

# Financial Management

András Danis, Ph.D.

Associate Professor of Finance

Twitter: @AndrasDanis

# Brief Bio

Dr. Danis received his doctoral degree in 2012 from the Vienna Graduate School of Finance, a joint PhD program of the Institute for Advanced Studies in Vienna, the University of Vienna, and the WU Vienna University of Economics and Business. He pursued his undergraduate studies at the University of Vienna, where he received a Diplom in International Business Administration (equivalent to MSc). His current research topics are the effects of credit derivatives on the restructuring of financially distressed firms, optimal capital structure, and shareholder activism. Dr. Danis teaches Finance at the bachelor, master, and PhD levels.

# **Course management issues and grading**

# Course Materials

- Textbook
  - Corporate Finance, by Ross, Westerfield, and Jaffe, 10<sup>th</sup> to 13<sup>th</sup> editions
  - Library has e-book of shortened version of textbook, “Corporate finance: Core principles & applications”, 6th edition, 2021
- Other recommended texts
  - Wall Street Journal (or New York Times, Financial Times, Economist)
  - Library has free subscriptions for NYT and FT
- Syllabus and slides
  - Bring printed slides to each class
  - Find this and other material on Moodle
- Case studies
- Calculator: If you are specializing in finance you may want to invest in a TI BA II Plus, HP 10B, TI-83, or TI-89, nothing more sophisticated.
  - Otherwise, a basic scientific calculator is sufficient
  - Bring your calculator to class every day

# The 'most important text'

- *The Wall Street Journal*
- Some interesting facts of readers of WSJ.com:

Readers per month	42 million
Average household income	\$242,007
Average household net worth	\$1,489,932
Graduate from college	81%
Top management position	35%

# Who reads what?

- The Wall Street Journal is read by people who run the country
- The New York Times is read by people who think they run the country
- The Washington Post is read by people who think they should run the country
- USA Today is read by people who think they ought to run the country but can't understand the Washington Post

# Another reason to read the WSJ

- Employers (particularly in finance) like to ask questions about the economy!
- Some sample questions:
  - Where is the DOW, or S&P 500, or NIKKEI. How does it compare now to where it has been over the last two years? Where do you see it six months from now?
  - Why invest in a particular market (e.g., China, Nigeria, Poland)?
  - What stock do you recommend and why?
  - Where do you think the economy will go over the next year?

# Grading Scheme

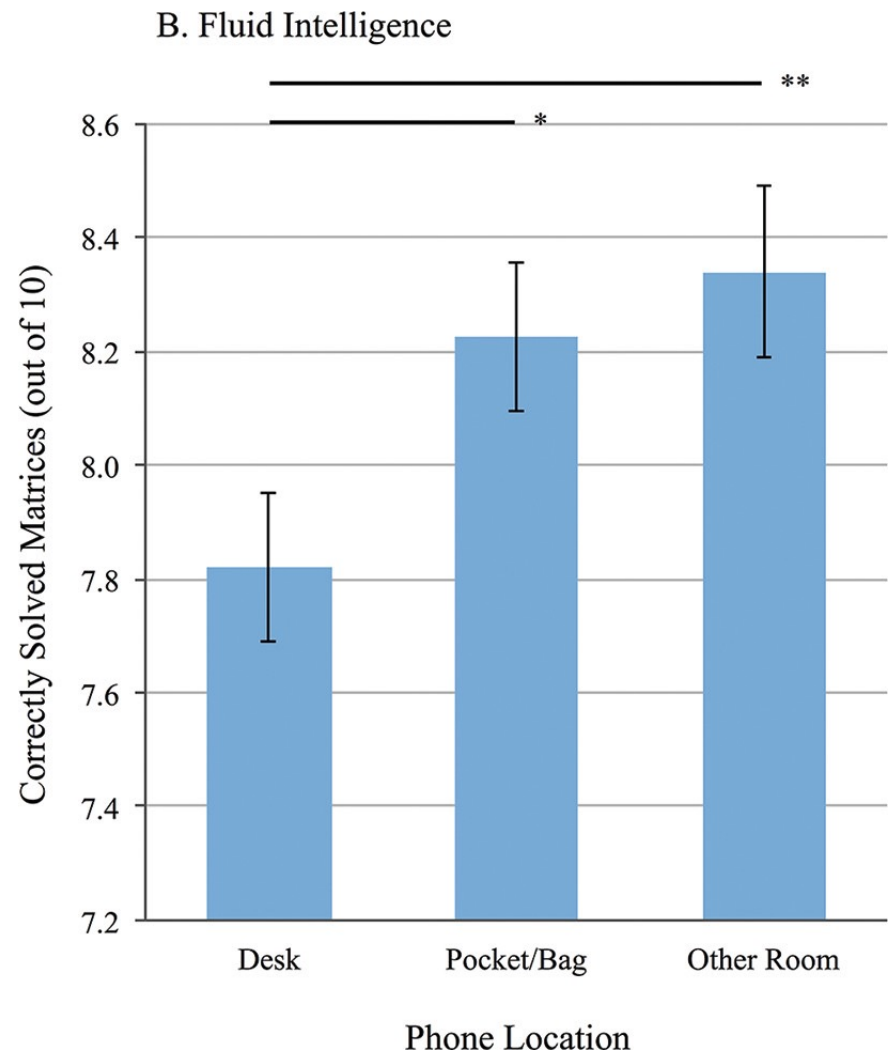
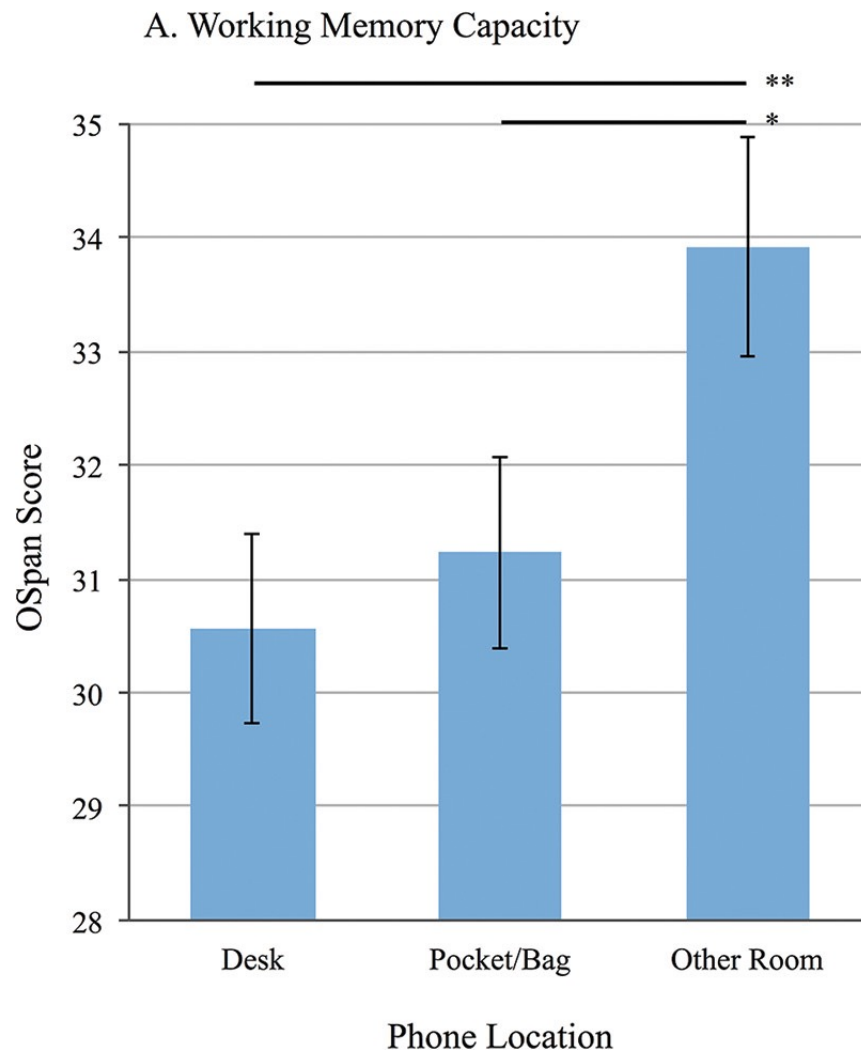
- Let's have a look at the syllabus
  - Course outline at the end gives you an overview of the topics



# Electronic devices

- Please do not use laptops/tablets/phones during class
- Why?
  - There is a lot of scientific evidence that devices are bad for your learning experience

- In a randomized classroom experiment, researchers have found that brain performance is significantly better if your phone is not on your desk
  - Ward et al., 2017, Journal of the Association for Consumer Research



# Electronic devices, cont'd: More scientific studies of negative effects

- Hand-written notes are more effective than laptop note taking
  - Mueller and Oppenheimer, 2014, Psychological Science
- Laptop use harms not only laptop user, but also nearby students
  - Sana et al., 2013, Computers & Education
- U.S. Military Academy, introductory economics class:
  - The course was taught in small sections, which the researchers randomly assigned to one of three conditions:
  - Electronics allowed, electronics banned, and tablets allowed but only if laid flat on desks
  - By the end of the semester, students in the classrooms with laptops or tablets had performed substantially worse than those in the sections where electronics were banned
  - Carter et al., 2017, Economics of Education Review

# Other course considerations, continued

- Courtesy: Arrive on time and limit disruptions
- I want these sessions to be as interactive as possible
  - Please stop me if you have questions
- Best way to do well on exam is to work the recommended problems outlined for each chapter
  - Very similar to the types of questions you will see on the exam
  - It's especially important to keep pace earlier.
    - This is in your interest!

