BITS Pilani
Hyderabad Campus

BITS Pilani presentation

Dr. Nivedita Sinha
Department of Economics & Finance

Security Analysis & Portfolio Management
Session 1

Instructor

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Education

PhD. Finance, IIM Bangalore

BE Electrical NIT Surat & PG Diploma in ML & AI from IIIT Bangalore

Previous Teaching of SAPM

IIM Calcutta, IIM Udaipur, NMIMS, IMT

BITS Pilani Hyd campus: 2019-2020 First Sem, 2021-22 Second Sem, 2021-22 Summer Term

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Chamber Consultation hours: Please send a prior email

SAPM - Introduction

Theory and practice related to equity markets, debt markets and portfolio management

Financial Analyst/Associate roles

Buy Side analyst

Portfolio managers, Fund managers (Asset management companies, Hedge funds, Wealth management)

Nomura Asset management

Morningstar

Credit Suisse – Asset management division

Sell Side analyst

Investment banking (Equity research, M&A advisory, Capital raising, Valuation), Brokerage houses

Credit Suisse – Investment banking

JPMorgan Chase & Co.

Learning Objectives - PreMidsem

innovate achieve lead

Foundation building

- Types of markets
- Types of orders
- Types of indices
- Returns and Risk calculations
- Utility theory

Modern Portfolio Theory

- Markowitz mean variance framework (Efficient frontier)
- Market model – statistical model
- CAPM, APT – equilibrium models
- Fama French 3 factor, Cahart, Fama- French 5 factor, Macroeconomic models - Multifactor micro and macro-economic models

Efficient Market Hypothesis

- What are characteristics of market?
- What is market efficiency?
- Event study methodology

Learning Objectives- Post Midsem

Fundamental Analysis & Technical Analysis	• Top down and bottom up approach of fundamental analysis • Valuation models – Absolute & Relative valuation • Chart patterns – various indicators
Portfolio Performance	• What is expected performance of a portfolio manager? • Composite measures • Other measures • Measuring market timing and stock selection skills
Introduction to fixed income securities	• Bond basics • Bond portfolio management strategies

Components of grading

Component	Duration	Weightage (%)	Nature of Component
Mid Sem Test	90 Minutes	30	CB
Quiz		20	CB
Assignments		10	OB
Comprehensive Examination	180 Minutes	40	Partially OB

Textbook

Reilly Frank K and Keith C. Brown, Investment Analysis and Portfolio Management, 10th edition CENGAGE Learning, 2012.

Zvi Bodie, Alex Kane, Alan Marcus, Pitabas Mohanty, “Investments”, 2010, McGraw Hill.

First Module - examples

THE WALL STREET JOURNAL.

Home World U.S. Politics Economy Business Tech Markets Opinion Books & Arts

Aug 16, 2022 at 4:40 pm ET

Short Interest Rises Alongside Market Rally

By Hannah Miao

S&P 500 Index

Stocks have climbed from their mid-June lows, but so has overall short interest.

- From June 16 to August 12, short interest in the U.S. stock market increased by $125.7 billion, or roughly 14%, according to technology and data-analytics firm S3 Partners.

Here's a reminder on how short selling works:

- Short sellers borrow shares and sell them, hoping to buy them back at a lower price and pocket the profit.
- Investors shorting the market might be placing an outright bet that stocks will fall, or hedging portfolios in case of a market downturn.
- Short interest measures shares sold short still outstanding.

https://www.wsj.com/livecoverage/stock-market-news-today-08-16-2022/card/short-interest-rises-alongside-market-rally-jpoVoHFp3uKCTlJdjS5E

First Module - examples

INVESTING

What is a short squeeze?

What is a short squeeze?

A short squeeze occurs when a stock moves higher and short sellers decide to cover their short positions or are forced to do so via margin calls. As these short sellers buy the stock, the price rises, potentially creating a situation in which more shorts have to cover. This sends the stock soaring even further in a vicious cycle. In theory, there's no limit to how far a stock can rise.

The backstory: In investing, there are two main ways to make money:

- **Going long:** When you go long, you buy stock and make money when it goes up in price. You can sell the stock or hold on and see if it goes up further. Generally, when people talk about investing, they're talking about going long.
- **Going short:** When you go short, you borrow stock from your broker to sell in the market. Then you attempt to repurchase the stock at a lower price. If you do so, you'll make money on the trade. However, if the stock rises, you'll lose money and, if the stock rises too much, you may be forced to repurchase the stock at a much higher price.

ENTERTAINMENT

GameStop meme stock movie 'Dumb Money' in the works with Seth Rogen, Pete Davidson

PUBLISHED THU, SEP 1 2022•5:21 PM EDT | UPDATED THU, SEP 1 2022•5:32 PM EDT

First Module - examples

POLITICS

Elon Musk cheers on Justice Department probe of short sellers

PUBLISHED WED, FEB 23 2022•11:23 AM EST | UPDATED WED, FEB 23 2022•6:32 PM EST

Brian Schwartz
@SCHWARTZBCNBC

SHARE

KEY POINTS

- Tesla CEO Elon Musk took fresh shots at short sellers and the SEC, two of the billionaire's most frequent targets for insults and criticism.
- He also lauded the Justice Department for launching a probe into short sellers. Two one-time Tesla shorts are reportedly under federal investigation.
- "I am greatly encouraged by the Justice Department investigating short sellers," Musk told CNBC in an email Tuesday. "This is something the SEC should have done, but, curiously, did not."

TV
The N
Shepa
UP NEXT
am ET

https://www.cnbc.com/2022/02/23/elon-musk-cheers-on-justice-department-probe-of-short-sellers.html

Game Stop short squeeze

GameStop timeline: A closer look at the saga that upended Wall Street

The stock market drama has been called a "David and Goliath" battle.

By Catherine Thorbecke
February 13, 2021, 4:30 PM

The GameStop saga.

No one could have anticipated that a struggling video game retailer would be at the center of a next-level frenzy in the stock market that captivated the world, brought hedge funds to their knees and upended the conventions about small investors.

Users from the Reddit page r/wallstreetbets earlier this month gobbled up stock from floundering chain GameStop, sending the price soaring and forcing institutional investors who bet against the company to back out -- performing what's known as a "short squeeze."

The phenomenon -- where short sellers are forced to repurchase stock as prices rise, thereby pushing the price higher -- isn't new, but the combination of characters and technology and novel trading platforms forced Wall Street and

https://abcnews.go.com/Business/gamestop-timeline-closer-saga-upended-wall-street/story?id=75617315

First Module - examples Indices

NIFTY 50

INDEXNSE: NIFTY_50

Overview | News | Compare

Market Summary > NIFTY 50

17,503.30

+7,569.65 (76.19%) ↑ past 5 years

2 Sept, 10:10 am IST • Disclaimer

1D | 5D | 1M | 6M | YTD | 1Y | 5Y | Max

Open	17,598.40	Low	17,485.60	52-wk high	18,604.45
High	17,643.85	Prev close	17,542.80	52-wk low	15,183.40

Market Summary > BSE SENSEX

58,606.28

+26,918.76 (84.95%) ↑ past 5 years

2 Sept, 10:11 am IST • Disclaimer

1D | 5D | 1M | 6M | YTD | 1Y | 5Y | Max

Open	58,969.02	Low	58,584.45	52-wk high	62,245.43
High	59,108.66	Prev close	58,766.59	52-wk low	50,921.22

Second Module topics

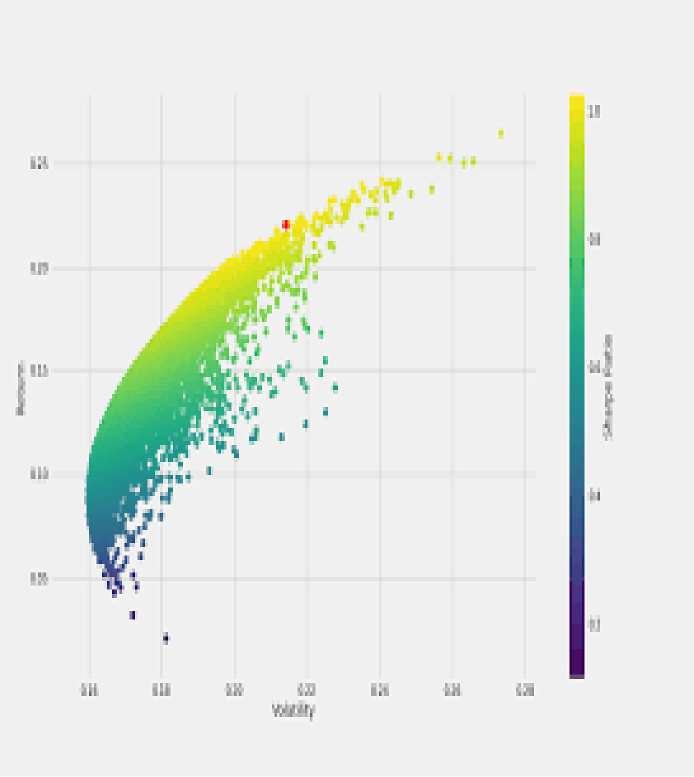
Modern Portfolio Theory

- Risk and Return calculations
- Utility theory
- Markowitz Mean-Variance portfolio
- Single factor, equilibrium and Multifactor models in Asset Pricing

Modern Portfolio Theory

<u>Asset allocation decision for a risk averse investor</u>

- **Portfolio Optimization**
  - Developing **efficient frontier** for n asset case
  - With 4 cases
  - With & without **short selling**
  - With & without **riskless lending & borrowing**
  - **Utility curve** of a risk averse investor
  - Final Optimal allocation for a particular investor



Efficient Market Hypothesis

2. <u>Event study</u>

- Impact of an event on the value of the firm
- Background : **Market efficiency**

- Application of Asset pricing models in calculation of abnormal returns

- Define economic event
- Perform the event study methodology looking at the stock market response to the event

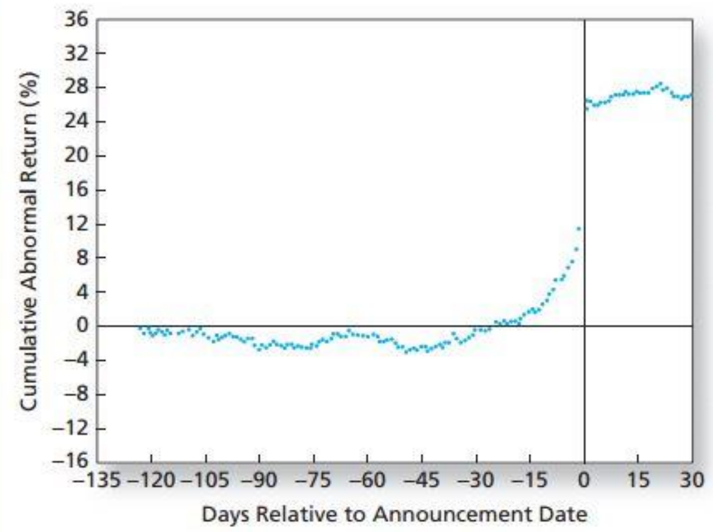


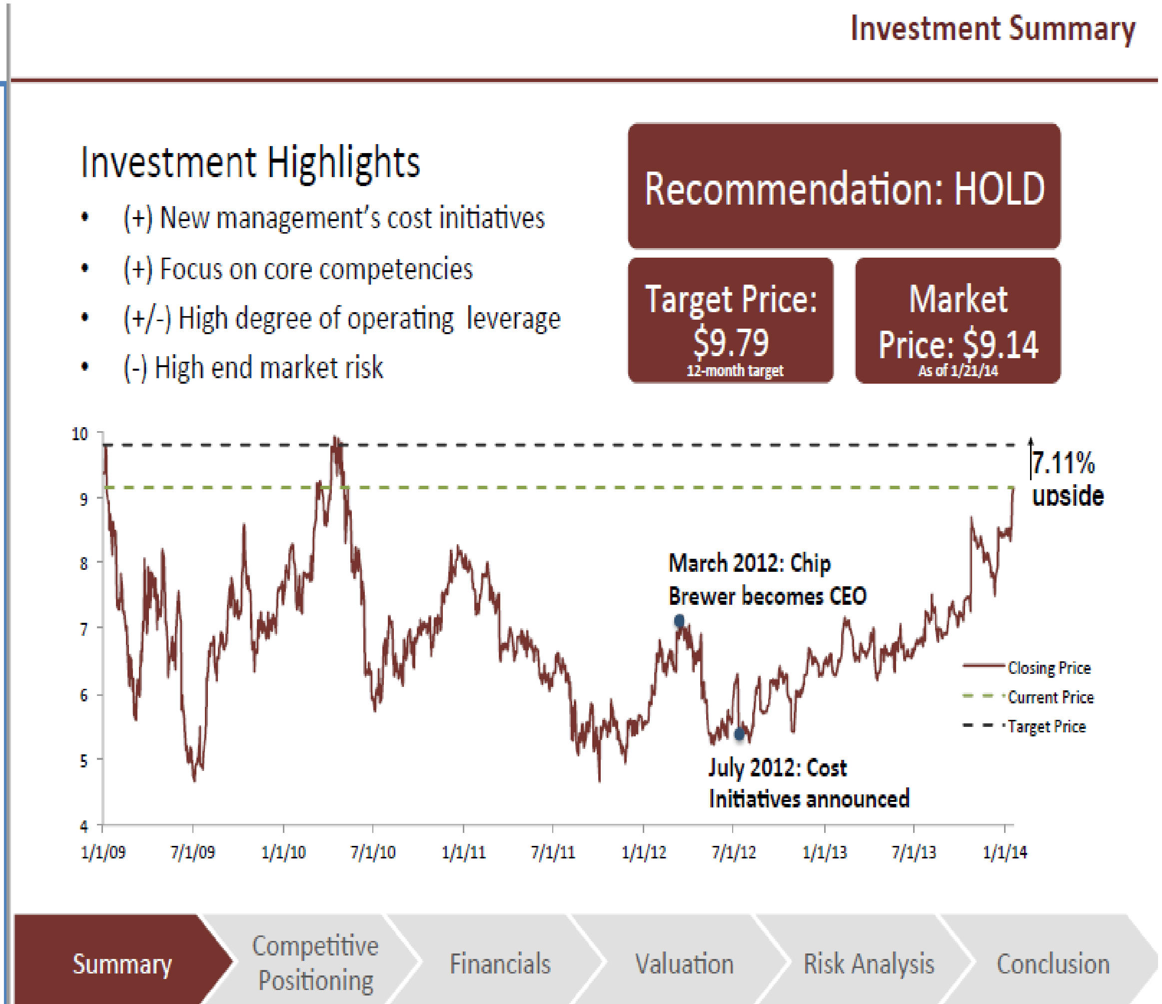
Figure 11.1 Cumulative abnormal returns before takeover attempts: target companies

Source: Arthur Keown and John Pinkerton, "Merger Announcements and Insider Trading Activity," *Journal of Finance* 36 (September 1981). Used with permission of John Wiley and Sons, via Copyright Clearance Center. Updates courtesy of Jinghua Yan.

Fundamental Analysis & Technical analysis

<u>Fundamental analysis of a firm</u>

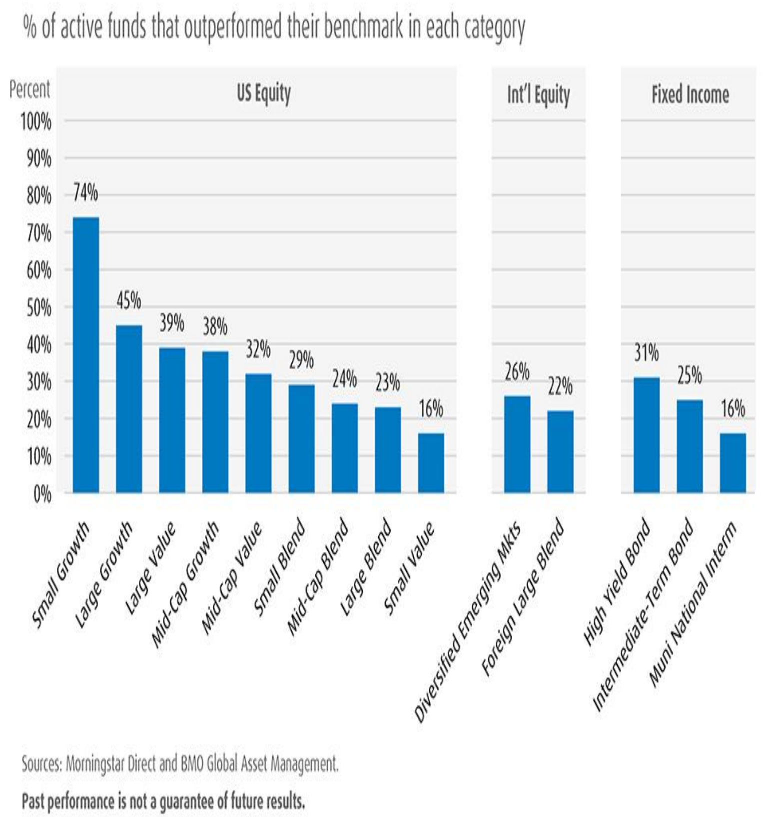
- ➢ Come up with an **analyst type presentation**
- ➢ Based on fundamental analysis as well as some *technical indicators* what is your investment recommendation



Portfolio Performance

<u>Performance of Mutual funds (actively managed)</u>

- Analyze the performance of mutual funds using measures learnt
- Calculate **alpha** using various asset pricing models
- Be able to assess that the positive alpha generated is it due to **style, stock selection skills** or **market timing skills**



Fixed Income securities

Bond Investing

How Does Rising Inflation Affect Bond Values?

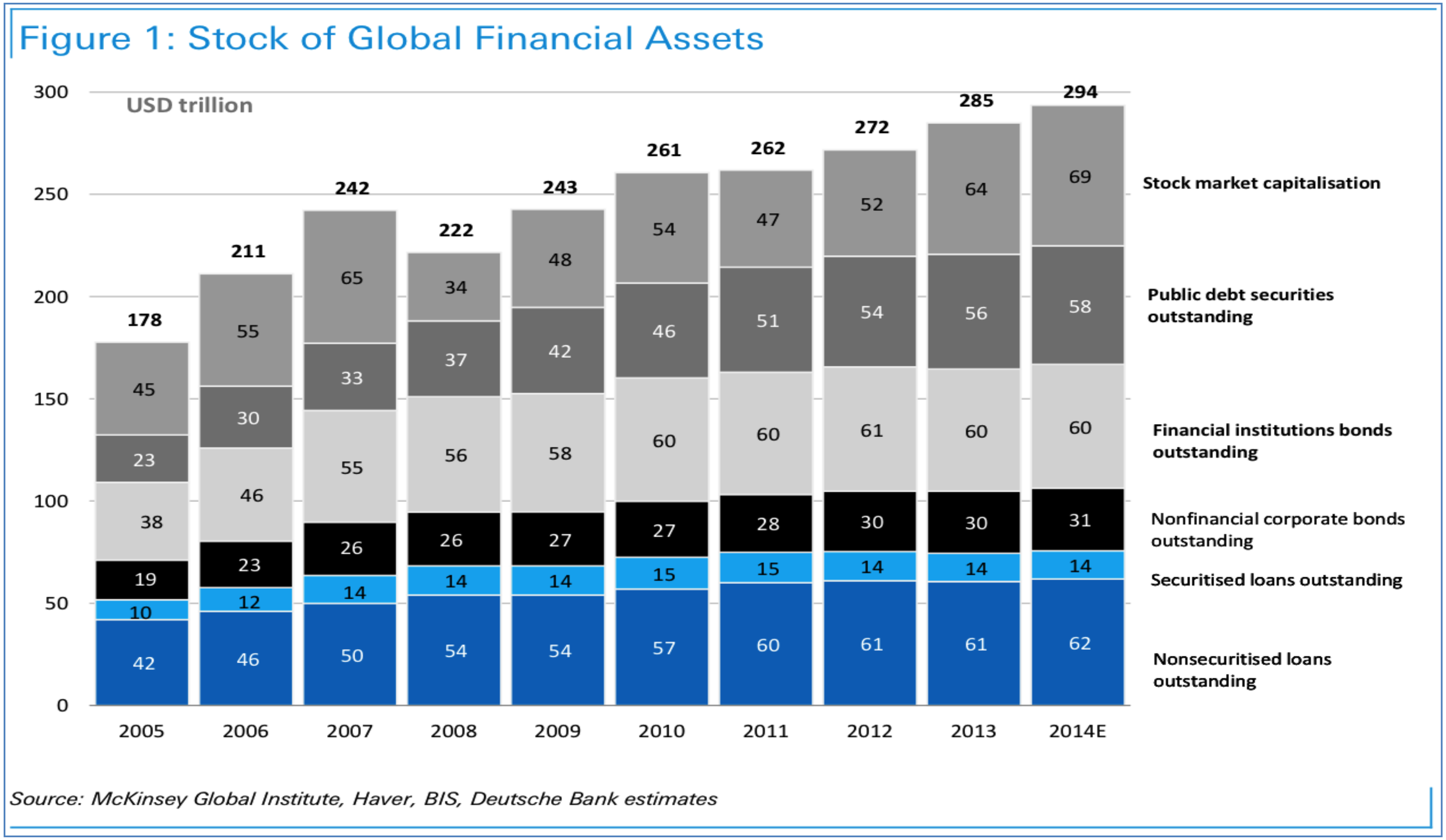
Higher inflation can harm bond values because of interest rate hikes. Let's take a closer look at the inverse relationship between interest rates and bond values

Christopher Greiner, CFA | 6 January, 2022 | 10:42AM

AAA

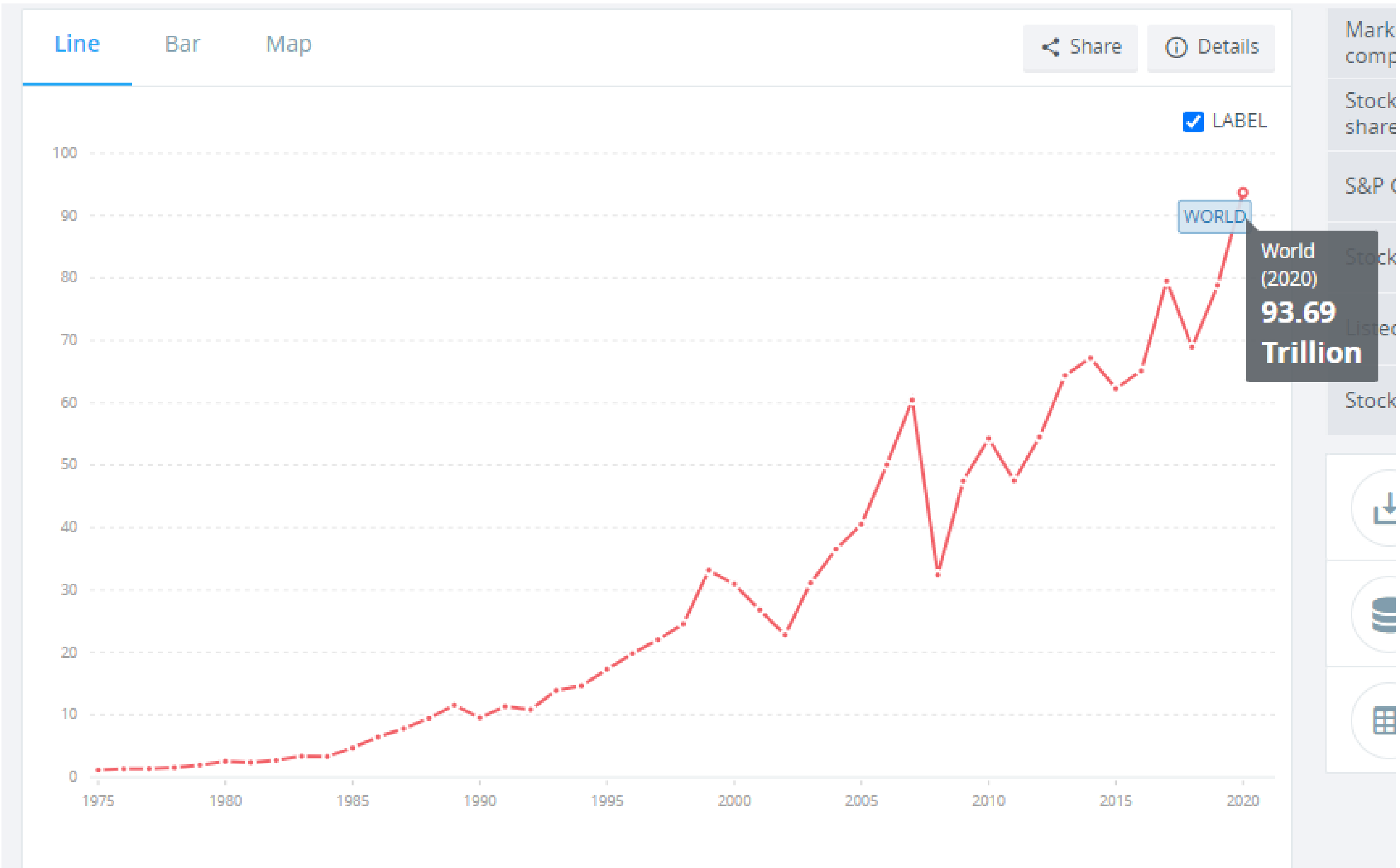
Interest rate risk
Bond Duration
Bond Convexity
Immunization strategies

Global Financial Assets



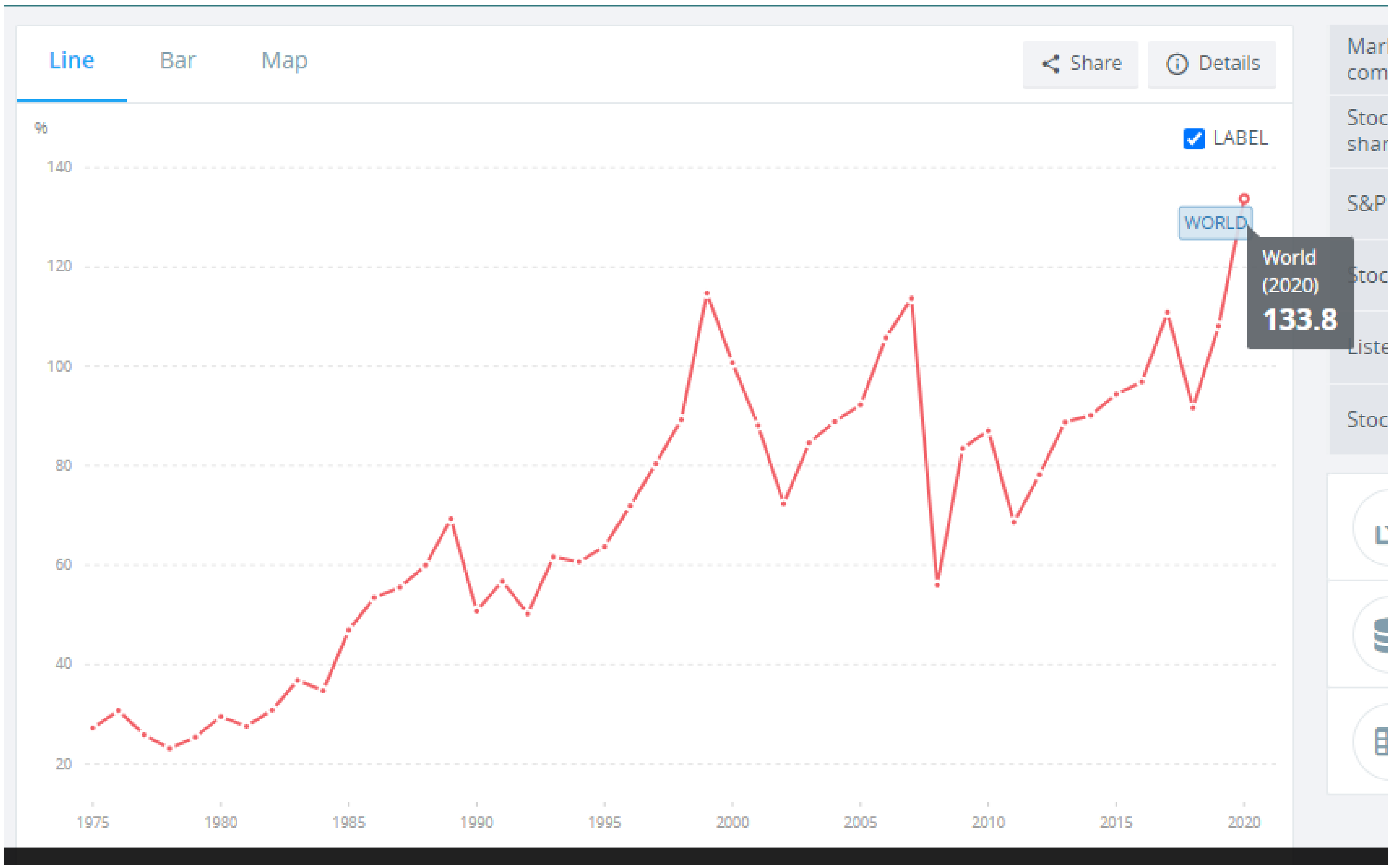
Reference : https://www.businessinsider.in/Heres-what-the-294-trillion-market-of-global-financial-assets-looks-like/articleshow/46207510.cms

Global Financial Assets – Equity market capitalization



https://data.worldbank.org/indicator/CM.MKT.LCAP.CD

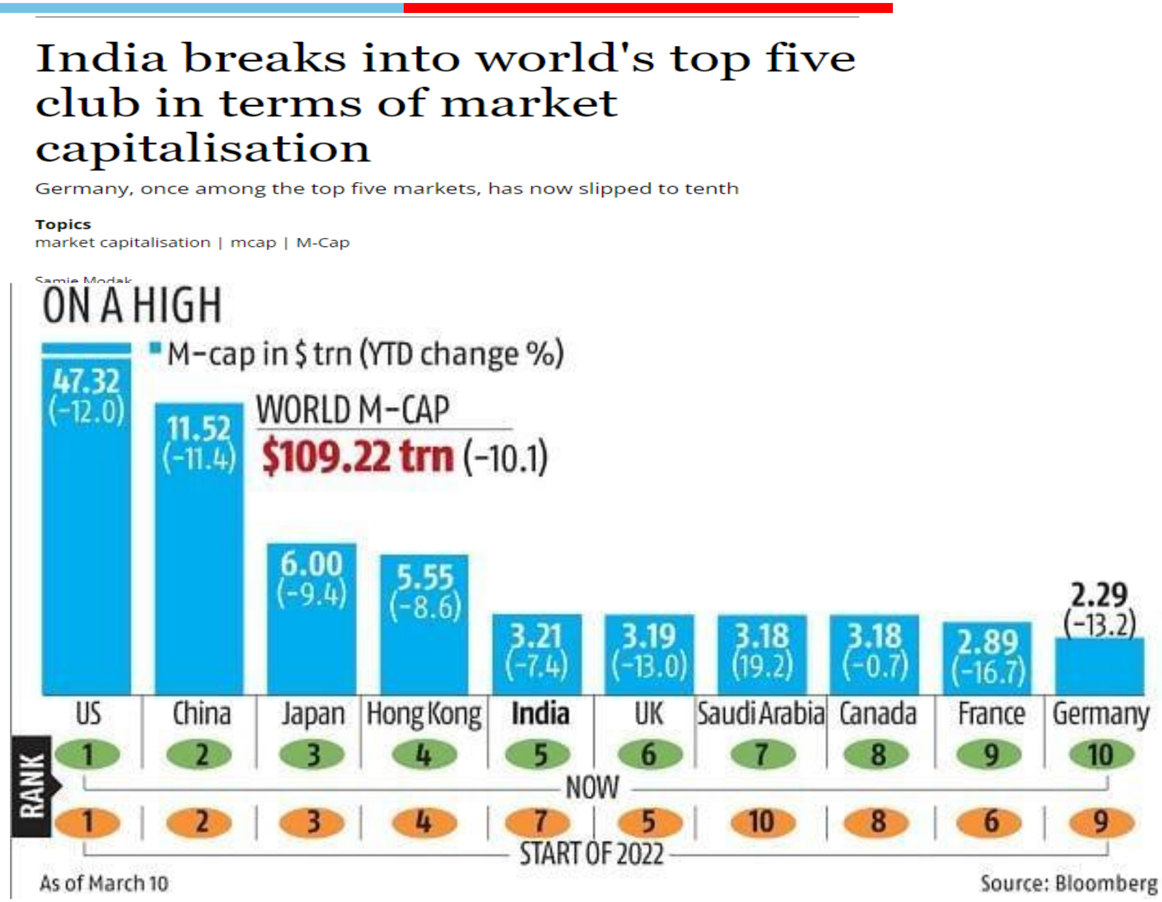
Market cap as % of GDP – Buffet Indicator



India – Market cap

GDP of India 2022 est: $3.53 trillion US

Market cap: $3.21trillion US

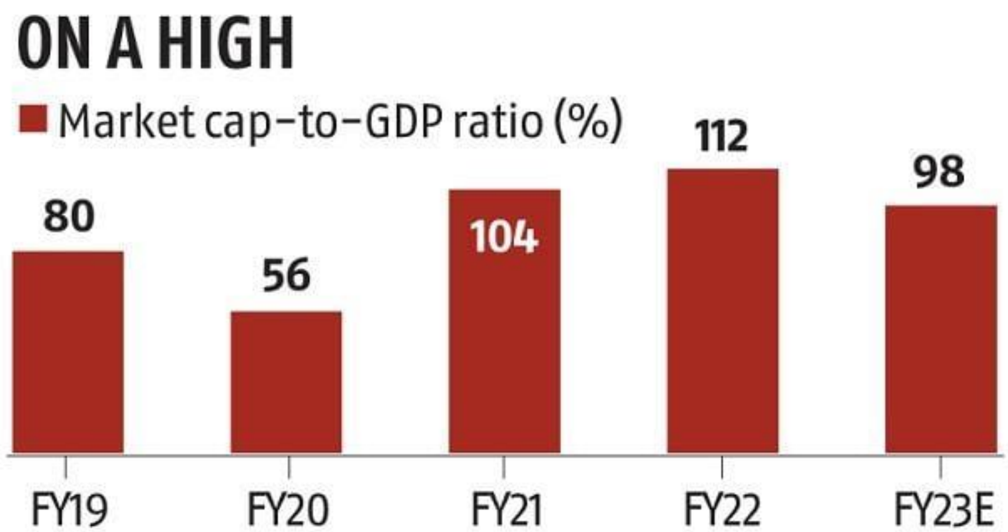


https://www.business-standard.com/article/markets/india-breaks-into-world-s-top-five-club-in-terms-of-market-capitalisation-122031200004_1.html#:~:text=India's%20equity%20market%20has%20broken,and%20Canada%20(%243.18%20trillion).

India- Market cap to GDP

India's market capitalisation-to-GDP at 116%, highest since 2007

Despite the wobble in the markets over the past few weeks, Indian equities remain expensive as measured by several yardsticks



Source: Motilal Oswal Financial Services

https://www.business-standard.com/article/markets/india-s-market-capitalisation-to-gdp-at-116-highest-since-2007-122020700060_1.html#:~:text=India's%20market%20capitalisation%2Dto%2DGDP%20ratio%2C%20for%20instance%2C,average%20of%2079%20per%20cent.

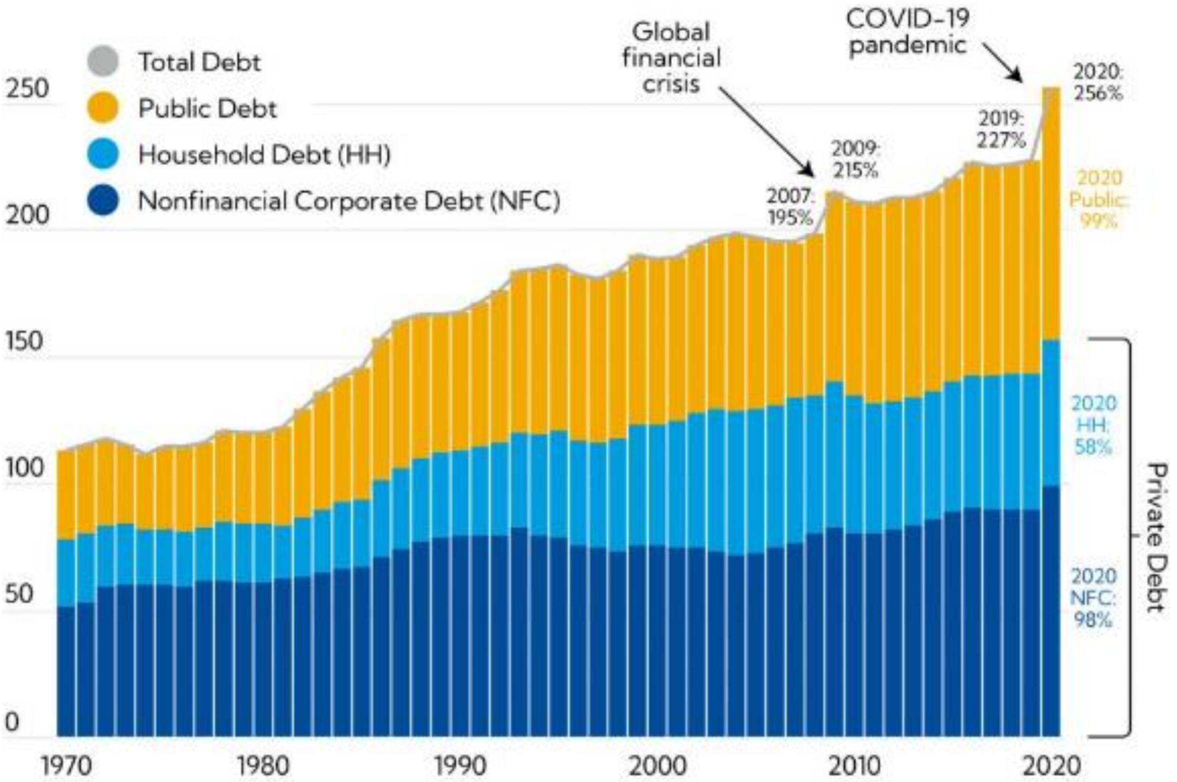
Global Debt Reaches a Record $226 Trillion

DECEMBER 15, 2021

Historic highs

In 2020, global debt experienced the largest surge in 50 years.

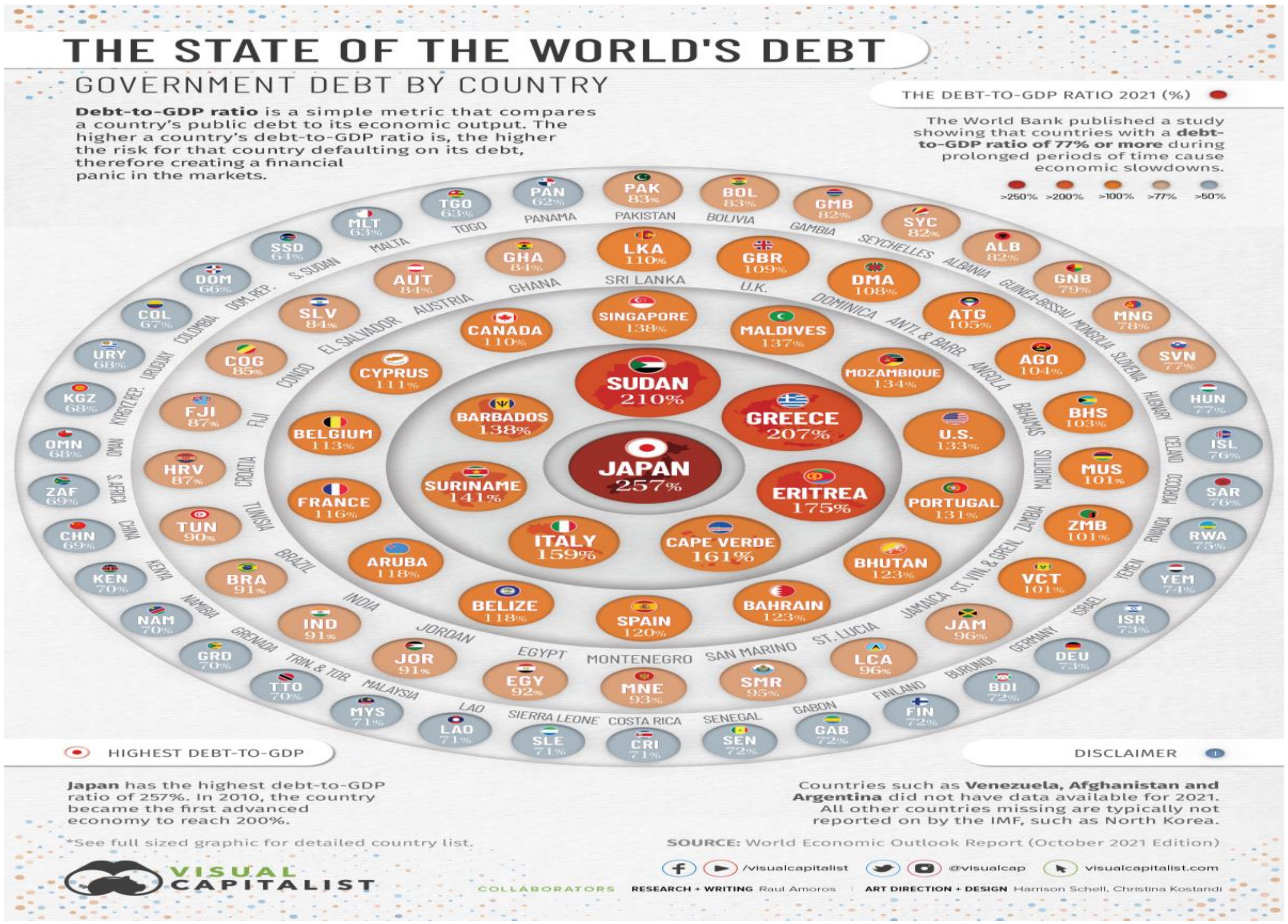
(debt as a percent of GDP)



Sources: IMF Global Debt Database and IMF staff calculations.
Note: The estimated ratios of global debt to GDP are weighted by each country's GDP in US dollars.

https://blogs.imf.org/2021/12/15/global-debt-reaches-a-record-226-trillion/

Global debt % of GDP



https://www.visualcapitalist.com/global-debt-to-gdp-ratio/

Financial Assets versus Real Assets

- **Real assets** :
  - Property , Plant and Equipment & other Fixed Intangible assets such as Patents, etc.

- **Financial assets/Financial instruments/ Financial securities** : Claims on the income derived from real assets or contractual obligation to future payments
  - Equity
  - Debt
  - Cash
  - Derivatives, etc.

