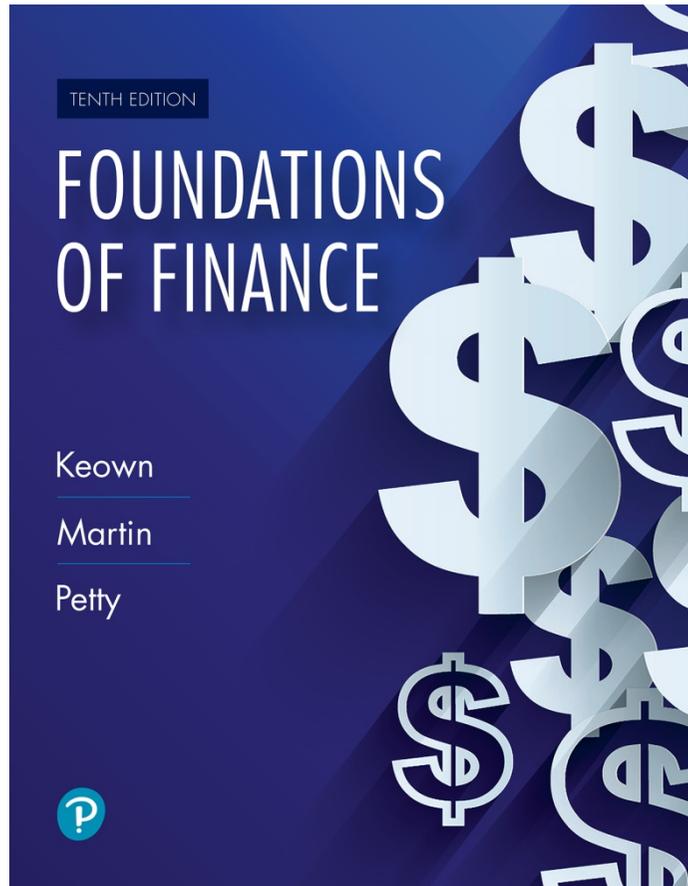


Foundations of Finance

Tenth Edition



Chapter 5

The Time Value of Money

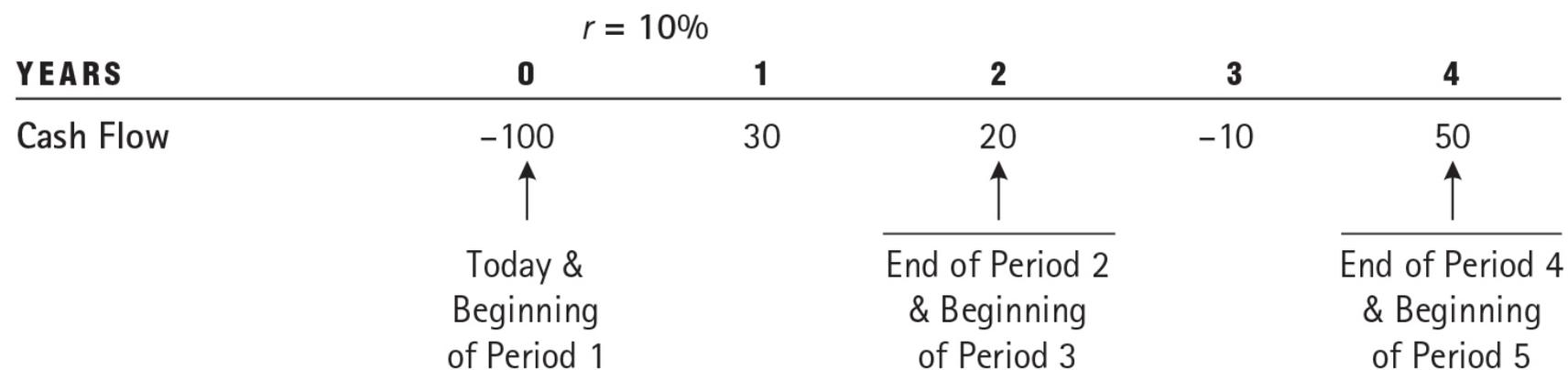
Learning Objectives

- 5.1** Explain the mechanics of compounding, and bringing the value of money back to the present.
- 5.2** Understand annuities.
- 5.3** Determine the future or present value of a sum when there are nonannual compounding periods.
- 5.4** Determine the present value of an uneven stream of payments and understand perpetuities.

Compound Interest, Future, and Present Value

Using Timelines to Visualize Cash Flows

Timeline of cash flows



Compound Interest (1 of 2)

- Compounding is when interest paid on an investment during the first period is added to the principal; then, during the second period, interest is earned on the new sum (that includes the principal **and** interest earned so far).
- Future value is the amount to which your investment will grow, or a future dollar amount.
- Future value factor is the value of $(1+r)^n$ used as a multiple to calculate an amount's future value.

