GFLEC
GLOBAL FINANCIAL LITERACY EXCELLENCE CENTER

Personal Finance

Lecture 1

Course Materials

- Course piloted by

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- Founder and Academic Director of **The Global Financial Literacy Excellence Center (GFLEC)**

  Web page: **http://www.gflec.org**

- Research experience in financial literacy and personal finance for over 15 years.

- No textbook required but a financial calculator is needed.

Goals of this Course

Goals of course

1. **Provide a rigorous framework to make financial decisions**
2. **Cover many life-cycle financial decisions**
3. **Provide tools to make financial decisions**
4. **Preparation for becoming financial planners/advisors**

What does a personal financial management course teach?

1. How to grow and protect wealth
2. How to take advantages of opportunities
3. How to be financially healthy
4. How to be a good advisor

Why personal finance

Video about the importance of studying personal finance

"The Importance of Personal Finance"

https://vimeo.com/176663508

You are your own CFO

A new economic landscape

Major changes that increase individuals' responsibility for well-being:

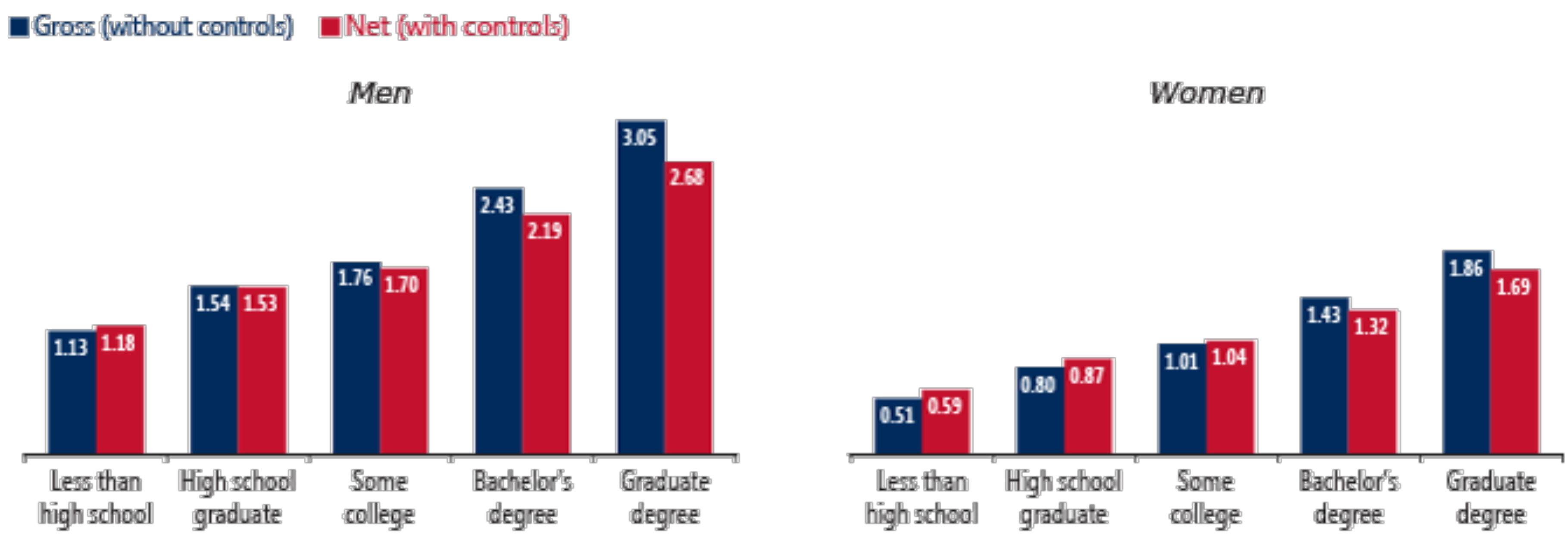
- **Changes in the pension landscape**
  - **More individual accounts**
- **Changes in the labor market**
  - **Workers change jobs more often**
  - **Skill-based wage differentials**
- **Changes in the financial markets**
  - **More complexity**
  - **More opportunities to borrow and in large amounts**

Increase in individual responsibility

Being our own CFO

- **Individuals make many financial decisions**
  - Investment in education
  - Financial security after retirement
  - Investing in financial markets & other markets (buying a home, car, etc)
- **Not enough to look at asset side; liability side is equally important**
  - Increase in debt & borrowing
  - Debt normally incurs higher interest rates than what is earned on assets
- **Financial decisions are complex**
  - Many more financial products than in the past

Earnings over a lifetime



Source: Tamborini, Christopher R., ChangHwan Kim, and Arthur Sakamoto. 2015. "Education and Lifetime Earnings in the United States." *Demography* 52: 1383–1407.

Background: The US market

Before the financial crisis

1. Americans were saving very little
2. Household debt had been growing steadily
3. Opportunities to borrow became widely available
4. Majority of individuals are not financially literate

→ **Importance of financial advisors**

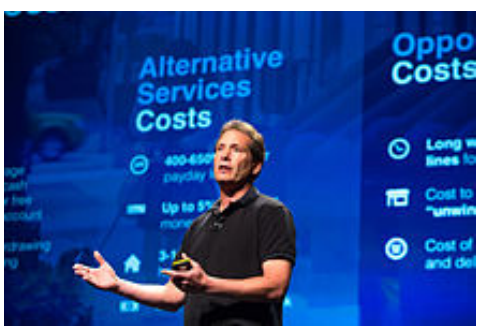
Background: Other markets

Opportunities offered by new landscape in other markets as well

1. Increase in individual responsibility in other economies, particularly those which have privatized or are planning to privatize Social Security or pensions.
2. Emerging middle class in BRICS (Brazil, Russia, India, China, and South Africa) and other economies (Turkey, Indonesia, etc.). These individuals have to participate in "formal" markets and use financial products.

Technology is not a substitute for financial literacy

"All the financial apps in the world mean nothing if consumers don't know they exist, let alone how to use them . . . As we increase access to banking services, we need to increase financial literacy, as well."



Daniel Schulman,
President and CEO of PayPal
The Wall Street Journal, June 16, 2016

Course Preview

Consumer Applications to Come

The value of a degree

An MBA costs tens of thousands of dollars for tuition and takes two years of study, but promises a higher salary in the future. Is it better to keep your tuition dollars, or get the degree?

Tuition

Degree

Housing

Consumers are faced with many decisions when financing housing. Is better to have a fixed or adjustable rate mortgage? What are mortgage points and should I take them? When should I refinance?

Fixed or adjustable rates?

Refinance?

Mortgage points?

Retirement

And then there are retirement decisions. How do I consider inflation when planning for retirement? Should I collect Social Security early? How do I protect myself against financial crises and changing interest rates?

Inflation?

