



Investment-Savings equilibrium

ECON 302, Intermediate Macroeconomics

Nicolas Franz-Pattillo

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University of British Columbia

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Introduction

- In previous lectures we described the consumption/savings behavior of consumers, and investment decisions of firms.
- There is a link between both: goods market clearing.
 - The amount of goods produced (Y) has to be equal to the aggregate expenditure ($AE = C + I + G$).
 - Aggregate investment (I) has to be equal to aggregate savings (S).
 - Both points above are equivalent (national accounts: income, product and expenditure).

- At the end of this lecture you should understand how interest rate and output translates in movements along the IS curve.
- How present and future economic conditions shift the IS curve.
- How to construct the IS curve starting from the loanable funds market.
- How to construct the IS curve using the Keynesian cross — goods market clearing.
- You should understand what the government *multiplier* is and how it works.

A thorough exposition of the material of this lecture can be found in

- [Abel et al. \(2018, Chapter 4\)](#)
- [Mankiw \(2009, Chapter 10.1\)](#)

Investment-savings equilibrium

- Two equivalent ways to describe market clearing in the goods market (closed economy):

- Supply = Demand:

$$Y = C + I + G$$

- Savings = Investment

$$S \equiv Y - C - G = I$$

- What is the relevant price for investment and savings?
- In our theory r is the relative price of using resources in the present versus the future.

How to determine aggregate savings? : the sum of private and government savings

- Government savings ($S_G = T - G$): Exogenous.
- Household savings:
 - Euler equation: $u'(c_t) = \beta(1 + r)u'(c_{t+1})$
 - If current disposable income is temporarily and unexpectedly higher, the household will save part of it: Marginal Propensity to Consume $0 < \frac{\partial c_t}{\partial y_t} < 1$.
 - When r is higher, current consumption is lower (substitution effect dominates income effect), therefore higher savings.

How to determine aggregate investment? and how it change with r ?

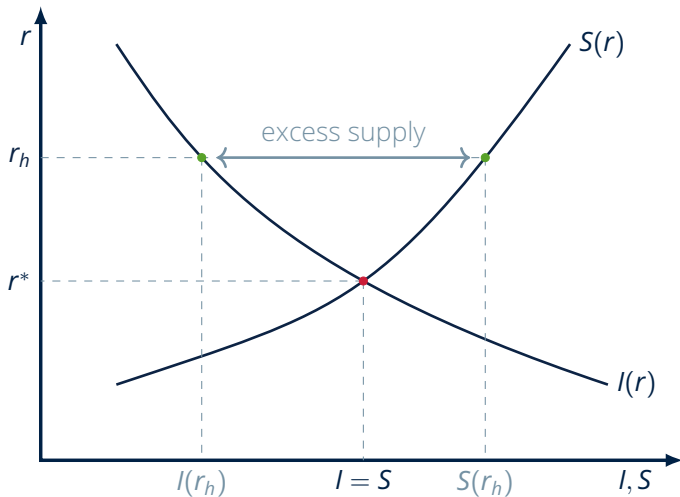
- Investment I , with a proportional tax to firm revenues and relative price equal to 1:

$$A_{t+1}F_K(K_{t+1}, N_{t+1}) = \frac{r + \delta}{1 - \tau}$$

- when r is higher, investment is lower.

- As in every competitive market, the equilibrium is achieved by adjustment in the price.
- If the price is too high, the households want to save more than what the firms would like to invest (excess of supply)
- If the price is too low, the households want to save less than what the firms would like to invest (excess of demand)

Figure 1: Investment-Savings equilibrium



- An increase in the real interest rate increases the quantity saved (movement along the curve).
- The saving curve shifts right due to:
 1. Temporary rise in the household income.
 2. Fall in expected future income.
 3. Fall in government purchases.
 4. A raise in income taxes. (why? this would decrease household income, right?)
- Note how the Ricardian equivalence might change the previous statements

- An increase in the real interest rate decreases the level of investment (movement along the curve).
- The investment curve shifts right due to:
 1. Fall in the effective tax rate
 2. Rise in expected future marginal productivity of capital
- The investment curve shifts with changes in the depreciation rate. The direction of the shift depends on the magnitude of the depreciation change and the initial state of the economy (initial level of capital).

