Business Cycles

Part 2: Microeconomic Foundations
Lecture 3: Equilibrium in an endownment economy, fiscal policy

Prof. Dr. Maik Wolters
University of Wuerzburg

Outline

Part 1: Introduction

Part 2: Microeconomic Foundations

- Lecture 2: Consumption-Savings Problem
- Lecture 3: Equilibrium in an endownment economy, fiscal policy
- Lecture 4: Production and labor supply

Part 3: The Real Business Cycle Model

Part 4: The New Keynesian Model

Part 5: Financial Crises

Learning Objective of Todays Lecture

1. So far, we have taken the real interest rate as given. Need to derive an equilibrium to determine the real interest rate.
2. How do we go from decision rules to equilibrium? What determines prices?
3. Understanding the concept of general equilibrium.
4. Completing the model.
5. Including fiscal policy in the analysis and see how this affects in equilibrium the real interest rate.

Literature

Required reading:

- Textbook chapter 11 and 13

Optional reading:

- -

General Equilibrium

- We previously studied the optimal decision problem of a household. The outcome of this was an optimal decision rule (the consumption function)
- The decision rule takes prices as given. In two period consumption model, the only price is r_t.
- Three modes of economic analysis:
    1. Decision theory: derivation of optimal decision rules, taking prices as given
    2. Partial equilibrium: determine the price in one market, taking the prices in all other markets as given
    3. General equilibrium: simultaneously determine all prices in all markets
- Macroeconomics is focused on general equilibrium

Competitive Equilibrium

- In economics, an equilibrium is a situation in which prices adjust so that (i) all parties are content supplying/demanding a given quantity of goods or services at those prices and (ii) markets clear.
- If parties were not content, they would have an incentive to behave differently. Things wouldn't be "balanced".
- A competitive equilibrium is a set of prices and allocations where (i) all agents are behaving according to their optimal decision rules, taking prices as given, and (ii) all markets simultaneously clear.

Competitive Equilibrium in an Endowment Economy

- An endowment economy is a fancy term for an economy in which there is no endogenous production – the amount of income/output is exogenously given.
- With fixed quantities, it becomes particularly clear how price adjustment results in equilibrium.
- Basically, what we do is take the two-period consumption model:
  - Optimal decision rule: consumption function
  - Market: market for saving, S_t
  - Price: r_t (the real interest rate)
  - Market-clearing: in aggregate, saving is zero (equivalently $Y_t = C_t$)
  - Allocations: C_t and C_{t+1}
- This is a particularly simple environment, but the basic idea carries over more generally.

Setup

- There are L total agents who have identical preferences, but potentially different levels of income. Index households by j.
- Each household can borrow/save at the same real interest rate, r_t.
- Each household solves the following problem:

$$\max_{C_t(j),C_{t+1}(j)} U(j) = u\big(C_t(j)\big) + \beta u(C_{t+1}(j))$$

s.t.

$$C_t(j) + \frac{C_{t+1}(j)}{1+r_t} = Y_t(j) + \frac{Y_{t+1}(j)}{1+r_t}$$

- Optimal decision rule is the standard consumption function:

$$C_t(j) = C^d(Y_t(j), Y_{t+1}(j), r_t)$$

Market-Clearing

- In this context, what does it mean for markets to clear?
- Aggregate saving must be equal to zero:

$$S_t = \sum_{j=1}^{L} S_t(j) = 0$$

- Why? One agent's saving must be another's borrowings and vice-versa
- But this implies:

$$\sum_{j=1}^{L} \left(Y_t(j) - C_t(j)\right) = 0 \;\Rightarrow\; \sum_{j=1}^{L} Y_t(j) = \sum_{j=1}^{L} C_t(j)$$

- In other words, aggregate income must equal aggregate consumption:

$$Y_t = C_t$$

Everyone the Same

- Suppose that all agents in the economy have identical endowment levels in both period t and $t + 1$
- Convenient to just normalize total number of agents to $L = 1$: representative agent. Can drop j references
- Optimal decision rule:

$$C_t = C^d(Y_t, Y_{t+1}, r_t)$$

- Market-clearing condition:

$$Y_t = C_t$$

- Y_t and Y_{t+1} are exogenous.
- Overall, two equations (optimal decision rule + market clearing condition) and two unknowns – C_t (the allocation) and r_t (the price).
- Can be solved to determine both r_t and C_t.