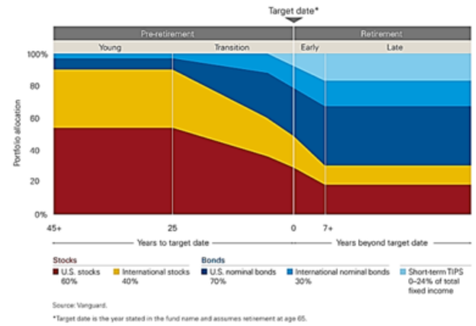
Social Security?

Financial crises?

Changing interest rates?

And more

…and much more!



Personal taxes

Diversification

Risk and leverage

Biases in consumer finance

Interest Rates

Lecture 1

The price of money

Most financial transactions involve an exchange of money over time.

Essential elements:

1. Time
2. Price

Interest rate is the price of money.

Economists also define it as the opportunity cost of money.

The interest rate

Which unit of time?

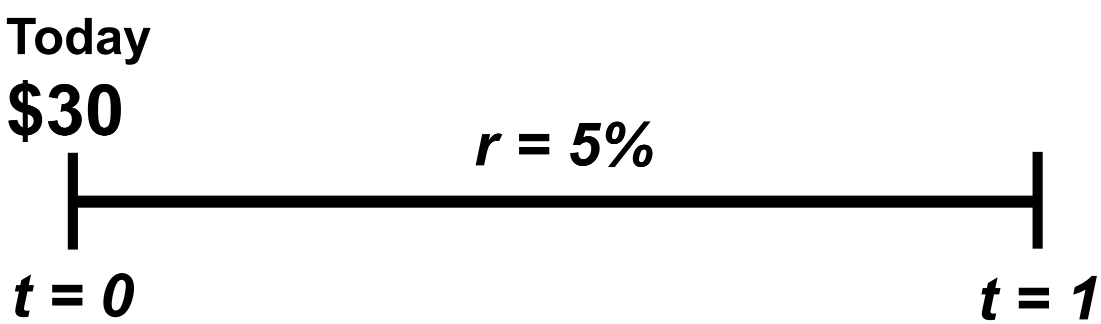
Note that the interest rate is measured as a **percent per some unit of time**. Time needs to be specified.

An interest rate of 2% *per month* is very different from an interest rate of 2% *per year.*

Future value of a dollar: Example

Ex. Compare the relative value of $30 today to (a) $30 one year from today, (b) $31 one year from today, and (c) $32 one year from today, assuming an interest rate of 5%.

Which one would you take, if given these three options?



A. $30?
B. $31?
C. $32?

Ans= ?

The growth rate of savings

The **interest rate** may also be defined as

1. The **growth rate of savings**

When an investor deposits a sum of money into a bank account or invests in the financial markets, that sum of money grows into a larger sum, and the higher the interest rate, the faster and larger that sum grows.

The cost of borrowing

The **interest rate** may also be defined as

1. The **cost of borrowing**

Not only is the interest rate the rate at which savings grows, but it is also the **rate at which debt grows**.

Borrowing and lending

Ex. A consumer borrows $750 from a bank, to be repaid in one year. The interest rate on the loan is 10% (per year). At the end of the year, how much must the borrower repay the bank?

Ans.

The $750 debt grows by 10%, or 0.10*$750 = $75.
The borrower owes $750 + $75 = $825 at the end of the year.
The $750 that the borrower repays is known as the **principal.**
The $75 in interest was the **cost of borrowing.**

For the bank, its investment of $750 grew by 10% to $825.

Two sides in every transaction

Saving and borrowing are the **flip sides of the same type of transaction.**

- When you deposit at a bank, you are **lending** to that bank, and the bank is **borrowing** from you.

- Depositing savings, investing, and lending are equivalent. Borrowing is the opposite side of this transaction.

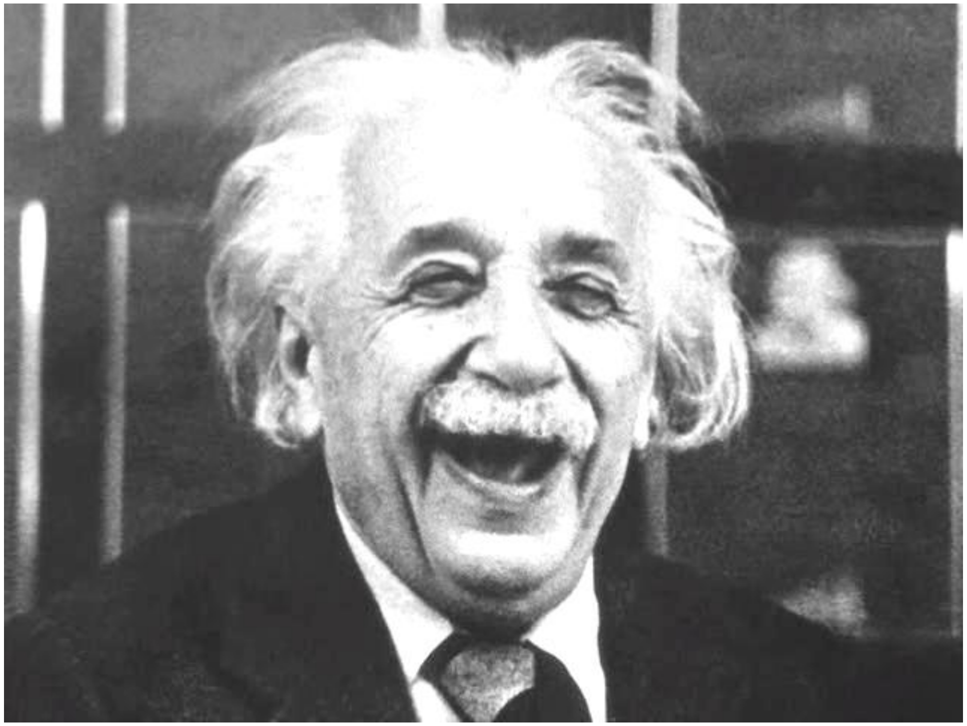
The rental price of money

Borrowers **rent** money from lenders (savers/investors), and the **interest rate is the price** they pay to do so.

