EC 3101 Microeconomic Analysis II

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Intermediate Microeconomics
(9th edition)

by Hal Varian

Syllabus (subject to change)

Week 1	Course Overview; Intertemporal Choice, Ch.10
Week 2	Uncertainty, Ch.12
Week 3*	Monopoly, Ch.25
Week 4	Oligopoly, Ch.28
Week 5	Oligopoly, Ch.28
Week 6	Game Theory, Ch.29
	[Recess Week]
Week 7	Midterm
Week 8	Game Applications, Ch.30
Week 9	Game Applications, Ch.30
Week 10*	Externalities, Ch.35; Public Goods, Ch.37
Week 11*	Welfare, Ch.34; Asymmetric Information, Ch.38
Week 12	Asymmetric Information, Ch.38
Week 13	Review; AOB

Assessment

- Quiz $\times$ 2, 10%
- Presentation and Participation, 10%
- Midterm Exam, 30%
- Final Exam, 50%

Quiz

- Two Quizzes
- To be posted on Canvas 10 days before due date (W6, W12)
- To be submitted on Canvas
- Each student will be allowed two attempts
- There will be no makeup quizzes and no extension of due dates

Presentation and Participation

- Practice Problems to be posted from week 2 onwards
- To be discussed in tutorial the following week
- You will present solutions during tutorial
- Everyone needs to present at least once
- Only first presentation will be graded, based on content (concepts and logic) and delivery (clarity and organization)

Exams

- Midterm
  - Closed-book
  - February 27 (Mon), 10 am (Venue to be confirmed)

- Final
  - Closed-book
  - Cumulative
  - April 24 (Mon), 9 am

Some Ground Rules

- Lectures and Tutorials:
  - Turn your cell phone on silent mode
  - Avoid distracting your classmates
  - Ask questions if you are confused

- Attendance to be taken in tutorials

- Academic dishonesty is unacceptable

INTERTEMPORAL CHOICE

Week 1

(Chapter 10, except 10.4, 10.10, 10.11)

Chinese Idiom: Three at dawn, Four at dusk

Parable by Zhuangzi (4th century BC)

- A man from the country of Song raised monkeys
- 4 bananas at dawn & 4 at dusk
- He wanted to reduce the monkeys’ ration to 3 bananas in the morning & 4 in the evening
- The monkeys protested angrily
- How about 4 at dawn & 3 at dusk?
- The monkeys were satisfied

Intertemporal Choice

- Were the monkeys gullible?
- Is one banana at dawn equivalent to one at dusk?
- Is a dollar today the same as a dollar tomorrow?

Model of Two Time Periods

We begin with the simplest financial arithmetic

- Take just two periods: 1 and 2

- Let r denote the nominal interest rate per period

Future Value

- If r = 0.1 then $1 saved in period 1 becomes $1.10 in period 2

- The next-period value of $1 saved now is the future value of that dollar

Future Value

- Given an interest rate r, the future value one period from now of $1 is

$$FV = 1 + r$$

- Given an interest rate r, the future value one period from now of $m is

$$FV = m(1 + r)$$

Present Value

How much money would have to be saved now to obtain $1 in the next period?

- $k saved now becomes $k(1+r) in the next period
  - Set $k(1+r) = 1$
  - So $k = \frac{1}{1+r}$

- $k = \frac{1}{1+r}$ is the present-value of $1 obtained in the next period

Present Value

- The present value of \$1 available in the next period is $PV = \frac{1}{1+r}$

- And the present value of \$m available in the next period is $PV = \frac{m}{1+r}$

Higher r leads to lower PV

- If r = 0.1, the most you should pay now for $1 available next period is

$$PV = \frac{1}{1+0.1} = 0.91$$

- If r = 0.2, the most you should pay now for $1 available next period is

$$PV = \frac{1}{1+0.2} = 0.83$$

The Intertemporal Choice Problem

- Suppose there are two time periods: 1 and 2
  - Let m_1 and m_2 be incomes ($) received in periods 1 and 2
  - Let c_1 and c_2 be consumptions (physical units) in periods 1 and 2
  - Let p_1 and p_2 be the prices of consumption ($ per unit) in periods 1 and 2

The Intertemporal Choice Problem

- The intertemporal choice problem:
  Given incomes (m_1, m_2) and prices (p_1, p_2), what is the most preferred intertemporal consumption bundle (c_1, c_2)?
  - (m_1, m_2, p_1, p_2 exogenous; c_1, c_2 endogenous)
- For an answer we need to know:
  - intertemporal budget constraint
  - intertemporal consumption preferences

The Intertemporal Budget Constraint

- To keep things simple, for now suppose that there is no inflation

  and $p_1 = p_2 = \$1$ (per unit)

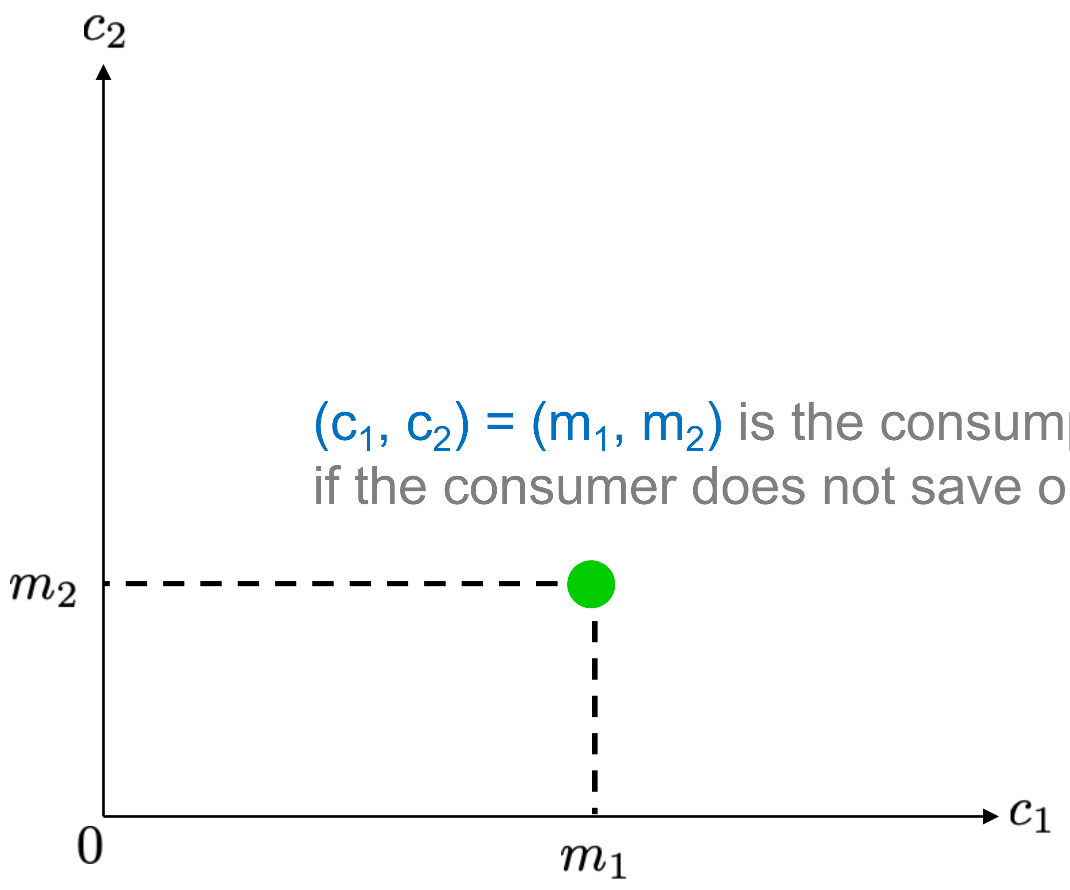
The Intertemporal Budget Constraint

- Suppose that consumer chooses not to save or to borrow.