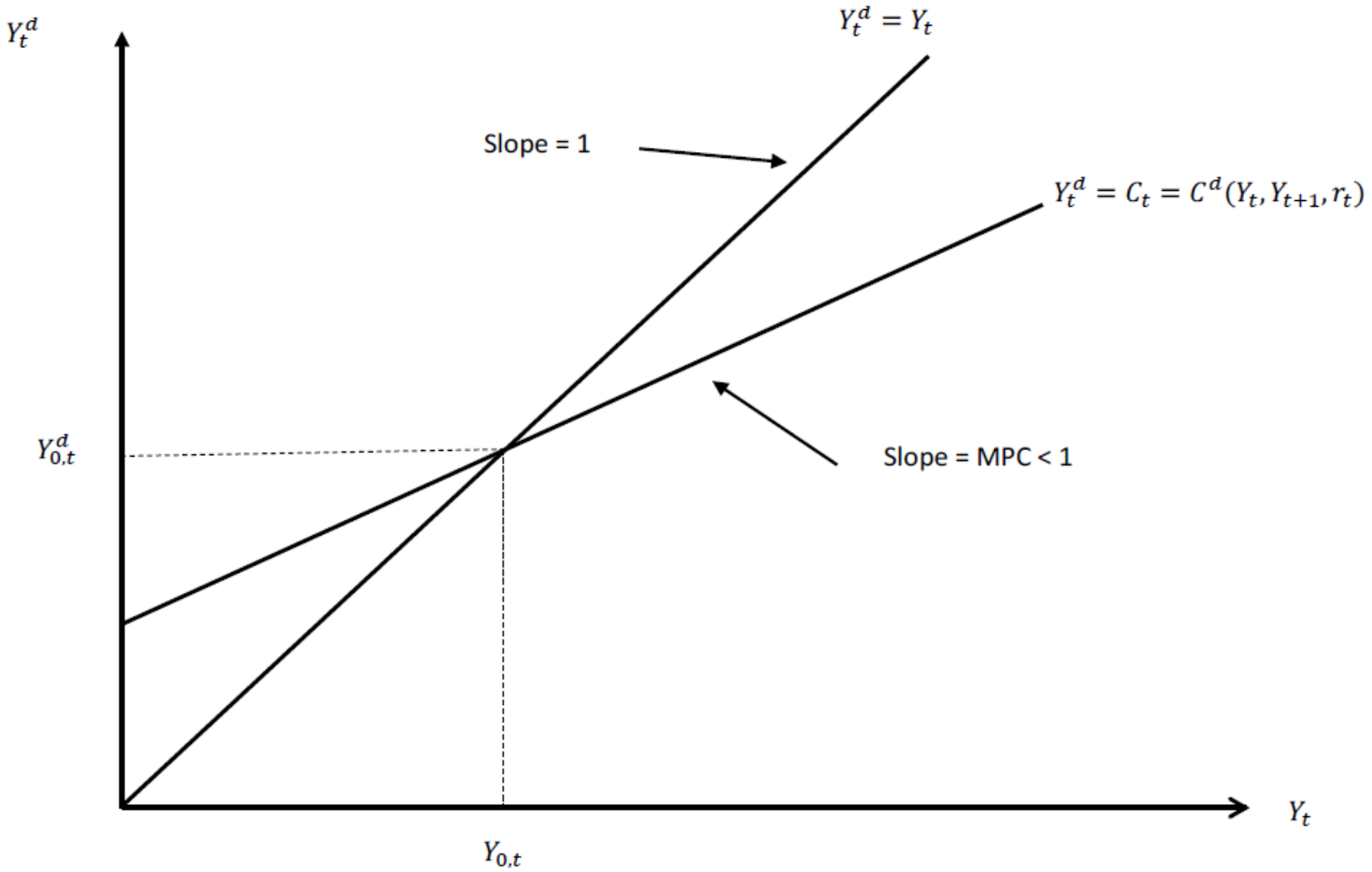
Graphical Analysis

- Define total desired expenditure as equal to consumption:

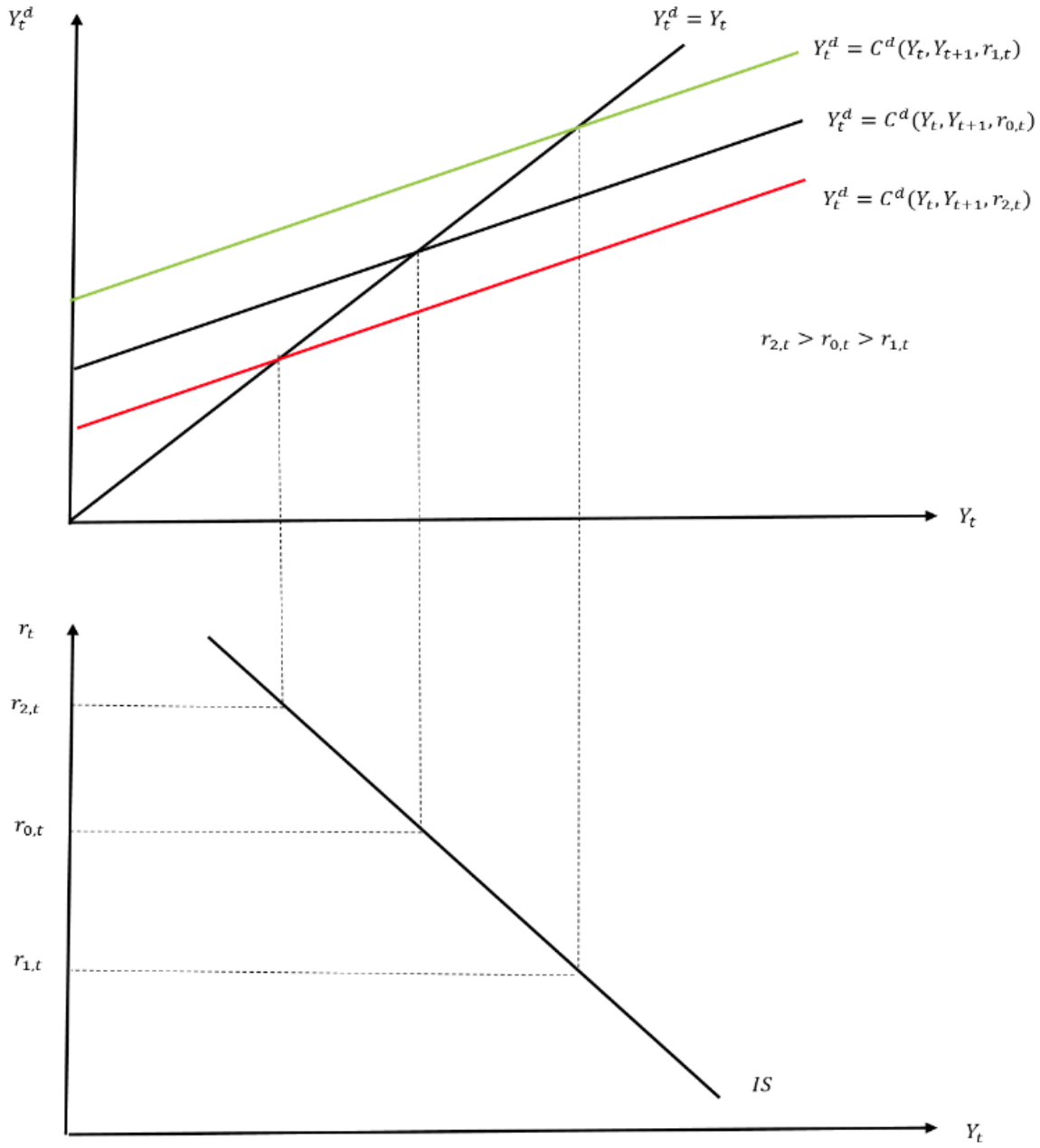
$$Y_t^d = C^d(Y_t, Y_{t+1}, r_t)$$

- Total desired expenditure is a function of income, Y_t.
- But income must equal expenditure in any equilibrium.
- Graph desired expenditure against income. Assume total desired expenditure with zero current income is positive – i.e. $C^d(0, Y_{t+1}, r_t) > 0$. This is sometimes called "autonomous expenditure".
- Since $MPC < 1$, there will exist one point where income equals expenditure.
- IS curve: the set of (r_t, Y_t) pairs where income equals expenditure assuming optimal behavior by household. Summarizes "demand" side of the economy. Negative relationship between r_t and Y_t.

