EE311 Microeconomic Theory

Semester 1/2017

Network Externalities*

*We are grateful to Pindyck, Robert S. and Daniel E. Rubinfeld for the useful study material.

4.5 NETWORK EXTERNALITIES

- **network externality** When each individual's demand depends on the purchases of other individuals.

A *positive* network externality exists *if the quantity of a good demanded by a typical consumer increases in response to the growth in purchases of other consumers*. If the quantity demanded decreases, there is a *negative* network externality.

The Bandwagon Effect

- **bandwagon effect** Positive network externality in which a consumer wishes to possess a good in part because others do.

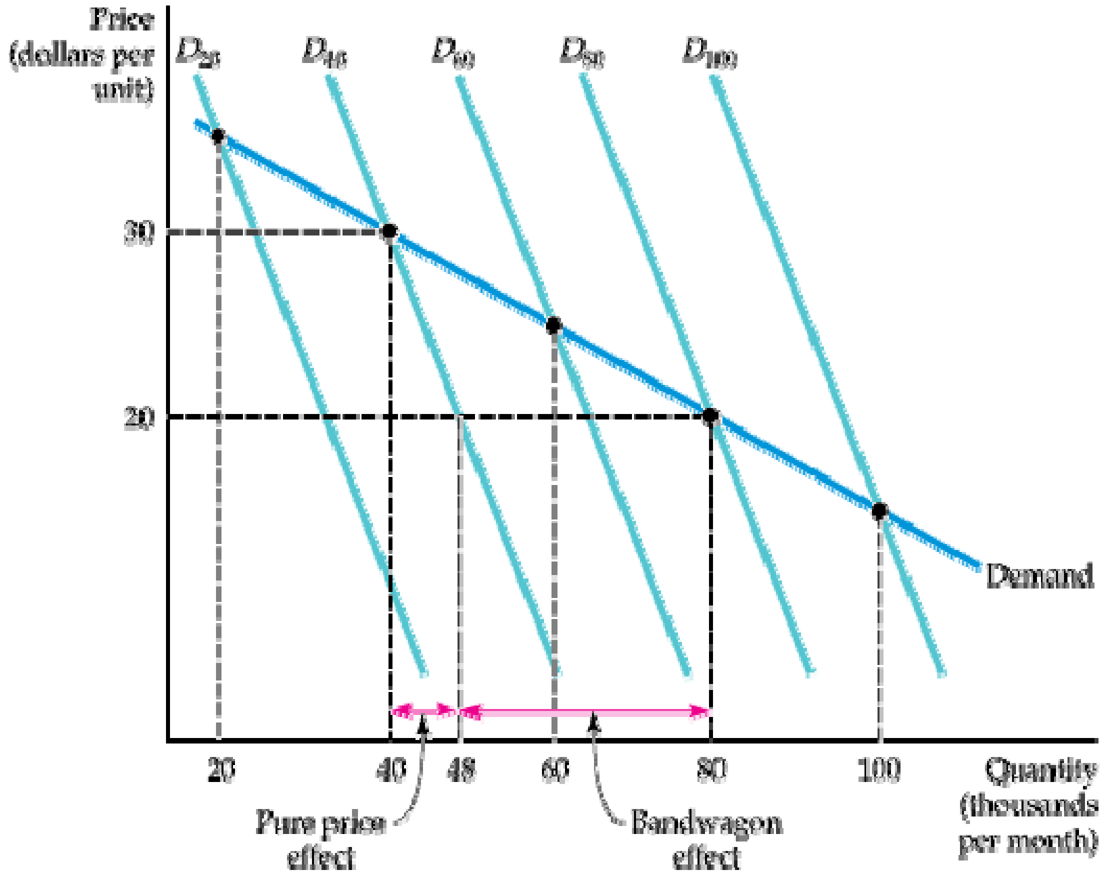
The Bandwagon Effect

Figure 4.16

Positive Network Externality: Bandwagon Effect

A bandwagon effect is a positive network externality in which the quantity of a good that an individual demands grows in response to the growth of purchases by other individuals.

Here, as the price of the product falls from $30 to $20, the bandwagon effect causes the demand for the good to shift to the right, from D_{40} to D_{80}.