Financial Assets

- **Equity : Residual claim on the earnings or the assets of the company.**
  - For very small businesses: Owners investing their savings
  - For slightly large businesses: It can be venture capital
  - For publicly traded firms: It is common stock

- **Debt : A contractual obligation to make fixed payments in the future. (interest payments and principal repayment)**
  - Bank loans, Corporate bonds, Treasury bonds, Treasury bills

Financial assets – Equity example

OYO raises $1 bn from investors led by Softbank; firm now valued at $5 bn

This e-series funding round makes OYO the most valued hospitality company in the country, ahead of Tata Group's Indian Hotels Company and EIH

Ajay Modi | New Delhi
Last Updated at September 26, 2018 01:50 IST

Forget about the crash in the Indian equity market. Indian hospitality start-up OYO has raised a massive $1 billion (Rs 72.63 billion) from four existing investors led by SoftBank. The latest fundraising is estimated to value OYO, which operates in the budget hospitality space, at around $5 billion (Rs 363 billion), a five-fold increase since September last year, when the last funding round took place. OYO was not even a unicorn (a start-up valued at $1 billion and above) before this funding round.

Venture capital

https://www.business-standard.com/article/companies/oyo-raises-1-bn-from-investors-led-by-softbank-start-up-valued-at-5-bn-118092500381_1.html

Financial assets – Equity example

Coffee Day nets Rs 1,150 cr from IPO, price fixed at Rs 328

The IPO closed on October 16 after three days of bidding in a price band of Rs 316-328 a piece for the shares on offer.

PTI | Updated: Oct 23, 2015, 11.26 AM IST

Save

https://economictimes.indiatimes.com/markets/ipos/fpos/coffee-day-nets-rs-1150-cr-from-ipo-price-fixed-at-rs-328/articleshow/49492734.cms

IndiaMart IPO opens, to raise over Rs 474 cr

The company has offered 48,87,862 equity shares in the issue, which will close on June 26.

PTI | Jun 24, 2019, 01.38 PM IST

Save

https://economictimes.indiatimes.com/markets/ipos/fpos/indiamart-ipo-opens-to-raise-over-rs-474-cr/articleshow/69924962.cms

Common stock

Financial assets – Debt examples

Reliance Jio to raise Rs 2,000 crore from bond market at 8.7% coupon

Billionaire Mukesh Ambani-owned group has been on fund raising spree to support its expanding businesses.

By Saikat Das, ET Bureau | Jun 14, 2018, 08.22 AM IST

Save

https://economictimes.indiatimes.com/markets/bonds/reliance-jio-to-raise-rs-2000-crore-from-bond-market-at-8-7-coupon/articleshow/64581226.cms?from=mdr

Corporate Bonds

Questions ?

Expectations?

BITS Pilani
Hyderabad Campus

BITS Pilani presentation

Dr. Nivedita Sinha
Department of Economics & Finance

Security Analysis & Portfolio Management
Lecture 2
Date: 14/09/2022

Motivation

mint

Home / Market / Mark-to-market / Don't be fooled by t

Don't be fooled by the Sensex's new highs

The only category of stocks that has risen during this period is the one with extremely high market capitalization, or stocks with a valuation of over Rs1 trillion. Photo: Hindustan Times

MARKET MECHANICS

Mid- and small-cap stocks have corrected between 2.6% and 5.5% in the past two weeks, while the Sensex has been hitting new highs

https://www.livemint.com/Money/tGKS8E1XkhTbsS5Yh9cVjM/Dont-be-fooled-by-new-highs-of-Sensex.html

innovate achieve lead

Markets

FPIs maintained investment interest in the primary markets: RBI

BL Chennai Bureau | May 28 | Updated On: May 28, 2022

0

FPIs were net sellers in the Indian capital market in nine out of 12 months of FY22

Even as foreign portfolio investors (FPIs) stayed away from the secondary market for the entire second half of FY22.

Even as foreign portfolio investors (FPIs) stayed away from the secondary market for the entire second half of FY22, they maintained their investment interest in the Indian primary market on account of a slew of initial public offerings (IPOs) that hit the capital markets, the Reserve Bank of India, said, in its annual report.

https://www.thehindubusinessline.com/markets/fpis-maintained-investment-interest-in-the-primary-markets-rbi/article65469776.ece

HOME / MARKET / Sensex Nifty Up 2 As Bulls Clutch D Street India Vix Down 6 Whats Fueling The Rally To

Sensex, Nifty up 2% as bulls clutch D-Street, India VIX down 6%; what's fueling the rally today?

Domestic equity market benchmarks BSE Sensex and NSE Nifty 50 jumped over 2 per cent intra day on Monday riding on a firm global momentum

Written by Surbhi Jain

May 30, 2022 1:52:26 pm

https://www.financialexpress.com/market/sensex-nifty-up-2-as-bulls-clutch-d-street-india-vix-down-6-whats-fueling-the-rally-today/2542261/

MARKETS

What is a Market?

– A market is a means through which buyers and sellers are brought together to aid in the transfer of goods and/or services.

- ✓ Need not have a physical location
- ✓ Does not necessarily have to own the goods and services
- ✓ It can deal in any variety of goods and services
- ✓ Both buyers and sellers benefit from the market

What is a Good Market?

- ✓ Provides timely and accurate information
- ✓ Liquidity – ability to buy or sell an asset quickly at a known price
  - ✓ Depth – numerous buyers and sellers willing to trade
  - ✓ Impact cost – measure of liquidity
- ✓ Low transaction costs : Internal efficiency
- ✓ Rapid adjustment of prices to new information : External efficiency

Types of Financial Markets

- **Financial Markets**
  - **Capital Markets**
    raising long term finance
    - **Primary Capital Markets**
      New issues of bonds or stocks to acquire new capital
    - **Secondary Capital Markets**
      Trading in outstanding issues
  - **Money Markets**
    lending and borrowing of short-term funds
    maturity ranging from overnight to one year
    financial instruments that are deemed to be close substitutes of money

Why are secondary markets important?

- Provides liquidity to the individuals who acquired securities in the primary market

- Price discovery is determined by transactions in secondary market – important for those selling seasoned securities, IPOs in primary market

<u>What would have happened if there was no active secondary market?</u>

- Issuers of stocks and bonds would have to provide much higher rate of return to investors to compensate for substantial liquidity risk.

What is an Index

What is an Index?

…A statistical figure

Uses of Security Market Index

- ➢As benchmarks to evaluate the performance of funds
- ➢To create and monitor an index fund
- ➢To measure market rates of return in economic studies
- ➢For predicting future market movements by technicians
- ➢As a substitute for the market portfolio of risky assets when calculating the systematic risk of an asset

Differentiating factors – Index construction

- Sample
- Weighting Sample members
- Computational procedure

Weighting Sample members

- Price weighted Index
- Value weighted Index
- Unweighted (equally weighted) Index
- Fundamental weighted Index

Price Weighted Index

CNN BUSINESS Markets Tech Media Success Video

DOW JONES INDU AVERAGE NDX

(Dow Jones Global Indexes:INDU)

31,104.97 Delayed Data As of Sep 13

-1,276.37 / -3.94% Today's Change

TODAY 29,653 36,953 52-Week Range

-14.40% Year-to-Date

Quote Details

Previous close	32,381.34	Today's volume	433,796,382
Open	32,006.50	Average daily volume (3 months)	352,999,836
Day high	32,006.50	Average P/E	--
Day low	31,018.54	1 year change	-10.80%

https://money.cnn.com/data/dow30/

Price Weighted Index

➢It is the arithmetic mean of current stock prices which means that Index movements are influenced by the differential prices of the components

➢ eg. DJIA – price weighted average of 30 large industrial stocks, Nikkei-Dow Jones Average – 225 stocks

$$\text{Index}_t = \sum_{t=1}^{n} Pit / Dadj$$

Where Index_t = Value of Index on day t, P_{it} = closing price of stock i on day t and D_{adj} = adjusted divisor on day t

The DJIA is a price-weighted index that tracks **30 large, publicly-owned companies trading on the New York Stock Exchange (NYSE) and the Nasdaq**. The index was created by Charles Dow in 1896 to serve as a proxy for the broader U.S. economy.

Price Weighted Index

Assume the price-weighted index consists of three stocks, A, B and C. This example illustrates how the index and the new divisor are computed before and after a 3-for-1 stock split for Stock A.

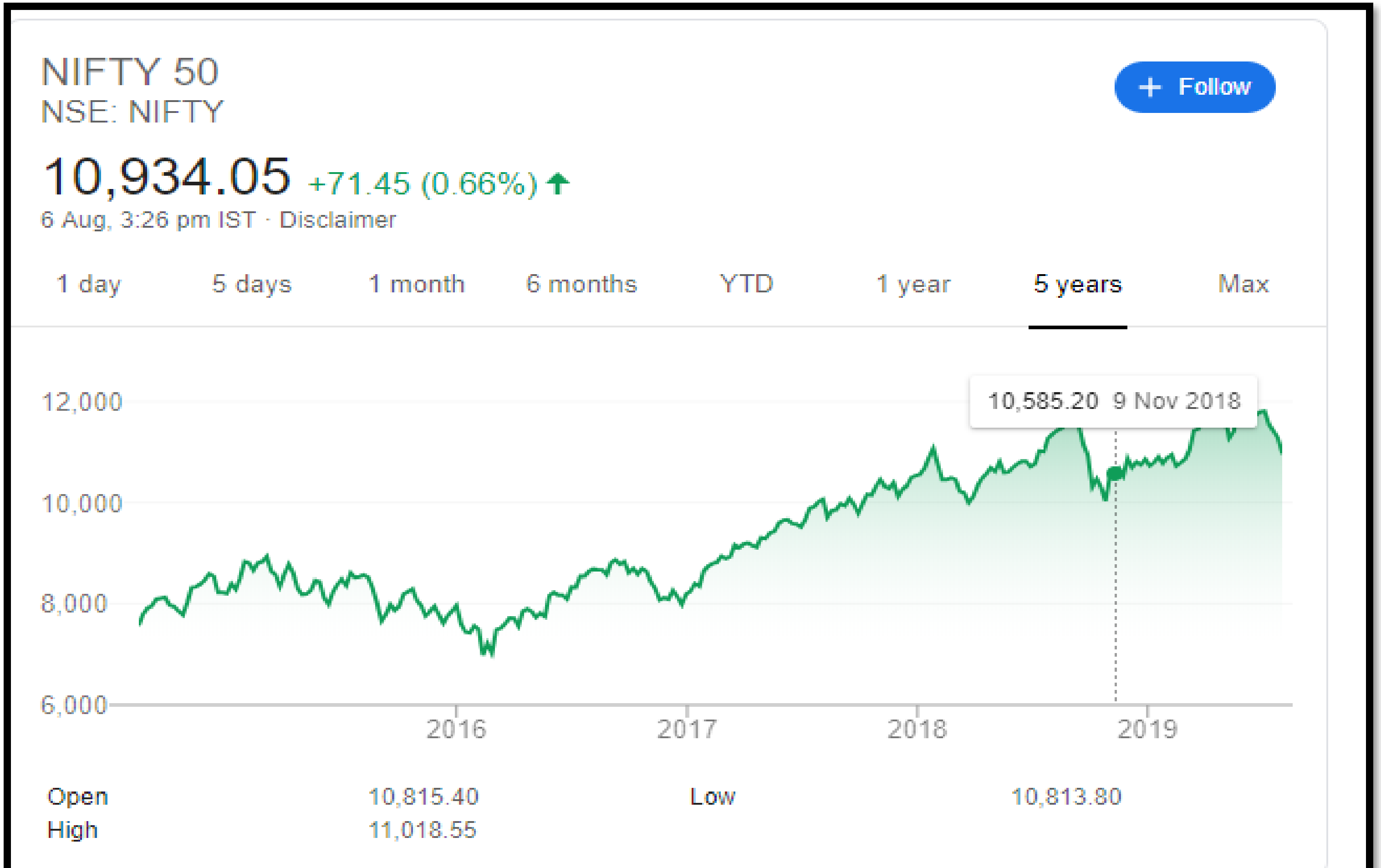
Stock	Price Before Split	Price After Split
A	30	10
B	20	20
C	10	10
Index	60 / 3 = 20	40 / X = 20
Divisor	3	X=2

Price Weighted Index

Criticism of Price Weighted Index

- The divisor needs to be adjusted every time one of the companies in the index has a stock split

Value weighted Index



https://www.niftyindices.com/indices/equity/broad-based-indices/NIFTY-50
https://www.nseindia.com/products/content/equities/indices/nifty_50.htm

Value Weighted Index

- Free float market value weighted
  - Market Value = Number of Shares Outstanding (Free floating shares) X Current Market Price
- Assign an beginning index value (say 100 or 1000) and new market values are compared to the base index
- Automatic adjustment for splits
- Weighting depends on market value
- Eg. Nifty 50

$$\text{Index}_t = \frac{\sum P_t Q_t}{\sum P_h Q_h} \times \text{Beginning Index Value}$$

where:

Index_t = index value on day t

P_t = ending prices for stocks on day t

Q_t = number of outstanding shares on day t

P_h = ending price for stocks on base day

Q_h = number of outstanding shares on base day

Value Weighted Index

Impact of different values on a Market-Value weighted stock index

		DECEMBER 31, 2011		DECEMBER 31, 2012			
				Case A		Case B	
Stock	Number of Shares	Price	Value	Price	Value	Price	Value
A	1,000,000	$10.00	$ 10,000,000	$12.00	$ 12,000,000	$10.00	$ 10,000,000
B	6,000,000	15.00	90,000,000	15.00	90,000,000	15.00	90,000,000
C	5,000,000	20.00	100,000,000	20.00	100,000,000	24.00	120,000,000
			$200,000,000		$202,000,000		$220,000,000
Index Value			100.00		101.00		110.00

Price changes for large market value stocks in a value-weighted index will dominate changes in the index value over time mint

Home / Market / Mark-to-market / Don't be fooled by the Sensex's new highs

Don't be fooled by the Sensex's new highs

The only category of stocks that has risen during this period is the one with extremely high market capitalization, or stocks with a valuation of over Rs1 trillion. Photo: Hindustan Times

https://www.livemint.com/Money/tGKS8E1XkhTbsS5Yh9cVjM/Dont-be-fooled-by-new-highs-of-Sensex.html

Unweighted or Equally weighted index

https://www.niftyindices.com/indices/equity/strategy-indices/nifty50-equal-weight

Unweighted Index

- All stocks carry equal weight regardless of price or market value
- Some use arithmetic average of the percent price changes for the stocks in the index – each % change has equal weight – price level or market value of stock does not make a difference
- Value Line and the Financial Times Ordinary Share Index compute a geometric mean of the holding period returns

Unweighted Index

	DECEMBER 31, 2011			DECEMBER 31, 2012		
Stock	Number of Shares	Price	Value	Price	Value	Percent Change
X	2,000,000	$20	$40,000,000	$30	$60,000,000	50.0
Y	8,000,000	15	120,000,000	20	160,000,000	33.3
Z	10,000,000	30	300,000,000	33	330,000,000	10.0
			$460,000,000		$550,000,000	93.3/3 = 31.1

Equal Wtd. Index: $100 \times 1.311 = 131.100$

Market Value Wtd Index: $100 \times \dfrac{550{,}000{,}000}{460{,}000{,}000} = 119.565$

Market Value index did not do well because the large –cap stock experienced the poorest performance

Unweighted Index-A.M. or G.M.

	Share Price			
Stock	T	T+1	% change	HPR
X	10	12	0.20	1.20
Y	22	20	-0.09	0.91
Z	44	47	0.07	1.07

Geometric Mean = (1.2 x 0.91 x 1.07)^1/3 = 1.0531 OR 5.31%
Arithmetic Mean = 0.18/3 = 0.06 = 6%

Index value (t) x 1.0531 = Index value (t+1)
Index Value (t) x 1.06 = Index Value (t+1)

Fundamental Weighted Index

https://www.niftyindices.com/indices/equity/strategy-indices/nifty-100-low-volatility

Fundamental Weighted Index

Rationale

- Market-value weighting scheme results in overweighting overvalued stocks and underweighting undervalued stocks over time

Fundamental measures of firm size

- Sales
- Profits (cash flow)
- Net asset (book value)
- Distributions to shareholders (dividends)
- Eg. FTSE RAFI US 1000 Index, WisdomTree Dividend Index and WisdomTree LargeCap Value Index

Style Index

https://www.niftyindices.com/indices/equity/strategy-indices/nifty500-value-50

Style Indexes

- ❑ Small-cap growth
- ❑ Mid-cap growth
- ❑ Large-cap growth
- ❑ Small-cap value
- ❑ Mid-cap value
- ❑ Large-cap value
- ❑ Socially responsible investment (SRI) indexes
  - ❑ Global ethical stock index

Global Equity Index

MSCI ACWI Index market allocation

MSCI ACWI INDEX					
MSCI WORLD INDEX			MSCI EMERGING MARKETS INDEX		
DEVELOPED MARKETS			EMERGING MARKETS		
Americas	Europe & Middle East	Pacific	Americas	Europe, Middle East & Africa	Asia
Canada	Austria	Australia	Argentina	Czech Republic	China
United States	Belgium	Hong Kong	Brazil	Egypt	India
	Denmark	Japan	Chile	Greece	Indonesia
	Finland	New Zealand	Colombia	Hungary	Korea
	France	Singapore	Mexico	Poland	Malaysia
	Germany		Peru	Qatar	Pakistan
	Ireland			Russia	Philippines
	Israel			Saudi Arabia	Taiwan
	Italy			South Africa	Thailand
	Netherlands			Turkey	
	Norway			United Arab Emirates	
	Portugal				
	Spain				
	Sweden				
	Switzerland				
	United Kingdom				

https://www.msci.com/acwi

Global Equity Index

- There are stock-market indices available for most individual foreign markets
- These are closely followed within each country
- These are difficult to compare due to differences in sample selection, weighting, or computational procedure
- **Groups have computed country indexes**
- EG. FT/S&P-Actuaries World Indexes - Measures 2,500 securities in 30 countries, Index is market-value weighted with a base date of December 31, 1986 = 100, Covers 70% of the total value of all listed companies in each country
- Morgan Stanley Capital International (MSCI) Indexes - Include 1,673 companies listed on stock exchanges in 22 countries with a combined capitalization representing approximately 60 percent of the aggregate market value of the stock exchanges of these countries, Market value weighted
- Dow Jones World Stock Index - Includes 33 countries representing more than 80 percent of the combined capitalization of these countries, 2200 cos. worldwide

Problem on Index - 1

	Share Price		
Stock	T	T+1	No. of shares
A	60	80	1000000
B	20	35	10000000
C	18	25	30000000

a) Price-weighted index for these three stocks and compute % change in index
b) Value-weighted index for these three stocks and compute % change in index (t being base year)
c) Discuss difference in results

Solution 1-a

Given a three security series and a price change from period t to t+1, the percentage change in the series would be 42.85 percent.

	Period t	Period t+1	
A	$ 60	$ 80	
B	20	35	
C	18	25	
Sum	$ 98	$140	
Divisor		**3**	**3**
Average		32.67	46.67

$$\text{Percentage change} = \frac{46.67 - 32.67}{32.67} = \frac{14.00}{32.67} = 42.85\%$$

Solution 1-b

Period t

Stock	Price/Share	# of Shares	Market Value
A	$60	1,000,000	$ 60,000,000
B	20	10,000,000	200,000,000
C	18	30,000,000	540,000,000
Total			$800,000,000

Period t+1

Stock	Price/Share	# of Shares	Market Value
A	$80	1,000,000	$ 80,000,000
B	35	10,000,000	350,000,000
C	25	30,000,000	750,000,000
Total			$1,180,000,000

$$\text{Percentage change} = \frac{1{,}180 - 800}{800} = \frac{380}{800} = 47.50\%$$

Problem on Index-2

	Share Price	
Stock	T	T+1
A	60	80
B	20	35
C	18	25

a) Construct equal weighted index assuming 1000$ is invested in each stock. What is the % change in wealth
b) Compute arithmetic mean of % price change
c) Compute geometric mean of % price change

Solution 2-a

Period t

Stock	Price/Share	# of Shares	Market Value
A	$60	16.67	$ 1,000,000
B	20	50.00	1,000,000
C	18	55.56	1,000,000
Total			$3,000,000

Period t+1

Stock	Price/Share	# of Shares	Market Value
A	$80	16.67	$ 1,333.60
B	35	50.00	1,750.00
C	25	55.56	1,389.00
Total			$4,472.60

$$\text{Percentage change} = \frac{4{,}472.60 - 3{,}000}{3{,}000} = \frac{1{,}472.60}{3{,}000} = 49.09\%$$

Solution 2-b & 2-c

$$A = \frac{80-60}{60} = \frac{20}{60} = 33.33\%$$

$$B = \frac{35-20}{20} = \frac{15}{20} = 75.00\%$$

$$C = \frac{25-18}{18} = \frac{7}{18} = 38.89\%$$

$$\text{Arithmetic average} = \frac{33.33\% + 75.00\% + 38.89\%}{3}$$

$$= \frac{147.22\%}{3} = 49.07\%$$

$$\begin{aligned}\text{Geometric average} &= [(1.3333)\ (1.75)\ (1.3889)]^{1/3} - 1 \\ &= [3.2407]^{1/3} - 1 \\ &= 1.4798 - 1 \\ &= .4798 \text{ or } 47.98\%\end{aligned}$$

Bond Index

NIFTY G-SEC Indices

Nifty G-SEC

NIFTY G-Sec Indices represent Government of India bonds across 6 distinct duration buckets. Up to 3 liquid securities, within each duration bucket, shall be eligible to be part of the indices.

Highlights

- The Indices have a base date of 3rd September, 2001 and a base value of 1000
- The Index seeks to measure the performance of most liquid Government of India bonds across 6 distinct duration buckets
- Based on a well-defined, market relevant and rules-based framework, the index is a transparent and objective indicator of Indian G-sec market performance.
- The index is rebalanced and reconstituted on a monthly basis

1. NIFTY Ultra Short Duration G-Sec Index
2. NIFTY Low Duration G-Sec Index
3. NIFTY Short Duration G-Sec Index
4. NIFTY Medium Duration G-Sec Index
5. NIFTY Medium to Long Duration G-Sec Index
6. NIFTY Long Duration G-Sec Index

Activate Windows
Go to Settings to activate Windows.

https://www.niftyindices.com/indices/fixed-income/gsec-indices/nifty-g-sec-indices

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Thank you!

BITS Pilani Hyderabad Campus

BITS Pilani presentation

Dr. Nivedita Sinha
Department of Economics & Finance

Security Analysis & Portfolio Management (SAPM)
Lecture 3
Date: 15/09/2022

Motivation – News article

MarketWatch
• Latest Watchlist Markets Investing Personal Finance Economy Retirement More ▾

Short Interest

Home > Tools > **Short Interest**

MOST SHORTED STOCKS

These are the companies with the largest proportions of outstanding shares currently sold short.

SYMBOL	COMPANY NAME	PRICE	CHG% (1D)	CHG% (YTD)	SHORT INTEREST	SHORT DATE	FLOAT	FLOAT SHORTED (%)
PMVP	PMV Pharmaceuticals Inc.	$13.00	-2.62%	-43.72%	13,082,656	08/31/22	30,728,828	42.57%
BBBY	Bed Bath & Beyond Inc.	$8.76	4.66%	-39.92%	30,617,290	08/31/22	76,053,126	40.26%
UPST	Upstart Holdings Inc.	$25.31	1.36%	-83.27%	26,070,720	08/31/22	68,878,653	37.85%
BIG	Big Lots Inc.	$20.94	0.38%	-53.52%	9,966,643	08/31/22	26,514,369	37.59%
CLAR	Clarus Corp.	$14.91	-2.87%	-46.21%	8,881,999	08/31/22	25,054,923	35.45%
NERV	Minerva Neurosciences Inc.	$9.98	-5.67%	55.74%	1,596,058	08/31/22	4,552,031	35.06%
MSTR	MicroStrategy Inc.	$225.99	-2.27%	-58.50%	3,173,086	08/31/22	9,331,001	34.01%
BYND	Beyond Meat Inc.	$20.13	-4.69%	-69.11%	19,244,344	08/31/22	56,880,978	33.83%
AVYA	Avaya Holdings Corp.	$1.74	-4.40%	-91.21%	23,946,334	08/31/22	71,108,241	33.68%
GRPN	Groupon Inc.	$12.48	2.63%	-46.11%	6,373,220	08/31/22	19,072,993	33.41%
BXRX	Baudax Bio Inc.	$0.33	3.23%	-95.67%	2,561,786	08/31/22	7,778,075	32.94%
SANA	Sana Biotechnology Inc.	$6.64	-1.04%	-57.11%	25,494,615	08/31/22	79,525,536	32.06%

https://www.marketwatch.com/tools/screener/short-interest

Home › Stock Market › News » Melvin Capital To Shut Down One Year After GameStop Short-Squeeze

Melvin Capital to shut down one year after GameStop short-squeeze caused billions in losses for the hedge fund

MATTHEW FOX | MAY 19, 2022, 21:21 IST

https://www.businessinsider.in/stock-market/news/melvin-capital-to-shut-down-one-year-after-gamestop-short-squeeze-caused-billions-in-losses-for-the-hedge-fund/articleshow/91670368.cms

Short selling

- Short squeeze
- Short selling as hedging device –Pairs trade strategy
  - Long stocks (expected to do well) and simultaneously short the stocks (expected to do badly)


FINANCE | BANKS | INVESTING | WALL STREET | HEDGE FUNDS | M&A | INS

Hedge funds lose more than half a billion on wrong-way bet against Tesla

- S3 Partners says traders are collectively down $607 million Thursday on their bearish bet against Tesla.
- The shares were up 6 percent at the open of trading Thursday.
- Tesla has the highest level of short interest for a U.S. company at $9.03 billion, according to the firm.

Thomas Franck | @tomwfranck
Published 9:10 AM ET Thu, 3 Aug 2017 | Updated 5:09 PM ET Thu, 3 Aug 2017
CNBC

https://www.livemint.com/Money/RgOm95bNcDp4k9IgwOcytO/What-is-short-selling-and-what-are-its-risks.html

https://finance.yahoo.com/news/hedge-funds-lose-more-half-143643781.html

Short selling : news articles

https://www.livemint.com/Money/RgOm95bNcDp4k9IgwOcytO/What-is-short-selling-and-what-are-its-risks.html

https://seekingalpha.com/article/4274367-tesla-short-interest-remains-high

https://finance.yahoo.com/news/hedge-funds-lose-more-half-143643781.html

https://www.statista.com/statistics/1201001/most-shorted-stocks-worldwide/

Agenda

- Types of orders
  - Market order
  - Limit order
  - Special orders
- Margin transactions
- Short selling

Types of orders

- **Market orders**
  - Buy or sell at the best current price
  - Provides immediate liquidity

- **Limit orders**
  - Order specifies the buy or sell price
  - Time specifications for order may vary

Exercise on Limit & Market order

The stock of company Y is selling for 28$ a share. You put in a limit buy order at 24$ a share for one month. During the month the stock price declines to 20$ a share, then jumps to 36$.

a) Ignoring commissions, what would have been your rate of return on this investment?

b) What would have been your rate of return if you had put a market order.

c)What if your limit order was at 18$?

Exercise on Limit & Market order

Limit order @ \$24: When market declined to \$20, your limit order was executed \$24 (buy), then the price went to \$36.

a)

Rate of return = (\$36 - \$24)/\$24 = 50%.

b) Assuming market order @ \$28: Buy at \$28, price goes to \$36

Rate of return = (\$36 - \$28)/\$28 = 28.57%.

c) Limit order @ \$18: Since the market did not decline to \$18 (lowest price was \$20) the limit order was never executed

Types of orders contd.

- **Special orders -**

  – <u>Stop Loss Order</u>
    - A conditional market order to sell stock if it drops to a given price
    - Does not guarantee price you will get upon sale

  – <u>Stop Buy/Gain Order</u>
    - A conditional market order to buy stock if it increases to a specified price
    - Investor who sold short may want to limit loss if stock increases in price

Exercise on Special orders

- You own 200 shares of X that you had bought for 25$. The stock is now selling for 45$ a share.

a) You now put a stop loss order at 40$. Discuss reasoning for your action.

b) If stock eventually declines to 30$ a share, what will be your rate of return with or without stop loss order?

Solution to Stop loss exercise

a)

I want to protect some of the profit I have; should prices drop I will still have a profit of

$15/share.

b) With the stop loss: ($40 - $25)/$25 = 60%

Without the stop loss: ($30 - $25)/$25 = 20%

Types of orders contd.

- **Margin transactions**

  - On any type order, instead of paying 100% cash, investors can borrow a portion of the transaction and use the stock as collateral
  - Changes in stock price, change the total market value of the stock bought and affect the investor's equity position in the stock

  – **<u>Maintenance Margin</u>**

    - Required proportion of equity to stock after purchase
    - Protects broker if stock price declines
    - Margin call on under margined account to meet margin requirement
    - If margin call is not met, the stock will be sold to pay off the loan

Margin transactions - India

- In Indian context, buying/selling on margin refers to building a leverage position at the beginning of the settlement cycle and squaring off the trade before the settlement comes to end.
- In case the price during the course of the settlement cycle moves in your favour (risen in case of purchase done earlier and fallen in case of a sale done earlier) you will make a profit and you receive the payment from the exchange.
- In case the price movement is adverse, you will make a loss and you will have to make the payment to the exchange.

Problem on Margin transactions

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a) Suppose you bought 200 shares of a $50 stock and borrowed the maximum amount of money given an initial margin requirement of 50%. If the stock price increase to $60 per share, what will be your equity position in the stock? Ignore taxes and commissions.

b) What would be your percentage return if the price reaches $60 in the earlier example? If the maintenance margin is 25%, what is the margin call price?

c) If the stock price decrease to $40 per share, what will be your equity position in the stock?

d) If we assume 4% interest on the borrowed funds and 100$ commission on transaction, how would the return change.

Margin Transaction exercise

"Borrowing may not always be the way to prosperity"

Srujana had recently opened a demat account. She wanted to try her luck with equity trading. She had recently read about intraday trading and the use of the margin account. She was quite amazed to know that one can borrow and invest and then return the borrowed amount by the end of the day.

Srujana had some INR15,000 to invest in stock of a company. Stock price of company XYZ was INR1000 and the initial margin requirement was 25%. She decided to borrow the maximum amount of money and use all of her INR15,000 also as initial equity. Ignore brokerage fees.

1) If the stock price increases by 20%, what is her return on investment?

2) If the stock price decreases by 20%, what is her return on investment?

3) What do you interpret from the above results in 1 and 2?

4) If the maintenance margin is 10%, what is the margin call price?

Short sales

- Short sales
  - Sell overpriced stock that you don't own and purchase it back later (hopefully at a lower price)
  - Borrow the stock from another investor (through your broker)

Short selling games & Strategies – Pairs trading

A portfolio manager Raj in a hedge fund company has gone long in the stock of XYZ company; 10000 shares of stock purchased at 30$ per share. The expectation was that the price of the stock will appreciate, however, the uncertainty was more.

The stock price went to 40$ per share. His boss asked him to lock in the profits. However, due to tax purposes, he was asked not to sell the stocks but still lock-in the profits.

He short sold 10,000 shares of stock XYZ at 40$ per share.

Say in December of 2016, Raj is long 10,000 at 30$ per share and short 10,000 at 40$ per share

What will his gain or loss be if the prices in January 2017 were as follows:-

Price of XYZ = $60

Price of XYZ = $35

Price of XYZ = $20

Solution to Short selling problem

Short selling at Price	40		
Going long at Price	30		
Prices	60	35	20
gain from long position	300000	50000	-100000
gain from short position	-200000	50000	200000
Total gain	100000	100000	100000

Thank you!

Measuring risk and return

- Risk-return trade-off
- Measures of return – realized return, expected return, required rate of return
- Measures of risk – absolute and relative measures

Return

Expected return- rate of return that the investor can expect to earn given the characteristic of the security (ex-ante)

Realized return/ actual return – rate of return that the investor actually earns on the investment (ex-post)

Expected return and realized return are more often than not different

Investment decisions are based on **<u>expected return</u>**

Risk return trade-off

- Consider two securities A & B similar in all respects except expected returns:

- Expected return of A =10%;
- Expected return of B =15%

- Is it possible?

Risk-return trade-off contd.

- All rational investors will buy B and price of B will rise
- All rational investors will sell A and price of A will fall
  - Until their returns are equal
- What can explain presence of securities with different returns?
- Higher return is a kind of price for risk - **Risk-return trade-off**

Measures of historical return

Total return/ holding period return – amount of value an investor earns from an investment

HPR= (Value of investment at the end of time horizon/ Initial amount invested)-1

Ending value of investment can be due to change in price of the security, dividend payments or both.

HPR>0: positive rate of return

HPR<0: negative rate of return

HPR=0: no return

*Note: HPR referred here is same as HPY in Reilly & Brown text

Geometric mean

Annual HPR (AHPR) - Annual change in value of investment

$$\mathbf{AHPR} = \{\prod(1 + \mathrm{HPR})\}^{1/n} - 1$$

n – time horizon in years

Also known as annualized returns – geometric mean rate of return

Various frequencies

- Annualizing return using monthly returns =(1+Monthly Return)^12-1
- Annualizing return using weekly returns =(1+Weekly Return)^52-1
- Annualizing return using daily returns =(1+Daily Return)^252-1

Arithmetic mean

Average annual return (AAR)

Arithmetic mean rate of return $=\sum HPR/n$

Mean returns are useful for evaluating performance of the security in the past

AAR assumes constant investment every year whereas annualized return assumes previous years gains and losses will be reinvested

Expected return

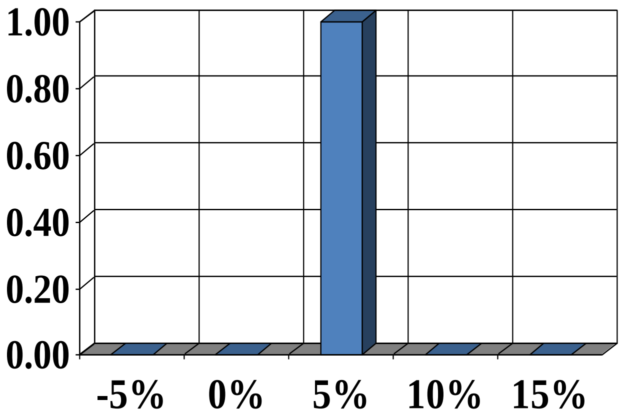
- Risk is uncertainty that an investment will earn its expected rate of return

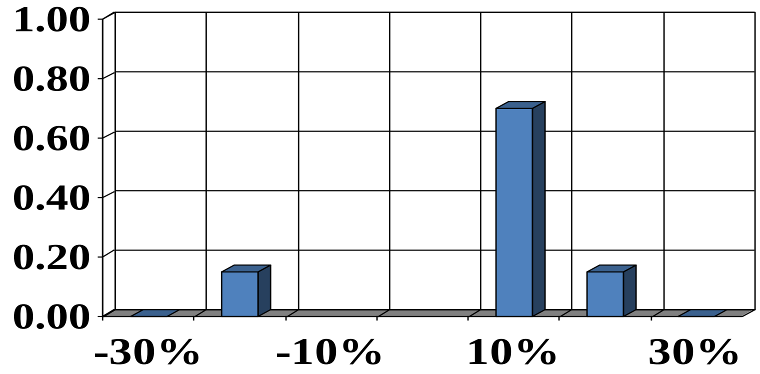
- Depends upon various possible states in the future and the probability of these states

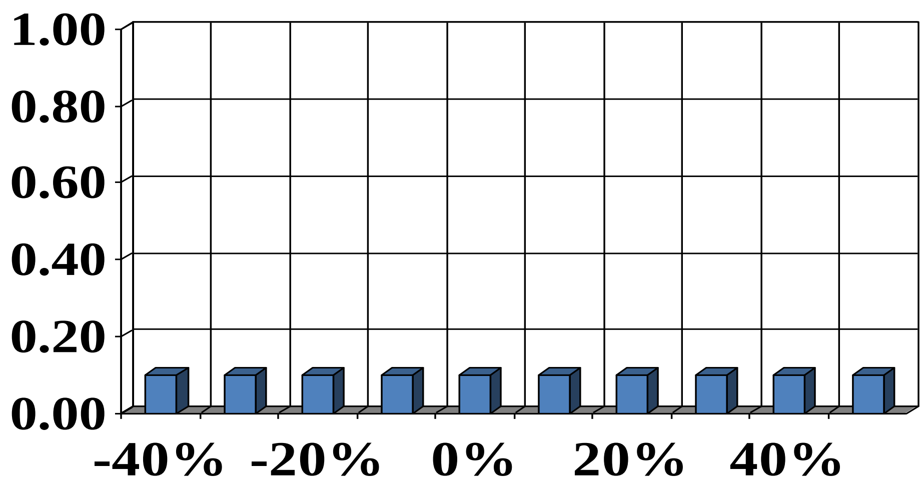
- Probability will always lie between zero and one

- Probabilities are subjective estimates based on past performance, future's expected global macro environment, investor sentiments, etc.

Few examples







Expected return

$$E(r_{Asset1}) = \sum_{i=1}^{n} p_i \, r_i$$

- n- possible states like boom, recession ,normal times
- This is the return expected on an average and likely to be never realized actually (except by chance)!

An Example

Consider following possible outcomes:

	Expected return of Sensex Column 1	Probability Column 2	Col.1*Col. 2	Expected return
Boom	20%	0.20	0.04	**0.08 or 8%**
Recession	-10%	0.20	-0.02	
Normal	10%	0.60	0.06	

If the input is correct can the investor ever earn 8%?

No.

Investor will earn either 20% or 10% or -10%

Making sense of expected return

If E(r) is never realized how do we interpret the number?

Is it useful?

Yes

Compare E(R) to certain return in the market (risk-free rate)

If **E(r) > risk-free rate** only then worth considering the asset for investment otherwise not

If two assets are same except $\mathbf{E}(\boldsymbol{r}_{\mathbf{Asset1}})$**>** $\mathbf{E}(\boldsymbol{r}_{\mathbf{Asset2}})$ then investor will prefer asset 1

Risk aversion – Investor will always lower uncertainty over higher (or no) uncertainty

Required rate of return

Minimum return to compensate for time, inflation and risk

Determinants –

- Time – Risk free rate – e.g: T-Bills rate
- Inflation – CPI/ core CPI
- Investors care about real return (nominal return minus inflation rate)
- Risk

Required rate of return

- Investors will invest in an asset if and only if expected return>=required rate of return

- Suppose E(r) of an asset remains unchanged at 10%, but requires rate of return changes from 9% to 11% - this may lead to sell-off in this security

- Similarly, E(r) changing to12% from 10% without any change in required rate of return will generate buying pressure for the security

- Example :
- Moderna's E(r) skyrocketed since January and buying pressure is immense (stock price increased from 19.23USD on 2nd Jan, 2020 to 64.88USD on 24th Aug, 2020)

Risk measures

Uncertainty that the investor will earn the expected return

Risk is measured by the variability of returns.

Variance – Sum of squared deviation from the expected return

$$\sigma^2 = \sum_{i=1}^{n} p_i(R_i - E(R_i))^2$$

Standard deviation – positive square root of variance

$$\sigma = \sqrt{\sum_{i=1}^{n} p_i(R_i - E(R_i))^2}$$

Higher the variance/ standard deviation greater is the risk of investment

Absolute risk measure

Variance / standard deviation of HPR

Expected HPR is given by AM of HPR

$$\sigma^2 = \sum_{i=1}^{n} \frac{(HPR_i - \overline{HPR})^2}{n-1}$$

n- number of observations

Relative risk measure

Coefficient of variation – risk (standard deviation) per unit of expected return

$$CV = \frac{\sigma}{E(R)}$$

Annualizing risk

- Annualizing risk using monthly returns =Monthly return standard deviation*√12
- Annualizing return using weekly returns =Weekly return standard deviation*√52
- Annualizing return using monthly returns = Daily return standard deviation*√252

Thank you

BITS Pilani
Hyderabad Campus

BITS Pilani presentation

Dr. Nivedita Sinha
Department of Economics & Finance

Security Analysis & Portfolio Management (SAPM)
Lecture 5

Agenda

- Returns calculation
- Risk calculation
- Mini Case-Risk and Return calculation
- Theory of choice under certainty

Motivation- Mini Case

FINSHOTS

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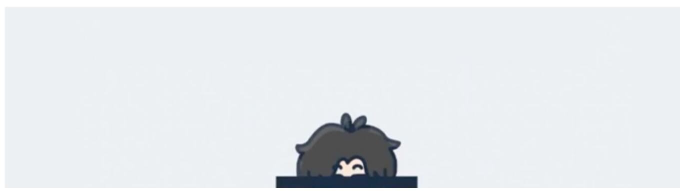
13 FEBRUARY 2020 / BUSINESS

The Small Hedge Fund that bet big on Parasite



So after the Oscar Win, Bloomberg reported this

> *"For a tiny South Korean hedge fund, the shock Oscar win of dark comedy "Parasite" couldn't be better news. The fund, run by Seoul-based Ryukyung PSG Asset Management Inc., has invested around **$500,000** in the movie that became the first foreign-language film in history to win the coveted Oscar for best picture. "Parasite" cost $11 million to make and has raked in $165 million so far, and ticket sales are set to climb even more after the award"*

https://finshots.in/archive/hedge-fund-that-bet-parasite-movie/

Motivation- Mini Case

Fine Art Lending Thrives Thanks to Yield-Hungry Hedge Funds

https://www.bloomberg.com/news/articles/2021-08-12/fine-art-lending-thrives-thanks-to-yield-hungry-hedge-funds#xj4y7vzkg

Motivation- Mini Case

WEALTH

Life's a beach: Super-rich invest in island life

PUBLISHED THU, OCT 23 2014•11:24 AM EDT | UPDATED THU, OCT 23 2014•11:37 AM EDT

Jenny Cosgrave
@PROFILE/VIEW?ID=140014113
@JENNY_COSGRAVE

SHARE

The growth in numbers of the super-wealthy has driven demand for life on a tropical island, a new study shows.

Bermuda topped the list of the world's top 20 islands for real estate investment, with the region now containing the highest concentration of island property holdings owned by ultra-high net worth individuals (UHNW), or those as having wealth in excess of $30 million outside the U.S..

https://www.cnbc.com/2014/10/23/lifes-a-beach-super-rich-invest-in-island-life.html

Refer to pdf

Risk and Return pdf

Returns

You had invested 10 crores INR in the project and after 3.5 years you receive 15 crores INR . What is the annualized return you got (EAR) on your investment? What is annualized HPY? Annualized HPY = annualized return =((15/10)^(1/3.5)) – 1 = 12.28% p.a.
If the daily average return is 0.1%, what is the annualized return (EAR)? = ((1+0.1%) ^365) -1 = 44.025%

Returns for individual assets

For An Individual Asset

It is equal to the sum of the potential returns multiplied with the corresponding probability of the returns

For A Portfolio of Investments

It is equal to the weighted average of the expected rates of return for the individual investments in the portfolio

$$E(R_{port}) = \sum_{i=1}^{n} W_i R_i$$

where: W_i = the percent of the portfolio in asset i

$E(R_i)$ = the expected rate of return for asset i

Returns

Expected Return, Variance, and Covariance

Consider the following two risky asset world. There is a 1/3 chance of each state of the economy, and the only assets are a stock fund and a bond fund.

