

The IS Curve and Aggregate Demand

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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.

The Aggregate Demand for G&S

The total amount of planned expenditures on G&S, which we will call (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

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

- \bar{C} : exogenous consumption expenditures
- Y : GDP, income, or “output”
- T : income taxes
- Y_D : disposable income

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.

- 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:
 - \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

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

...

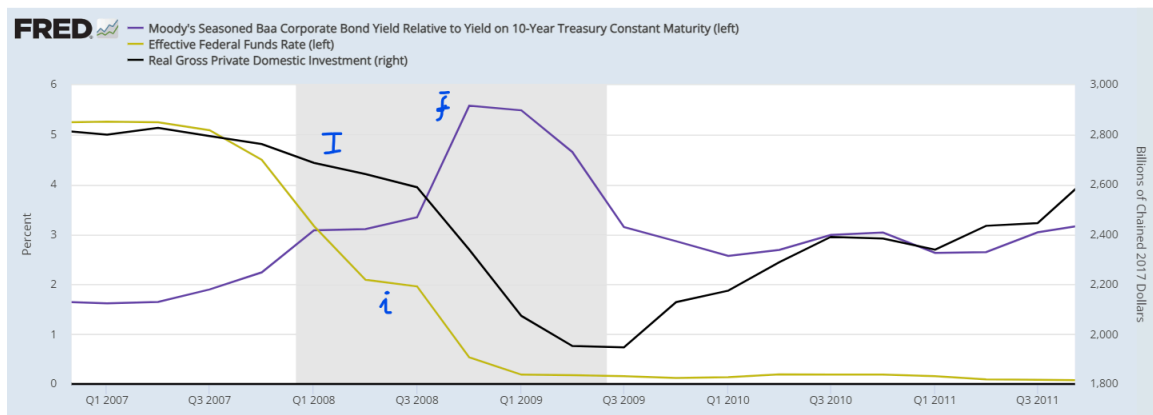
- Therefore, the demand expenditures on investment G&S will be given by:

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

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

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%.



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:

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

$$G = \bar{G}$$

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.

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.

Why r Affects Net-Exports?

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

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

- 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 appreciates $\Rightarrow \uparrow NX$

2. The IS Curve

The Relationship Between 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:

...

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

...

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

...

Rearranging better the previous equation, we get:

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

...

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

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

Derivation of the IS Curve (continuation)

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

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

...

which can be solved for Y as follows:

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

...

But we can simplify it even further:

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

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

The IS Curve: Summary

i Definition: IS curve

For a given 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 (\bar{A}), and negatively by the level of the real interest rate (r):

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

...

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

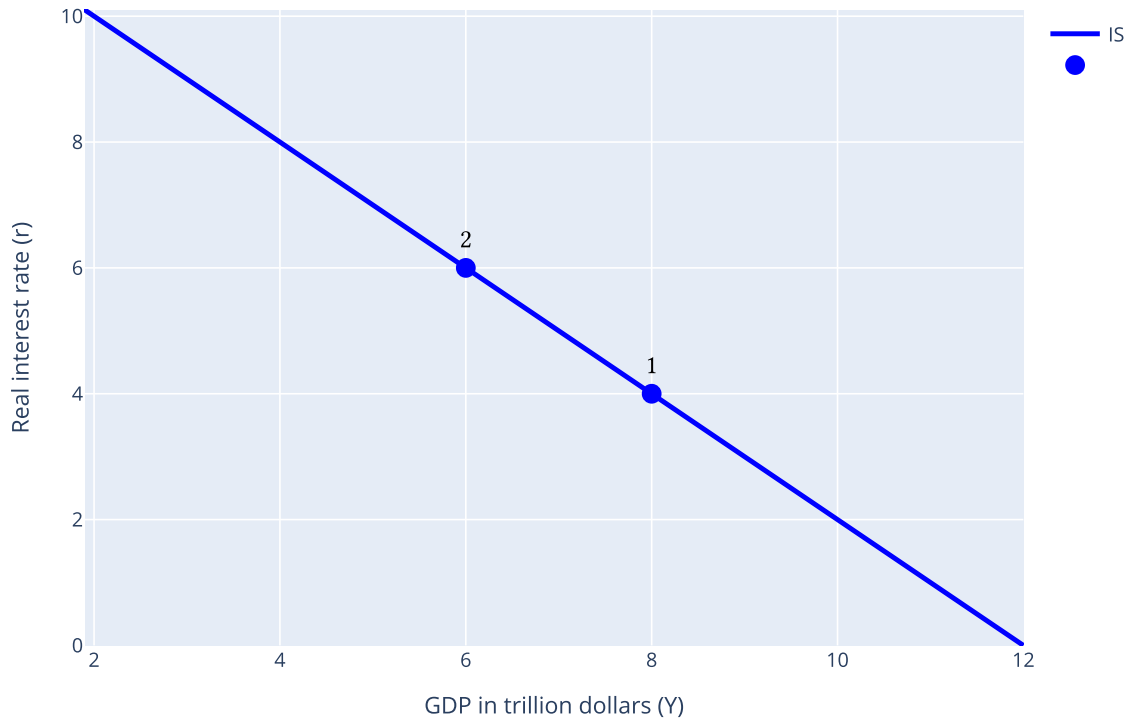
- $m = \frac{1}{1-c} > 1$
- $\phi = b + d + x > 0$
- $\bar{A} = \bar{C} + \bar{I} - d \cdot \bar{f} + \bar{G} + \bar{NX} - c \cdot \bar{T}$