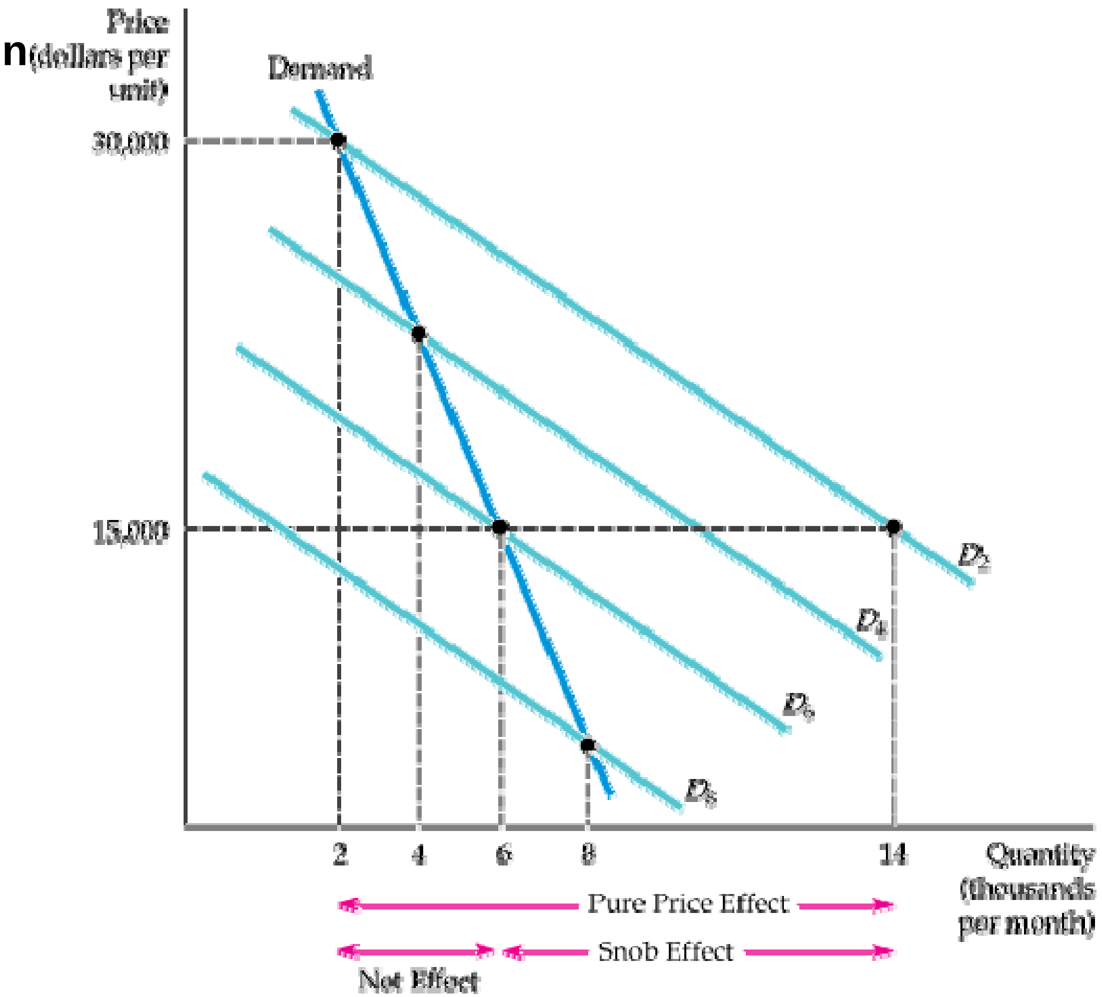
The Snob Effect

- **snob effect**

Negative network externality in which a consumer wishes to own an exclusive or unique good.

Figure 4.17

Negative Network Externality: Snob Effect



The snob effect is a negative network externality in which the quantity of a good that an individual demands falls in response to the growth of purchases by other individuals.

Here, as the price falls from \$30,000 to \$15,000 and more people buy the good, the snob effect causes the demand for the good to shift to the left, from D_2 to D_6.

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Intertemporal Choice*

*We are grateful to Hal Varian for the useful study material.

Intertemporal Choice

- **Persons often receive income in “lumps”; *e.g.* monthly salary.**
- **How is a lump of income spread over the following month (saving now for consumption later)?**
- **Or how is consumption financed by borrowing now against income to be received at the end of the month?**

Present and Future Values

- **Begin with some simple financial arithmetic.**
- **Take just two periods: 1 and 2.**
- **Let r denote the interest rate per period.**

Future Value

- **E.g., if r = 0.1 then $100 saved at the start of period 1 becomes $110 at the start of period 2.**
- **The value next period 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**

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

Present Value

- **Suppose you can pay now to obtain \$1 at the start of next period.**
- **What is the most you should pay?**
- **\$1?**
- **No. If you kept your \$1 now and saved it then at the start of next period you would have \$(1+r) > \$1, so paying \$1 now for \$1 next period is a bad deal.**

Present Value

- **Q: How much money would have to be saved now, in the present, to obtain \$1 at the start of the next period?**
- **A: \$m saved now becomes \$m(1+r) at the start of next period, so we want the value of m for which**

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

That is, $$m = 1/(1+r),$$

the present-value of \$1 obtained at the start of next period.

