This project has been supported by an American Council on Education – Alfred P. Sloan Foundation Faculty Retirement Transition award to San José State University

Financial Literacy

Module 1 – Time Value of Money (TVM) and the Power of Compounding

Overview

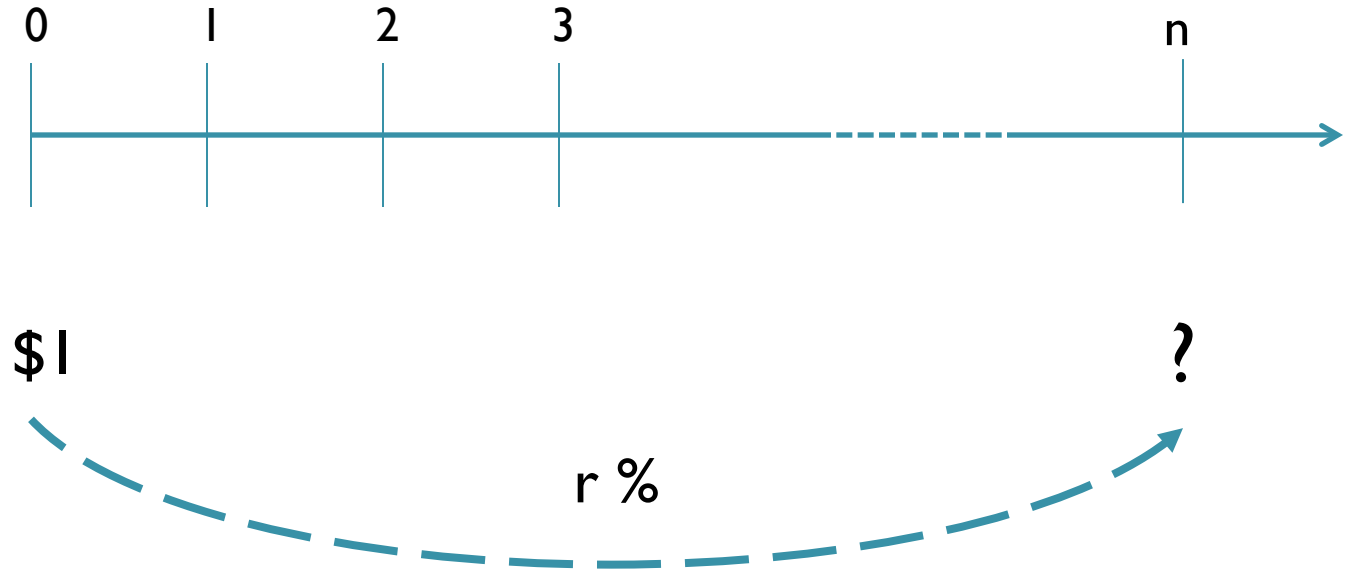
- Time Value Of Money (TVM)
  - Definition
  - Why Do We Care?
  - Examples
  - Graphs
- Conclusion

The Power of Compounding

- *"A nearby penny is worth a distant dollar",* ***Anonymous***
- *"The most powerful force in the universe is compound interest",* ***Albert Einstein***
- *"…the world's greatest invention was 6 per cent compound interest, which goes on twenty-four hours a day, seven days a week and fifty-two weeks a year.",* ***Roger W. Babson***

TVM - Compounding

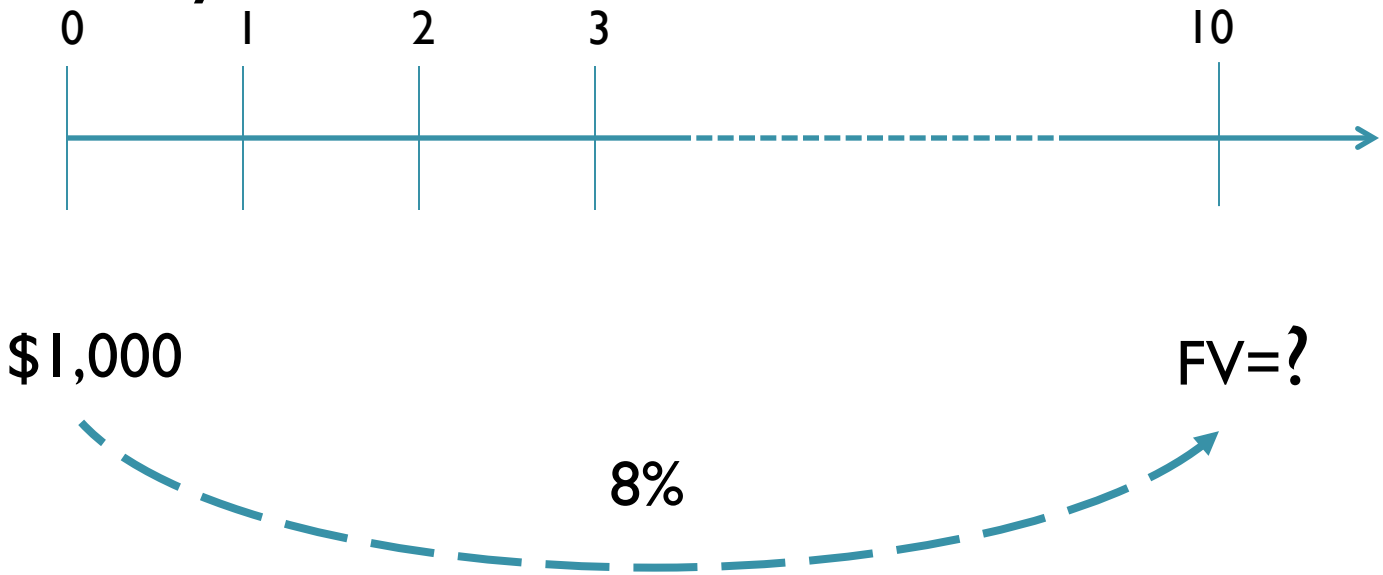
- $1 invested today at r% per year for n years



