How Effective are Tax Cuts?

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Econ 520 – UNC Chapel Hill

Introduction

We study tax cuts in more detail

- how effective are they?
- how does the answer depend on households' consumption behavior?

Along the way, we think more carefully about how consumption is determined.

- including the role of expectations

1 Tax Cuts in the IS/LM Model

1.1 Does cutting taxes have a big impact on demand?

The answer critically depends on the **marginal propensity to consume** (MPC) of households.

The effect of any shock depends on

- how big is the stimulus (direct change in demand)?
- how big is amplification?

1.2 Stimulus from tax cuts

Aggregate demand

$$Z = \overline{Z} + c_1(Y - T) + b_1 Y - b_2 i$$

with $\overline{Z} = C_0 + I_0 + G - c_1 T$

Stimulus = direct change in Z due to the shock

$c_1 \times \Delta T$

High $MPC \Longrightarrow$ large stimulus (intuitive)

Notation: ΔT is the change in T

1.3 How much does IS shift right?

The right shift of IS is larger than the stimulus

- recall the multiplier effect of fiscal shocks

The right shift is the change in Y holding i constant.

IS curve

$$Y = \overline{Z} + (c_1 + b_1)Y - b_2 i$$

Right shift

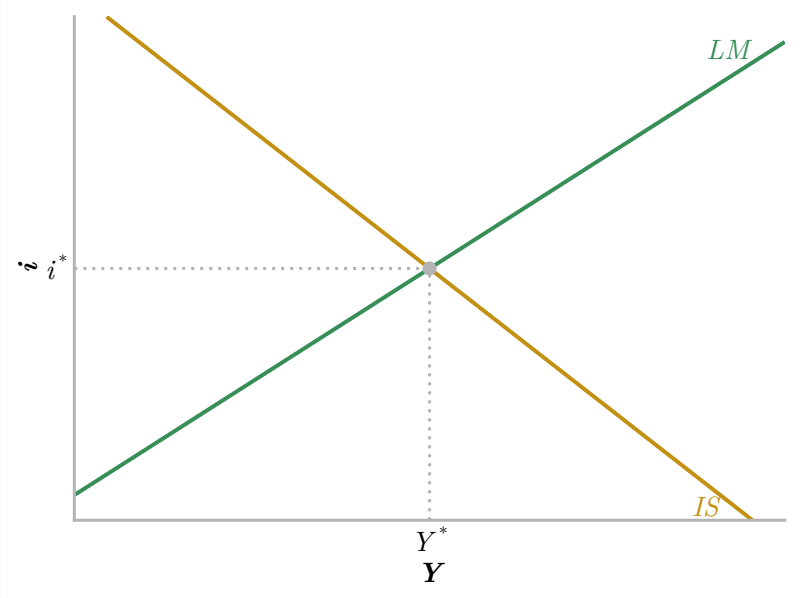
- $\Delta Y \times (1 - b_1 - c_1) = -c_1 \times \Delta T$ (holding i fixed)
- $\Delta Y = -\frac{c_1}{1-b_1-c_1}\Delta T$

High $MPC \Longrightarrow$ large right shift.

1.4 Amplification

For a given shift of IS, how much does equilibrium Y rise?

The answer depends on the slope of IS (and LM)



1.5 Slope of IS

Solve for the interest rate:

$$i = \frac{\overline{Z} - c_1 T - (1 - b_1 - c_1) Y}{b_2}$$

High MPC c_1 implies

- flat IS
- small change in Y for given shift in IS

Intuition?

1.6 How big is the change in Y?

High MPC means

- big right shift of IS
- lots of crowding out (movement along IS)

Is the answer ambiguous?

- the question being: does a high MPC make tax cuts more or less effective?

1.7 Second attempt

Let's look at the **vertical shift** of IS:

$$i = \frac{\overline{Z} - c_1 T - (1 - b_1 - c_1) Y}{b_2}$$

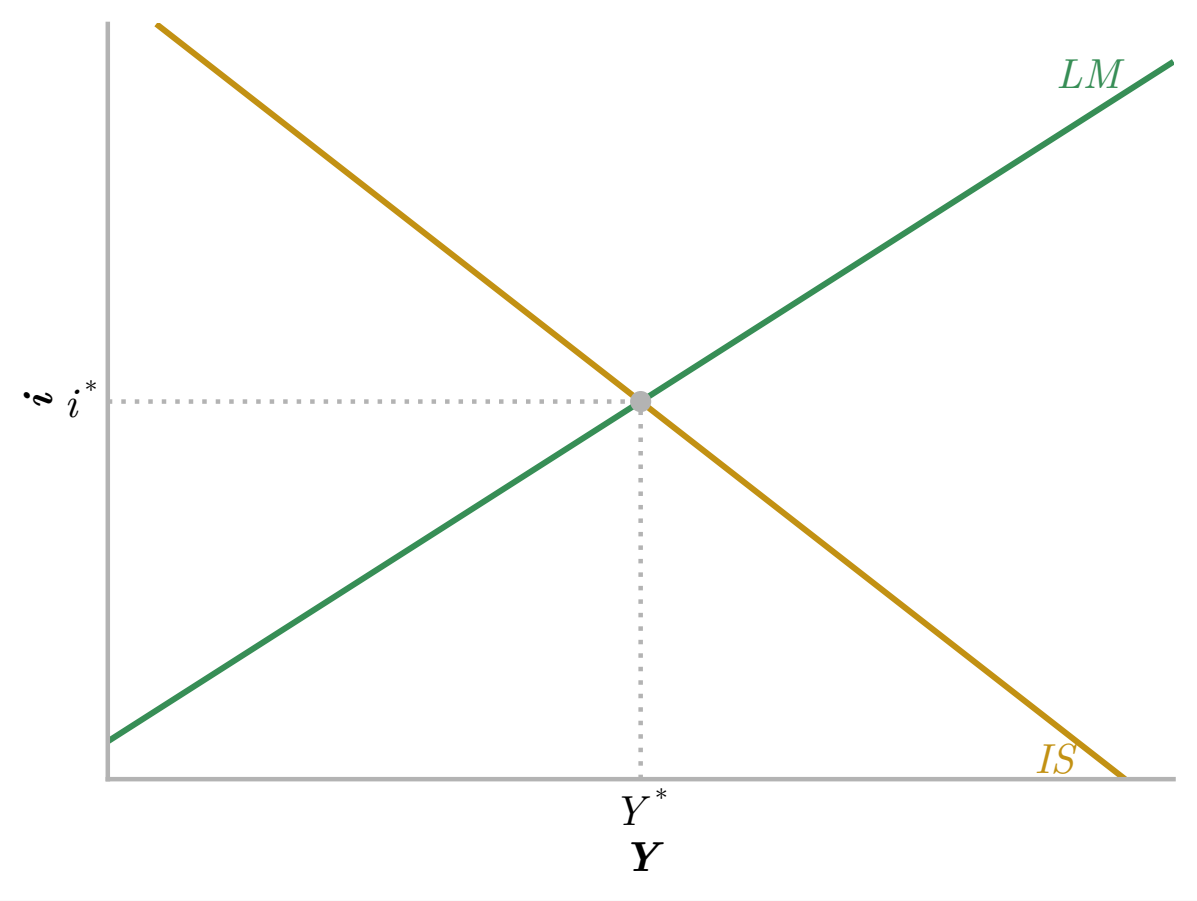
Holding Y constant, the vertical shift is: $\Delta i = -\frac{c_1}{b_2} \times \Delta T$

High MPC implies:

- large vertical shift
- flat IS

Now what is the total effect on Y?

1.8 How effective are tax cuts?



2 How Large is the MPC?

2.1 How large is the MPC?

The effectiveness of tax cuts depends critically on the MPC.

How big is the MPC in the data?

> Empirical estimates of the aggregate marginal propensity to consume (MPC) in the U.S. range from **0.05** to **0.9** depending on the event and sample of the study.
>
> Background: Marginal Propensities to Consume in the 2021 Economy. Penn Wharton Budget Model, 2021.

That's a pretty wide range!

Why so wide?

2.1 How large is the MPC?

Key point:
There is no single MPC.

Each person has their own MPC.

Each stimulus / shock has its own MPC.

A simple model of consumption / saving helps to understand this.

2.2 A Simple Model of Consumption

Assumptions:

- Households like smooth consumption
- They can borrow and lend freely

Budget constraint:

present value of consumption = present value of income + initial wealth

Why?

- We derive this later for the government
- The same logic applies to any household who can borrow and save

If you want to see the details in a more general model, see the slides from previous years.

Model Details

Households live for T periods.

Exogenous income stream y_t

Consumption prices: p_t (in units of account)

Preferences: $\sum_{t=1}^{T} U(c_t)$

Key assumption: diminishing marginal utility of c

- $U'(c) > 0$ but $U''(c) < 0$ (graph)
- this is what causes household to want smooth consumption

Solving the Model

Budget constraint (without initial assets):

$$Y \equiv \underbrace{\sum_{t=1}^{T} y_t}_{\text{P.V. of earnings}} = \underbrace{\sum_{t=1}^{T} p_t c_t}_{\text{P.V. of consumption}}$$

Solving this problem with a Lagrangian:

$$\mathcal{L} = \sum_{t=1}^{T} U(c_t) + \lambda\left(Y - \sum_{t=1}^{T} p_t c_t\right)$$

2.3 Lagrangian Review

Let's take a simple static problem.

The household values consumption and leisure: $U(c) - v(l)$

subject to the constraint $wl - pc = 0$

Set up the **Lagrangian**

$$\mathcal{L} = \underbrace{U(c) - v(l)}_{\text{objective}} + \lambda \times \underbrace{(wl - pc)}_{\text{constraint}}$$

λ is the **Lagrange multiplier**.

- the value of relaxing the constraint a bit
- in this case: the value of a unit of additional income
- in units of account!

