

The IS Curve and Aggregate Demand

Week 03

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1. The Components of Aggregate Expenditure

The Aggregate Demand for G&S

At the level of the entire economy, there are **two sides** in the market for Goods & Services (**G&S**):

- The **Demand side**: G&S are demanded, which is translated into a set of “Planned Expenditures”
 - The **Supply side**: G&S are produced/supplied at a certain market price.
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The Aggregate Demand for G&S

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The total amount of planned expenditures on G&S, which we will call by **aggregate demand** (D) is given by:¹

$$D = C + I + G + NX$$

- C : Personal consumption expenditures on G&S
 - I : Investment expenditures on G&S
 - G : Government purchases of G&S
 - NX : Net exports of G&S
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Personal Consumption Expenditures

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In a developed market economy, personal consumption expenditures C are explained by three fundamental variables:²

¹The textbook uses Y^{pe} instead of D . For simplicity we choose D for “**demand**”. The notation is better and it is more intuitive.

²In eq. (2), where we use c , the textbook uses mpc , and where we have b the textbook uses c . Our notation is easier to manage.

$$C = \bar{C} + c \cdot \underbrace{(Y - T)}_{=Y_D} - b \cdot r$$

- $\bar{C}$: exogenous consumption expenditures
 - Y : GDP, income, or “output”
 - T : income taxes
 - Y_D : disposable income
 - r : real interest rate
 - $c > 0$: parameter (known as the “marginal propensity to consume”)
 - $b > 0$: parameter
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Investment Expenditures

- In a developed market economy, the level of investment depends upon:
 - $\bar{I}$: exogenous investment (the textbook calls it “Autonomous” investment)
 - r_i : real interest rate charged on investments
- Banks charge r_i as the sum of the risk-free market real interest rate (r) and the risk-premium or spread ($\bar{f}$):³

$$r_i = r + \bar{f}$$

- Therefore, the demand expenditures on investment G&S will be given by:

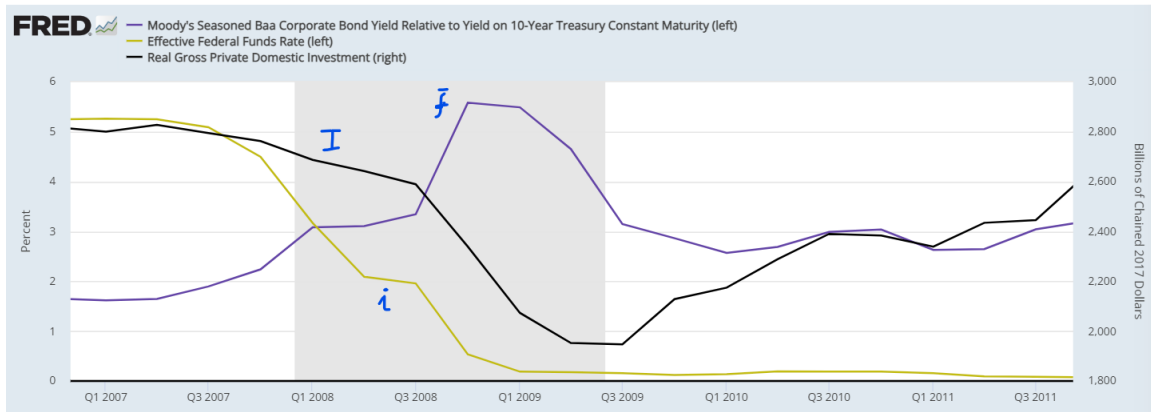
$$I = \bar{I} - d \cdot \underbrace{(r + \bar{f})}_{r_i}$$

- where d is a parameter: ($d > 0$)
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Financial Frictions and Investment

In the great financial crisis of 2007-2010, the inverse relationship between $(\bar{f})$ and I can be easily spotted in the figure below: $\uparrow \bar{f}, \downarrow I$, despite (i) going down. And $\downarrow \bar{f}, \uparrow I$, despite i remaining at 0%.

³The textbook calls $\bar{f}$ a *financial friction*. The three terms represent the same thing: a measure of risk.



Government Expenditures and Income Taxes

- The level of government expenditures on G&S is a result of a political decision in the Parliament
- So (G) is *exogenously* determined:

$$G = \bar{G}$$

Government Expenditures and Income Taxes

- The level of income taxes (T) increases with income, so we could describe taxes with the following tax function:

$$T = \bar{T} + t \cdot Y$$

where t is the marginal income tax rate.