Present Value

- The present value of $1 available at the start of the next period is

- And the present value of $m available at the start of the next period is

Present Value

- **E.g., if r = 0.1 then the most you should pay now for $1 available next period is**

- **And if r = 0.2 then the most you should pay now for $1 available next period is**

The Intertemporal Choice Problem

- **Let m_1 and m_2 be incomes received in periods 1 and 2.**
- **Let c_1 and c_2 be consumptions in periods 1 and 2.**
- **Let p_1 and p_2 be the prices of consumption in periods 1 and 2.**

The Intertemporal Choice Problem

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

The Intertemporal Budget Constraint

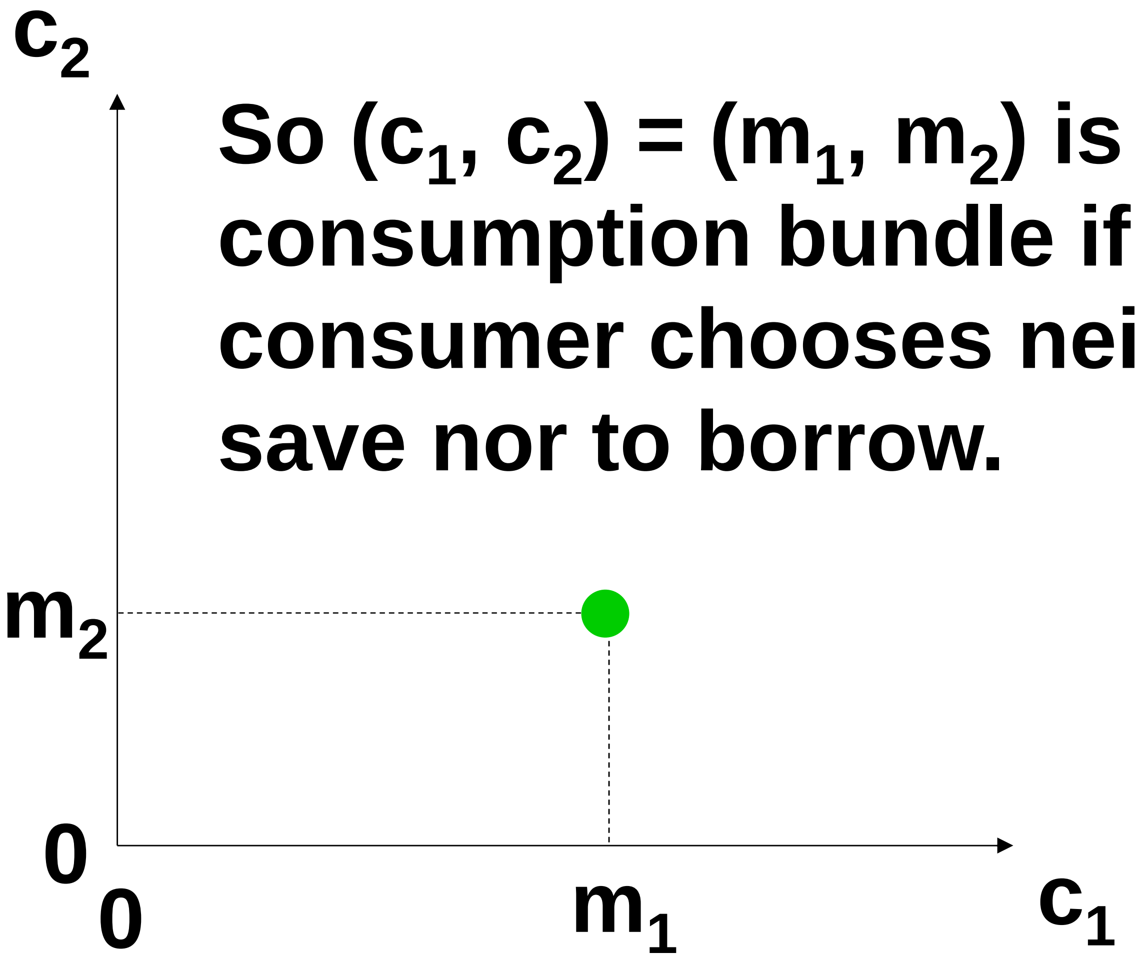
- **To start, let's ignore price effects by supposing that**

$$p_1 = p_2 = \$1.$$

The Intertemporal Budget Constraint

- **Suppose that the consumer chooses not to save or to borrow.**
- **Q: What will be consumed in period 1?**
- **A:**
- **Q: What will be consumed in period 2?**
- **A:**

The Intertemporal Budget Constraint



So $(c_1, c_2) = (m_1, m_2)$ is the consumption bundle if the consumer chooses neither to save nor to borrow.