$$FV_n = C \times (1+r)^n$$

TVM – Compounding – Single Cash Flow - Example 1

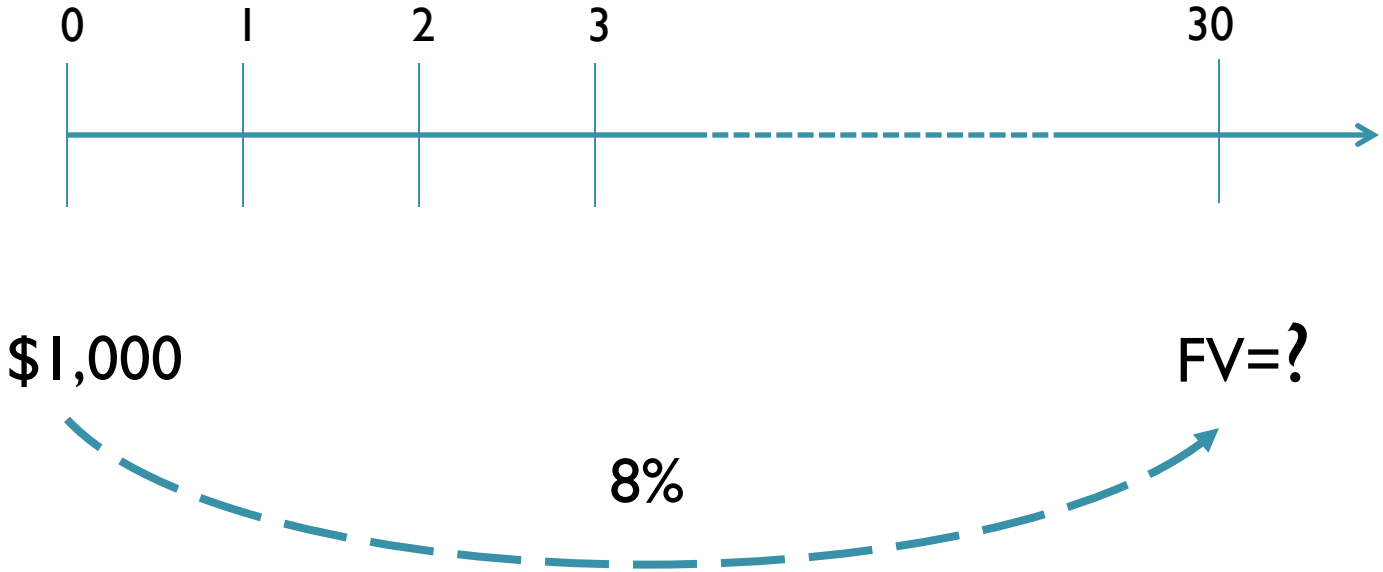
- $1,000 invested today at 8% per year for 10 years