		Rate of Return	
Scenario	***Probability***	***Stock Fund***	***Bond Fund***
Recession	33.3%	-7%	17%
Normal	33.3%	12%	7%
Boom	33.3%	28%	-3%

Returns

	Stock Fund		Bond Fund	
Scenario	***Rate of Return***	***Squared Deviation***	***Rate of Return***	***Squared Deviation***
Recession	-7%	0.0324	17%	0.0100
Normal	12%	0.0001	7%	0.0000
Boom	28%	0.0289	-3%	0.0100
Expected return	11.00%		7.00%	
Variance	0.0205		0.0067	
Standard Deviation	14.3%		8.2%	

$$E(r_S) = \tfrac{1}{3} \times (-7\%) + \tfrac{1}{3} \times (12\%) + \tfrac{1}{3} \times (28\%$$

$$E(r_S) = 11\%$$

Variance of returns for an Individual Investment

Variance

It is a measure of the variation of possible rates of return R_i, from the expected rate of return $[E(R_i)]$

$$\text{Variance } (\sigma^2) = \sum_{i=1}^{n} [R_i - E(R_i)]^2 P_i$$

where P_i is the probability of the possible rate of return, R_i

Standard Deviation (σ)

– It is simply the square root of the variance

Variance

Scenario	Stock Fund Rate of Return	Stock Fund Squared Deviation	Bond Fund Rate of Return	Bond Fund Squared Deviation
Recession	-7%	0.0324	17%	0.0100
Normal	12%	0.0001	7%	0.0000
Boom	28%	0.0289	-3%	0.0100
Expected return	11.00%		7.00%	
Variance	0.0205		0.0067	
Standard Deviation	14.3%		8.2%	

$$(-7\% - 11\%)^2 = .032$$

$$.0205 = \frac{1}{3}(.0324 + .0001 + .0289)$$

Standard deviation

Scenario	Stock Fund Rate of Return	Stock Fund Squared Deviation	Bond Fund Rate of Return	Bond Fund Squared Deviation
Recession	-7%	0.0324	17%	0.0100
Normal	12%	0.0001	7%	0.0000
Boom	28%	0.0289	-3%	0.0100
Expected return	11.00%		7.00%	
Variance	0.0205		0.0067	
Standard Deviation	14.3%		8.2%	

$$14.3\% = \sqrt{0.0205} = \sigma$$

Standard Deviation of a Portfolio

The Formula

$$\sigma_{port} = \sqrt{\sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{i=1}^{n} w_i w_j \mathrm{Cov}_{ij}}$$

where :

σ_{port} = the standard deviation of the portfolio

W_i = the weights of the individual assets in the portfolio, where weights are determined by the proportion of value in the portfolio

σ_i^2 = the variance of rates of return for asset i

Cov_{ij} = the covariance between the rates of return for assets i and j, where $\mathrm{Cov}_{ij} = r_{ij}\sigma_i\sigma_j$

Covariance and Correlation coeff. of returns

Covariance of returns

Covariance of returns is the measure of the degree to which rates of return move together relative to the individual mean values over time.

For two assets, I and j , covariance of rates of return :-

$$\mathrm{Cov}\,ij = E\{[Ri - E(Ri)]\,[Rj - E(Rj)]\}$$

Correlation coefficient of returns

The correlation coefficient is obtained by standardizing (dividing) the covariance by the product of the individual standard deviations.

$$r_{ij} = \frac{\mathrm{Cov}_{ij}}{\sigma_i \sigma_j}$$

r_{ij} = the correlation coefficient of returns

σ_i = the standard deviation of R_{it}

σ_j = the standard deviation of R_{jt}

Covariance is an important concept

Consider n securities each with return r_i where i= 1 to n and variances σ_i^2
Let there be equal proportion of investments in securities.

$R_p = (r_1 + r_2 + \ldots. + r_n)/n$

$\sigma_p^2 = 1/n^2 (\sigma_1^2 + \ldots\ldots. + \sigma_n^2) + 2/n^2 (\sigma_{1,2} + \ldots\ldots. + \sigma_{n-1,n})$

Let us define Average Covariance = Sum of distinct covariances/ No. of distinct covariances

No. of distinct covariances = 1+2+3+….+n-1 = (n-1) (n)/2
Average covariance = Sum of all distinct covariance /{n(n-1)/2}

$\sigma_p^2 = 1/n^2 (\sigma_1^2 + \ldots\ldots. + \sigma_n^2) + (n-1)/n$ * [Average covariance]
As n tends to infinity, Variance (R_p) = Average covariance of securities

Covariance is an important concept

- The contribution to the portfolio variance of the variance of the individual securities goes to zero as n gets very large.

- The contribution of the covariance terms approaches average covariance as n gets very large.

- Hence, Individual risks of securities can be diversified away but the contribution to the total risk caused by covariance terms cannot be diversified away.

Covariance

Scenario	Stock Deviation	Bond Deviation	Product	Weighted
Recession	-18%	10%	-0.0180	-0.0060
Normal	1%	0%	0.0000	0.0000
Boom	17%	-10%	-0.0170	-0.0057
Sum				-0.0117
Covariance				-0.0117

Deviation compares return in each state to the expected return.

Weighted takes the product of the deviations multiplied by the probability of that state.

Correlation

$$\rho = \frac{Cov(a,b)}{\sigma_a \sigma_b}$$

$$\rho = \frac{-.0117}{(.143)(.082)} = -0.998$$

Real and Nominal Return- Fisher's equation

$(1 + R) = (1 + r)(1 + h)$, where

R = nominal rate

r = real rate

h = expected inflation rate

Approximation

$R = r + h$

Effective Annual Rate (EAR), Effective Annual Yield (EAY) or Effective Interest Rate

$$EAR = [(1 + \frac{r}{m})^\wedge m] - 1$$

Where r is the stated annual interest rate or Annual Percentage Rate (APR) compounded m times in year

•EAR is a way of restating the APR so that it takes into account the effects of compounding

•APR should always be stated with periods of compounding otherwise APR has no meaning

EAR and APR example

Given : APR (Annual Percentage rate) or SAIR (Stated Annual Interest rate) is equal to 10% compounded monthly

What is the equivalent EAR (Effective annual rate)?

EAR =[(1+10%/12)^12] -1 = 10.471%

An APR of 10% p.a compounded monthly is equivalent to
An EAR of 10.471% p.a. which is again equivalent to
An APR of 10.471% p.a. compounded annually

Theory of choice under certainty

Theory of Choice under certainty

- A decision problem involves:
  - Identification of the set of **feasible alternatives**
  - A **selection criterion** for choosing among the available alternatives
  - A **solution** to the problem

- The individual solutions can be aggregated to describe equilibrium conditions that prevail in the marketplace

Example

- An investor will receive an income of $\$10,000$ at the end of years 1 and 2 with certainty.
- The only investment available is a savings account with interest rate r=5%. The investor can also borrow money at a 5% rate.

Question

How much should the investor save and how much should he consume each year?

Opportunity Set – Options open to the investor

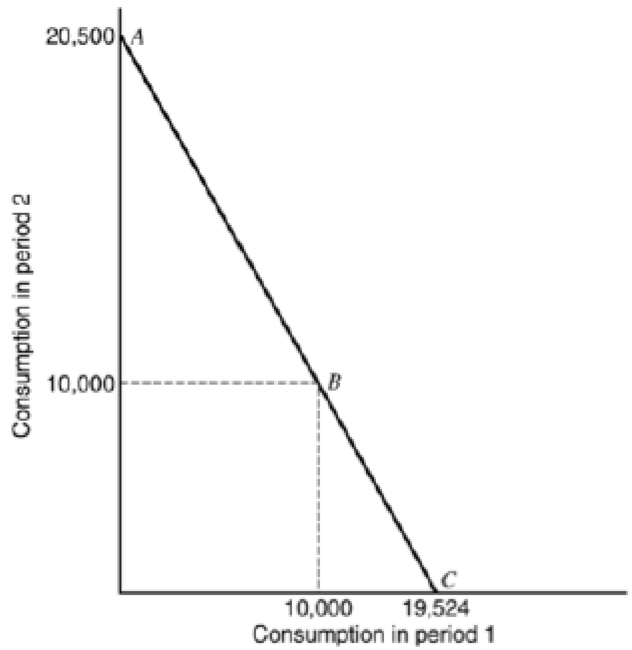


FIGURE 1-1 The investor's opportunity set.

- The set of feasible consumption patterns in periods 1 and 2 lie along the straight line known as the *opportunity set.*

Opportunity Set – Options open to the investor

- Point B $\Rightarrow$ the investor saves nothing and consumes \$10,000 in each period.
- Point A $\Rightarrow$ the investor saves all his income and consumes nothing in period 1 $\Rightarrow$ in the second period, he consumes:

$$
\begin{aligned}
C_2 &= \underbrace{10,000}_{\text{Period 2's income}} + \underbrace{10,000}_{\text{Period 1's income}} + \underbrace{500}_{\text{interest on period 1's income}} \\
&= \$20,500
\end{aligned}
$$

- Point C $\Rightarrow$ the investor consumes everything in period 1 and nothing in the second period$\Rightarrow$ his consumption in period 1 is:

$$
\begin{aligned}
C_1 &= \underbrace{10,000}_{\text{Period 1's income}} + \underbrace{\frac{10,000}{1.05}}_{\text{Maximum amount that can be borrowed against Period 2's income}} \\
&= \$19,524
\end{aligned}
$$

Opportunity Set – Options open to the investor

- The set of feasible consumption patterns in periods 1 and 2 lie along the straight line ABC.
- This is because the amount consumed in period 2 is the income, $\$10,000$, earned in period 2 plus the period 2 value of the savings in period 1:

$$
\begin{aligned}
C_2 &= 10,000 + (10,000 - C_1) \times (1.05) \\
&= 20,500 - 1.05C_1
\end{aligned}
$$

- This is the equation of the straight line in Figure 1.1

Indifference curves

- The investor is equally happy with or "indifferent" between all possible patterns of consumption along the same indifference curve.
- The investor is assumed to prefer more to less $\Rightarrow$ he prefers to be on indifference curves higher up and to the right.
- The indifference curves are convex $\Rightarrow$ each additional dollar of consumption forgone in period 1 requires greater consumption in period 2 in order for the investor to remain indifferent.

Selection criterion - Indifference curves

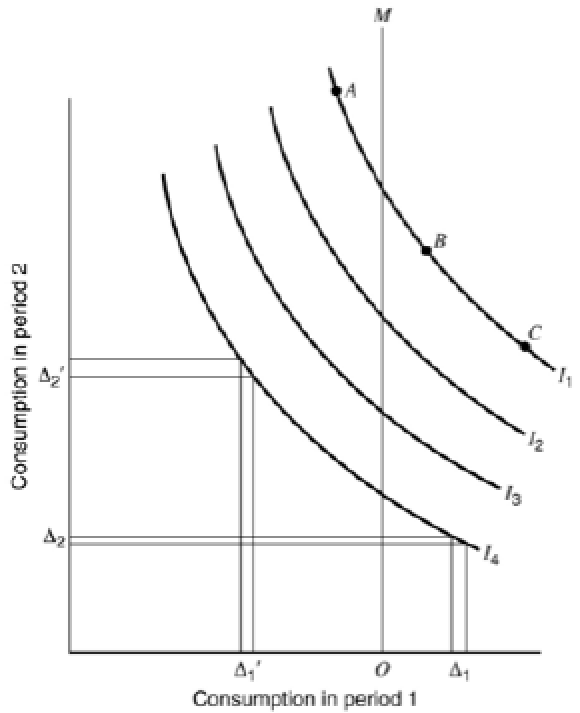


FIGURE 1-2 Indifference curves.

- Indifference curves represent the investor's preference for consumption in the two periods.

The Solution

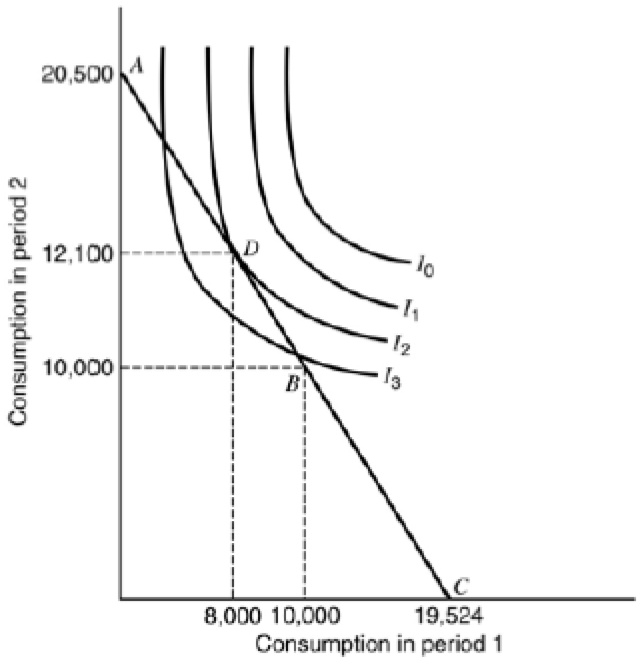


FIGURE 1-3 Investor equilibrium.

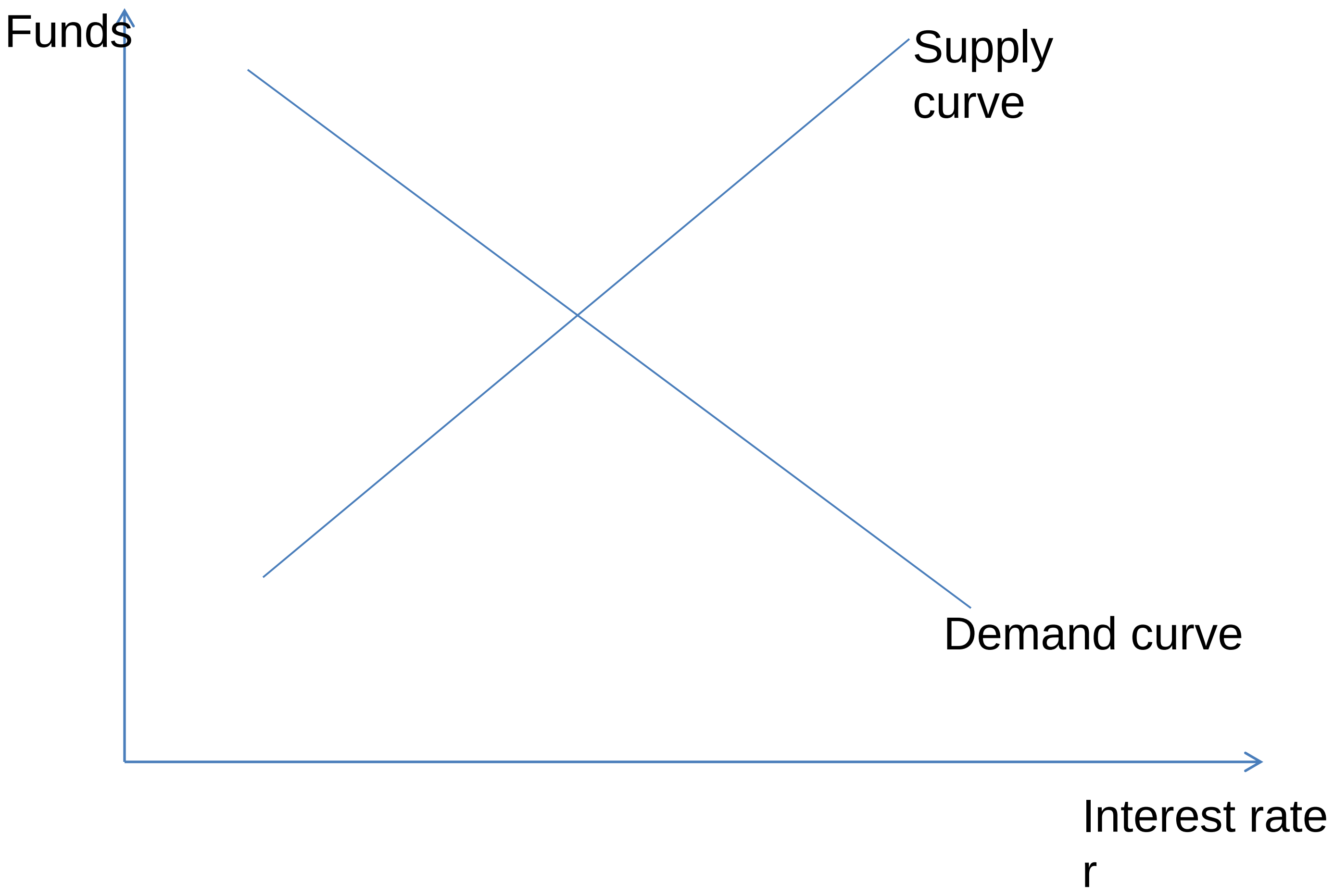
The optimum consumption pattern for the investor is determined by the point at which an indifference curve is tangent to the opportunity set.

Determining Equilibrium Interest rates

- In the above example, the investor wishes to consume \$8,000 in period 1 and lend the remainder of his income, namely \$2,000, at r=5%.
- Summing across all investors who wish to lend when r=5% gives one point on the supply curve.
- Similarly, summing across all investors who wish to borrow when r=5% gives one point on the demand curve.
- By varying the interest rate, the supply and demand curves can be traced out.
- The equilibrium interest rate is rate at which the demand and supply curves intersect $\Rightarrow$ the rate at which the amount investors wish to borrow is equal to the amount investors wish to lend.

In this simple world, equilibrium interest rates are determined by investors' tastes and income.

Determining Equilibrium Interest rates



Problem

Investor X has $200,000 available in period 0 (now) to support consumption in periods 0 (now) and 1 (next year). He wants to consume exactly the same amount in each period. The interest rate is 8% and there is no uncertainty. How much can he consume in each period?

Problem Solution

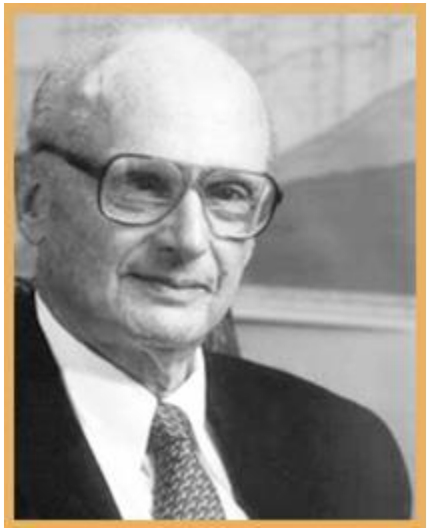
Let C be the amount investor consumes in each period

C =(200000 – C) X 1.08

C = 103846.20

Risk in uncertain world

Uncertainty plays an important role in determining market rates of return

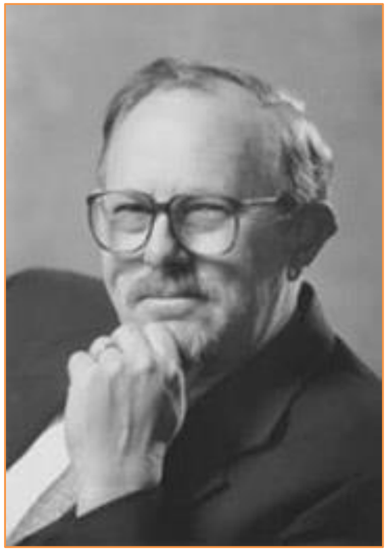


Harry Max Markowitz (born August 24, 1927)

Nobel Prize in Economic Sciences (1990)

Laid the foundations of Portfolio Theory

Markowitz paper on Portfolio selection in 1952



William Forsyth Sharpe (born June 16, 1934)

Nobel Prize in Economic Sciences (1990)

Built on the work of Prof. Markowitz.

One of the originators of Capital Asset Pricing model (1964)

Stephen Ross (born 1944)

Developed the Arbitrage Pricing theory (1976)

Eugene Francis "Gene" Fama (February 14, 1939)

Nobel Prize in Economic Sciences (2013) for the empirical analysis of asset prices

Fama – French 3 factor model (1992) (along with Kenneth French (born 1954))

Robert James "Bob" Shiller (born March 29, 1946)

Nobel Prize in Economic Sciences (2013) for the empirical analysis of asset prices

Behavioral Finance aspect

Theory of Choice under uncertainty

Markowitz Portfolio Theory – Few Assumptions regarding investor behavior

- Investors consider each investment alternative as being represented by a probability distribution of expected returns over some holding period.
- Investors estimate risk of the portfolio on the basis of variability of expected returns.
- Investors base their decisions solely on expected return and risk, so their utility is a function of return and risk.
- For a given expected return, investors prefer less risk to more risk and for a given risk, investors prefer higher returns to lower returns

Step 1: Feasible set of alternatives Efficient frontier

Steps to be followed

1. Feasible set of alternatives
2. Selection criterion
3. Solution

Cases to be considered (2 asset case)

- No short selling
  No riskless lending and borrowing

- With short selling & no riskless lending and borrowing

- With riskless lending and borrowing & no short selling

- With riskless lending and borrowing & short selling

Cases to be considered (n asset case)

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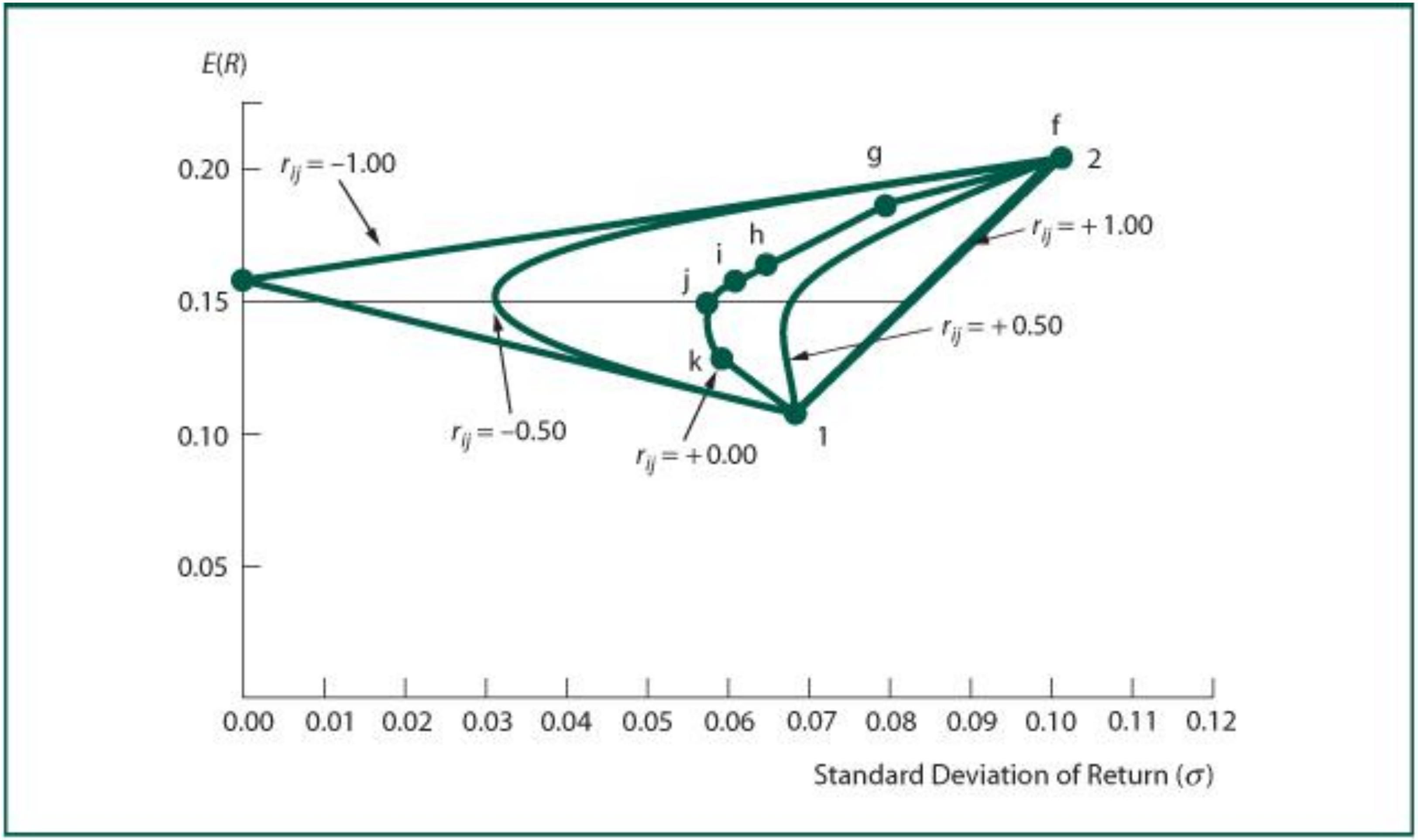
Portfolio Risk – Return plots for different weights when rij = -1, -0.5 , 0, 0.5 and 1



Motivation

Home » Money
Last Published: Wed, Jun 21 2017. 08 01 AM IST
http://www.livemint.com/Money/QoJIiGgGsS4YKaDVWedXNP/Analysing-the-diversity-in-diversified-equity-funds.html

Analysing the diversity in diversified equity funds

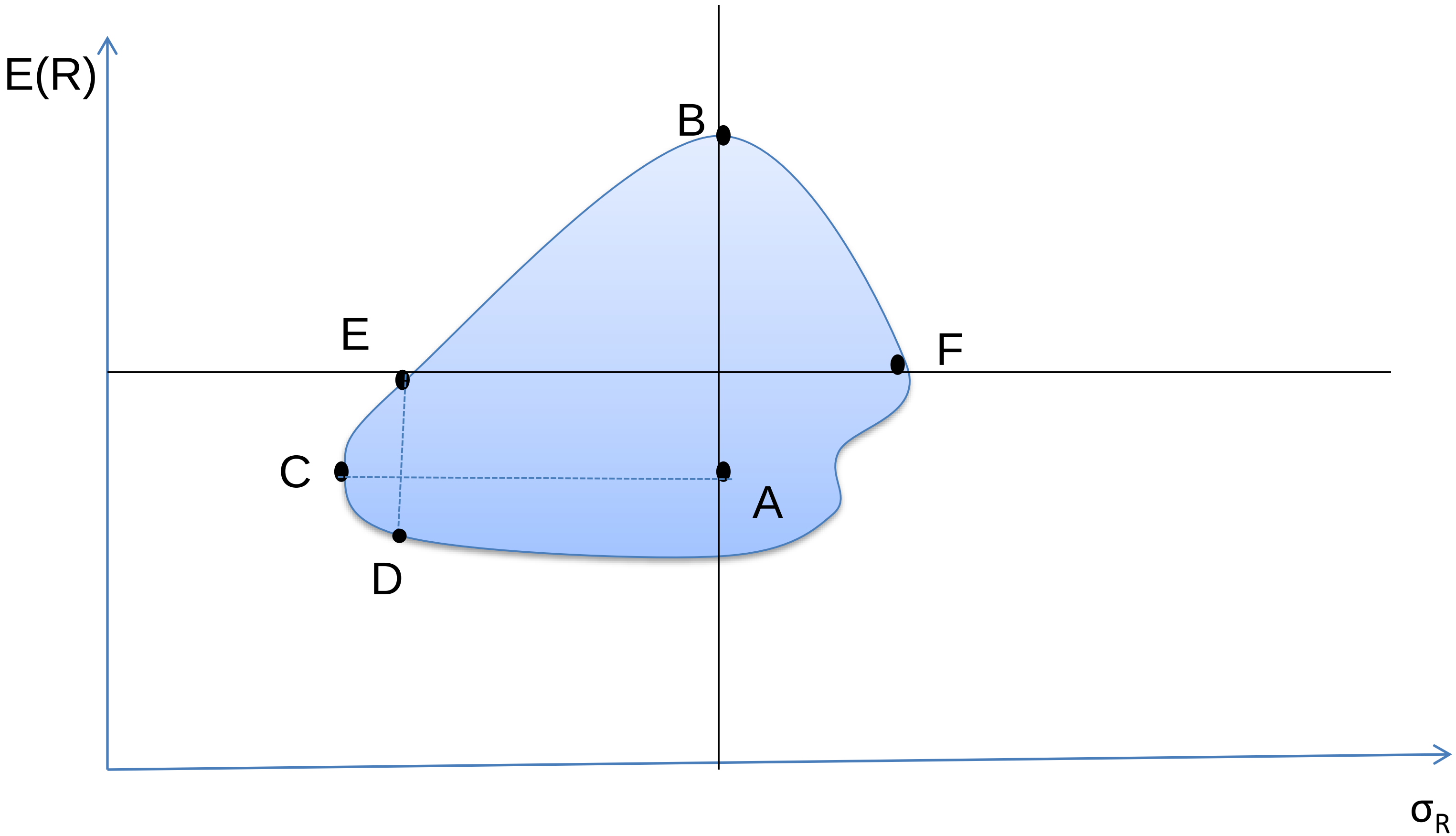
There are so many types of diversified funds. Let's analyse this diversity, so you can choose the mutual fund that best suits your needs

The most common terms can sometimes be the most confusing or misleading. Take the case of a diversified equity fund. Your distributor says you must invest in one. Your fund house says it's the most basic of all equity funds and you must invest in it. But what exactly is a diversified equity fund? Where to find it and how to make money from it? Is it a multi-cap or a flexi-cap fund? If yes, then isn't a large-cap or a mid-cap fund diversified? It's important to know what this term *diversified equity fund* means because that's what a typical adviser sells to most of us, especially if we are first-time mutual fund investors.

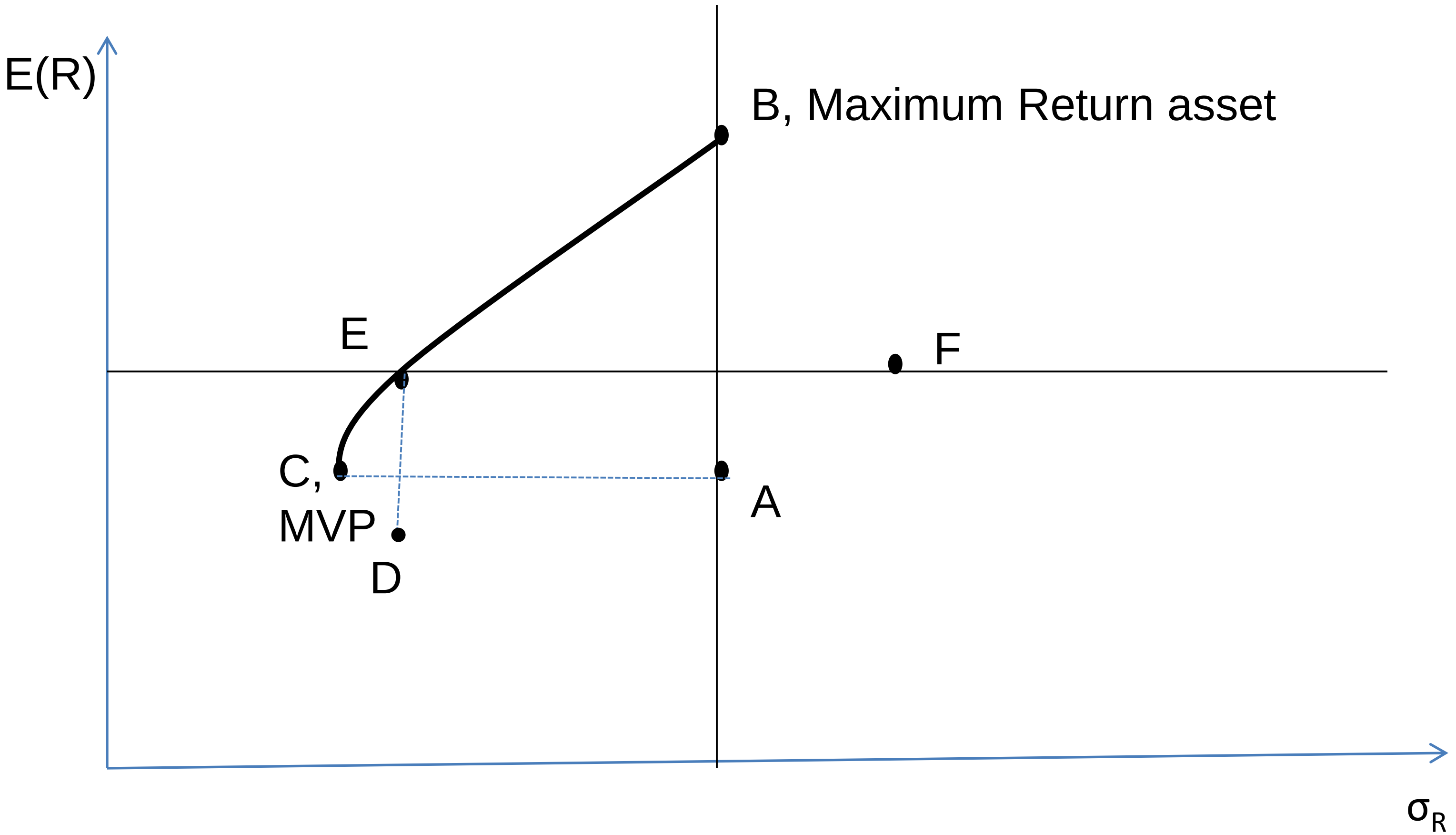
Efficient Frontier – Set of feasible alternatives

The efficient frontier represents that set of portfolios with the maximum rate of return for every given level of risk, or the minimum risk for every level of return.

Numerous portfolio combinations



Efficient Frontier with no short selling and no riskless lending and borrowing



Efficient set consists of the envelope curve of all portfolios that lie between the Minimum Variance portfolio and the maximum return portfolio. This set of portfolios is called Efficient Frontier

Efficient Frontier and Investor Utility curve

➢An individual investor's utility curve specifies the trade-offs he is willing to make between expected return and risk

➢The interactions of these two curves (utility curve and efficient frontier) will determine the particular portfolio selected by an individual investor

➢The optimal portfolio has the highest utility for a given investor

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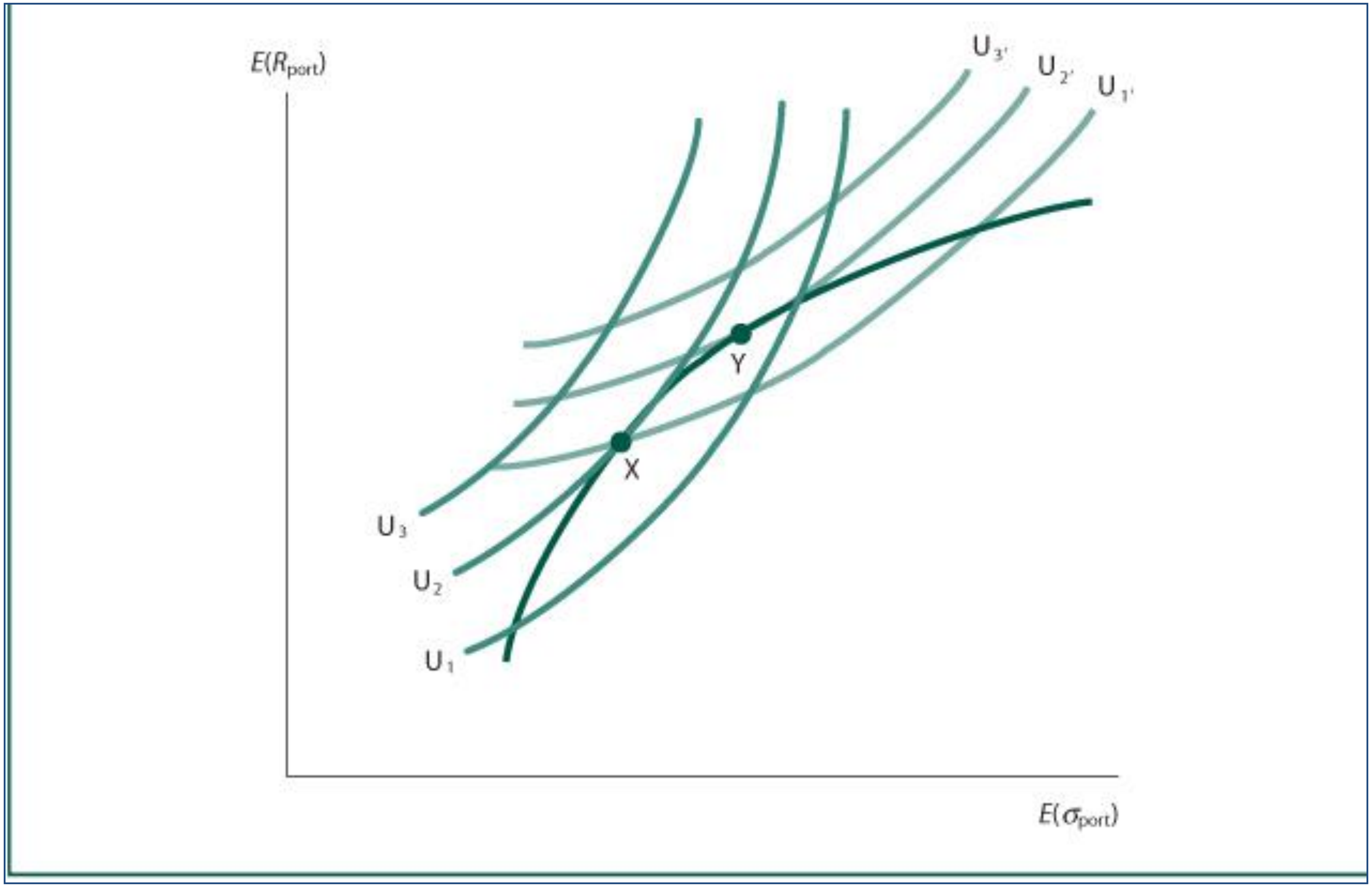
Selecting an Optimal Risky Portfolio



Which Investor is more risk averse?

Thank you!

BITS Pilani
Hyderabad Campus

BITS Pilani presentation

Dr. Nivedita Sinha
Department of Economics & Finance

Security Analysis & Portfolio Management (SAPM) Lecture 11_26092022

Agenda

- **Theory of choice under uncertainty**
  - **Feasible set of alternatives**
  - Selection criterion
  - Solution to asset allocation

Theory of Choice under uncertainty

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Step 1: To determine the feasible set of alternatives

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http://www.livemint.com/Money/QoJIiGgGsS4YKaDVWedXNP/Analysing-the-diversity-in-diversified-equity-funds.html

Analysing the diversity in diversified equity funds

There are so many types of diversified funds. Let's analyse this diversity, so you can choose the mutual fund that best suits your needs

The most common terms can sometimes be the most confusing or misleading. Take the case of a diversified equity fund. Your distributor says you must invest in one. Your fund house says it's the most basic of all equity funds and you must invest in it. But what exactly is a diversified equity fund? Where to find it and how to make money from it? Is it a multi-cap or a flexi-cap fund? If yes, then isn't a large-cap or a mid-cap fund diversified? It's important to know what this term *diversified equity fund* means because that's what a typical adviser sells to most of us, especially if we are first-time mutual fund investors.