- Q: What will be consumed in period 1?
- A: $c_1 = m_1$.

- Q: What will be consumed in period 2?
- A: $c_2 = m_2$.

The Intertemporal Budget Constraint



$(c_1, c_2) = (m_1, m_2)$ is the consumption bundle if the consumer does not save or borrow

The Intertemporal Budget Constraint

- Now suppose that the consumer spends nothing on consumption in period 1

- So, $c_1 = 0$ and $s_1 = m_1$

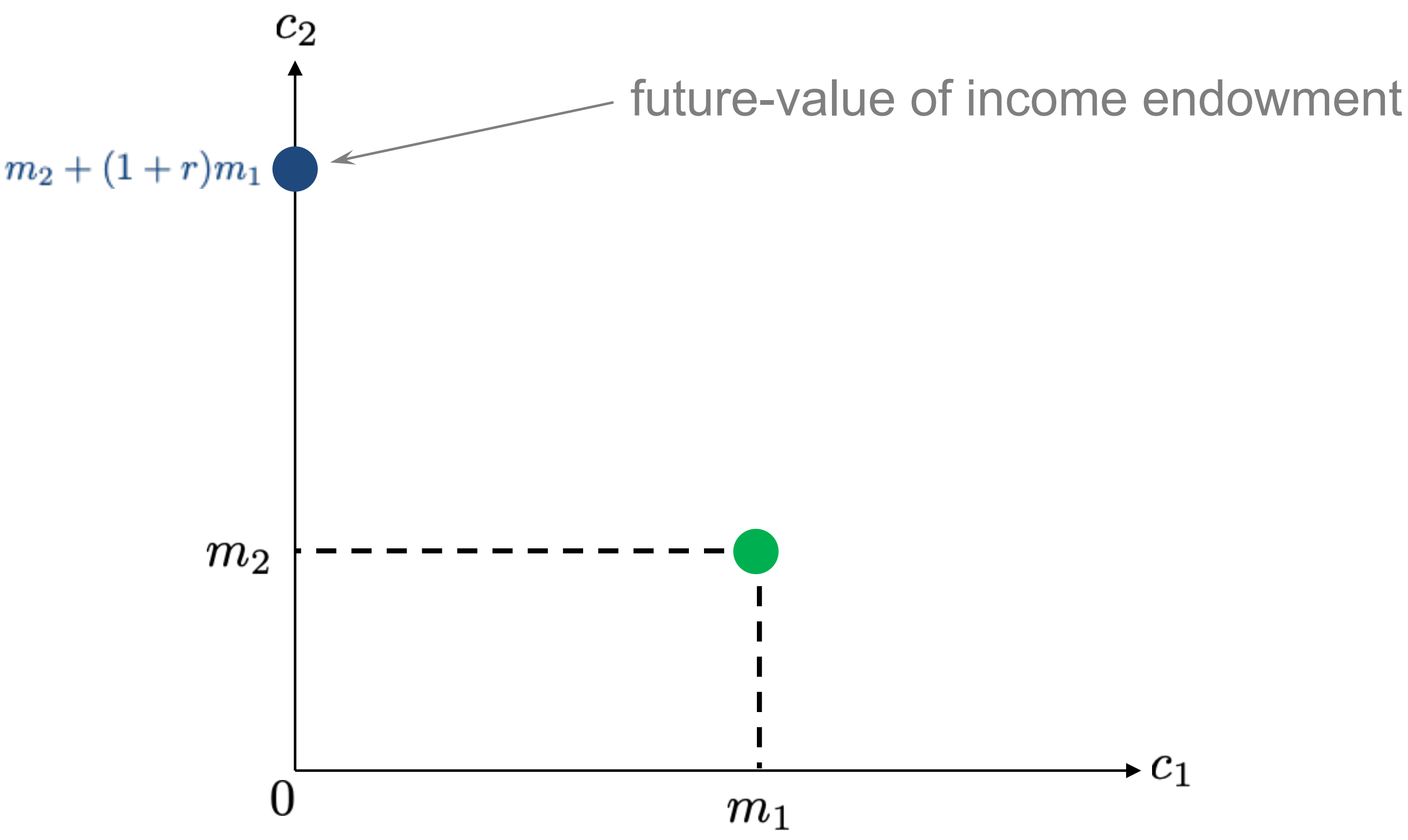
- The interest rate is r

- What will c_2 be?