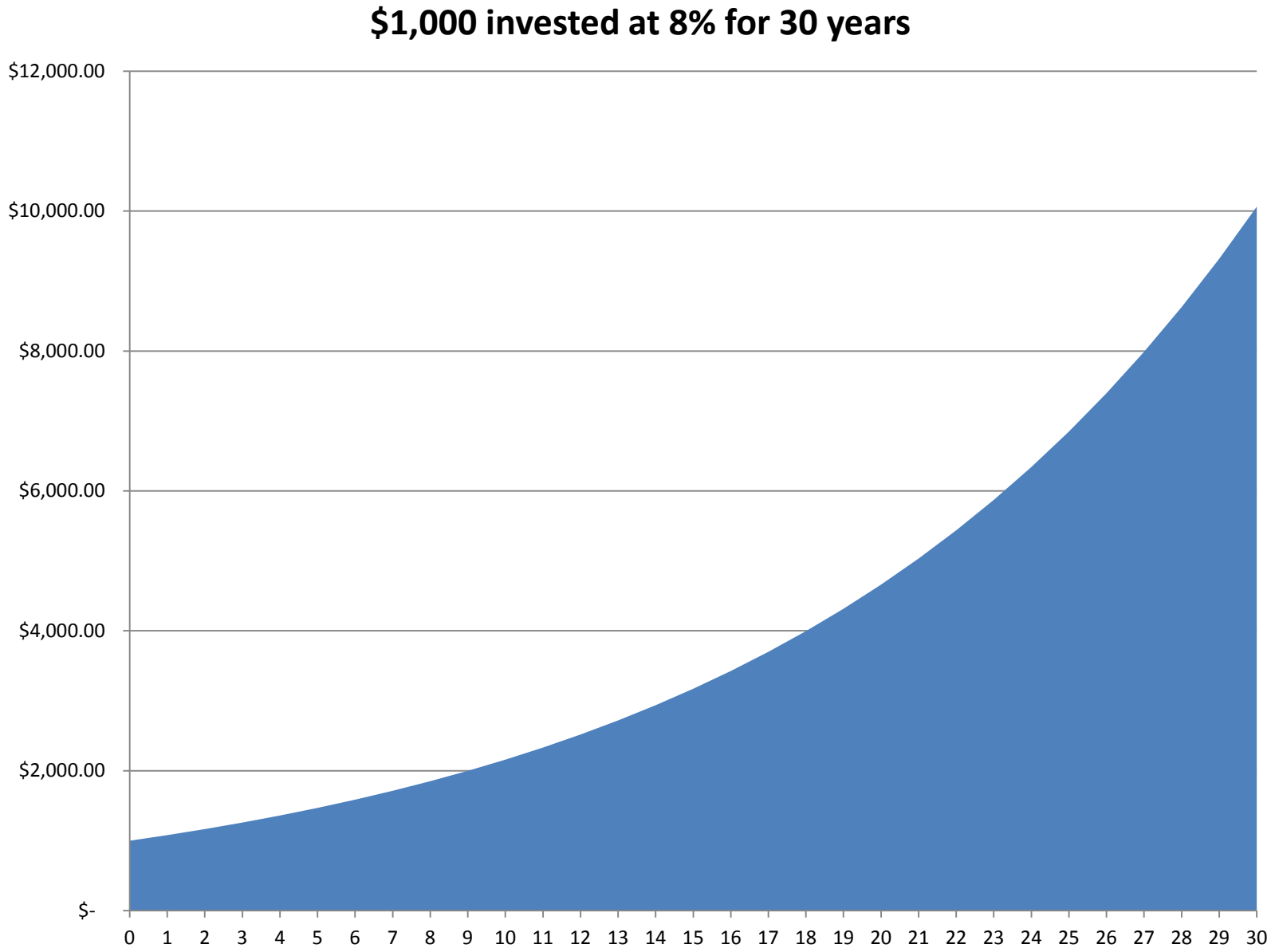
$$FV_{10} = \$1{,}000 \times (1.08)^{10} = \$2{,}158.92$$