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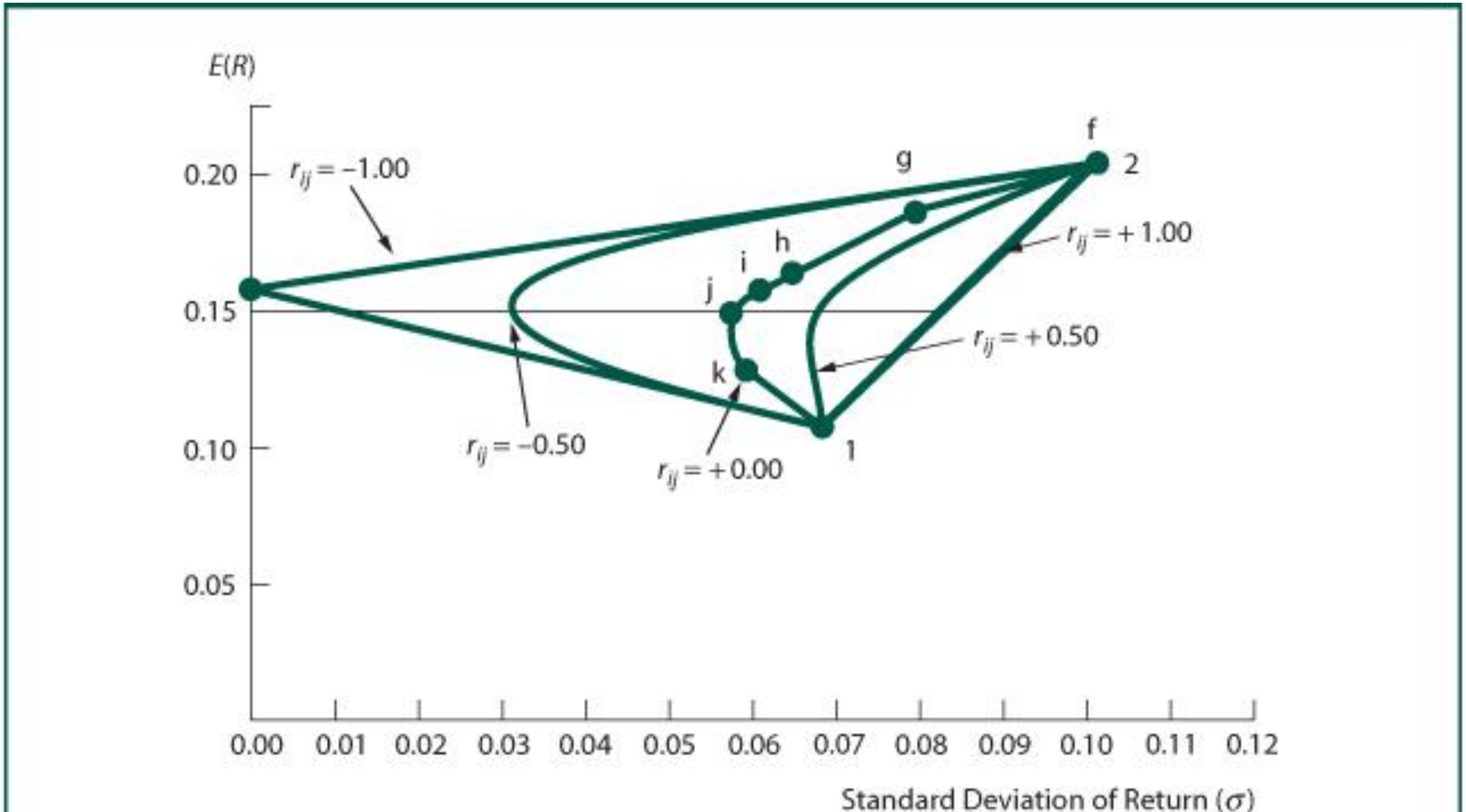

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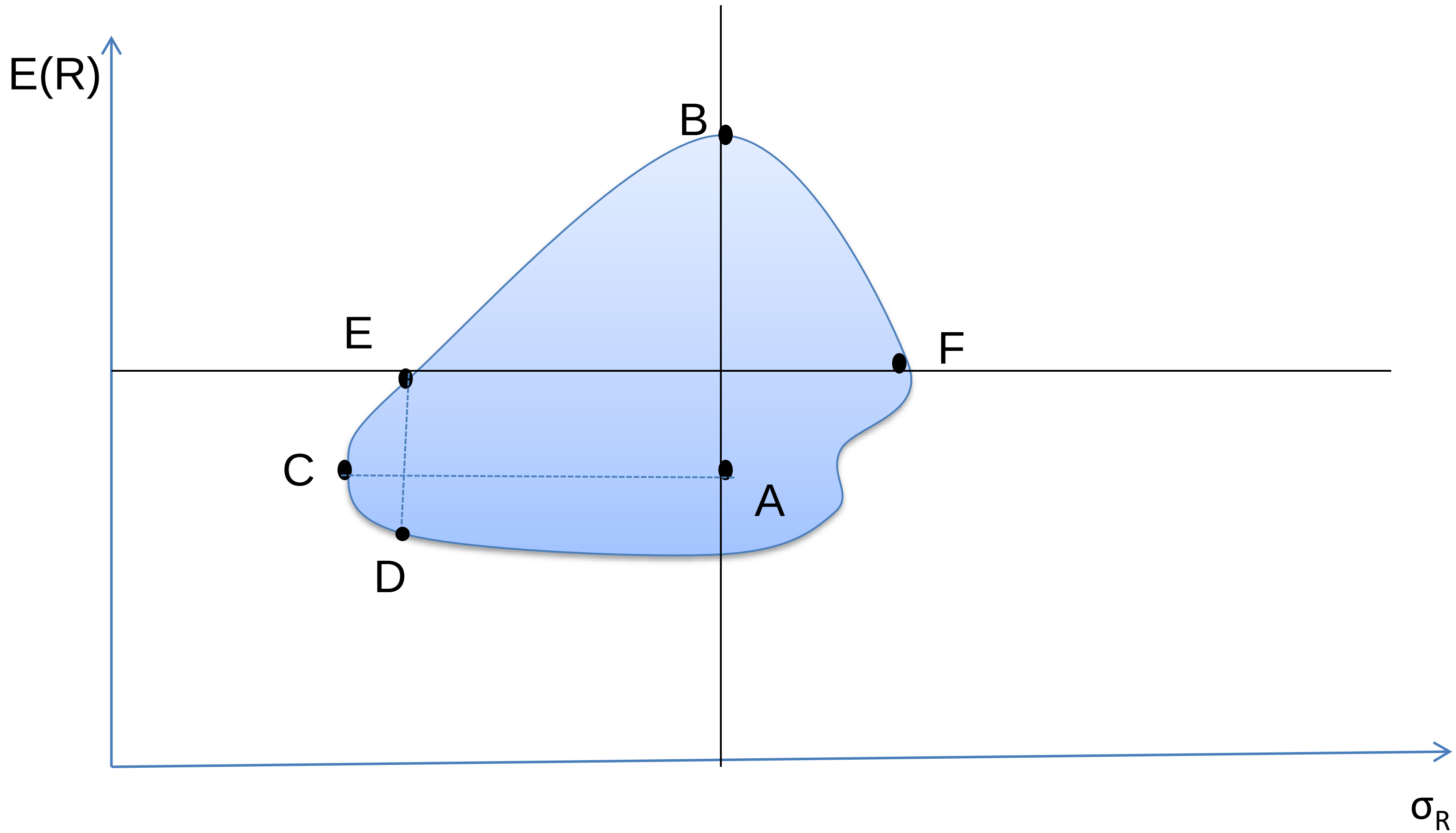
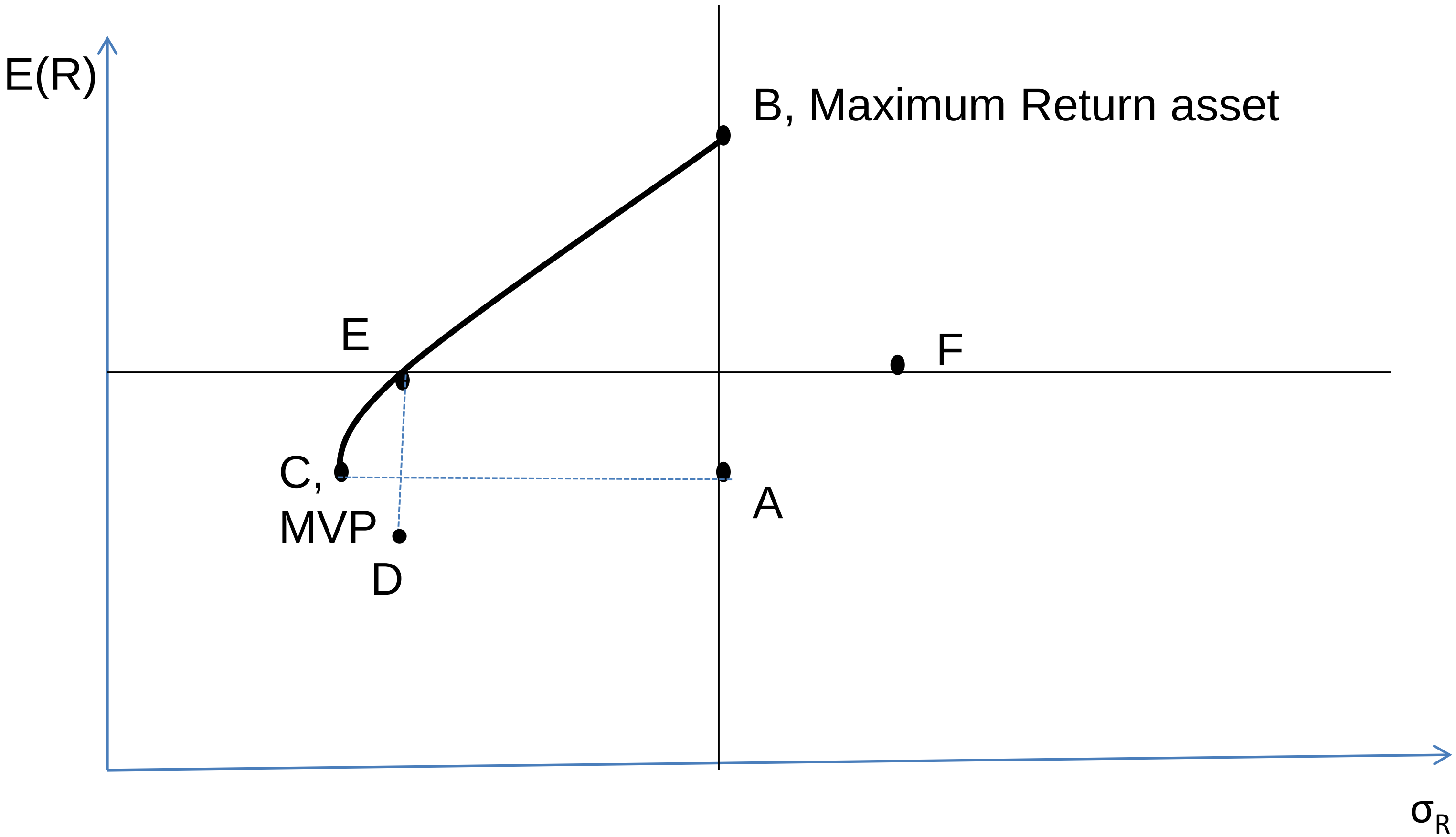
Numerous portfolio combinations



Efficient Frontier with no short selling and no riskless lending and borrowing



Efficient set consists of the envelope curve of all portfolios that lie between the Minimum Variance portfolio and the maximum return portfolio. This set of portfolios is called Efficient Frontier

Risk aversion

Which of these investments would a risk averse investor prefer to invest in?

Asset	Risk	Expected Return
GOI Bonds	0	8%
Titan Industries Ltd.	34.29%	24.76%
GHFL Ltd.	44.79%	51.83%

a) GOI Bonds
b) Titan Industries Ltd.
c) GHFL Ltd.
d) Need more information

Attitudes towards risk

- Risk aversion
- Risk preferrer/seeking
- Risk neutrality

Let us talk about impact of investor's risk and return upon investor's utility function

An investor's utility function describes the way in which risk and return interact to drive utility

Attitudes towards risk

Risk aversion

I don't hate risk, I am just averse to it

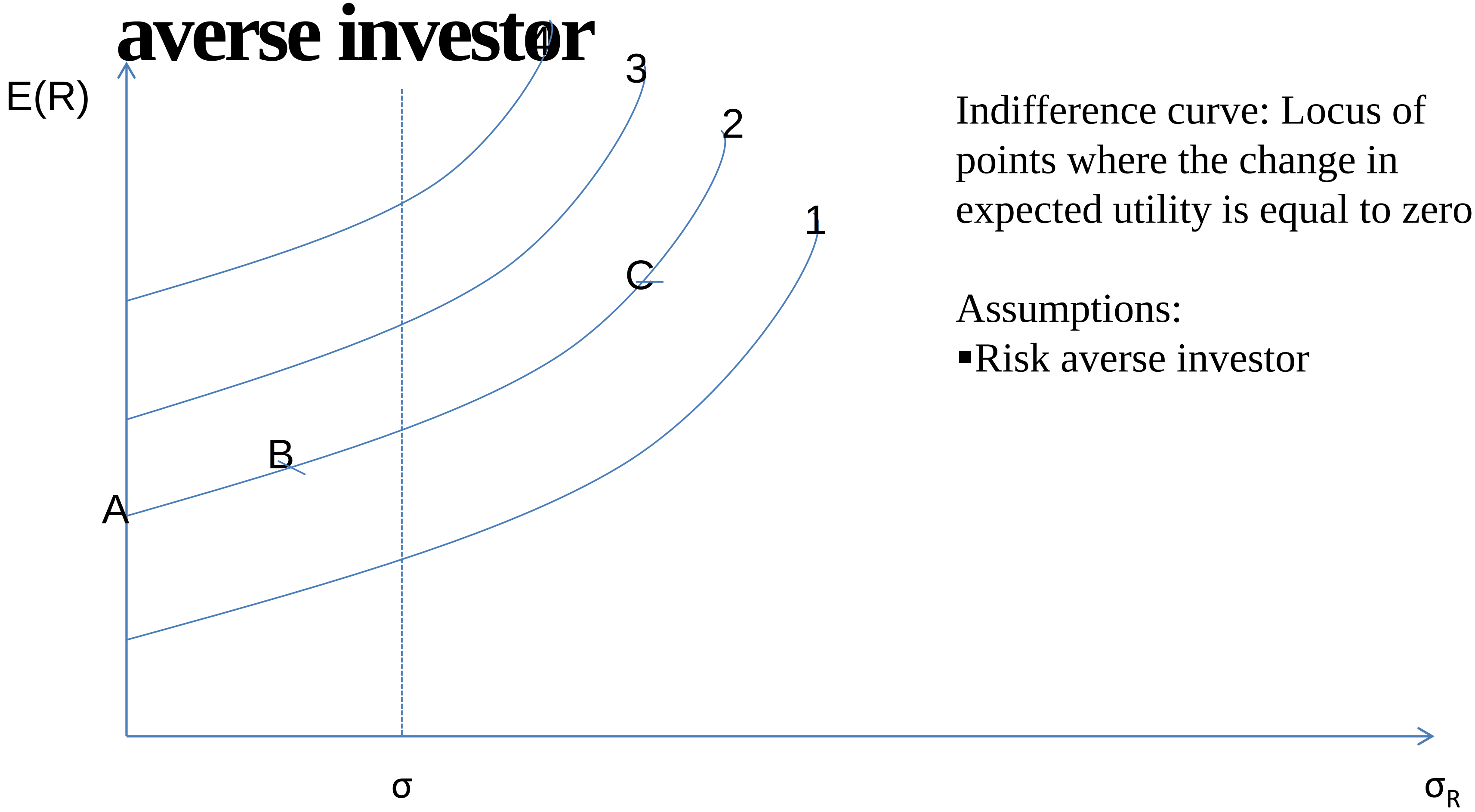
- A risk averse investor demands compensation in the form of higher returns for bearing the risk

- At any given level of expected return, risk averse investors would prefer to minimize risk

To show how risk and return combine to give a specific level of satisfaction, we draw indifference curves

Indifference curves are a combination of risk-return combinations that generate same level of utility (a specific investor is indifferent between each of these combinations of risk and return)

Using Mean and Variance as choice criteria – Indifference curve of a risk averse investor

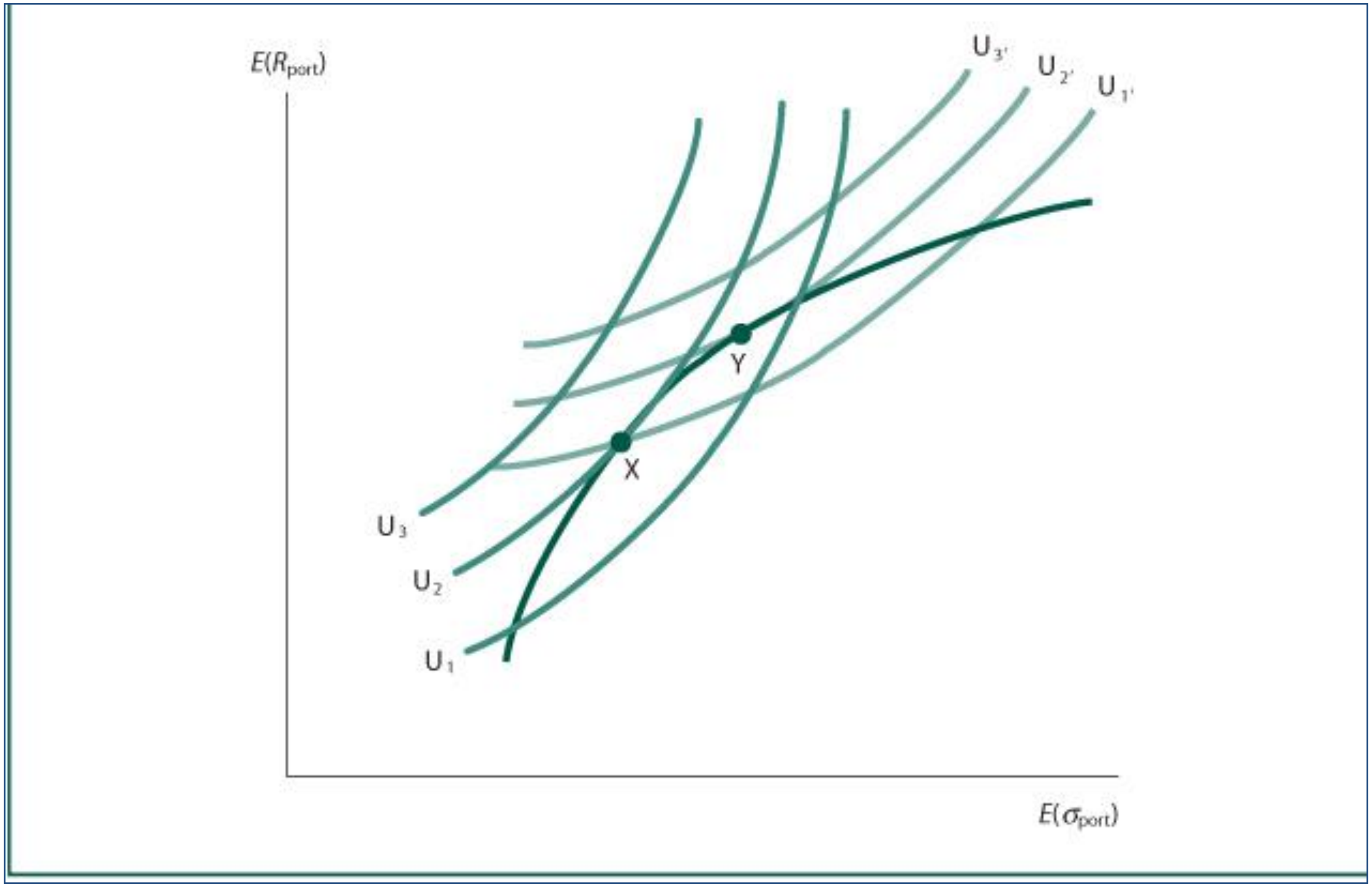


Indifference curve: Locus of points where the change in expected utility is equal to zero

Assumptions:

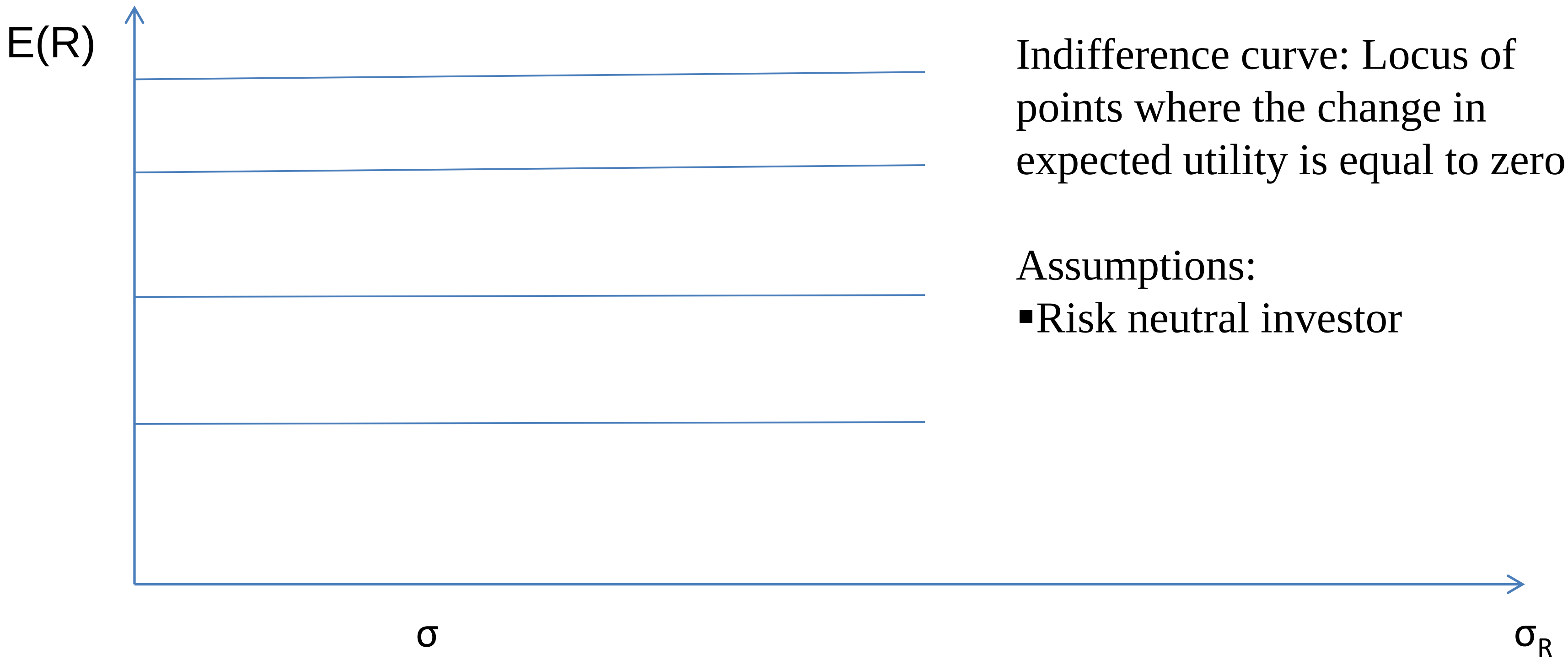
- Risk averse investor

Which Investor is more risk averse?



Risk Neutral Investor

- Risk neutral investor has a utility function that is not affected by risk
- They make their investment decisions solely based upon expected return



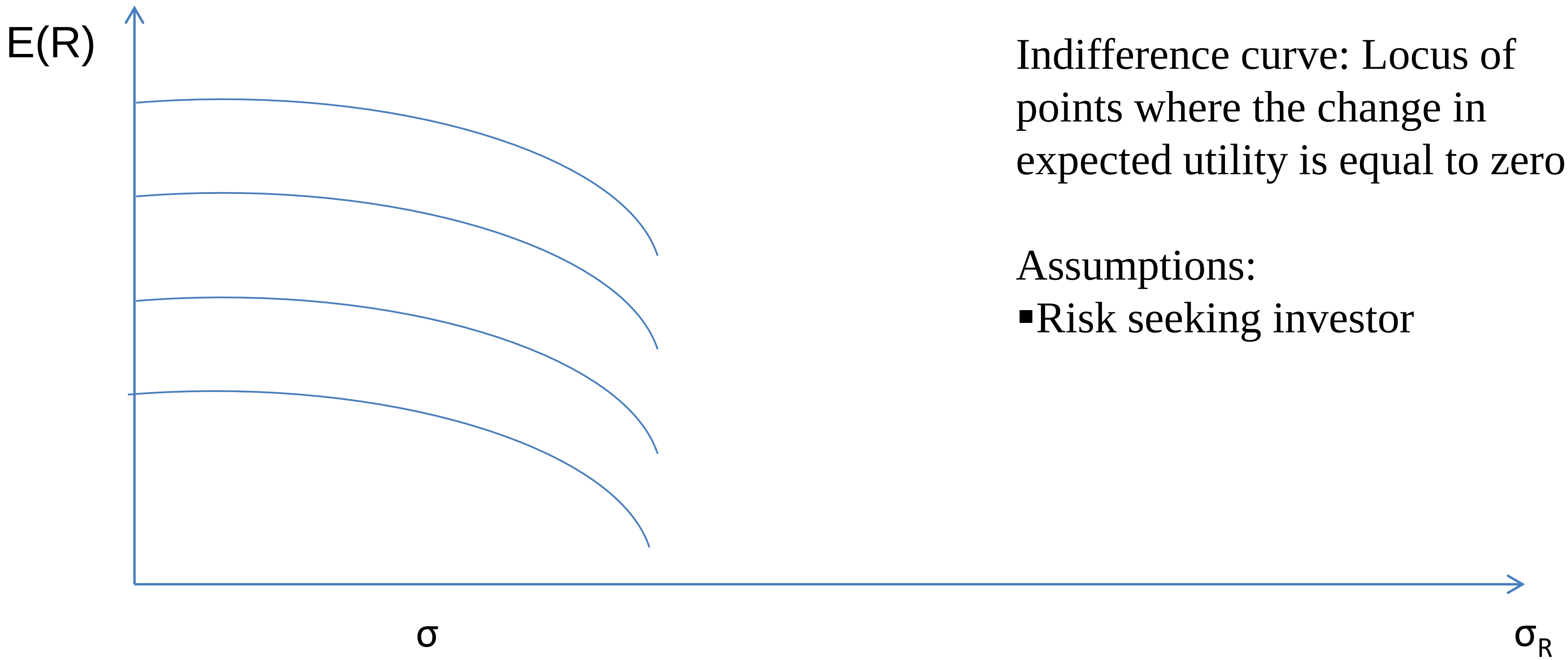
Indifference curve: Locus of points where the change in expected utility is equal to zero

Assumptions:

▪Risk neutral investor

Risk Seeking Investor

- Risk seeking investor is one who may be willing to give up some expected return in order to be exposed to risk



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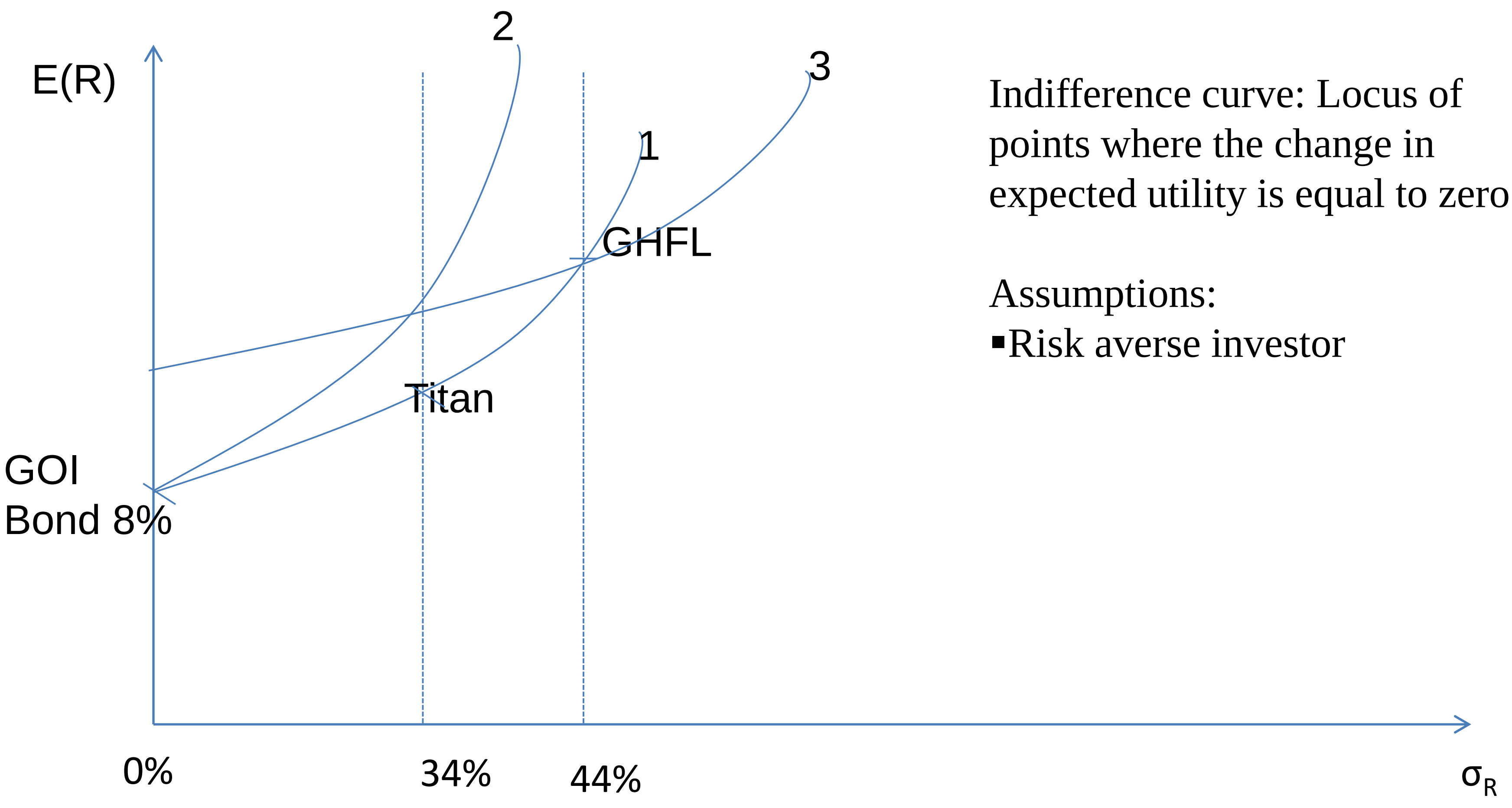

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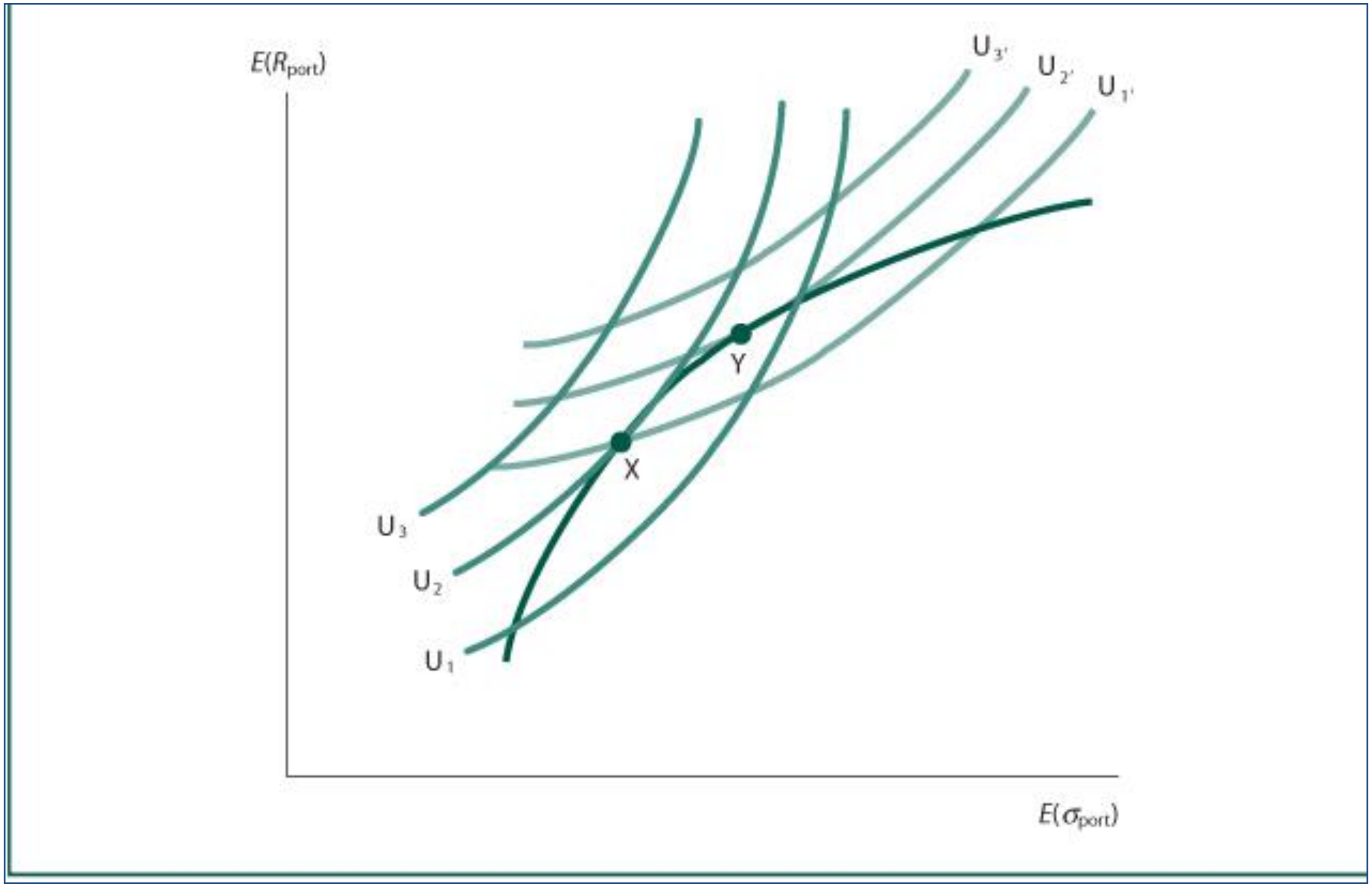
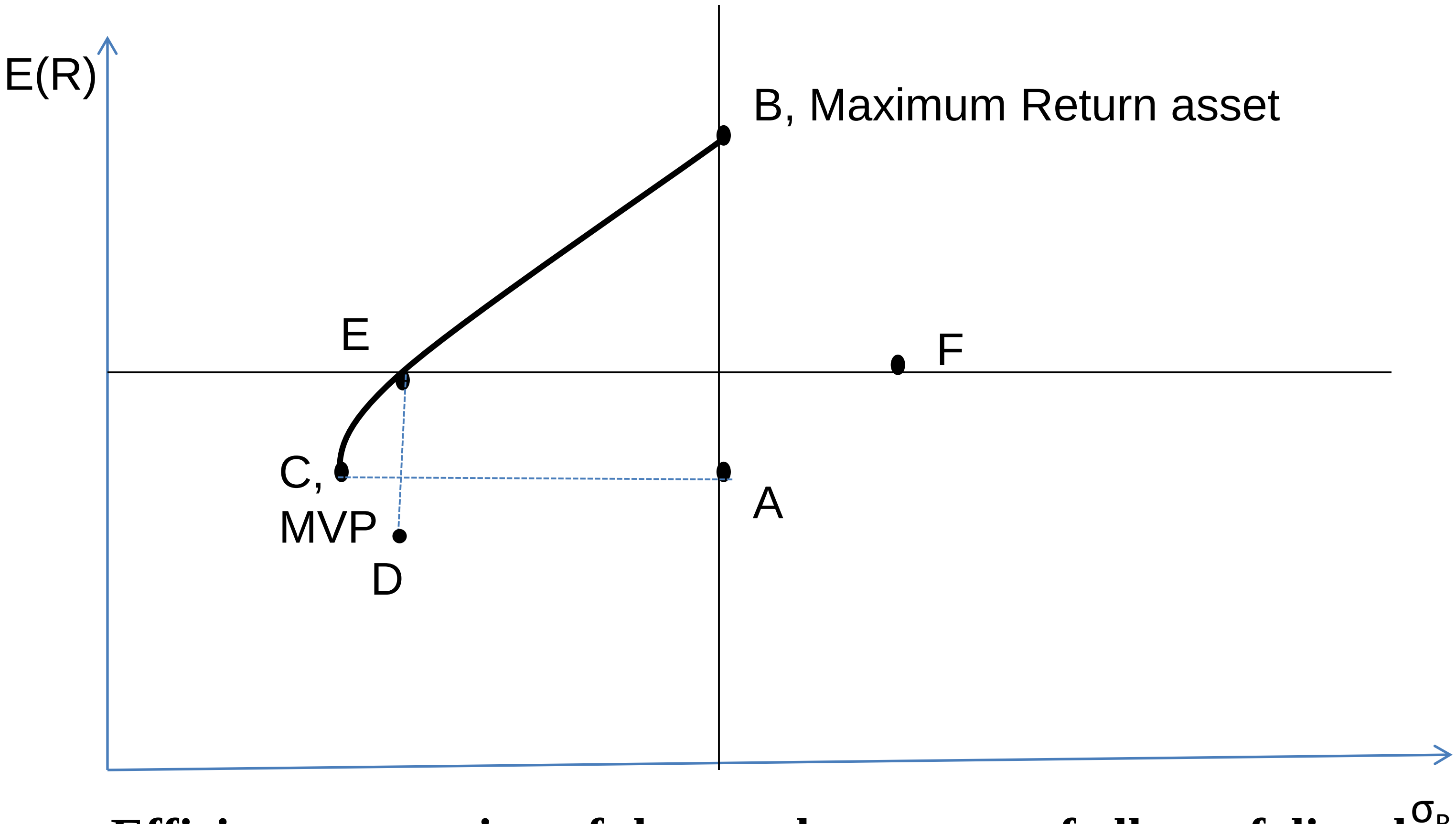


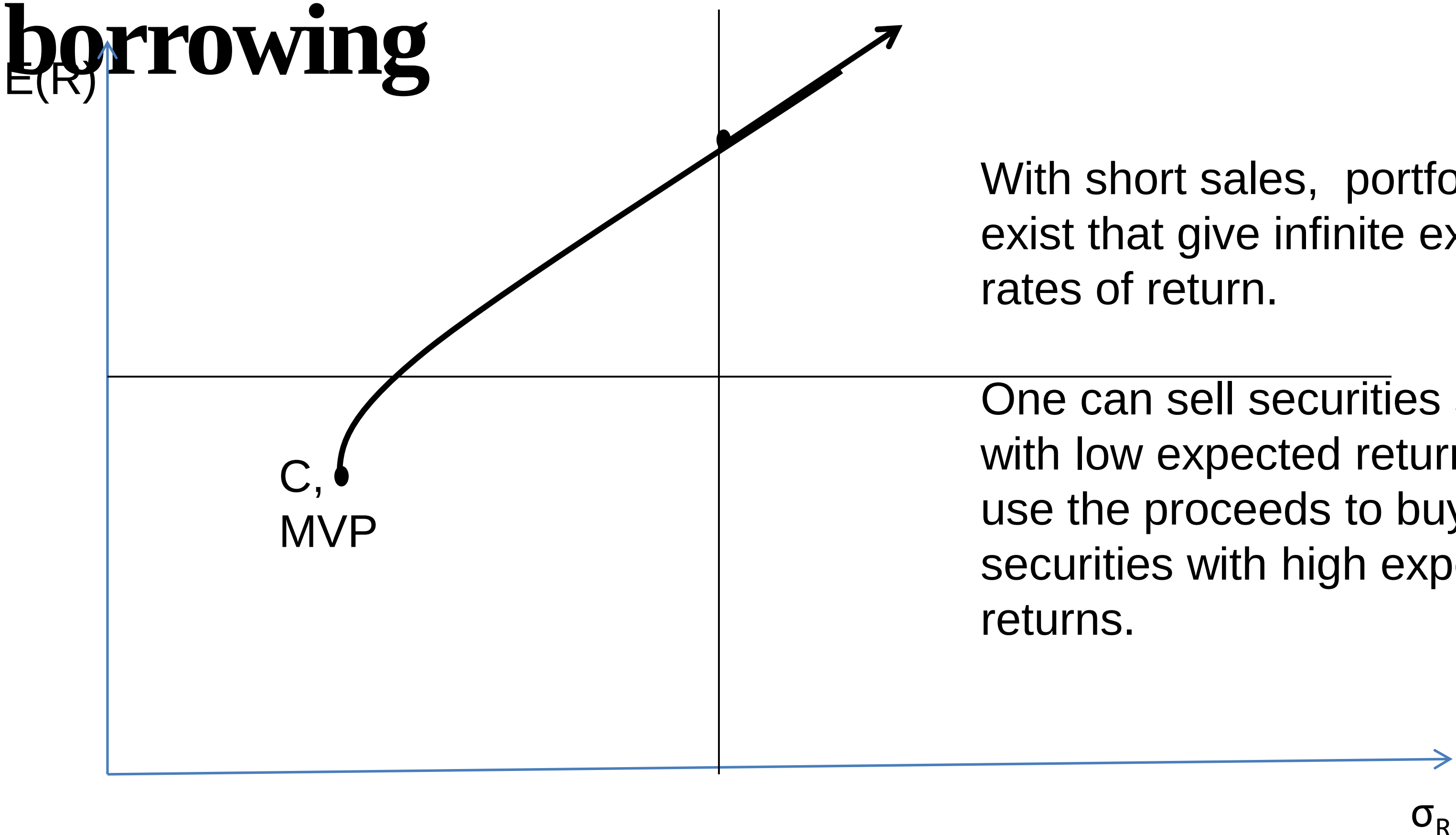
Which Investor is more risk averse?

Efficient Frontier with no short selling and no riskless lending and borrowing



Efficient set consists of the envelope curve of all portfolios that lie between the Minimum Variance portfolio and the maximum return portfolio. This set of portfolios is called Efficient Frontier (with no short selling and no riskless lending and borrowing)

Efficient Frontier with short sales allowed and no riskless lending and borrowing



With short sales, portfolios exist that give infinite expected rates of return.

One can sell securities short with low expected returns and use the proceeds to buy securities with high expected returns.

Efficient set consists of the envelope curve of all portfolios that lie between the Minimum Variance portfolio and infinity. This set of portfolios is called Efficient Frontier (with short selling and no riskless lending and borrowing)

Efficient Frontier riskless lending and borrowing

What is a riskless asset?

An asset whose return is certain and hence the standard deviation of the return is zero.

Many academics say that there is no such thing as a risk-free asset because all financial assets carry some degree of risk.

However, the level of risk is so small that, for the average investor, it is OK to assume that the return is certain.

The return on domestically held short-dated government bonds is normally perceived as a good proxy for the risk free rate – theoretically if there is no perceived risk of default associated with the bond.

Efficient Frontier with riskless lending and borrowing

Riskless lending

Investing in an asset (buying an asset) with a certain outcome/return

Riskless borrowing

Borrowing can be considered as selling the riskless security short.

Developing Efficient Frontier with riskless lending and borrowing

Assume: Investor places part of the funds in the portfolio A and either lends or borrows at riskless rate.

