

Economics 100B: Macroeconomics

The IS Curve

September 25 & 28, 2020

Reading:

- Mishkin - Chapter 9

Agenda:

- 1 Introduction.
- 2 Planned Expenditures.
- 3 Goods Market Equilibrium.
- 4 The IS Curve.

The IS Curve: Introduction

Investment and Saving

The production function analysis indicates the economy's full-employment output level, i.e., how much the economy *could* produce.

- Determined by the quantity of the factor inputs and the level of total factor productivity.
- This is the basis for the economy's *aggregate supply*.

The IS Curve: Introduction

Investment and Saving

The focus now shifts to how much demand is in the economy.

- This is the basis for the economy's *aggregate demand*.
- *Aggregate demand* and *aggregate supply* are both important for explaining *short-run fluctuations* in economic activity.

The IS Curve: Introduction

Goods-market equilibrium and planned expenditures

The first building block to understanding aggregate demand is *short-run equilibrium* in the goods market.

- This is represented by the *IS curve*.
- The *IS curve* is the inverse relationship between planned spending and the real interest rate.

Start with the concept of *planned expenditures*.

Actual and planned expenditures

- *Actual expenditures*, Y , are the total amount of spending on domestically produced goods and services that households, businesses, the government, and foreigners *actually make*.
 - This is equivalent to the *total output* actually produced in the economy.
- *Planned expenditures*, Y^p , are the total amount of spending on domestically produced goods and services that households, businesses, the government, and foreigners *want to make*.
 - This is equivalent to *aggregate demand*.

Actual and planned expenditures

The economy will be in equilibrium only when actual expenditures equal planned expenditures, i.e., when:

$$Y = Y^{pl}$$

This is the basis of the IS curve.

Planned Expenditures

Planned expenditures, Y^{pl}

The components of planned expenditures, Y^{pl}

- ① Consumption expenditures, C ,
- ② Planned investment spending, I^{pl} ,
- ③ Government purchases, G , and
- ④ Net exports, NX .

The equation for planned expenditures is

$$Y^{pl} = C + I^{pl} + G + NX$$

The Consumption Function

Consumption expenditures are represented by the *consumption function*:

$$C = \overline{C} + mpc \times Y^d - \zeta_C \times r_L$$

where

$\overline{C} \equiv$ autonomous consumption expenditure,

$Y^d \equiv$ disposable income $= Y - T$,

$mpc \equiv$ the marginal propensity to consume,

$\zeta_C \equiv$ the sensitivity of C to r_L ,

$r_L \equiv$ the real lending interest rate.

Autonomous consumption

Autonomous consumption, $\bar{C}$, includes those factors that affect consumption expenditures but are not explicitly included in the model.

This would include:

- 1 Consumer confidence or sentiment (+).
- 2 Household wealth (+).
- 3 Expected future income (+).

The marginal propensity to consume

The marginal propensity to consume, mpc , is the change in consumer spending that results from a change in disposable income:

$$mpc \equiv \frac{\partial C}{\partial Y^d}$$

The mpc is assumed to be:

- 1 a constant.
- 2 $0 < mpc < 1$.

Consumption function sensitivity

The components of the *consumption function*

$$C = \overline{C} + mpc \times Y^d - \zeta_C \times r_L$$

indicate that consumer spending depends upon:

- 1 Autonomous consumption (+).
- 2 Disposable income (+).
- 3 The real interest rate (-).

The Investment Function

Planned investment expenditures are represented by the *investment function*:

$$I^{pl} = \bar{I} - \zeta_I \times r_L$$

where

$\bar{I} \equiv$ autonomous planned investment,

$\zeta_I \equiv$ the sensitivity of I^{pl} to r_L ,

$r_L \equiv$ the real interest rate.

The Investment Function

Autonomous investment, $\bar{I}$, includes those factors that affect investment expenditures but are not explicitly in the model.

This would include:

- ① Business confidence or sentiment (+).
- ② Expected future profits and/or cash flow (+).
- ③ Changes in technology (+).

The Investment Function

The components of the *investment function*

$$I^p = \bar{I} - \zeta_I \times r_L$$

indicate that planned investment spending depends upon:

- 1 Autonomous investment (+).
- 2 The real interest rate (-).