TVM – Compounding – Single Cash Flow - Example 2

- $1,000 invested today at 8% per year for 30 years

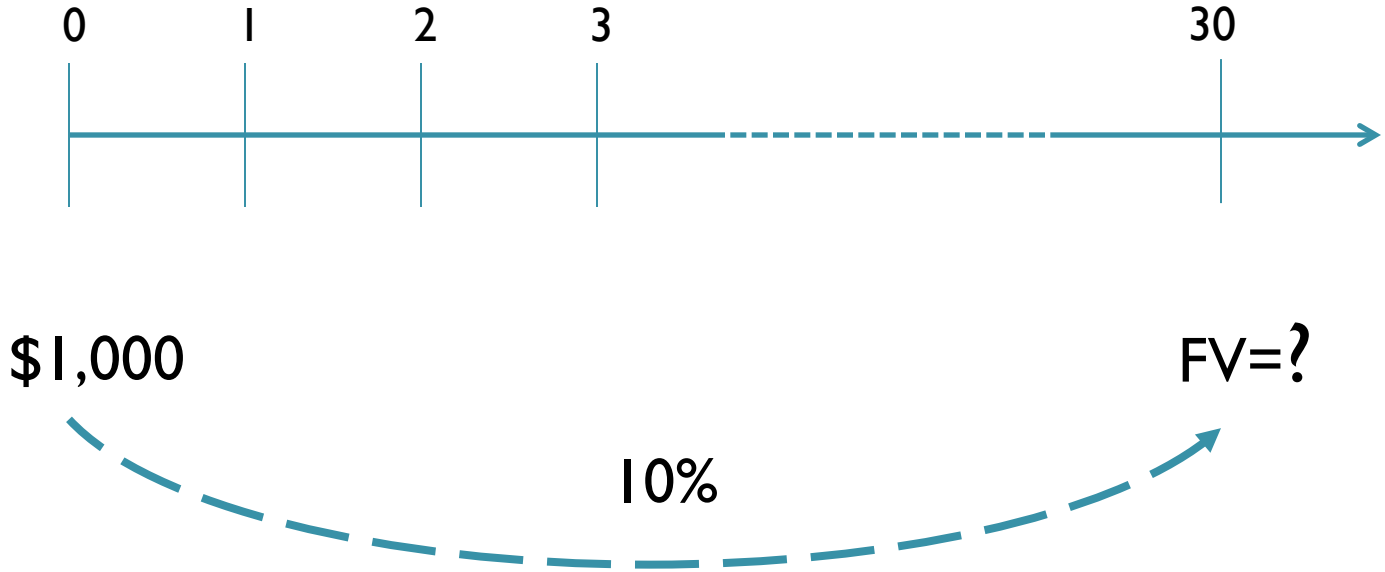


$$FV_{30} = \$1{,}000 \times (1.08)^{30} = \$10{,}062.66$$


$1,000 invested at 8% for 30 years
$12,000.00
$10,000.00
$8,000.00
$6,000.00
$4,000.00
$2,000.00
$-
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

TVM – Compounding – Single Cash Flow - Example 3

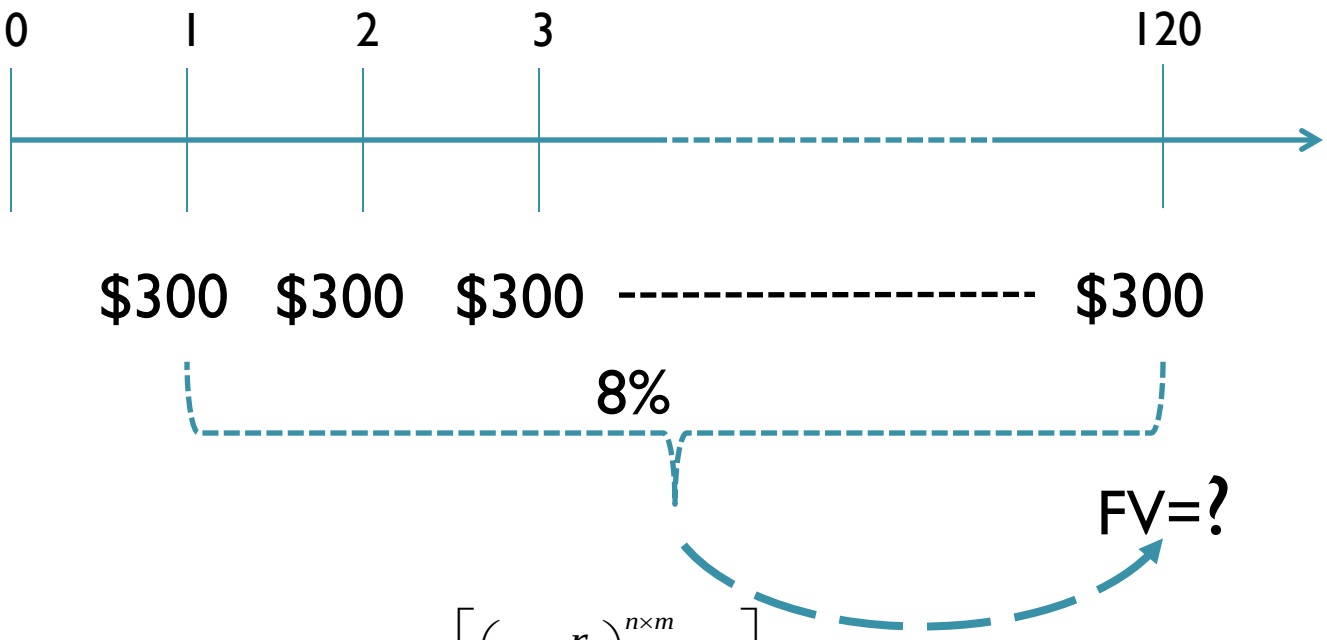
- $1,000 invested today at 10% per year for 30 years



$$FV_{30} = \$1{,}000 \times (1.1)^{30} = \$17{,}449.40$$

TVM – Compounding – Ordinary Annuity - Example 1

- Series of cash flows: $300 invested at the end of each month for 10 years at 8% per year (APR)