# Course Communication: Moodle

- Please do not send me messages with general questions.
  - Ask these questions in the Moodle Forum
  - I will answer your questions there, which hopefully will benefit other students too
  - You might get an answer much faster from another student
- Of course, there will be confidential questions, for example, related to your grade
  - Please send me a private message on Moodle
  - We can always arrange a meeting, too
- I will do my best to respond within 48 hours. Please do not expect answers after 5 pm or on the weekends
- Please monitor the notifications sent out through Moodle

# Program Communication

- This is different from Course Communication

# Office Hours

- I will be available after every class for some time
- Office hours:
  - Wednesday 2 - 3 pm
- For students outside of Vienna, sign up for Zoom meeting:
  - <https://calendly.com/andrasdanis/office-hour>

# **Some thoughts about finance**



# Is finance good for society?

- During the 2008 financial crisis:
  - Many people lost their jobs
  - Many people lost their homes
  - Few intermediate level finance executives went to jail
  - No high-level finance executives went to jail
- As a consequence, public opinion of finance is very bad
- Some of the criticism is justified
  - Several documented cases of illegal or unethical behavior
- But is finance really detrimental to society?

# New book by Nobel Prize winner Robert Shiller

- Economics professor at Yale
- Predicted the Dotcom bubble and the housing bubble
- Nobel Prize in 2013
- Book about the value of finance for society
- “Society appreciates innovations by Apple, but not by financial institutions”

Princeton University Press, 2012

The image shows the front cover of the book 'Finance and the Good Society' by Robert J. Shiller. The cover is white with a thin grey border. The author's name, 'Robert J. Shiller', is printed in a dark blue serif font at the top. A thin yellow horizontal line is positioned below the author's name. The title, 'Finance and the Good Society', is printed in the same dark blue serif font, with 'Finance' and 'Good Society' in a larger, bold font, and 'and the' in a smaller, italicized font between them.

Robert J.  
Shiller

---

Finance  
*and the*  
Good  
Society

# Financial innovations can improve well-being of society

- Money
- Insurance
- Public corporation and the stock market
- Savings account
- Mutual fund
- Mortgage
- Exchange traded funds / index funds
- Bitcoin?
- Green finance?
- ...

# **Overview of Financial Management**

# What I want you to learn in this course

## 1. Make good decisions

- Choose good long-term investments, like buying a house
- Distinguish good mutual funds from bad ones
- Don't be fooled by false promises of 'financial experts'
- Learn how you can obtain funding for your own firm

## 2. Understand the finance world out there

- Why is the Fed interest rate so important?
- What's the fuzz about IPOs?
- Why are stocks riskier than bonds?

# Why is the Chair of the Federal Reserve (Fed) so important?

The New York Times

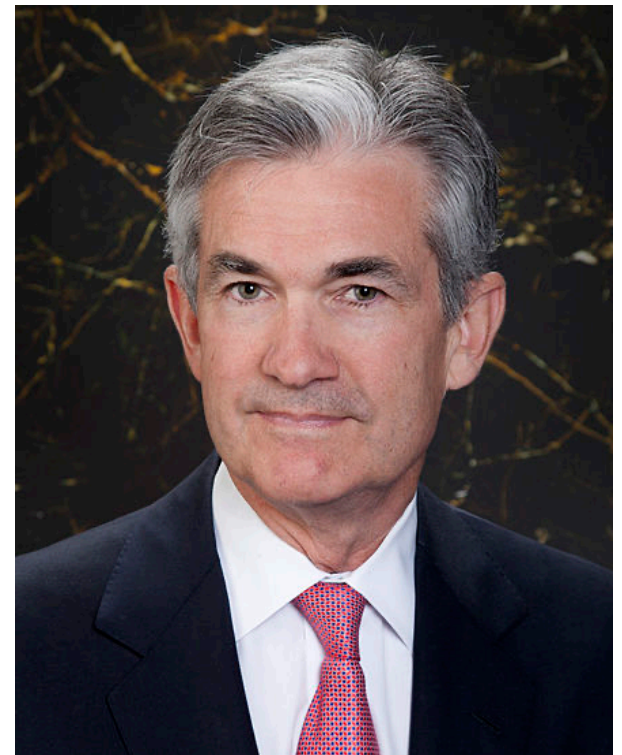
## ***Jerome Powell Tries a Nuanced Fed Policy. Markets Don't Like It.***

Walking a narrow line between signaling interest rate intentions and vowing to be nimble in response to changing conditions, he helps prompt a stock sell-off.



By Neil Irwin

Dec. 19, 2018



# In the news: Inflation

THE WALL STREET JOURNAL.

MARKETS | CREDIT MARKETS

## Treasury Yields Jump After Inflation Data Exceeds Expectations

Data shows core prices rose 0.6% in August from the previous month



Investors are anticipating that the Federal Reserve will raise interest rates again next week.

PHOTO: JOSHUA ROBERTS/BLOOMBERG NEWS

By [Sam Goldfarb](#) [Follow](#)

Updated Sept. 13, 2022 4:07 pm ET

# In the news: Volkswagen/Porsche IPO



THE WALL STREET JOURNAL.

[BUSINESS](#) | [AUTOS & TRANSPORTATION](#) | [AUTOS INDUSTRY](#)

## Volkswagen to List Porsche in One of Biggest IPOs in Years

Porsche shares could be trading by the end of September, early October



Porsche models at a showroom in Berlin earlier this year.

PHOTO: LIESA JOHANNSEN-KOPPITZ/BLOOMBERG NEWS

By [William Boston](#) [Follow](#)

Updated Sept. 6, 2022 10:08 am ET



# The Big Picture

- Corporate Finance is all about determining value
- Over the course of the semester, we will learn how to value:
  - Firms
  - Projects and other real investments
  - Securities
- We will focus our discussion of value on the two broad components of Corporate Finance:
  - Investment policy
    - How does the firm spend its money? How can we identify good investments that increase firm value?
  - Financing and payout policy
    - How does the firm obtain funds and dispose of excess cash in a way that maximizes firm value?
- We will make connections between Corporate and Personal Finance