The structure of the Net Export function

Net exports has 2 components:

- ① *Exports*, which is spending by foreigners on domestically-made goods and services.
- ② *Imports*, which is spending by domestic residents on foreign-made goods and services.

The structure of the Net Export function

Net exports are represented by the *net export function*:

$$NX = \overline{NX} - \zeta_{NX} \times r_L$$

where

$\overline{NX} \equiv$ autonomous net exports,

$\zeta_{NX} \equiv$ the sensitivity of NX to r_L ,

$r_L \equiv$ the real interest rate.

The structure of the Net Export function

Autonomous net exports, $\overline{NX}$, includes those factors that affect investment expenditures but are not explicitly in the model.

This would include:

- 1 Domestic preferences for foreign goods (-).
- 2 Foreign preferences for domestic goods (+).
- 3 Foreign trade barriers (-).

The structure of the Net Export function

The components of the *net export function*

$$NX = \overline{NX} - \zeta_{NX} \times r_L$$

indicate that planned investment spending depends upon:

- 1 Autonomous net exports (+).
- 2 The real interest rate (-).

Structure and functions

- *Government purchases* has 2 components:
 - 1 Federal government purchases.
 - 2 State and local government purchases.
- Government purchases are represented by the *government purchases function*, $G = \bar{G}$, where $\bar{G}$ are autonomous government purchases.
- Taxes are represented by the *tax function*, $T = \bar{T}$, where $\bar{T}$ is autonomous taxes.
- Both $\bar{G}$ and $T = \bar{T}$ are determined within the political system.

Goods Market Equilibrium

Our work so far ...

- Goods market equilibrium exists only when

$$Y = Y^{pl}$$

- This happens only that planned spending *exactly* equals the amount that is actually produced.
- This further implies that

$$Y = C + I^{pl} + G + NX$$

or

$$Y = \underbrace{\bar{C} + mpc \times Y^d - \zeta_C \times r_L}_{\text{consumption func.}} + \underbrace{\bar{I} - \zeta_I \times r_L}_{\text{investment func.}} \\ + \bar{G} + \underbrace{\bar{NX} - \zeta_{NX} \times r_L}_{\text{net-exp. func.}}$$

Goods Market Equilibrium

Our work so far ...

From the prior slide we have that

$$Y = \bar{C} + mpc \times Y^d - \zeta_C \times r_L + \bar{I} - \zeta_I \times r_L + \bar{G} + \bar{NX} - \zeta_{NX} \times r_L .$$

Collecting terms in r we obtain

$$Y = \bar{C} + mpc \times Y^d + \bar{I} + \bar{G} + \bar{NX} - (\zeta_C + \zeta_I + \zeta_{NX}) r_L .$$

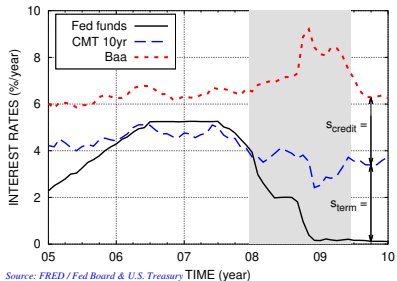
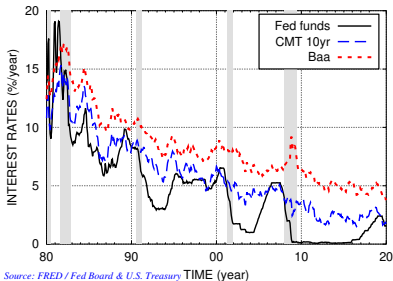
Recalling that $Y^d = Y - T = Y - \bar{T}$, substituting and solving for Y , we obtain an *equation for the IS curve*:

$$Y = \frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T})}{(1 - mpc)} - \frac{(\zeta_C + \zeta_I + \zeta_{NX})}{(1 - mpc)} r_L$$

The IS Curve

The rate function

The *rate function*, the policy rate r , and the lending rate r_L .



$$r_L = r + s_{\text{term}} + s_{\text{credit}}$$

The terms r , s_{term} , and s_{credit} are controlled by the central bank, bond market, and credit market, respectively.

From the Policy Rate to the Lending Rate.

The *policy rate* is set by the central bank.

The *government bond rate* is set by the bond market.

- The difference between the government bond rate (e.g., 10-year CMT rate) and the policy rate (e.g., Fed Funds rate) is *the term spread*.

