Intertemporal consumption and investment
EE 311

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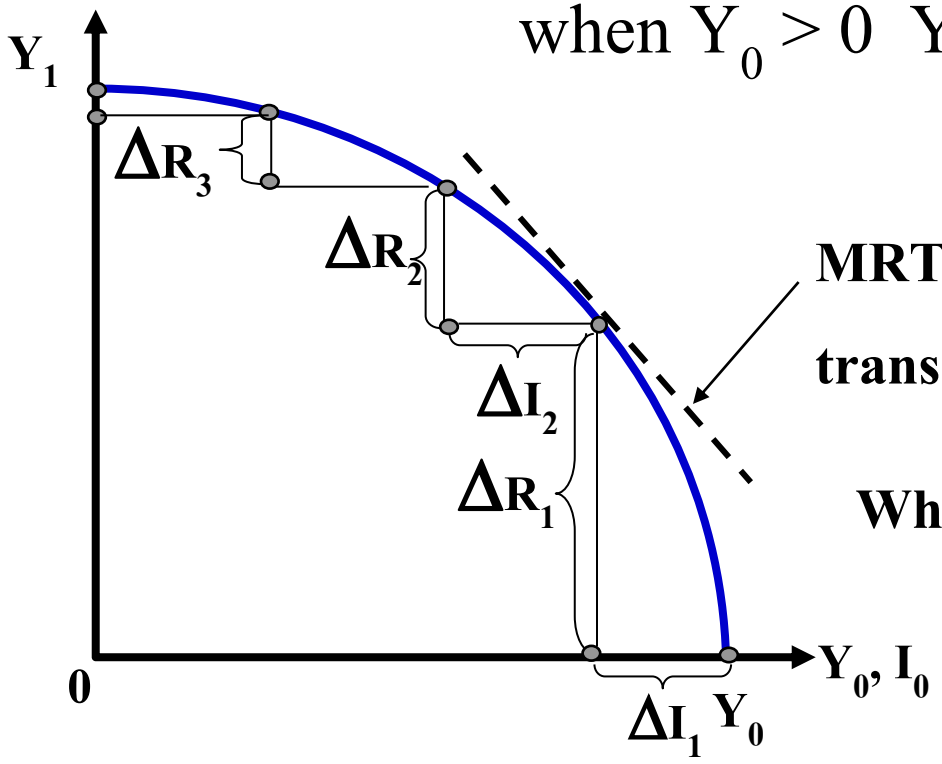
Consumption, saving and investment equilibrium

1) Assume no money market but there are investment opportunities.