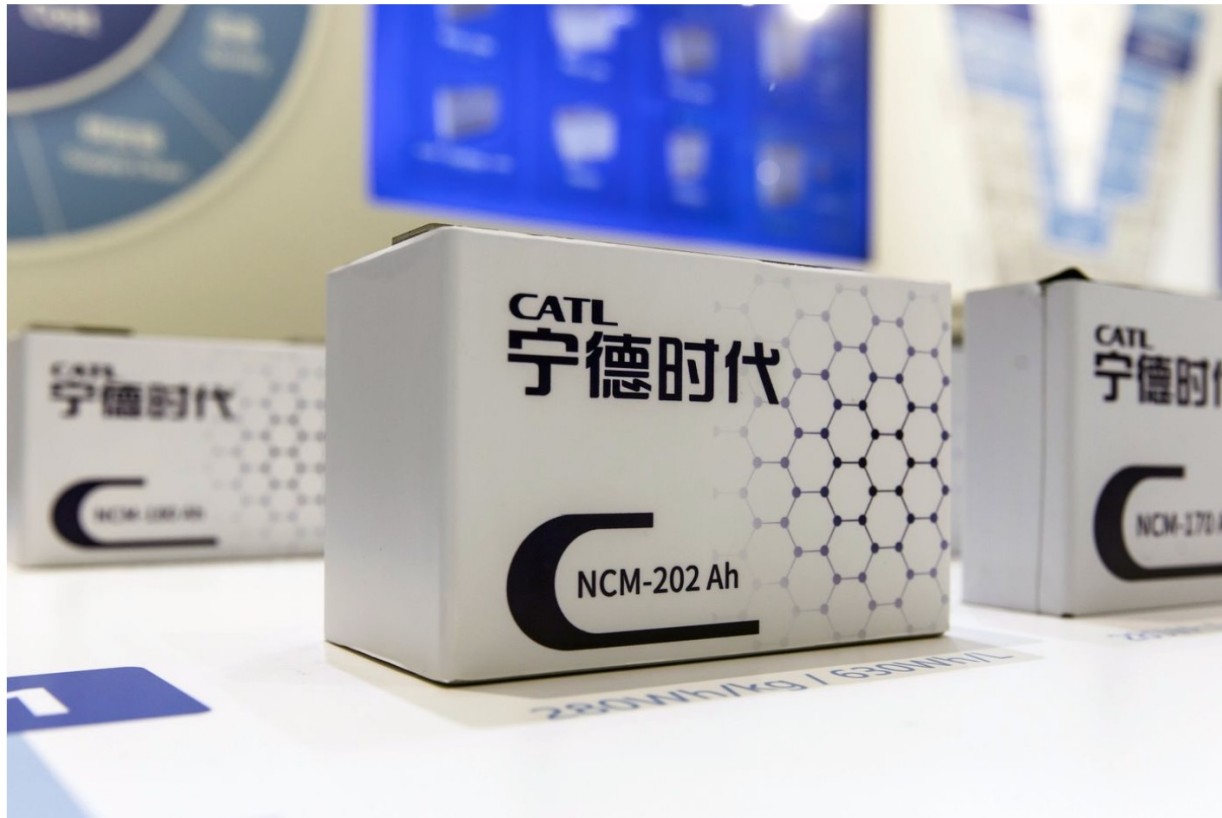
# Investment Policy

- How do we evaluate a corporate investment project:
  - New plant and equipment?
  - Market entry?
- How should we compare:
  - Payoffs today vs. down the road?
  - Projects with different risks?
- How do we value:
  - An established company? A start-up?
  - A merger?

Markets | Hyperdrive

## Mercedes, CATL Partner on \$7.6 Billion Hungary Battery Plant

- BMW, Stellantis, VW set to take cells from Hungary project
- New facility will be CATL's second in Europe following Germany



CATL battery products. *Photographer: Qilai Shen/Bloomberg*

By Danny Lee and William Wilkes

12 August 2022, 10:56 CEST *Updated on 12 August 2022, 13:39 CEST*

# Financing and payout policy

- How can we forecast how much funding we need?
- Should we finance those funding needs with:
  - Debt?
  - Equity?
  - Other sources?
- If we have internally generated funds, what do we do with the excess?
- When should we raise funds from the capital markets?
- In this course, we will focus more on investment than financing and payout

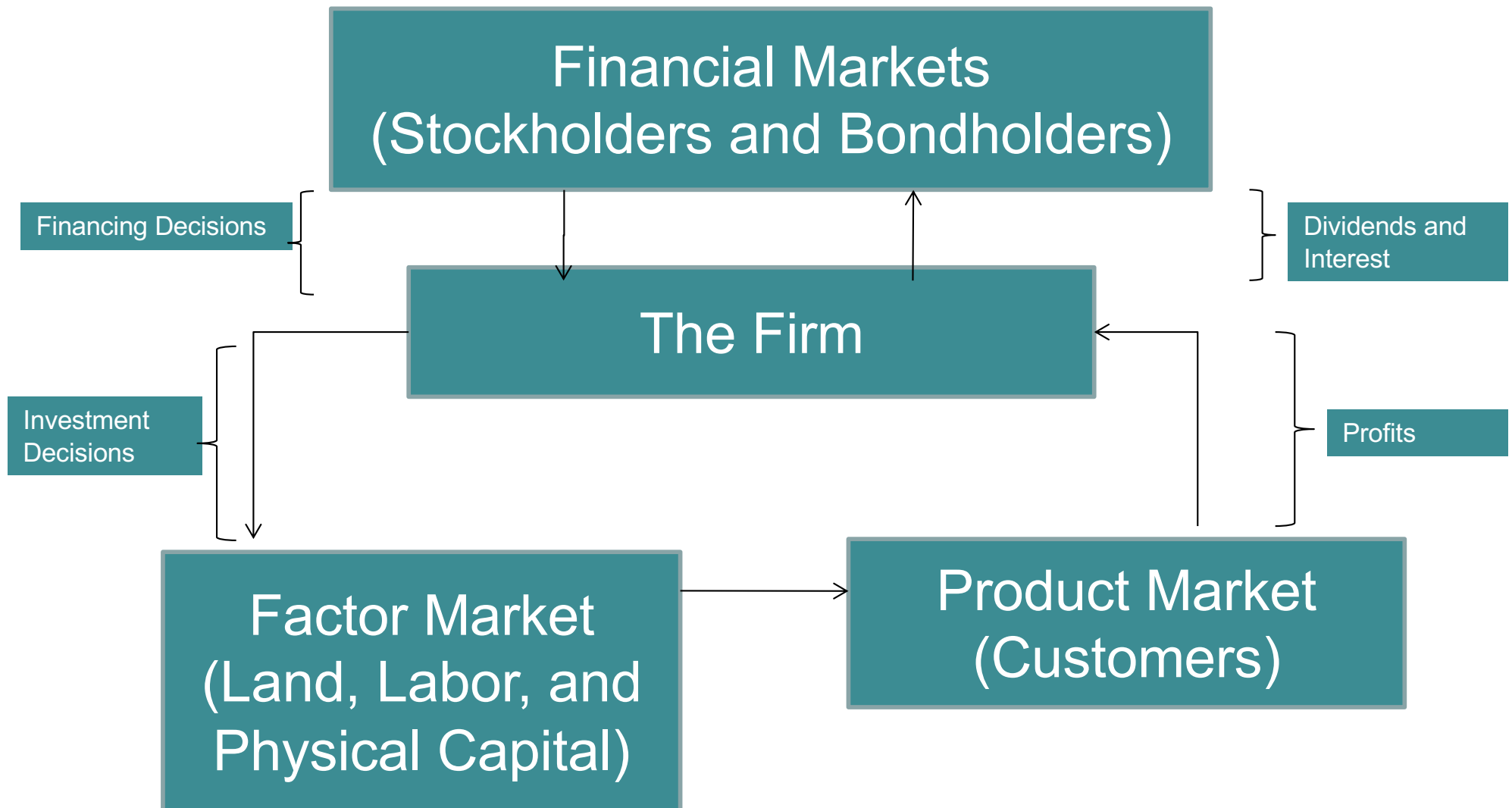
MARKETS | JOURNAL REPORTS: WEALTH MANAGEMENT

## How Bond Investors Can Also Jump on the ESG Train

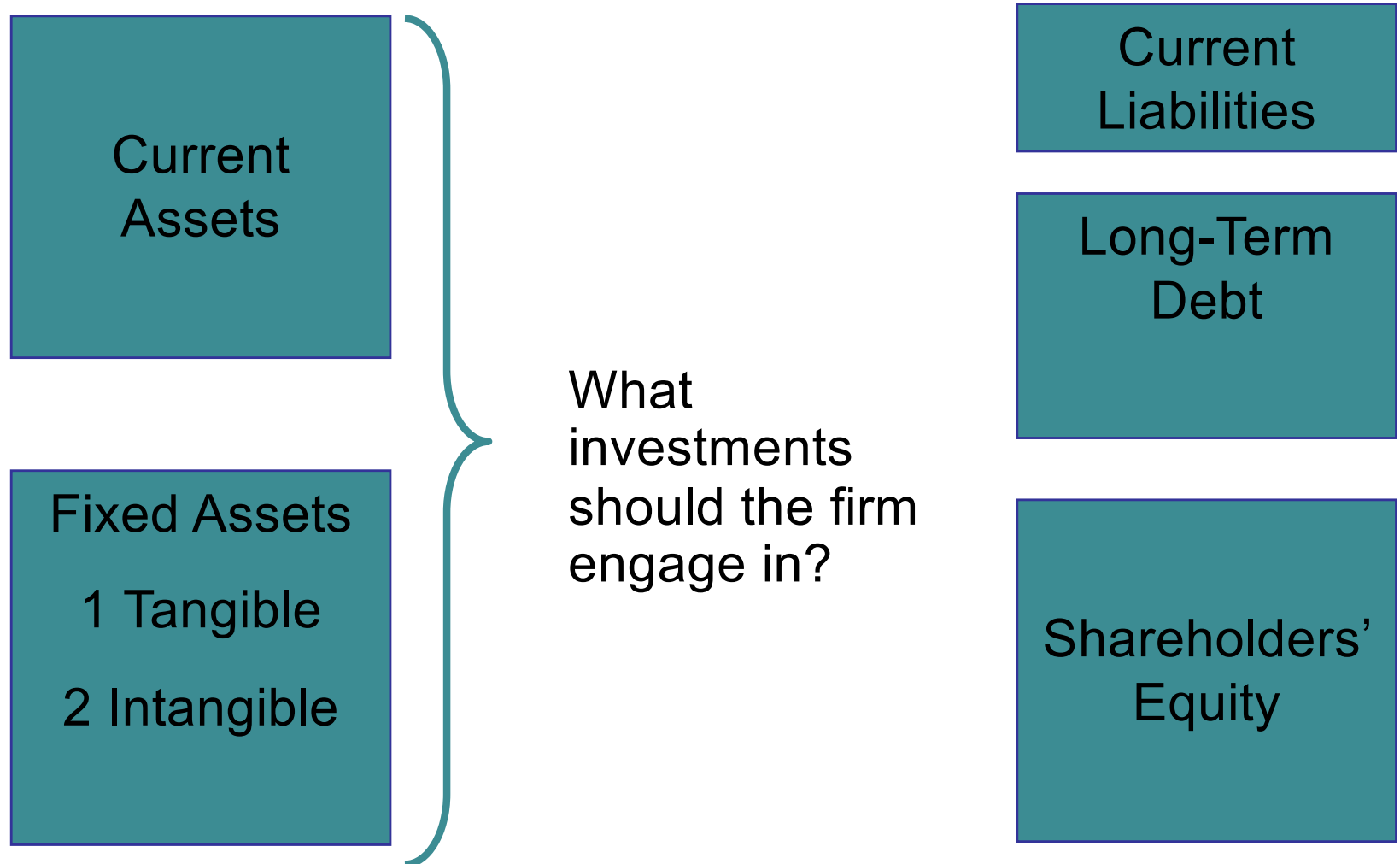
Stock investors aren't the only ones who can put their money in socially responsible funds. Fixed-income investors now have options as well.