First-order conditions

$$\mathcal{L} = \underbrace{U(c) - v(l)}_{\text{objective}} + \lambda \times \underbrace{(wl - pc)}_{\text{constraint}}$$

First order (optimality) conditions are

$$\frac{\partial \mathcal{L}}{\partial c} = 0 \Longrightarrow U'(c) = \lambda p$$

$$\frac{\partial \mathcal{L}}{\partial l} = 0 \Longrightarrow v'(l) = \lambda w$$

First-order conditions

In words:

1. $U'(c) = \lambda p$

   An additional unit of income (relaxing the constraint) c
   can be used to buy $1/p$ units of consumption
   with marginal utility $U'(c)$

2. $v'(l) = \lambda w$

   An additional hour of working costs marginal utility $v'(l)$
   It earns w units of income, each worth λ

2.4 Solving the Simple Model

The Lagrangian for the consumption problem again:

$$\mathcal{L} = \sum_{t=1}^{T} U(c_t) + \lambda\left(Y - \sum_{t=1}^{T} p_t c_t\right)$$

First-order conditions for c_t:

$$U'(c_t) = \lambda p_t$$

In words…

$$U'(c_t) = \lambda p_t$$

Note that λ **is the same for all** t**.**

Key implication:
If prices are smooth, **households want smooth consumption**

Households really want smooth marginal utility, but that implies smooth consumption.

Intuition and graph …

2.5 Consumption Smoothing

Simplifying assumption: prices p_t are constant

- this actually means: constant real interest rate
- makes the math simpler without changing main message

Then households want **constant consumption**:

- $U'(c_t) = \lambda$ is a constant
- $c_t = \overline{c}$

More general with prices that smoothly vary over time:

- Households wantsmooth consumption
- similar implications with more complicated math

2.6 Marginal Propensity to Consume

Solve for consumption:

$$\overline{c} = 1/T\left(\sum_{t=1}^{T}(y_t - Tax_t) + a_1\right)$$

MPC out of one year's income: $\partial\overline{c}/\partial y_t = 1/T$

- age $t = 20$; life-expectancy $T = 85 - 20$: MPC = $1/65$
- age $t = 50$; life-expectancy $T = 85 - 50$: MPC = $1/35$

2.7 Implications

The MPC out of **current** income should be **small** for most people.

- key, robust intuition …

But is that the whole story?

Next: how the MPC depends on the shock

- transitory or permanent?
- current or announced for the future?

3 How Consumption Responds to Income Shocks

3.1 One Principle

Recall the solution of the simple model:

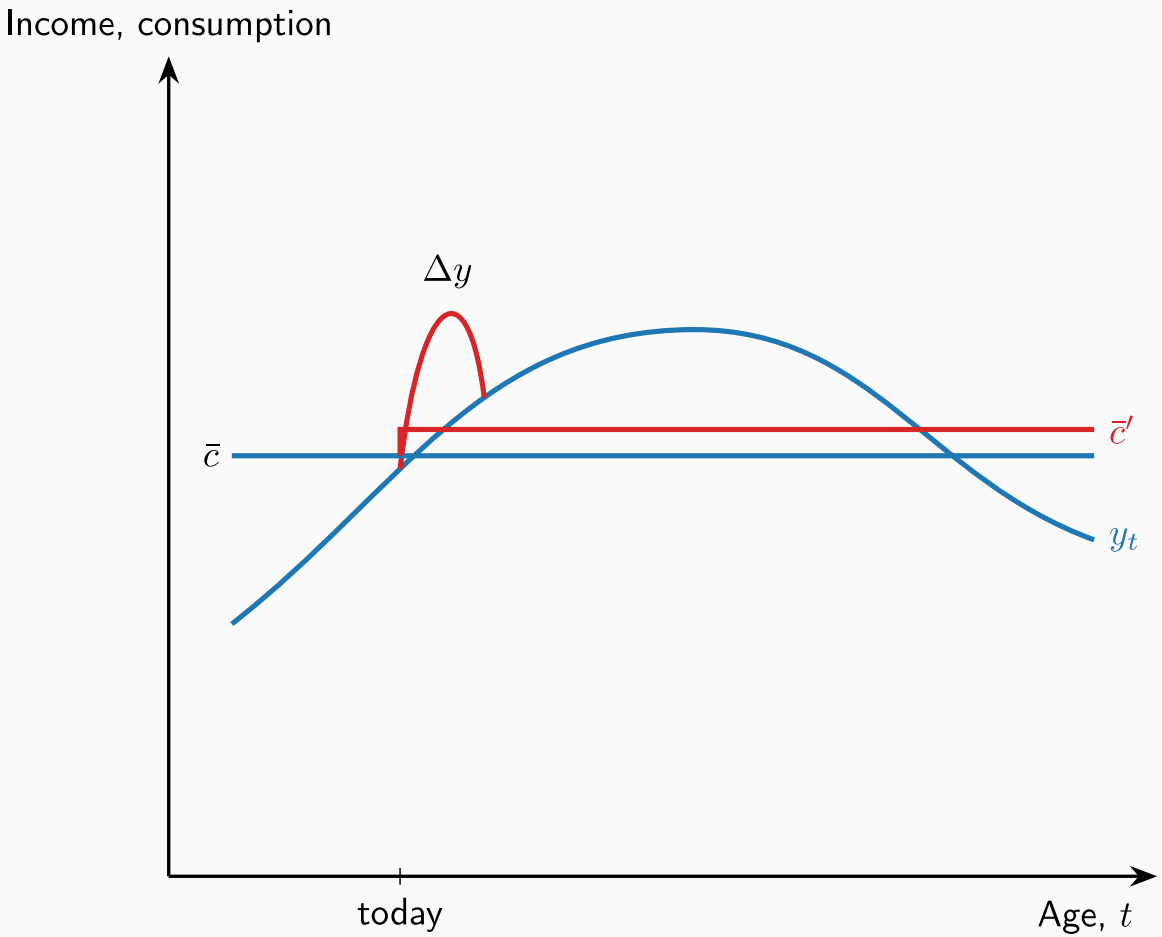
$$\bar{c} = \frac{1}{T} \times \underbrace{\left(\sum_{t=1}^{T} y_t + a_1 \right)}_{\text{lifetime income}}$$

Any income shock changes consumption by

$$\Delta \bar{c} = \frac{\Delta \text{ lifetime income}}{T}$$

To find the effect of **any** income shock, ask one question:
How much does it change **lifetime income**?