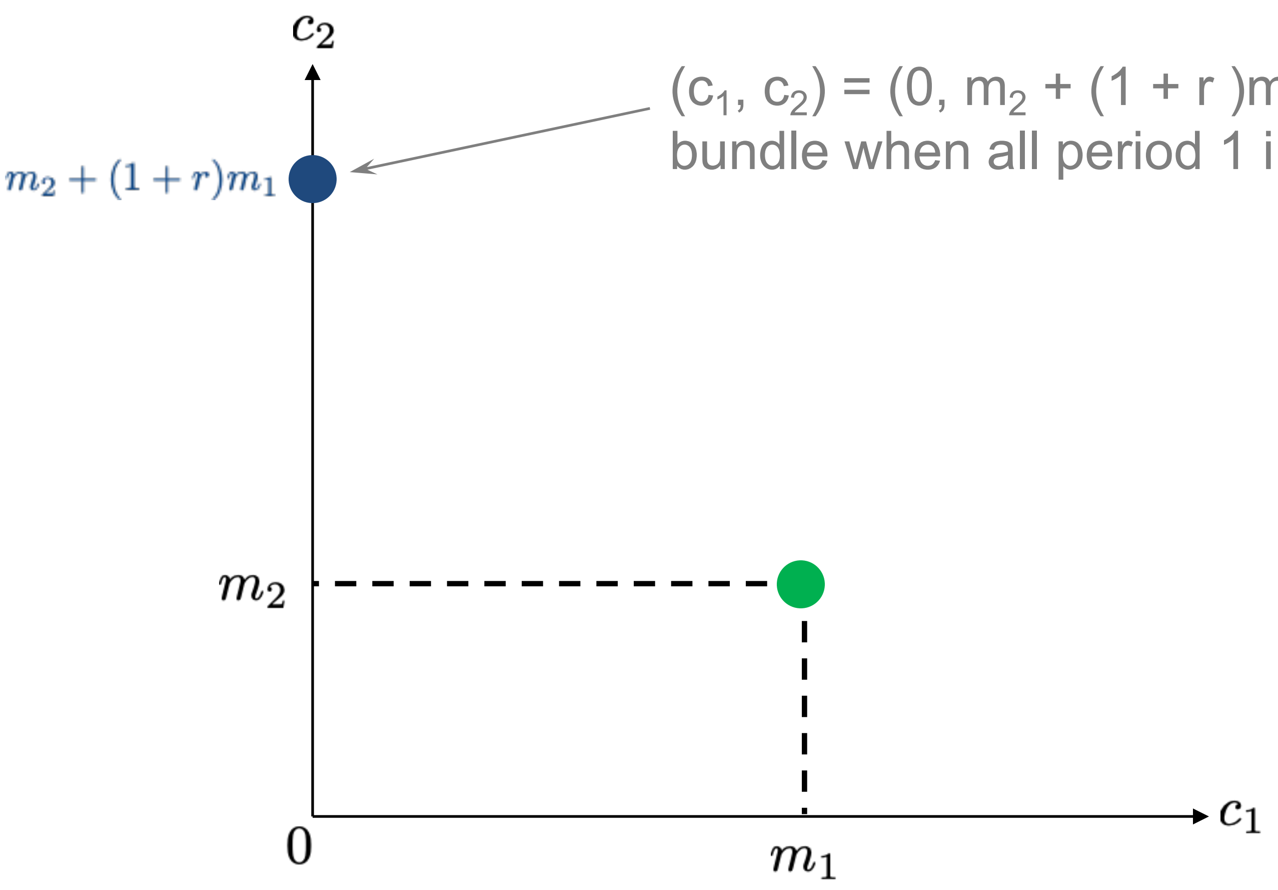
The Intertemporal Budget Constraint

- Period 2 income is \$ m_2
- Savings plus interest from period 1 sum to \$ $(1 + r)m_1$
- So total income available in period 2 is \$ $m_2 + (1 + r)m_1$
- So period 2 consumption expenditure is $c_2 = m_2 + (1 + r)m_1$

The Intertemporal Budget Constraint



The Intertemporal Budget Constraint



$(c_1, c_2) = (0, m_2 + (1 + r)m_1)$ is the consumption bundle when all period 1 income is saved

The Intertemporal Budget Constraint

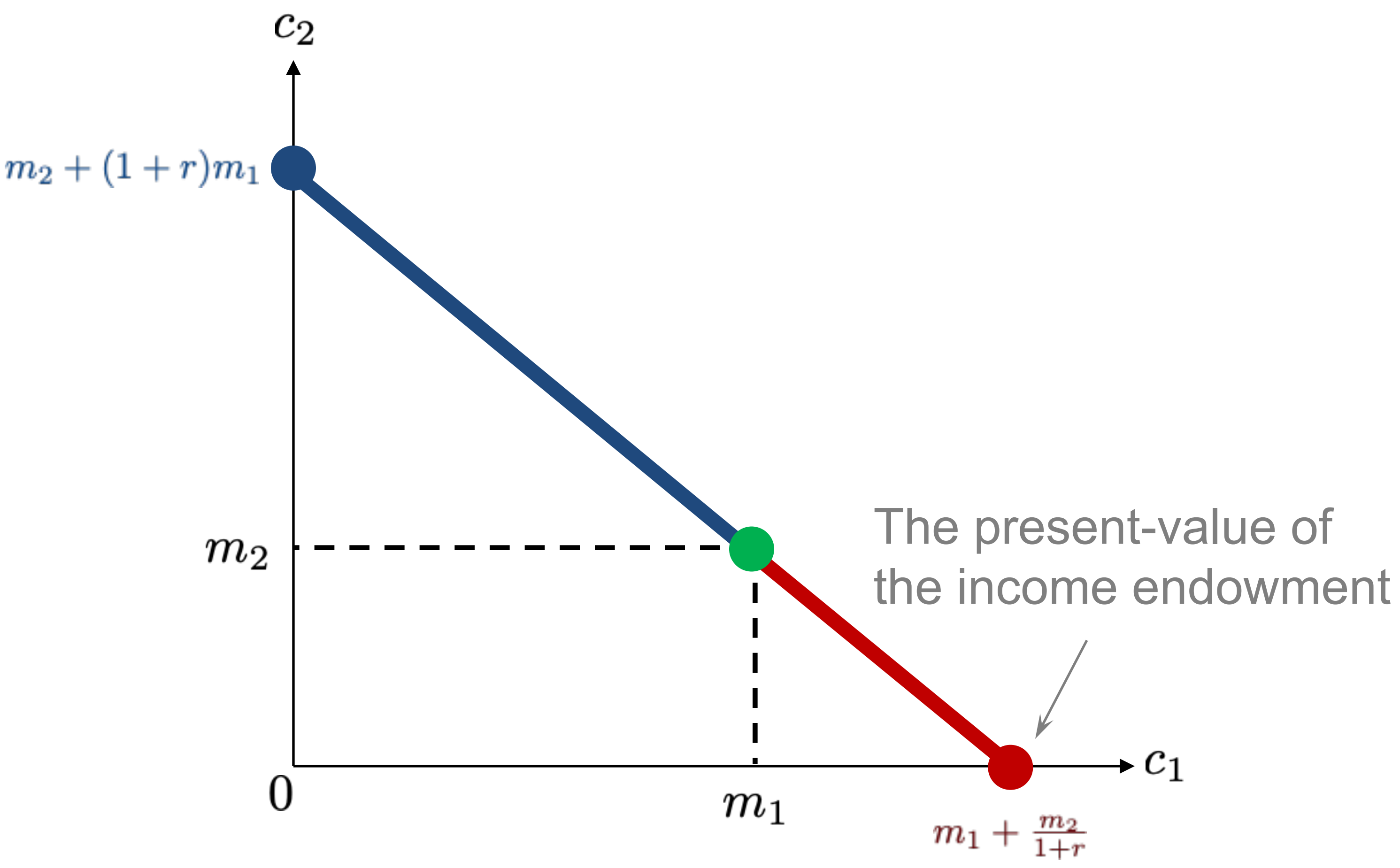
- Now suppose that consumer spends everything in period 1, so $c_2 = 0$
- What is the most that the consumer can borrow in period 1 given her period 2 income of $\$m_2$?
- Let $\$b_1$ denote the amount borrowed in period 1

The Intertemporal Budget Constraint

- \$$m_2$ available in period 2 to pay back \$$b_1$ borrowed in period 1
- So $$b_1(1+r) = m_2$$
- That is, $$b_1 = \frac{m_2}{1+r}$$
- The largest possible period 1 consumption level is