Investment Possibility Frontier

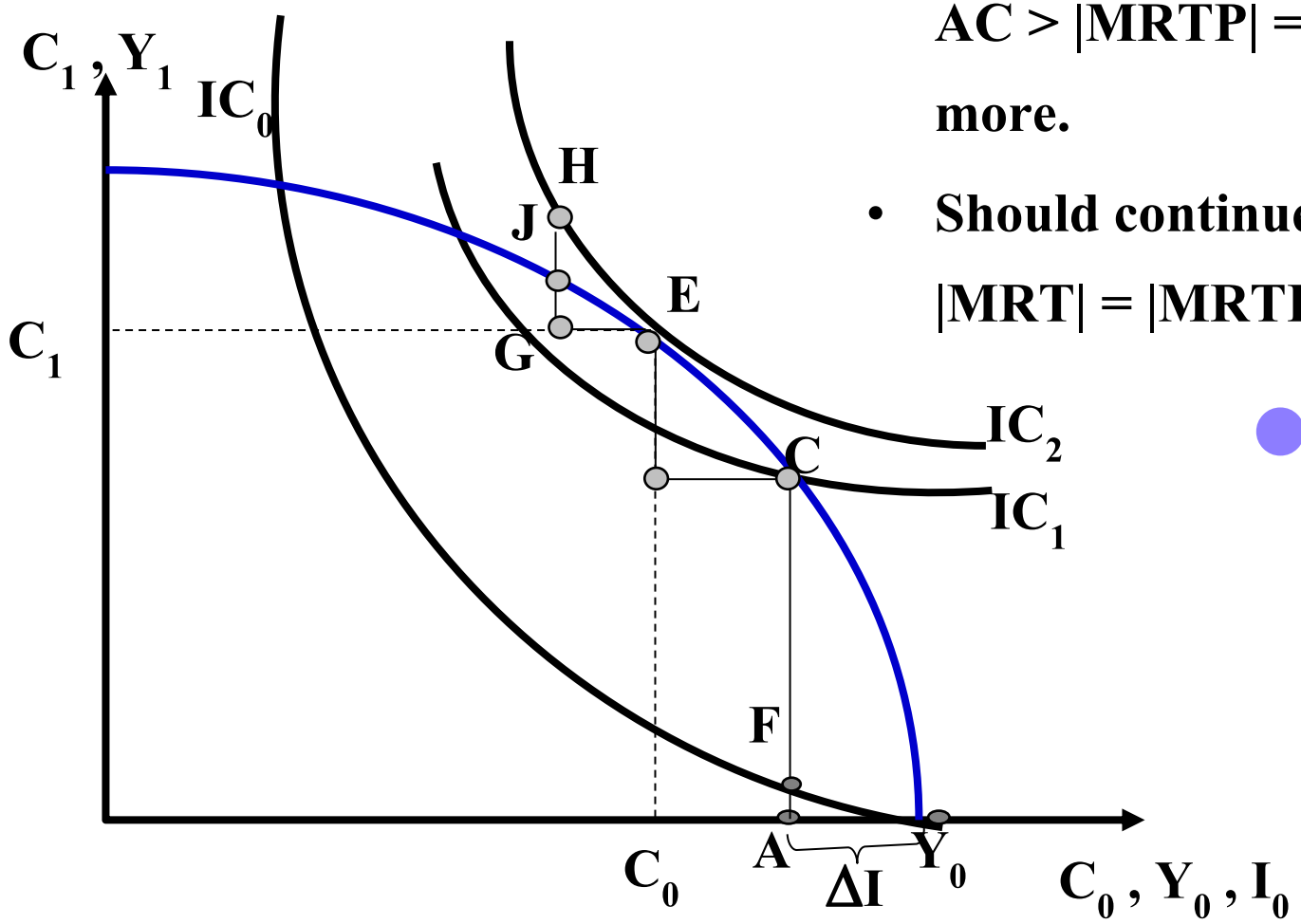
when $Y_0 > 0$ $Y_1 = 0$



MRT: marginal rate of transformation

What if the $Y_1 > 0$?

Consumption, saving and investment equilibrium



- **The return on investment is AC > |MRTP| = FA --> invest more.**
- **Should continue to invest until |MRT| = |MRTP| at point E.**