3.2 A Transitory Shock

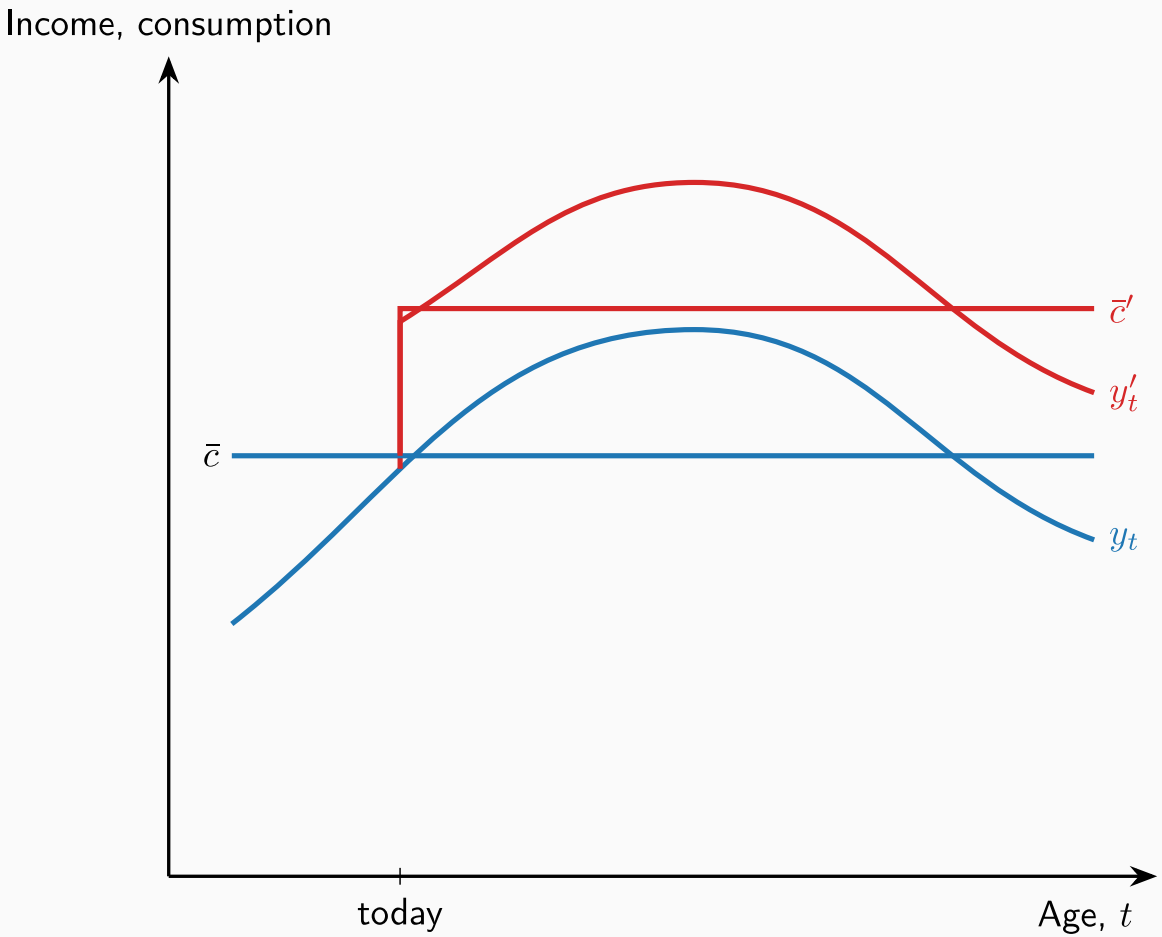


- unexpectedly, income rises by Δy – for one year only
- lifetime income rises by Δy
- a drop in the bucket
- $\Delta \bar{c} = \Delta y / T$: small

Consumption **jumps** today – by a little. Then it is flat again.

Most of the windfall is saved and spread over the remaining lifetime.