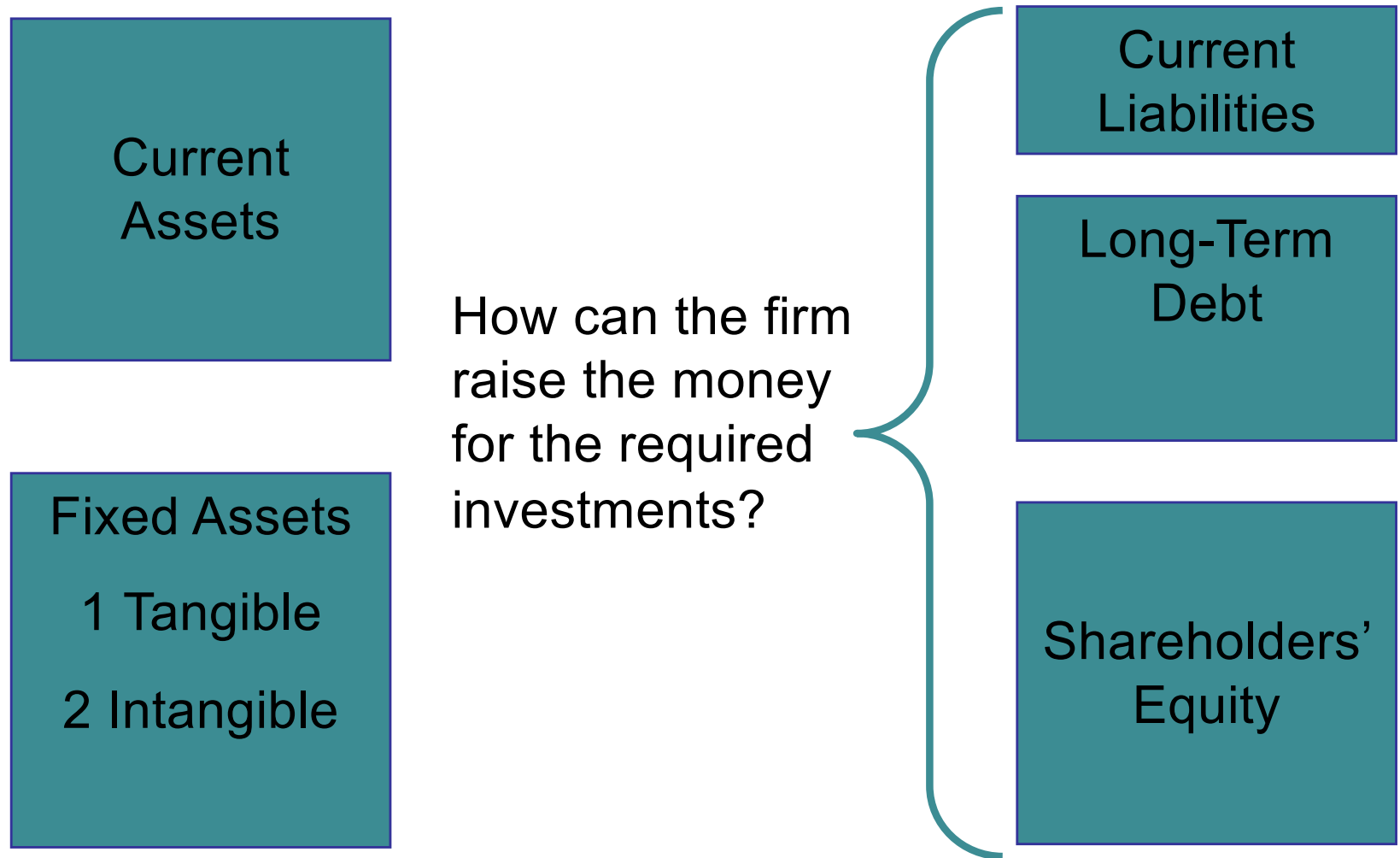
# The Value Creation Process



# The Balance-Sheet Model of the Firm: The Capital Budgeting Decision



# The Balance-Sheet Model of the Firm: The Capital Structure Decision





# Central Question of the course

How do we create value through investment  
and financing decisions?

# Necessary tools

- To answer this question, we are going to have to spend significant time developing some skills:
  - Time value of money
    - Cash today is worth more than cash in the future
  - Types of securities in the marketplace (stocks, bonds, etc.)
  - Calculation of free cash flow
  - Portfolio theory
    - The diversification effect
    - Risk and return
  - Efficient markets hypothesis
    - Prices react quickly and accurately to new information

# Possible objectives

- A corporation needs an objective function – something that guides decision making within the firm
- Possible objectives:
  1. Maximize growth
  2. Maximize customer satisfaction
  3. Maximize employee satisfaction
  4. Maximize earnings
  5. Maximize the stock price

# In the news: Walmart

**Bloomberg** ▼

Sign In  
Subscribe



## Wal-Mart Raises Hourly Wage to \$11 in Wake of Tax Overhaul

By **Matthew Boyle**

January 11, 2018, 8:01 AM EST *Updated on* January 11, 2018, 10:13 AM EST

→ Largest private U.S. employer to give bonuses of up to \$1,000

**TicToc**

# In the news: Amazon

## THE WALL STREET JOURNAL.

English Edition | Print Edition | Video | Podcasts | [Latest Headlines](#)

[Home](#) [World](#) [U.S.](#) [Politics](#) [Economy](#) [Business](#) **Tech** [Markets](#) [Opinion](#) [Books & Arts](#) [Real Estate](#) [Life & Work](#) [WSJ. Magazine](#) [Sports](#)

◆ WSJ NEWS EXCLUSIVE | [TECH](#)

### Amazon Dangles Free Bachelor's Degrees as New Perk in Fight for U.S. Workers

E-commerce giant will expand college education benefit as it battles to hire hourly workers in tight U.S. labor market



A photograph showing several Amazon warehouse workers in a large industrial facility. In the foreground, a worker in a black t-shirt and shorts is using a white handheld device to scan a large stack of cardboard boxes on a pallet. To the left, two other workers in orange safety vests are visible. The background features complex conveyor belt systems and more stacks of boxes, illustrating the scale of Amazon's logistics operations.

# How can we tell if we are adding value through our decisions?

- Our objective function:
  - The objective of the financial manager and the corporation is to:

**MAXIMIZE THE CURRENT VALUE OF SHAREHOLDERS' WEALTH**

- That is, a firm should pursue policies that maximize the current stock price per share

# What's so special about the shareholder?

- Shareholders are residual claimants
- They receive money only after:
  - suppliers have been paid
  - wages to workers have been paid
  - interest to bondholders have been paid
  - taxes have been paid
- Legally, shareholders are owners of the firm, not lenders
- Ideally, all stakeholders are satisfied, but this can be difficult to achieve

# Shareholders vs. Other Stakeholders

- “A proper balance between shareholders, employees, and communities is what we all try to achieve. But it is a tough balancing act because, in the end, if you don’t satisfy shareholders you don’t have the flexibility to do the things you have to do to take care of employees or communities. In our society, whether we like it or not, we have to satisfy shareholders.”

Jack Welch, Former Chairman and CEO of GE



# Is maximizing shareholder value a goal or a strategy?

- Peter Drucker, famous management consultant:  
“Securities analysts believe that companies make money. Companies make shoes.”
- Jack Welch, former CEO of General Electric:  
“Shareholder value is a result, not a strategy ... Your main constituencies are your employees, your customers and your products.”

# What can you do to maximize the stock price?

1. Implement more efficient processes
2. Eliminate processes/steps that are non-value added
3. Redesign products to reduce costs
4. Work to reduce costs throughout the entire value chain
5. By choosing good capital investments
6. By managing receivables and payables
7. By choosing the lowest cost source of funds

Can these techniques be useful for non-profit organizations as well?