Simple Interest

- If you only earned interest on your initial investment (which is your principal only), it would be referred to as as simple interest.
- Example: Compute simple interest on \$100 invested at 6% per year for three years.
 - 1st year interest is \$6.00
 - 2nd year interest is \$6.00
 - 3rd year interest is \$6.00
 - Total interest earned: **\$18.00**

Compound Interest (2 of 2)

- **Example:** Compute compound interest on \$100 invested at 6% for three years with annual compounding.
 - First year interest is \$6.00; principal now is \$106.00.
 - Second year interest is \$6.36; principal now is \$112.36.
 - Third year interest is \$6.74; principal now is \$119.10.
 - Total interest earned: **\$19.10**

Future Value

- Future value is the amount a sum will grow to in a certain number of years when compounded at a specific rate.

$$FVN = PV(1 + r)^n$$

- FVN = the future of the investment at the end of “ n ” years
- r = the annual interest (or discount) rate
- n = number of years
- PV = the present value, or original amount invested at the beginning of the first year

Future Value Example

- **Example:** What will be the *FV* of \$100 in 2 years at interest rate of 6%?

$$\begin{aligned}FV_2 &= PV(1+r)^2 = \$100(1+0.06)^2 \\ &= \$100(1.06)^2 \\ &= \mathbf{\$112.36}\end{aligned}$$

How to Increase the Future Value?

- Future value can be increased by
 - Increasing number of years of compounding (N)
 - Increasing the interest or discount rate (r)
 - Increasing the original investment (PV)
- See example on next slide.

Changing R, N, and PV

a. You deposit \$500 in bank for 2 years. What is the *FV* at 2%? What is the *FV* if you **change interest rate** to 6%?

$$FV \text{ at } 2\% = 500 \times (1.02)^2 = \$520.20$$

$$FV \text{ at } 6\% = 500 \times (1.06)^2 = \$561.80$$

b. Continue the same example but **change time** to 10 years. What is the *FV* now?

$$FV = 500 \times (1.06)^{10} = \$895.42$$

c. Continue the same example but **change contribution** to \$1,500. What is the *FV* now?

$$FV = 1,500 \times (1.06)^{10} = \$2,686.27$$

Future Value Reflective Thinking #1

1. What will \$1000 invested for 4 years at 4% compounded annually accumulate to? What will it be if you change interest rate to 5%?
2. Continue the same example but change time to 8 years. What is the FV now?
3. Continue the same example but change the invested amount to \$2000. What is the FV now?
4. If you invest \$500 in a bank earning 4% interest, how much will it worth at the end of 7 years?

