(a) IS-LM Diagram: Floating + Monetary Expansion

1. Negative demand shock, unchanged fiscal policy.
2. Expansionary monetary policy to offset shock.
3. Home interest rate falls.
4. Output stabilized at point 3.

(b) FX Market: Floating + Monetary Expansion

1. Large decline in domestic return and large depreciation at new equilibrium 3.'

(c) IS-LM Diagram: Fixed + Fiscal Contraction

1. Negative demand shock, plus fiscal austerity.
2. Contractionary monetary policy to maintain peg.
3. Home interest unchanged.
4. Output falls dramatically to point 4.

(d) FX Market: Fixed + Fiscal Contraction

1. Domestic return unchanged and peg maintained, no change in equilibrium.
Applying IS-LM model to case of Poland & Latvia in 2008-9 global financial crisis

Observations
1) Poland had flexible exchange rate, and its currency depreciated in 2008-9, while Latvia had a fixed exchange rate to the euro
2) GDP fell much in Latvia but not Poland
3) Also, Latvia lowered government spending rather than use fiscal policy

Graphical Analysis:

Poland:

Shock: fall in demand from Europe for Polish exports due to European recession → shift IS curve left

Policy response: increase money supply to shift LM curve right

Result: currency depreciation, no fall in output
Latura

Shock: fall in TB (as for Poland). But also because it hoped to join EMU (eurozone), rules required it to keep government budget deficit small. So it cut G spending.

→ Two reasons shifting IS left.

Policy response: fixed exchange rate required fall in money supply → shift LM curve left.

Result: fall in output very large.