1. Money is a **scarce resource**.
2. There are individuals who would like to borrow money.
3. There are individuals who have a surplus of money.
4. Money is lent and borrowed through a price-based market, where the **rental price is the interest rate.**

Interest Compounding

The most powerful force in the universe

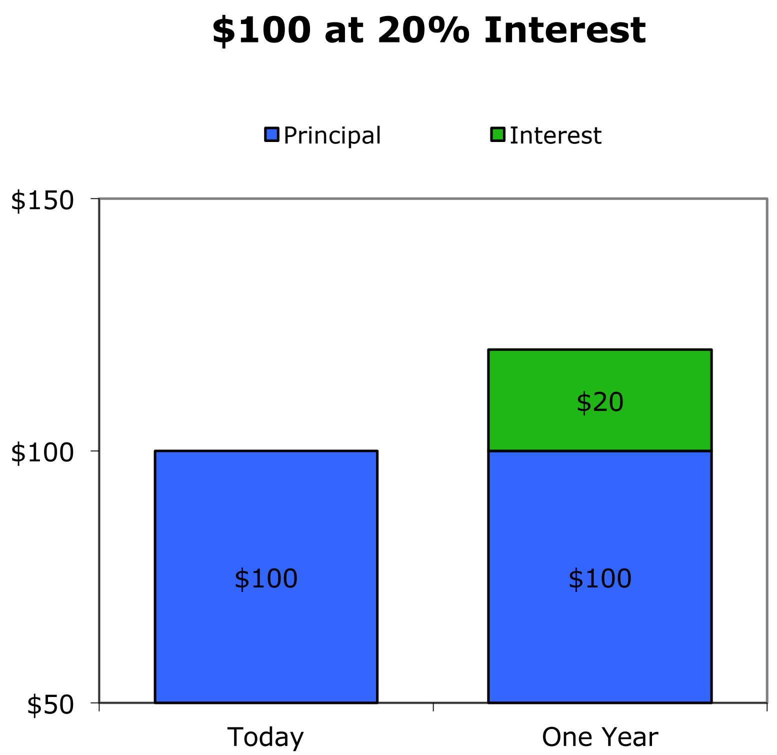


When asked to name the greatest invention in human history, **Einstein** simply replied **"compound interest**."

Hartgill, David. "Power of Compounding." The Advertiser. 15 September 1997.

Visualizing compound interest

If you borrow $100 at 20% interest, you will owe $20 after one year in interest.



Interest compounding

Over multiple years, interest accrues on interest. This is known as interest compounding.

Ex. Assume $100 is borrowed at 20% for *two* years. How much must the borrower pay back at the end of the second year?

Ans.

After the first year, the debt grows to $100*1.20 = $120.

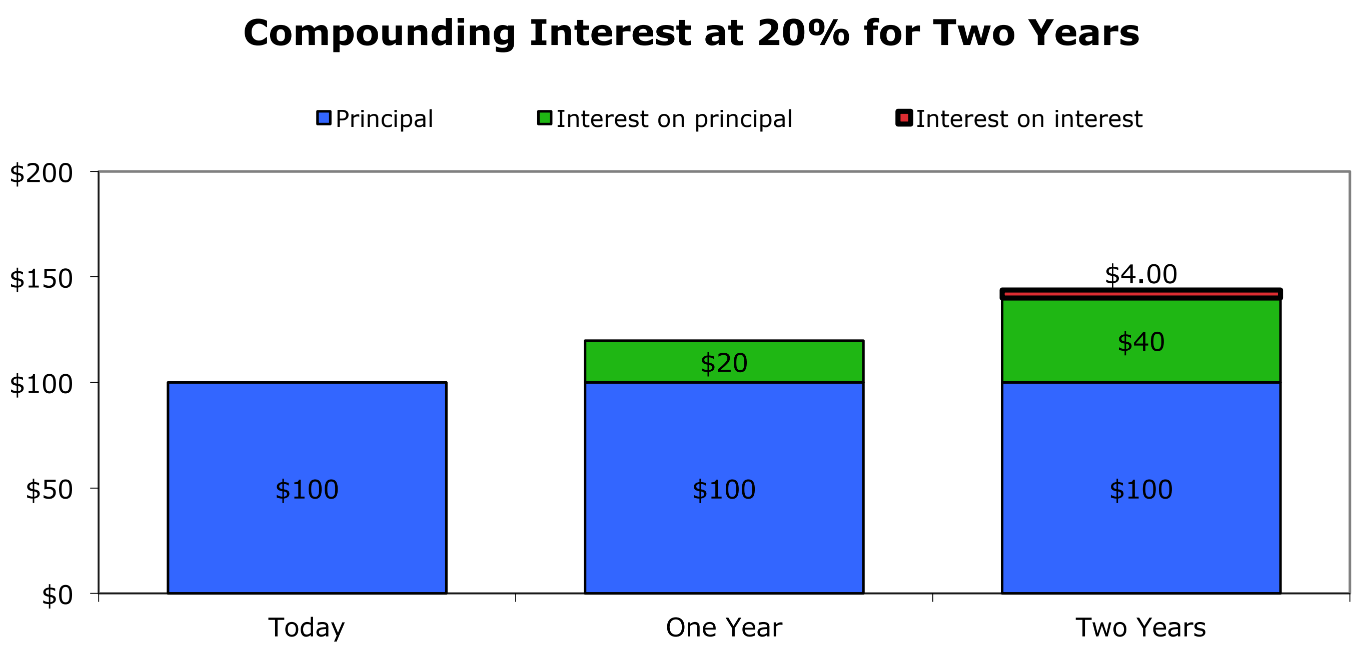
The interest is then applied to this new $120 balance in the second year and grows to $120*1.20 = $144.

Therefore, the interest is $44 and *not* $20 + $20 = $40.

This extra $4 in the second year is the interest on the $20 worth of interest in the first year. This is interest compounding.