Expenditure and Income

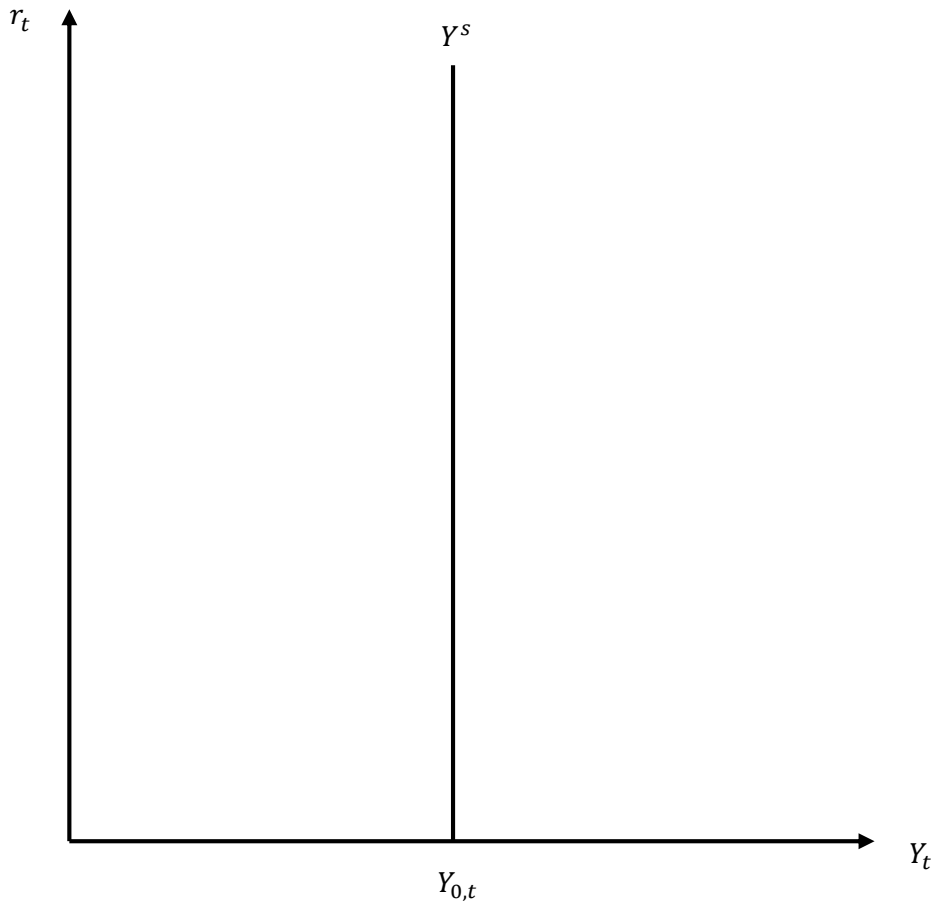


Derivation of the IS Curve



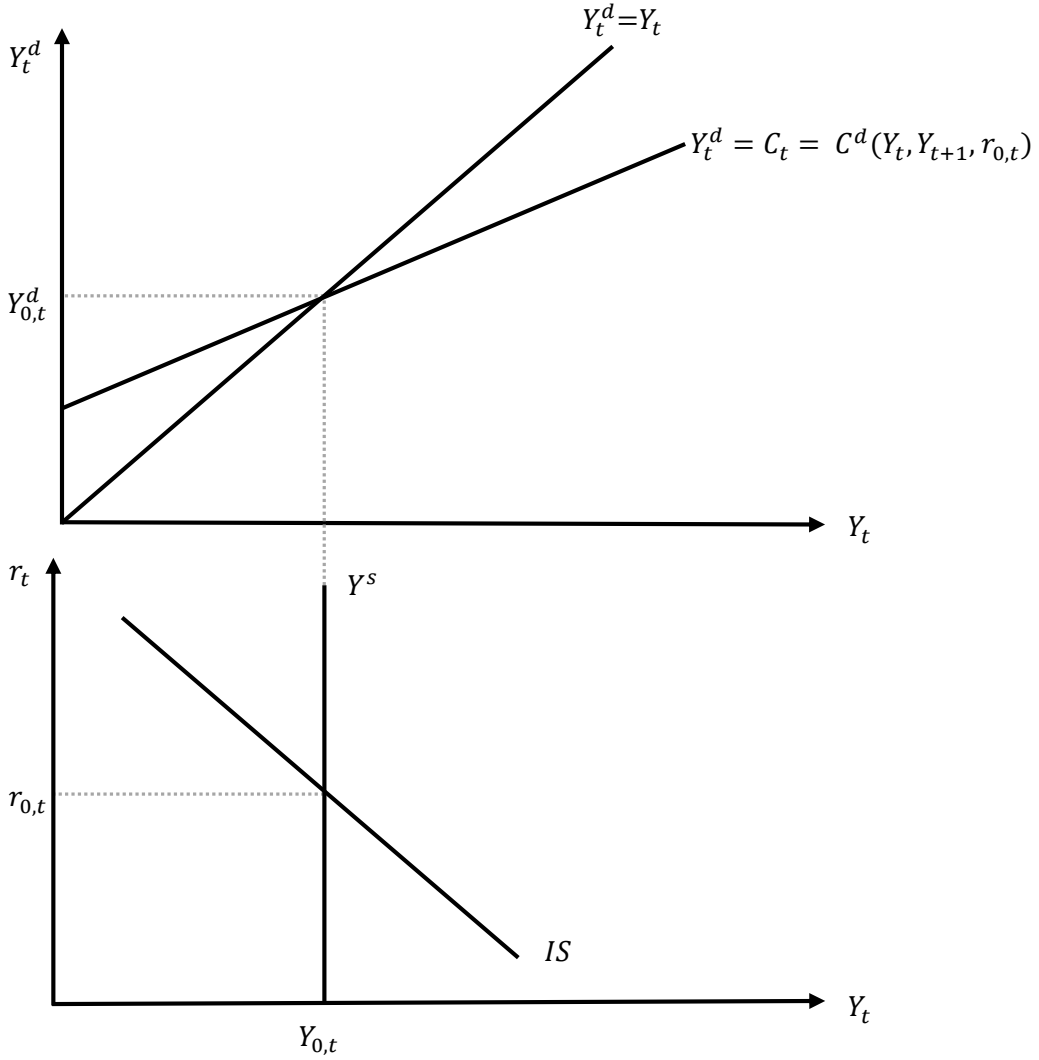
The Y^s Curve

- The Y^s curve summarizes the production side of the economy
- In an endowment economy, there is no production! So, the Y^s curve is just a vertical line at the exogenously given level of Y_t