# Our approach to answering these questions

## What we will do

- Acquire a set of *general* tools that are crucial to make good business decisions.
  - Financial Managers
  - General Managers
- Apply and confront them to a number of real business cases

## What we won't do

- Pretend to be experts in any particular industry
- Discuss many institutional aspects in detail

# **Time Value of Money**

# Objectives

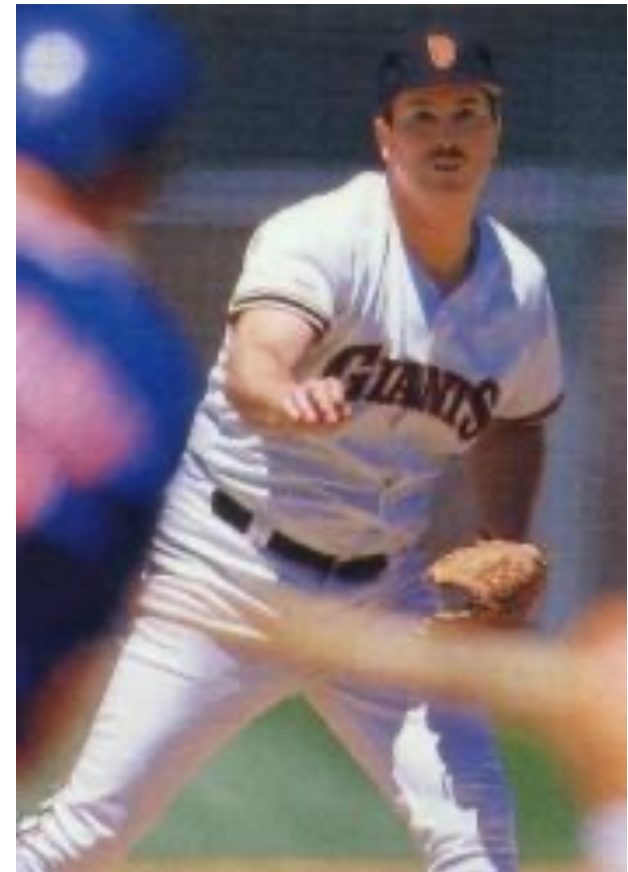
- Describe why a dollar today is worth more than a dollar received in the future
- Describe the impact of compounding on interest rates
- Solve problems using the present value and future value formulas focusing on:
  - annuities
  - perpetuities
  - growing annuities
  - growing perpetuities
- Recommended problems from Chapter 4:
  - 10<sup>th</sup> edition: 1-5, 11-15, 30-33, 35-38, 40, 41, 46-48, 65-69, 72
  - 11<sup>th</sup> edition: 1-5, 11-15, 30-33, 35-38, 40, 41, 46-48, 65-69, 72
  - 12<sup>th</sup> edition: 1-5, 11-15, 30-33, 35-38, 40, 41, 46-48, 65-69, 72

# The nature of finance

- Two problems are often encountered in finance
  - Cash flows are often spread out over long periods of time in the future
  - The cash flows themselves are often uncertain
- Some notable examples:
  - Dividends paid on stocks
  - Coupon payments on bonds
  - Compensation contracts
  - Revenues from investment projects
- A fundamental question:
  - Does money in the future have different value than money held today?

# Illustrative example from baseball contracts

- Rick Reuschel (“Big Daddy”):
  - Made major league debut in 1972
  - Played for Chicago Cubs, NY Yankees, Pittsburgh Pirates, San Francisco Giants
  - Career record: 214-191, ERA: 3.37
  - Most importantly, one of baseball’s first free agents in 1978
- Signed one of baseball’s most unique contracts:
  - Reported in press to be worth **\$8,096,000**
- The catch:
  - The payments took place over 52 years
  - Rick will be 81 years old when he gets his final payment



# The contract

- Payment schedule:

1979	\$20,000
1980	\$20,000
1981	\$20,000
1982	\$164,000
1983	\$164,000
1984	\$164,000
...	
2030	\$164,000

- The sum of these payments is \$8,096,000
  - But is this the “true” worth of the contract?



# Why does money received in the future have less value?

- Inflation
  - Refers to a general rise in prices measured against a standard level of purchasing power
- Compensation for lost opportunities
  - This is because the amount could be deposited in an interest-bearing bank account (or otherwise invested) from now to some time in the future and yield some return
- Risk of investment
  - Compensation for the risk of default on the contract

# What is the implication?

- Investments have to grow over time
  - Investor must be offered a rate of return on the investment
- Rate of return will depend on:
  - Compensation for inflation losses
  - Compensation for opportunity cost
  - Compensation for incurred risk
- Money in the future is worth less than money today
  - Discount future promised money

# Time value of money algebra

- The **future value of money**:
  - Amount an investment will grow to after one or more periods
- How much will \$100 grow to after 1 yr if I invest at a 7% interest rate?
- Each \$1 invested must grow into  $$(1+0.07)$  after 1 yr
  - $FV = \$100 * (1+0.07) = \$107$

# What if we invest for 4 years?

- **After one year:**
  - $FV_1 = 100 * (1 + 0.07) = \$107$
- **After two years:**
  - $FV_2 = 107 * (1 + 0.07) = 100 * (1 + 0.07) * (1 + 0.07) = 100 * (1.07)^2 = \$114.49$
- **After three years:**
  - $FV_3 = \$114.49 * (1 + 0.07) = 100 * (1.07)^2 * (1.07) = 100 * (1.07)^3 = \$122.50$
- **After four years:**
  - $FV_4 = \$122.50 * (1 + 0.07) = 100 * (1.07)^3 * (1.07) = 100 * (1.07)^4 = \$131.08$

# Future Value - Generalization

- $FV_t$  of  $\$X$  invested today at a rate of  $r$  per period for  $t$  periods is:

$$FV_t = \$X * (1+r)^t$$

- $(1+r)^t$  is called the future value factor
- If we call  $\$X$  the present value of an investment, then:

$$FV_t = PV * (1+r)^t$$

# Present value of money

- Suppose you receive \$X in a couple of years
  - How much is that worth today?
- Previous example: How much do you have to save today in order to receive \$107 in one year?
- Answer: \$100. How did you get this number?
- Example: Suppose you need \$15,000 to pay tuition next year. How much do you have to put into your bank account today? Assume interest rate is 6%.
  - $PV \times (1.06) = \$15,000$
  - $PV = \$15,000 / (1 + 0.06) = \$14,151$

# Generalization

- Present value of \$X to be received in t periods is:

$$PV = \$X / (1+r)^t$$

- The expression  $1/(1+r)^t$  is called discount factor
- We can also re-write this as:

$$PV = FV_t / (1+r)^t$$

## One more example...

- You are selling your house. You have been offered \$300,000 by one buyer who will pay you in cash today. The other buyer has offered you \$350,000 but cannot pay you until three years from today. The interest rate is 8%. Which offer should you choose?



# Find the interest rate

- Suppose you invest \$100 today
- After two years, your wealth will have grown to \$115
  - What is the interest rate per year (assuming annual compounding)?
  - What if there are four years instead of two?

# Rick Reuschel example re-visited

- Assume a discount rate of 15%
- The PV of Rick Reuschel's 1979 salary is:
  - $PV = \$20,000 / (1.15) = \$17,391.30$
  - Interpretation: Rick would be indifferent between receiving \$17,391.30 in 1978 or \$20,000 in 1979
- We could keep repeating this procedure:
  - PV of his pay in 1980 is:  $PV = \$20,000 / (1.15)^2 = \$15,122.87$
  - PV of his pay in 2030 is:  $PV = \$164,000 / (1.15)^{52} = \$114.43$

## Real value of the contract

- $PV = 20,000/(1.15) + 20,000/(1.15)^2 + 20,000/(1.15)^3 + 164,000/(1.15)^4 + 164,000/(1.15)^5 + \dots + 164,000/(1.15)^{52}$
- True value of contract is approximately \$760,000

# The general formula

- Present value of a general cash flow stream:

$$PV = \frac{\text{Cash Flow}_1}{(1 + r)} + \frac{\text{Cash Flow}_2}{(1 + r)^2} + \frac{\text{Cash Flow}_3}{(1 + r)^3} + \dots$$

- This can be written in compact form as:

$$PV = \sum_{t=1}^{\infty} \frac{\text{Cash Flow}_t}{(1 + r)^t}$$

In the news...