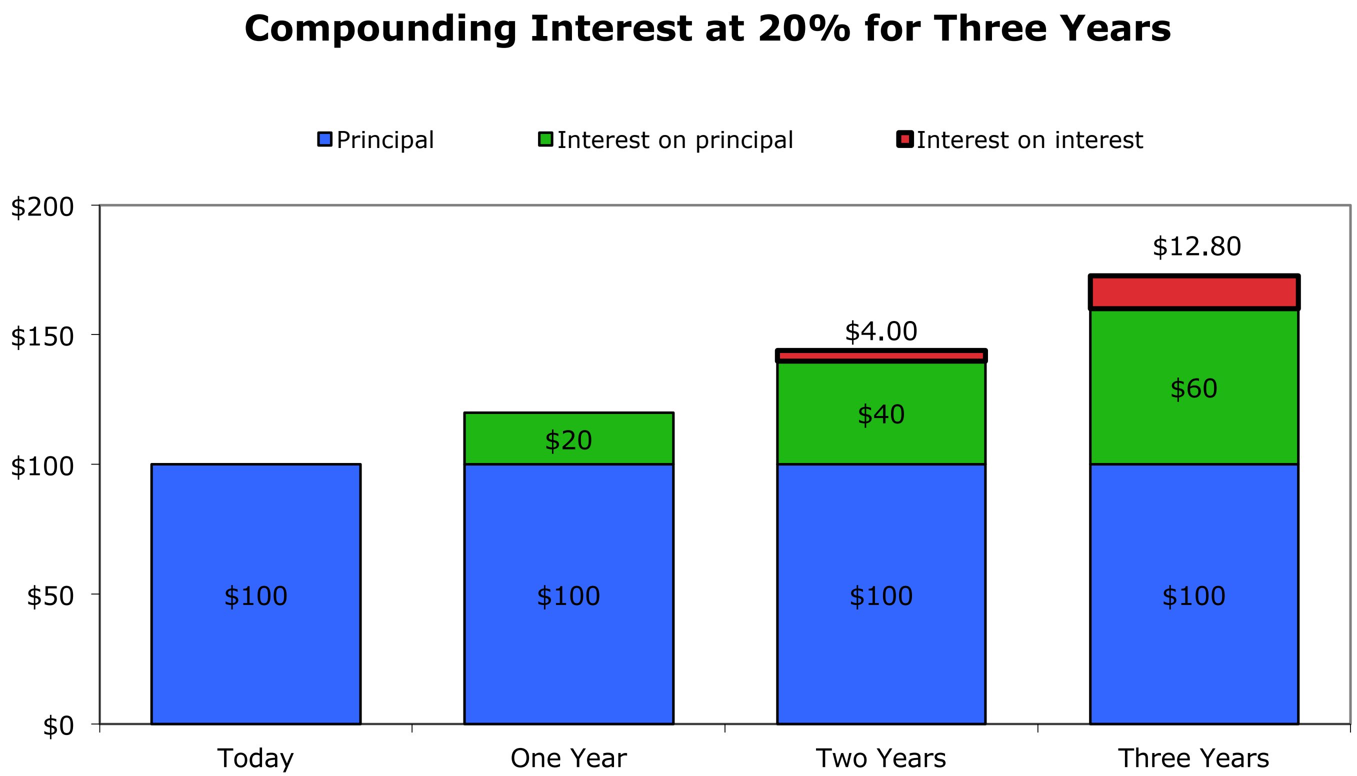
Visualizing compound interest

The total interest accrues not only on the principal, but also on the interest.



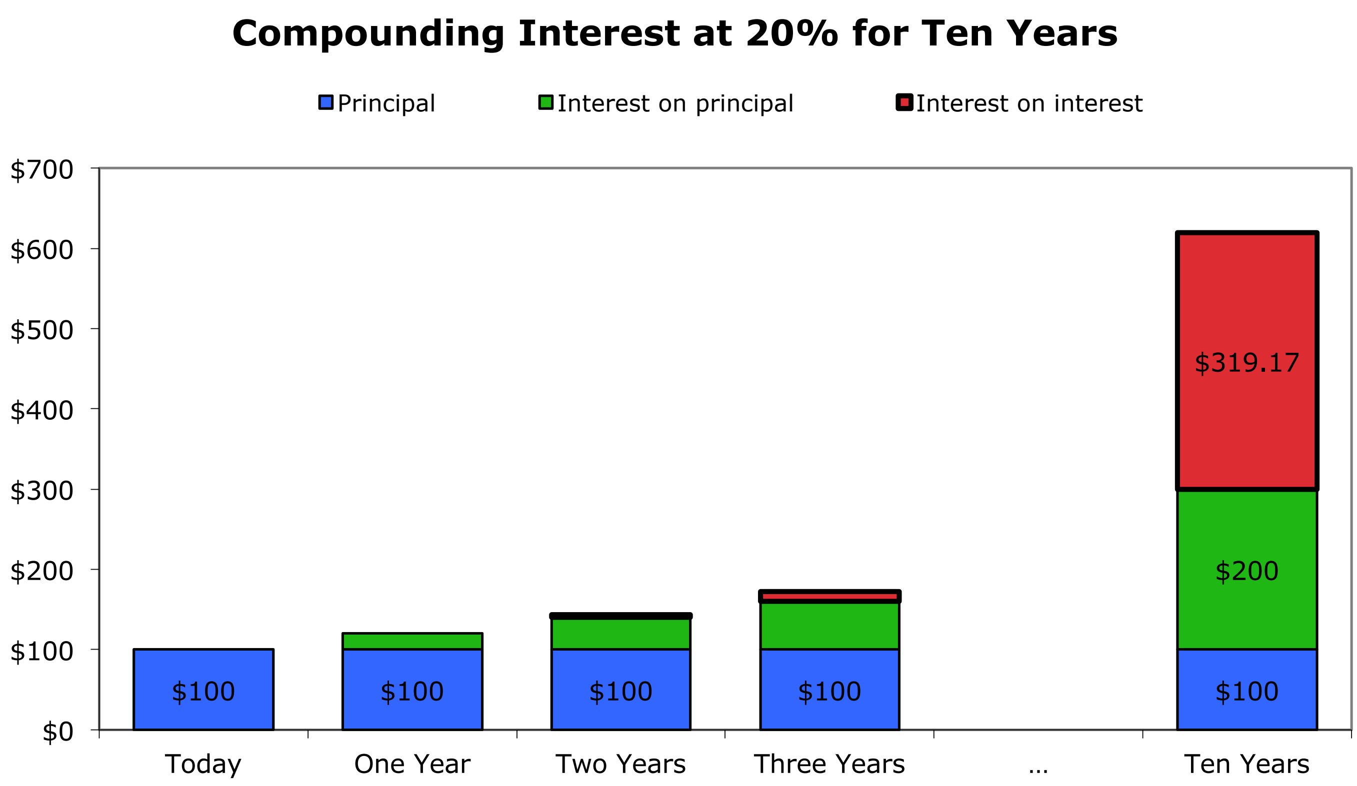
Visualizing compound interest

Interest on interest increases exponentially over time...



Visualizing compound interest

And eventually outweighs the interest on the principal!



The interest compounding formula

Interest compounding can be calculated using a simple formula.

Ex. Assume \$100 is borrowed at an interest rate **of *r*** for several years. How much must the borrower pay back after *T* years?

After one year, the \$100 will grow to $\$100 * (1 + r)$.

The next year, this amount is again multiplied by $(1 + r)$ **and grows to:**

$$\$100 * (1 + r) * (1 + r) = \$100 * (1 + r)^2$$

This continues for *T* years until it grows to:

$$\$100 * (1 + r) * (1 + r) * \cdots * (1 + r) = \$100 * (1 + r)^T$$

The interest compounding formula

In general, the **interest compounding formula** is:

$$F = P(1+r)^T$$

Where:

P = starting amount (principal)

r = interest rate

T = time periods

F = final amount

The interest compounding formula

In general, the **interest compounding formula** is:

$$F = P(1+r)^T$$

This is an *exponential formula*.

As the amount of time, *T*, increases, the final value grows faster and faster.

Investment Strategies

Investing for the long-term

So over the long-term, interest compounding can lead to great wealth.