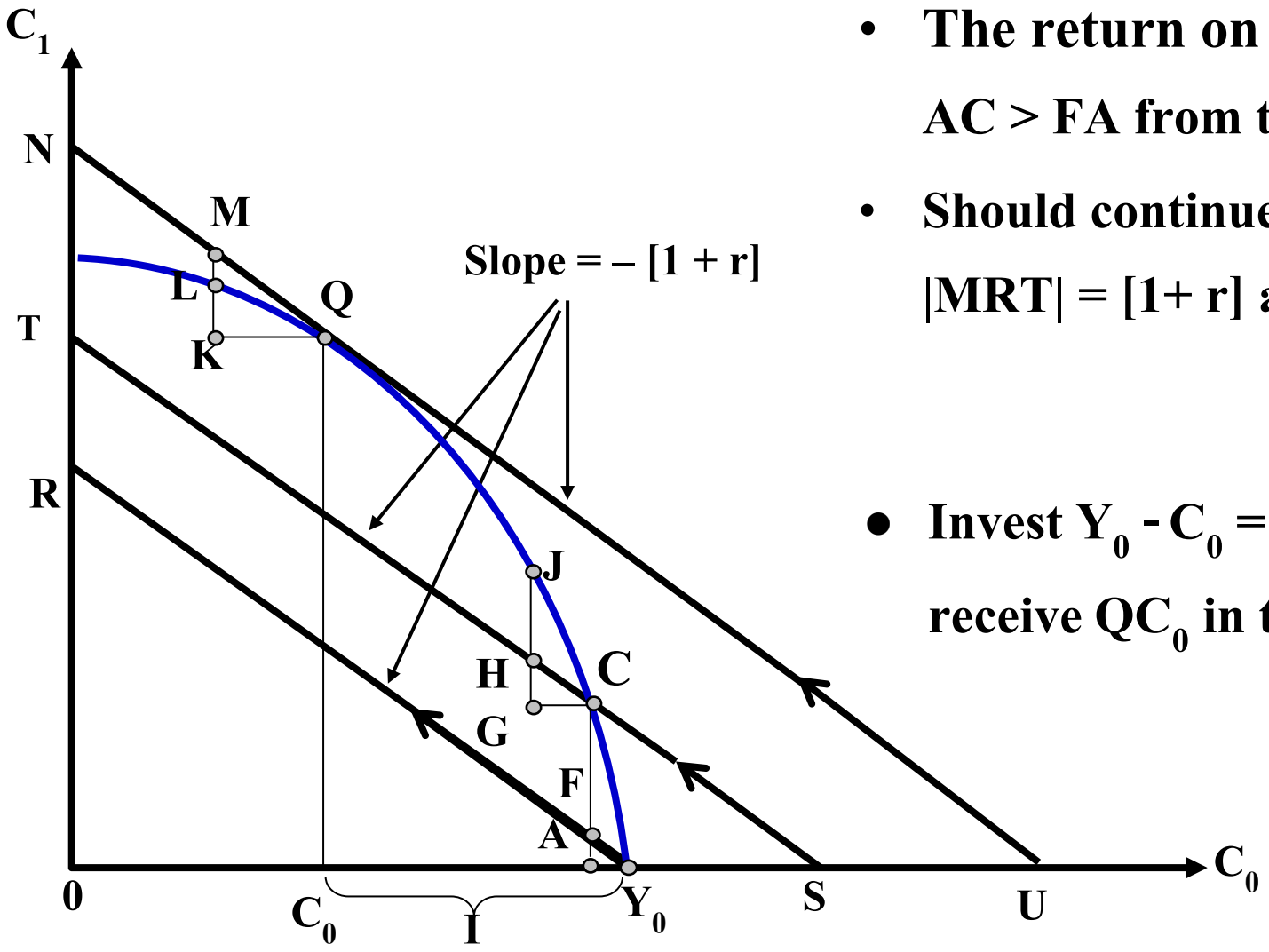
- **Consume C_0, C_1 by investing $Y_0 - C_0$ now and receiving EC_0 in the future.**

Consumption, saving and investment equilibrium

2) There are money market and investment opportunities.