- However, for simplicity, we will assume that the level of income taxes is also *exogenously determined*:

$$T = \bar{T}$$

- This simplification will not significantly change our results in this course.
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Net-Exports Expenditures

Net-exports expenditures are made up of two components:

- Autonomous net exports ($\bar{NX}$)
- Net exports affected by changes in real interest rates (r)
- Putting together these two components, we get:

$$NX = \bar{NX} - x \cdot r$$

where $x > 0$ is a parameter.

- Why are net exports negatively dependent on the real interest rate?

- See next slide.
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Why r Affects Net-Exports?

An example. Suppose the ECB (European Central Bank) reduces interest rates in the EuroZone (EZ):

$$\downarrow r_{(EZ)}$$

- This leads to **financial investments** denominated in € becoming less internationally attractive: they now have a lower return.
- Lower demand for € in the foreign exchange markets, leads to a **depreciation** of the € against other currencies.
- A depreciated € leads to G&S produced in the EuroZone becoming relatively less expensive than before, resulting in an **increase in NX** from Euro countries.
- So: $\downarrow r \Rightarrow$ national currency depreciates $\Rightarrow \uparrow NX$

2. The IS Curve

The Relationship Between GDP and Demand

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From **eq. (1)**, we saw that the level of aggregate demand is given by:

$$D = C + I + G + NX$$

...

And from **week 2**, we know that GDP (Y) can be calculated by the sum of all expenditures on final G&S. So we must have:

$$Y = D$$

...

Therefore, we can relate GDP with the demand side by writing:

$$Y = C + I + G + NX$$

Eq. (10) allows us to obtain a very simple and useful curve: **IS curve**

Derivation of the IS Curve

To obtain an equation that reflects the impact of demand forces on the level of GDP (Y), we have to do as follows:

...

$$Y = C + I + G + NX$$

...

$$Y = \underbrace{\overline{C} + c \cdot (Y - \overline{T}) - b \cdot r}_{=C} + \underbrace{\overline{I} - d \cdot (r + \overline{f})}_{=I} + \underbrace{\overline{G}}_{=G} + \underbrace{\overline{NX} - x \cdot r}_{=NX}$$

...

Rearranging better the previous equation, we get:

$$Y = \overline{C} + \overline{I} - d \cdot \overline{f} + \overline{G} + \overline{NX} - c \cdot \overline{T} + c \cdot Y - (b + d + x) \cdot r$$

...

Simplify the exposition, by grouping together all the elements with an over bar, and call it the **Exogenous/Autonomous Aggregate Demand**:

$$\overline{A} = \overline{C} + \overline{I} - d \cdot \overline{f} + \overline{G} + \overline{NX} - c \cdot \overline{T}$$

Derivation of the IS Curve (continuation)

Inserting eq. (12) into eq. (11), we get a very simple equation:

$$Y = \overline{A} + c \cdot Y - (b + d + x) \cdot r$$

...

which can be solved for Y as follows:

$$Y = \frac{1}{1-c} \cdot \overline{A} - \frac{(b+d+x)}{1-c} \cdot r$$

...

But we can simplify it even further:

$$Y = m \cdot \overline{A} - m \cdot \phi \cdot r$$

- $\frac{1}{1-c} = m \rightarrow m$ is a parameter know as the **demand multiplier**
 - $b + d + x = \phi \rightarrow \phi$ is a parameter (or a sum of parameters)
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The IS Curve: Summary

i Definition: IS curve

For the set of parameters $\{m, \phi\}$, the level of Aggregate Demand and GDP (D, Y) is positively affected by the level of the autonomous/exogenous aggregate demand $(\overline{A})$, and negatively by the level of the real interest rate (r) :

$$Y = m \cdot \overline{A} - m \cdot \phi \cdot r$$

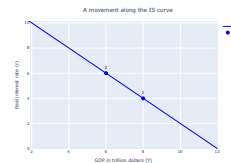
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- Notice that, to simplify things, we have defined:

- $m = \frac{1}{1-c} > 1$
- $\phi = b + d + x > 0$
- $\bar{A} = \bar{C} + \bar{I} - d \cdot \bar{f} + \bar{G} + \bar{NX} - c \cdot \bar{T}$