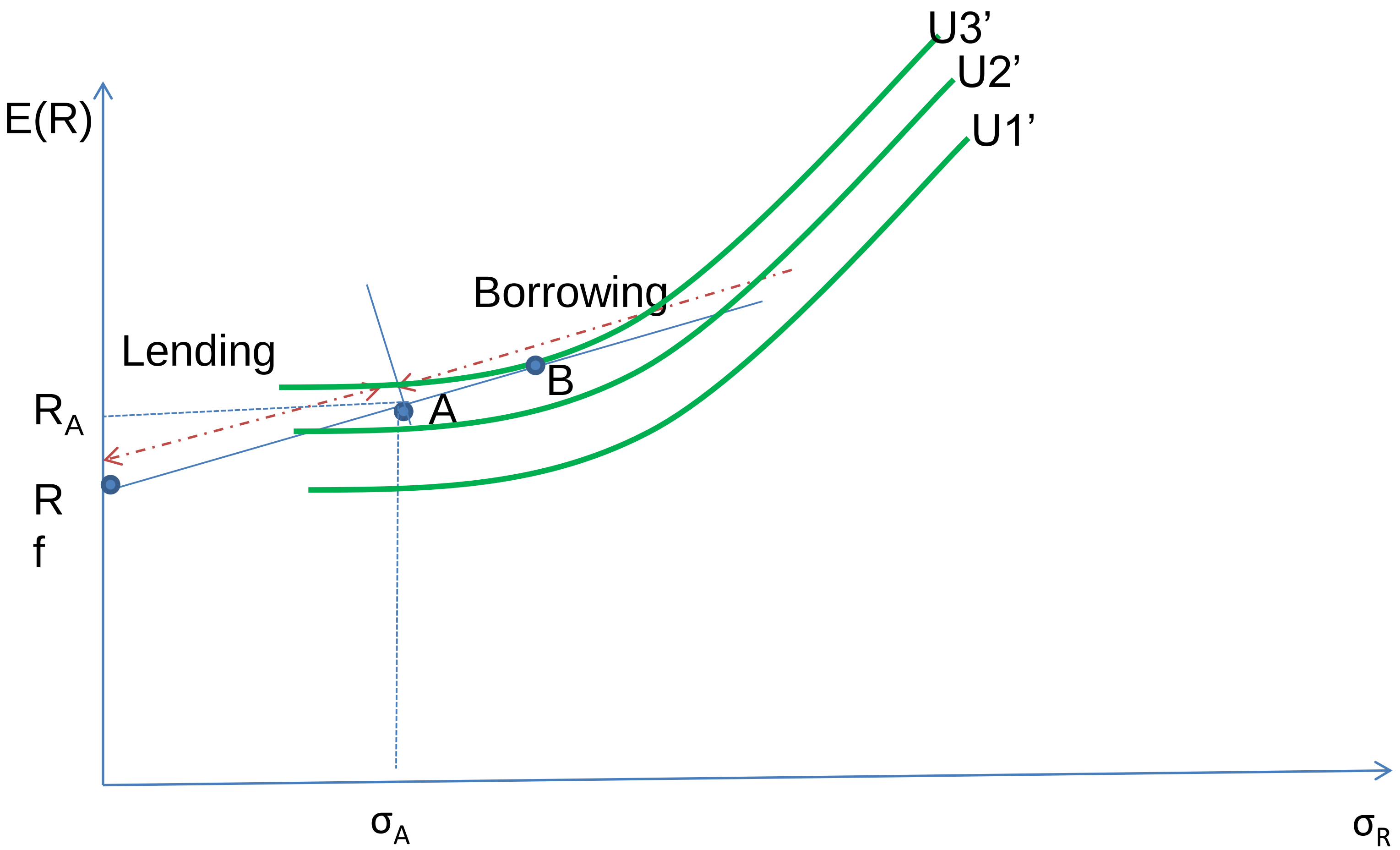
Let X be the fraction of assets placed in the portfolio A
1-X is the fraction of funds placed in the riskless asset

The Expected return on the combination of riskless asset and risky portfolio is:-

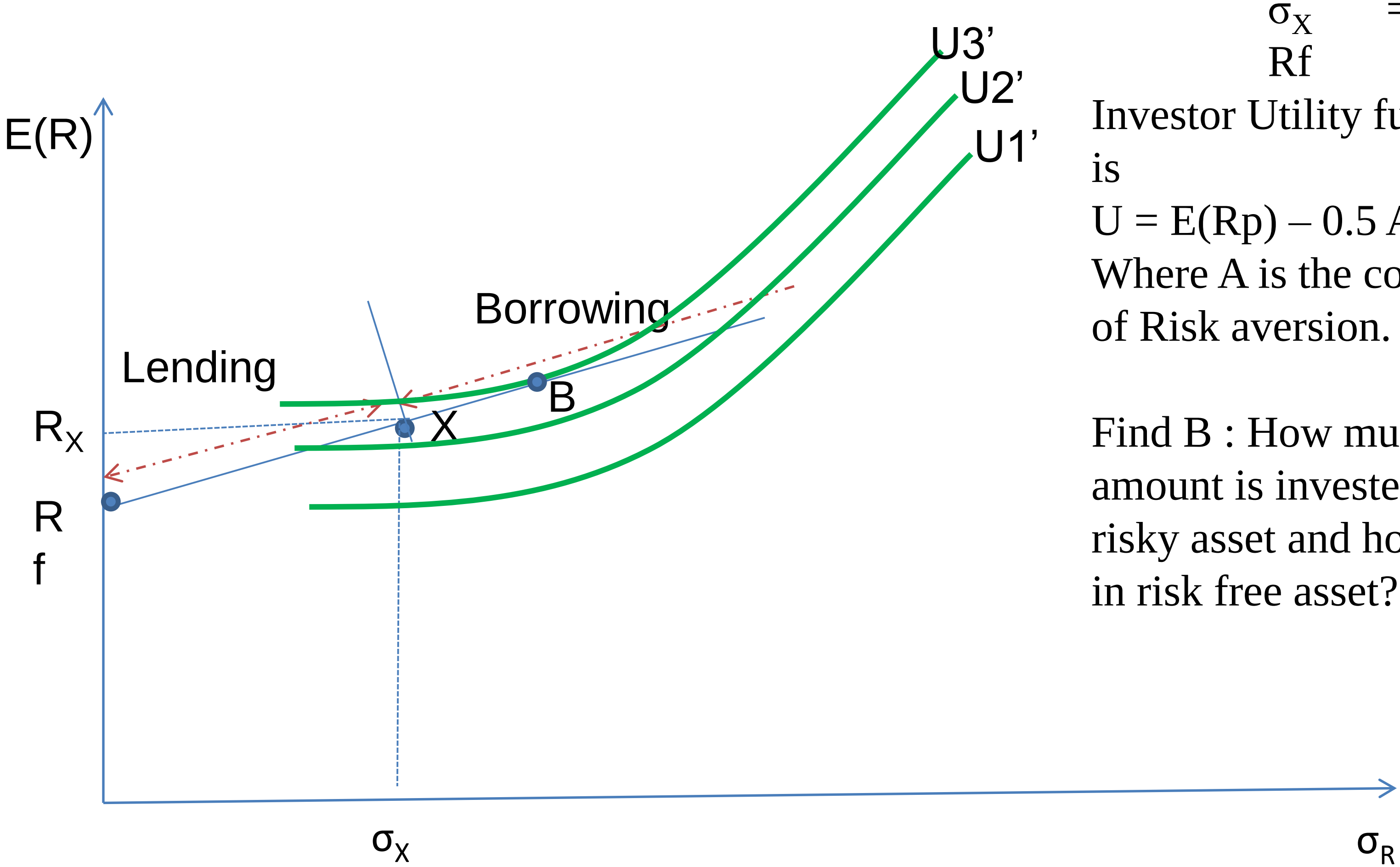
$$E(R_c) = R_f + (E(R_A) - Rf)\sigma_c / \sigma_A$$

- All combinations of riskless lending or borrowing with portfolio A lie on a straight line in expected return standard deviation space.
- This straight line is the Capital Allocation line (CAL).
- The slope of the line is Reward to Variability ratio.

Capital Allocation line



Problem 1



Given : $E(Rx) = 15\%$

$\sigma_X = 22\%$

$Rf = 7\%$

Investor Utility function is

$U = E(Rp) - 0.5\ A\ \sigma_P^2$

Where A is the coefficient of Risk aversion. A = 4.

Find B : How much amount is invested in risky asset and how much in risk free asset?

Problem 2

Assets	X	Y
Returns	0.2	0.15
σ	0.45	0.32
Cov xy	0.0475	

$U = E(Rp) - 0.5A\,\sigma_P^2$

Find portfolio T and then find how much is invested in riskless asset and portfolio T.

Thank you!

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Security Analysis & Portfolio Management (SAPM)
N asset case – Matrix calculations

Agenda

Matrix calculations

Solver

Matrix algebra for Portfolio Optimization

Matrix Algebra Representation

$$\mathbf{R} = \begin{pmatrix} R_A \\ R_B \\ R_C \end{pmatrix}, \ \mu = \begin{pmatrix} \mu_A \\ \mu_B \\ \mu_C \end{pmatrix}, \ \mathbf{1} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

$$\mathbf{x} = \begin{pmatrix} x_A \\ x_B \\ x_C \end{pmatrix}, \ \mathbf{\Sigma} = \begin{pmatrix} \sigma_A^2 & \sigma_{AB} & \sigma_{AC} \\ \sigma_{AB} & \sigma_B^2 & \sigma_{BC} \\ \sigma_{AC} & \sigma_{BC} & \sigma_C^2 \end{pmatrix}$$

Portfolio weights sum to 1

$$\mathbf{x}'\mathbf{1} = \begin{pmatrix} x_A & x_B & x_C \end{pmatrix} \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

$$= x_1 + x_2 + x_3 = 1$$

[Reference: https://faculty.washington.edu/ezivot/econ424/portfoliotheorymatrixslides.pdf](https://faculty.washington.edu/ezivot/econ424/portfoliotheorymatrixslides.pdf)

Portfolio expected return

$$\mu_{p,x} = \mathbf{x}'\mu = \begin{pmatrix} x_A & x_B & x_X \end{pmatrix} \begin{pmatrix} \mu_A \\ \mu_B \\ \mu_C \end{pmatrix}$$
$$= x_A\mu_A + x_B\mu_B + x_C\mu_C$$

Portfolio variance

$$
\begin{aligned}
\sigma^2_{p,x} &= \mathbf{x}'\Sigma\mathbf{x} \\
&= \begin{pmatrix} x_A & x_B & x_C \end{pmatrix} \begin{pmatrix} \sigma^2_A & \sigma_{AB} & \sigma_{AC} \\ \sigma_{AB} & \sigma^2_B & \sigma_{BC} \\ \sigma_{AC} & \sigma_{BC} & \sigma^2_C \end{pmatrix} \begin{pmatrix} x_A \\ x_B \\ x_C \end{pmatrix} \\
&= x^2_A\sigma^2_A + x^2_B\sigma^2_B + x^2_C\sigma^2_C \\
&+ 2x_A x_B \sigma_{AB} + 2x_A x_C \sigma_{AC} + 2x_B x_C \sigma_{BC}
\end{aligned}
$$

Portfolio distribution

$$R_{p,x} \sim N(\mu_{p,x}, \sigma^2_{p,x})$$

Derivatives of Simple Matrix Functions

Let $\mathbf{A}$ be an $n \times n$ symmetric matrix, and let $\mathbf{x}$ and $\mathbf{y}$ be an $n \times 1$ vectors. Then

$$\frac{\partial}{\underset{n\times 1}{\partial \mathbf{x}}} \mathbf{x}'\mathbf{y} = \begin{pmatrix} \frac{\partial}{\partial x_1}\mathbf{x}'\mathbf{y} \\ \vdots \\ \frac{\partial}{\partial x_n}\mathbf{x}'\mathbf{y} \end{pmatrix} = \mathbf{y}, \tag{1}$$

$$\frac{\partial}{\underset{n\times 1}{\partial \mathbf{x}}} \mathbf{x}'\mathbf{A}\mathbf{x} = \begin{pmatrix} \frac{\partial}{\partial x_1}\mathbf{x}'\mathbf{A}\mathbf{x} \\ \vdots \\ \frac{\partial}{\partial x_n}\mathbf{x}'\mathbf{A}\mathbf{x} \end{pmatrix} = 2\mathbf{A}\mathbf{x}. \tag{2}$$

Computing Global Minimum Variance Portfolio

Problem: Find the portfolio $\mathbf{m} = (m_A, m_B, m_C)'$ that solves

$$\min_{m_A, m_B, m_C} \sigma^2_{p,m} = \mathbf{m}'\Sigma\mathbf{m} \text{ s.t. } \mathbf{m}'\mathbf{1} = 1$$

1. Analytic solution using matrix algebra

2. Numerical Solution in Excel Using the Solver (see 3firmExample.xls)

Analytic solution using matrix algebra

The Lagrangian is

$$L(\mathbf{m},\lambda) = \mathbf{m}'\Sigma\mathbf{m} + \lambda(\mathbf{m}'\mathbf{1} - 1)$$

1×3 3×3 3×1 1×1 1×3 3×1 1×1

First order conditions (use matrix derivative results)

$$\underset{(3\times1)}{\mathbf{0}} = \frac{\partial L(\mathbf{m},\lambda)}{\partial \mathbf{m}} = \frac{\partial \mathbf{m}'\Sigma\mathbf{m}}{\partial \mathbf{m}} + \frac{\partial}{\partial \mathbf{m}}\lambda(\mathbf{m}'\mathbf{1} - 1) = 2\cdot\Sigma\mathbf{m} + \lambda\mathbf{1}$$

$$\underset{(1\times1)}{0} = \frac{\partial L(\mathbf{m},\lambda)}{\partial \lambda} = \frac{\partial \mathbf{m}'\Sigma\mathbf{m}}{\partial \lambda} + \frac{\partial}{\partial \lambda}\lambda(\mathbf{m}'\mathbf{1} - 1) = \mathbf{m}'\mathbf{1} - 1$$

Write FOCs in matrix form

$$\begin{pmatrix} 2\Sigma & \mathbf{1} \\ \mathbf{1}' & 0 \end{pmatrix}\begin{pmatrix} \mathbf{m} \\ \lambda \end{pmatrix} = \begin{pmatrix} \mathbf{0} \\ 1 \end{pmatrix} \begin{array}{l} 3\times1 \\ 1\times1 \end{array}.$$

The FOCs are the linear system

$$\mathbf{A}_m \mathbf{z}_m = \mathbf{b}$$

where

$$\mathbf{A}_m = \begin{pmatrix} 2\mathbf{\Sigma} & \mathbf{1} \\ \mathbf{1}' & 0 \end{pmatrix}, \; \mathbf{z}_m = \begin{pmatrix} \mathbf{m} \\ \lambda \end{pmatrix} \text{ and } \mathbf{b} = \begin{pmatrix} \mathbf{0} \\ 1 \end{pmatrix}.$$

The solution for $\mathbf{z}_m$ is

$$\mathbf{z}_m = \mathbf{A}_m^{-1}\mathbf{b}.$$

The first three elements of $\mathbf{z}_m$ are the portfolio weights $\mathbf{m} = (m_A, m_B, m_C)'$ for the global minimum variance portfolio with expected return $\mu_{p,m} = \mathbf{m}'\mu$ and variance $\sigma^2_{p,m} = \mathbf{m}'\mathbf{\Sigma}\mathbf{m}$.

Efficient Portfolios of Risky Assets: Markowitz Algorithm

Problem 1: find portfolio $\mathbf{x}$ that has the highest expected return for a given level of risk as measured by portfolio variance

$$\max_{x_A, x_B, x_C} \mu_{p,x} = \mathbf{x}'\mu \ \text{ s.t}$$
$$\sigma^2_{p,x} = \mathbf{x}'\Sigma\mathbf{x} = \sigma^0_p = \text{ target risk}$$
$$\mathbf{x}'\mathbf{1} = 1$$

Problem 2: find portfolio $\mathbf{x}$ that has the smallest risk, measured by portfolio variance, that achieves a target expected return.

$$\min_{x_A, x_B, x_C} \sigma^2_{p,x} = \mathbf{x}'\Sigma\mathbf{x} \ \text{ s.t.}$$
$$\mu_{p,x} = \mathbf{x}'\mu = \mu^0_p = \text{target return}$$
$$\mathbf{x}'\mathbf{1} = 1$$

Remark: Problem 2 is usually solved in practice by varying the target return between a given range.

Analytic solution using matrix algebra

The Lagrangian function associated with Problem 2 is

$$L(x, \lambda_1, \lambda_2) = \mathbf{x}'\Sigma\mathbf{x} + \lambda_1(\mathbf{x}'\mu - \mu_{p,0}) + \lambda_2(\mathbf{x}'\mathbf{1} - 1)$$

The FOCs are

$$\underset{(3\times1)}{\mathbf{0}} = \frac{\partial L(\mathbf{x}, \lambda_1, \lambda_2)}{\partial \mathbf{x}} = 2\Sigma\mathbf{x} + \lambda_1\mu + \lambda_2\mathbf{1},$$

$$\underset{(1\times1)}{0} = \frac{\partial L(\mathbf{x}, \lambda_1, \lambda_2)}{\partial \lambda_1} = \mathbf{x}'\mu - \mu_{p,0},$$

$$\underset{(1\times1)}{0} = \frac{\partial L(\mathbf{x}, \lambda_1, \lambda_2)}{\partial \lambda_2} = \mathbf{x}'\mathbf{1} - 1.$$

These FOCs consist of five linear equations in five unknowns

$(x_A, x_B, x_C, \lambda_1, \lambda_2)$.

We can represent the FOCs in matrix notation as

$$\begin{pmatrix} 2\boldsymbol{\Sigma} & \mu & 1 \\ \mu' & 0 & 0 \\ 1' & 0 & 0 \end{pmatrix} \begin{pmatrix} \mathbf{x} \\ \lambda_1 \\ \lambda_2 \end{pmatrix} = \begin{pmatrix} \mathbf{0} \\ \mu_{p,0} \\ 1 \end{pmatrix}$$

or

$$\mathbf{A}_x \mathbf{z}_x = \mathbf{b}_0$$

where

$$\mathbf{A}_x = \begin{pmatrix} 2\boldsymbol{\Sigma} & \mu & 1 \\ \mu' & 0 & 0 \\ 1' & 0 & 0 \end{pmatrix}, \ \mathbf{z}_x = \begin{pmatrix} \mathbf{x} \\ \lambda_1 \\ \lambda_2 \end{pmatrix} \text{ and } \mathbf{b}_0 = \begin{pmatrix} \mathbf{0} \\ \mu_{p,0} \\ 1 \end{pmatrix}$$

The solution for $\mathbf{z}_x$ is then

$$\mathbf{z}_x = \mathbf{A}_x^{-1}\mathbf{b}_0.$$

The first three elements of $\mathbf{z}_x$ are the portfolio weights $\mathbf{x} = (x_A, x_B, x_C)'$ for the efficient portfolio with expected return $\mu_{p,x} = \mu_{p,0}$.

Thanks

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Security Analysis & Portfolio Management (SAPM)
Lecture 15

Agenda

Index models

Efficient frontier using Index models

Excel exercise

Previous Midsem Question on Index model

Markowitz Mean – Variance portfolio

With n risky assets, we need $2n + (n^2 - n)/2$ parameters:

n	expected returns $E[r_j]$
n	return standard deviations σ_j
$n(n-1)/2$	correlations (or covariances)

Example

$n = 2$	number of parameters = 2	+	2	+	1	=	5
$n = 8$	number of parameters = 8	+	8	+	28	=	44
$n = 100$	number of parameters = 100	+	100	+	4950	=	5150
$n = 1000$	number of parameters = 1000	+	1000	+	499500	=	501500

With large n:

Large estimation error,
Large data requirements (for monthly estimates, with n=1000, need at least 1000 months, i.e., more than 83 years of data)

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Index Model

A Single Index Model

An Index Model is a *Statistical* model of security returns (as opposed to an economic, equilibrium-based model).

A Single Index Model (SIM) specifies two sources of uncertainty for a security's return:

1. *Systematic* (macroeconomic) uncertainty (which is *assumed* to be well represented by a single index of stock returns)

2. *Unique* (microeconomic) uncertainty (which is represented by a security-specific random component)

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Index Model

Formalizing the Basic Idea: The Return Generating Model

Can always write the return of asset j as related linearly to a single common underlying factor (typically chosen to be a stock index):

$$r_j = \alpha_j + \beta_j\, r_I + e_j$$

where

r_I is the *random* return on the index (the common factor),

e_j is the *random* firm-specific component of the return, where $E[e_j] = 0$, $Cov[e_j, r_I] = 0$,

α_j is the expected return if $E[r_I]=0$ (when the index is neutral),

β_j is the sensitivity of r_j to r_I, $\beta_j = Cov[r_j, r_I]/Var[r_I]$.

Also, *assume* (and this is the only, but crucial assumption) that:

$$Cov[e_j, e_i] = 0.$$

So, $\alpha_j + e_j$ is the return part independent of the index return,

$\beta_j\, r_I$ is the return part due to index fluctuations.

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Index model equations

Expressing the First and Second Moments using the Model's Components

1. Mean return of security j: $E[r_j] = \alpha_j + \beta_j E[r_I]$

2. Variance of security j: $\sigma_j^2 = \beta_j^2 \sigma_I^2 + \sigma^2[e_j]$

3. Covariance between return of security j and return of security i

$$\sigma_{ji} = \beta_j \beta_i \sigma_I^2$$

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Market model (eg. of Index model)

Typically, the chosen index is a "Market Index"

You need to choose an index so that e_j and e_i are *indeed uncorrelated* for any two assets.

It "makes sense" to choose the entire stock market (a value-weighted portfolio) as a proxy to capture all macroeconomic fluctuations.

In practice, take a portfolio, i.e., index, which proxies for the market. A popular choice is for the S&P500 index to be the index in the SIM.

Then, the model states that

$$r_j = \alpha_j + \beta_j r_M + e_j$$

where r_M is the *random* return on the market proxy.
This SIM is often referred to as the "Market Model."

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Benefit over Markowitz model

Assuming the SIM is correctly specified, we only need the following parameters:

n	α_j parameters
n	β_j parameters
n	$\sigma^2[e_j]$ parameters
1	$E[r_I]$
1	$\sigma^2\,[r_I]$

These $3n$+2 parameters generate all the $E[r_j]$, σ_j, and σ_{ji}.
We get the parameters by estimating the index model for each of the n securities.

Example

With 100 stocks need 302 parameters. With 1000 need 3002.

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Lecture Notes 8

Index Models

Buzz Words: ***Return Generating Model,***
Zero Correlation Component of Securities Returns,
Statistical Decomposition of Systematic and Nonsystematic Risks,
Regression, Security Characteristic Line,
Historical (Raw and Adjusted) Beta.

I. Readings and Suggested Practice Problems

BKM, Chapter 10, Section 1 (Skim Section 4)
Suggested Problems, Chapter 10: 5-13

II. A Single Index Model

An Index Model is a *Statistical* model of security returns (as opposed to an economic, equilibrium-based model).

A Single Index Model (SIM) specifies two sources of uncertainty for a security's return:

1. *Systematic* (macroeconomic) uncertainty (which is *assumed* to be well represented by a single index of stock returns)

2. *Unique* (microeconomic) uncertainty (which is represented by a security-specific random component)

A. Model's Components

1. The Basic Idea

A Casual Observation**:** Stocks tend to move together, driven by the same economic forces.

Based on this observation, as an ad-hoc approach to represent securities' returns, we can model the way returns are generated by a simple equation.

2. *Formalizing the Basic Idea: The Return Generating Model*

Can always write the return of asset *j* as related linearly to a single common underlying factor (typically chosen to be a stock index):

$$r_j = \alpha_j + \beta_j r_I + e_j$$

where

r_I is the *random* return on the index (the common factor),
e_j is the *random* firm-specific component of the return, where $E[e_j] = 0$, $Cov[e_j, r_I] = 0$,
α_j is the expected return if $E[r_I]=0$ (when the index is neutral),
β_j is the sensitivity of r_j to r_I , $\beta_j = Cov[r_j, r_I]/Var[r_I]$.

Also, *assume* (and this is the only, but crucial assumption) that:

$$Cov[e_j, e_i] = 0.$$

So, $\alpha_j + e_j$ is the return part independent of the index return,
$\beta_j r_I$ is the return part due to index fluctuations.

B. Expressing the First and Second Moments using the Model's Components

1. Mean return of security *j*: $E[r_j] = \alpha_j + \beta_j E[r_I]$

2. Variance of security *j*: $\sigma_j^2 = \beta_j^2 \sigma_I^2 + \sigma^2[e_j]$

3. Covariance between return of security *j* and return of security *i*

$$\sigma_{ji} = \beta_j \beta_i \sigma_I^2$$

C. Systematic & Unique Risk of an Asset according to the SIM

1. ***Expected Return,*** $E[r_j] = \alpha_j + \beta_j E[r_I]$, ***has 2 parts*:**

a. Unique (asset specific): α_j
b. Systematic (index driven): $\beta_j E[r_I]$

2. ***Variance,*** $\sigma_j^2 = \beta_j^2 \sigma_I^2 + \sigma^2[e_j]$, ***has similarly 2 parts*:**

a. Unique risk (asset specific): $\sigma^2[e_j]$
b. Systematic risk (index driven): $\beta_j^2 \sigma_I^2$

3. ***Covariance between securities' returns is due to only the systematic source of risk*:**

$$\begin{aligned}\mathrm{Cov}[r_j, r_i] &= \mathrm{Cov}[\alpha_j + \beta_j r_I + e_j, \alpha_i + \beta_i r_I + e_i] \\ &= \mathrm{Cov}[\beta_j r_I, \beta_i r_I] = \beta_j \beta_i \mathrm{Cov}[r_I, r_I] \\ &= \beta_j \beta_i \sigma_I^2\end{aligned}$$

Covariance ($\beta_j \beta_i \sigma_I^2$) depends (by assumption) only on single-index risk and sensitivities of returns to that single index.

D. Typically, the chosen index is a "Market Index"

You need to choose an index so that e_j and e_i are *indeed uncorrelated* for any two assets.

It "makes sense" to choose the entire stock market (a value-weighted portfolio) as a proxy to capture all macroeconomic fluctuations.

In practice, take a portfolio, i.e., index, which proxies for the market. A popular choice is for the S&P500 index to be the index in the SIM.

Then, the model states that

$$r_j = \alpha_j + \beta_j\, r_M + e_j$$

where r_M is the *random* return on the market proxy.
This SIM is often referred to as the "Market Model."

Example

You choose the S&P500 as your market proxy. You analyze the stock of General Electric (GE), and find (see later in the notes) that, using weekly returns, α_j = -0.07%, β_j = 1.44.

If you expect the S&P500 to increase by 5% next week, then according to the market model, you expect the return on GE next week to be:

$$\mathrm{E}[r_{GE}] = \alpha_{GE} + \beta_{GE}\,\mathrm{E}[r_M] = -0.07\% + 1.44 \times 5\% = 7.13\%.$$

III. Why the Single Index Model is Useful?

A. The SIM Provides the Most Simple Tool to Quantify the Forces Driving Assets' Returns

This is what we discussed above.

However, note that the SIM does not fully characterize the determinants of *expected* returns -- we don't know how α_j varies across assets.

Also, remember that the SIM assumes that the correlation structure across assets depends on a single factor (but more factors may be needed in practice).

B. The SIM Helps us to Derive the Optimal Portfolio for Asset Allocation (the Tangent Portfolio T) by Reducing the Necessary Inputs to the Markowitz Portfolio Selection Procedure

We identified the portfolio P, used for the asset allocation, with the tangency portfolio T.

To compute the weights of T , we need to describe all the risky assets in the portfolio selection model. This requires a large number of parameters.

Usually these parameters are unknown, and have to be estimated.

1. With n risky assets, we need $2n + (n^2 - n)/2$ parameters:

n	expected returns $E[r_j]$
n	return standard deviations σ_j
$n(n-1)/2$	correlations (or covariances)

Example

$n = 2$	number of parameters =	2	+ 2	+	1	=	5
$n = 8$	number of parameters =	8	+ 8	+	28	=	44
$n = 100$	number of parameters =	100	+ 100	+	4950	=	5150
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With large n:

Large estimation error,

Large data requirements (for monthly estimates, with n=1000, need at least 1000 months, i.e., more than 83 years of data)

2. Assuming the SIM is correctly specified, we only need the following parameters:

n	α_j parameters
n	β_j parameters
n	$\sigma^2[e_j]$ parameters
1	$E[r_I]$
1	$\sigma^2\,[r_I]$

These $3n$+2 parameters generate all the $E[r_j]$, σ_j, and σ_{ji}. We get the parameters by estimating the index model for each of the n securities.

Example

With 100 stocks need 302 parameters. With 1000 need 3002.

IV. A Detailed Example

A. SIM for GE

How is the return on an individual stock (GE) driven by the return on an overall market index, *M*, measured by the S&P500 index?

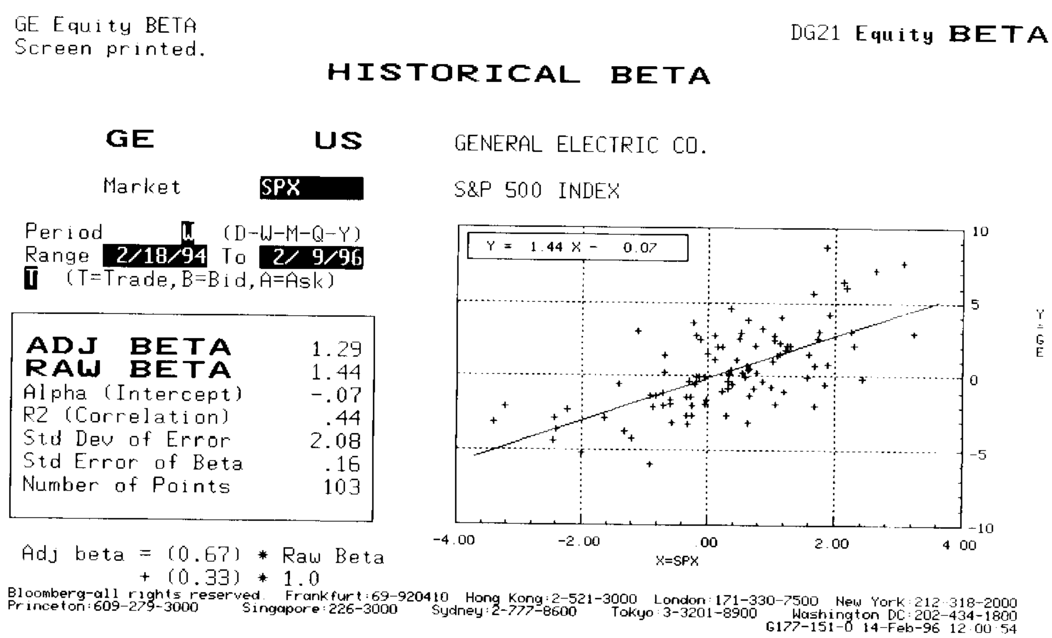
To answer this:

- Collect historical data on r_{GE} and r_M
- Run a simple linear regression of r_{GE} against r_M:

$$r_{GE} = \alpha_{GE} + \beta_{GE}\, r_M + e_{GE}$$

where α_{GE} ("alpha") is the intercept,
β_{GE} ("beta") is the slope,
e_{GE} is the regression error.

The fitted regression line is called the ***Security Characteristic Line*** (SCL).



B. Using the SIM to Interpret the Risk of Investing in GE

The variance of GE is $\sigma_{GE}^2 = \beta_{GE}^2 \sigma_M^2 + \sigma^2[e_{GE}]$
Where $\sigma[e_{GE}]$ is the "Std. Dev. Of Error."

Over the sample, $\sigma_M = 1.28\%$ (from other data):

$$\sigma_{GE}^2 = \beta_{GE}^2 \sigma_M^2 + \sigma^2[e_{GE}]$$
$$= (1.44)^2 (1.28)^2 + (2.08)^2 = 3.40 + 4.33 = 7.73$$

$$R^2 = \frac{\beta_{GE}^2 \sigma_M^2}{\sigma_{GE}^2} = \frac{3.40}{7.73} = .44$$

R^2 is called ***the coefficient of determination***, and it gives the fraction of the variance of the dependent variable (the return on GE) that is explained by movements in the independent variable (the return on the Market portfolio).

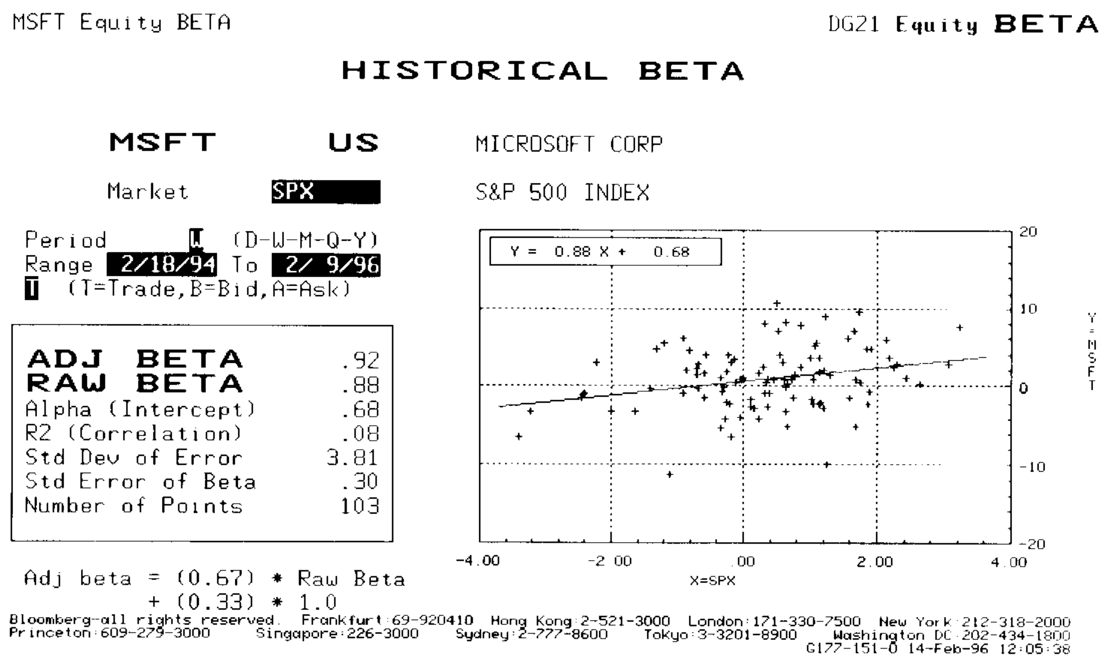
Note that for portfolios, the coefficient of determination from a regression estimation can be used as a measure of diversification (0 min, 1 max).

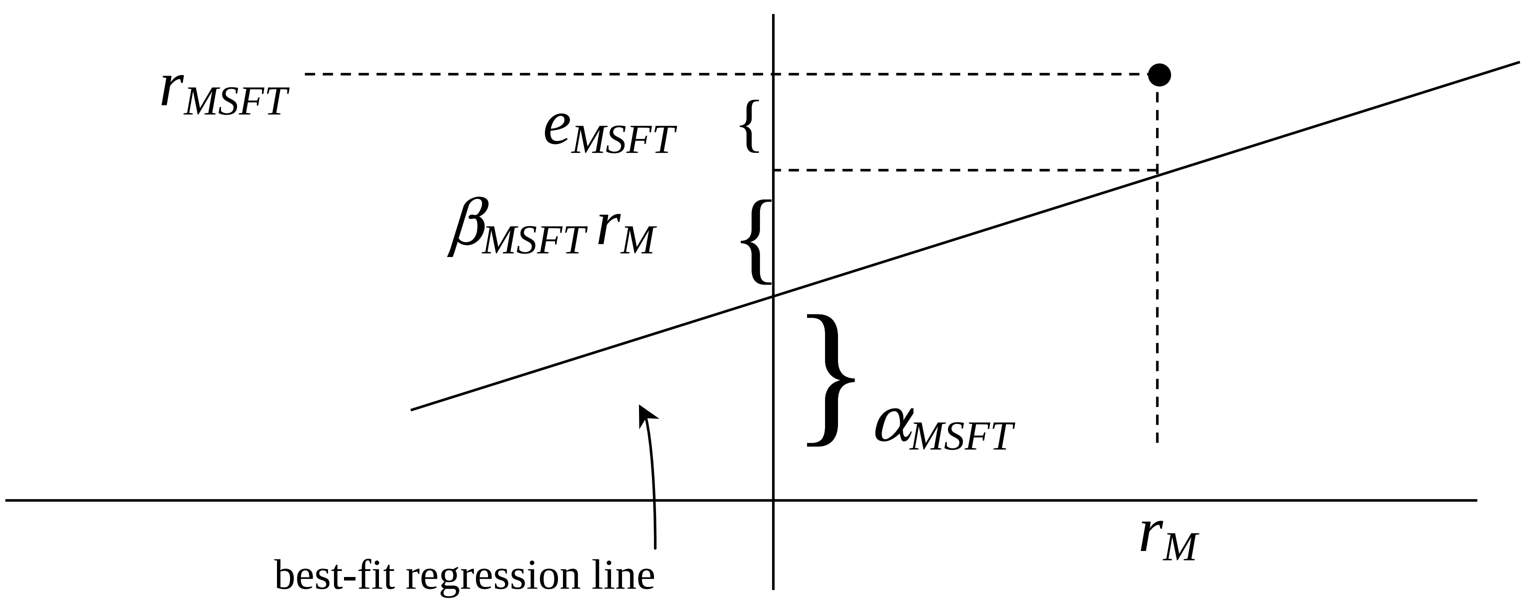
$$r_{GE} = \underbrace{\alpha_{GE}}_{\text{constant}} + \underbrace{\beta_{GE}\, r_M}_{\substack{\text{market-driven,}\\ \text{systematic}}} + \underbrace{e_{GE}}_{\substack{\text{non-market,}\\ \text{firm-specific}}}$$

$$\underbrace{\sigma_{GE}^2}_{\text{Total "risk"}} = \underbrace{\beta_{GE}^2 \sigma_M^2}_{\substack{\text{Market or}\\ \text{systematic risk}}} + \underbrace{\sigma^2(e_{GE})}_{\substack{\text{Non-market,}\\ \text{firm-specific risk}}}$$

$$\underbrace{7.73}_{\text{Total "risk"}} = \underbrace{3.40}_{\substack{\text{Market or}\\ \text{systematic risk}}} + \underbrace{4.33}_{\substack{\text{Non-market,}\\ \text{firm-specific risk}}}$$

C. SIM for Microsoft





$$\text{Over the sample,} \sigma_M = 1.28\% \text{ (from other data)}$$

$$\sigma^2_{MSFT} = \beta^2_{MSFT}\sigma^2_M + \sigma^2(e_{MSFT})$$

$$= (0.88)^2(1.28)^2 + (3.81)^2$$

$$= 1.27 + 14.52 = 15.79$$

$$R^2 = \frac{\beta^2_{MSFT}\sigma^2_M}{\sigma^2_{MSFT}} = \frac{1.27}{15.79} = 0.08$$

Unlike GE, firm-specific risk dominates for MSFT (which is indeed more single-industry focused than GE).

D. The SIM and the Covariance between r_{GE} and r_{MSFT}

$$r_{GE} = \alpha_{GE} + \beta_{GE} r_M + e_{GE}$$

constant

firm-specific

$$r_{MSFT} = \alpha_{MSFT} + \beta_{MSFT} r_M + e_{MSFT}$$

The *only common influence* driving GE and MSFT is the market return r_M, so can easily calculate the covariance and correlation:

$$Cov(r_{GE}, r_{MSFT}) = \beta_{GE}\beta_{MSFT}\sigma^2_M = (.88)(1.44)(1.28)^2 = 2.08$$

$$Corr(r_{GE}, r_{MSFT}) = 2.08/\sqrt{7.33 \times 15.79} = 0.19$$

E. More Realistic Models

A more realistic model than the SIM, should allow the systematic risk to be driven by *several* factors.

We assume that more than one common factor affect securities' returns, and try to identify the "macro-non-market" forces that cause all stocks (or large groups of stocks) to move together.

For example, a ***two-factor*** model may account for interest-rate effects in addition to market effects:

$$r_j = \alpha_j + \beta_{jM}\, r_M + \beta_{jIR}\, r_{IR} + e_j$$

where r_M is a return on a market index, and
r_{IR} is a return on a portfolio of bonds.

Clearly, such models will better capture the correlation between GE and MSFT (but in our course we focus only on the basic single index model, and you should only remember that multi-index models exist as well).

V. Two Approaches for Specifying Index Models

We often use the index model given in these notes:

$$(*) \quad r_{GM} = \alpha_{GM} + \beta_{GM} r_M + e_{GM}$$

A common variation is the "excess return" form of the model:

$$(**) \quad r_{GM} - r_f = \alpha_{GM} + \beta_{GM}\left(r_M - r_f\right) + e_{GM}$$

or,

$$R_{GM} = \alpha_{GM} + \beta_{GM} R_M + e_{GM}$$

where $R_{GM} = r_{GM} - r_f$ and $R_M = r_M - r_f$

- BKM use the "excess return" form.
- Note: the α's are not the same in (*) and (**), and β's are not the same in (*) and (**) if r_f varies over time.

Unless stated otherwise, in all the problems in this course we will assume a constant, non-random riskfree rate, r_f , and then the β's above are the same in the raw return form as in (*) and the excess return form as in (**). The α's then differ just by a constant: $\alpha^{(*)}=\alpha^{(**)}+r_f(1-\beta)$

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Security Analysis & Portfolio Management (SAPM)
Lecture 15

Agenda

Index models

Efficient frontier using Index models

Excel exercise

Previous Midsem Question on Index model

Markowitz Mean – Variance portfolio

With n risky assets, we need $2n + (n^2 - n)/2$ parameters:

n	expected returns $E[r_j]$
n	return standard deviations σ_j
$n(n-1)/2$	correlations (or covariances)

Example

$n = 2$	number of parameters =	2	+	2	+	1	=	5
$n = 8$	number of parameters =	8	+	8	+	28	=	44
$n = 100$	number of parameters =	100	+	100	+	4950	=	5150
$n = 1000$	number of parameters =	1000	+	1000	+	499500	=	501500

With large n:

Large estimation error,

Large data requirements (for monthly estimates, with n=1000, need at least 1000 months, i.e., more than 83 years of data)

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Index Model

A Single Index Model

An Index Model is a *Statistical* model of security returns (as opposed to an economic, equilibrium-based model).

A Single Index Model (SIM) specifies two sources of uncertainty for a security's return:

1. *Systematic* (macroeconomic) uncertainty (which is *assumed* to be well represented by a single index of stock returns)

2. *Unique* (microeconomic) uncertainty (which is represented by a security-specific random component)

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Index Model

Formalizing the Basic Idea: The Return Generating Model

Can always write the return of asset j as related linearly to a single common underlying factor (typically chosen to be a stock index):

$$r_j = \alpha_j + \beta_j \, r_I + e_j$$

where

r_I is the *random* return on the index (the common factor),
e_j is the *random* firm-specific component of the return, where $E[e_j] = 0$, $Cov[e_j, r_I] = 0$,
α_j is the expected return if $E[r_I]=0$ (when the index is neutral),
β_j is the sensitivity of r_j to r_I, $\beta_j=Cov[r_j, r_I]/Var[r_I]$.

Also, *assume* (and this is the only, but crucial assumption) that:

$$Cov[e_j, e_i] = 0.$$

So, $\alpha_j + e_j$ is the return part independent of the index return,
$\beta_j \, r_I$ is the return part due to index fluctuations.

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Index model equations

Expressing the First and Second Moments using the Model's Components

1. Mean return of security j: $E[r_j] = \alpha_j + \beta_j E[r_I]$

2. Variance of security j: $\sigma_j^2 = \beta_j^2 \sigma_I^2 + \sigma^2[e_j]$

3. Covariance between return of security j and return of security i

$$\sigma_{ji} = \beta_j \beta_i \sigma_I^2$$

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Market model (eg. of Index model)

Typically, the chosen index is a "Market Index"

You need to choose an index so that e_j and e_i are *indeed uncorrelated* for any two assets.

It "makes sense" to choose the entire stock market (a value-weighted portfolio) as a proxy to capture all macroeconomic fluctuations.

In practice, take a portfolio, i.e., index, which proxies for the market. A popular choice is for the S&P500 index to be the index in the SIM.

Then, the model states that

$$r_j = \alpha_j + \beta_j r_M + e_j$$

where r_M is the *random* return on the market proxy. This SIM is often referred to as the "Market Model."

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Benefit over Markowitz model

Assuming the SIM is correctly specified, we only need the following parameters:

n	α_j parameters
n	β_j parameters
n	$\sigma^2[e_j]$ parameters
1	$\mathrm{E}[r_I]$
1	$\sigma^2\ [r_I]$

These $3n+2$ parameters generate all the $\mathrm{E}[r_j]$, σ_j, and σ_{ji}.
We get the parameters by estimating the index model for each of the n securities.

Example
With 100 stocks need 302 parameters. With 1000 need 3002.

Reference material: Foundations of Finance: Index models by Prof. Alex Shapiro
http://people.stern.nyu.edu/ashapiro/courses/B01.231103/FFL08.pdf

Multi-Factor model

2-factor model to calculate the estimates by running a multivariate regression.

$$Ri = \alpha i + \boldsymbol{\beta} i1\, \boldsymbol{F}1 + \boldsymbol{\beta} i2\, \boldsymbol{F}2 + ei$$

Following are the general equations related to the 2-factor model

Var(*Ri*) = ($\boldsymbol{\beta} i1$)^2 var(*F1*) + ($\boldsymbol{\beta} i2$)^2 var(*F2*) + 2 $\boldsymbol{\beta} i1 * \boldsymbol{\beta} i2 * cov(F1, F2)$ + var(*ei*)

E(Ri) = $\alpha i + \boldsymbol{\beta} i1\, E(\boldsymbol{F}1) + \boldsymbol{\beta} i2\, E(\boldsymbol{F}2) + E(ei)$

Cov(*Ri,Rj*) = $\boldsymbol{\beta} i1\, \boldsymbol{\beta} j1 var(F1) + \boldsymbol{\beta} i2\, \boldsymbol{\beta} j2 var(F2) +$

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Security Analysis & Portfolio Management (SAPM)
Lecture 16

Agenda

CAPM

CAPM : Capital Asset Pricing model

Main assumptions of Capital Market Theory

In addition to assumptions for Markowitz Portfolio model, additional assumptions are:-

- All investors are Markowitz efficient investors who seek to invest in tangent points on the efficient frontier. Exact location (specific portfolio selected) depends on the risk-return utility function of the investor.
- Investors can borrow or lend any amount of money at the risk-free rate of return (RFR)
- All investors have homogeneous expectations; that is, they estimate identical probability distributions for future rates of return
- All investors have the same one-period time horizon such as one-month, six months, or one year

Main assumptions of Capital Market Theory contd.