- Assume an increase in G
- Keeping everything else constant, the demand for loanable funds increases.
- Interest rates increases and the level of investment decreases

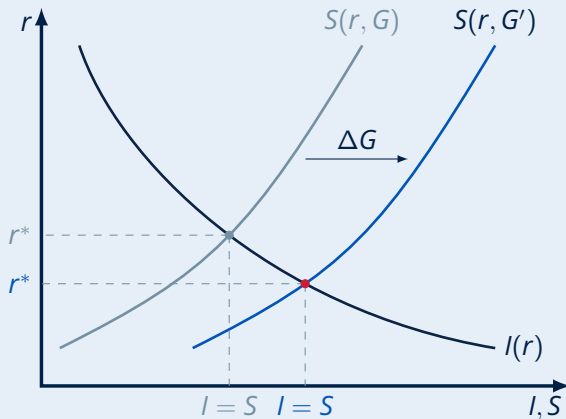
Government expenditure "crowding out" of investment

A reduction of private investment caused by an increase in government spending. This happens because the government is demanding more loanable funds and thus causing increased interest rates and therefore reducing investment spending.

Fall in government expenditures

- Assume G falls to $G' < G$ and T remains the same.
- The public sector savings increase.
- If the Ricardian equivalence does not hold, the saving decisions of the private sector will no change.
- Investment (demand for loanable funds) does not change.
- The supply of loanable funds increase and, therefore, the interest rate decrease.

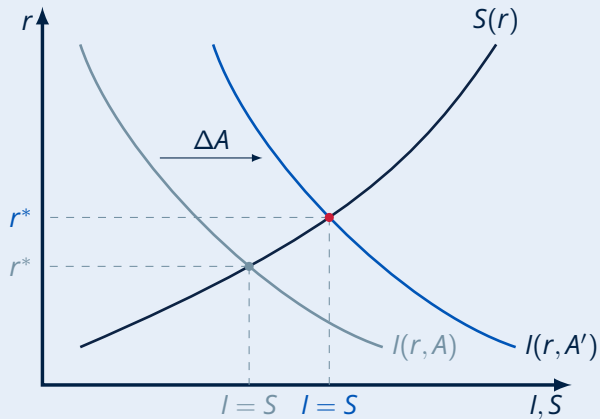
Fall in government expenditures (cont.)

Figure 2: G decreases

Increase in future TFP

- Assume the TFP will jump up in the future. The private sector knows this today.
- The public and private sector savings (supply of loanable funds) don't change.
- Firms would like to increase their stock of capital to take advantage of higher productivity in the future.
- To increase the stock of capital in next period, the firm must increase investment today.
- The demand for loanable funds increase and, therefore, the real interest rate rises.

Increase in future TFP (cont.)

Figure 3: *TFP* increase

Goods market clearing and the Keynesian cross

- From our consumption model we know that the propensity to consume income shocks $\in (0, 1)$
- Aggregate expenditures is the sum of consumption, investment and government expenditures.
- The goods market clearing implies that aggregate expenditure is equal to output.
- We also know that output equals aggregate income given the circular flow of income.
- This implies a cycle where aggregate expenditure depends on income and income on expenditure.

- To understand better the previous slide, let's write aggregate expenditures

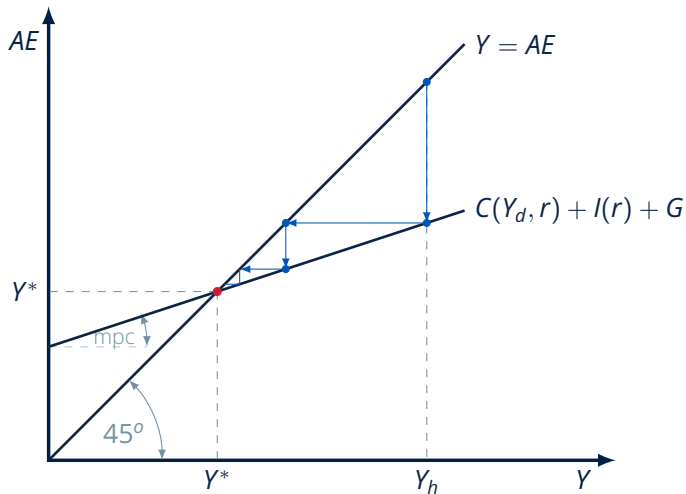
$$AE = C(Y_d, r) + I(r) + G$$

- Here $Y_d = Y - T$, where T are lump sum taxes.
- Goods market clearing implies $AE = Y$
- This is an equation that has Y in both sides (LHS: output, and RHS: income).

$$Y = C(Y - T, r) + I(r) + G$$

- The important fact is that if output is higher than aggregate expenditures, firms will produce less in order to clear the market.
- This will imply a reduction of income for the household, which in turn will reduce its consumption.
- This cycle ends because the marginal propensity to consume is strictly between zero and one.