Figure 5.1 \$100 Compounded at 6 Percent over 20 Years

FIGURE 5-1 \$100 Compounded at 6 Percent over 20 Years

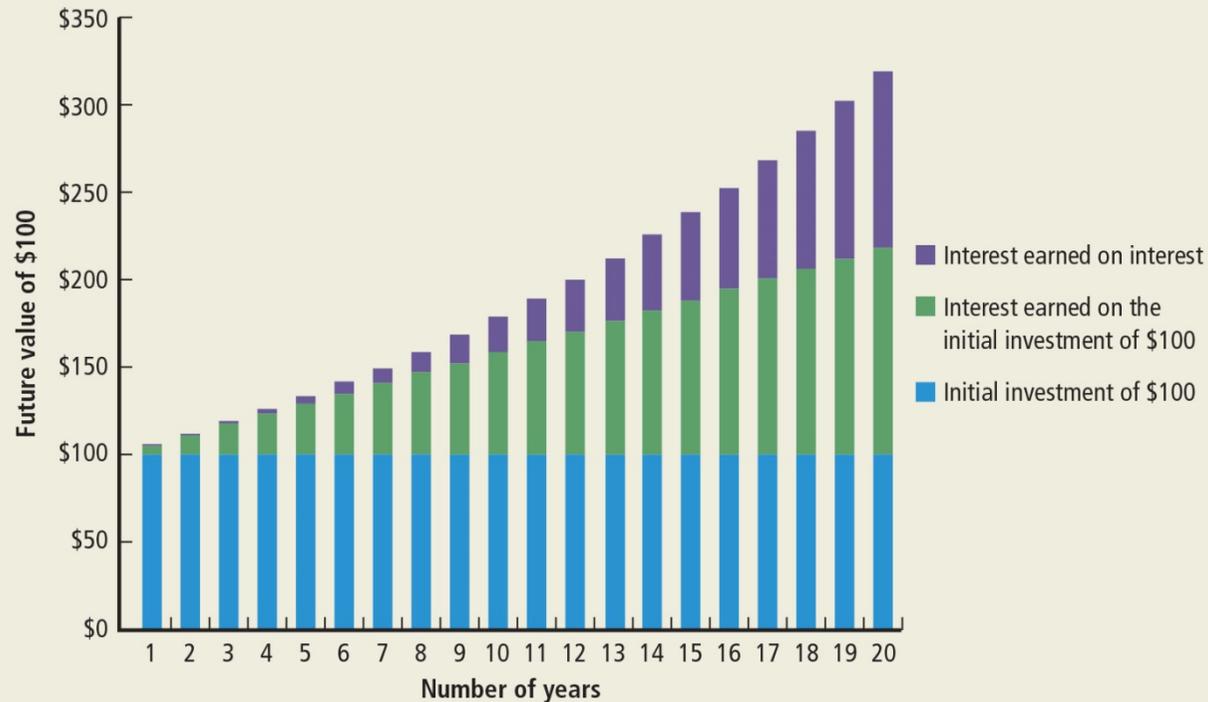


Figure 5.2 The Future of \$100 Initially Deposited and Compounded at 0, 5, 10, and 15 Percent (1 of 2)

FIGURE 5-2 The Future Value of \$100 Initially Deposited and Compounded at 0, 5, 10, and 15 Percent

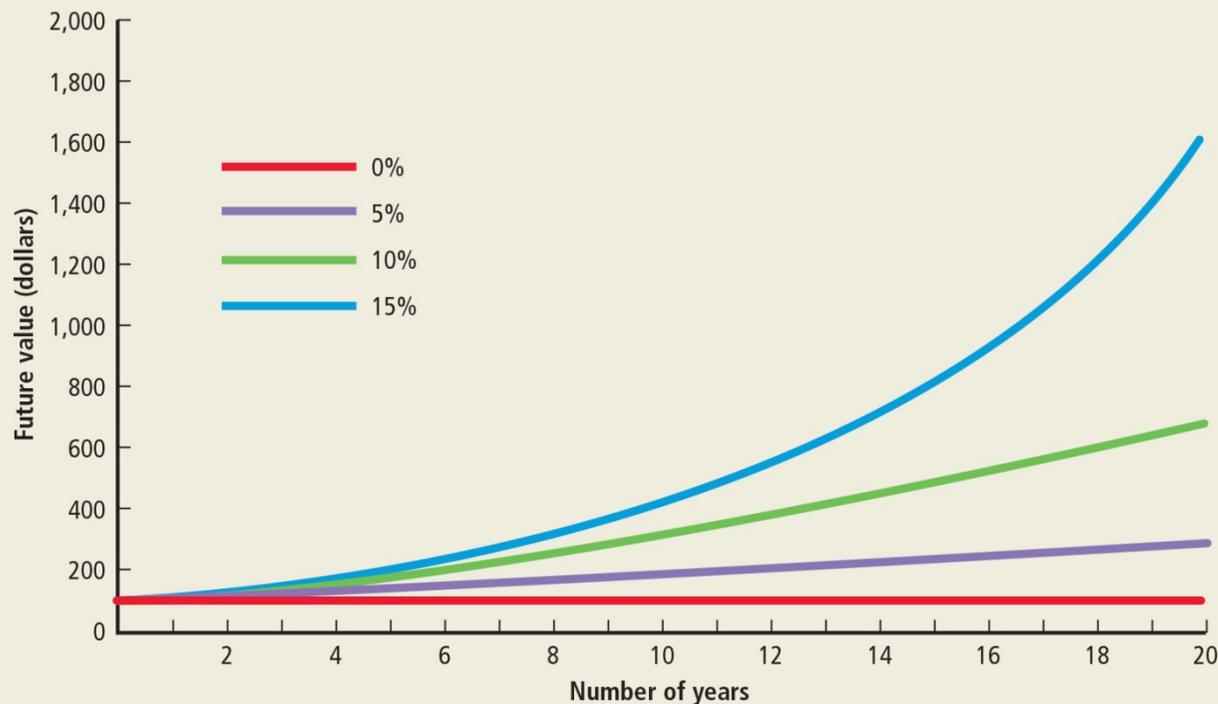


Figure 5.2 The Future of \$100 Initially Deposited and Compounded at 0, 5, 10, and 15 Percent (2 of 2)

- Figure 5.2 illustrates that we can increase the *FV* by
 - Increasing the number of years for which money is invested
 - Investing at a higher interest rate

Computing Future Values Using Calculator or Excel

- Review discussion in the textbook.
- Excel Function for FV : = $FV(\text{rate}, \text{nper}, \text{pmt}, \text{pv})$

Present Value (1 of 2)

- Present value reflects the current value of a future payment or receipt.