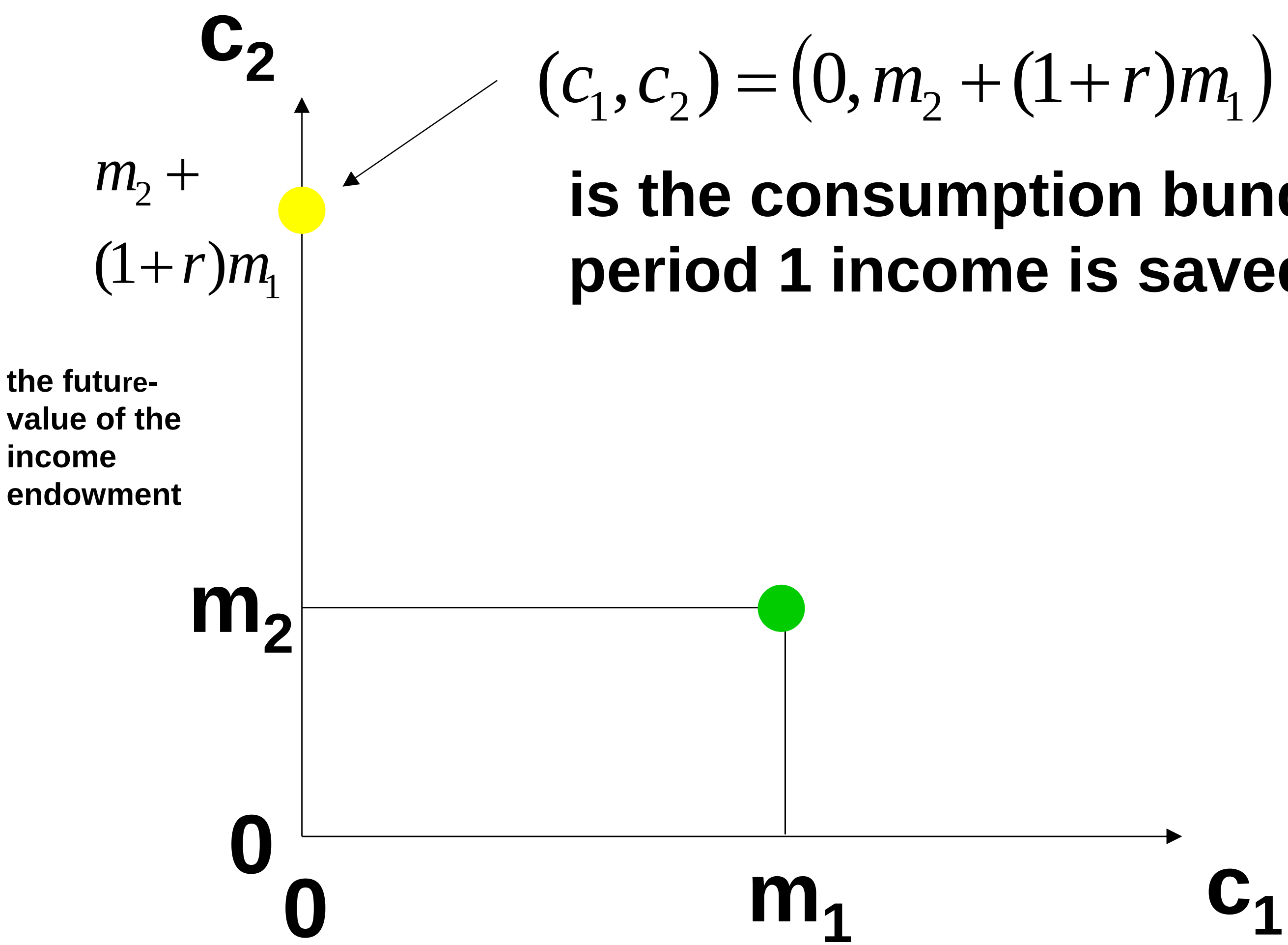
The Intertemporal Budget Constraint

- **Now suppose that the consumer spends nothing on consumption in period 1; that is, $c_1 = 0$ and the consumer saves**
  $$s_1 = m_1.$$
- **The interest rate is r.**
- **What now will be period 2's consumption level?**

The Intertemporal Budget Constraint

- **Period 2 income is m_2.**
- **Savings plus interest from period 1 sum to**
- **So total income available in period 2 is**
- **So period 2 consumption expenditure is**

The Intertemporal Budget Constraint



$$(c_1, c_2) = \left(0, m_2 + (1+r)m_1\right)$$

is the consumption bundle when all period 1 income is saved.