- All investments are infinitely divisible, which means that it is possible to buy or sell fractional shares of any asset or portfolio .

- There are no taxes or transaction costs involved in buying or selling assets.

- There is no inflation or any change in interest rates, or inflation is fully anticipated.

- Capital markets are in equilibrium, implying that all investments are properly priced in line with their risk levels.

Development of Capital Market theory

The major factor that allowed portfolio theory to develop into capital market theory is the concept of a risk-free asset

- An asset with zero standard deviation
- Zero correlation with all other risky assets
- Provides the risk-free rate of return (Rf)
- Will lie on the vertical axis of a portfolio graph
- William Sharpe (1964) received a Nobel prize for it

Capital Market line

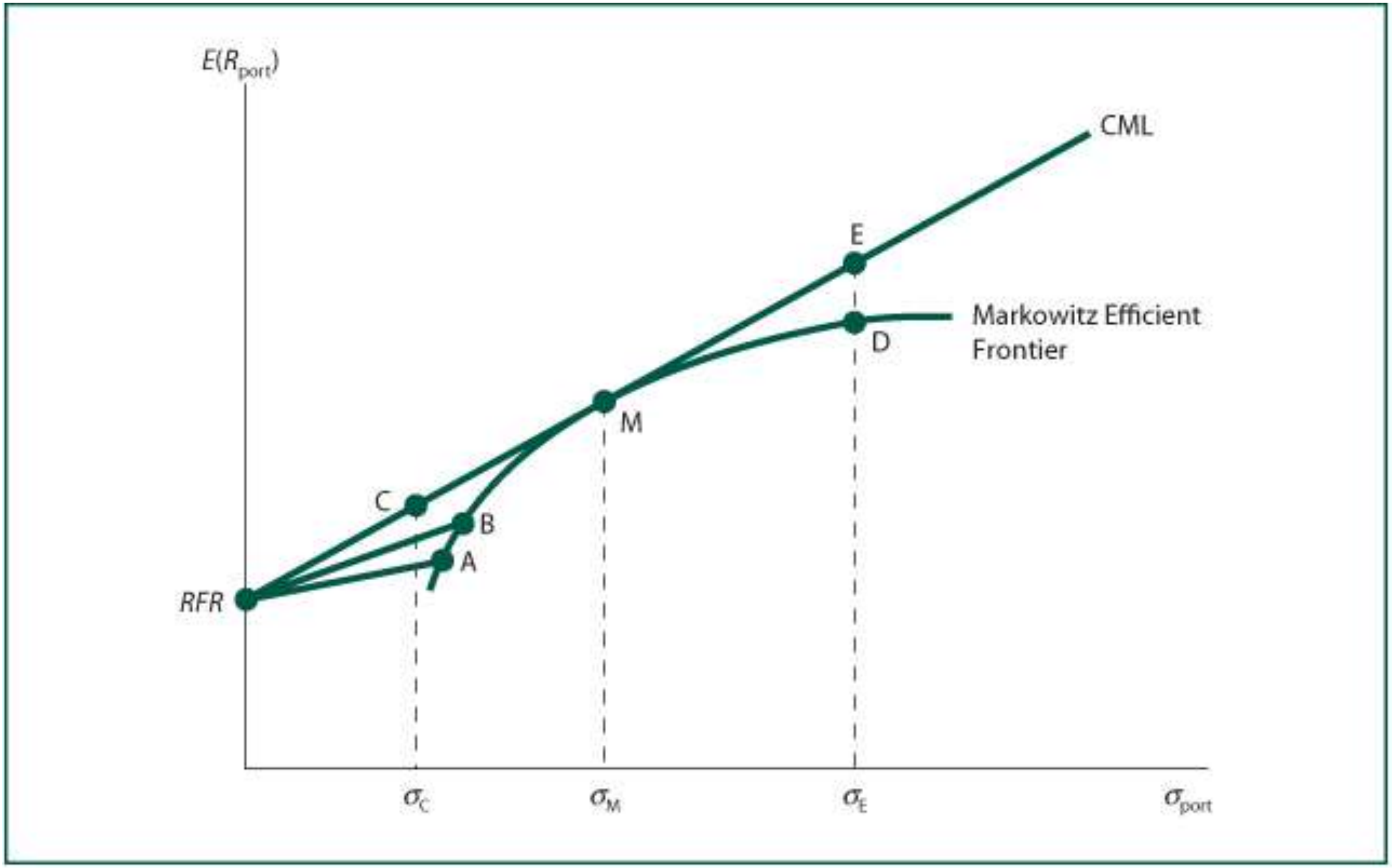
Combining a Risk-Free Asset with a Risky Portfolio, M we get :-

$$E(R_{\text{port}}) = Rf + \sigma_{port}\left[\frac{E(R_{\text{M}}) - Rf}{\sigma_M}\right]$$

- This relationship holds for every combination of the risk-free asset with *any* collection of risky assets.

- However, when the risky portfolio, M, is the market portfolio containing all risky assets held anywhere in the marketplace, this linear relationship is called the **Capital Market Line**

Capital Market line



The Market portfolio M

➢Portfolio M lies at the point of tangency, it has the highest portfolio possibility line (CAL with maximum slope)

➢Everybody will want to invest in Portfolio M and borrow or lend to be somewhere on the CML

➢It must include ALL RISKY ASSETS

➢Since the market is in equilibrium, all assets in this portfolio are in proportion to their market values

➢Because it contains all risky assets, it is a completely diversified portfolio, which means that all the unique risk of individual assets (unsystematic risk) is diversified away

➢ Any portfolio which has achieved complete diversification will have all unsystematic risk or unique risk eliminated and would correlate perfectly with the market portfolio

Systematic Risk

- Systematic risk is the variability in all risky assets caused by macroeconomic variables
  - Variability in growth of money supply
  - Interest rate volatility
  - Variability in factors like (1) industrial production (2) corporate earnings (3) cash flow
- Systematic risk can be measured by the standard deviation of returns of the market portfolio and can change over time whenever there are changes in the underlying economic forces affecting valuation of risky assets
- Only systematic risk remains in the market portfolio

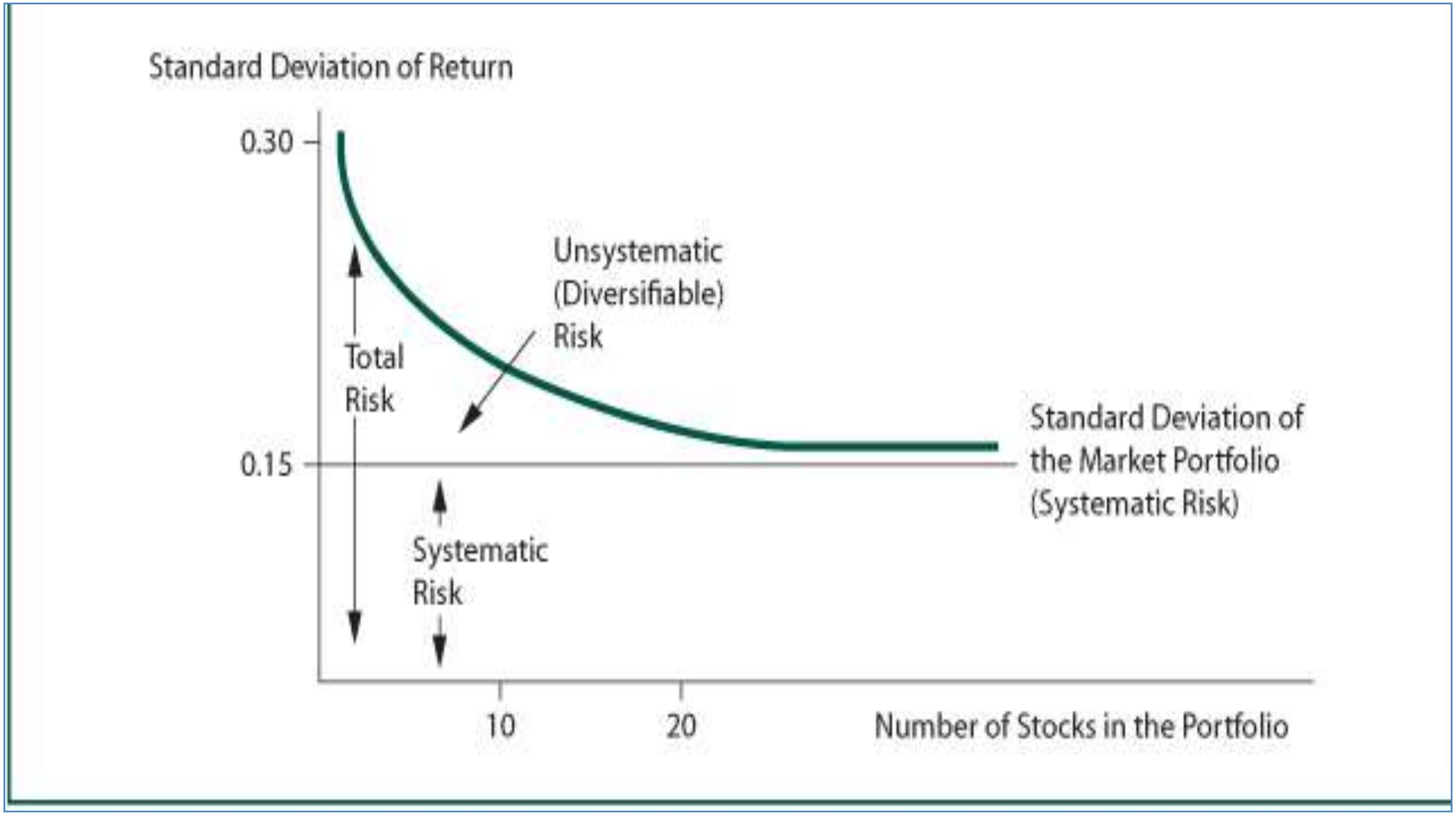
Diversification and elimination of Unsystematic risk

- The purpose of diversification is to reduce the standard deviation of the total portfolio

- As you add securities, you expect the average covariance for the portfolio to decline

- How many securities must we add to obtain a completely diversified portfolio?

Diversification and elimination of Unsystematic Risk



CML and Separation theorem

- The CML leads all investors to invest in the M portfolio

- Individual investors should differ in position on the CML depending on risk preferences – utility curve

- How an investor gets to a point on the CML is based on financing decisions

- Risk averse investors will lend at the risk-free rate while investors preferring relatively more risk might borrow funds at the Rf and invest in the market portfolio
- The investment decision of choosing the point on CML is separate from the financing decision of reaching there through either lending or borrowing

Investing in Market portfolio – Investment decision. Based on utility (indifference curve) investors make separate financing decision (borrow or lend at risk free rate)

Risk measure of CML

- The Markowitz portfolio model considers the average covariance with all other assets

- The only important consideration is the asset's covariance with the market portfolio (all risky assets in portfolio M)

- Individual risky assets are part of Market portfolio,

  $R_{it} = a_i + b_i R_{Mt} + \varepsilon$

  Variance of a risky asset i

  $$Var(R_{it}) = Var(b_i R_{Mt}) + Var(\varepsilon)$$

  =Systematic Variance + Unsystematic Variance

  where b_i = slope coefficient for asset *i*

  ε = random error term

Investing with CML - Example

Suppose you have a riskless security at 4% and a market portfolio with a return of 9% and a standard deviation of 10%. How should you go about investing your money so that your investment will have a risk level of 15%?

Investing with CML - Example

- Portfolio Return

  $$E(R_{port})=RFR+\sigma_{port}[(E(R_M)-RFR)/\sigma_M)$$

  $$=4\%+15\%[(9\%-4\%)/10\%]=11.5\%$$

- Money invested in riskless security, w_{RF}

  $$11.5\% = w_{RF}\,(4\%) + (1-w_{RF}\,)(9\%) \text{ ----> } w_{RF} = -0.5$$

- The investment strategy is to borrow 50% and invest 150% of equity in the market portfolio

CAPM – Capital Asset Pricing Model – Conceptual development

- The existence of a risk-free asset resulted in deriving a capital market line (CML) that became the relevant frontier

- However, CML cannot be used to measure the expected return on an individual asset – contains unique risk

- For individual asset (or any portfolio), the relevant risk measure is the asset's covariance with the market portfolio

- That is, for an individual asset i, the relevant risk is not σ_i, but rather $\sigma_i r_{iM}$, where r_{iM} is the correlation coefficient between the asset and the market

CAPM – Capital Asset Pricing Model – Conceptual development

- Applying the CML using this relevant risk measure

$$E(R_i) = Rf + \sigma_i r_{iM}\left[\frac{E(R_M) - Rf}{\sigma_M}\right]$$

- Let $\beta_i = (\sigma_i r_{iM}) / \sigma_M$ be the asset beta measuring the relative risk with the market, the systematic risk
- The CAPM indicates what should be the expected or required rates of return on risky assets

$$E(R_i) = Rf + \beta_i [E(R_M) - Rf]$$

CAPM states that only overall market risk premium matters and that this quantity can then be adapted to any risky asset by scaling it up or down according to asset's riskiness relative to the market.

The Security Market Line (SML)

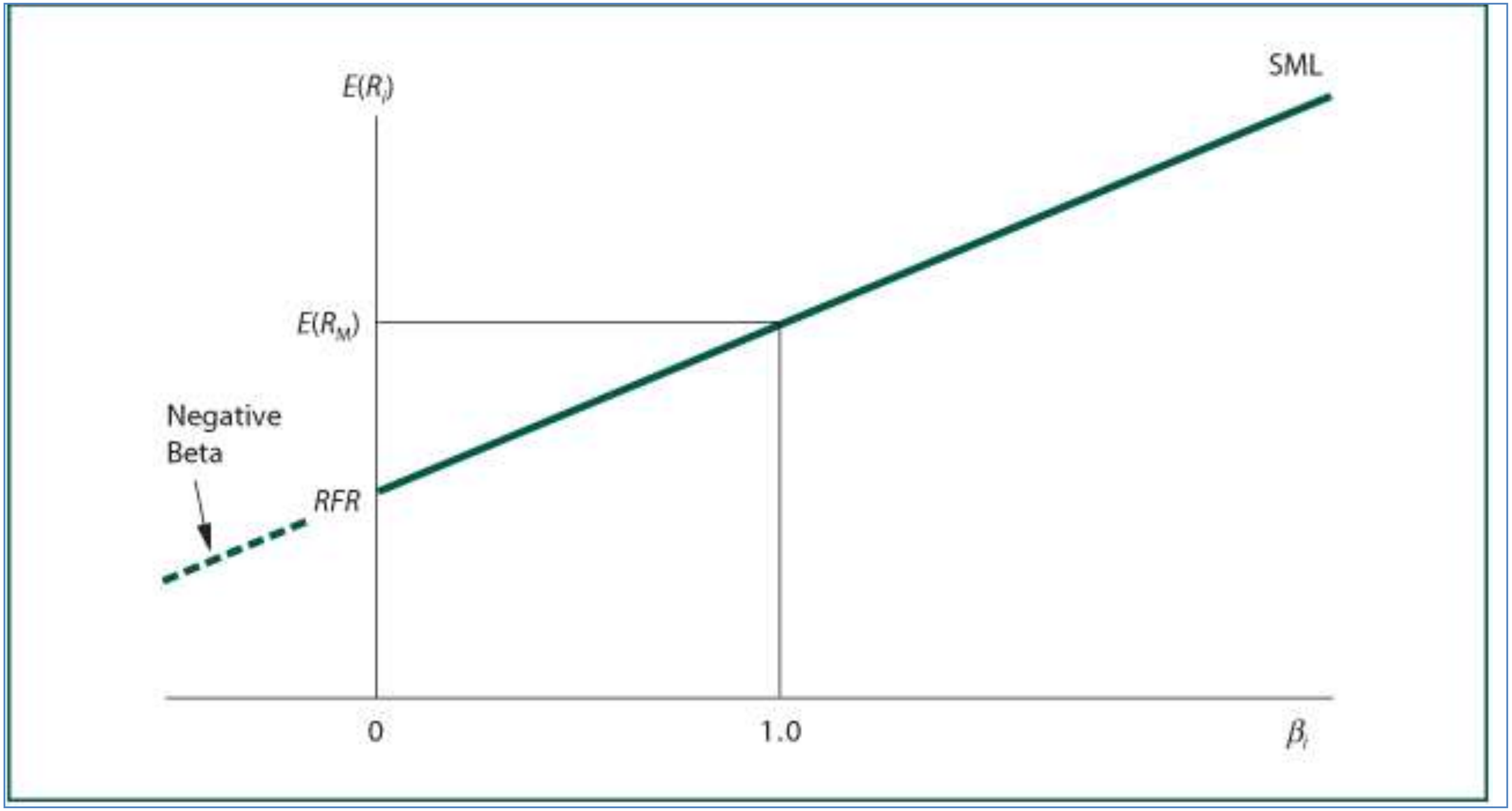
- The SML is a graphical form of the CAPM

- SML shows the relationship between the expected or required rate of return and the systematic risk on a risky asset

- The expected rate of return of a risk asset is determined by the Rf plus a risk premium for the individual asset

- The risk premium is determined by the systematic risk of the asset (beta) and the prevailing market risk premium (R_M-Rf)

The Security Market Line (SML)



CAPM Example

Determining the Expected Rate of Return

Risk-free rate is 5% and the market return is 9%

Stock	A	B	C	D	E
Beta	0.70	1.00	1.15	1.40	-0.30

Compare the required rate of return/expected rate of return to the estimated rate of return for a specific risky asset using the SML over a specific investment horizon to determine overpriced and underpriced stocks

Stock	Estimated Return
A	8.0%
B	6.2%
C	15.15%
D	5.15%
E	6.0%

CAPM Example contd.

–Applying $$E(R_i) = Rf + \beta_i [E(R_M) - Rf]$$

$E(R_A) = 0.05 + 0.70\ (0.09\text{-}0.05) = 0.078 = 7.8\%$

$E(R_B) = 0.05 + 1.00\ (0.09\text{-}0.05) = 0.090 = 09.0\%$

$E(R_C) = 0.05 + 1.15\ (0.09\text{-}0.05) = 0.096 = 09.6\%$

$E(R_D) = 0.05 + 1.40\ (0.09\text{-}0.05) = 0.106 = 10.6\%$

$E(R_E) = 0.05 + -0.30\ (0.09\text{-}0.05) = 0.038 = 03.8\%$

CAPM Example contd.

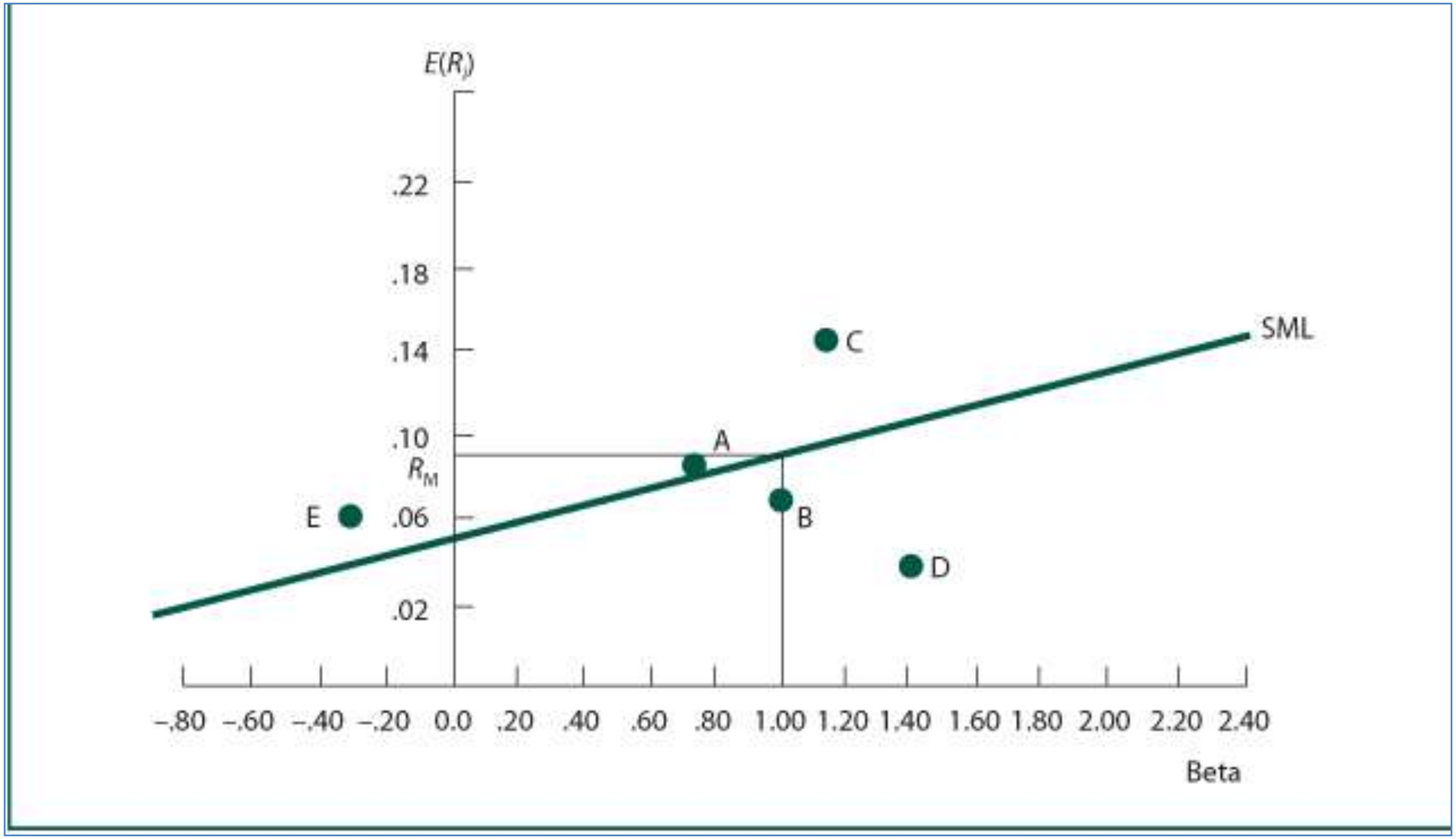
Stock	Required Return	Estimated Return
A	7.8%	8.0%
B	9.0%	6.2%
C	9.6%	15.15%
D	10.6%	5.15%
E	3.8%	6.0%

Identifying Undervalued & Overvalued Assets

- In equilibrium, all assets and all portfolios of assets should plot on the SML
- Any security with an estimated return that plots above the SML is underpriced
- Any security with an estimated return that plots below the SML is overpriced
- An overpriced security is a security that provides an investor with a rate of return smaller than the rate that is appropriate for the security's risk level.

Eg. If you buy the stock you expect to get a return of 16% however CAPM says that based on its risk you only deserve 14.75%. That means you are getting a good deal on this stock as it is expected to return more than is warranted by its systematic risk. That means the stock is underpriced.

Plot of Estimated Returns on SML Graph (CAPM Example contd.)



A, C and E are underpriced but B and D are over priced

Beta and Characteristic Line

Calculating Systematic Risk

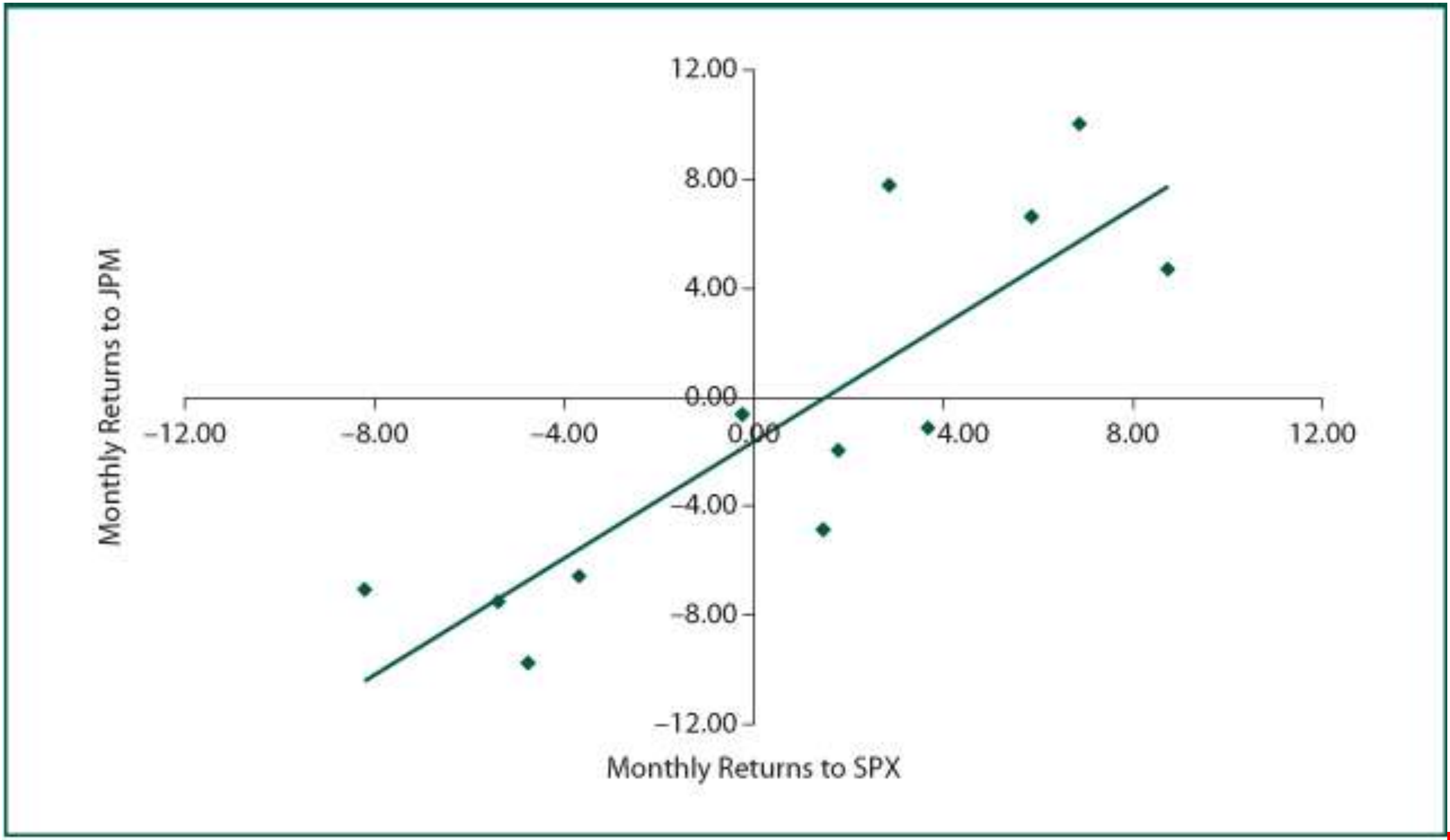
The formula

$$\beta_i = \frac{\sigma_i}{\sigma_M} r_{iM} = \frac{Cov(R_i, R_M)}{\sigma_M^2}$$

The characteristic line

- A regression line between the returns to the security (R_{it}) over time and the returns (R_{Mt}) to the market portfolio
- The slope of the regression line is beta

Characteristic Line example



Thanks

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Agenda

Asset Pricing Models

Arbitrage Pricing theory

3 key propositions:-

1. Security returns can be described by a factor model
2. There are sufficient securities to diversify away the idiosyncratic risk
3. Well-functioning securities market do not allow for the persistence of arbitrage

What is arbitrage?

Investor earns riskless profit without making any net investment

Sell short say \$1 million of B and Buy \$1 million of A.

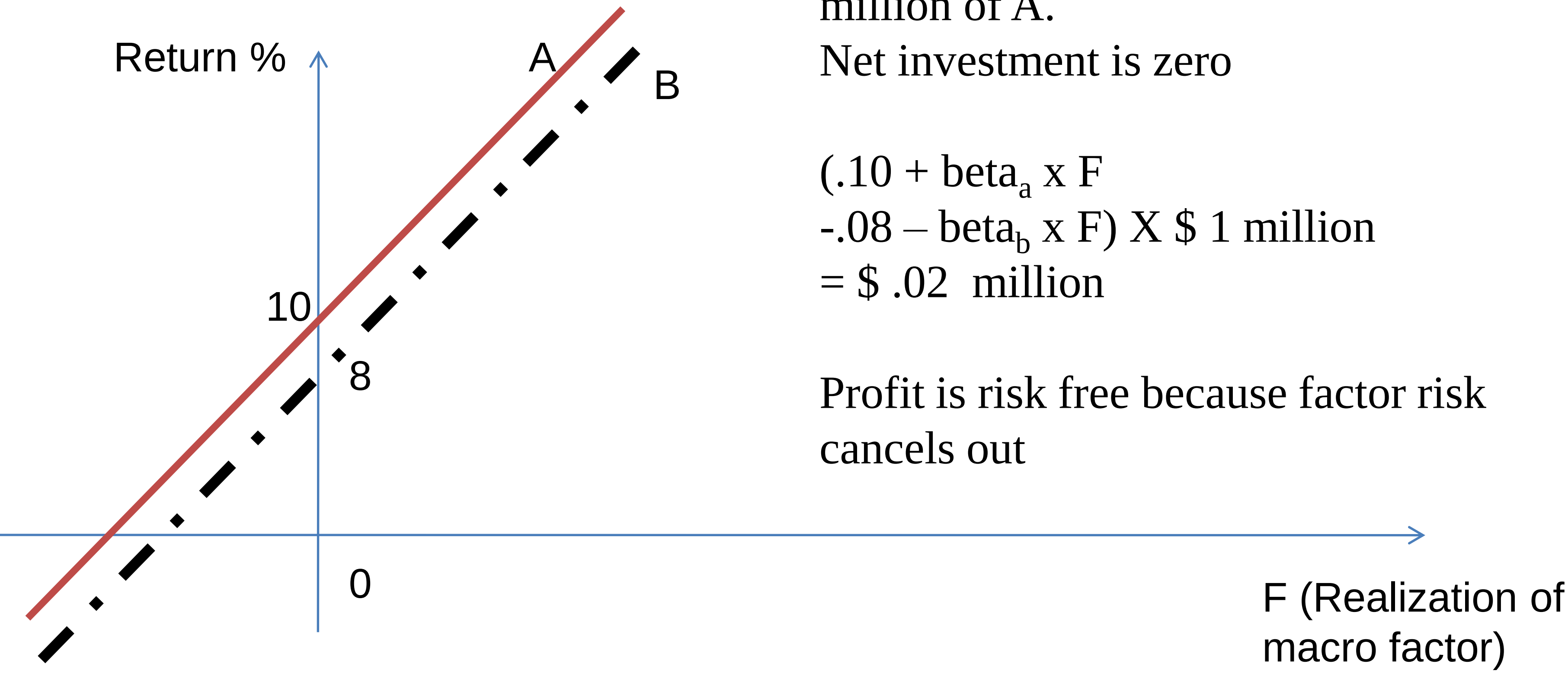
Net investment is zero

$(.10 + \text{beta}_a \times F$

$-.08 - \text{beta}_b \times F) \text{ X } \$ 1$ million

$= \$ .02$ million

Profit is risk free because factor risk cancels out



Well diversified portfolios with *equal betas* must have equal expected returns in market equilibrium – for no-arbitrage opportunities

Arbitrage Pricing Theory

- CAPM is criticized because of
  - The many unrealistic assumptions
  - The difficulties in selecting a proxy for the market portfolio as a benchmark

- An alternative pricing theory with fewer assumptions was developed: Arbitrage Pricing Theory (APT)

Arbitrage Pricing Theory

- Three Major Assumptions:
  - Capital markets are perfectly competitive
  - Investors always prefer more wealth to less wealth with certainty
  - The stochastic process generating asset returns can be expressed as a linear function of a set of *K* factors or indexes

- In contrast to CAPM, APT doesn't assume
  - Normally distributed security returns
  - Quadratic utility function
  - A mean-variance efficient market portfolio

Arbitrage Pricing Theory

The APT Model

$$E(R_i)=\lambda_0+\lambda_1 b_{i1}+\lambda_2 b_{i2}+\ldots+\lambda_k b_{ik}$$

where:

λ_0=the expected return on an asset with zero systematic risk

λ_j=the risk premium related to the *j* th common risk factor

b_{ij}=the pricing relationship between the risk premium and the asset; that is, how responsive asset *i* is to the *j* th common factor

Arbitrage Pricing Theory

A Comparison with CAPM

In CAPM, the relationship is as follows:

$$E(R_i)=RFR + \beta_i[(E(R_M-RFR)]$$

<u>Comparing CAPM and APT</u>

	CAPM	APT
Form of Equation	Linear	Linear
Number of Risk Factors	1	K (≥ 1)
Factor Risk Premium	$[E(RM) – RFR]$	$\{\lambda_j\}$
Factor Risk Sensitivity	β_i	$\{b_{ij}\}$
"Zero-Beta" Return	RFR	λ_0

Arbitrage Pricing Theory

<u>More Discussions on APT</u>

- Unlike CAPM that is a one-factor model, APT is a multifactor pricing model
- However, unlike CAPM that identifies the market portfolio return as the factor, APT model does not specifically identify these risk factors in application
- These multiple factors may include
  - Inflation
  - Growth in GNP
  - Major political upheavals
  - Changes in interest rates

Arbitrage Pricing Theory

More Discussions on APT

- Unlike CAPM that is a one-factor model, APT is a multifactor pricing model
- However, unlike CAPM that identifies the market portfolio return as the factor, APT model does not specifically identify these risk factors in application
- These multiple factors may include
  - Inflation
  - Growth in GNP
  - Major political upheavals
  - Changes in interest rates

Using Arbitrage Pricing Theory

- Selecting Risk Factors
  - As discussed earlier, the primary challenge with using the APT in security valuation is identifying the risk factors

  - For model illustration, assume that there are two common factors
    - First risk factor: Unanticipated changes in the rate of inflation
    - Second risk factor: Unexpected changes in the growth rate of real GDP

Security Valuation using APT

Three stocks (A, B, C) and two common systematic risk factors have the following relationship (Assume λ_0=0)

$$E(R_A)=(0.8)\,\lambda_1 + (0.9)\,\lambda_2$$
$$E(R_B)=(-0.2)\,\lambda_1 + (1.3)\,\lambda_2$$
$$E(R_C)=(1.8)\,\lambda_1 + (0.5)\,\lambda_2$$

If λ_1=4% and λ_2=5%, then it is easy to compute the expected returns for the stocks:

$$E(R_A)=7.7\%$$
$$E(R_B)=5.7\%$$
$$E(R_C)=9.7\%$$

Security Valuation using APT

Arbitrage Opportunity

If analyst have forecasted prices of stocks A, B, and C to be \$37.20, \$37.80, and \$38.50 one year later, then is there a riskless arbitrage opportunity existing (meaning 0 investment and riskless profit)

Thanks

Session 19

Agenda of Session 19

Fama French 3 factor, 4 factor and 5 factor models

Multifactor Models in Theory

In a multifactor model, the investor chooses the exact number and identity of risk factors, while the APT model doesn't specify either of them

The Equation

$$R_{it} = a_i + [b_{i1}F_{1t} + b_{i2}\, F_{2t} + \ldots + b_{iK}\, F_{Kt}] + e_{it}$$

where:

F_{it} =Period t risk premium to the *j*th designated risk factor (as compensation for jth risk factor)

R_{it} =Security *i's* return

Where should we look for factors?

Multifactor Models in Practice

- Macroeconomic-Based Risk Factor Models: Risk factors are viewed as macroeconomic in nature
- Microeconomic-Based Risk Factor Models: Risk factors are viewed at a microeconomic level by focusing on relevant characteristics of the securities themselves

Macroeconomic-Based Risk Factor Models

Security returns are governed by a set of broad economic influences in the following fashion [by Chen, Roll, and Ross in 1986]

$$R_{it} = a_i + [b_{i1}R_{mt} + b_{i2}MP_t + b_{i3}DEI_t + b_{i4}UI_t + b_{i5}UPR_t + b_{i6}UTS_t] + e_{it}$$

where:

R_m= the return on a value weighted index of NYSE-listed stocks

MP=the monthly growth rate in US industrial production

DEI=the change in inflation, measured by the US consumer price index

UI=the difference between actual and expected levels of inflation

UPR=the unanticipated change in the bond credit spread

UTS= the unanticipated term structure shift (long term less short term RFR)

Microeconomic-Based Risk Factor Models

Fama and French (1993) developed a multifactor model specifying the risk factors in microeconomic terms using the characteristics of the underlying securities

$$(R_{it} - RFR_t) = a_i + b_{i1}(R_{mt} - RFR_t) + b_{i2}SMB_t + b_{i3}HML_t + e_{it}$$

SMB (i.e. small minus big) is the return to a portfolio of small capitalization stocks less the return to a portfolio of large capitalization stocks

HML (i.e. high minus low) is the return to a portfolio of stocks with high ratios of book-to-market values less the return to a portfolio of low book-to-market value stocks

Microeconomic-Based Risk Factor Models

Carhart (1997), based on the Fama-French three factor model, developed a four-factor model by including a risk factor that accounts for the tendency for firms with positive past return to produce positive future return

$$(R_{it} - RFR_t) = a_i + b_{i1}(R_{mt} - RFR_t) + b_{i2}SMB_t + b_{i3}HML_t + b_{i4}MOM_t + e_{it}$$

SMB (i.e. small minus big) is the return to a portfolio of small capitalization stocks less the return to a portfolio of large capitalization stocks

HML (i.e. high minus low) is the return to a portfolio of stocks with high ratios of book-to-market values less the return to a portfolio of low book-to-market value stocks

where, MOM_t = the momentum factor

Empirical Contradictions to CAPM

CAPM :

➢Expected returns on securities are a positive linear function of the market betas (slope in the regression of security's return or market return) .

➢Also market betas suffice to describe the cross-section of expected returns

Empirical contradictions to CAPM (Anomalies):

➢Size effect of Banz (1981) : Market equity (stock's price times shares outstanding) adds to the explanation of cross-section of average returns provided by market betas – average return on small stocks are too high and large stocks are too low.

➢ Leverage effect of Bhandari (1988) : Leverage explains the cross-section of average stock returns (positively) keeping size and beta fixed.

Empirical Contradictions to CAPM contd.

- Book to Market equity effect (Stattman (1980), etc.) – Average return on US stocks are positively related to the ratio of firm's book value of common equity to its market value.
  - Chan et al (1991) : B/M explains cross-section of average returns on Japanese stocks.
- Basu (1983) : E/P helps explain cross-section of average returns on US stocks (keeping size and beta constant) – positive relation

Fama and French (1992) : Some explanatory variables might be redundant – Size (ME) and B/M (Book to Market equity) capture cross-sectional variation in average stock returns associated with size, E/P, B/M and leverage. [Note: 1963-1990 period for US stocks]

Fama French 3 factor model

- Size and BE/ME proxy for common risk factors in returns.
- Size and BE/ME are related to economic fundamentals
- High BE/ME (low stock price relative to book value, “value stocks”) – tend to have low earnings on assets and low BE/ME (“growth stocks”) is associated with persistently high earnings
  - Relative profitability is one of the sources of common risk factor in returns that might explain positive relation between BE/ME and average return
- Size is also related to profitability. Keeping BE/ME fixed, small firms tend to have lower earnings on assets than big firms.

Fama French 3 factor model – Building blocks

Ranking on size : June of each year t from 1963 to 1991, all NYSE stocks are ranked on size (price times shares outstanding). Median is then used to split the stocks into two groups , Small and Big (S and B)

Ranking on BE/ME : June of each year t from 1963 to 1991, all NYSE stocks are ranked on values of BE/ME. Divided into 3 groups (Bottom 30% as Low), Middle 40% (Medium) and Top 30% (High).

For each year, Monthly value weighted returns on six portfolios are calculated from July of Year t to June of t+1 and portfolios are formed again in June t+1

	Low BE/ME	Medium BE/ME	High BE/ME
Small (Size)	S/L	S/M	S/H
Big (Size)	B/L	B/M	B/H

Fama French 3 factor model – Building blocks contd.

Explanatory variables in time series regression :-

1. Excess market return
2. Mimicking portfolio for Size – Mimic the underlying risk factors in returns related to size
3. Mimicking portfolio for Book to Market – Mimic the underlying risk factors in returns related to Book to Market equity

Fama French 3 factor model – Building blocks contd.

- Mimicking portfolio for Size – Mimic the underlying risk factors in returns related to size
  - SMB (Small – Big) meant to mimic the risk factors in returns related to size
  - -Difference each month between the simple average of the returns on the three small stock portfolios (S/L, S/M ,S/H) and simple average of returns on three big stock portfolios. (B/L,B/M,B/H)
  - SMB is the difference in returns on small and big stock portfolios with about same weighted average BE/ME

Fama French 3 factor model – Building blocks contd.

- Mimicking portfolio for Book to Market – Mimic the underlying risk factors in returns related to Book to Market equity
  - HML (High - Low) meant to mimic the risk factors in returns related to BE/ME
  - -Difference each month between the simple average of the returns on the two high BE/ME stock portfolios (S/H,B/H) and simple average of returns on two low BE/ME portfolios. (S/L, B/L)
  - HML is the difference in returns between the high and low BE/ME stock portfolio with about the same weighted average size.