$$c_1 = m_1 + \frac{m_2}{1+r}$$

The Intertemporal Budget Constraint



The Intertemporal Budget Constraint

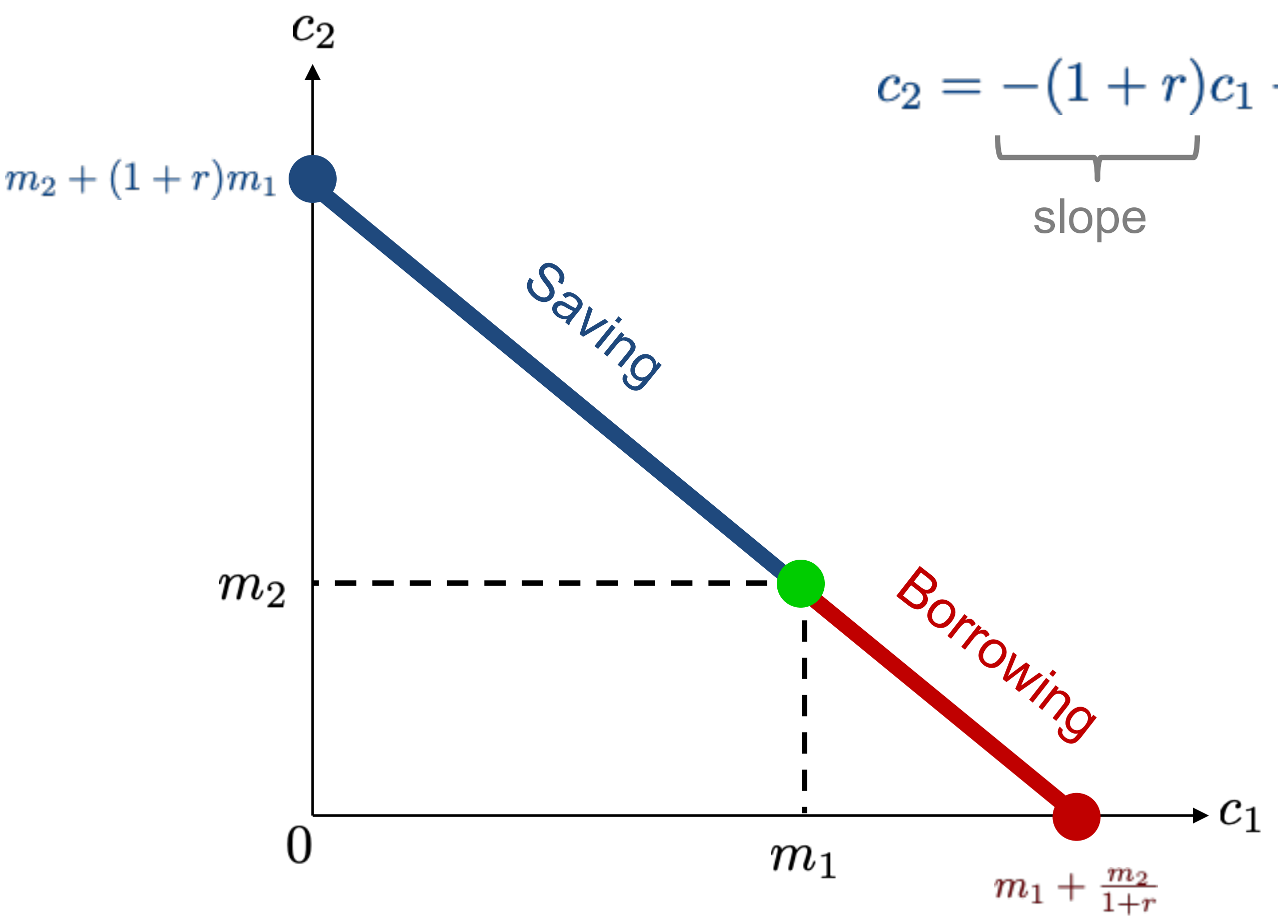
- More generally, suppose that c_1 units are consumed in period 1. This costs \$$c_1$ and leaves \$$m_1 - c_1$ saved. Period 2 consumption will then be

$$c_2 = m_2 + (1+r)(m_1 - c_1)$$

- Rearranging gives us,

$$c_2 = \underbrace{-(1+r)}_{\text{slope}}c_1 + \underbrace{m_2 + (1+r)m_1}_{\text{intercept}}$$

The Intertemporal Budget Constraint



$$c_2 = \underbrace{-(1+r)}_{\text{slope}} c_1 + \underbrace{m_2 + (1+r)m_1}_{\text{intercept}}$$

The Intertemporal Budget Constraint

- Now add prices p_1 and p_2 for consumption in periods 1 and 2
- (Assume that consumer received $\frac{m_1}{p_1}$ in period 1 and $\frac{m_2}{p_2}$ in period 2)
- How does this affect the budget constraint?

Intertemporal Choice

- Given her endowment (m_1,m_2) and prices (p_1, p_2), which intertemporal consumption bundle (c_1, c_2) will the consumer choose?

- Maximum possible expenditure in period 2 is

$$m_2 + (1+r)m_1$$

- So, maximum possible consumption in period 2 is

$$c_2 = \frac{m_2 + (1+r)m_1}{p_2}$$

Intertemporal Choice

- Maximum possible expenditure in period 1 is $m_1 + \frac{m_2}{1+r}$

- So, maximum possible consumption in period 1 is $c_1 = \frac{m_1 + \frac{m_2}{1+r}}{p_1}$

Intertemporal Choice

- Finally, if c_1 units are consumed in period 1 then the consumer spends \$$p_1c_1$ in period 1, leaving \$(m_1 - p_1c_1) saved for period 1. Available income in period 2 will then be