The Intertemporal Budget Constraint

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

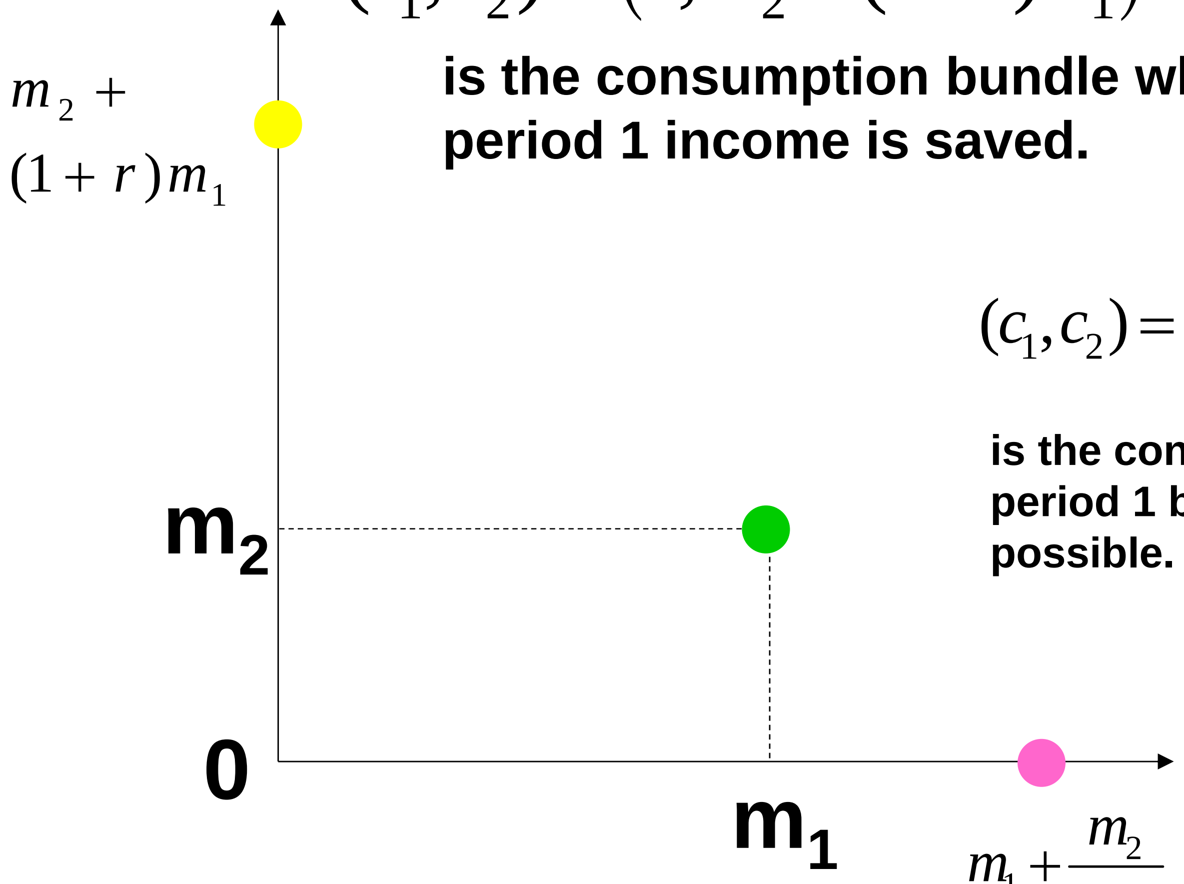
The Intertemporal Budget Constraint

- **Only \$$m_2$ will be available in period 2 to pay back \$$b_1$ borrowed in period 1.**
- **So $b_1(1 + r) = m_2$.**
- **That is, $b_1 = m_2 / (1 + r)$.**
- **So the largest possible period 1 consumption level is**

The Intertemporal Budget Constraint

$$(c_1, c_2) = \left(0, m_2 + (1+r)m_1\right)$$

is the consumption bundle when all period 1 income is saved.



$$(c_1, c_2) = \left(m_1 + \frac{m_2}{1+r}, 0\right)$$

is the consumption bundle when period 1 borrowing is as big as possible.

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

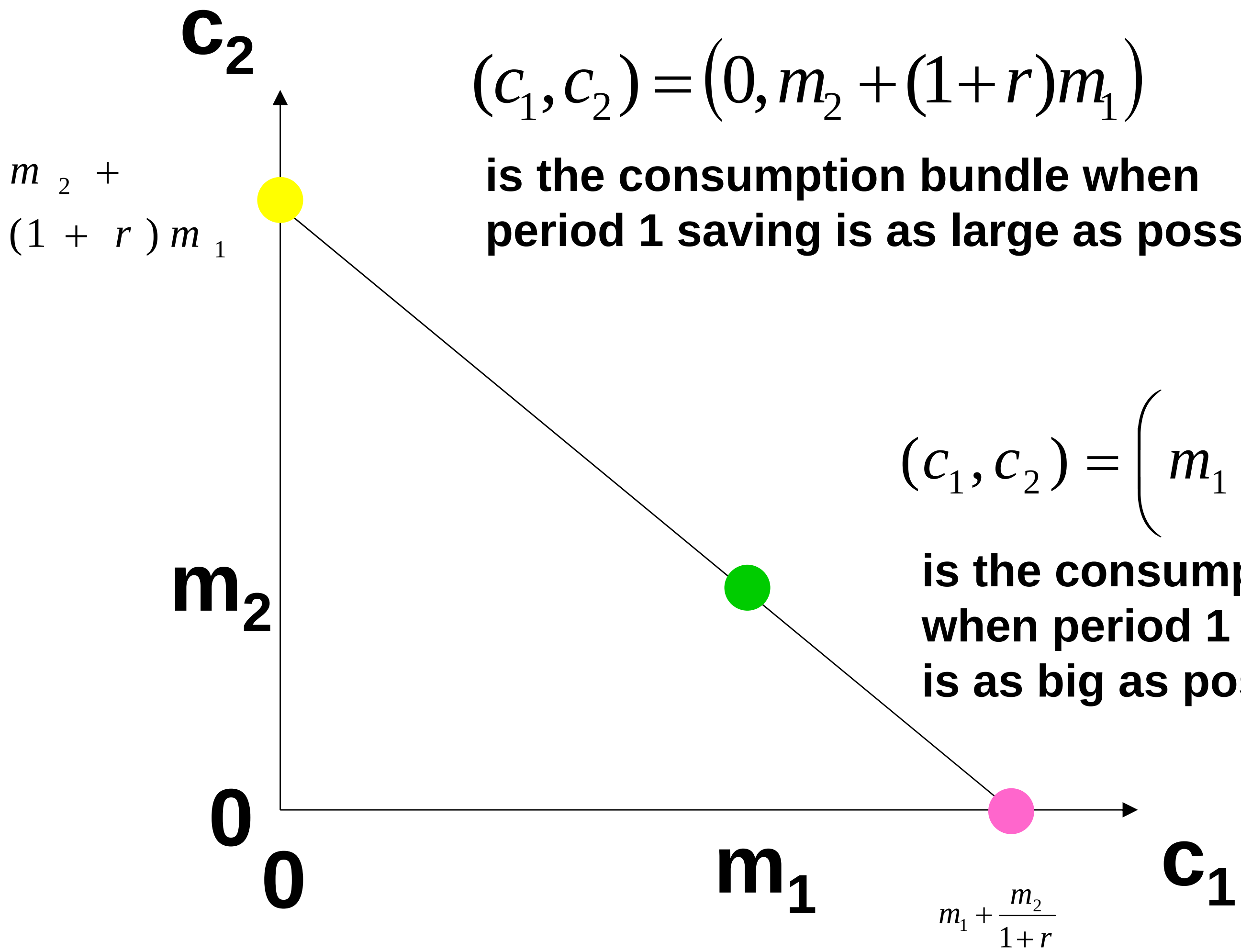
the present-value of the income endowment