The *lending rate* is set by the commercial banking system.

- The difference between the 10-year *lending rate* and the government bond rate (e.g., 10-year CMT rate) is the 10-year *credit spread*.
- The credit spread depends on the:
 - Riskiness of the loan.
 - Risk tolerance of the bank.

The IS Curve

The rate function

With the rate function

$$r_L = r + s_{\text{term}} + s_{\text{credit}} ,$$

the IS curve becomes

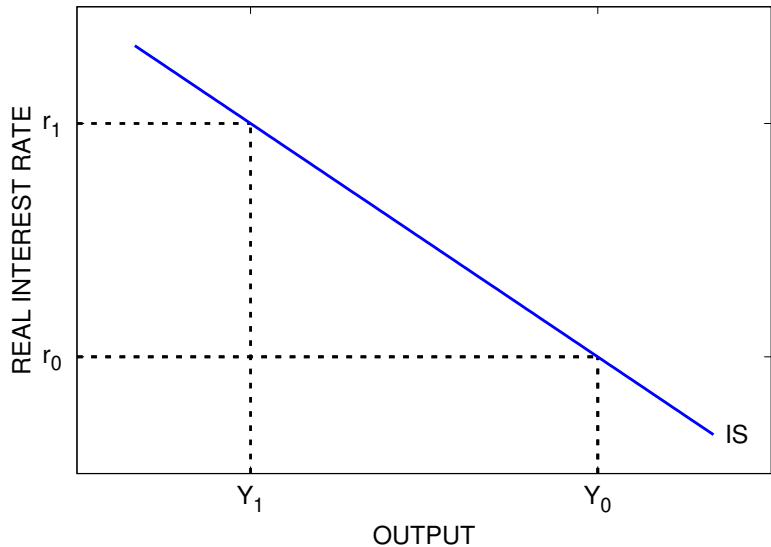
$$Y = \frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T} - \bar{S})}{(1 - mpc)} - \frac{(\zeta_C + \zeta_I + \zeta_{NX})}{(1 - mpc)} r$$

where

$$\bar{S} = (\zeta_C + \zeta_I + \zeta_{NX}) (s_{\text{term}} + s_{\text{credit}})$$

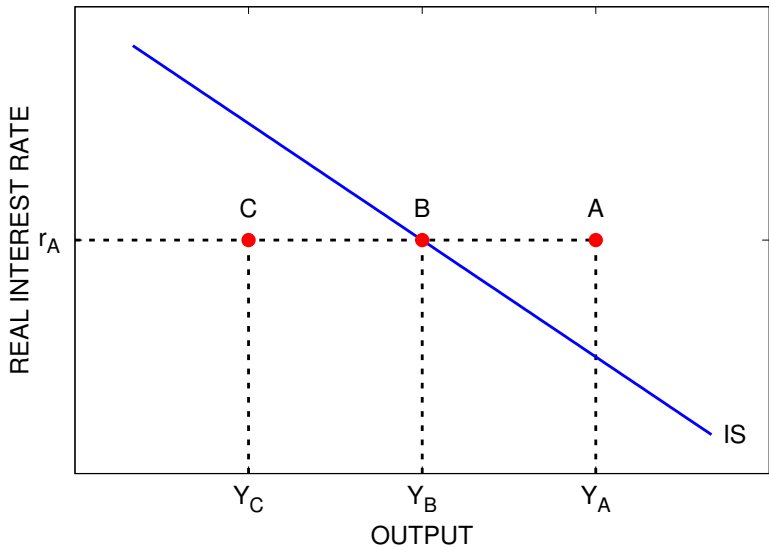
The IS Curve:

Output and the real interest rate in equilibrium.



The IS Curve:

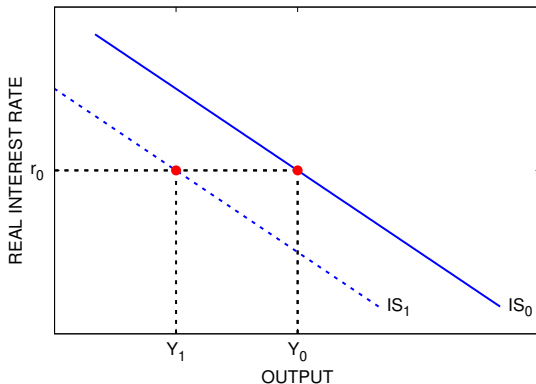
Output and the real interest rate with disequilibrium.