IS Curve: Graphical Representation

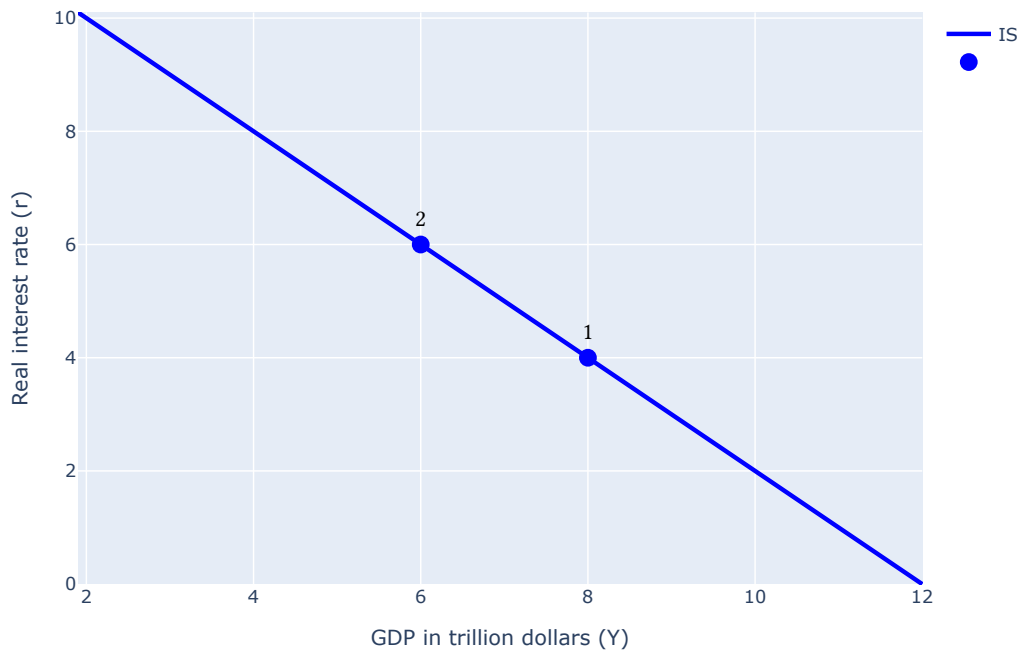
For a given level of $(\bar{A})$, an increase in (r) will cause a reduction in aggregate demand (D) ,



which will lead to a decline in GDP (Y) , and *vice-versa*.

IS Curve: Graphical Representation

A movement along the IS curve



- $\Delta r = +2pp$
- $\Delta \bar{A} = 0$
- $\Delta Y = -2trillion$
- If $\Delta \bar{A} \neq 0$, the **IS** would shift to the right/left

3. Forces that Shift the IS Curve

Exogenous Demand and Shifts in the IS Curve

- Recall that the exogenous/autonomous aggregate demand is given by:⁴

$$\bar{A} = \bar{C} + \bar{I} - d \cdot \bar{f} + \bar{G} + \bar{NX} - c \cdot \bar{T}$$

- A change in any of these components of $\bar{A}$ will force the **IS** curve to shift.
- For example, consider an increase in public spending: $\Delta \bar{G} > 0$. From the expression above we get:

$$\Delta \bar{A} = \Delta \bar{G} > 0$$

- However, from the **IS** curve we know that:

$$\Delta Y = m \cdot \Delta \bar{A} \Rightarrow \Delta Y = m \cdot \Delta \bar{G}$$

- Because $m > 1$, we have: $\uparrow \bar{G} \Rightarrow \uparrow \bar{A} \Rightarrow \uparrow Y$: the **IS** curve shifts to the right
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Another Example of a Shift in the IS Curve

- The exogenous aggregate demand: $\bar{A} = \bar{C} + \bar{I} - d \cdot \bar{f} + \bar{G} + \bar{NX} - c \cdot \bar{T}$
- A change in the spread (or as the textbook calls it: the “financial friction”) will also shift the **IS** curve. Suppose that the spread increases by 4 percentage points:

$$\Delta \bar{f} = +4pp$$

- From the exogenous aggregate demand expression above we get:

$$\Delta \bar{A} = -d \cdot \Delta \bar{f} = -d \times 4pp$$

- However, from the **IS** curve we know that:

$$\Delta Y = m \cdot \Delta \bar{A} \Rightarrow \Delta Y = m \cdot (-d \times 4pp)$$