The Intertemporal Budget Constraint

- **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**

which is

The Intertemporal Budget Constraint



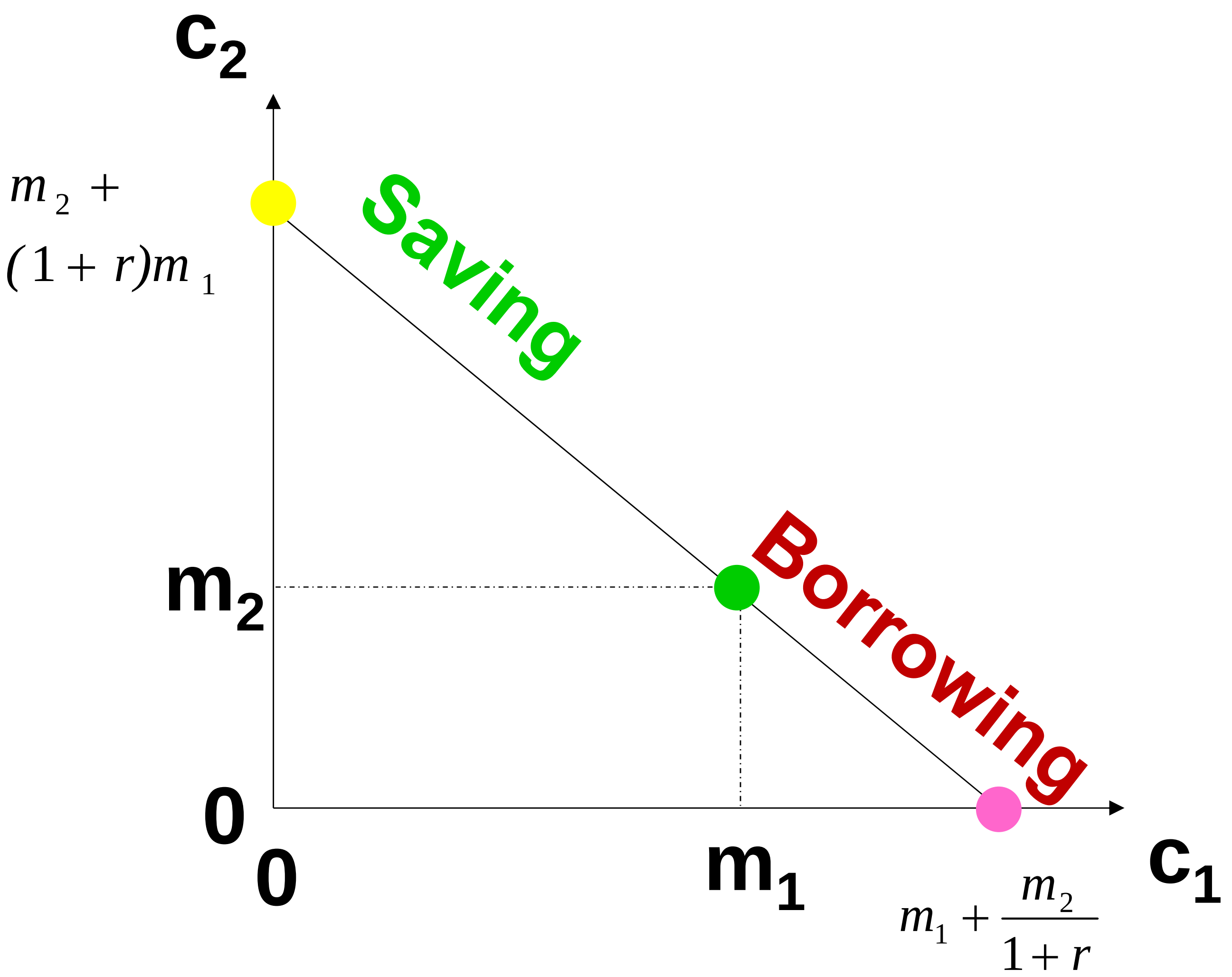
$$(c_1, c_2) = \left(0, m_2 + (1+r)m_1\right)$$