# Why is the Chair of the Federal Reserve (Fed) so important?

The New York Times

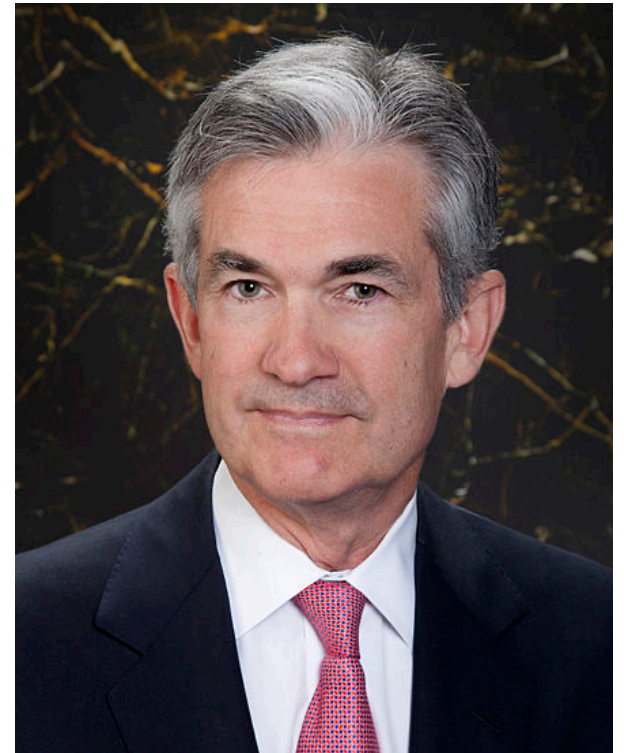
## ***Jerome Powell Tries a Nuanced Fed Policy. Markets Don't Like It.***

Walking a narrow line between signaling interest rate intentions and vowing to be nimble in response to changing conditions, he helps prompt a stock sell-off.



By Neil Irwin

Dec. 19, 2018





ECONOMY

## ECB Sticks With Easy-Money Policies to Counter Delta's Impact

Central bank says it will conduct bond purchases as a 'moderately lower pace'



The European Central Bank, headed by Christine Lagarde, signaled that the bank would continue to keep monetary policy loose.

PHOTO: LUDOVIC MARIN/AGENCE FRANCE-PRESSE/GETTY IMAGES

By [Tom Fairless](#)

Updated Sept. 9, 2021 2:35 pm ET

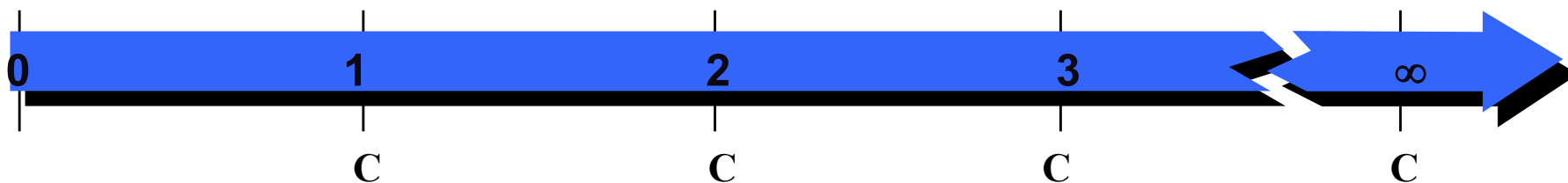
# Simplifications

- We are generally dealing with multiple cash flows over time
  - Even (or uniform) cash flows over a fixed period:  $C_1 = C_2 = \dots = C_t$
  - Perpetual even cash flows:  $C_1 = C_2 = \dots = C_t = \dots$
  - Cash flows that are growing over time:  $C_2 = (1+g)*C_1$ , where  $g$  is some constant growth rate
- To make things tractable, we are going to need some simplifying formulas
- Four simplifying formulas:
  - Perpetuities
  - Growing Perpetuities
  - Annuities
  - Growing Annuities



# Perpetuities

- Perpetuity: series of identical cash flows (\$C), starting at time t=1, paid *forever*
- We have the following situation:



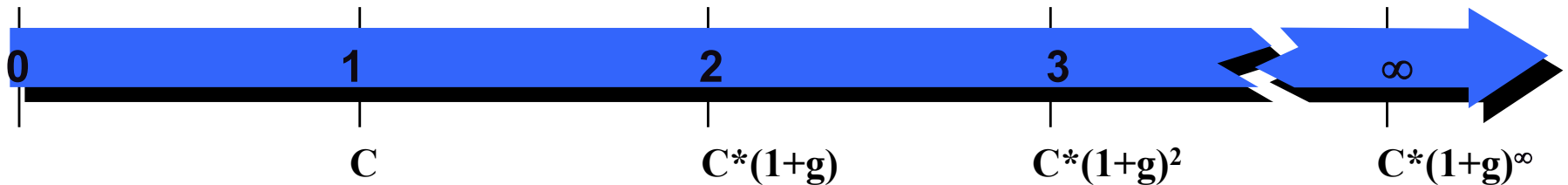
- We want to find the sum of the present values of this stream of cash flows:

$$\frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \dots + \frac{C}{(1+r)^t} + \dots$$

- Formula for PV of a perpetuity =  $C / r$

# Growing perpetuities

- Cash flows grow over time:



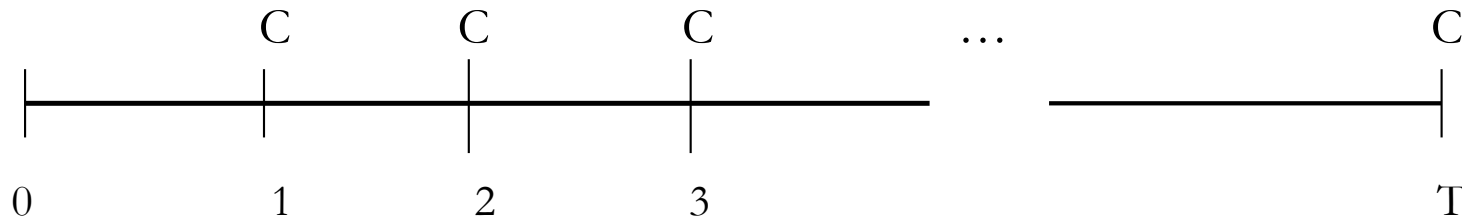
- Above,  $g$  is a constant growth rate
- PV of growing perpetuity =  $C / (r-g)$
- For this formula to work  $g < r$ , otherwise the sum will be infinitely large

# Perpetuity examples

- A life insurance co. is trying to sell you an investment policy that will pay you and your heirs \$1,000 per year forever. If the required return on this investment is 12%, how much will you pay for the policy?
- What if the payment grew at 5% per year forever?

# Annuities

- An annuity is characterized by:
  1. Multiple, identical cash flows (\$C)
  2. First cash flow at the *end* of the first period
  3. Cash flows end after a fixed number of periods
- On a timeline, we would have the following:



- To figure out the PV, we could sum the present values of each of the components of the annuity:

$$PV = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \dots + \frac{C}{(1+r)^T}$$

# Simplifying formula

- We can make use of formulas on geometric series
- Expression simplifies to:

$$PV = \frac{C}{r} \left[ 1 - \frac{1}{(1 + r)^T} \right]$$

- We can also arrive at a formula for future value of an annuity:

$$FV = \frac{C}{r} [(1 + r)^T - 1]$$

# Example: Mutual Fund Fees (Active versus Passive Management)

## The Cost of Active Investing

KENNETH R. FRENCH\*

### ABSTRACT

I compare the fees, expenses, and trading costs society pays to invest in the U.S. stock market with an estimate of what would be paid if everyone invested passively. Averaging over 1980 to 2006, I find investors spend 0.67% of the aggregate value of the market each year searching for superior returns. Society's capitalized cost of price discovery is at least 10% of the current market cap. Under reasonable assumptions, the typical investor would increase his average annual return by 67 basis points over the 1980 to 2006 period if he switched to a passive market portfolio.

# In the news: Inflation, rising interest rates



THE WALL STREET JOURNAL.

[ECONOMY](#) | [THE OUTLOOK](#)

## Central Banks May Stoke Risks by Raising Interest Rates Together

The most widespread rate increases on record have some economists worrying a lack of coordination may result in unnecessary economic harm



The World Bank said the number of interest-rate increases announced by central banks in July was the highest since the early 1970s.

