The IS Curve and Aggregate Demand

Vivaldo Mendes
Instituto Universitário de Lisboa (ISCTE-IUL)
vivaldo.mendes@iscte-iul.pt

2025-02-24

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 a set of "Planned Expenditures"
- The ***Supply side*** : G&S are produced/supplied at a certain market price.

The Aggregate Demand for G&S

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

Personal Consumption Expenditures

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

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

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

[2]In 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.

- $\overline{C}$: 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

Investment Expenditures

- In a developed market economy, the level of investment depends upon:
  - $\overline{I}$: 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 $\left(\overline{f}\right)$:[3]

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

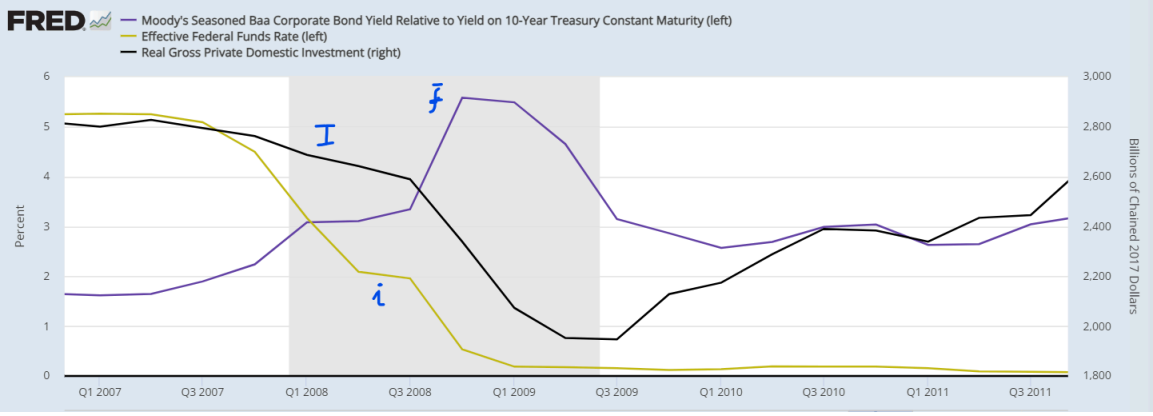
- Therefore, the demand expenditures on investment G&S will be given by:

$$I = \overline{I} - d \cdot \left(r + \overline{f}\right)$$

  - where d is a parameter: $(d > 0)$

Financial Frictions and Investment

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



[3] The textbook calls $\overline{f}$ 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:

$$G = \overline{G}$$

Government Expenditures and Income Taxes

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

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

  where t is the marginal income tax rate.

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

$$T = \overline{T}$$

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

Net-Exports Expenditures

Net-exports expenditures are made up of two components:

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

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

  where $x > 0$ is a parameter.

- Why are net exports negatively dependent on the real interest rate?
- See next slide.

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 Betwwen GDP and Demand

...

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:

...

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

...

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

...

Rearranging better the previous equation, we get:

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

...

Smplify 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:

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

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

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 $\left(\overline{A}\right)$, and negatively by the level of the real interest rate (r) :

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

...

- Notice that, to simplify things, we have defined:
  - $m = \frac{1}{1-c} > 1$
  - $\phi = b + d + x > 0$
  - $\overline{A} = \overline{C} + \overline{I} - d \cdot \overline{f} + \overline{G} + \overline{NX} - c \cdot \overline{T}$

IS Curve: Graphical Representation

For a given level of $\left(\overline{A}\right)$, an increase in (r) will cause a reduction in aggregate demand (D), which will lead to a decline in GDP (Y), and *vice-versa.*

...

- $\Delta r = +2pp$
- $\Delta \overline{A} = 0$
- $\Delta Y = -2trillion$
- If $\Delta \overline{A} \neq 0$, 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]

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

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

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

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

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

- Because $m > 1$, we have: $\uparrow \overline{G} \Rightarrow \uparrow \overline{A} \Rightarrow \uparrow Y$: the **IS** curve shifts to the right

---

Another Example of a Shift in the IS Curve

- The exogenous aggregate demand: $\overline{A} = \overline{C} + \overline{I} - d \cdot \overline{f} + \overline{G} + \overline{NX} - c \cdot \overline{T}$
- 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:

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

- From the exogenous aggregate demand expression above we get:

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

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

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

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

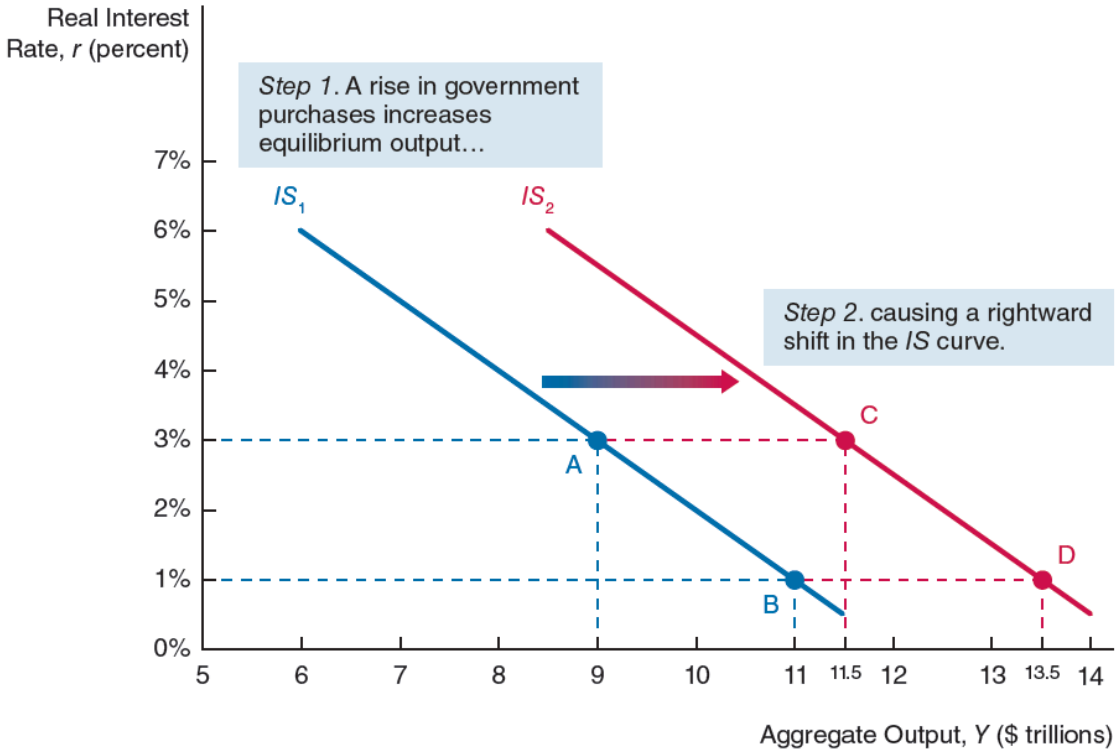
---

A Shift in the IS: a Graphical Example

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

. . .

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

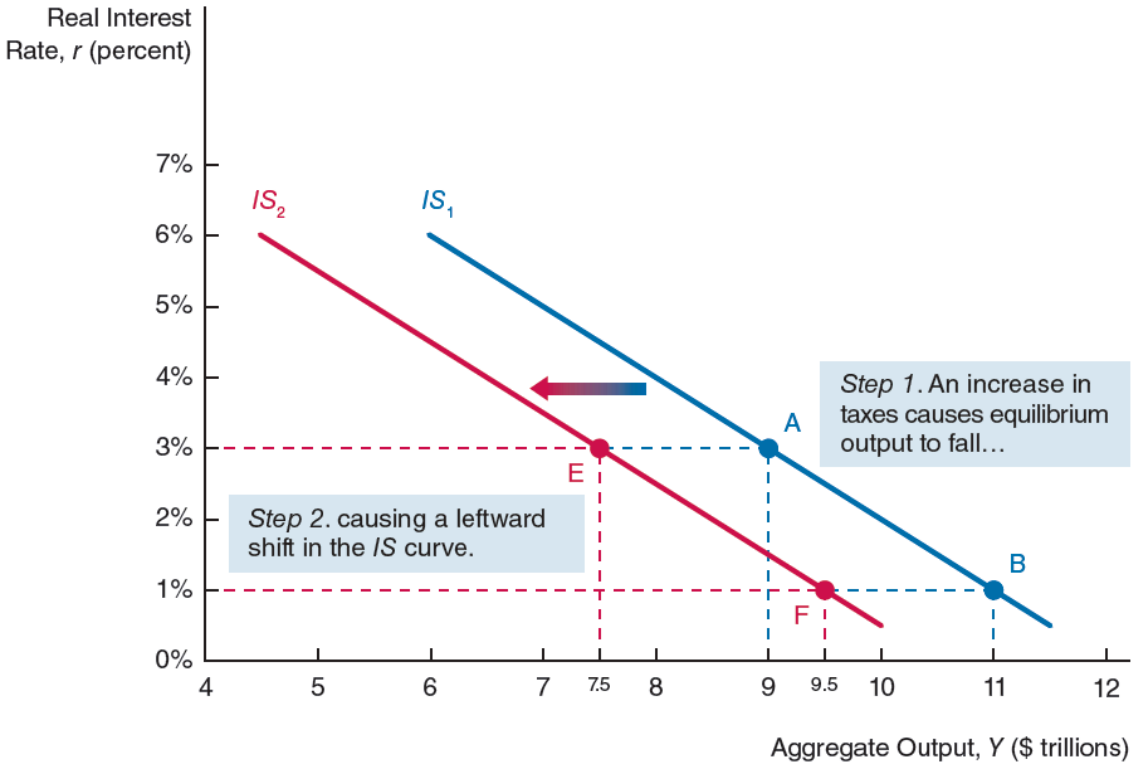


- The IS shifts to the right for any r level
- The shift is the same for $r = 3\%$, $r = 1\%$, $r = 0\%$, or ...

A Shift in the IS: another Graphical Example

If $\uparrow \overline{T} \Rightarrow \downarrow \overline{A} \Rightarrow \downarrow Y$, 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 $\overline{A}$, 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 $$ m=\frac{1}{1-c}>1 \quad \Rightarrow \quad \Delta Y= m \cdot \Delta \overline{A} \quad \Rightarrow \quad {\color{blue} {\Delta Y > \Delta \overline{A}}} $$
- Where $\overline{A} = \overline{C} + \overline{I} - d \cdot \overline{f} + \overline{G} + \overline{NX} - c \cdot \overline{T}$
- One shock upon $\overline{A}$ 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 $\overline{C}$, $\overline{I}$, $\overline{G}$, $\overline{T}$, $\overline{NX}$, AND $\overline{f}$

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

Note: Only increases (↑) 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