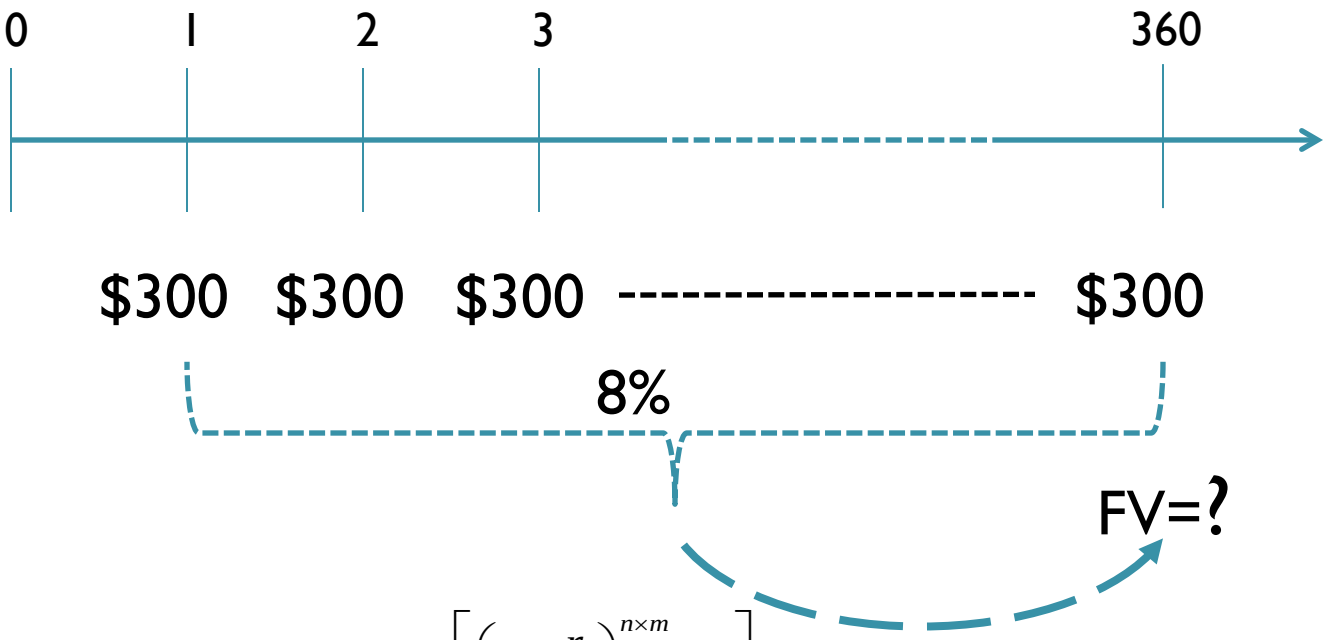


$$FV_{120} = C \times \left[\frac{(1+i)^{n \times m} - 1}{i} \right] = C \times \left[\frac{\left(1 + \frac{r}{m}\right)^{n \times m} - 1}{\frac{r}{m}} \right] = \$300 \times \left[\frac{(1.006667)^{120} - 1}{0.006667} \right] = \$54{,}883.81$$