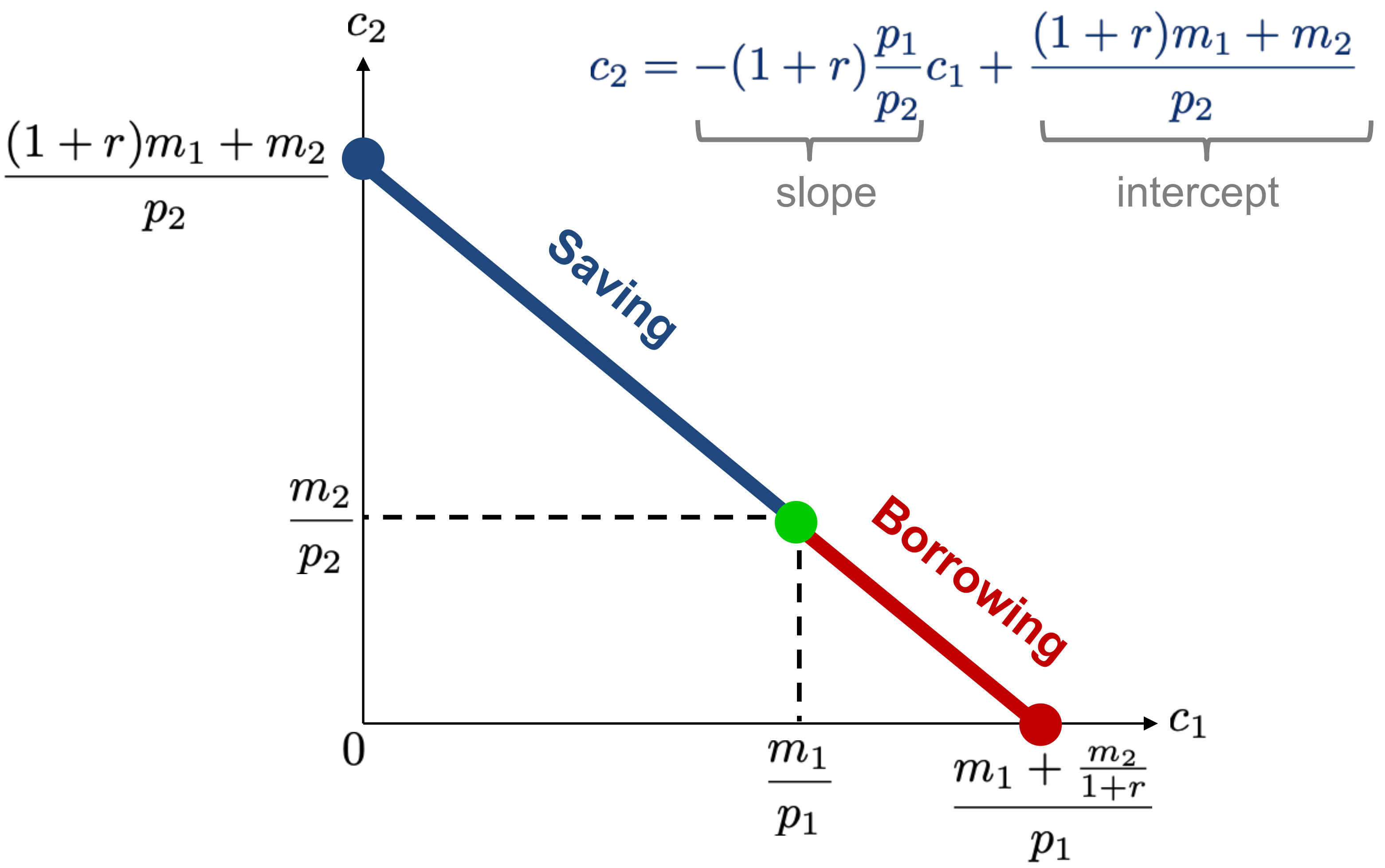
$$m_2 + (1+r)(m_1 - p_1c_1)$$

- So,

$$p_2c_2 = m_2 + (1+r)(m_1 - p_1c_1)$$

$$c_2 = -(1+r)\frac{p_1}{p_2}c_1 + \frac{(1+r)m_1 + m_2}{p_2}$$

The Intertemporal Budget Constraint



Price Inflation

- Define the inflation rate by π where $p_1(1+\pi) = p_2$

- For example,
  π = 0.2 means 20% inflation
  π = 1.0 means 100% inflation

Price Inflation

- We lose nothing by setting $p_1 = 1$, so that $p_2 = 1 + \pi$

- The budget constraint is given by

$$c_2 = -(1+r)\frac{p_1}{p_2}c_1 + \frac{(1+r)m_1 + m_2}{p_2}$$

- We can rewrite as $$c_2 = -\frac{1+r}{1+\pi}c_1 + \frac{(1+r)m_1 + m_2}{1+\pi}$$

- Slope of the intertemporal budget constraint: $-\frac{1+r}{1+\pi}$

Price Inflation

- When there was no price inflation (p_1=p_2=1), slope of budget constraint was

$$-(1+r)$$

- Now, with price inflation, slope of budget constraint is $-\frac{1+r}{1+\pi}$

- Define ρ such that $$-(1+\rho) = -\frac{1+r}{1+\pi}$$

ρ (rho) is known as the real interest rate

Real Interest Rate

$$-(1+\rho) = -\frac{1+r}{1+\pi} \quad \Longrightarrow \quad \rho = \frac{r-\pi}{1+\pi}$$

- For low inflation rates $(\pi \approx 0)$, $\rho \approx r - \pi$
- As inflation rate increases, this approximation becomes increasingly poor

Real Interest Rate

r	0.30	0.30	0.30	0.30	0.30
π	0.0	0.05	0.10	0.20	1.00
r - π	0.30	0.25	0.20	0.10	-0.70
$\rho = \frac{r-\pi}{1+\pi}$	0.30	0.24	0.18	0.08	-0.35

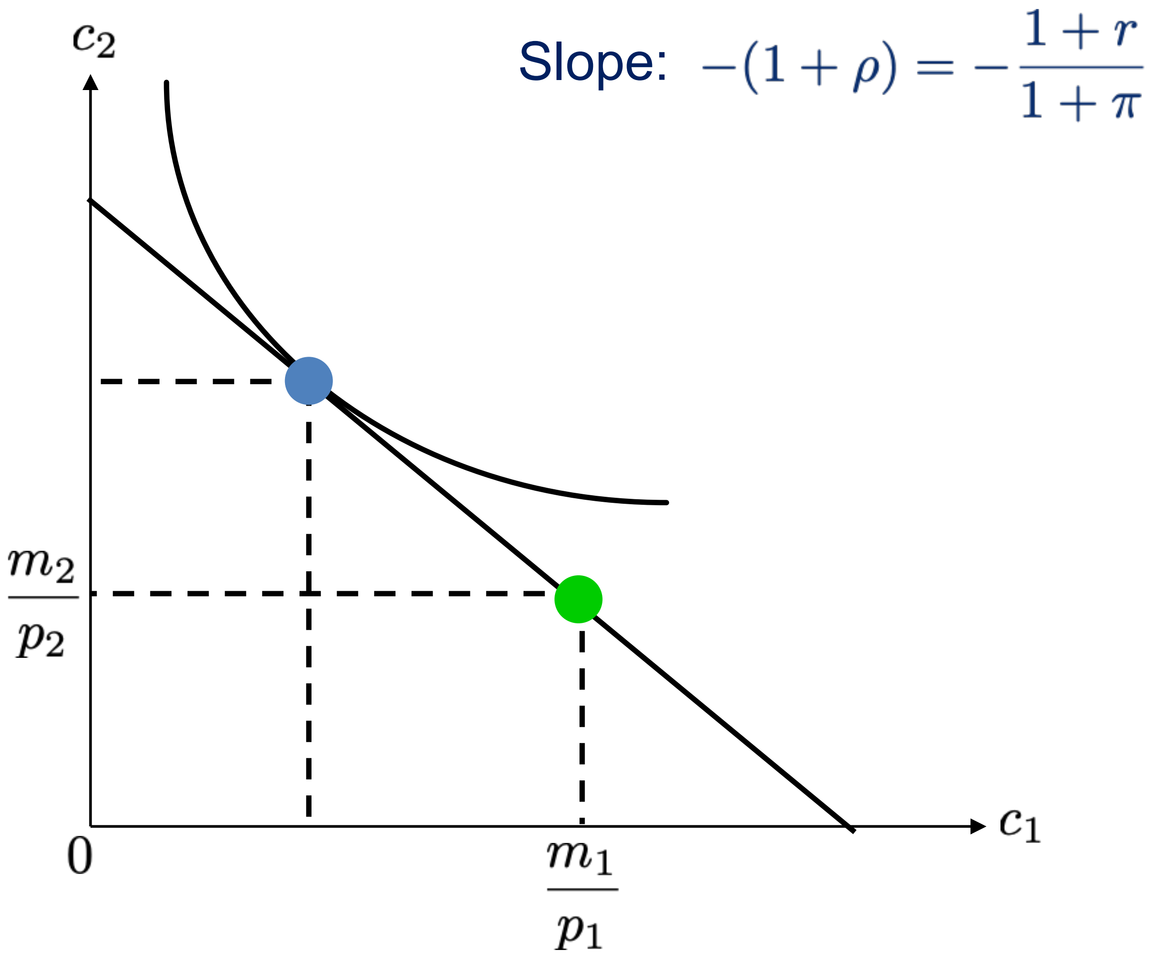
Comparative Statics

- The slope of the budget constraint is $-(1+\rho) = -\dfrac{1+r}{1+\pi}$

- The constraint becomes flatter if
  – the interest rate r falls or
  – the inflation rate π rises