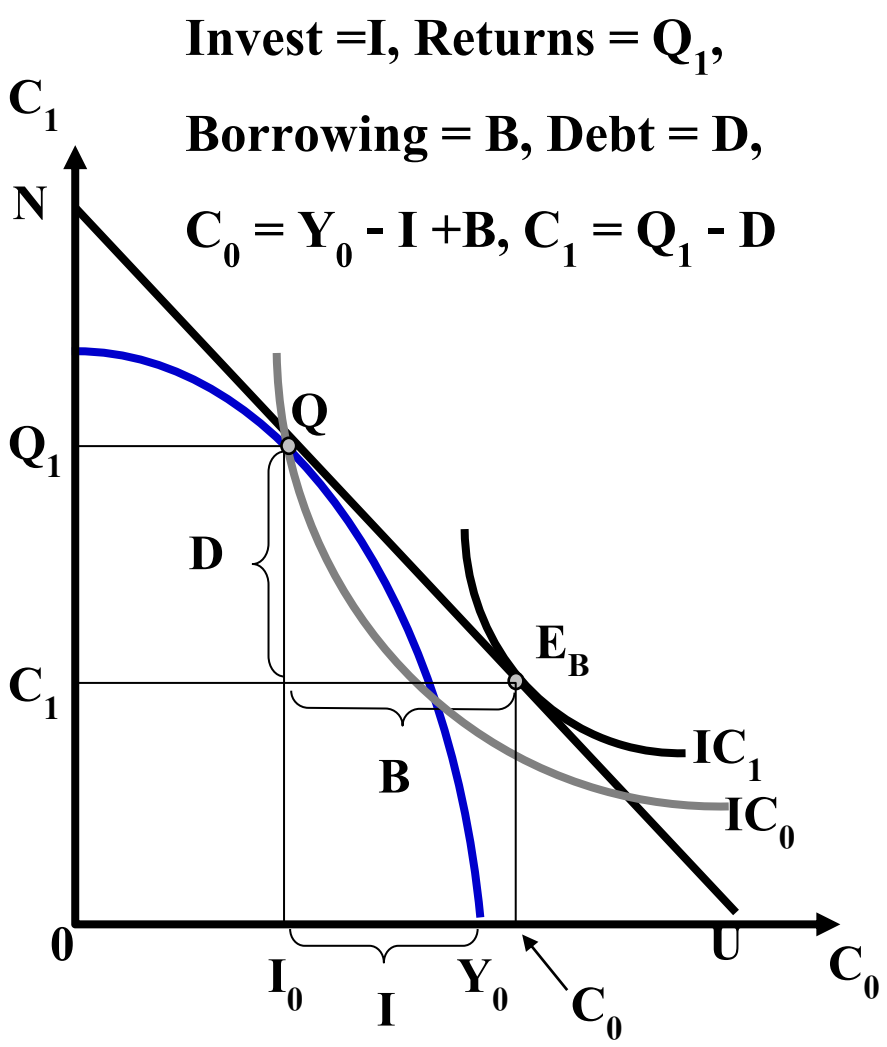
- The interest rate is r, the rate of returns on investment depends on the size of investment, given by MRT.
- The consumer needs to choose among consumption, investment, lending or borrowing.

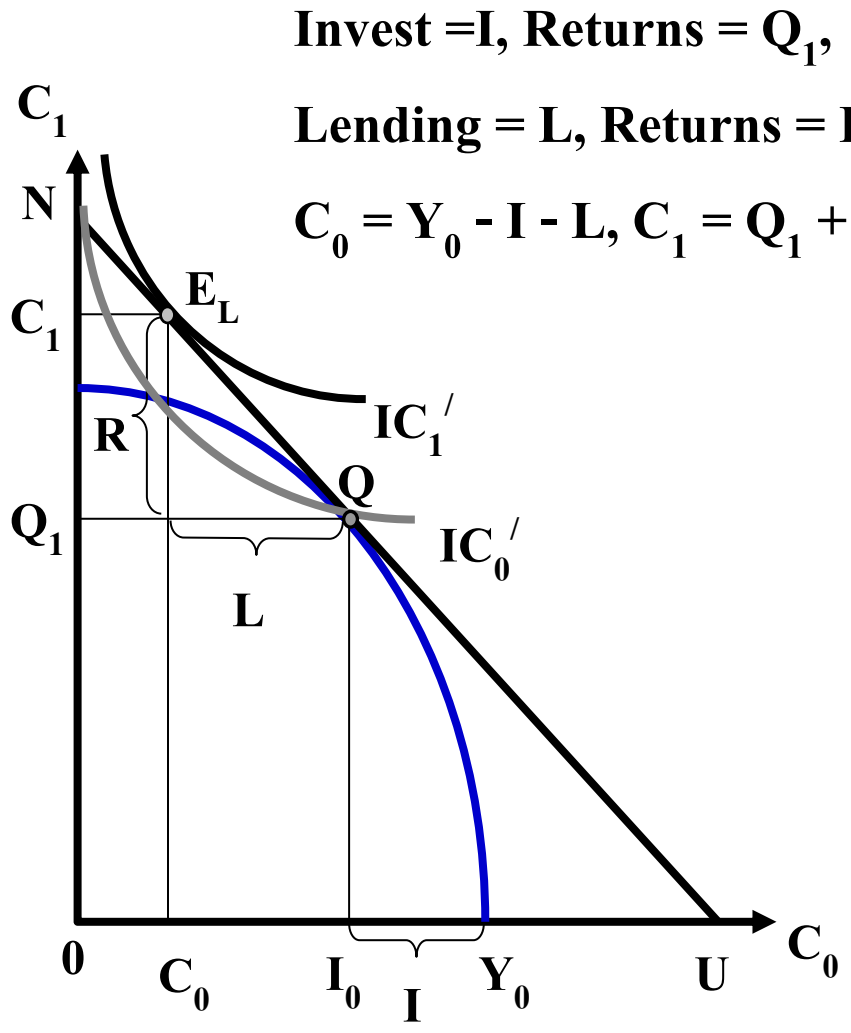
Consumption, saving and investment equilibrium