- If George Washington had set aside \$1 in a trust fund earning 8% (the average rate of return of stocks over the past 200 years) for his heirs on the first day of his presidency in 1789, his heirs would have millions!

$$F = P(1+r)^T = \$1 * (1.08)^{(2015-1789)} = \$35{,}790{,}580$$

Think about that every time you see Washington's face on a \$1 bill!

Investing for the long-term

So over the long-term, interest compounding can lead to great wealth.

- **Of course, we don't all have 200+ year investment horizon. If you invest \$1,000 at 8% at age 55, when you reach age 65 you'll have:**

$$F = P(1+r)^T = \$1{,}000 * (1.08)^{(65-55)} = \$2{,}158$$

- **But if you start at age 25 you'll have much more!**

$$F = P(1+r)^T = \$1{,}000 * (1.08)^{(65-25)} = \$21{,}724$$

- **It pays to start saving early!**

Investing at a high interest rate

And over the long-term, investing at a higher rate makes a big difference.

- **If you put $1,000 in a bank account earning 2% interest today, it will more than double in 40 years.**

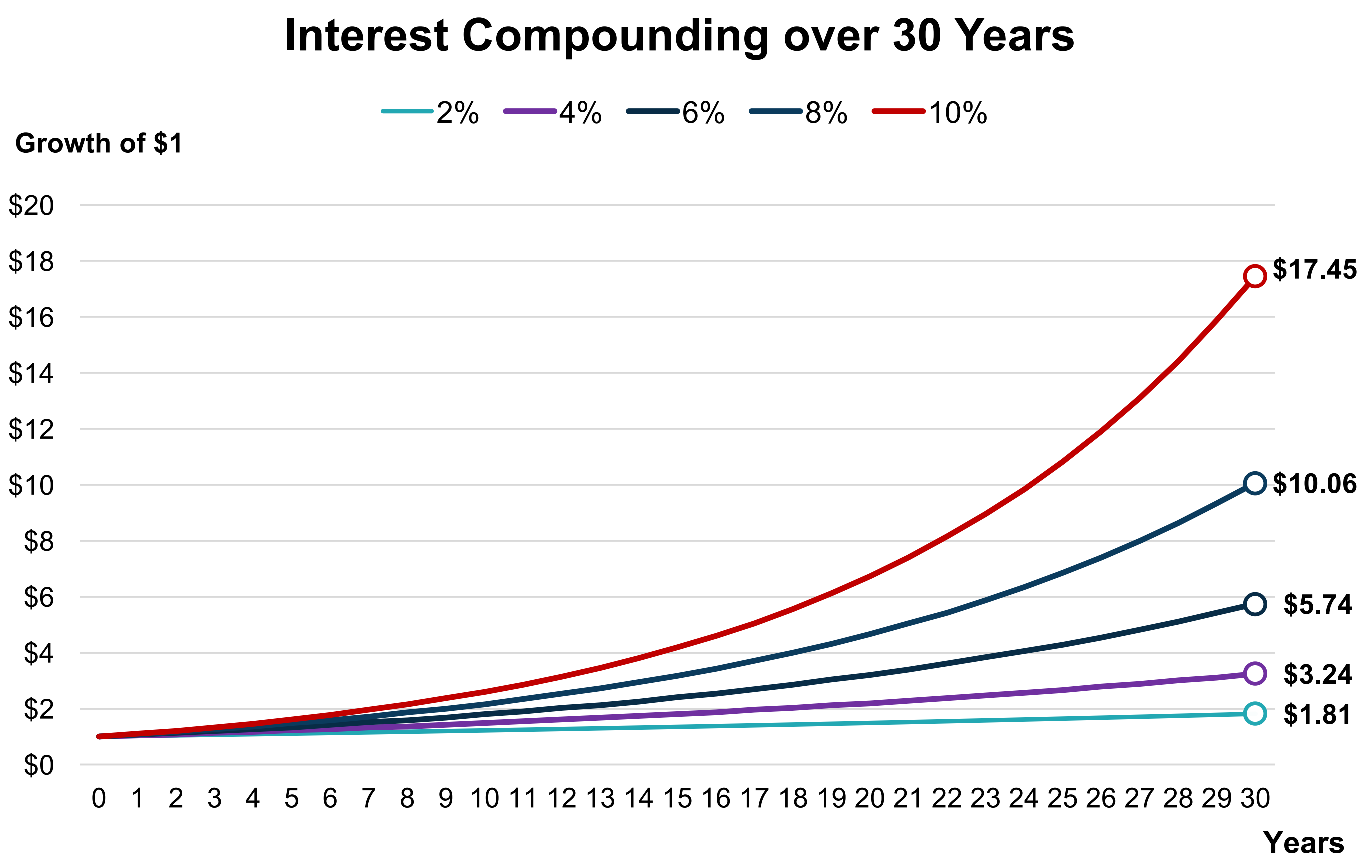
$$F = P(1 + r)^T = \$1{,}000 * (1.02)^{40} = \$2{,}210$$

- **But if you put that same $1,000 in the stock market and earn 10% per year, in 40 years you would have many times that initial amount.**

$$F = P(1 + r)^T = \$1{,}000 * (1.10)^{40} = \$45{,}260$$

Investing at a high interest rate

The higher the interest rate, the larger the effect of interest compounding over time.



Investing early

The interest compounding formula implies that it's best to start saving early.

- **If you start saving for your child's $200,000 private college education only three years before they begin school, you'll need to put $172,768 in an investment account earning 5%.**

$$F = P(1+r)^T = \$172{,}768 * (1.05)^3 = \$200{,}000$$

- **But if you start saving when they are born, your money will grow for 18 years, and you need only set aside $83,104.**

$$F = P(1+r)^T = \$83{,}104 * (1.05)^{18} = \$200{,}000$$

Doubling debt

But interest compounding is bad news when it concerns debt…

- **A college student buys a $1,500 laptop using a credit card that charges 15%. The student goes through four years of college and wait an additional year in his new job before paying of the debt. By this time, the cost of the laptop will double!**

$$F = P(1+r)^T = \$1{,}500 * (1.15)^5 = \$3{,}017$$

Who wants to be a millionaire?

The magic of interest compounding

If a 25-year-old investor invests $20,000 at 10%, how old will this investor be when the investment becomes $1,000,000?

Formula:

$$F = P \cdot (1 + r)^t$$

What is your guess?

Who wants to be a millionaire?

The magic of interest compounding

Ans.

P = \$20,000;

F = \$1,000,000;

r = 10%;

$$F = P(1+r)^t$$

$$T = \frac{\ln(F/P)}{\ln(1+r)}$$

Solve for T

$$T = \frac{\ln(50)}{\ln(1.1)} =$$

= 41.05

The investor will be 25 + 41.05 = 66 years old.