$$m = 12 \qquad i = monthly \quad rate \quad i = \frac{8\%}{12} = 0.6667\%$$

TVM – Compounding – Ordinary Annuity - Example 2

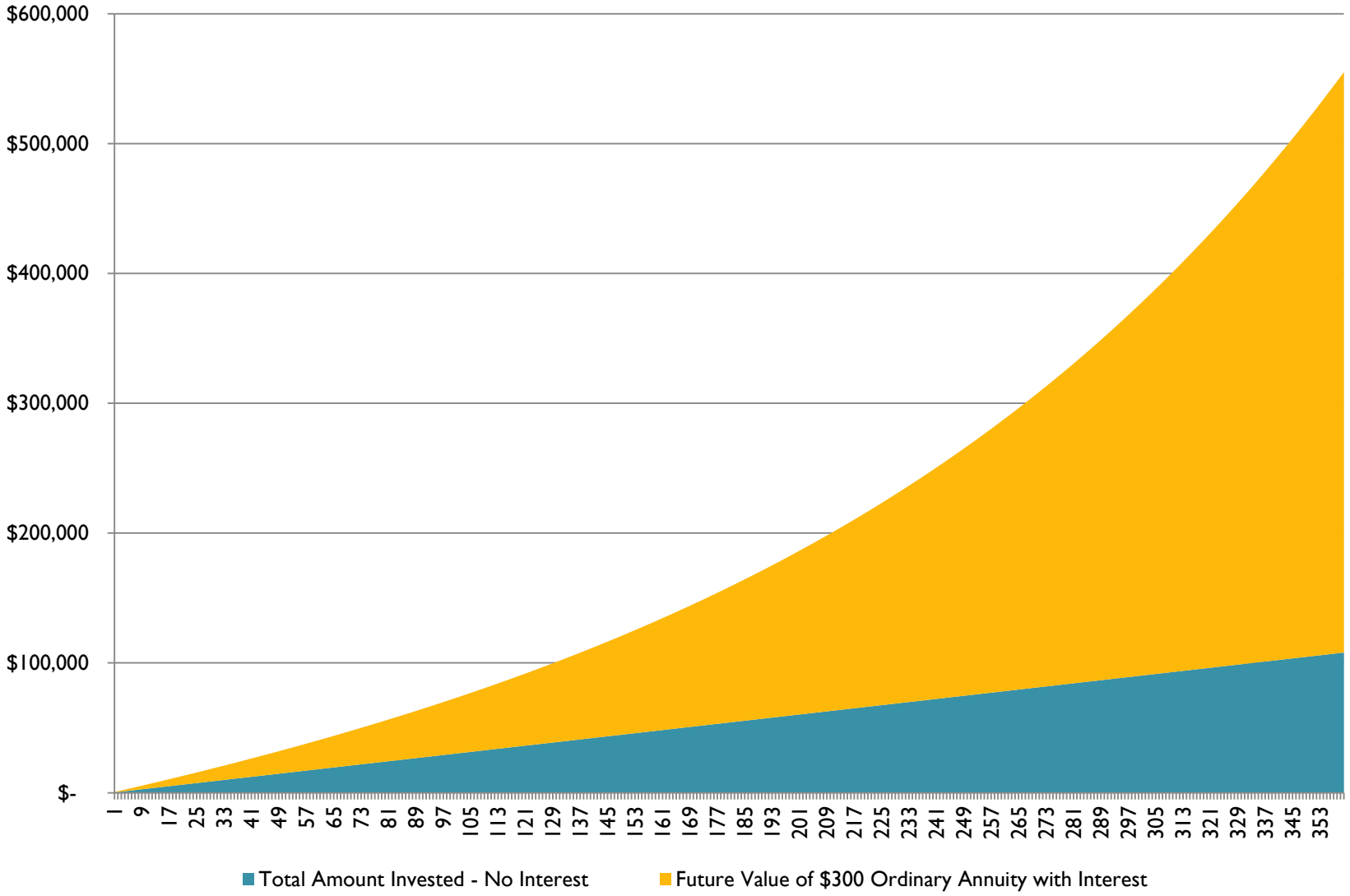
- Series of cash flows: $300 invested at the end of each month for 30 years at 8% per year (APR)



$$FV_{360} = C \times \left[\frac{(1+i)^{n \times m} - 1}{i} \right] = C \times \left[\frac{\left(1 + \frac{r}{m}\right)^{n \times m} - 1}{\frac{r}{m}} \right] = \$300 \times \left[\frac{(1.006667)^{360} - 1}{0.006667} \right] = \$447{,}107.83$$

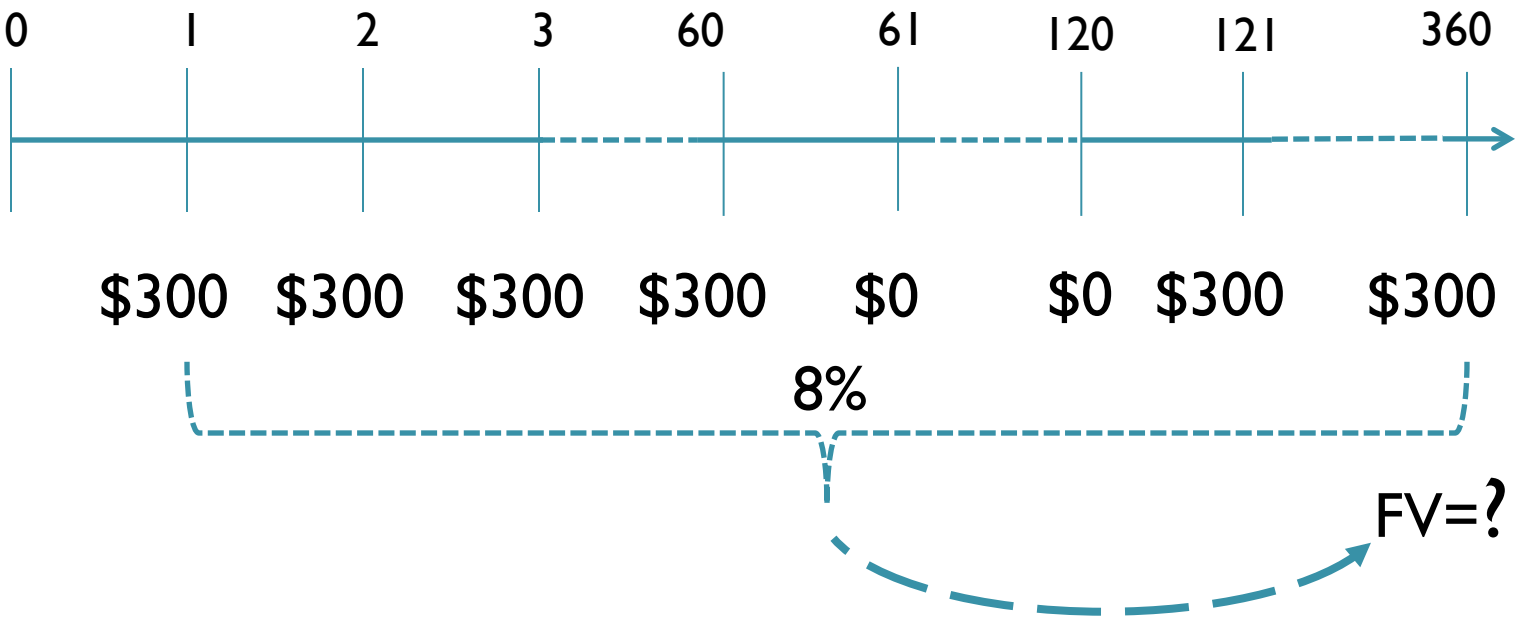
$$m = 12 \qquad i = monthly \quad rate \quad i = \frac{8\%}{12} = 0.6667\%$$