- Market – Excess market return Rm – Rf . Rm is the return on the value weighted portfolio of stocks in the six Size – BE/ME portfolios plus negative BE stocks excluded from portfolios. Rf is one month bill rate

Fama French 3 factor model

Fama and French (1993) developed a multifactor model specifying the risk factors in microeconomic terms using the characteristics of the underlying securities

$$(R_{it} - RFR_t) = a_i + b_{i1}(R_{mt} - RFR_t) + b_{i2}SMB_t + b_{i3}HML_t + e_{it}$$

SMB (i.e. small minus big) is the return to a portfolio of small capitalization stocks less the return to a portfolio of large capitalization stocks

HML (i.e. high minus low) is the return to a portfolio of stocks with high ratios of book-to-market values less the return to a portfolio of low book-to-market value stocks

Result : The signs of the coefficients suggested that small cap and value portfolios (high BE/ME) have higher expected returns—and arguably higher expected risk—than those of large cap and growth portfolios https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

https://faculty.iima.ac.in/~iffm/Indian-Fama-French-Momentum/

Fama French 5 factor model

$$(R_{it} - RFR_t) = a_i + b_{i1}(R_{mt} - RFR_t) + b_{i2}SMB_t + b_{i3}HML_t + e_{it}$$

$$+ b_{i4}RMW \quad + b_{i5}CMA$$

Fama French 4 factor model or Cahart Model

$$(R_{it} - RFR_t) = a_i + b_{i1}(R_{mt} - RFR_t) + b_{i2}SMB_t + b_{i3}HML_t + e_{it}$$

$$+\, b_{i4}Momentum\ factor$$

Linear Factor Model

Linear Factor Model: Cross-Sectional Regressions

$$\mathbf{x}_t = \alpha + B\mathbf{f}_t + \epsilon_t,$$

for each $t \in \{1, 2 \ldots, T\}$, where

$$\alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_m \end{bmatrix} \ (m \times 1); \quad B = \begin{bmatrix} \beta_1' \\ \beta_2' \\ \vdots \\ \beta_m' \end{bmatrix} = [[\beta_{i,k}]] \ (m \times K); \quad \epsilon_t = \begin{bmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \\ \vdots \\ \epsilon_{m,t} \end{bmatrix} \ (m \times 1)$$

- α and B are the same for all t.
- $\{\mathbf{f}_t\}$ is ($K-$variate) covariance stationary $I(0)$ with

$$\begin{aligned} E[\mathbf{f}_t] &= \mu_f \\ Cov[\mathbf{f}_t] &= E[(\mathbf{f}_t - \mu_f)(\mathbf{f}_t - \mu_f)'] = \Omega_f \end{aligned}$$

- $\{\epsilon_t\}$ is m-variate white noise with:

$$\begin{aligned} E[\epsilon_t] &= 0_m \\ Cov[\epsilon_t] &= E[\epsilon_t \epsilon_t'] = \Psi \\ Cov[\epsilon_t, \epsilon_{t'}] &= E[\epsilon_t \epsilon_{t'}'] = 0 \ \ \forall t \neq t' \end{aligned}$$

  Ψ is the $(m \times m)$ diagonal matrix with entries $(\sigma_1^2, \sigma_2^2, \ldots, \sigma_m^2)$ where $\sigma_i^2 = var(\epsilon_{i,t})$, the variance of the ith asset specific factor.
- The two processes $\{\mathbf{f}_t\}$ and $\{\epsilon_t\}$ have null cross-covariances:

Reference: MIT Coursework

Linear Factor Model

Summary of Parameters

- α: $(m \times 1)$ intercepts for m assets
- B: $(m \times K)$ loadings on K common factors for m assets
- μ_f: $(K \times 1)$ mean vector of K common factors
- Ω_f : $(K \times K)$ covariance matrix of K common factors
- $\Psi = diag(\sigma_1^2, \ldots, \sigma_m^2)$: m asset-specific variances

Features of Linear Factor Model

- The $m-$variate stochastic process $\{\mathbf{x}_t\}$ is a covariance-stationary multivariate time series with
  - Conditional moments:
    $$\begin{aligned} E[\mathbf{x}_t \mid \mathbf{f}_t] &= \alpha + B\mathbf{f}_t \\ Cov[\mathbf{x}_t \mid \mathbf{f}_t] &= \boldsymbol{\Psi} \end{aligned}$$
  - Unconditional moments:
    $$\begin{aligned} E[\mathbf{x}_t] &= \mu_x = \alpha + B\mu_f \\ Cov[\mathbf{x}_t] &= \boldsymbol{\Sigma}_x = B\boldsymbol{\Omega}_f B' + \boldsymbol{\Psi} \end{aligned}$$

Reference: MIT Coursework

EMH and Event study

Set of Assumptions for Efficient capital markets?

Premise/Assumptions of An Efficient Market

- New information regarding securities comes to the market in a random fashion

- A large number of competing profit-maximizing participants analyze and value securities, each independently of the others

- Profit-maximizing investors (their buy and sell decisions) cause security prices to adjust rapidly to reflect the effect of new information

Efficient Market Hypothesis (EMH)

- Maurice Kendall (1953) found no predictable pattern in stock price changes.
- Prices are as likely to go up as to go down on any particular day.
- How do we explain random stock price changes?

Efficient Market Hypothesis (EMH)

- EMH says stock prices already reflect all available information
- A forecast about favorable <u>future</u> performance leads to favorable <u>current</u> performance, as market participants rush to trade on new information.
  - Result: Prices change until expected returns are exactly commensurate with risk.

Efficient Market Hypothesis (EMH)

- New information is unpredictable; if it could be predicted, then the prediction would be part of today's information.
- Stock prices that change in response to new (unpredictable) information also must move unpredictably.
- Stock price changes follow a random walk.

EMH and Competition

- Information: The most precious commodity
  - Strong competition assures prices reflect information.
  - Information-gathering is motivated by desire for higher investment returns.
  - The marginal return on research activity may be so small that only managers of the largest portfolios will find them worth pursuing.

Figure 11.1 Cumulative Abnormal Returns Before Takeover Attempts: Target Companies

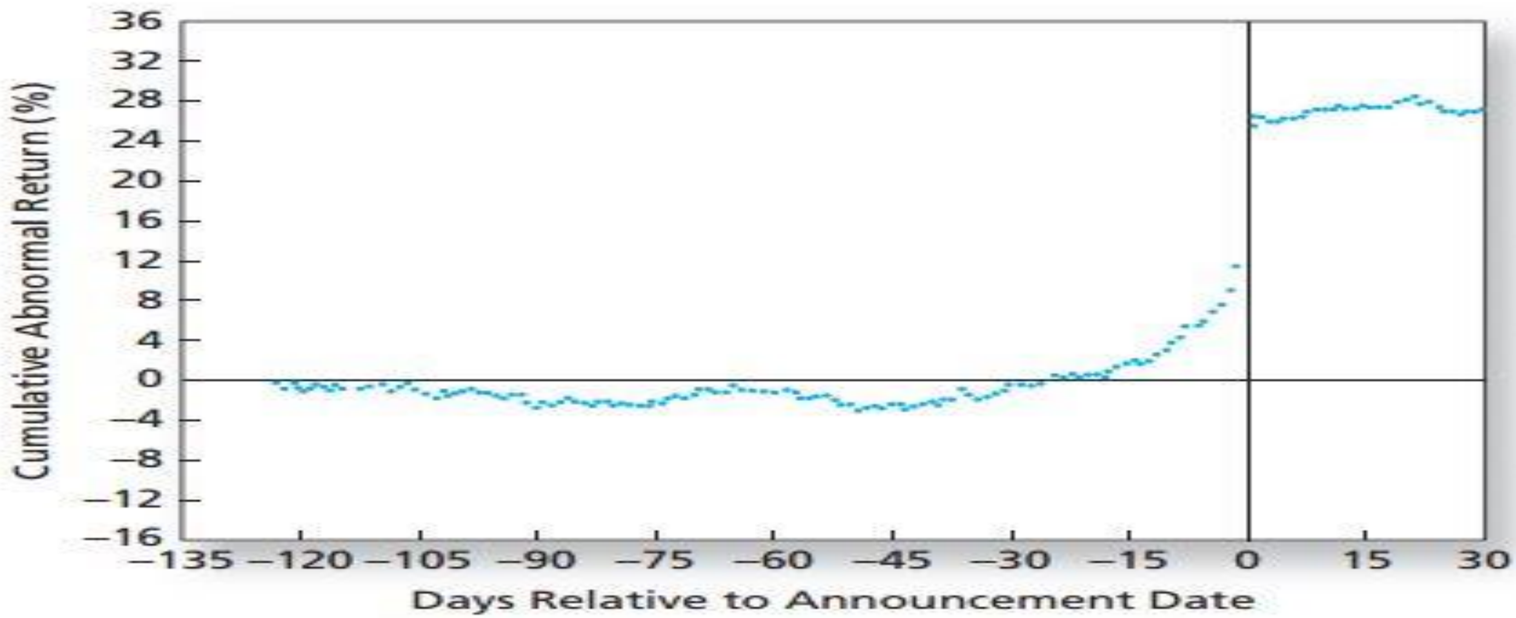


Figure 11.1 Cumulative abnormal returns before takeover attempts: target companies

Source: Arthur Keown and John Pinkerton, "Merger Announcements and Insider Trading Activity," *Journal of Finance* 36 (September 1981). Used with permission of John Wiley and Sons, via Copyright Clearance Center. Updates courtesy of Jinghua Yan.

Figure 11.2 Stock Price Reaction to CNBC Reports

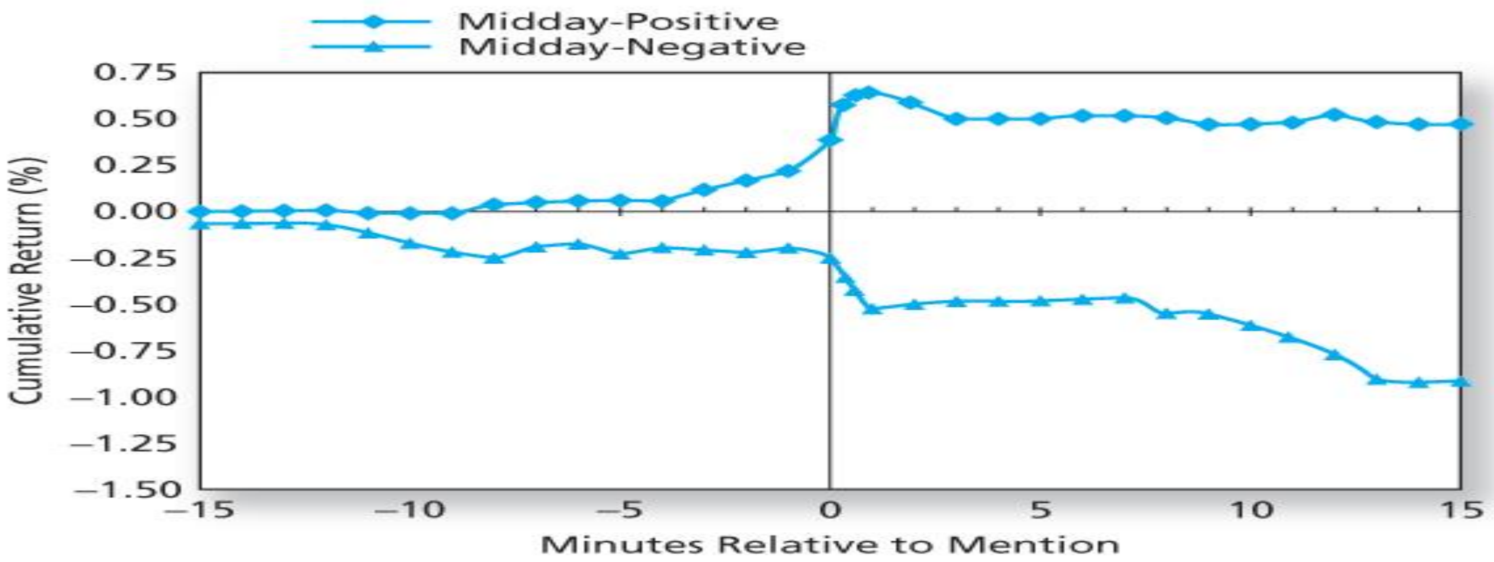


Figure 11.2 Stock Price Reaction to CNBC Reports. The figure shows the reaction of stock prices to on-air stock reports during the "Midday Call" segment on CNBC. The chart plots cumulative returns beginning 15 minutes before the stock report.

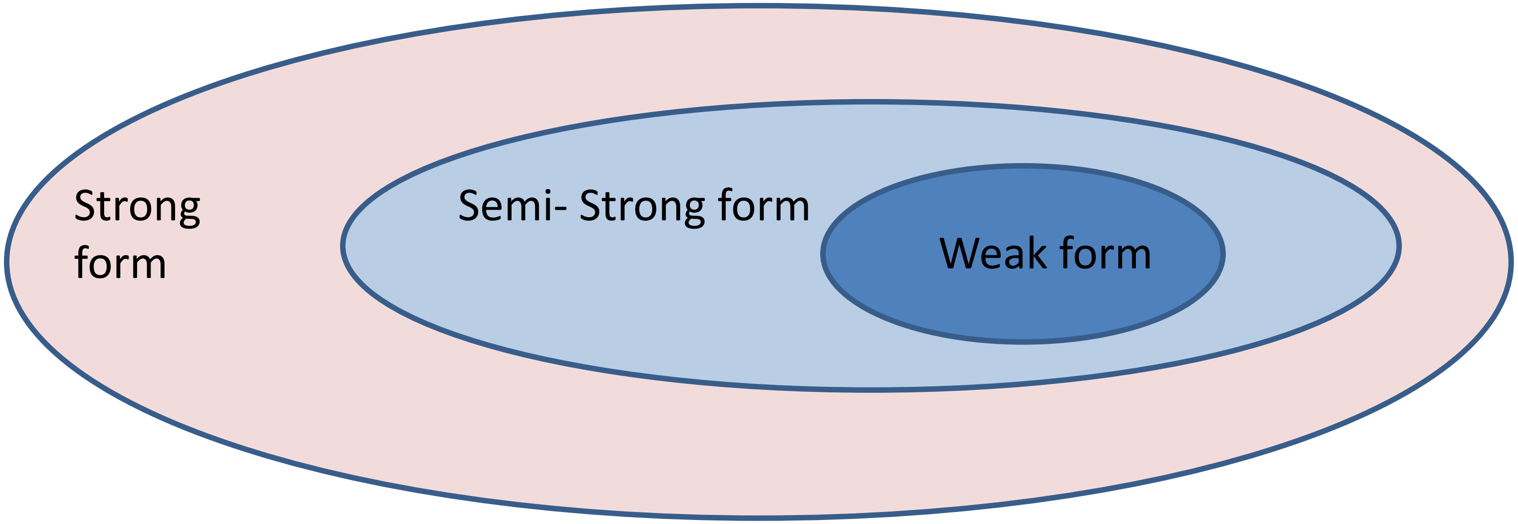
Source: Reprinted from J. A. Busse and T. C. Green, "Market Efficiency in Real Time," *Journal of Financial Economics* 65 (2002), p. 422. Copyright 2002 with permission from Elsevier Science.

Versions of the EMH

- Weak
- Semi-strong
- Strong

- All versions assert that prices should reflect *available* information

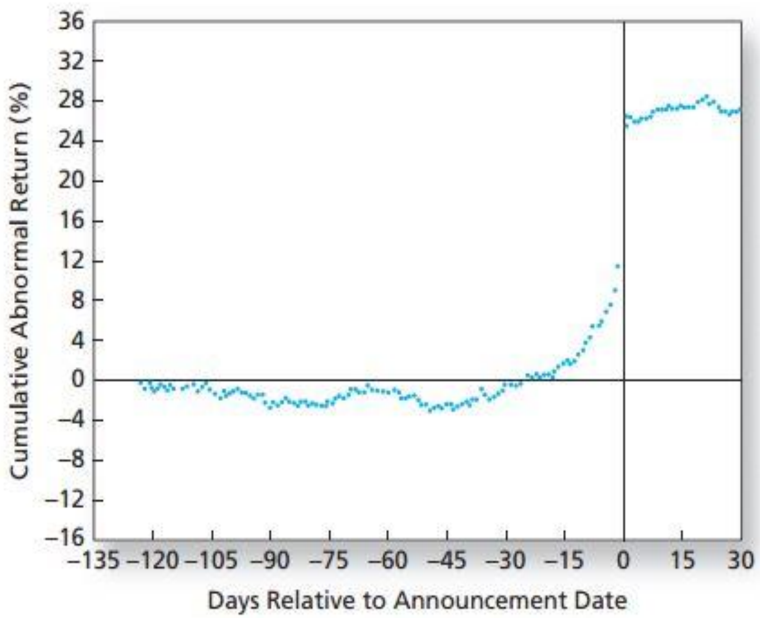
Versions of EMH – Information set



EMH (Efficient Market Hypothesis)

- EMH says stock prices already reflect all available information
- A forecast about favorable future performance leads to favorable current performance
- New information is unpredictable

Event Study – Testing the Efficient Market Hypothesis



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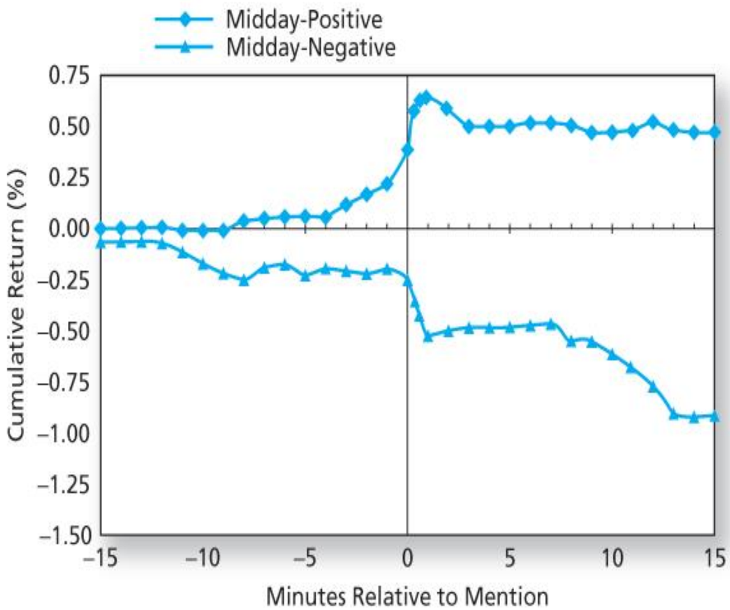

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What is an Event Study?

Event Study

- The effects of an economic event on the value of firms.
- Response of the stock price around the event.

Assumption

- Market must be efficient.
- The effects of an event will be reflected immediately in the security prices.

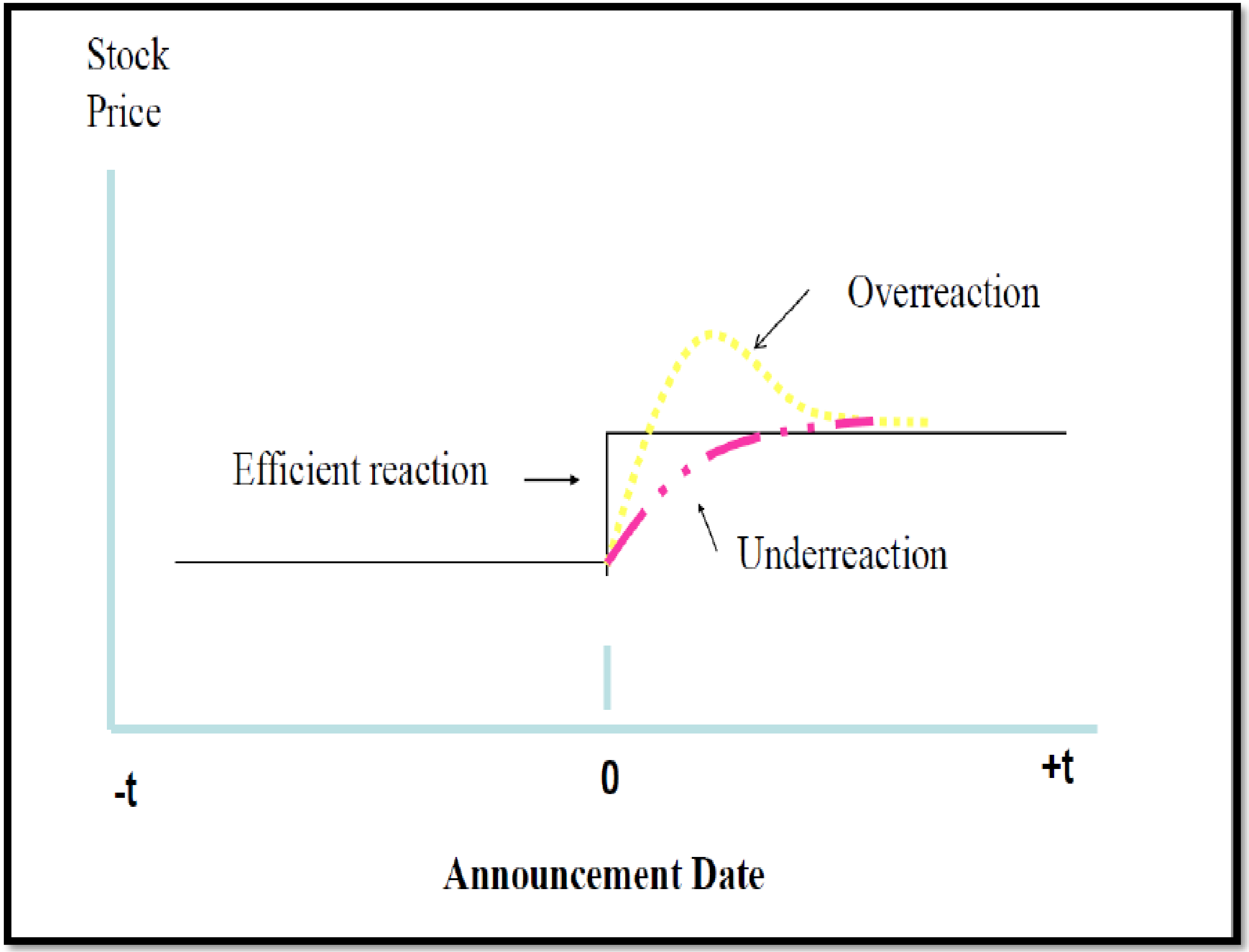
Use of Event Study

- Widely accepted tool to measure economic impact of wide range of events

- SEC uses event studies to measure illicit gains captured by traders who may have violated insider trading or securities laws.

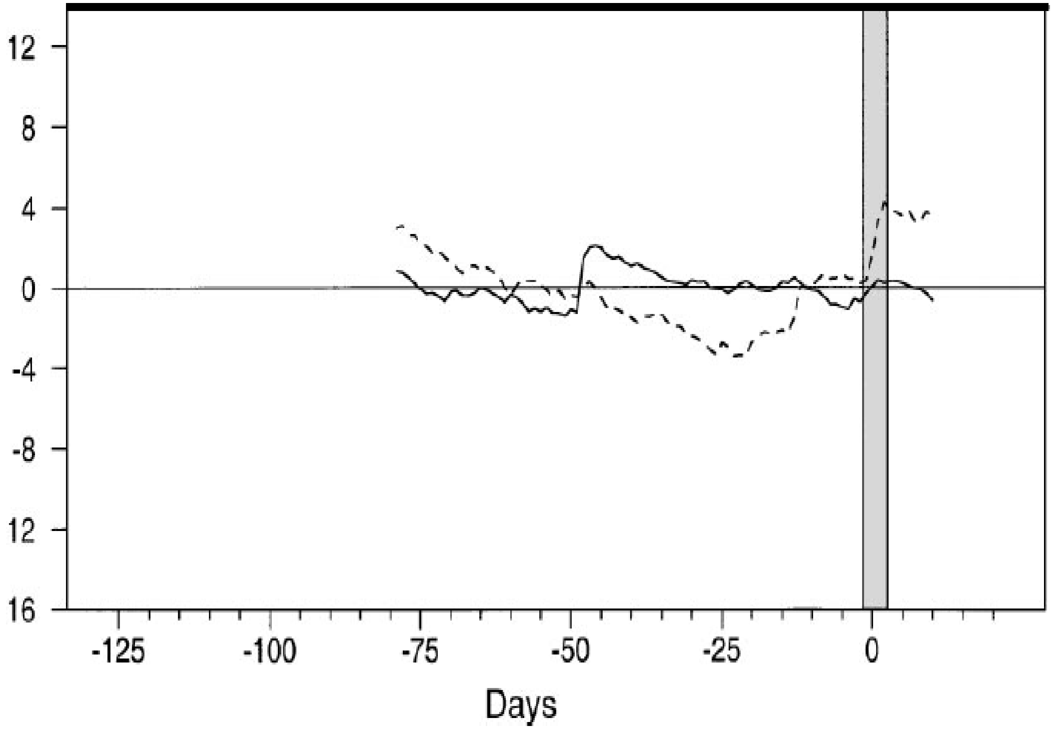
- Fraud cases where court assesses the damages caused by a fraudulent activity

Prices under EMH



Use of Event Study

- The National Exchange of Mexico (Bhattacharya et al., 2000).
  - A-shares: Only held by Mexican nationals
  - B-shares: Open to foreigners
- Abnormal returns around corporate announcements.

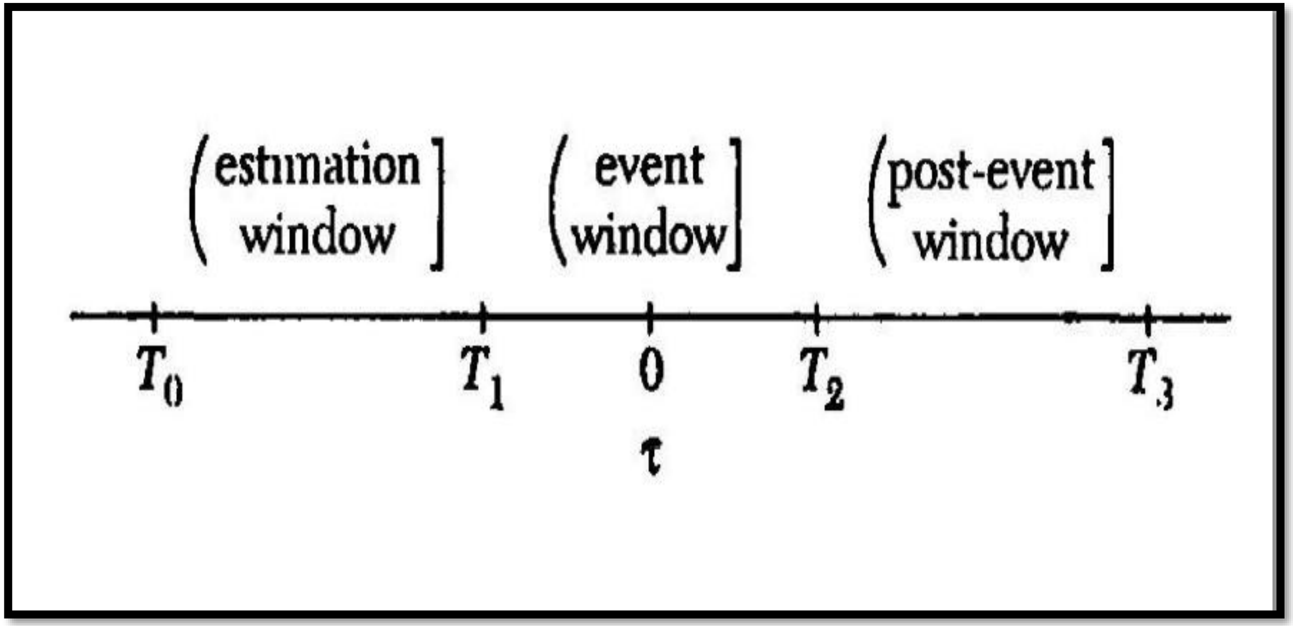


Event Study design

1. Define the event
2. Identify the affected firms and the event dates
3. Calculate unexpected (abnormal returns)
4. Test the hypothesis and evaluate the results

Null Hypothesis: Event has no impact on returns

Relevant dates



Event window : -20 to +20, -10 to +10 or -5 to +5
Estimation window : -220 to a day prior to event window date (approx.)
Post event window : Beyond the event window

Event Study design contd.

Log transformed returns [R = ln(1+r)]

– Improves the normality of the return distribution

Individual abnormal returns are calculated as:

$$AR_{it} = R_{it} - E(R_{it}) \tag{1}$$

Where:	AR_{it}	=	The abnormal return for company *i* in period *t*;
	R_{it}	=	The actual return for company *i* period *t*; and,
	$E(R_{it})$	=	The expected return for company *i* in period *t*.

Event Study design contd.

$$E(R_{it}) = \alpha_i + \beta_i R_{mt} \tag{2}$$

Where: $E(R_{it})$ = The expected return for company *i* in period *t*;

α_i = The intercept term;

β_i = A regression constant; and,

R_{mt} = The return on the market in period *t*.

Average abnormal return is calculated as:

$$AAR_t = \frac{1}{n}\sum_{i=1}^{n} AR_{it} \tag{3}$$

Where: AAR_t = The average abnormal return for time *t*;

AR_{it} = The abnormal return for company *i* at time *t*; and,

n = The sample size.

$$t_{AR} = \frac{AAR_t}{\sigma_{AR}/\sqrt{n}} \tag{4}$$

Where: t_{AR} = The t-statistic;

AAR_t = The average abnormal return for time *t*;

σ_{AR} = The standard deviation of abnormal returns at time *t*; and,

One can use any of the Asset Pricing models for calculating Expected Return

Event Study design contd.

In order to ascertain the magnitude of abnormal returns over the entire event window, we then calculate firm specific cumulative abnormal returns (CARs), and cumulative average abnormal returns (CAARs) overall, which are defined as follows:

$$CAR_t = CAR_{t-1} + AR_t \quad (5)$$

Where: CAR_t = The cumulative abnormal return at time *t*;

CAR_{t-1} = The cumulative abnormal return at time *t-1*; and,

AR_t = The abnormal return at time *t*.

$$CAAR_t = CAAR_{t-1} + AAR_t \quad (6)$$

Where: $CAAR_t$ = The cumulative average abnormal return at time *t*;

$CAAR_{t-1}$ = The cumulative average abnormal return at time *t-1*;

and,

AAR_t = The average abnormal return for time *t*.

The significance of these overall cumulative abnormal returns is ascertained via the calculation of a t-statistic, defined as follows:

$$t_{CAR} = \frac{CAAR_t}{\sigma_{CAR} / \sqrt{n}} \quad (7)$$

Where: t_{CAR} = The CAR t-statistic;

$CAAR_t$ = The cumulative average abnormal return at time *t*;

σ_{CAR} = The cross-sectional standard deviation of the abnormal returns for the sample of n firms at time *t*; and,

n = The sample size.

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Security Analysis & Portfolio Management
Session 24

Motivation

Bear market ahead: Global fund managers expect 20% fall this year, raise cash levels to highest since Apr 2020

In anticipation of a bear market, fund managers have increased cash positions to the highest since April 2022 – early covid-19 pandemic days – while their equities allocation plummeted.

Written by Kshitij Bhargava
March 16, 2022 12:36:22 pm

Global fund managers expect stock markets across the globe to enter a bear market, with a more than 20% decline likely this year, Bank of America's monthly survey showed. Nudged by the Russia-Ukraine war, 60% of the BofA survey respondents now believe a bear market is around the corner in 2022, double of 30% last month. In anticipation of a bear market, fund managers have increased cash positions to the highest since April 2022 – early covid-19 pandemic days – while their equities allocation plummeted. During the last one month, the S&P 500 is down 4.75%, Dow Jones slipped 4%, and the NASDAQ has tanked 8.3%.

Cash levels rise, macro outlook falls

BofA survey showed that fund managers' cash position is up at 5.9%, from 5.3% last month as investors get more cautious and bearish. Data showed that cash position for fund managers was at similar levels during March and April 2020 as the covid-19 pandemic began spreading across the globe. Cash levels are higher than during the global financial crisis of 2008 and higher than the Euro Debt crisis of 2011-2012. Investors prefer booking profits and holding on to cash when anticipating a bear market. Foreign Institutions have been net sellers of domestic equities for months now.

https://www.financialexpress.com/investing-abroad/featured-stories/stock-market-to-fall-global-fund-managers-say-cash-level-rise-equity-holdings-down/2462686/

https://www.cnbc.com/2021/10/13/why-every-stock-market-investor-should-be-ready-to-go-to-cash.html

What is Required of a Portfolio Manager

- The ability to derive above-average returns for a given risk class

- The ability to diversify the portfolio completely to eliminate unsystematic risk relative to the portfolio's benchmark

What is Required of a Portfolio Manager

- The ability to derive above-average returns for a given risk class. The superior risk-adjusted returns can be derived from either
  - Superior Market timing
  - Superior Security selection (Ability to pick best securities of a given level of risk)
- The ability to diversify the portfolio completely to eliminate unsystematic risk relative to the portfolio's benchmark
  - A completely diversified portfolio is perfectly correlated with the fully diversified benchmark portfolio

Market Timing

- Buying low and selling high

- In its pure form it means shifting funds between a market index portfolio and safe asset such as T-bills or money market fund depending on whether the market as a whole is expected to outperform the safe asset

- Suppose investor holds only the market index portfolio and T-bills. If proportion invested in the market were constant say 0.6, portfolio beta will also be constant and SCL will plot as a straight line with slope 0.6

- Now if investor correctly times the market and moves funds into it when the market does well. How will the SCL look like?

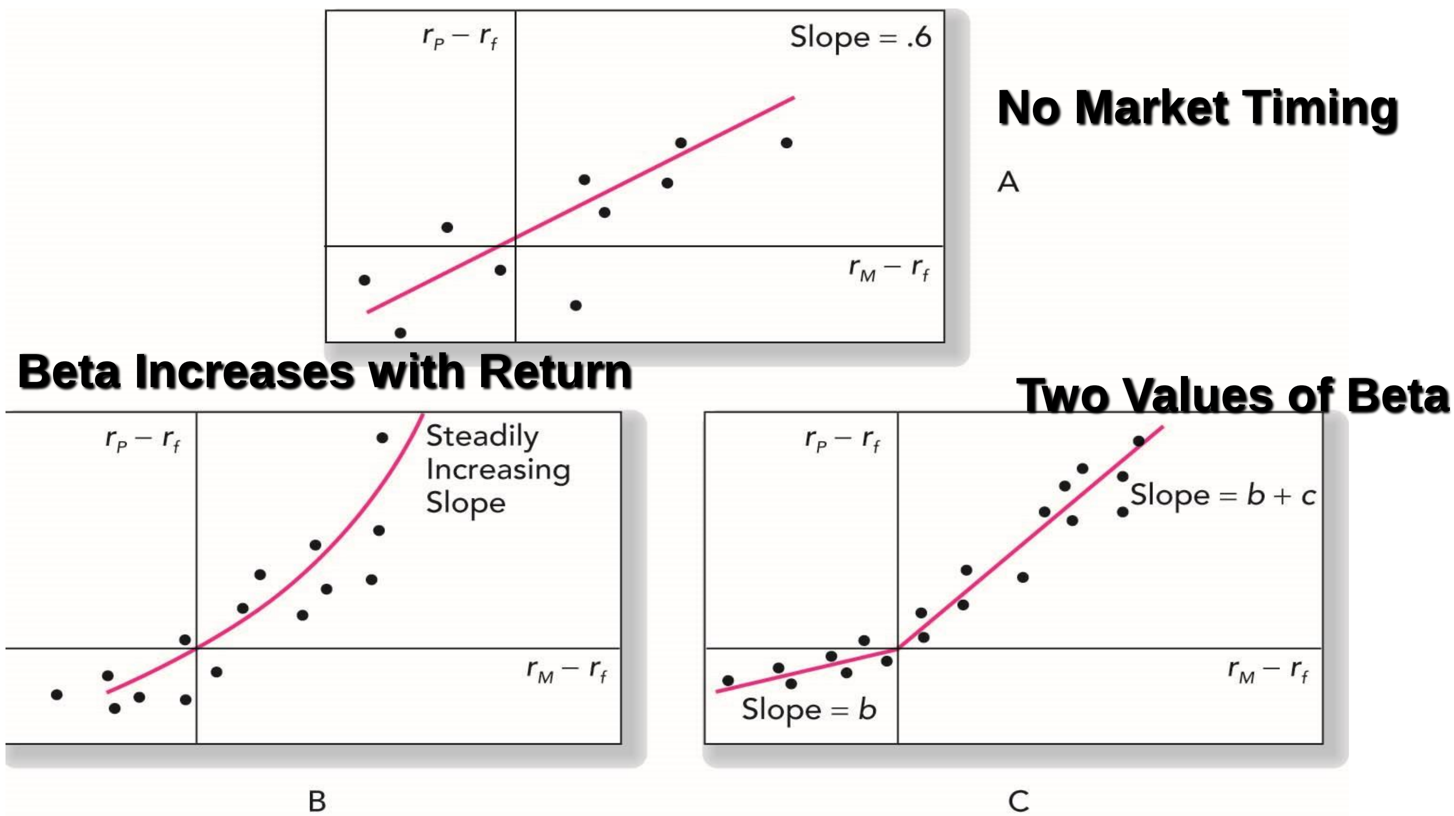
Market Timing contd.

- The effect of correctly timing the market would be to increase the portfolio beta in up markets and decrease it in down markets. For the purpose of this discussion, an up market is one in which the market return exceeds the risk-free rate, and a down market is one in which the market return is less than the risk-free rate.

- Adjusting portfolio weights for up and down movements in market returns, we would have:

- Low Market Return - low weight on the market - low ßeta
- High Market Return – high weight on the market - high ßeta

Market Timing and Characteristic Lines



How do you test such relationship?...

Student discussion..

To be continued with data…

Questions ?

Composite Portfolio Performance Measures

- Treynor Portfolio Performance Measure
- Sharpe Portfolio Performance Measure
- Jensen Portfolio Performance Measure
- The Information ratio Performance Measure

Treynor Portfolio Performance Measure

$$T_i = \frac{\left(\overline{R}_i - \overline{RFR}\right)}{\beta_i}$$

- Where R_i bar is average rate of return for Portfolio i during the specified time period,
- RFR bar is avg. ror on risk-free investment during that period
- Beta_i is slope of the fund's characteristic line during that period

➢The numerator is the risk premium

➢The denominator is a measure of risk

➢The expression is the risk premium return per unit of risk

➢Risk averse investors prefer to maximize this value

➢This assumes a completely diversified portfolio leaving systematic risk as the relevant risk

Treynor's measure -Illustration

Assume the market return is 14% and risk-free rate is 8%. The average annual returns for Managers W, X, and Y are 12%, 16%, and 18% respectively. The corresponding betas are 0.9, 1.05, and 1.20. What are the T values for the market and managers?

– The T Values

T_M = (14%-8%) / 1 =6%

T_W = (12%-8%) / 0.9 =4.4%

T_X = (16%-8%) / 1.05 =7.6%

T_Y = (18%-8%) / 1.20 =8.3%

If beta is negative and risk premium is positive, we get negative T values. To compare portfolio performance, compare the expected return to actual return

Sharpe Measure - Illustration

Assume the market return is 14% with a standard deviation of 20%, and risk-free rate is 8%. The average annual returns for Managers D, E, and F are 13%, 17%, and 16% respectively. The corresponding standard deviations are 18%, 22%, and 23%. What are the Sharpe measures for the market and managers?

- The Sharpe Measures

  S_M = (14%-8%) / 20% =0.300

  S_D = (13%-8%) / 18% =0.273

  S_E = (17%-8%) / 22% =0.409

  S_F = (16%-8%) / 23% =0.348

Sharpe Portfolio Performance Measure

- Shows the risk premium earned over the risk free rate per unit of standard deviation
- Sharpe ratios greater than the ratio for the market portfolio indicate superior performance

The Formula

$$S_i = \frac{\overline{R}_i - \overline{RFR}}{\sigma_i}$$

where:

σ_i = the standard deviation of the rate of return for Portfolio *i*

Or recently used – standard deviation of the portfolio returns in excess of a risk free rate

Sharpe Measure - Illustration

Assume the market return is 14% with a standard deviation of 20%, and risk-free rate is 8%. The average annual returns for Managers D, E, and F are 13%, 17%, and 16% respectively. The corresponding standard deviations are 18%, 22%, and 23%. What are the Sharpe measures for the market and managers?

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Sharpe Measure versus Treynor measure

- Sharpe uses standard deviation of returns as the measure of risk
- Treynor measure uses beta (systematic risk)
- Sharpe therefore evaluates the portfolio manager on the basis of both rate of return performance and diversification
- The methods agree on rankings of completely diversified portfolios
- Produce relative not absolute rankings of performance

Portfolio	Return	Beta	Standard deviation of return
P	0.15	1	0.05
Q	0.2	1.5	0.10
R	0.1	0.6	0.03
S	0.17	1.1	0.06
Market	0.13	1	0.04

1. Consider risk free rate as 6%
2. Check for diversification by calculating unsystematic risk
3. Calculate Sharpe measure for each portfolio and market portfolio. Rank based on Sharpe measure
4. Calculate Treynor measure for each portfolio and market portfolio. Rank based on Treynor measure
5. Are the ranking order similar in Sharpe and Treynor? If not, why do you think it is different?

Jensen Portfolio Performance Measure

Jensen Portfolio Performance Measure

The Formula

$$R_{jt} - RFR_t = \alpha_j + \beta_j [R_{mt} - RFR_t] + e_{jt}$$

where:

α_j = Jensen measure

- Jensen measure represents the average excess return of the portfolio above that predicted by CAPM
- Superior managers will generate a significantly positive alpha; inferior managers will generate a significantly negative alpha
- Jensen measure is flexible enough to allow for alternative models of risk and expected return than the CAPM. Risk-adjusted performance can be computed relative to any of the multifactor models

Information Ratio Performance measure

The Formula

$$IR_j = \frac{\overline{R}_j - \overline{R}_b}{\sigma_{ER}} = \frac{\overline{ER}_j}{\sigma_{ER}}$$

where:

R_b = the average return for the benchmark portfolio
σ_{ER} = the standard deviation of the excess return

- Information ratio measures the average return in excess that of a benchmark portfolio divided by the standard deviation of this excess return
- σ_{ER} can be called the tracking error of the investor's portfolio and it is a "cost" of active management
- IR is a benefit to cost ratio

innovate achieve lead

Refer to Sortino's measure data

Motivation

February 22, 2022
11:55 PM GMT+5:30
Last Updated a month ago

Finance

Allianz fires two managers in wake of investment fund collapse

By Tom Sims

FRANKFURT, Feb 21 (Reuters) - Allianz (ALVG.DE) has dismissed two asset managers who oversaw a group of investment funds that collapsed after racking up massive losses when the spread of coronavirus triggered wild market swings, according to regulatory filings.

In their lawsuits, investors alleged Allianz had strayed from its stated investment strategy of hedging to limit potential losses.

In a 2016 video reviewed by Reuters, Tournant likened Structured Alpha's strategy to insurance.