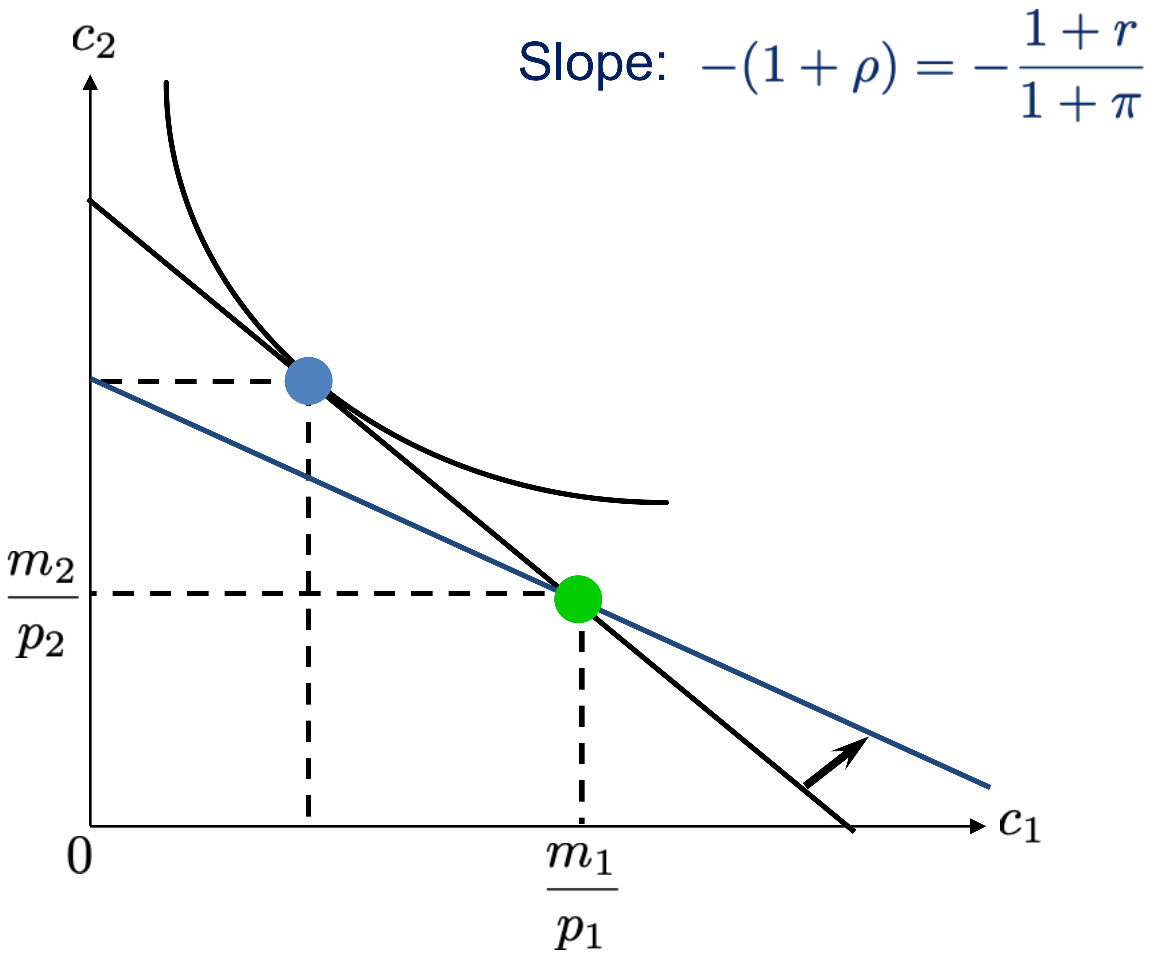
    (both decrease the real rate of interest)

Comparative Statics



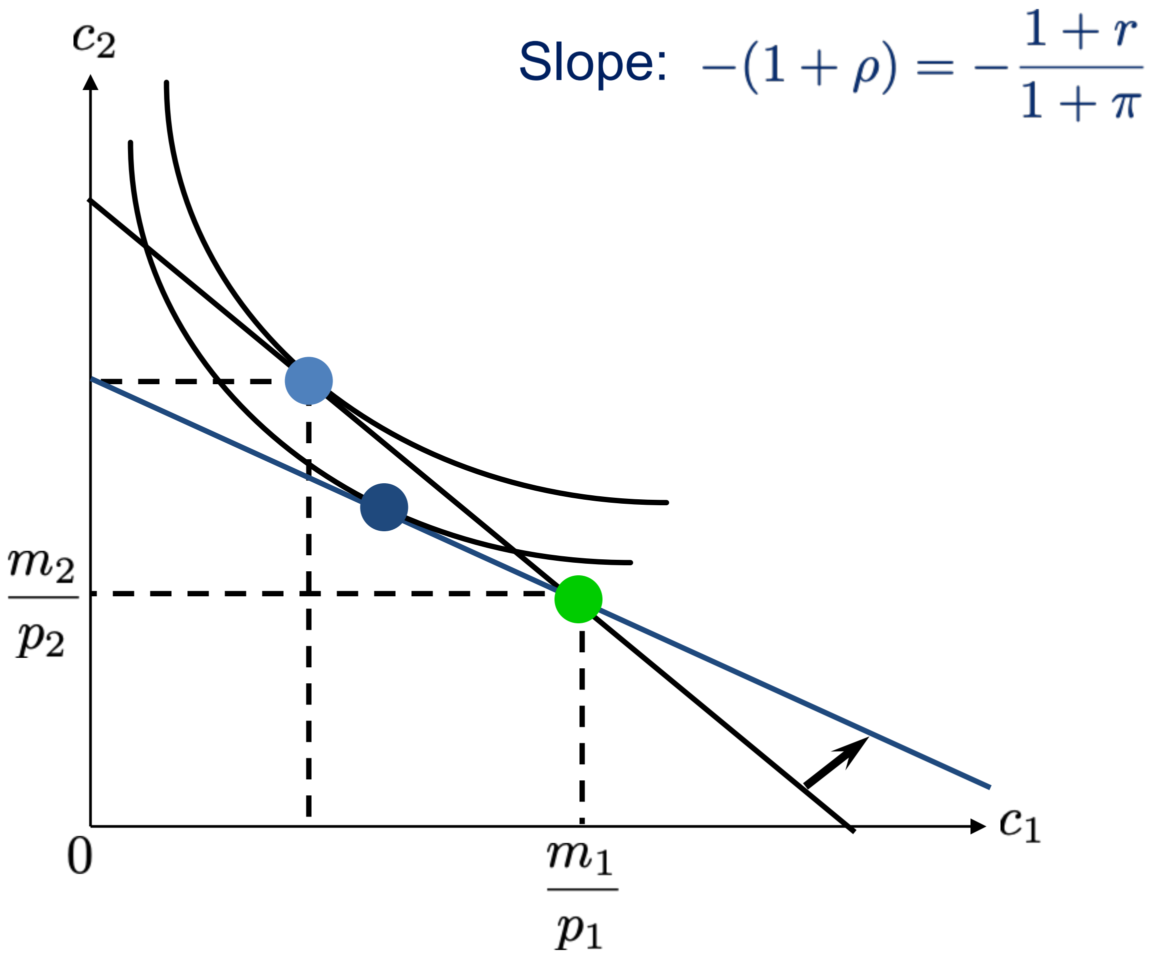
The consumer saves.