Figure 4: Keynesian cross



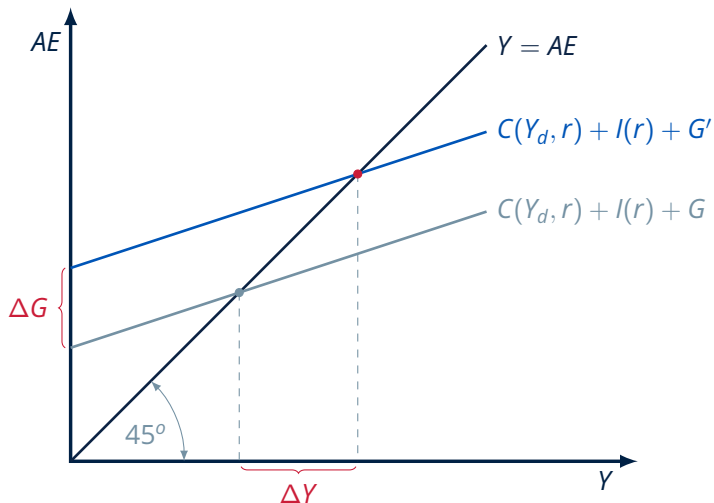
The fiscal multipliers

- Fiscal policy in our model will typically consist in changes of government expenditure and taxes.
- Assume government expenditure increases inadvertently.
- This increase in aggregate expenditures should translate in higher output.
- Higher output implies higher income.
- Unanticipated and transitory changes in income translate in higher consumption, which implies another increase in aggregate expenditures.

Government expenditure multiplier

Is the ratio of a change in national income to the change in government spending that causes it. The fiscal multiplier is bigger the closer the marginal propensity to consume is to one.

Figure 5: Expenditure multiplier



The fiscal expenditure multiplier in a linear world

- Assume a linear version of our aggregate expenditures equals to output:

$$Y = c_0 + c_1(Y - T) - c_2r + i_0 - i_1r + G$$

- Assume an exogenous change in government expenditure ΔG
- First, aggregate expenditures increase by ΔG , which implies that output and income will increase by ΔG
- If income increased by ΔG , then consumption will increase by $c_1 \Delta G$, and therefore aggregate expenditure, output and income will increase by $c_1 \Delta G$.
- If income increased by $c_1 \Delta G$, then consumption, aggregate expenditure, output and income will increase by $c_1^2 \Delta G$...

The fiscal expenditure multiplier in a linear world (cont.)

- The total change in output will be

$$\Delta Y = \Delta G \sum_{i=0}^{\infty} c_1^i = \frac{1}{1 - c_1} \Delta G$$

- This is analogous to solve

$$\begin{aligned} Y &= c_0 + c_1(Y - T) - c_2r + i_0 - i_1r + G \\ \Leftrightarrow Y &= \frac{1}{(1 - c_1)}(c_0 - c_1T - c_2r + i_0 - i_1r + G) \\ \Rightarrow \Delta Y &= \frac{1}{1 - c_1} \Delta G \end{aligned}$$

- In this case the fiscal multiplier is $\frac{\Delta Y}{\Delta G} = \frac{1}{1 - c_1}$

The IS curve

- So far we have defined the equilibrium in the loanable funds market and stated how it is analogous to the goods market clearing and the Keynesian cross.
- These are only stepping-stones on our path to explain the economy's aggregate demand curve.
- The next step is to see how changes in Investment and Savings relates changes in real interest rates with output.

The IS curve

The IS curve is the combination of output and real interest rates where the goods and loanable funds markets are in equilibrium. The IS curve is negatively sloped.