Waiting to be a millionaire

The magic of interest compounding

If the same investor instead waits until she is 46 before making the initial investment, how large must the initial investment be for it to grow to $1,000,000 when she is 66 years old?

What is your guess?

Waiting to be a millionaire

The magic of interest compounding

Ans.

F = $1,000,000;

r = 10%;

t = 66 – 46 = 20;

Solve for P

$$P = \frac{F}{(1+r)^t}$$

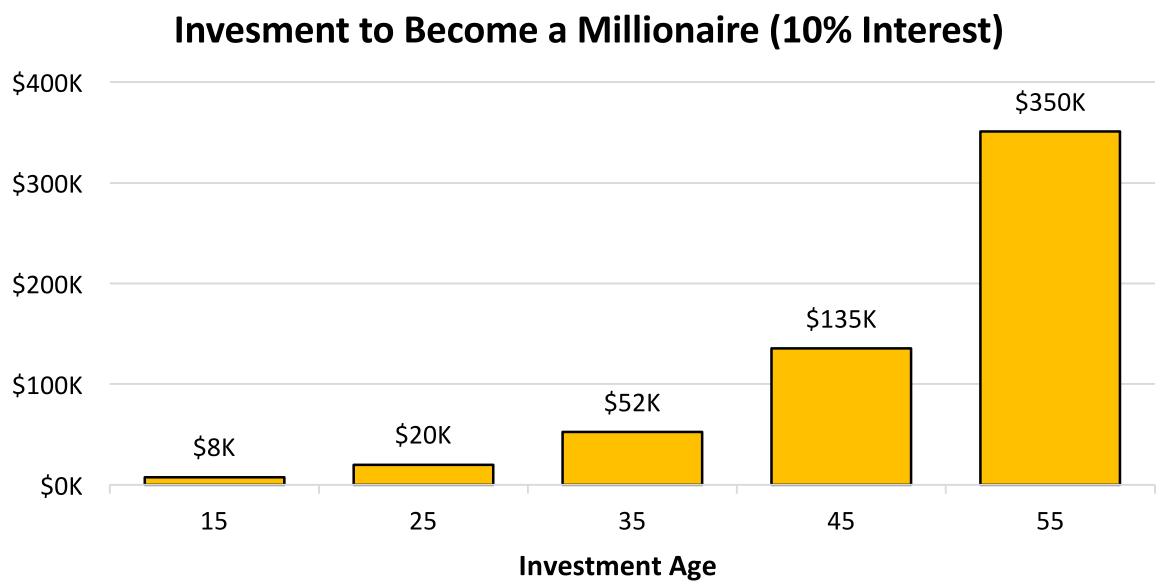
= $148,643.

So, the sum is large, it pays to save early!

Waiting to be a millionaire

The magic of interest compounding

The chart below shows the initial investment needed to become a millionaire (at 66) for different ages.



The benefit of investing early comes from compounding interest…

Getting rich via interest compounding

The magic of interest compounding

If the interest on the investment did not compound, how many years would the investment of \$20,000 take to become \$1,000,000 if r =10%?

What is your guess?

Getting rich via interest compounding

The magic of interest compounding

Ans.

The formula for simple interest compounding is:

$$F = P(1 + r \cdot T)$$

Therefore:

$$T = \frac{(\frac{F}{P} - 1)}{r} \qquad T = \frac{(50 - 1)}{0.10} =$$ **490 years!**

This shows the power of compounding!

Different investment strategies

Similar people with different investments

Example:

Take 2 people with the same income.
Both have $10,000 in savings at age 30.

One puts the money in a checking account at 1%
The other in stock mutual funds at 7%.

At age 65, how much do they have?

$14,166 versus $106,766

Example: Debt growth in countries A and B

(Replace Country B with favorite country, ex: Greece, Spain, Italy, the US…)

- The debt of Country B is currently less than half the size of that of Country A; Country A's debt is about \$15 trillion, while Country B's debt is around \$7 trillion.

- Debt in Country B, however, pays a much higher interest rate than in Country A, and is projected to do so in the near future.

- Given an interest rate of 3% in Country A and an interest rate of 8% in Country B, how long will it take for the debt of Country B to surpass the debt of Country A?

Example: Debt growth in countries A and B

The number of years from today at which the two countries' debt is equal can be found by setting the two equations equal and solving for T:

$$D_A(T) = D_B(T)$$

$$\$15 * 1.03^T = \$7 * 1.08^T$$

$$\frac{\$15}{\$7} = \frac{1.08^T}{1.03^T}$$

$$\frac{\$15}{\$7} = \left(\frac{1.08}{1.03}\right)^T$$

Example: Debt growth (cont.)

Apply the log function:

$$\frac{\$15}{\$7} = \left(\frac{1.08}{1.03}\right)^T$$

$$\ln\left(\frac{\$15}{\$7}\right) = \ln\left[\left(\frac{1.08}{1.03}\right)^T\right]$$

$$\ln\left(\frac{\$15}{\$7}\right) = T\ln\left(\frac{1.08}{1.03}\right)$$

$$T = \frac{\ln\left(\frac{\$15}{\$7}\right)}{\ln\left(\frac{1.08}{1.03}\right)} \approx 16$$

Thus, at these interest rates, Country B's debt will become equal to, and then surpass, Country A's debt in **about 16 years.**

A Look at the Market

Data on financial capability

National Financial Capability Study (NFCS)

2015 NFCS Data Release

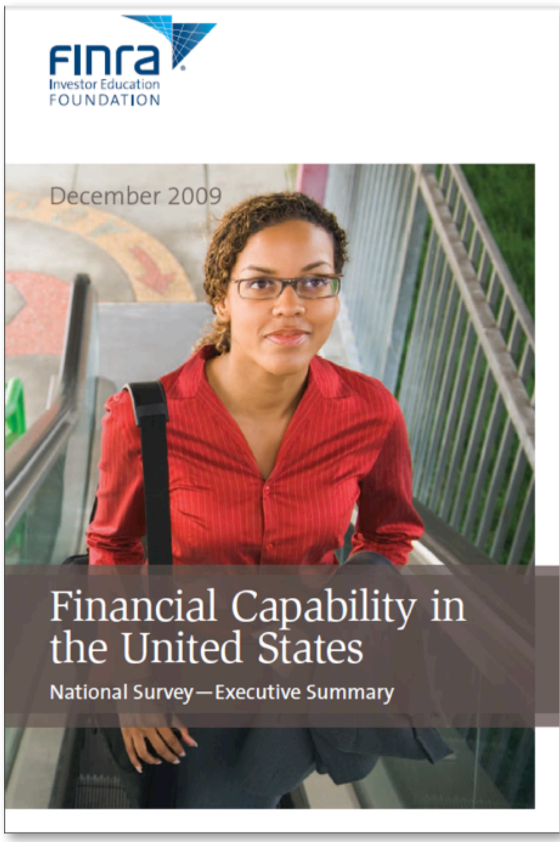
Now in its third iteration, the NFCS is one of the largest and most comprehensive financial capability studies in the country... the Study allows for state-by-state comparisons of financial literacy, making it invaluable to policy makers... The NFCS is one of many initiatives undertaken by the FINRA Investor Education Foundation to benchmark, better understand and build financial capability in America.