PHOTO: SAMUEL CORUM/BLOOMBERG NEWS

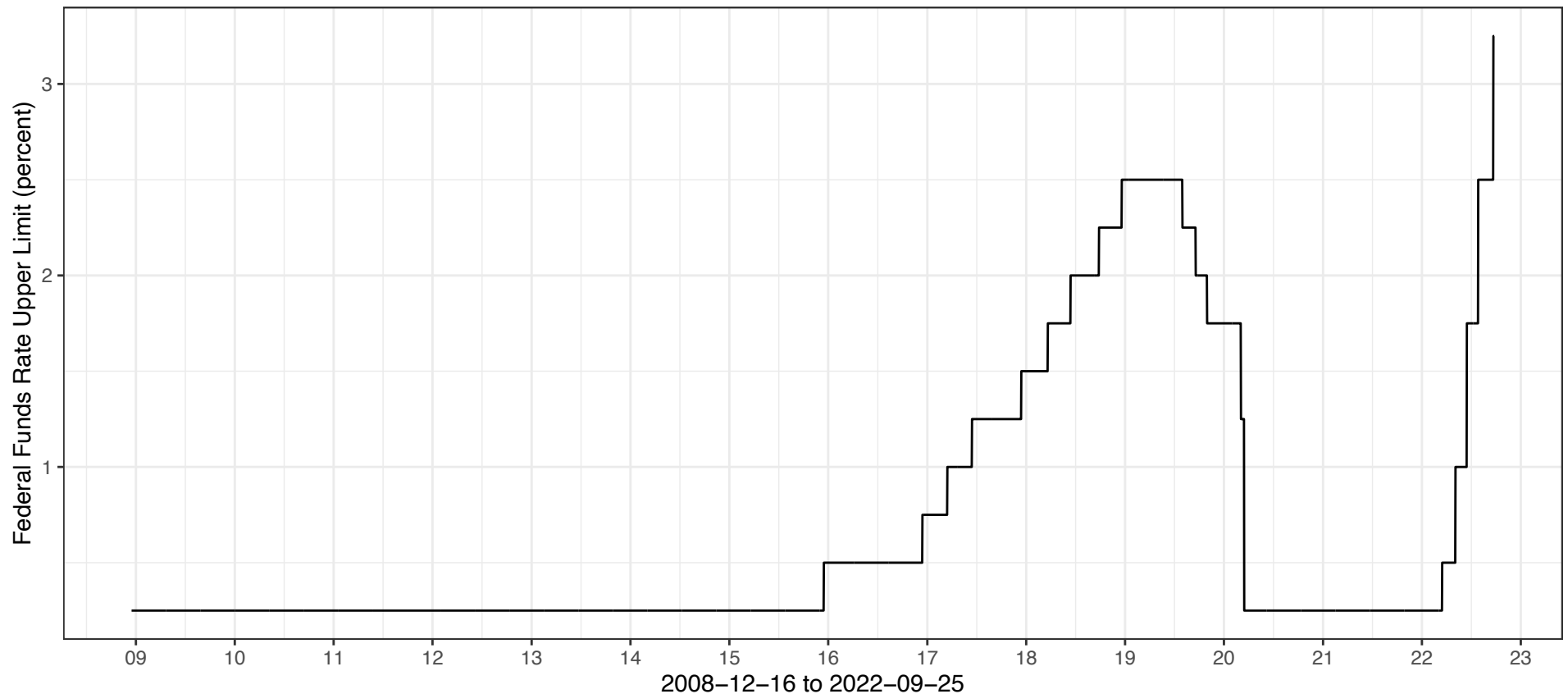
By [Paul Hannon](#) [Follow](#)

Updated Sept. 25, 2022 11:14 pm ET

# In the news: Inflation, rising interest rates

## Federal Funds Target Range – Upper Limit

Percent, daily, not seasonally adjusted; Source: St. Louis Fed

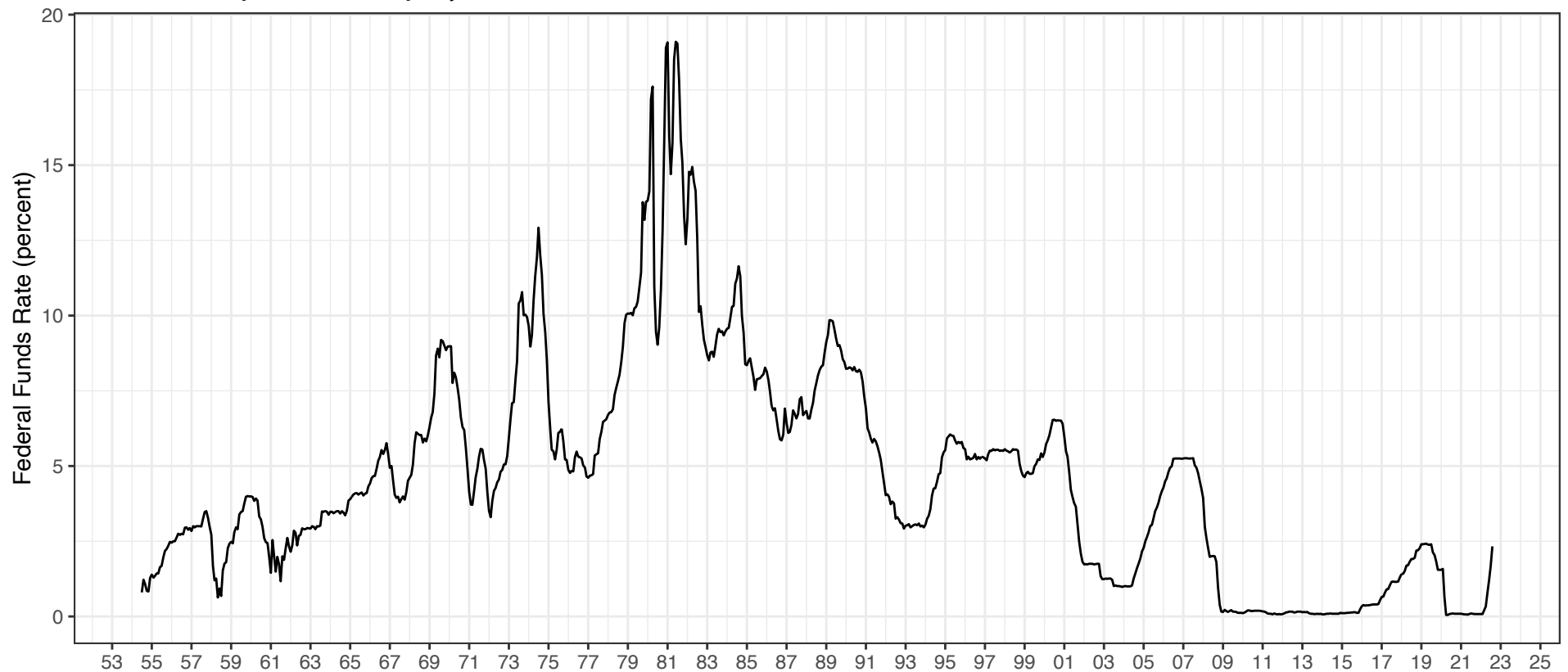




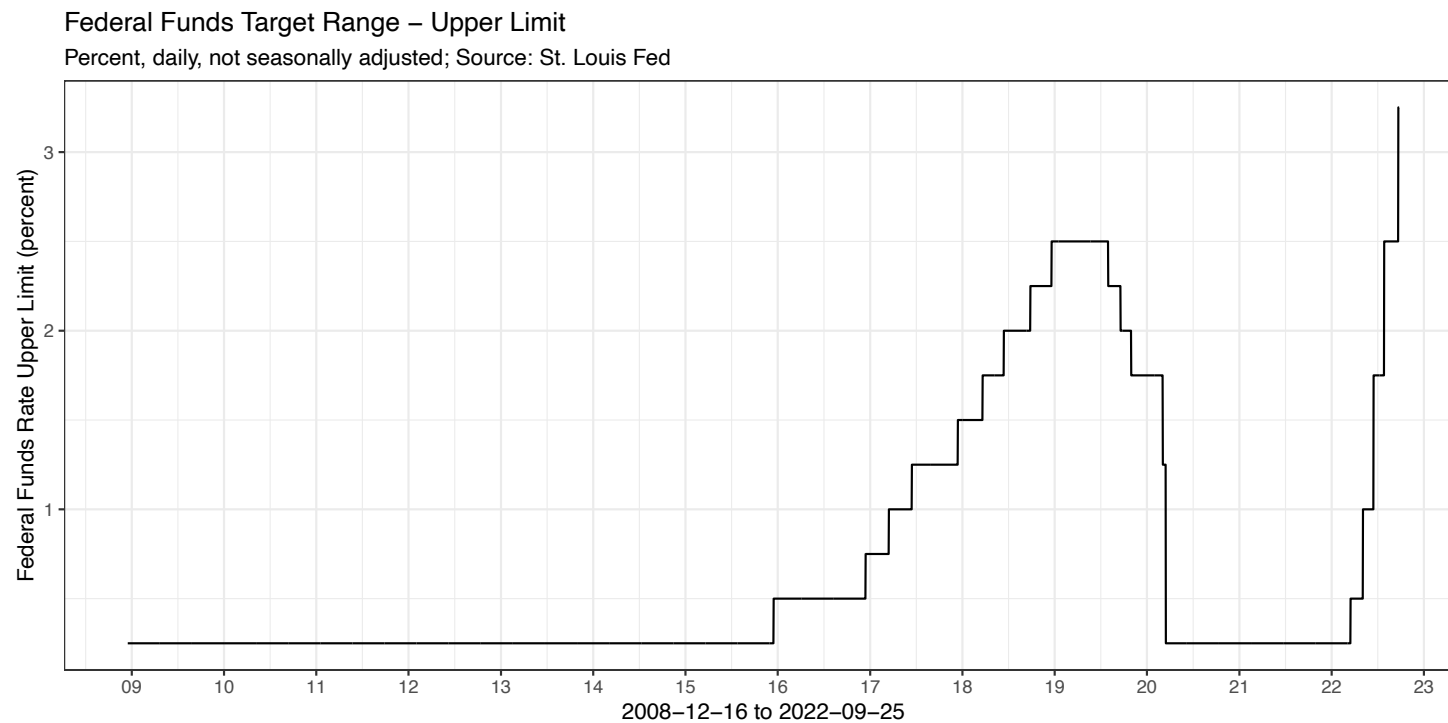
# In the news: Inflation, rising interest rates

## Federal Funds Effective Rate

Percent, monthly, not seasonally adjusted; Source: St. Louis Fed



# In the news: Inflation, rising interest rates



- What are rising interest rates doing to inflation?
- What are they doing to bond prices?
- What are they doing to stock prices?