3.3 A Permanent Shock



- unexpectedly, income rises by Δy – now and in **every** future year
- lifetime income rises by $T \times \Delta y$
- that is a lot
- $\Delta \bar{c} = \Delta y$: MPC ≈ 1

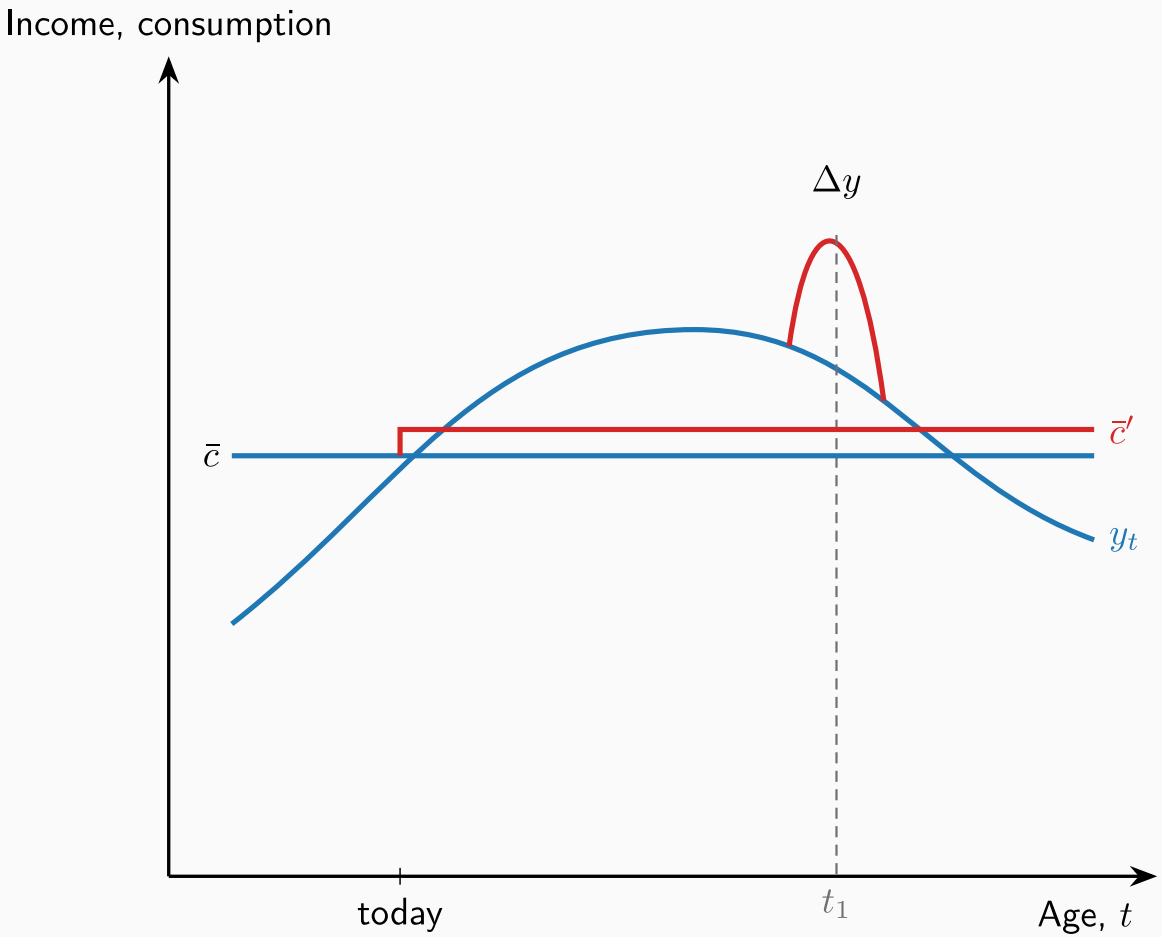
No need to save the windfall: it arrives again every year.

3.3 A Permanent Shock

Same change in **current** income. Very different consumption responses.

What matters is the change in **lifetime** income.

3.4 An Announced Future Shock



- news today: income will rise by Δy at the future date t_1
- lifetime income rises by Δy
- exactly as if the money arrived today
- $\Delta \bar{c} = \Delta y / T$

Consumption rises **today**, long before income changes.

The household borrows (or saves less) until t_1.

3.4 An Announced Future Shock

Consumption responds to **news**, not to cash in hand.

It jumps when news arrives. Between news, it is smooth.

3.5 Summary: Each Shock Has Its Own MPC

Shock	Δ lifetime income	$\Delta \bar{c}$
transitory, today	Δy	$\Delta y / T$ (small)
permanent	$T \times \Delta y$	Δy (MPC ≈ 1)
transitory, at future date t_1	Δy	$\Delta y / T$ (small)

This is why empirical MPC estimates range from 0.05 to 0.9.

- the answer depends on the shock (and on who receives it)

3.6 Implications for Tax Cuts

So one-time tax cuts are hopeless for stimulating the economy?

- who has a high MPC?

3.6 Implications for Tax Cuts

Tax cuts can be effective, but they need to target the right populations.

- tax cuts that benefit the rich are mostly saved
- tax cuts that benefit the poor are mostly consumed
- many poor households cannot borrow: they spend windfalls right away (our simple model rules this out by assumption)

4 The Interest Rate and Consumption

4.1 What About Interest Rates?

So far: constant prices p_t – that is, a constant interest rate.

What happens when the interest rate rises?

Key idea: r is the price of consuming today rather than tomorrow.

- save one dollar today: buy $(1 + r)$ units tomorrow
- higher r: future consumption becomes **cheaper**

Intuition suggests: households postpone consumption.

- but savers also earn more interest – an income effect
- to sort this out, we need a model; 2 periods are enough

Households live for 2 periods with incomes y_1, y_2.

They save $s = y_1 - c_1$ (borrow if $s < 0$).