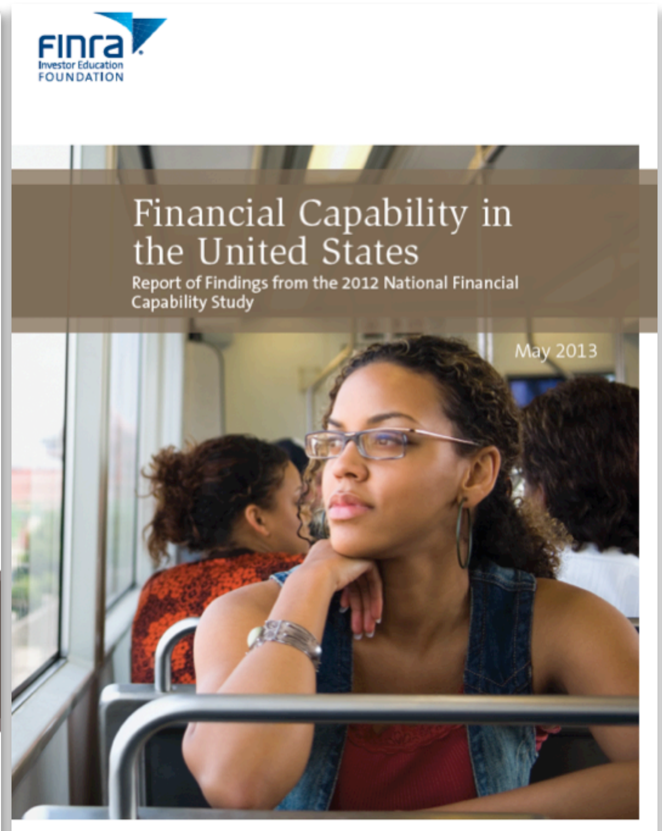
- Geraldine Walsh

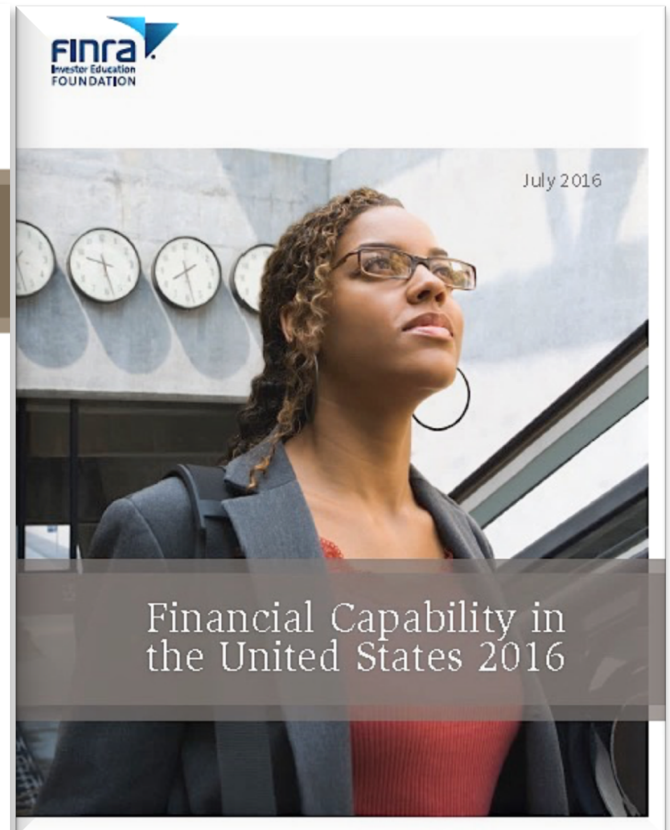
  President of the FINRA Investor Education Foundation

Data on financial capability

National Financial Capability Study (NFCS)







2009, 2012, and 2015 Reports by FINRA Investor Education Foundation

Measuring numeracy and interest compounding

To test numeracy and understanding of interest rates, the survey asked:

"Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?"

a) More than $102
b) Exactly $102
c) Less than $102
d) Don't know
e) Prefer not to say

Source: 2015 National Financial Capability Survey

Measuring numeracy and interest compounding

To test numeracy and understanding of interest rates, the survey asked:

"Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?"

a) **More than $102**
b) Exactly $102
c) Less than $102
d) Don't know
e) Prefer not to say

75% responded correctly

(13% incorrect; 12% Don't know)

Source: 2015 National Financial Capability Survey

Knowledge of interest compounding (US)

Suppose you owe $1,000 on a loan and the interest rate you are charged is 20% per year compounded annually. If you didn't pay anything off, at this interest rate, how many years would it take for the amount you owe to double?

a) Less than 2 years
b) At least 2 years but less than 5 years
c) At least 5 years but less than 10 years
d) At least 10 years
e) Don't know
f) Prefer not to say

Source: 2015 National Financial Capability Survey

Knowledge of interest compounding (US)

Suppose you owe $1,000 on a loan and the interest rate you are charged is 20% per year compounded annually. If you didn't pay anything off, at this interest rate, how many years would it take for the amount you owe to double?

a) Less than 2 years
b) **At least 2 years but less than 5 years**
c) At least 5 years but less than 10 years
d) At least 10 years
e) Don't know
f) Prefer not to say

33% answered correctly

(29% At least 5 years but less than 10 years, 25% Don't know)

Source: 2015 National Financial Capability Survey

Measuring financial literacy (Sweden)

To test understanding of interest compounding, respondents were asked:

"Suppose you had SEK 200 in a savings account and the interest rate is 10% per year and is paid in the same account. How much will you have in the account after 2 years?

i) Your calculation (correct answer is SEK 242)
ii) Don't know

35% of respondents answered correctly

Source: Almenberg, J. and Save-Soderbergh, J. "Financial literacy and retirement Planning in Sweden." *Journal of Pension Economics and Finance*, 2011.

Financial literacy: Smart about methods of payment

You purchase an appliance which costs $1,000. To pay for this appliance, you are given the following two options: (a) Pay 12 monthly installments of $100 each; (b) Borrow at a 20% annual interest rate and pay back $1,200 a year from now. Which is the cheaper offer?

a) Option (a)
b) Option (b)
c) They are the same
d) Do not know
e) Prefer not to answer

Appliance payment	Percent
Option a	**40.6**
Option b (correct)	**6.9**
They are the same	**38.8**
Do not know	**9.2**
No answer	**4.5**

Source: Lusardi, A. and Tufano, P. "Debt Literacy, Financial Experiences, and Overindebtedness ." *Harvard Business Review*, 2009.