$300 Monthly Ordinary Annuity Invested at 8% p.a. for 30 Years



TVM – Compounding – Ordinary Annuity - Example 3

- Series of cash flows: …..similar to example 2, but NO contributions during years 6-10.

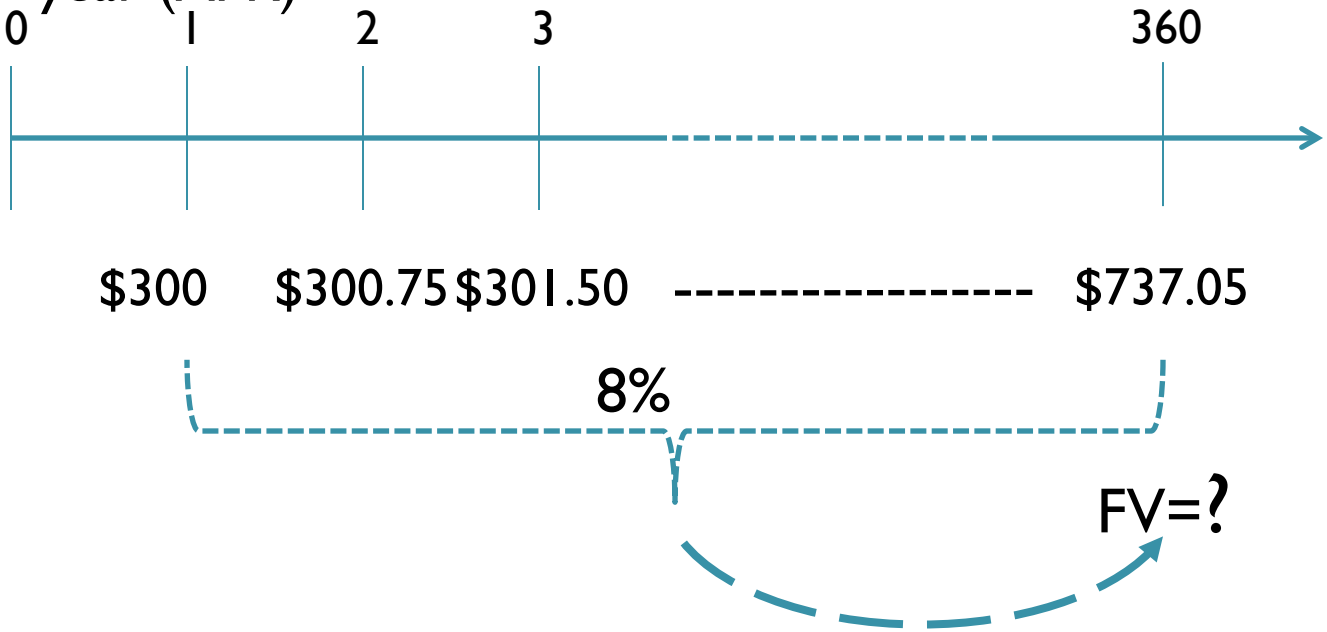


$$FV_{360} = \left\{\$300 \times \left[\frac{(1.006667)^{60} - 1}{0.006667}\right] \times (1.006667)^{300}\right\} + \left\{\$300 \times \left[\frac{(1.006667)^{240} - 1}{0.006667}\right]\right\}$$

$$= \$338{,}506.02$$

TVM – Compounding – Ordinary Growing Annuity - Example 1

- Series of cash flows: monthly investment of $300 and growing 3% per year (APR) invested for 30 years at 8% per year (APR)