is the consumption bundle when period 1 saving is as large as possible.

$$(c_1, c_2) = \left(m_1 + \frac{m_2}{1+r}, 0\right)$$

is the consumption bundle when period 1 borrowing is as big as possible.

The Intertemporal Budget Constraint



The Intertemporal Budget Constraint

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

is the "future-valued" form of the budget constraint since all terms are in period 2 values. This is equivalent to

which is the "present-valued" form of the constraint since all terms are in period 1 values.

The Intertemporal Budget Constraint

- **Now let's add prices p_1 and p_2 for consumption in periods 1 and 2.**
- **How does this affect the budget constraint?**

Intertemporal Choice

- **Given her endowment (m_1,m_2) and prices p_1, p_2 what intertemporal consumption bundle (c_1^*,c_2^*) will be chosen by the consumer?**
- **Maximum possible expenditure in period 2 is**
  so maximum possible consumption in period 2 is

Intertemporal Choice

- **Similarly, maximum possible expenditure in period 1 is**

  so maximum possible consumption in period 1 is

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**

  so

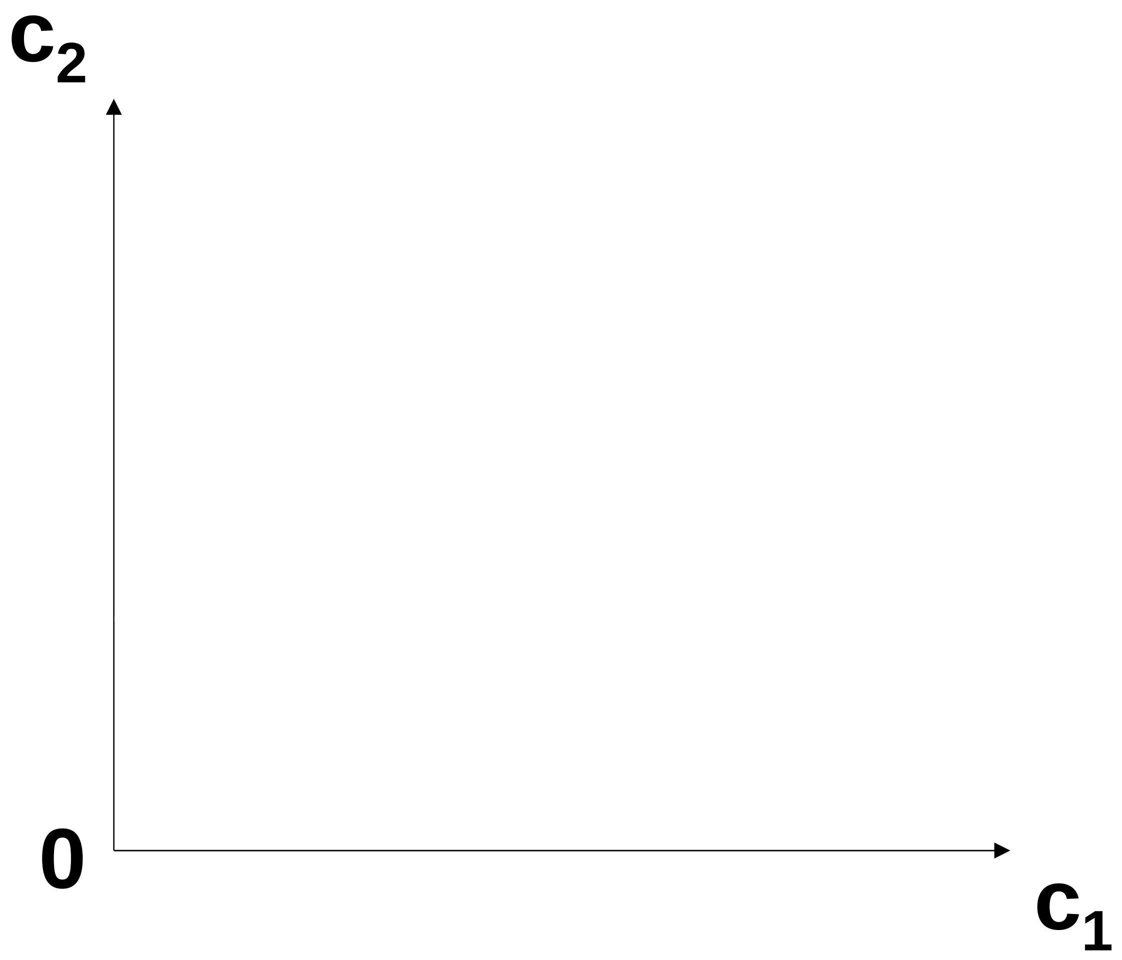
Intertemporal Choice

rearranged is

This is the "future-valued" form of the budget constraint since all terms are expressed in period 2 values. Equivalent to it is the "present-valued" form:

where all terms are expressed in period 1 values.