Returns to different investments

Example: Below is a table showing hypothetical average returns for different types of investments.

Asset Class	Return
Savings Account	1.5%
Treasury Bill	3.5%
Corporate Bond	6.0%
Stock	13.0%

Author's calculations

For each of these assets, if you invest $100,000, how much will have after 40 years?

Returns to different investments

Ans.

For each asset class, the final value of the savings can be calculated with the formula:

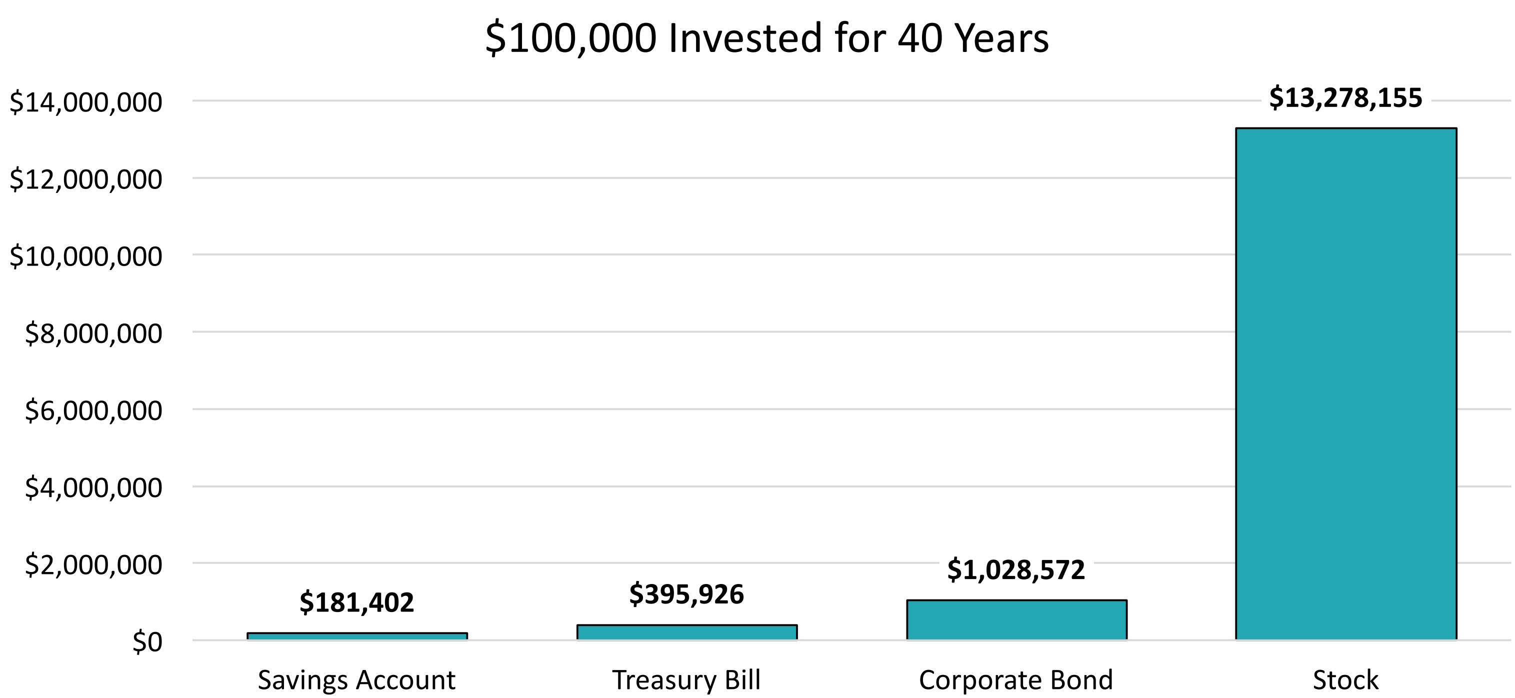
$$F = P(1+r)^T = \$100{,}000 * (1+r)^{40}$$

Where *r* is the listed return for the asset class. The following table shows the final value of $100,000 invested in each asset class:

Asset Class	Return	Final Value
Savings Account	1.5%	$181,402
Treasury Bill	3.5%	$395,926
Corporate Bond	6.0%	$1,028,571
Stock	13.0%	$13,278,155

Returns to different investments

The difference between investing in a savings account and the stock market is huge over the long term!



Returns to different investments

For each of the above assets, how much would you need to set aside when your child is born to pay for their $200,000 private college education in 18 years?

Here are the hypothetical average returns one more time:

Asset Class	Return
Savings Account	1.5%
Treasury Bill	3.5%
Corporate Bond	6.0%
Stock	13.0%

Returns to different investments

Ans. To solve this problem, we first need to use some algebra to solve for the starting amount *P* in the interest compounding formula:

$$F = P(1+r)^T$$

Divide both sides by to isolate *P*:

$$\frac{F}{(1+r)^T} = P$$

We know have a formula for the starting amount ***P*. By plugging in the desired final amount of $200,000 and the 18 year investment horizon, we get:**

$$P = \frac{\$200{,}000}{(1+r)^{18}}$$

Returns to different investments

Ans. (continued)

By plugging in the appropriate return for each asset class, we get:

Asset Class	Return	Starting Amount
Savings Account	1.5%	$152,982
Treasury Bill	3.5%	$107,672
Corporate Bond	6.0%	$70,069
Stock	13.0%	$22,162

Because stock returns compound at a higher rate, **much less needs to be set aside today to meet a future savings goal.**

Returns to different investments

The reason returns differ between asset classes is because of their **liquidity** and **risk**:

- **Liquidity** refers to the ability to convert an investment into cash quickly, without fee or penalty, and for a known amount. Savings accounts are very liquid, bonds and stock are not.

- **Risk** refers to the possibility that the amount received from the investment will differ from what is expected. Both savings accounts and Treasury bills are riskless because the full amount is guaranteed to be returned. Corporate bonds are risky because the corporation that issued the bond might default. Stocks are risky because the price at which they can be purchased or sold is constantly changing.

There is a necessary trade-off between risk and return. As economists say, “there is no free lunch.”

Interest compounding

Video about the importance of interest compounding

“How Compound Interest Boosts Savings”

http://gflec.org/education/educational-videos/

The power of interest compounding

Looking at interest compounding teaches us some important lessons:

- Savings barely grow in an account earning 1% interest.
- It pays to start saving early.
- Debt at a high interest rate will double quickly!

Today we learned…

- ✓ Course topics
- ✓ Interest rates
- ✓ Interest compounding
- ✓ Investment strategies