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*.

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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:

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

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

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:

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

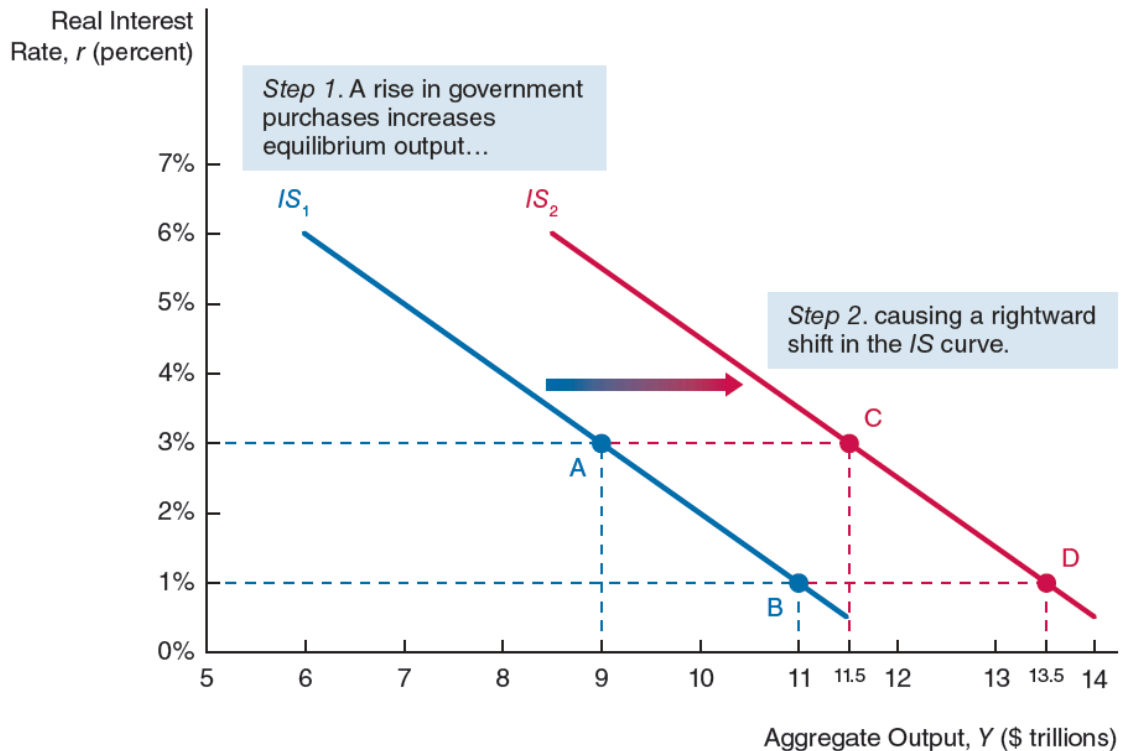
- However, from the **IS** curve we know that:

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

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

A Shift in the IS: a Graphical Example

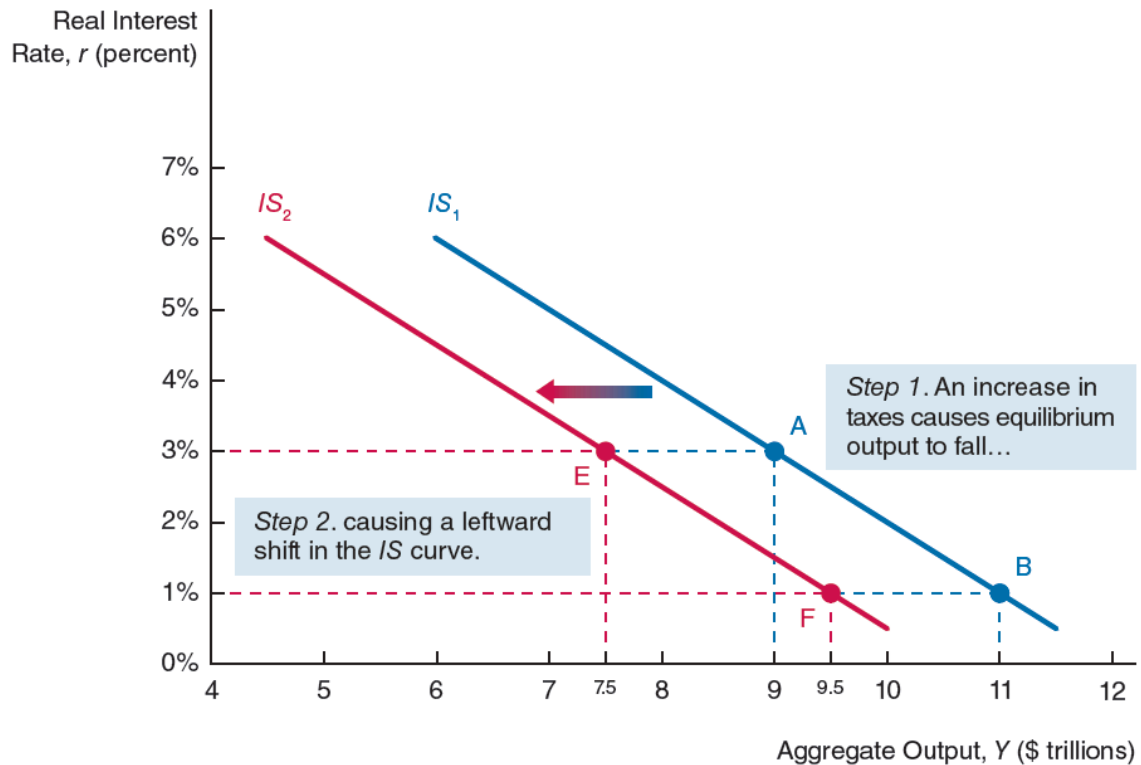
An increase in $\bar{G} \Rightarrow \uparrow \bar{A} \Rightarrow \uparrow Y$: the **IS** shifts to the right:



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

A Shift in the IS: another Graphical Example

An increase in $\bar{T} \Rightarrow \downarrow \bar{A} \Rightarrow \downarrow Y$: the IS shifts to the left:



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 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 <i>IS</i> Curve	Reason
Autonomous consumption expenditure, \bar{C}	↑	→	$C \uparrow Y \uparrow$
Autonomous investment, \bar{I}	↑	→	$I \uparrow Y \uparrow$
Government spending, \bar{G}	↑	→	$G \uparrow Y \uparrow$
Taxes, \bar{T}	↑	←	$T \uparrow \Rightarrow C \downarrow Y \downarrow$
Autonomous net exports, \bar{NX}	↑	→	$\bar{NX} \uparrow Y \uparrow$
Financial frictions, \bar{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