- The return on investment is AC > FA from the money market.
- Should continue to invest until |MRT| = [1+ r] at point Q.
- Invest $Y_0 - C_0 = I$ now, and receive QC_0 in the future.

Consumption, saving and investment equilibrium





Present Value (PV)

- Determining the value today of a future flow of income
  - The value of a future payment must be discounted for the time period and interest rate that could be earned.
    - Interest rate – rate at which one can borrow or lend money

Present Value (PV)

Future Dollar Value of \$1 invested today $= (1 + r)^n$

where n = Number of year in future.

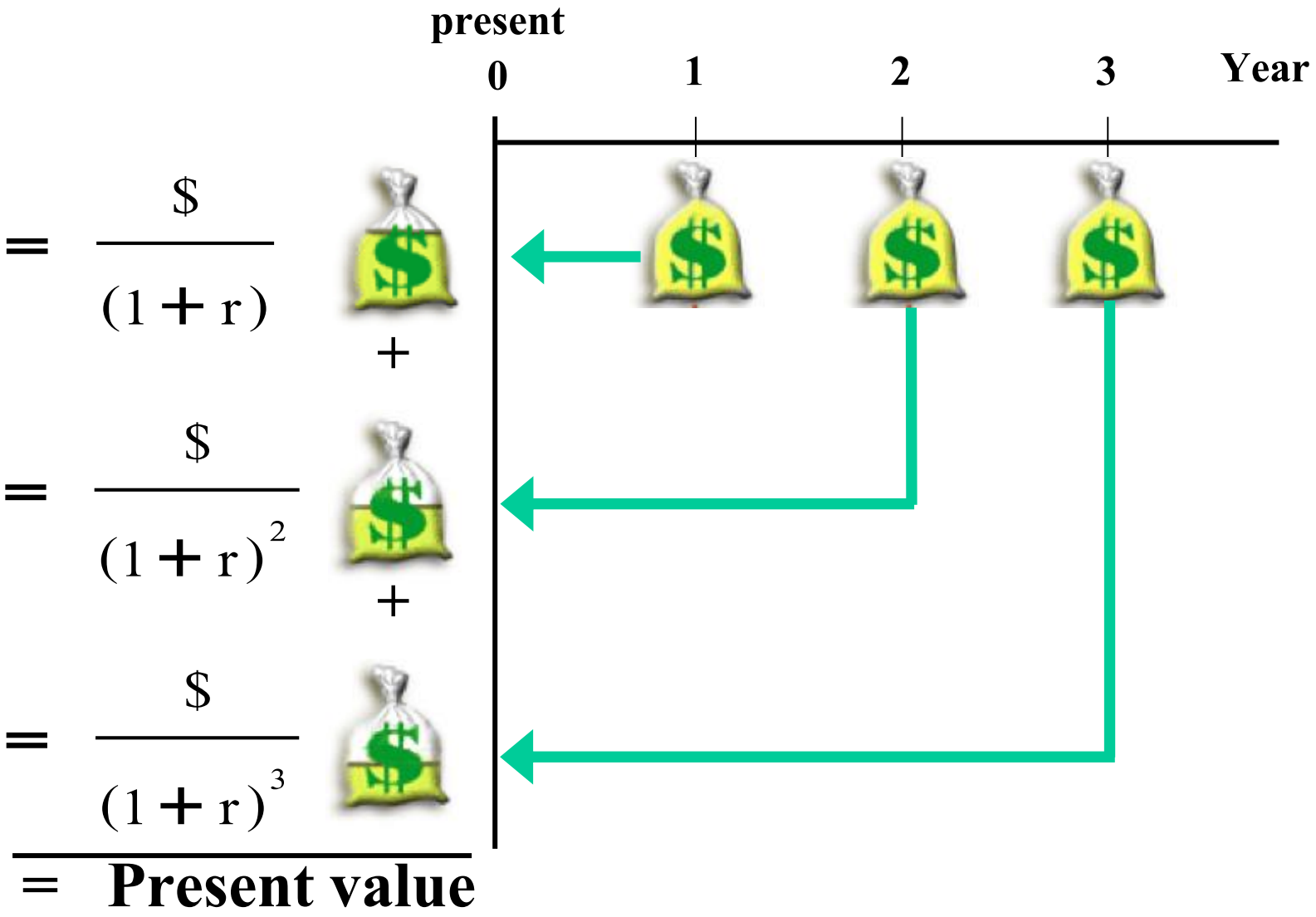
PV = Present dollar value of \$1 received