Period 2: consume income plus savings with interest

$$c_2 = y_2 + (1 + r)s$$

Substitute out s:

$$\underbrace{c_1 + \frac{c_2}{1+r}}_{\text{PV of consumption}} = \underbrace{y_1 + \frac{y_2}{1+r}}_{\text{PV of income}}$$

The same budget constraint as before, with prices $p_1 = 1$ and $p_2 = 1/(1 + r)$.

- higher r = lower price of future consumption

What is a **real** interest rate?

The definition you may remember: nominal interest rate minus inflation.

The useful definition here: **the relative price of consumption at two dates**.

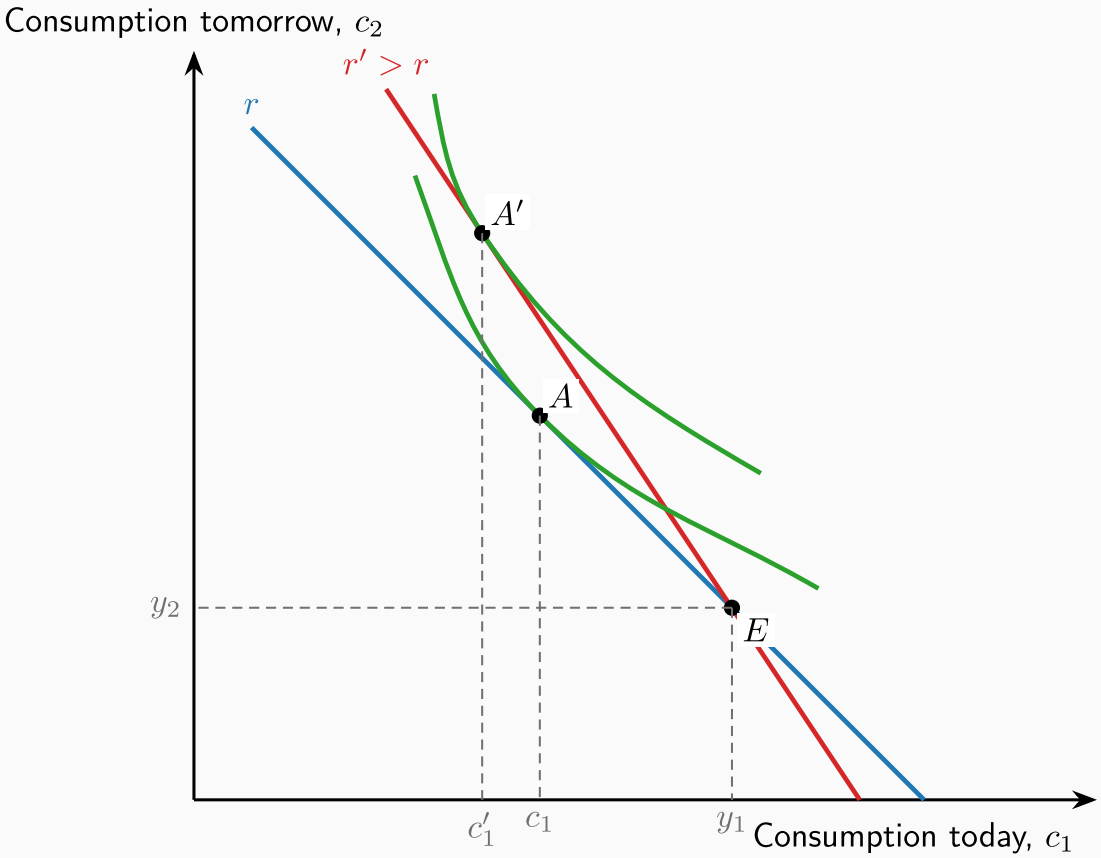
Giving up 1 unit of consumption today buys $(1+r)$ units tomorrow.
In our price notation:

$$\frac{p_1}{p_2} = \frac{1}{1/(1+r)} = 1+r$$

Higher r: consumption today becomes relatively more expensive.

For a refresher on this material, see Moll, 2023.

4.3 A Higher Interest Rate



- budget line: slope $-(1+r)$
- the endowment point E is always affordable
- higher r: the budget line **rotates** around E
- the choice moves from A to A'

4.3 A Higher Interest Rate

Two effects of a higher r (for a saver, $c_1 < y_1$):