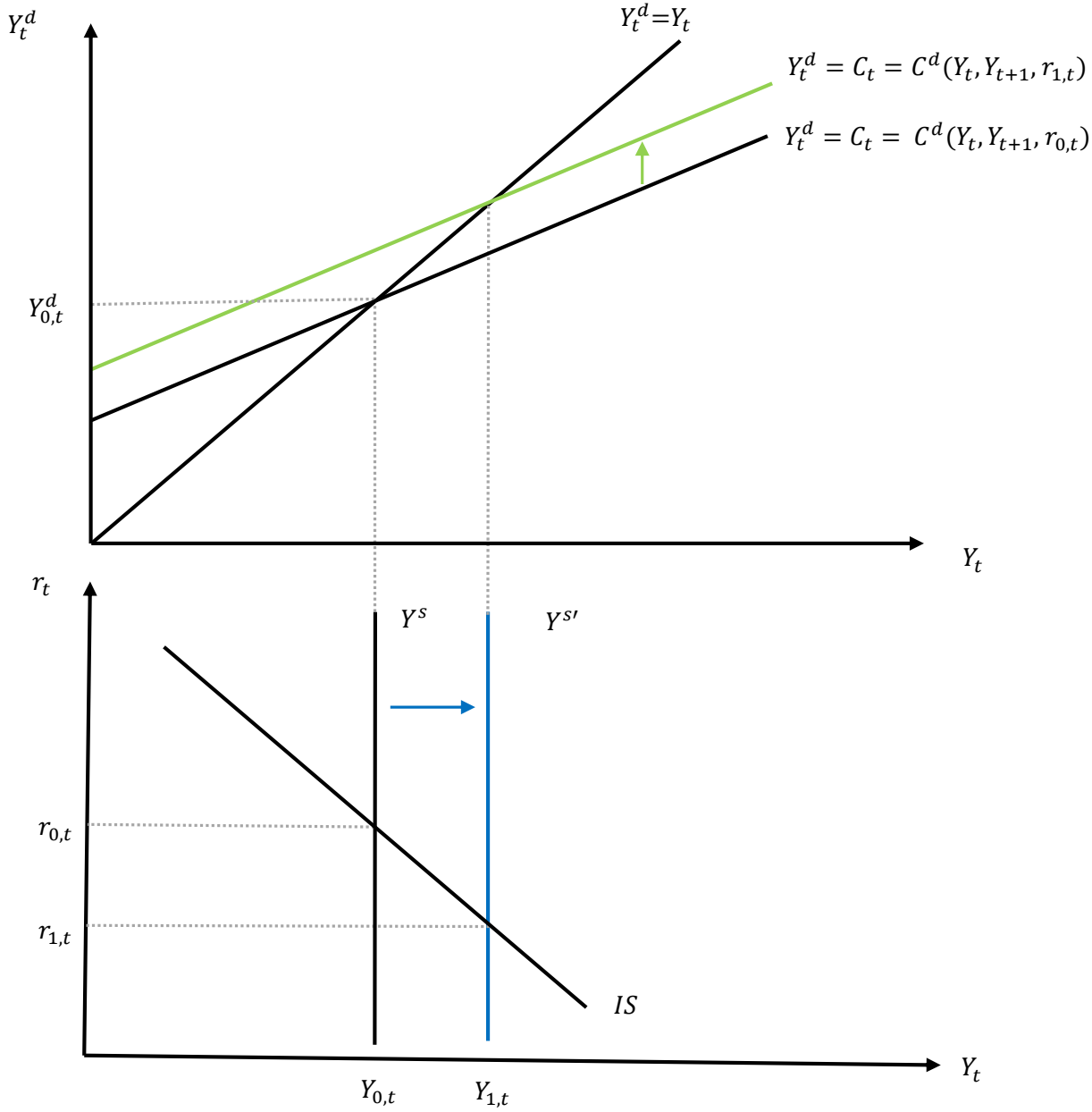


Equilibrium

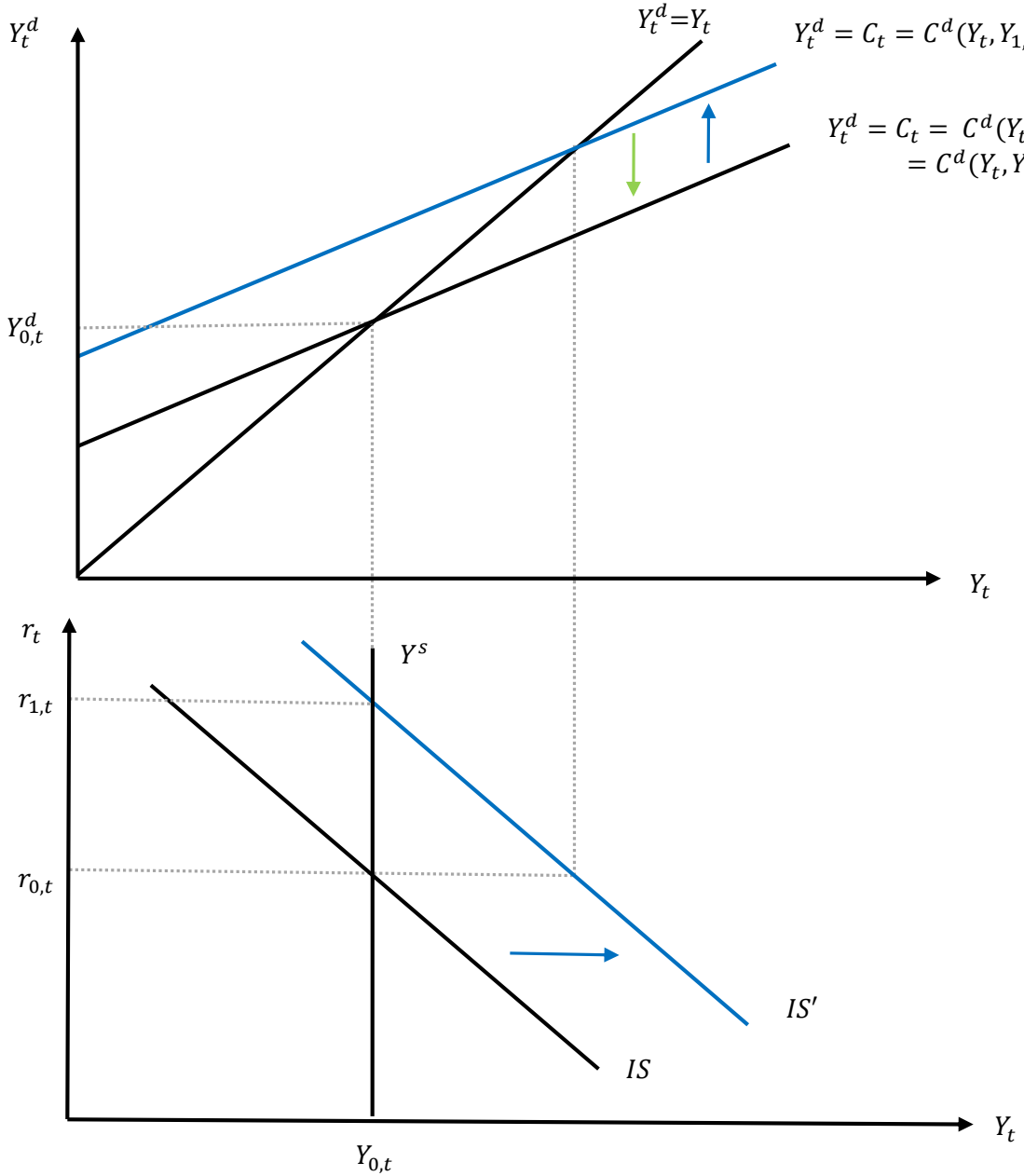
Must have income = expenditure (demand side) = production (supply-side). Find the r_t where IS and Y^s cross.



Supply Shock: ↑ Y_t



Demand Shock: ↑ Y_{t+1}



Discussion

- Market-clearing requires $C_t = Y_t$.
- For a given r_t, household does not want $C_t = Y_t$. Wants to smooth consumption relative to income.
- But in equilibrium cannot.
- r_t adjusts so that household is content to have $C_t = Y_t$.

Example with Log Utility

- With log utility, equilibrium real interest rate comes out to be (just take Euler equation and set $C_t = Y_t$ and $C_{t+1} = Y_{t+1}$):

$$1 + r_t = \frac{1}{\beta}\frac{Y_{t+1}}{Y_t}$$

- r_t proportional to expected income growth
- Potential reason why interest rates are so low throughout world today: people are pessimistic about the future. They would like to save for that pessimistic future, which ends up driving down the return on saving.
- One can extend the model to agents with identical preferences, but different endowments (see the book chapter). On the micro-level there will be savings and borrowing, but on the macro-level results do not depend on the distribution, but on aggregate endowments. It still holds $1 + r_t = \frac{1}{\beta}\frac{Y_{t+1}}{Y_t}$

Fiscal Policy

- The term fiscal policy refers to government spending and tax collection
- We will study fiscal policy the simple two period endowment economy. Basic conclusions will carry over to a model with production
- Government does an exogenous amount of expenditure, G_t and G_{t+1}. We do not model the usefulness of this expenditure (i.e., public good provision)
- Like the household, the government faces two flow budget constraints:

$$G_t \leq T_t + B_t$$

$$G_{t+1} + r_t B_t \leq T_{t+1} + B_{t+1} - B_t$$

- B_t: stock of debt government debt issued in t and carried into $t + 1$
- Government can finance its period t spending by raising taxes (T_t) or issuing debt (B_t, with initial level $B_{t-1} = 0$)
- Same in period $t + 1$, except government also has interest expense on debt, $r_t B_t$