# Another view from S&P

- Standard & Poor's issues an active versus passive report each year. E.g., U.S. SPIVA report for 2021:
- Over the last 3 years, 67.85% of Large-Cap funds underperformed the S&P 500, 52.94% of Mid-Cap funds underperformed the S&P MidCap 400, and 51.49% of Small-Cap funds underperformed the S&P SmallCap 600. – *SPIVA Report 2021*.
- Over the last 5 years, 74.1% of Large-Cap funds underperformed the S&P 500, 59.22% of Mid-Cap funds underperformed the S&P MidCap 400, and 63.26% of Small-Cap funds underperformed the S&P SmallCap 600. – *SPIVA Report 2021*.

Reference: <https://www.spglobal.com/spdji/en/research-insights/spiva/>

# Performance Question

- If you could earn returns that are 67 bps higher each year over your investing lifetime, how much more money would you have?
- Suppose you invest \$15,000 a year for 35 years
  - One fund is actively managed and earns 8% minus a 0.75% fee, so 7.25% after fees
  - One fund is an index fund and earns 8% minus a 0.08% fee, so 7.92% after fees
- What would be the dollar difference between the investments at the end of the 35 years?

# Growing annuities

- A growing annuity is an annuity in which the cash flows grow at a constant rate  $g$

- $C$  is the cash flow you receive at the end of the first period:

<u>Period</u>	<u>Cash Flow</u>
1	$C$
2	$C(1+g)$
3	$C(1+g)^2$
...	
$T$	$C(1+g)^{T-1}$

- Relevant Formula:

$$\text{PV of a growing annuity} = \frac{C}{r - g} \left[ 1 - \frac{(1 + g)^T}{(1 + r)^T} \right]$$

## Example: Growing annuity

Your grandfather left you an inheritance that will provide an annual income for the next 20 years. You will receive the first payment one year from now in the amount of \$16,500. Every year after that, the payment amount will increase by 5 percent. What is your inheritance worth to you today if you can earn 7.5 percent on your investments?

# Annuities and perpetuities – other issues

- The annuity formulas link together four factors:
  - PV (or FV),
  - $C$
  - $r$
  - $t$
- If we know 3 of them, we can compute the fourth.
- We are not able to find the value of  $r$  directly for annuities.
  - Use a financial calculator
  - Use the method of trial and error.

# Solving for $r$ : An example involving John J. Raskob



- He's famous for five reasons:
  - Building the Empire State Building
  - Wrote "Everybody Ought to be Rich" - an article for the Ladies Home Journal in August, 1929
  - His role as Democratic National Chairman from 1928 to 1932
  - His career as a financier (General Motors, DuPont) and
  - His endowment of the Bill Raskob Foundation and the Raskob Foundation for Catholic Activities, Inc
- A quote from his article:

"Suppose a man marries at the age of twenty-three and begins a regular saving of fifteen dollars a month – almost anyone who is employed can do that if he tries. If he invests in good common stocks and allows the dividends to accumulate, he will have at the end of twenty years at least eighty thousand dollars. . . I am firm in my belief that anyone not only can be rich but ought to be rich." John J. Raskob, Ladies Home Journal, 1929

  - Key Question: What rate of return did Raskob assume?



# The solution to Raskob's Statement

- We can use the future value of an annuity formula:

$$FV = \frac{C}{r} [(1 + r)^T - 1]$$

- More specifically, we want to solve the following for  $r$ :

$$\$80,000 = \frac{\$15}{r} [(1 + r)^{240} - 1]$$

- It turns out that  $r$  is equal to 1.96% per month, or about 24% per year.
  - Is this achievable?

# **Interest rates: Different compounding periods, APRs and EARs**

# There are (at least) two reasons why interest rates in real life can be confusing

1. Interest rates can be quoted per day, per week, per month, per year, etc.
2. The compounding frequency can be daily, weekly, monthly, yearly, etc.

# What is the effective cost of borrowing per year in this case?

- Michigan law allows pawn shops to charge 3% interest per month.
  - How much is this on an annual basis?
  - There are two methods to compute this: the first is simple, the second precise
  - Simple method:  $12 \times 3\% = 36\%$  is called the stated rate or annual percentage rate (APR)
- The second method: For every \$1 borrowed, you would owe
  - $\$1 \times (1.03)$  after 1 month
  - $\$1 \times (1.03)^2$  after 2 months
  - ...
  - After one year, you will owe \$1.4258
- Therefore, effective borrowing cost is 42.58%

# Compounding interest rates

- Problem: Interest payments are often realized (e.g., written to the balance of your loan or savings account) more frequently than once a year
  - E.g., monthly, quarterly, ...
- However, rates are usually quoted on an annual basis without recognition of compounding
  - I.e., “earning interest on interest” is not taken into account
- Why is it a problem? Want to pick “best” rate for our investments
  - When we borrow, want to pick the *lowest* rate. When we lend (invest), want to pick the *highest* rate (provided that the risk of investment does not change). However, the rates the banks quote often differ in levels and the frequency of compounding. How can we compare those rates?

# The Annual Percentage Rate (or Stated Rate)

- The *only rate banks are required to quote* when they make loans is the **Annual Percentage Rate (APR)** defined as
  - (the rate per period) \* (the number of periods within one year).
- The rate before considering any compounding effects, such as 10% per year compounded quarterly (your balance will increase by 2.5% every quarter of a year).
  - Q: What's wrong with APR?
  - A: Does not recognize earning interest on interest.

# APR Example

- The APR on a loan is 10%, interest is compounded quarterly. How much money do you really have to pay to the bank in one year?
- A: The interest rate per period (quarter):  $r = 0.10/4 = 0.025 = 2.5\%$
- Thus, every dollar of your initial balance will grow over the course of one year into:
- $FV = \$1 * (1+0.025)*(1+0.025)*(1+0.025)*(1+0.025) = (1+0.025)^4 = \$1.1038.$
- Thus, the interest rate you are charged over the course of one year is 10.38%, not 10%!

# Effective Annual Rate

- Lesson learned? We want to know the return, *on an annual basis*, that reflects the impact of compounding – we want to know the **effective annual rate (EAR)** of an investment.
- The general formula:
  - $\text{EAR} = (1 + \text{return per period})^{\text{number of periods per year}} - 1$
- Let's denote the number of periods per year by  $m$ . Note that the return per period is equal to  $\text{APR}/m$ . Therefore:
  - $\text{EAR} = (1 + \text{APR}/m)^m - 1$



# Practice problem EAR

- First National Bank charges 13.2% compounded monthly on its business loans.
- First United Bank charges 13.5% compounded semiannually.
- As a potential borrower, which bank would you go to for a new loan?

# EAR Example

Compound. freq.	# of times compounded	APR=10%	APR=18%
		EAR	EAR
Yearly	1	10.000%	18.000%
Quarterly	4	10.381	19.252
Monthly	12	10.471	19.562
Weekly	52	10.506	19.685
Daily	365	10.516	19.716

Note that the higher the frequency of compounding, the higher the EAR.

# Practice problem APR

- Barcain Credit Corp. wants to earn an effective annual return on its consumer loans of 15% per year.
- The bank uses daily compounding on its loans.
- What interest rate is the bank required by law to report to potential borrowers?
- Explain why this rate is misleading to an uninformed borrower.

# The best trick not to get confused by the different interest rates

- All that matters is cash!
- If you are saving:
  - What is your initial wealth, and what is your final wealth?
- If you are borrowing:
  - Suppose you pay back the loan as a lump sum at the end of the loan. How much did you borrow in the beginning?  
How much do you have to pay back at the end?
- Example with saving:
  - Suppose you start with \$100, and at the end of the year you have \$120.
  - How many ways can you think of expressing the interest rate on this increase in wealth?

**Example: Multiple interest rates (together with information on the length of a time period and a compounding frequency) can represent the same increase in wealth**

- Suppose you invest \$100 today
- You don't look at your account for one year
- After one year, you see that you have \$120 in your account
  - What is your effective one-year return (expressed per annum)?
  - Suppose the bank compounded interest quarterly. What is your APR? What is your quarterly interest rate?
  - Suppose the bank compounded interest monthly. What is your APR? What is your monthly interest rate?