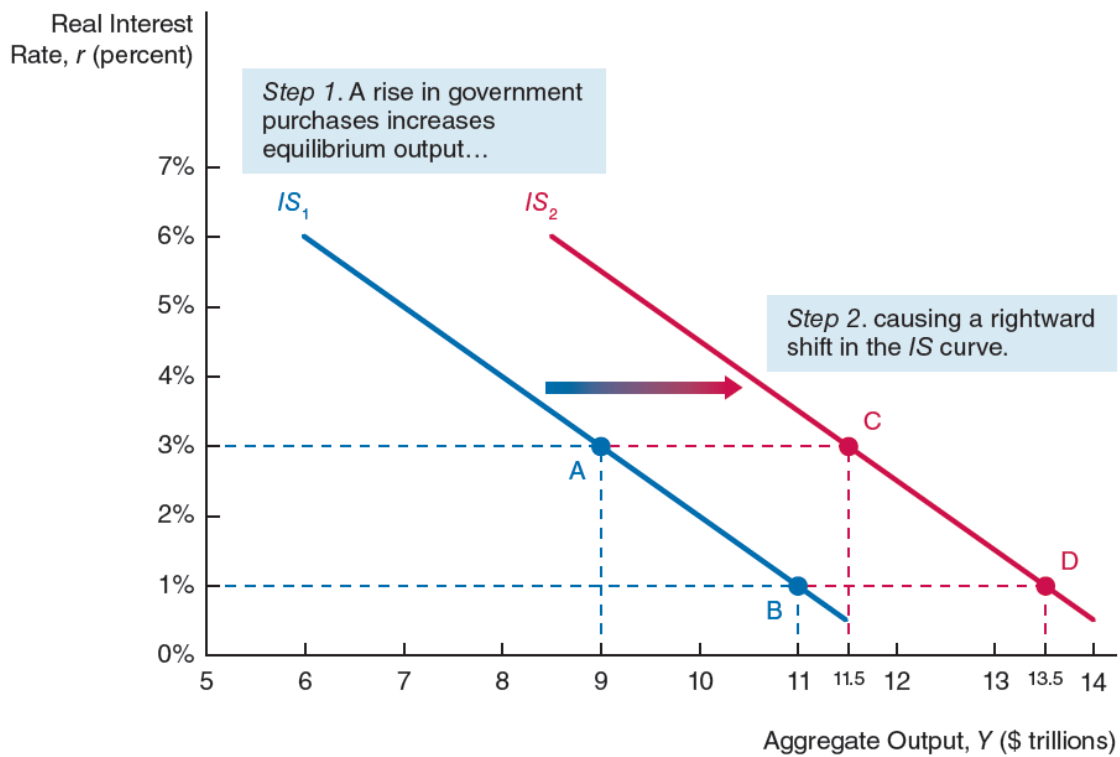
- Because $m > 1, d > 0$, we have: $\uparrow \bar{f} \Rightarrow \downarrow \bar{A} \Rightarrow \downarrow Y$: the **IS** curve shifts to the left
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A Shift in the IS: a Graphical Example

If $\uparrow \bar{G} \Rightarrow \uparrow \bar{A} \Rightarrow \uparrow Y$, the **IS** shifts to the right:

...

⁴No need to memorize this expression. Try to understand which ones have a negative/positive impact upon $\bar{A}$.