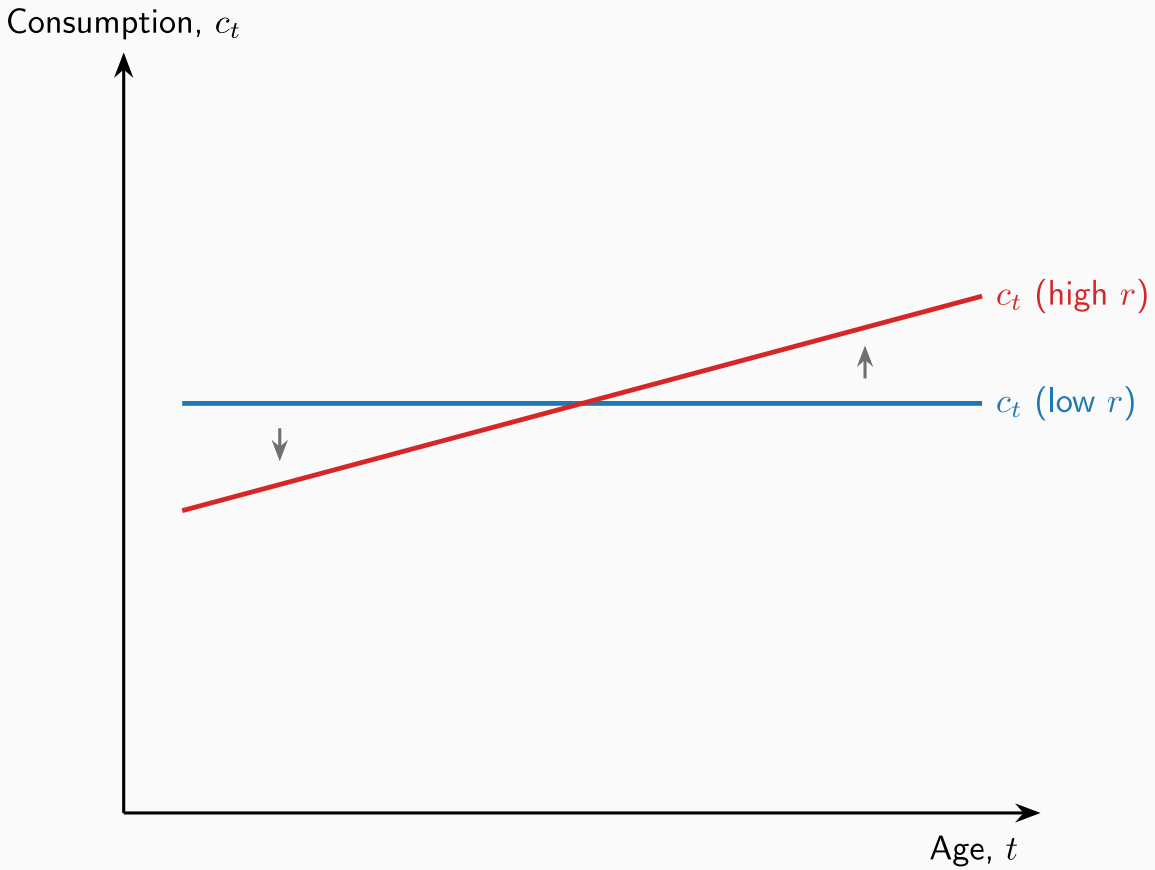
1. **Substitution effect**
   Consumption today became more expensive.
   Shift toward tomorrow: $c_1 \downarrow, c_2 \uparrow$

2. **Income effect**
   Savings earn more interest. The household is richer.
   Consume more in both periods: $c_1 \uparrow, c_2 \uparrow$

c_2 rises for sure. For c_1, theory is ambiguous.

- standard case (and evidence): substitution wins; c_1 falls
- for a borrower, both effects cut c_1

4.4 Back to Many Periods



- the same logic applies with many periods
- higher r: consume less now, more later
- the age-consumption profile **rotates**

4.4 Back to Many Periods

A higher interest rate leads households to postpone consumption.

4.5 Why This Matters

The consumption side of the IS curve:

- higher i: households postpone consumption; current demand falls
- so far, only investment responded to i (the b_2 term)
- consumption strengthens that channel

And it sets up the next topic:

- consumption depends on **expected future income** and on **interest rates**
- exactly the variables that policy announcements and news move
- next: expectations

5 Expectations

5.1 The Role of Expectations

Consumption and investment decisions are forward looking.

Future output increases today's spending.

Implications for policy:

1. Expectations become a policy tool.
2. Persistent policies are stronger than temporary ones.

5.2 Expectations: Monetary Policy

A monetary expansion now has 2 effects:

1. direct: $i \downarrow \Longrightarrow LM$ shifts right
2. indirect: expectations change