in the future $= \frac{1}{(1 + r)^n}$; (how much would you have to invest today to have a dollar in the future)

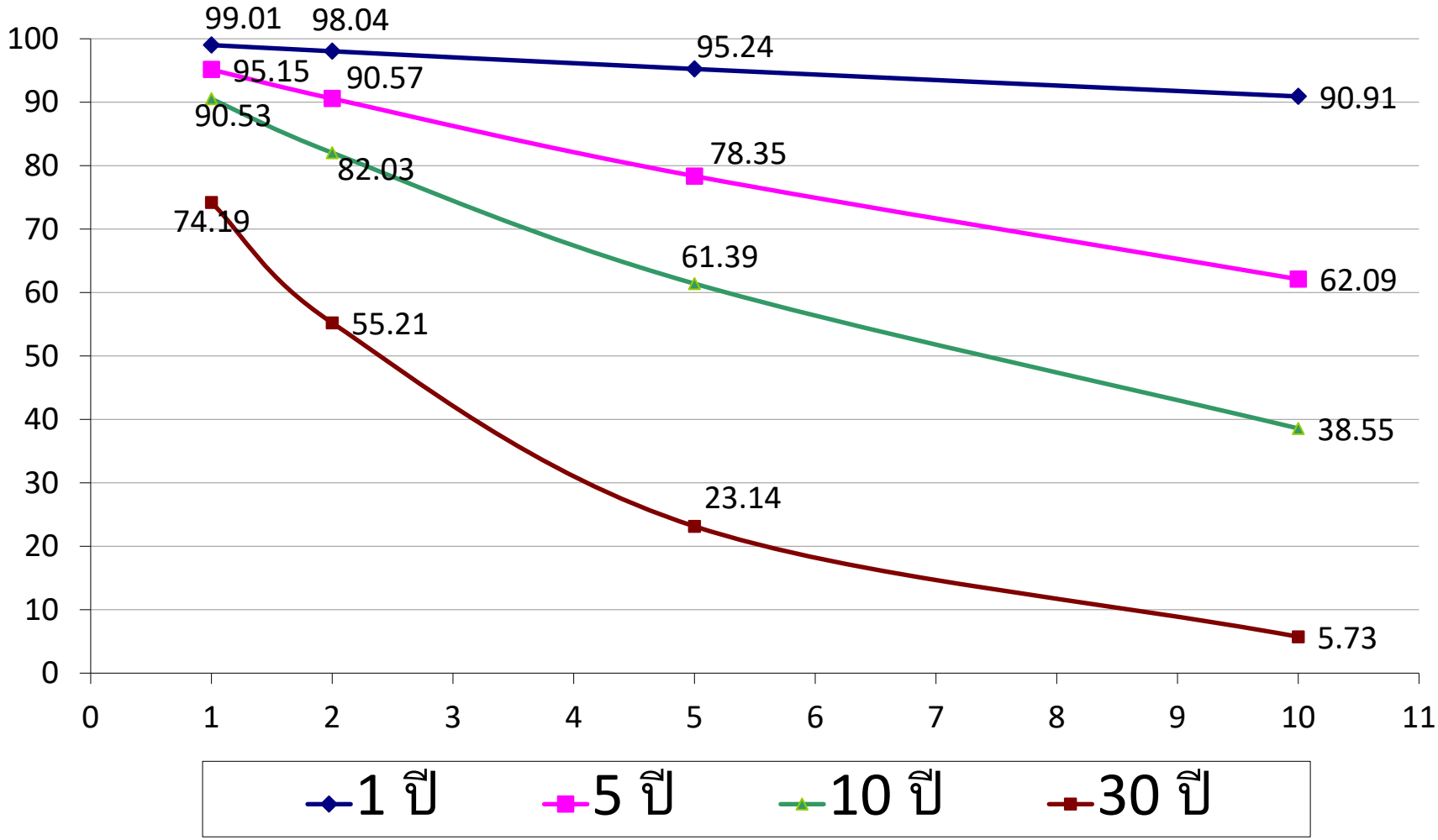
Example: Put \$X in the bank for 2 years at r = 0.1