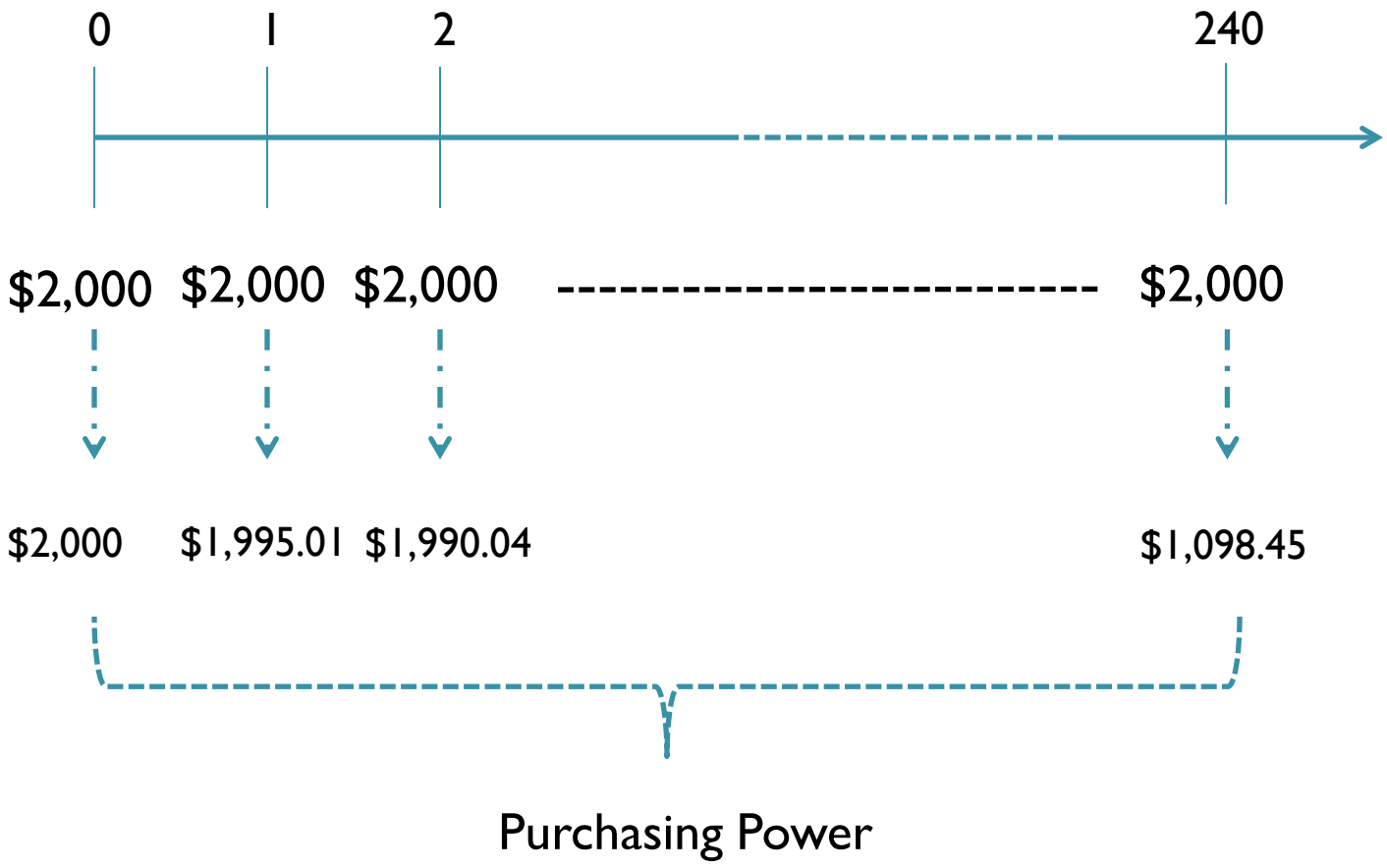


$$FV_{360} = C \times \left[\frac{(1+i)^{n \times m} - (1+g)^{n \times m}}{i - g} \right] = \$300 \times \left[\frac{(1.006667)^{360} - (1.0025)^{360}}{0.006667 - 0.0025} \right] = \$610{,}480$$

$$i = \frac{8\%}{12} = 0.6667\% \qquad g = \frac{3\%}{12} = 0.25\%$$

TVM – The Pernicious Effect of Inflation

- The purchasing power of a monthly income of $2,000 over a twenty-year period when the annual inflation rate is 3% (APR)



Conclusion

- TVM and the Power of Compounding can be Your Friends
- When is it Best to Start Saving?
- How do I Save?

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