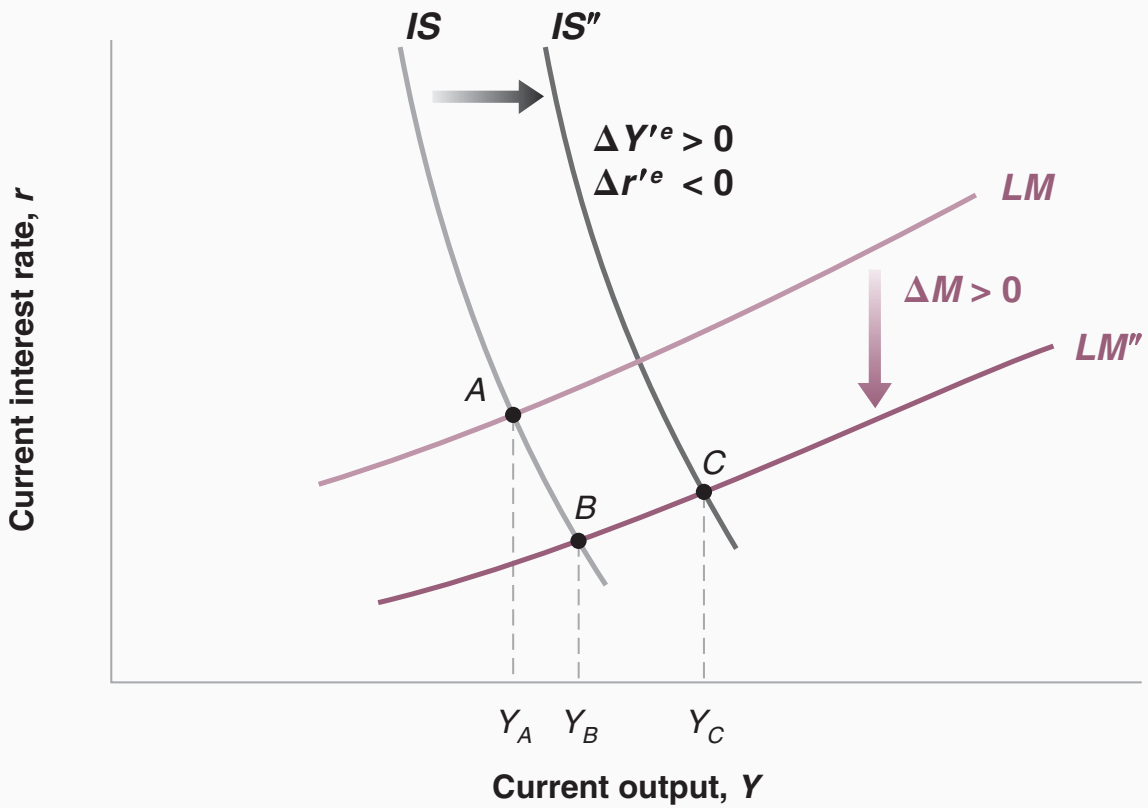
Transitory monetary expansion:

- no change in future Y', i' (primes denote future)
- small policy effect

Persistent monetary expansion:

- expect LM to stay shifted
- $Y' \uparrow$ and $i' \downarrow$
- IS shifts right as well

5.3 Expectations: Monetary Policy



Transitory $M \uparrow$: $A \to B$. Persistent $M \uparrow$: $A \to C$

5.4 Expectations: Monetary Policy

Key point Monetary policy is more powerful, if it can change expectations.

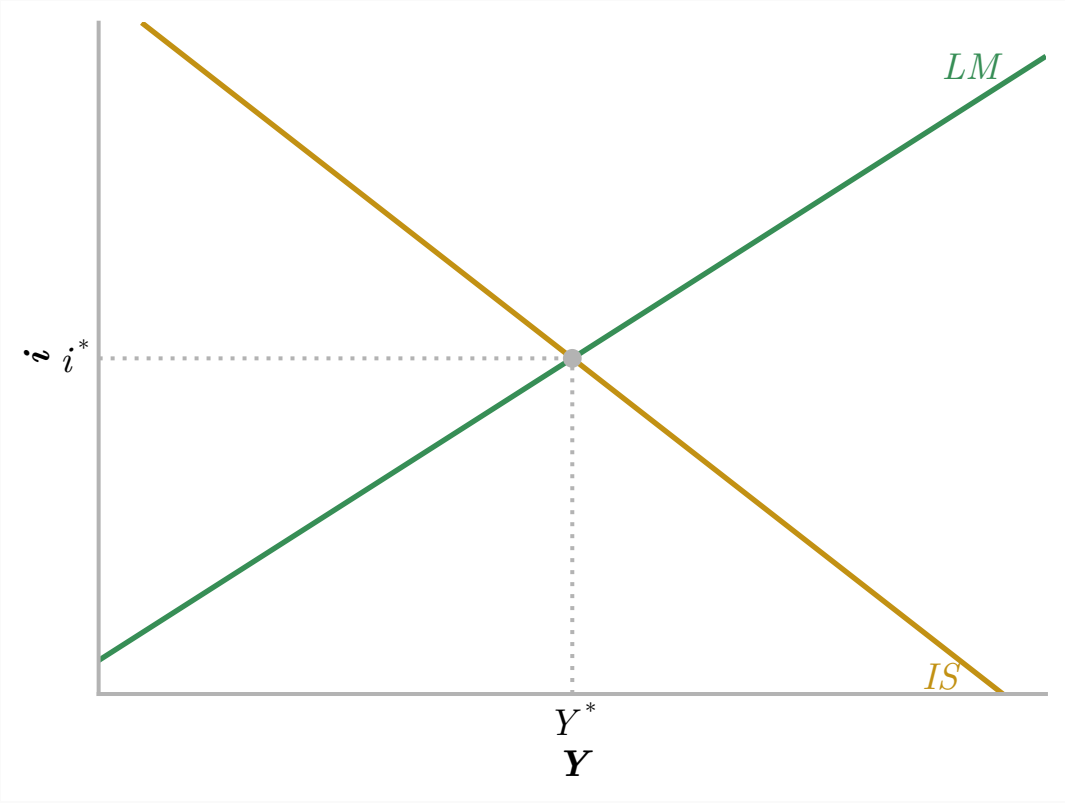
Quantitative Easing

The Fed buys large amounts of long-term bonds.

Signals that interest rates will remain low for a long time.

5.5 Expectations: Fiscal Policy

Can a cut in government spending stimulate aggregate demand?



5.6 Reading

Blanchard, Macroeconomics, 7th ed.

- ch. 9.2 and 17 on expectations.