--> $(1+0.1)(1+0.1)\$X = \$1$ or $X = 1/(1+0.1)^2 = 0.83$

Present Value (PV)



PV of $100 Paid in the Future



Two Payment Streams

	Today	1 Year	2 Years
Payment Stream A:	100	100	0
Payment Stream B:	20	100	100

$$PV_A = 100 + \frac{100}{(1+r)}$$

$$PV_B = 20 + \frac{100}{(1+r)} + \frac{100}{(1+r)^2}$$

PV of Payment Streams

	r = .05	r = .10	r = .15	r = .20
PV of Stream *A*:	195.24	190.90	186.96	183.33
PV of Stream *B*:	205.94	193.54	182.57	172.77

- Notice which stream is worth more depends on interest rate.
- When r is small, B is worth more.
- But when r is large, A is worth more.

The Net Present Value Criterion for Capital Investment Decisions

- Firms have to decide when and how much capital to invest in
- Comparing the present value (PV) of the cash flows from the investment to the cost of the investment can give firm information needed to make worthwhile decisions.
- NPV Criterion: Firms should invest if the present value of the expected future cash flows from an investment exceeds the cost of the investment.

The Net Present Value Criterion for Capital Investment Decisions

$C =$ capital cost

$\pi_n =$ profits for n years $(n = 10)$

$$NPV = -C + \frac{\pi_1}{(1+r)} + \frac{\pi_2}{(1+r)^2} + ... + \frac{\pi_{10}}{(1+r)^{10}}$$

r = discount rate on opportunity cost of capital with a similar risk

Invest if NPV > 0

The Net Present Value Criterion for Capital Investment Decisions

- The Electric Motor Factory (choosing to build a $10 million factory)
  - 8,000 motors/ month for 20 yrs
    - Cost = $42.50 each
    - Price = $52.50/motor
    - Profit = $10/motor or $80,000/month , $960,000/year
    - Factory life is 20 years with a scrap value of $1 million
  - Should the company invest?