Present Value (2 of 2)

$$PV = FVn \left\{ \frac{1}{(1+r)^n} \right\}$$

FVn = the future value of the investment at the end of n years

n = number of years until payment is received

r = the interest rate

PV = the present value of the future sum of money

Present Value Example

Calculating the Discounted Value to Be Received in 10 years

- What will be the present value of **\$500** to be received **10** years from today if the discount rate is **6%**?

$$\begin{aligned}PV &= \$500 \left\{ \frac{1}{(1 + 0.06)^{10}} \right\} \\ &= \$500 \left(\frac{1}{1.791} \right) \\ &= \$500 (0.558) \\ &= \mathbf{\$279.00}\end{aligned}$$

Present Value Example

Calculating the Present Value of a Savings Bond

- You are given \$100 savings bond for taking a tour; however, you will not get the \$100 for 10 years. What is the present value of \$100 to be received 10 years from today if your discount rate is 6 percent?
- #1 Formulate a Solution Strategy using the formula
- #2 $FV = \$100$, $n = 10$, and $r = 6\%$
- #3 Crunch the Numbers = \$55.84

Thus, the value in today's dollars of that \$100 savings bond is only \$55.84.

Figure 5.3 The Present Value of \$100 to Be Received at a Future Date and Discounted Back to the Present at 0, 5, 10, and 15 Percent (1 of 2)

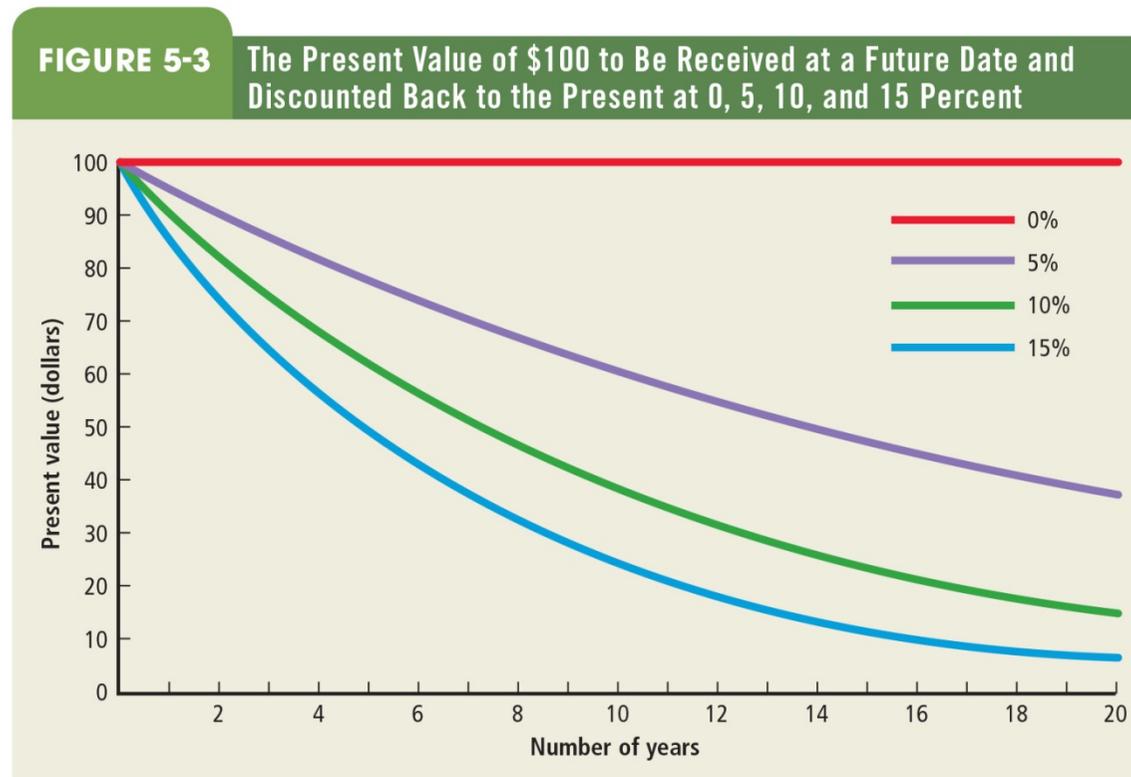


Figure 5.3 The Present Value of \$100 to Be Received at a Future Date and Discounted Back to the Present at 0, 5, 10, and 15 Percent (2 of 2)

- Figure 5.3 illustrates that PV is lower if
 - Time period is longer, or
 - Interest rate is higher.