Intertemporal Budget Constraint

- Note that $B_t > 0$ means debt (opposite for household savings) and $B_t < 0$ means government saving
- Terminal condition: $B_{t+1} = 0$
- Intertemporal budget constraint is then:

$$G_t + \frac{G_{t+1}}{1 + r_t} = T_t + \frac{T_{t+1}}{1 + r_t}$$

- Conceptually the same as the household
- Government's budget must balance in an intertemporal present value sense, not period-by-period

Household

- Utility as before: $U = u(C_t) + \beta u(C_{t+1})$
- Budget constraints include tax payments:

$$C_t + S_t \leq Y_t - T_t$$

$$C_t + S_{t+1} - S_t \leq Y_{t+1} - T_{t+1} + r_t S_t$$

- Imposing terminal condition that $S_{t+1} = 0$ yields household's intertemporal budget constraint:

$$C_t + \frac{C_{t+1}}{1 + r_t} = Y_t - T_t + \frac{Y_{t+1} - T_{t+1}}{1 + r_t}$$

Household Optimization

- Standard Euler equation:

$$u'(C_t) = \beta(1 + r_t)u'(C_{t+1})$$

- Can write household's IBC as:

$$C_t + \frac{C_{t+1}}{1 + r_t} = Y_t + \frac{Y_{t+1}}{1 + r_t} - \left[T_t + \frac{T_{t+1}}{1 + r_t}\right]$$

- But since present value of stream of taxes must equal present value of stream of government spending, this is:

$$C_t + \frac{C_{t+1}}{1 + r_t} = Y_t + \frac{Y_{t+1}}{1 + r_t} - \left[G_t + \frac{G_{t+1}}{1 + r_t}\right]$$

- Taxes drop out:

$$C_t + \frac{C_{t+1}}{1 + r_t} = Y_t - G_t + \frac{Y_{t+1} - G_{t+1}}{1 + r_t}$$

- Consumption function:

$$C_t = C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_t)$$

Intuition

- All the household cares about when making its consumption/saving decision is the present discounted value of the stream of income
- A cut in taxes, not met by a change in spending, means that future taxes must go up by an amount equal in present value
- Example:
  - Cut T_t by 1
  - Holding G_t and G_{t+1} fixed, the government's IBC holding requires that T_{t+1} go up by $(1 + r_t)$
  - Present value of this is $\frac{1+r_t}{1+r_t} = 1$, the same as the present value of the period t cut in taxes.

Equilibrium

Consumption function:

$$C_t = C^d(Y_t - G_t, Y_{t+1} - G_{t+1}, r_t)$$

Market clearing:

$$S_t = B_t$$

- Household saving must equal government borrowing (equivalently, household borrowing must equal government saving).
- It also holds that $B_t = G_t - T_t$ and $C_t + S_t = Y_t - T_t$.
- Replacing S_t with $G_t - T_t$ in the previous equation, we can write the market clearing condition as:

$$Y_t = C_t + G_t$$

- Intuition: the aggregate market-clearing condition requires that total output equals the sum of private and public consumption. This is equivalent to imposing that aggregate saving is zero, where aggregate saving is $S_t - B_t$ (i.e. household saving plus public saving).
- T_t, T_{t+1}, and B_t do not show up in the two final equilibrium relations. All that matters is how much government spends, i.e. G_t and G_{t+1}, but not the timing of tax collection.