Comparative Statics



An increase in inflation rate or a decrease in interest rate <u>flattens</u> the budget constraint.

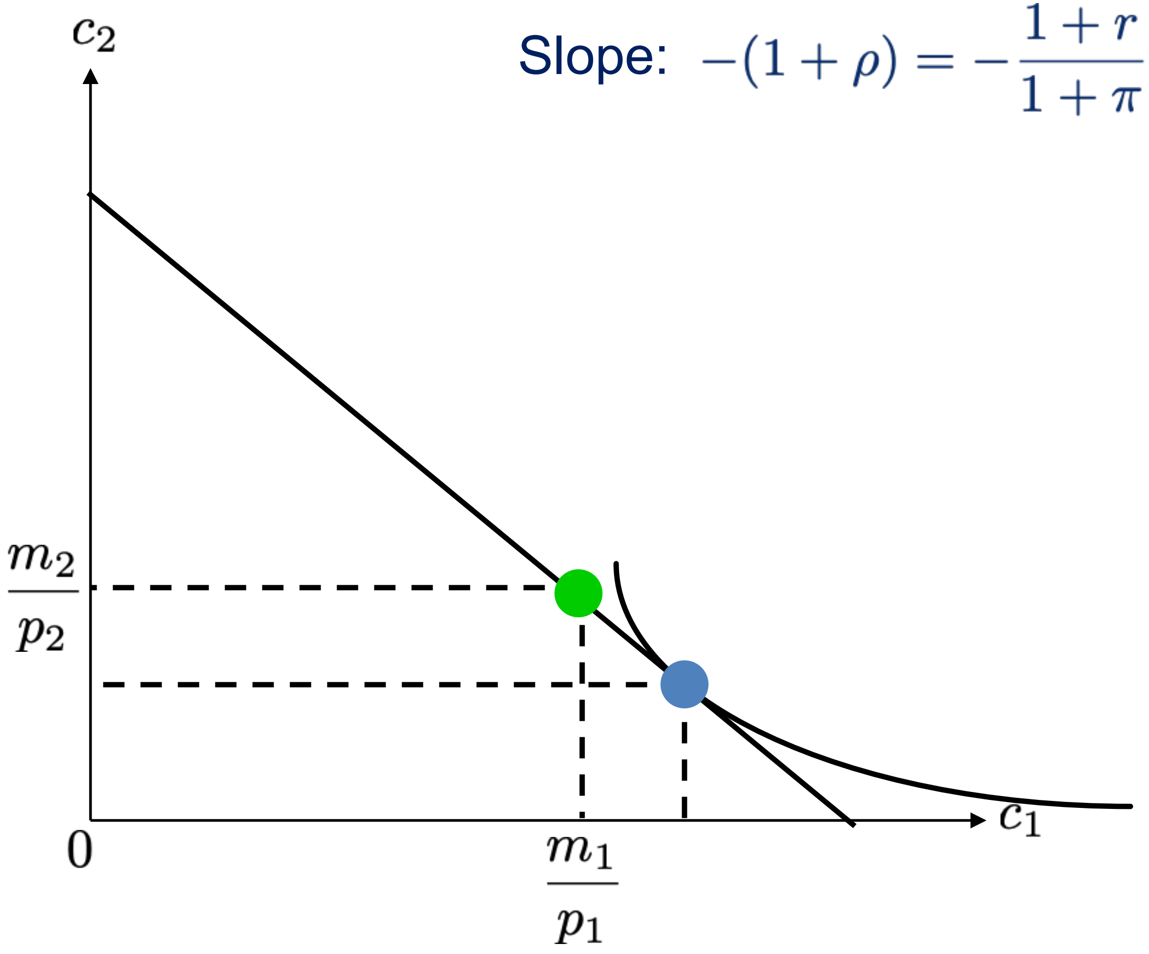
Comparative Statics



If the consumer saves, a lower interest rate or a higher inflation rate reduces welfare.

Comparative Statics

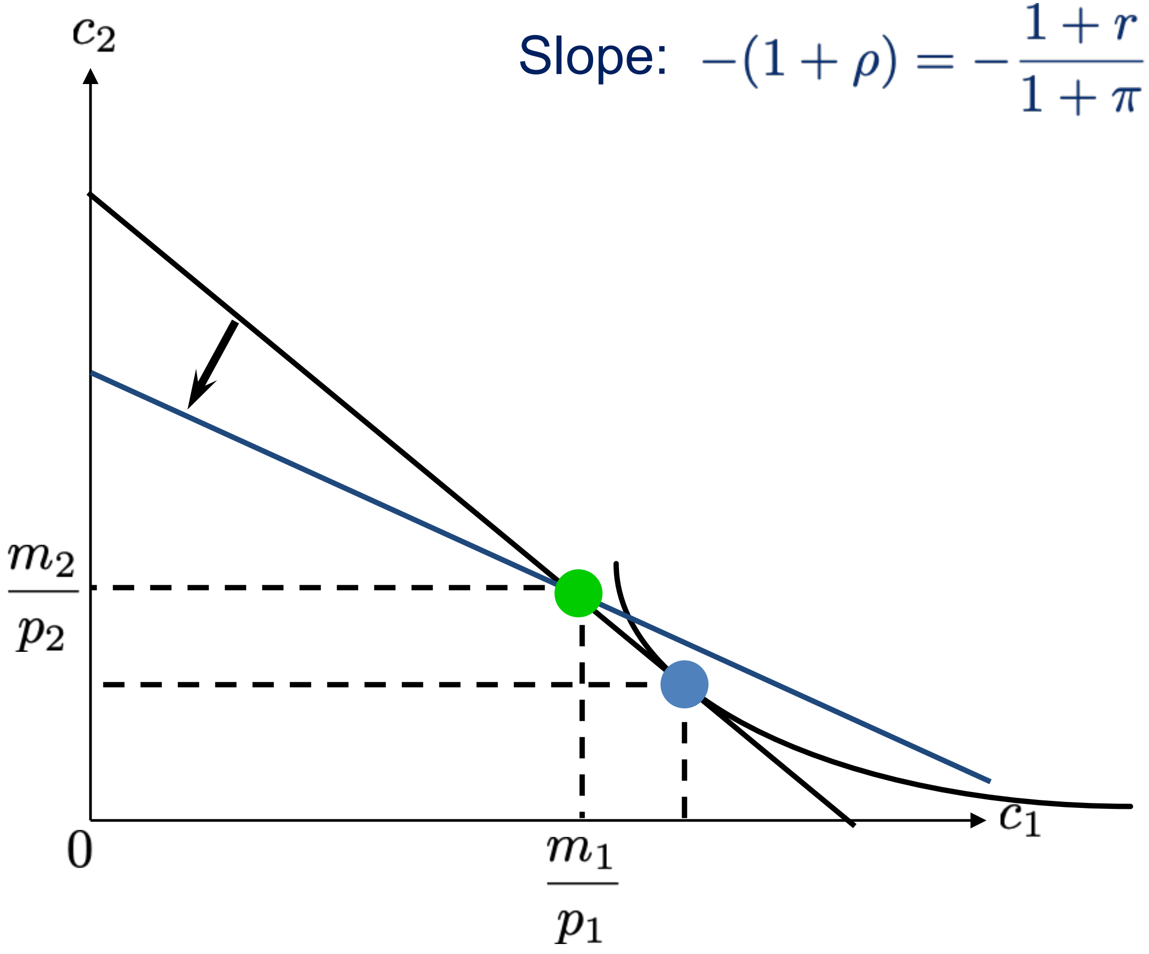
Slope: $-(1+\rho) = -\dfrac{1+r}{1+\pi}$



The consumer borrows.