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, and
  π = 1.0 means 100% inflation.

Price Inflation

- **We lose nothing by setting p_1=1 so that p_2 = 1+ π .**
- **Then we can rewrite the budget constraint**

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

as

$$c_1 + \frac{1+\pi}{1+r} c_2 = m_1 + \frac{m_2}{1+r}$$

Price Inflation

$$c_1 + \frac{1+\pi}{1+r} c_2 = m_1 + \frac{m_2}{1+r}$$

rearranges to

$$c_2 = -\frac{1+r}{1+\pi} c_1 + (1+\pi)\left(\frac{m_1}{1+r} + m_2\right)$$

so the slope of the intertemporal budget constraint is

Price Inflation

- **When there was no price inflation ($p_1=p_2=1$) the slope of the budget constraint was -(1+r).**
- **Now, with price inflation, the slope of the budget constraint is -(1+r)/(1+ π). This can be written as**

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

ρ is known as the real interest rate.

Real Interest Rate

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

gives

$$\rho = \frac{r - \pi}{1 + \pi}.$$

For low inflation rates ($\pi \approx 0$), $\rho \approx r - \pi$. For higher inflation rates this approximation becomes 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**
ρ	**0.30**	**0.24**	**0.18**	**0.08**	**-0.35**

Comparative Statics

- **The slope of the budget constraint is**

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

- **The constraint becomes flatter if the interest rate r falls or the inflation rate π rises (both decrease the real rate of interest).**

Keynes Vs. Fisher

Keynes:
current consumption depends only on current income

Fisher:
current consumption depends only on
the present value of lifetime income;
the timing of income is irrelevant
because the consumer can borrow or lend between
periods.

Comparative Statics

Comparative Statics

Valuing Securities

- **A financial security is a financial instrument that promises to deliver an income stream.**
- **E.g.; a security that pays**
  $\$m_1$ at the end of year 1,
  $\$m_2$ at the end of year 2, and
  $\$m_3$ at the end of year 3.
- **What is the most that should be paid now for this security?**

Valuing Securities

- **The security is equivalent to the sum of three securities;**
  - **the first pays only \$$m_1$ at the end of year 1,**
  - **the second pays only \$$m_2$ at the end of year 2, and**
  - **the third pays only \$$m_3$ at the end of year 3.**

Valuing Securities

- **The PV of $\$m_1$ paid 1 year from now is**

$$m_1/(1+r)$$

- **The PV of $\$m_2$ paid 2 years from now is**

$$m_2/(1+r)^2$$

- **The PV of $\$m_3$ paid 3 years from now is**

$$m_3/(1+r)^3$$

- **The PV of the security is therefore**

Valuing Bonds

- A bond is a special type of security that pays a fixed amount $x for T years (its maturity date) and then pays its face value $F.
- 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	$\frac{\$x}{1+r}$	$\frac{\$x}{(1+r)^2}$	$\frac{\$x}{(1+r)^3}$	…	$\frac{\$x}{(1+r)^{T-1}}$	$\frac{\$F}{(1+r)^T}$

Valuing Bonds

- **Suppose you win a State 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?**

Valuing Bonds

is the actual (present) value of the prize.

Valuing Consols

- A consol is a bond which 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
Present Value	$\frac{\$x}{1+r}$	$\frac{\$x}{(1+r)^2}$	$\frac{\$x}{(1+r)^3}$	…	$\frac{\$x}{(1+r)^t}$	…

Valuing Consols

$$
\begin{aligned}
PV &= \frac{x}{1+r} + \frac{x}{(1+r)^2} + \frac{x}{(1+r)^3} + \ldots \\
&= \frac{1}{1+r}\left[x + \frac{x}{1+r} + \frac{x}{(1+r)^2} + \ldots \right] \\
&= \frac{1}{1+r}\left[x + PV \right].
\end{aligned}
$$

Solving for PV gives

Valuing Consols

E.g. if r = 0.1 now and forever then the most that should be paid now for a console that provides $1000 per year is

References

On Network Externalities: Pindyck, Robert S. and Daniel E. Rubinfeld. Microeconomics, (7th ed.), New Jersey: Prentice -Hall, 2008

On Intertemporal Choice: Varian, Hal Intermediate Microeconomics, (5th ed.) New York: Norton, 1999.