The Net Present Value Criterion for Capital Investment Decisions

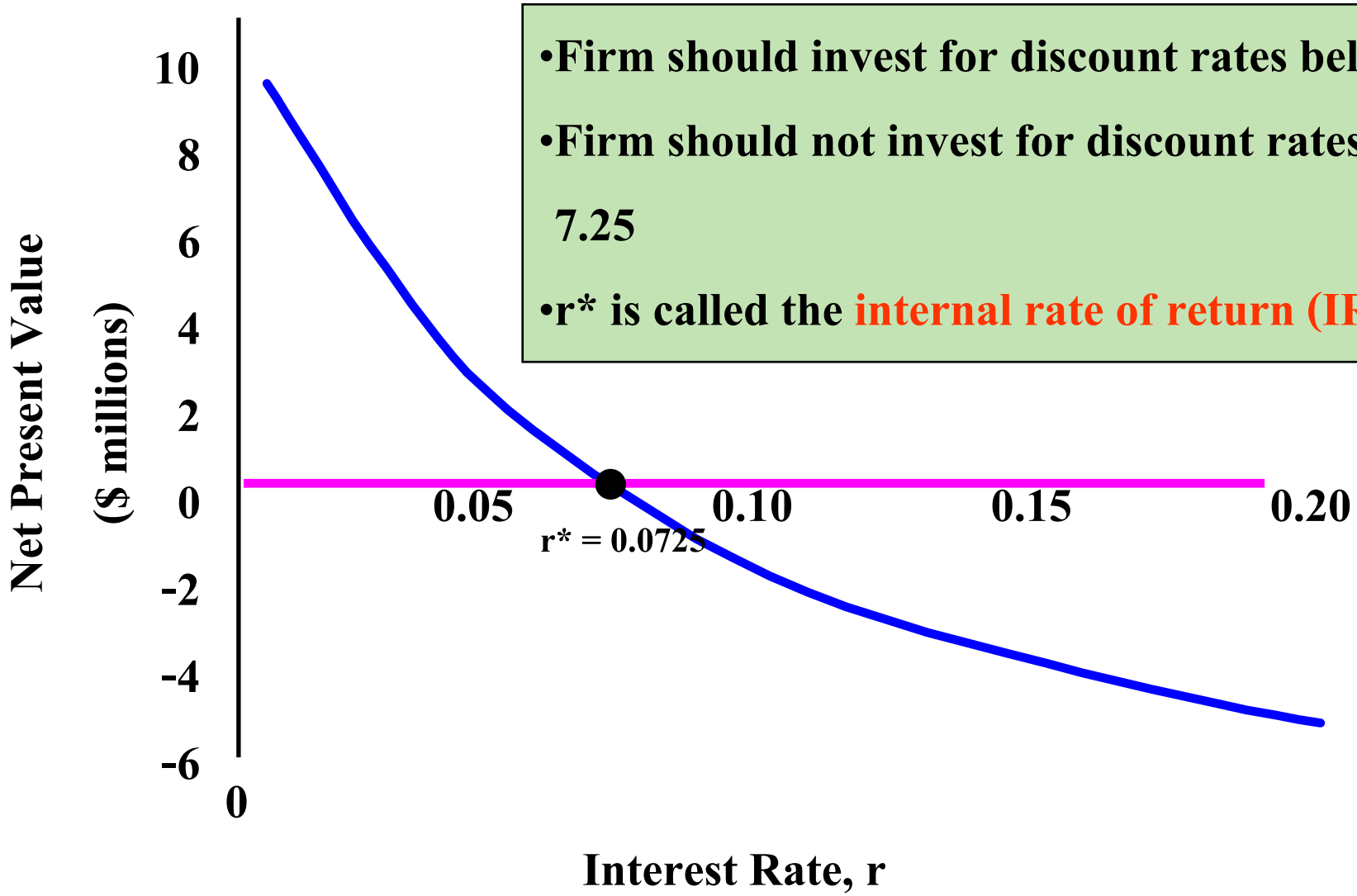
- Assume all information is certain (no risk)
  - r = government bond rate

$$NPV = -10 + \frac{.96}{(1+r)} + \frac{.96}{(1+r)^2} + \ldots + \frac{.96}{(1+r)^{20}} + \frac{1}{(1+r)^{20}}$$

$$r^* = 7.25\%$$

- Discount rates below 7.25, NPV is positive
- Discount rates above 7.25, NPV is negative

Net Present Value of a Factory



- Firm should invest for discount rates below 7.25
- Firm should not invest for discount rates above 7.25
- r* is called the internal rate of return (IRR)

The Value of a Bond

- A bond is a contract in which a borrower agrees to pay the bondholder (the lender) a stream of money

- Example: A bond issued by a company may make a "coupon" payment of $100 per year for the next 10 years and a final payment of $1000.

  – How much would you pay for this bond?

  --> Present value of payment stream

The Value of a Bond

- Determining the Price of a Bond
  - Coupon Payments = $100/yr. for 10 yrs.
  - Principal Payment = $1,000 in 10 yrs.

$$PV = \frac{\$100}{(1+r)} + \frac{\$100}{(1+r)^2} + \ldots + \frac{\$100}{(1+r)^{10}} + \frac{\$1000}{(1+r)^{10}}$$

Present Value of the Cash Flow from a Bond