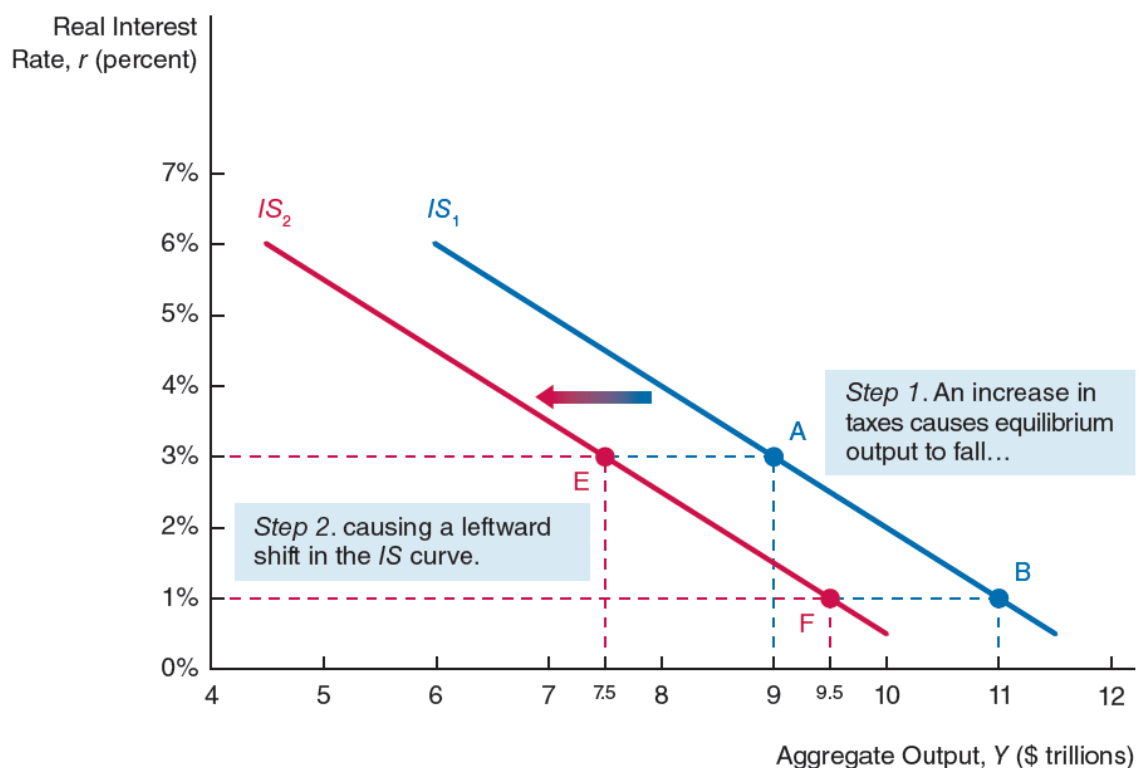


- The IS shifts to the right for any r level
- The shift is the same for $r = 3\%$, $r = 1\%$, $r = 0\%$, or ...

A Shift in the IS: another Graphical Example

If $\uparrow \bar{T} \Rightarrow \downarrow \bar{A} \Rightarrow \downarrow Y$, the IS shifts to the left:

...



- The IS shifts to the left for any r level
- The shift is the same for $r = 3\%$, $r = 1\%$, $r = 0\%$, or ...

The Multiplier of Aggregate Demand

- An increase/decrease in $\bar{A}$, will shift the **IS** curve leading to an increase/decline in aggregate demand and GDP. **But by how much?**
- It will depend upon the value of the demand multiplier m and the value of the shock.
- As $0 < c < 1$, then

$$m = \frac{1}{1-c} > 1 \Rightarrow \Delta Y = m \cdot \Delta \bar{A} \Rightarrow \Delta Y > \Delta \bar{A}$$

- Where $\bar{A} = \bar{C} + \bar{I} - d \cdot \bar{f} + \bar{G} + \bar{NX} - c \cdot \bar{T}$
- One shock upon $\bar{A}$ is **amplified/multiplied** through the other components of expenditure: the higher c is, the higher will be m .

A Textbook Useful Table

SHIFTS IN THE IS CURVE FROM AUTONOMOUS CHANGES IN $\bar{C}$, $\bar{I}$, $\bar{G}$, $\bar{T}$, $\bar{NX}$, AND $\bar{f}$

Variable	Change in Variable	Shift in IS Curve	Reason
Autonomous consumption expenditure, $\bar{C}$	$\uparrow$	$\rightarrow$	$C \uparrow Y \uparrow$
Autonomous investment, $\bar{I}$	$\uparrow$	$\rightarrow$	$I \uparrow Y \uparrow$
Government spending, $\bar{G}$	$\uparrow$	$\rightarrow$	$G \uparrow Y \uparrow$
Taxes, $\bar{T}$	$\uparrow$	$\leftarrow$	$T \uparrow \Rightarrow C \downarrow Y \downarrow$
Autonomous net exports, $\bar{NX}$	$\uparrow$	$\rightarrow$	$\bar{NX} \uparrow Y \uparrow$
Financial frictions, $\bar{f}$	$\uparrow$	$\leftarrow$	$I \downarrow Y \downarrow$

Note: Only increases ($\uparrow$) in the variables are shown; the effects of decreases in the variables on planned expenditure and aggregate output would be the opposite of those indicated in the last two columns.

4. Readings

Readings

Read **Chapter 9** of the adopted textbook:

Frederic S. Mishkin (2015). *Macroeconomics: Policy & Practice*, Second Edition, Pearson Editors

Bibliography