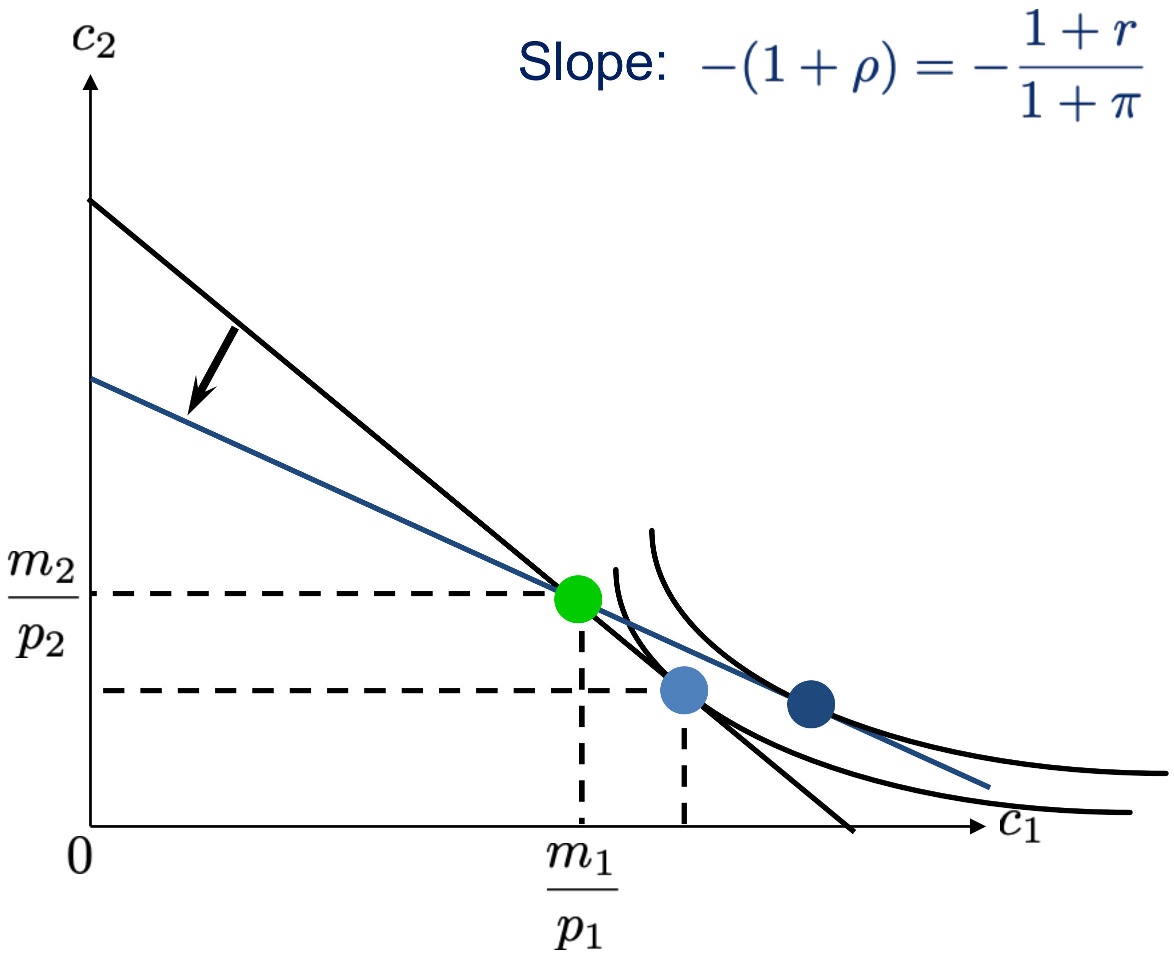
Comparative Statics

Slope: $-(1+\rho) = -\dfrac{1+r}{1+\pi}$



A fall in the interest rate or a rise in the inflation rate flatten the budget constraint.

Comparative Statics



If the consumer borrows, a lower interest rate or a higher inflation rate increases welfare.

Valuing Securities

- A security is a financial instrument that promises to deliver an income stream

- For example, a security that pays

  $\$m_1$ at the end of year 1

  $\$m_2$ at the end of year 2

  $\$m_3$ at the end of year 3

- What is the most that you should pay to buy this security?

Valuing Securities

- The PV of $\$m_1$ paid 1 year from now is $\dfrac{m_1}{(1+r)}$

- The PV of $\$m_2$ paid 2 years from now is $\dfrac{m_2}{(1+r)^2}$

- The PV of $\$m_3$ paid 3 years from now is $\dfrac{m_3}{(1+r)^3}$

- The PV of the security is therefore $\dfrac{m_1}{(1+r)} + \dfrac{m_2}{(1+r)^2} + \dfrac{m_3}{(1+r)^3}$

Valuing Bonds

- A bond is a special type of security that pays a fixed amount \$x for T-1 years (T: number of years to maturity) and then pays its face value \$F upon maturity

- What is the most that should now be paid for such a bond?

Valuing Bonds

End of Year	1	2	3	…	T-1	T
Income Paid	$\$x$	$\$x$	$\$x$	$\$x$	$\$x$	$\$F$
Present Value	$\frac{\$x}{(1+r)}$	$\frac{\$x}{(1+r)^2}$	$\frac{\$x}{(1+r)^3}$	…	$\frac{\$x}{(1+r)^{T-1}}$	$\frac{\$F}{(1+r)^T}$

$$PV = \frac{x}{(1+r)} + \frac{x}{(1+r)^2} + \frac{x}{(1+r)^3} + \ldots + \frac{x}{(1+r)^{T-1}} + \frac{F}{(1+r)^T}$$

Valuing Bonds

- Suppose you win a lottery

- The prize is \$1,000,000,
  but it is paid over 10 years in equal installments of \$100,000 each

- What is the prize actually worth?

$$PV = \frac{100,000}{(1+0.1)} + \frac{100,000}{(1+0.1)^2} + ... + \frac{100,000}{(1+0.1)^{10}}$$

$$= \$614,457$$

Valuing Consols

- A consol is a bond that never terminates, paying \$x per period forever

- What is a consol's present-value?

Valuing Consols

End of Year	1	2	3	…	t	…
Income Paid	$\$x$	$\$x$	$\$x$	$\$x$	$\$x$	$\$x$
PV	$\dfrac{\$x}{(1+r)}$	$\dfrac{\$x}{(1+r)^2}$	$\dfrac{\$x}{(1+r)^3}$	...	$\dfrac{\$x}{(1+r)^t}$	...

$$PV = \frac{x}{(1+r)} + \frac{x}{(1+r)^2} + \frac{x}{(1+r)^3} + ... + \frac{x}{(1+r)^t} + ...$$

Valuing Consols

Solving for PV gives $$PV = \frac{x}{r}$$

Valuing Consols

If r = 0.1 now and forever, the most you should pay now for a consol that provides $1000 per year is

$$PV = \frac{x}{r} = \frac{1000}{0.1} = \$10,000$$