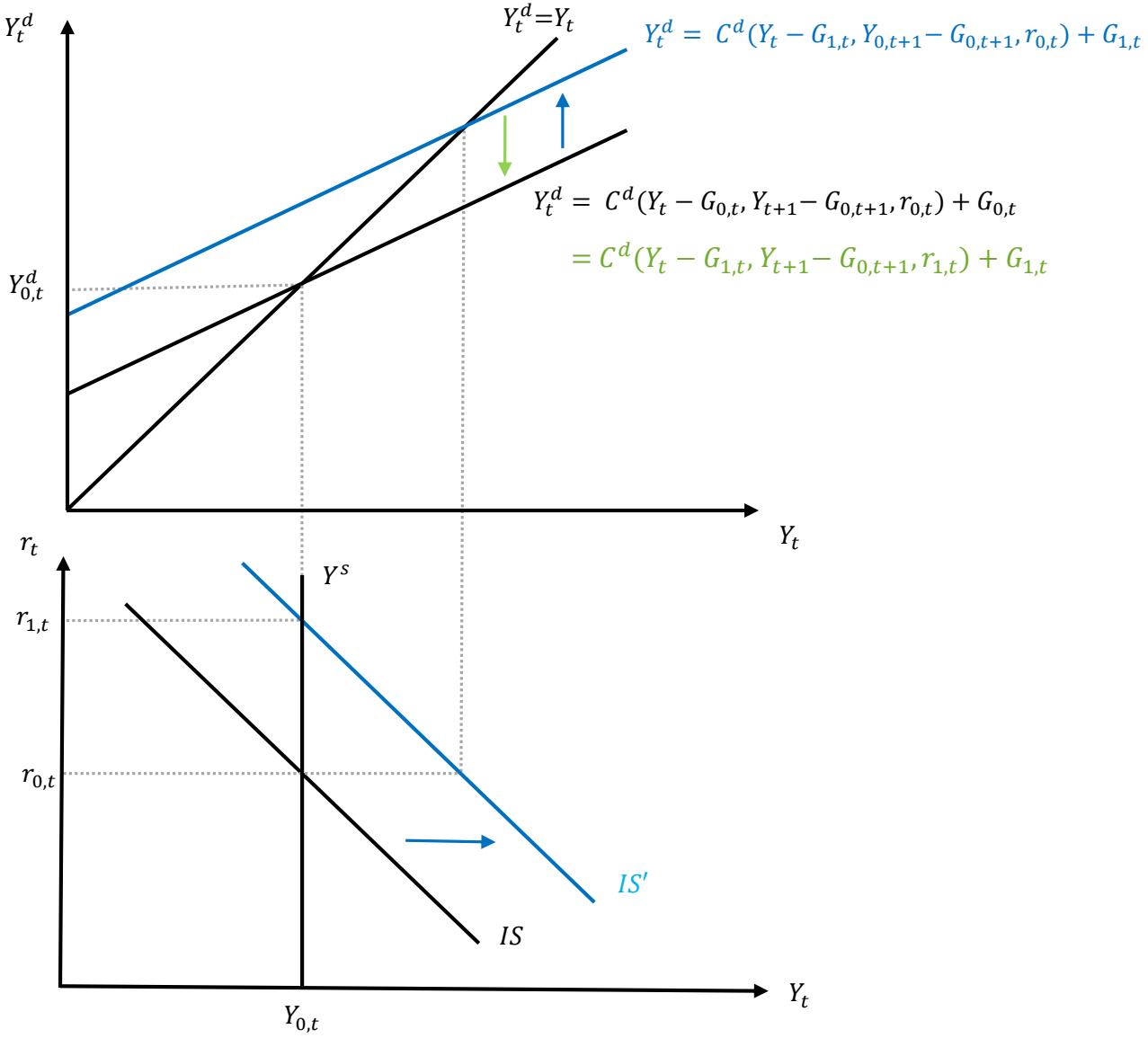
Ricardian Equivalence

- Ricardian Equivalence due to Barro (1979), named after David Ricardo
- Basic gist: the manner of government finance is irrelevant for how a change in government spending impacts the economy
- Increasing G_t by increasing T_t ("tax finance") will have equivalent effects to increasing G_t by increasing B_t ("deficit finance")
- Why? Current debt is equivalent to future taxes, and household is forward-looking. Issuing debt equivalent to raising future taxes.
- Ricardian Equivalence rests on several dubious assumptions:
    1. Taxes must be lump sum
    2. No borrowing constraints
    3. Households forward-looking
    4. No overlapping generations (i.e. government does not "outlive" households)
- Nevertheless, the basic intuition of Ricardian Equivalence is potentially powerful when thinking about the real world

Government Spending Multiplier

- In the endowment economy there are Y_t resources available. If the government increases spending, consumption must decrease by the same amount ($Y_t = C_t + G_t$). Complete crowding out of private consumption. Government spending multiplier is zero.
- Transmission:
  - One can show that without changing r_t consumption would not change (two off-setting forces: decrease of C_t due to anticipated tax increase, and increase of C_t via a multiplier effect cancel out each other). Hence, an increase in G_t would lead to a one-to-one increase in Y_t.
  - This is not possible in the endowment economy as Y_t is constant. In equilibrium r_t must increase, so that households want to save more until C_t decreases sufficiently.
- Multiplier with production and endogenous labor supply: Households dislike the reduction in consumption and therefore choose to work more to increase income/output and consumption. C_t still decreases as households anticipate higher tax burden. But C_t decreases less than in the endowment economy as Y_t increases if households supply more labor. Multiplier larger than 0.
- Keynesian multiplier, when households are not forward looking. Multiplier much larger because households do not take into account future tax increases and therefore there is no reason to reduce consumption.

Graphical Effects: Increase in G_t



Summary

- In general equilibrium, prices are not exogenous, but determined endogenously in order to equate supply and demand. In this case, the price is the real interest rate (price of consumption tomorrow in terms of consumption today).
- Competitive equilibrium: A set of prices and allocations such that all individuals optimize and markets clear.
- In equilibrium, some individuals can save and others can borrow, but in aggregate there is no saving.
- IS curve derived from microeconomic foundations. It is defined as in the basics macro courses as the set of (r_t, Y_t) where total desired expenditure equals income.
- Equilibrium: intersection of IS-curve and supply curve (here endowment)
- An increase in supply (here current endowment), increases output and lowers the interest rate.
- An increase in future endowment can be thought of as a demand shock from the perspective of the current period. The interest rate increases.
- Forward looking households anticipate future tax increases if government spending increases today and reduce consumption / increase savings accordingly. An increase in government spending leads to an increase in the real interest rate. This leads to a smaller fiscal multiplier compared to non-forward looking households.