The IS Curve: *What happens if $\bar{G}$ decreases?*

The Paradox of Thrift.

$$Y = \frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T} - \bar{S})}{(1 - mpc)} - \frac{(\zeta_C + \zeta_I + \zeta_{NX})}{(1 - mpc)} r$$



A decrease in $\bar{G}$ will move the IS curve to the left.

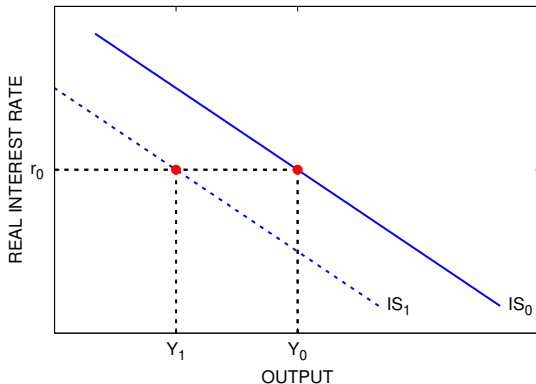
The IS Curve: A Deeper Dive

$$Y = \frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T} - \bar{S})}{(1 - mpc)} - \frac{(\zeta_C + \zeta_I + \zeta_{NX})}{(1 - mpc)} r$$

- 1 The response to $\bar{C} + \bar{I} + \bar{G} + \bar{NX}$, is “amplified” by the *expenditure multiplier*: $\frac{1}{(1-mpc)}$.
- 2 The response to $\bar{T}$ is:
 - of opposite sign to all other autonomous responses.
 - “amplified” *to a lesser extent* by the *tax multiplier*: $-\frac{mpc}{(1-mpc)}$.
- 3 A *negative* response to increases in the real interest rate r .

The IS Curve: *What happens if $\bar{T}$ increases?*

$$Y = \frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T} - \bar{S})}{(1 - mpc)} - \frac{(\zeta_C + \zeta_I + \zeta_{NX})}{(1 - mpc)} r$$



An increase in $\bar{T}$,
like a decrease in
 $\bar{G}$, will move the IS
curve to the left.

The IS Curve: *A Simplified Expression*

Our expression for the *IS curve*

$$Y = \frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T} - \bar{S})}{(1 - mpc)} - \frac{(\zeta_C + \zeta_I + \zeta_{NX})}{(1 - mpc)} r$$

can be simplified by making the identifications

$$Y = \underbrace{\frac{(\bar{C} + \bar{I} + \bar{G} + \bar{NX} - mpc \times \bar{T} - \bar{S})}{(1 - mpc)}}_{\bar{Y}} - \underbrace{\frac{(\zeta_C + \zeta_I + \zeta_{NX})}{(1 - mpc)}}_{\zeta_Y} r$$

from which we obtain a *simplified expression for the IS curve*:

$$Y = \bar{Y} - \zeta_Y r$$

The IS Curve: *The equilibrium real rate of interest.*

Given our simplified expression for the IS curve

$$Y = \bar{Y} - \zeta_Y r ,$$

it follows that there is a rate r^* that causes the IS curve to give potential output Y^P :

$$Y^P = \bar{Y} - \zeta_Y r^* ,$$

This rate, r^* , is *the equilibrium real rate of interest* and is referred to as “r-star”.

The IS Curve: *The output gap*.

From our expressions for the IS curve

$$Y = \bar{Y} - \zeta_Y r \quad \text{and} \quad Y^P = \bar{Y} - \zeta_Y r^*,$$

and the expression for the output gap¹

$$\tilde{y} = \frac{Y - Y^P}{Y^P} = \frac{Y}{Y^P} - 1 \approx \ln(Y) - \ln(Y^P) \equiv y - y^P,$$

the gap form of the IS curve is

$$\tilde{y} = -\frac{\zeta_Y}{Y^P} (r - r^*) \quad \text{or} \quad \boxed{\tilde{y} = -\zeta_y \tilde{r}}$$

where $\zeta_y = \zeta_Y / Y^P$ and $\tilde{r}$ is the real rate gap.

¹The approximation follows from the series expansion $\ln(x) = x - 1 + \dots$