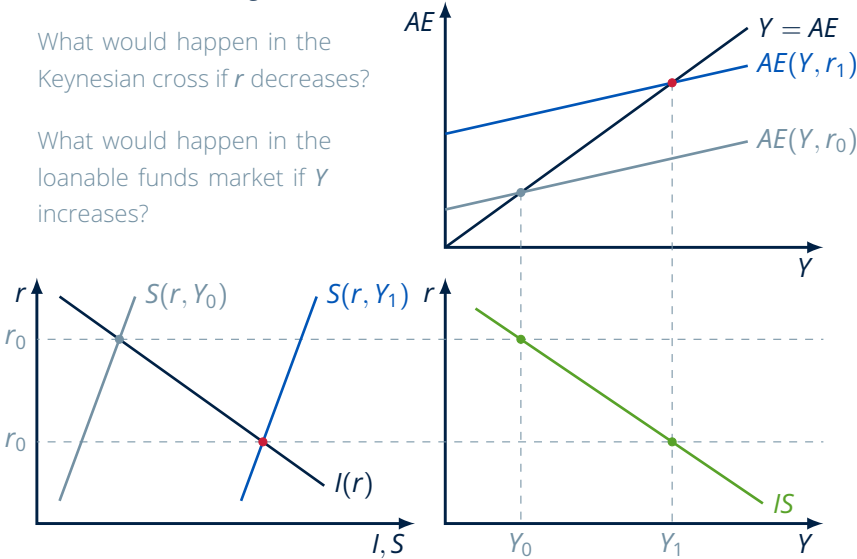
- To construct the IS curve you can start either from the Investment-Savings equilibrium, or from the Keynesian cross.
- Starting from y_0, r_0 , what would happen in the loanable funds market if we increase income from y_0 to $y_1 > y_0$? Savings increase and investment remains unchanged: the real interest rate falls
- Starting from y_0, r_0 , what would happen in the Keynesian cross if we decrease the interest rate from r_0 to $r_1 < r_0$? Investment and aggregate expenditures will increase, increasing the level of output.
- Both lead to the conclusion that the IS is negatively sloped

The IS curve

Figure 6: Derivation of the IS curve

What would happen in the Keynesian cross if r decreases?

What would happen in the loanable funds market if Y increases?



The IS in a linear world

- Assume a linear version of our aggregate expenditures equals to output:

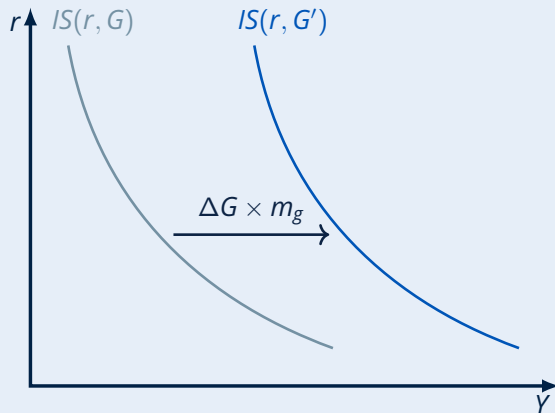
$$Y = c_0 + c_1(Y - T) - c_2r + i_0 - i_1r + G$$

- Solve for output as a function of the interest rate:

$$IS : Y = \frac{c_0 + i_0 + G - c_1T}{1 - c_1} - \frac{(c_2 + i_1)}{1 - c_1}r$$

- The IS curve is negatively sloped: higher interest rates are associated with lower output so the goods/loanable funds market clears.
- All other factors that move savings or investment (different from current income or interest rate) will translate in shifts of the IS curve.
- The IS shifts to the right when:
 - Future marginal productivity of capital increases.
 - Increase in expected future income.
 - Increase in government expenditures.
 - Fall in taxes to income or investment.
- Be aware of the Ricardian equivalence... all the time!

The government expenditure multiplier and the IS

Figure 7: Effects of increase in G in the IS curve

Summary

- Clearing of the goods market is analogous to the equilibrium in the loanable funds market.
- Households supply loanable funds (savings). They do it taking into account, among others, their income and interest rate, the price in this market.
- Firms demand loanable funds to invest in the future level of capital.
- The equilibrium in this market is reached by adjustment in the interest rate.
- Note that this equilibrium requires the level of output (income) to be determined.
- What we did in this class is to analyze what would happen at any level of output.

- The Keynesian cross reflects the idea that when income/output is different than expected, the household consumes just a fraction of this change.
- To achieve the goods market clearing, firms must adjust their production level.
- Both imply that changes in aggregate expenditures will translate in more exaggerated effects in output and income.
- For example, pessimism about the future would translate in a worst outcome today (is this bad?)
- Note that this equilibrium requires the real interest rate to be determined.
- What we did in this class is to analyze what would happen at any real interest rate.

- With the Keynesian cross or the loanable funds market we constructed the **IS curve**: the collection of points in the output and real interest rate space where the goods market clears.
- Note that the IS curve is not enough to determine the output level and real interest rate.
- For this we need to study other markets in the economy, and analyze their relevance.
- To come: Money and labor markets.

References

Abel, A., Bernanke, B., Kneebone, R., and Croushore, D. (2018). *Macroeconomics, Eighth Canadian Edition*. Pearson Education Canada, 8th edition.

Mankiw, N. G. (2009). *Macroeconomics*. Worth Publishers, 7th edition.