"Our strategies are not race cars looking to speed their way to high returns. They're four-wheel drive vehicles designed to tackle rough terrain," he said in separate marketing material.

https://www.reuters.com/business/finance/two-allianz-managers-fired-wake-investment-fund-collapse-2022-02-21/

Sortino's measure – Performance measurement with downside risk

- The Sortino measure is a risk-adjusted measure that differs from the Sharpe ratio in two ways
  - It measures the portfolio's average return in excess of a user-selected minimum acceptable return threshold
  - It captures just the downside risk (DR) in the portfolio rather than the total risk as in Sharpe measure

$$ST_i = \frac{\overline{R}_i - \tau}{DR_i}$$

where: $\boldsymbol{\tau}$ = the minimum acceptable return threshold

DR_i = the downside risk coefficient for Portfolio i

Sortino's measure – Performance measurement with downside risk

- Downside Risk measure
  - It is the volatility of returns produced by a portfolio that fall below some hurdle rate that the investor chooses.
  - This measure implicitly assumes that investor tries to minimize the damage from returns less than some target level
  - Volatility associated with the shortfall that occurs if investment produces a return that is lower than anticipated.
  - One measure is semi-deviation

Semi-deviation =

$$\sqrt{\frac{1}{n}\sum(Rit - Ribar)^2}$$

For all R<Rbar

Where n is number of portfolio returns falling below the expected return

Problem 6

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Security Analysis & Portfolio Management
Session 25

What is Required of a Portfolio Manager – Revision last session

- The ability to derive above-average returns for a given risk class. The superior risk-adjusted returns can be derived from either
  - Superior Market timing
  - Superior Security selection (Ability to pick best securities of a given level of risk)
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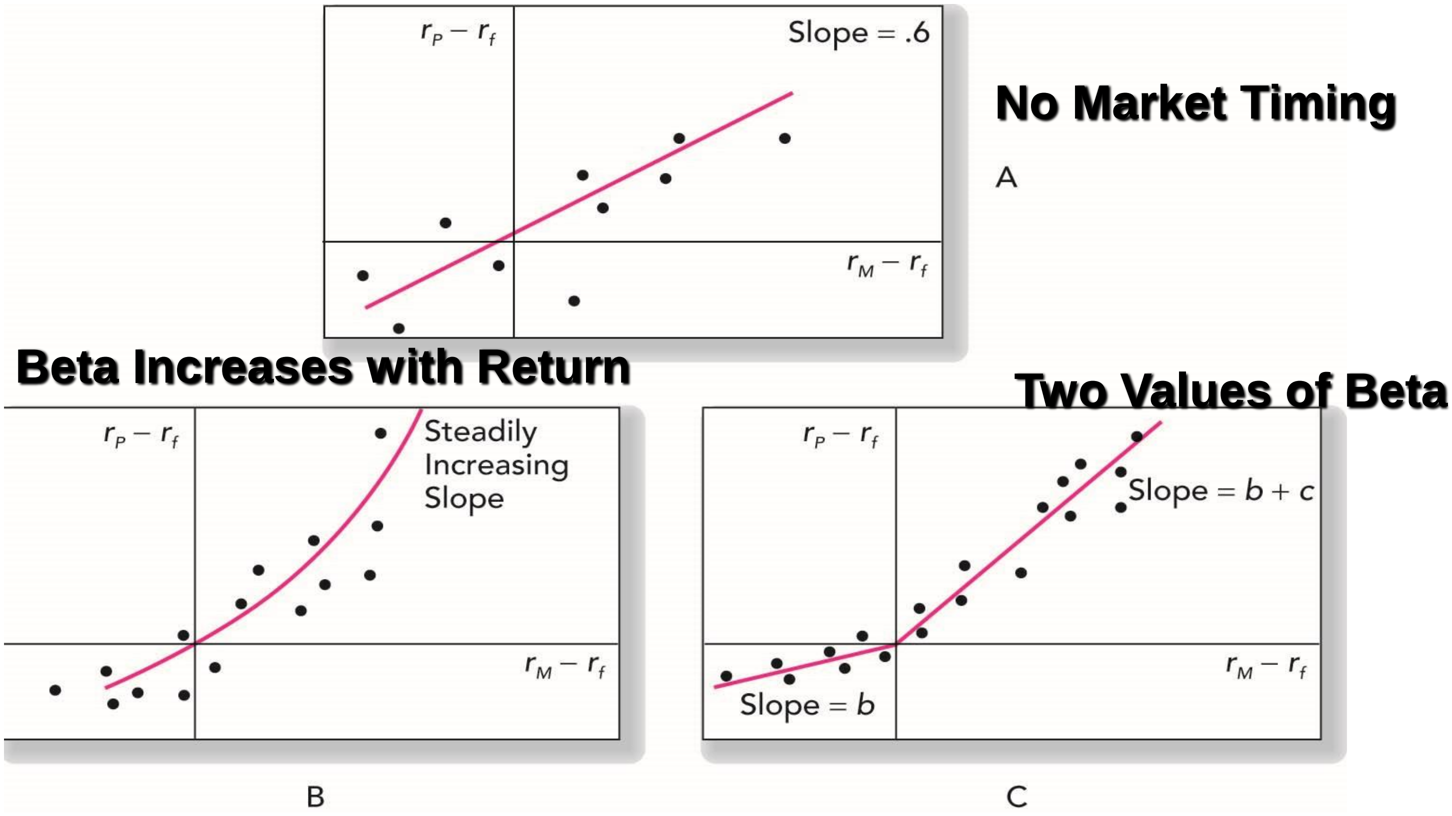
Market Timing and Characteristic lines – Revision last session



innovate achieve lead

How do you test such relationship?...

Student discussion..

To be continued with data…

What is Required of a Portfolio Manager

- **The ability to derive above-average returns for a given risk class**
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Composite Portfolio Performance Measures

- Treynor Portfolio Performance Measure
- Sharpe Portfolio Performance Measure
- Jensen Portfolio Performance Measure
- The Information ratio Performance Measure

Treynor Portfolio Performance Measure

$$T_i = \frac{\left(\overline{R}_i - \overline{RFR}\right)}{\beta_i}$$

➢The numerator is the risk premium

➢The denominator is a measure of risk

➢The expression is the risk premium return per unit of risk

➢Risk averse investors prefer to maximize this value

➢This assumes a completely diversified portfolio leaving systematic risk as the relevant risk

•Where R_i bar is average rate of return for Portfolio i during the specified time period,

•RFR bar is avg. ror on risk-free investment during that period

•Beta_i is slope of the fund's characteristic line during that period

Treynor's measure -Illustration

Assume the market return is 14% and risk-free rate is 8%. The average annual returns for Managers W, X, and Y are 12%, 16%, and 18% respectively. The corresponding betas are 0.9, 1.05, and 1.20. What are the T values for the market and managers?

– The T Values

T_M = (14%-8%) / 1 =6%

T_W = (12%-8%) / 0.9 =4.4%

T_X = (16%-8%) / 1.05 =7.6%

T_Y = (18%-8%) / 1.20 =8.3%

If beta is negative and risk premium is positive, we get negative T values. To compare portfolio performance, compare the expected return to actual return

Sharpe Measure - Illustration

Assume the market return is 14% with a standard deviation of 20%, and risk-free rate is 8%. The average annual returns for Managers D, E, and F are 13%, 17%, and 16% respectively. The corresponding standard deviations are 18%, 22%, and 23%. What are the Sharpe measures for the market and managers?

- The Sharpe Measures

  S_M = (14%-8%) / 20% =0.300

  S_D = (13%-8%) / 18% =0.273

  S_E = (17%-8%) / 22% =0.409

  S_F = (16%-8%) / 23% =0.348

Sharpe Portfolio Performance Measure

➢Shows the risk premium earned over the risk free rate per unit of standard deviation

➢Sharpe ratios greater than the ratio for the market portfolio indicate superior performance

The Formula

$$S_i = \frac{\overline{R}_i - \overline{RFR}}{\sigma_i}$$

where:

σ_i = the standard deviation of the rate of return for Portfolio *i*

Or recently used – standard deviation of the portfolio returns in excess of a risk free rate

Sharpe Measure - Illustration

Assume the market return is 14% with a standard deviation of 20%, and risk-free rate is 8%. The average annual returns for Managers D, E, and F are 13%, 17%, and 16% respectively. The corresponding standard deviations are 18%, 22%, and 23%. What are the Sharpe measures for the market and managers?

– The Sharpe Measures

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Sharpe Measure versus Treynor measure

- Sharpe uses standard deviation of returns as the measure of risk
- Treynor measure uses beta (systematic risk)
- The methods agree on rankings of completely diversified portfolios
- Produce relative not absolute rankings of performance

Portfolio	Return	Beta	Standard deviation of return
P	0.15	1	0.05
Q	0.2	1.5	0.10
R	0.1	0.6	0.03
S	0.17	1.1	0.06
Market	0.13	1	0.04

1. Consider risk free rate as 6%
2. Check for diversification by calculating unsystematic risk
3. Calculate Sharpe measure for each portfolio and market portfolio. Rank based on Sharpe measure
4. Calculate Treynor measure for each portfolio and market portfolio. Rank based on Treynor measure
5. Are the ranking order similar in Sharpe and Treynor? If not, why do you think it is different?

Jensen Portfolio Performance Measure

Jensen Portfolio Performance Measure

The Formula

$$R_{jt} - RFR_t = \alpha_j + \beta_j\,[R_{mt} - RFR_t\,] + e_{jt}$$

where:

α_j = Jensen measure

- ➢Jensen measure represents the average excess return of the portfolio above that predicted by CAPM
- ➢Superior managers will generate a significantly positive alpha; inferior performance will generate a significantly negative alpha
- ➢ Jensen measure is flexible enough to allow for alternative models of risk and expected return than the CAPM. Risk-adjusted performance can be computed relative to any of the multifactor models

Information Ratio Performance measure

The Formula

$$IR_j = \frac{\overline{R}_j - \overline{R}_b}{\sigma_{ER}} = \frac{\overline{ER}_j}{\sigma_{ER}}$$

where:

R_b = the average return for the benchmark portfolio
σ_{ER} = the standard deviation of the excess return

- Information ratio measures the average return in excess that of a benchmark portfolio divided by the standard deviation of this excess return
- σ_{ER} can be called the tracking error of the investor's portfolio and it is a "cost" of active management
- IR is a benefit to cost ratio

Refer to Sortino's measure data

Motivation

February 22, 2022
11:55 PM GMT+5:30
Last Updated a month ago

Finance

Allianz fires two managers in wake of investment fund collapse

By Tom Sims

FRANKFURT, Feb 21 (Reuters) - Allianz **(ALVG.DE)** has dismissed two asset managers who oversaw a group of investment funds that collapsed after racking up massive losses when the spread of coronavirus triggered wild market swings, according to regulatory filings.

In their lawsuits, investors alleged Allianz had strayed from its stated investment strategy of hedging to limit potential losses.

In a 2016 video reviewed by Reuters, Tournant likened Structured Alpha's strategy to insurance.

"Our strategies are not race cars looking to speed their way to high returns. They're four-wheel drive vehicles designed to tackle rough terrain," he said in separate marketing material.

https://www.reuters.com/business/finance/two-allianz-managers-fired-wake-investment-fund-collapse-2022-02-21/

Sortino's measure – Performance measurement with downside risk

- The Sortino measure is a risk-adjusted measure that differs from the Sharpe ratio in two ways
  - It measures the portfolio's average return in excess of a user-selected minimum acceptable return threshold
  - It captures just the downside risk (DR) in the portfolio rather than the total risk as in Sharpe measure

$$ST_i = \frac{\overline{R}_i - \tau}{DR_i}$$

where: $\boldsymbol{\tau}$ = the minimum acceptable return threshold

DR_i = the downside risk coefficient for Portfolio i

Sortino's measure – Performance measurement with downside risk

- Downside Risk measure
  - It is the volatility of returns produced by a portfolio that fall below some hurdle rate that the investor chooses.
  - This measure implicitly assumes that investor tries to minimize the damage from returns less than some target level
  - Volatility associated with the shortfall that occurs if investment produces a return that is lower than anticipated.
  - One measure is semi-deviation

Semi-deviation =

$$\sqrt{\frac{1}{n}\sum(Rit - Ribar)^2}$$

For all R<Rbar

Where n is number of portfolio returns falling below the expected return

Problem 6

Should you diversify?

"The whole secret of investment is to find places where it's safe and wise to **non-diversify**. It's just that simple. **Diversification** is *for the know-nothing investor*; it's not for the professional." Charlie Munger

"The idea that very smart people with investment skills should have hugely **diversified** portfolios is madness. It's a *very conventional madness*. And it's taught in all the business schools. But they're wrong." Charlie Munger

"The idea of excessive **diversification** is madness." Charlie Munger

http://mastersinvest.com/diversificationquotes

Should you diversify?

"If you can identify *six wonderful businesses*, that is all the **diversification** you need. And you will make a lot of money. And I can guarantee that going into a seventh one instead of putting more money into your first one is gotta be a terrible mistake. Very few people have gotten rich on their seventh best idea. But a lot of people have gotten rich with their best idea. So I would say for anyone working with normal capital who really knows the businesses they have gone into, six is plenty, and I probably have half of what I like best. I don‘t diversify personally." Warren Buffett

In support of Diversification

Diversification is vital

Einhorn says that even the perfect inventory concepts haven't any assure of figuring out as any given firm can have any variety of hidden dangers that buyers would not have data of.

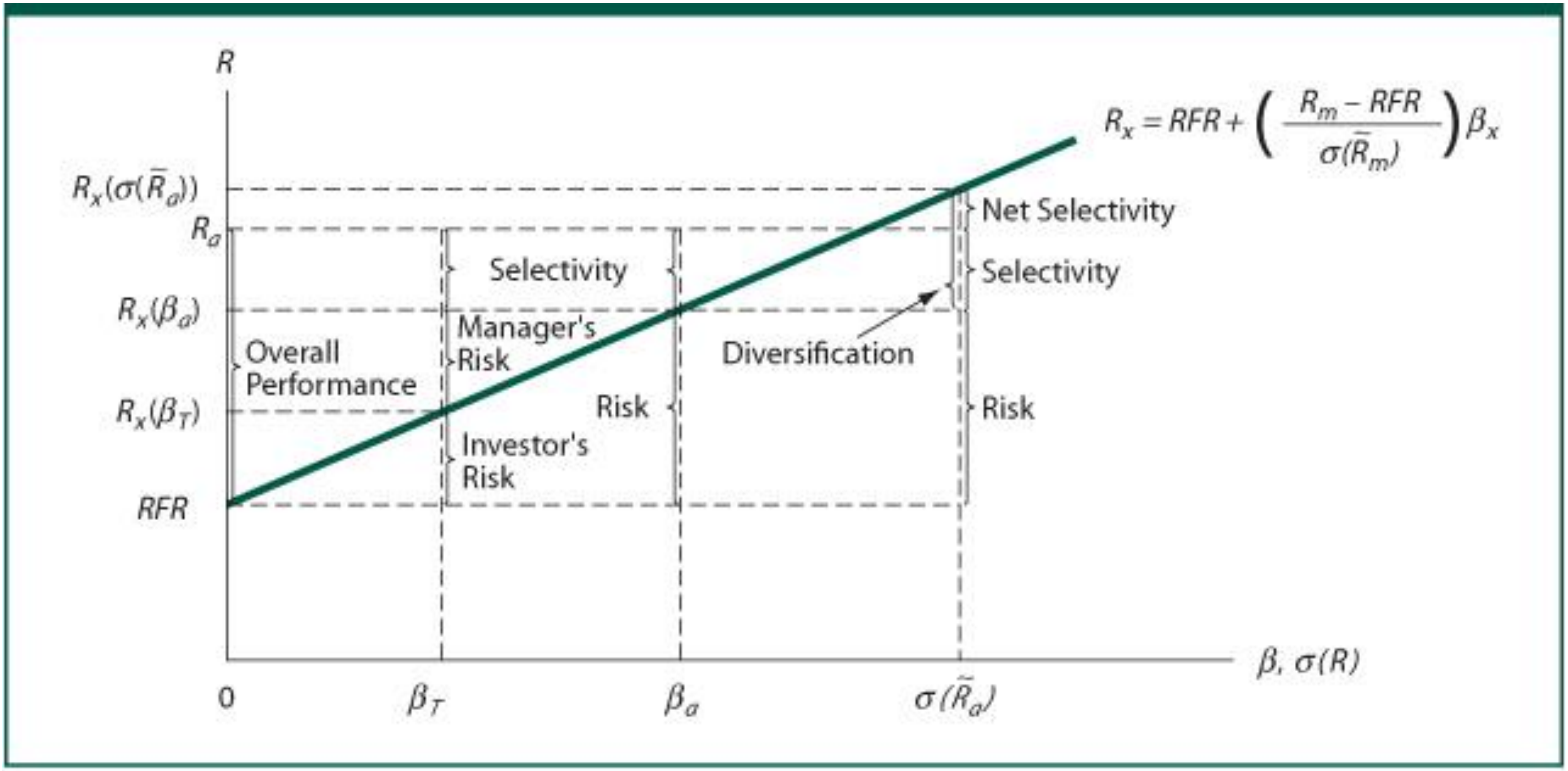
He says that is the explanation why diversification is so vital not as a result of buyers' evaluation may be unhealthy, however as a result of even the most effective evaluation on this planet may not be sufficient to come to the right conclusion when confronted with the unknown.

David Einhorn

https://www.pehalnews.in/bet-big-when-high-conviction-opportunities-come-along-david-einhorn/1770989/

Is there a way to check did selection of a mispriced security which was correlated with my already existing asset performed better?

Components of Investment Performance - Fama



Source: Eugene F. Fama, "Components of Investment Performance," *Journal of Finance* 27, no. 3 (June 1972): 588. Reprinted with permission of Blackwell Publishing.

Components of Investment Performance - Fama

Components of Investment Performance

Fama suggested overall performance, in excess of the risk-free rate, consists of two components:

Overall Performance =Excess return

=Portfolio Risk + Selectivity

The selectivity component represents the portion of the portfolio's actual return beyond that available to an unmanaged portfolio with identical systematic risk and is used to assess the manager's investment prowess

Questions ?

BITS Pilani
Hyderabad Campus

BITS Pilani presentation

Dr. Nivedita Sinha
Department of Economics & Finance

Security Analysis & Portfolio Management
Session 15

What is Required of a Portfolio Manager - Revision

- The ability to derive above-average returns for a given risk class
  - Good stock selection
  - Good market timing also called good allocation

- The ability to diversify the portfolio completely to eliminate unsystematic risk relative to the portfolio’s benchmark

Jensen Portfolio Performance Measure

Jensen Portfolio Performance Measure

The Formula

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where:

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- Jensen measure represents the average excess return of the portfolio above that predicted by CAPM
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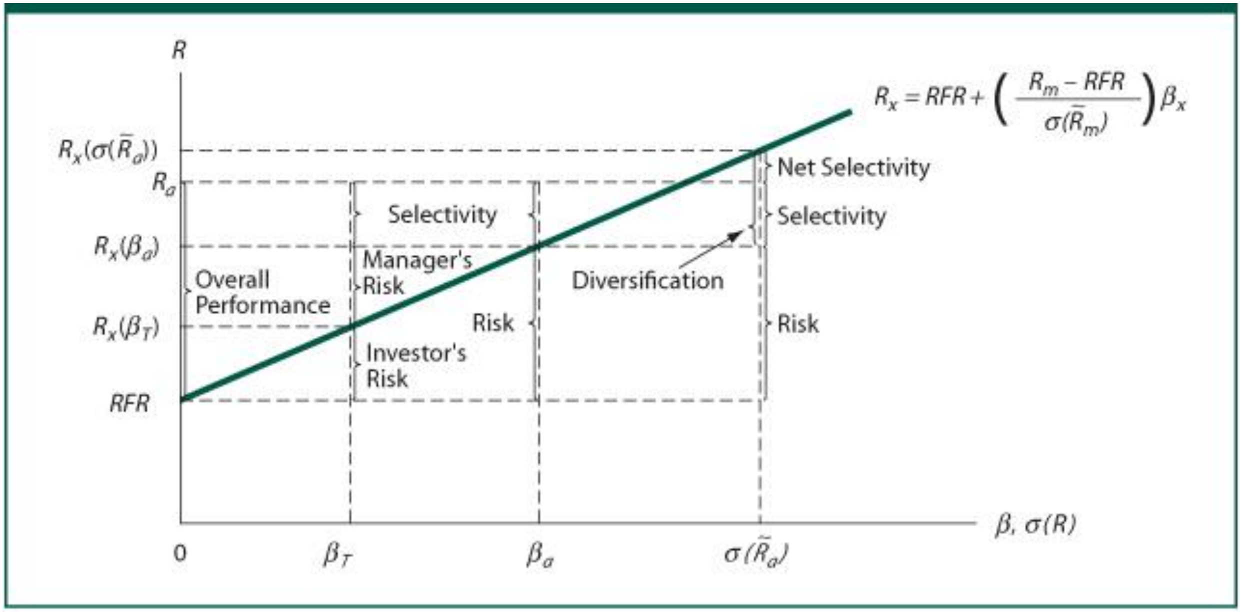
Components of Investment Performance - Fama



Source: Eugene F. Fama, "Components of Investment Performance," *Journal of Finance* 27, no. 3 (June 1972): 588. Reprinted with permission of Blackwell Publishing.

Motivation

You wouldn't look at a team's past record to evaluate its chance of success this year; you would consider the new roster (official list of players on a sports team) and coach.
The same is true with portfolios of investments. Whether you're evaluating a portfolio of individual stocks and bonds or that of a fund manager, the underlying holdings are constantly evolving both in terms of representation and their reaction to different events. Therefore, a holdings-based style analysis, which evaluates a portfolio by those holdings (*or what it currently is*), can be considered more relevant than returns-based style analysis, which evaluates a portfolio based on its historical returns (*or what it previously did*).
When a portfolio is outperforming, holdings-based style analysis will show you the true source of these gains so you can determine how to keep growing your client's investments.
A returns-based style analysis would only show that the fund is outperforming, without explaining the source of these gains—which may include high-momentum stocks from the previous year. It would be like looking at the raw numbers that make up a team's record, rather than digging into the precise factors that contributed to those wins and losses.
You need to take a closer look at the specific elements that make up the portfolio—or team—in order to be successful.

https://www.morningstar.com/insights/2019/04/05/holdings-based

Returns based Performance measure

There are two distinct advantages to assessing performance based on investment returns

- Returns are usually easy for the investor to observe on a frequent basis

- Represent the bottom line that the investor actually takes away from the portfolio manager's investing prowess

Holdings based Performance measure

- Returns-based measures of performance are indirect indications of the decision-making ability of a manager

- Holdings-based approach can provide additional insight about the quality of the portfolio manager –portfolio manager buys or sells which security – which security was responsible for creating the performance

Holdings based Performance measure

Grinblatt -Titman (GT) Performance Measure

- Assess the quality of the services provided by portfolio managers by looking at adjustments they made to the contents of their portfolios
- The Formula

$$GT_t = \Sigma_j \, (w_{jt} - w_{jt-1}) \, R_{jt}$$

$$\text{Average } GT = \Sigma_t \, GT_t \, / \, T$$

where:

(wjt, $wjt–1$) = the portfolio weights for the jth security at the beginning of Period t and Period t - 1, respectively,

R_{jt} = the return to the jth security during Period t,

which begins on Date t - 1 and ends on Date t

Holdings based Performance measure

Characteristic Selectivity (CS) Performance Measure

- The measure compares the returns of each stock held in an actively managed portfolio to the return of a benchmark portfolio that has the same aggregate investment characteristics as the security in question

- The Formula

$$CS_t = \Sigma_j\, w_{jt}\, (R_{jt} - R_{Bjt})$$

$$\text{Average } CS = \Sigma_t\, CS_t / T$$

where: R_{Bjt} = the Period t return to a passive portfolio whose investment characteristics are matched at the beginning of Period t with those of Stock j

Performance Attribution analysis

Performance Attribution Analysis

It attempts to distinguish the source of the portfolio's overall performance

- Selecting superior securities
- Demonstrating superior timing skills

The Formula

$$\text{Allocation Effect} = \Sigma_i \left[\left(W_{ai} - W_{pi} \right) \times \left(R_{pi} - R_p \right) \right]$$

$$\text{Selection Effect} = \Sigma_i \left[\left(W_{ai} \right) \times \left(R_{ai} - R_{pi} \right) \right]$$

where:

w_{ai}, w_{pi} = the investment proportions of the *i*th *market segment* in the manager's portfolio and the benchmark policy portfolio, respectively

R_{ai}, R_{pi} = the investment return to the *i*th market segment in the manager's portfolio and the benchmark policy portfolio, respectively

Performance Attribution analysis

The Formula

Allocation Effect $= \Sigma_i \left[(W_{ai} - W_{pi}) \times (R_{pi} - R_p) \right]$

Selection Effect $= \Sigma_i \left[(W_{ai}) \times (R_{ai} - R_{pi}) \right]$

Allocation effect measures the manager's decision to overweight or underweight a particular market segment in terms of that segment's return performance relative to the overall return to the benchmark.

-**Measures good timing skills**

-**Selection effect** measures the manager's ability to create specific market segment portfolios that generate superior market returns relative to how those market segments are defined in the benchmark, weighted by manager's actual investment proportions

Questions ?

BITS Pilani presentation

BITS Pilani
Hyderabad Campus

Dr. Nivedita Sinha
Department of Economics & Finance

Security Analysis & Portfolio Management (SAPM)

Agenda

Fundamental Analysis

Intrinsic value calculations

Motivation

Buy Aurobindo Pharma, target price Rs 785: Axis Securities

ETMarkets.com • Last Updated: Mar 28, 2022, 11:58 AM IST

SHARE FONT SIZE SAVE PRIN

Synopsis
Aurobindo Pharma Ltd., incorporated in the year 1986, is a Large Cap company (having a market cap of Rs 42046.95 Crore) operating in Pharmaceuticals sector.

Promoters held 51.83 per cent stake in the company as of 31-Dec-2021, while FIIs owned 22.74 per cent, DIIs 15.11 per cent.

Axis Securities has buy call on Aurobindo Pharma with a target price of Rs 785. The current market price of Aurobindo Pharma is Rs 713.15. Time period given by a

Aurobindo Phar

target.

Aurobindo Pharr
1986, is a Large C
of Rs 42046.95 C
Pharmaceuticals

Aurobindo Phar
Segments includ
Incentives, Scrap
ending 31-Mar-2

RELATED

Buy Jindal Steel & Power, target price Rs 590: Axis Securities

Buy Healthcare Global Enterprises, target price Rs 330: Axis Securities

Buy Prestige Estates Projects, target price Rs 505: ICICI Direct

Fundamental Tips

Company Name	Tips (Reco Date)	Target Price	CMP (Returns)	Time Frame	Investment Logic
GR Infraprojects	BUY (24 Mar)	1,775	1,449.20 (0.43%)	1 year	View
CreditAccess Grameen	BUY (21 Mar)	831	845.25 (11.81%)	1 year	View
Cipla	BUY (14 Mar)	1,200	1,018.35 (-2.08%)	1 year	View
Indiamart Intermesh	BUY (14 Mar)	6,800	4,373.25 (0.47%)	1 year	View
JK Cement	BUY (14 Mar)	3,100	2,251.10 (-1.96%)	1 year	View
Kotak Mahindra Bank	BUY (14 Mar)	1,941	1,725.00 (-2.10%)	1 year	View
Infosys	BUY (07 Mar)	1,895	1,873.45 (8.73%)	1 year	View

https://economictimes.indiatimes.com/markets/stock
pharma-target-price-rs-785-axis-securities/articleshow/90489176.cms

Fundamental Analysis

- **Intrinsic Value estimation (Valuation) to understand the fair price of the stock**

Problem 1

1. Reema, a lead fundamental analyst was trying to calculate the intrinsic value of X co. stock in order to provide some investment recommendations (buy, sell or hold) on the stock. Stock of X co. was currently trading in the market at ₹200 per share. X Co. just gave a dividend of ₹6.00 per share. It is expected that dividend will grow by 8.00% over the next 3 years. Subsequently, dividend will grow by 6.00% indefinitely. The relevant cost of capital is estimated at 10.00%. What is the intrinsic value of the stock per share (**nearest integer**) and what should the investment recommendation be (buy, sell or hold) for this stock? (Note: If IV> Market Stock price, buy; if IV<Market Stock price; sell and if IV=Market Stock price; hold where IV is intrinsic value.) **Provide the Equations as well.**

a) ₹168, buy

b) ₹225, buy

c) ₹168, sell

d) ₹225, sell

e) None of the above…….What is your answer?

Equations:

innovate achieve lead

Problem 2

An analyst was trying to calculate the intrinsic value (IV) of ABC Co. stock to provide some investment recommendations (buy, sell) on the stock. ABC Co. just gave (at t=0) a dividend of ₹5.00 per share. EPS (Earnings per share) currently (at t=0) is ₹20 per share. The company plans to maintain the same (as t=0) dividend payout ratio every year for the next four years. The return on retained earnings is expected to be the same as the historical ROE of 20% per annum EAR for all years till perpetuity. After four years, the dividend payout ratio will be 50% every year until perpetuity, with the ROE remaining the same as before (causing the growth rate in dividends to change from 5th year onwards, i.e., 5-6 and so on). The stock of ABC co. was currently trading in the market at ₹80 per share (Market price) after the dividend is paid at t=0. (Note: If IV> Market Stock price, buy; if IV<Market Stock price; sell where IV is intrinsic value.).What is the intrinsic value (range in ₹ per share) of the stock today if the discount rate is 30%, and What should the investment recommendation be (buy, sell) for this stock today?

Problem 3

1. A stock of X Co. just gave a dividend of Rs.6 per share. It is expected that dividends will grow by 8.00% over the next 3 years (0-1, 1-2, 2-3, 3-4 years); dividend payout of 20% and ROE as 10%. Beyond 3 years, X Co. will be retaining 50% of the earnings and investing in a project which is expected to return a 10% p.a. (EAR) return on equity (ROE) from the investment. This retention ratio of 50% is going to continue forever thereafter, and the ROE is also expected to continue at 10% p.a. EAR forever thereafter. The relevant cost of equity capital is estimated at 10.00% p.a. compounded annually. Assuming you plan to buy the stock at the end of Year 3 and plan to hold it for two years (at which point you will sell it at the end of Year 5), what is your expected capital gains yield (return due to just appreciation in price)? (Price of the share is the present value of future expected dividends).

How to Value Stocks?

Two broad categories of Valuing models

1. Absolute Valuation models (based on fundamentals)
    - Dividend Discount model
    - NPVGO model
    - Discounted CF model (where you forecast the free cash flows and find the Present value of forecasted free cash flows)

2. Relative Valuation models (based on comparison)
    - Price/Earnings multiple
    - EV/EBITDA multiple

Dividend Discount model

- The value of any asset is the present value of its expected future cash flows.
- Stock ownership produces cash flows from:
    - Dividends
    - Capital Gains

Investor 1: Buys stock at Year 0 and holds it for one year. At the End of year 1 he sells it.

$P_0 = Div_1/(1+R) \; + \; P_1/(1+R)$..................................(1)

Now there has to be a buyer to buy it at P1. Why will he buy at P1? Buyer determines the Price P1 (again he buys it at 1 and sells it at end of year 2)

$P_1 = Div_2/(1+R) + P_2/(1+R)$....................................(2)

And so on

Putting value of P1 from equation 2 in equation 1 we get

$P_0 = Div_1/(1+R) + Div_2/(1+R)^2 + \; P_2/\,(1+R)^2$

If we put the value of P_2 in terms of Div_3 and so on we get

$P_0 = Div_1/(1+R) + Div_2/(1+R)^2 + Div_3/(1+R)^3 +$.....

Dividend Discount model contd.

- The price of a stock is equal to the present value of all expected future dividends

Which is the same as saying

- The price of a stock is equal to the present value of sum of next period's dividend and next period's stock price.

How do we estimate all future dividend payments?

Estimating Dividends

- Constant dividend (Zero growth)
  - The firm will pay a constant dividend forever
  - The price is computed using the perpetuity formula
- Constant dividend growth (Constant growth) – Gordon growth model
  - The firm will increase the dividend by a constant percent every period
- Supernormal growth (Differential growth)
  - Dividend growth is not consistent initially, but settles down to constant growth eventually

Dividend Discount models – Zero growth

Assume that dividends will remain at the same level forever

$$\mathrm{Div}_1 = \mathrm{Div}_2 = \mathrm{Div}_3 = \cdots$$

Since future cash flows are constant, the value of a zero growth stock is the present value of a perpetuity:

$$P_0 = \frac{\mathrm{Div}_1}{(1+R)^1} + \frac{\mathrm{Div}_2}{(1+R)^2} + \frac{\mathrm{Div}_3}{(1+R)^3} + \cdots$$

$$P_0 = \frac{\mathrm{Div}}{R}$$

Dividend Discount models – Constant Growth (Gordon Growth formula)

Assume that dividends will grow at a constant rate, g, forever, *i.e.*,

$$\mathrm{Div}_2 = \mathrm{Div}_1(1+g)$$

$$\mathrm{Div}_3 = \mathrm{Div}_2(1+g)$$

Since future cash flows grow at a constant rate forever, the value of a constant growth stock is the present value of a growing perpetuity:

$$P_0 = \frac{\mathrm{Div}_1}{R-g}$$

;R>g for the above formula to hold

Constant Growth Example

Suppose Big D, Inc., just paid a dividend of $.50. It is expected to increase its dividend by 2% per year. If the market requires a return of 15% on assets of this risk level, how much should the stock be selling for?

P_0 = .50(1+.02) / (.15 - .02) = $3.92

Dividend Discount models – Differential growth

- Assume that dividends will grow at different rates in the foreseeable future and then will grow at a constant rate thereafter.

- To value a Differential Growth Stock, we need to:
  - Estimate future dividends in the foreseeable future.
  - Estimate the future stock price when the stock becomes a Constant Growth Stock
  - Compute the total present value of the estimated future dividends and future stock price at the appropriate discount rate

Differential Growth

Assume that dividends will grow at rate g_1 for N years and grow at rate g_2 thereafter.

$$\text{Div}_1 = \text{Div}_0(1+g_1)$$

$$\text{Div}_2 = \text{Div}_1(1+g_1) = \text{Div}_0(1+g_1)^2$$

$$\vdots$$

$$\text{Div}_N = \text{Div}_{N-1}(1+g_1) = \text{Div}_0(1+g_1)^N$$

$$\text{Div}_{N+1} = \text{Div}_N(1+g_2) = \text{Div}_0(1+g_1)^N(1+g_2)$$

$$\vdots$$

Differential Growth

Dividends will grow at rate g_1 for N years and grow at rate g_2 thereafter

$$\text{Div}_0(1+g_1) \qquad \text{Div}_0(1+g_1)^2$$

$$0 \qquad 1 \qquad 2 \qquad \cdots$$

$$\text{Div}_0(1+g_1)^N$$

$$\text{Div}_N(1+g_2)$$
$$= \text{Div}_0(1+g_1)^N(1+g_2)$$

$$\cdots \qquad N \qquad N+1 \qquad \cdots$$

Differential Growth

We can value this as the sum of:

- an N-year annuity growing at rate g_1

$$P_A = \frac{C}{R - g_1}\left[1 - \frac{(1+g_1)^N}{(1+R)^N}\right]$$

- plus the discounted value of a perpetuity growing at rate g_2 that starts in year N+1

$$P_B = \frac{\left(\dfrac{\mathrm{Div}_{\mathrm{N+1}}}{R - g_2}\right)}{(1+R)^N}$$

Example

A common stock just paid a dividend of $2. The dividend is expected to grow at 8% for 3 years, then it will grow at 4% in perpetuity.
What is the stock worth? The discount rate is 12%.

With the Formula

$$P = \frac{\$2 \times (1.08)}{.12 - .08}\left[1 - \frac{(1.08)^3}{(1.12)^3}\right] + \frac{\left(\dfrac{\$2(1.08)^3(1.04)}{.12 - .04}\right)}{(1.12)^3}$$

$$P = \$54 \times [1 - .8966] + \frac{(\$32.75)}{(1.12)^3}$$

$$P = \$5.58 + \$23.31 \qquad\qquad P = \$28.89$$

Estimates of Parameters – Growth rate of dividends

Earnings next year are expected to be the same as earnings this year unless a net investment is made

Net Investment occurs when you plowback certain earnings (or retain certain earnings)

Earnings next year = Earnings this year + Retained earnings x Return on Retained earnings

Dividing both sides by Earnings this year we get

Earnings next year/Earnings this year = 1+ (Retained Earnings/Earnings this year) x Return on Retained earnings

1+ g = 1+Retention ratio X Return on Retained earnings

Assumption: Return on retained earnings is assumed to be equal to historical Return on Equity

g = Retention ratio × Return on retained earnings (ROE)

Now growth rate in earnings = growth rate in dividends if the ratio of dividends /Earnings is constant

Estimates of Parameters – Discount rate R

- The discount rate can be broken into two parts.
  - The dividend yield
  - The growth rate (in dividends)

$$P_0 = \frac{D_1}{R - g}$$

$$R = \frac{D_1}{P_0} + g$$

$$R = \text{Dividend yield} + \text{Capital gains yield}$$

The dividend growth rate is also the stock price's growth rate since it is the rate at which value of investment grows.

Thanks

BITS Pilani
Hyderabad Campus

BITS Pilani presentation

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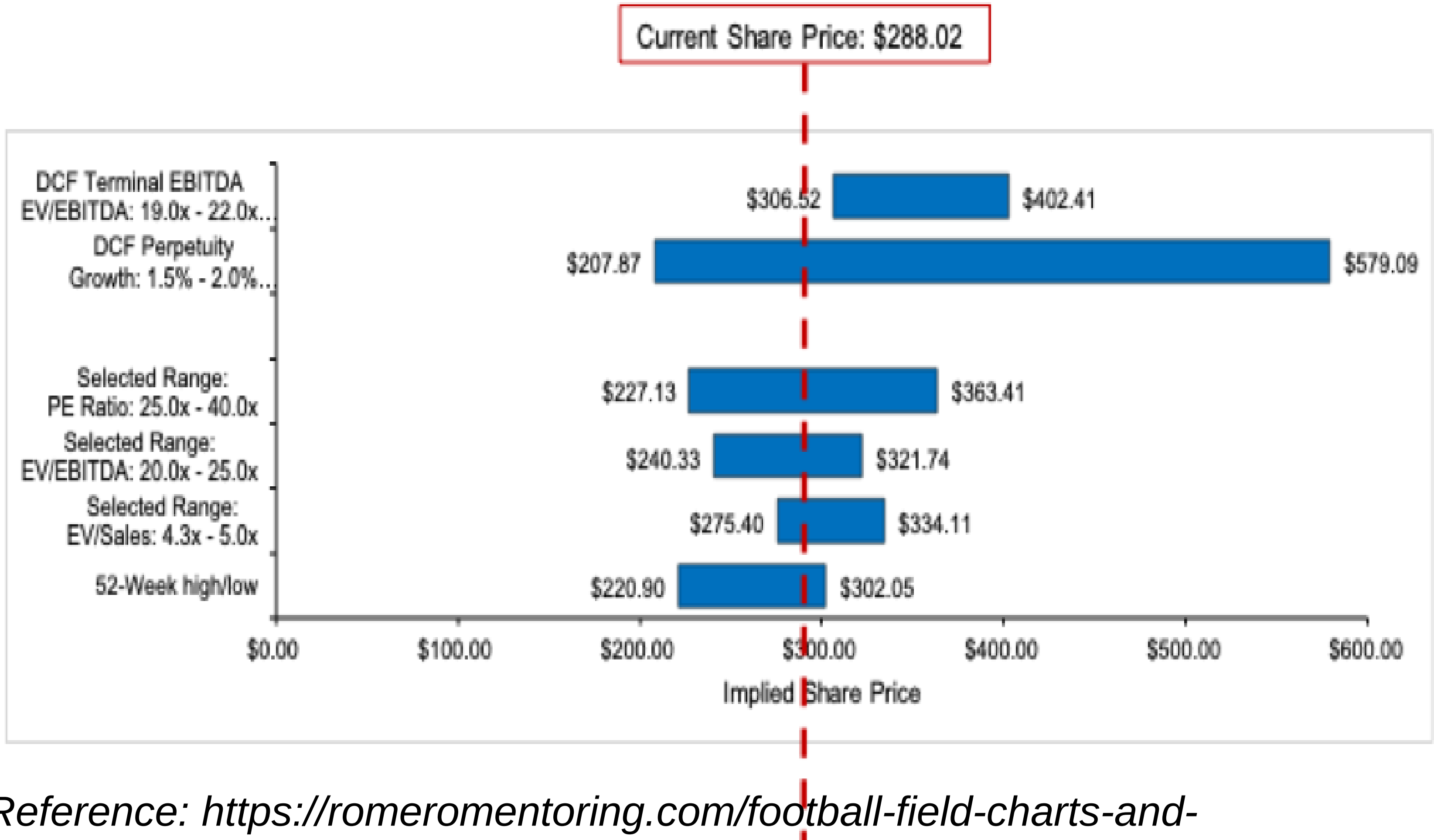
ECONF412/FINF313 SAPM
Session on Relative Valuation

Football field chart



Reference: https://romeromentoring.com/football-field-charts-and-valuations/

Practical Usage – BUY/SELL/HOLD

Value Scorecard

Value | Growth | Momentum

Value Score	MSFT: D	Industry [X]
Zacks Rank	3	
VGM Score	D	
Cash/Price	0.05	0.08
EV/EBITDA	26.34	15.95
PEG Ratio	2.66	2.62
Price/Book (P/B)	14.50	4.85
Price/Cash Flow (P/CF)	32.15	28.55
P/E (F1)	33.24	31.42
Price/Sales (P/S)	12.55	5.15
Earnings Yield	3.01%	3.01%
Debt/Equity	0.30	0.08
Cash Flow ($/share)	9.63	1.65

Reference: https://www.nasdaq.com/articles/is-trending-stock-microsoft-corporation-msft-a-buy-now
https://www.zacks.com/stock/research/MSFT/stock-style-scores

Bloomberg (RV)

innovate achieve lead

Overview | Comp Sheets | Markets | EPS Preview | Ownership | Credit | Custom

	Name (BI Peers)	Mkt Cap (INR)	Last Px (INR)	Chg Pct 1D	Chg Pct 1M	Rev - 1 Yr Gr:Y	EPS - 1 Yr Gr:Y	P/E	ROE	Dvd 12M Yld
	Median	1.46T	3314.05	0.63%	5.27%	4.61%	13.75%	36.96	18.85%	1.10%
101)	HCL TECHNOLOGIES LTD	3.22T	1187.05	1.49%	4.27%	2.40%	13.75%	26.23	20.97%	3.54%
102)	TECH MAHINDRA LTD	1.46T	1498.65	0.78%	3.10%	2.68%	9.10%	26.87	--	3.00%
103)	MINDTREE LTD	711.37B	4315.70	1.72%	11.10%	2.62%	87.37%	47.49	32.73%	0.46%
104)	WNS HOLDINGS LTD-ADR	326.55B	6688.62	3.56%	7.60%	-1.68%	-15.19%	38.19	16.69%	--
105)	TATA CONSULTANCY SVCS LTD	13.95T	3770.35	0.31%	6.98%	4.61%	3.15%	37.06	39.93%	0.95%
106)	COGNIZANT TECH SOLUTIONS-A	3.57T	6800.44	0.38%	1.27%	11.14%	38.06%	22.08	18.85%	1.10%
107)	GENPACT LTD	608.58B	3286.51	-0.02%	3.72%	8.43%	7.41%	25.11	17.97%	1.03%
108)	EXLSERVICE HOLDINGS INC	364.12B	10965.62	1.31%	17.75%	17.10%	74.00%	41.69	16.94%	--
109)	WIPRO LTD	3.32T	605.60	0.63%	5.27%	1.51%	15.16%	27.40	--	0.17%
110)	INFOSYS LTD	7.92T	1882.95	-1.08%	9.26%	10.66%	17.36%	36.96	30.53%	1.59%
111)	MPHASIS LTD	622.44B	3314.05	-0.90%	3.98%	9.94%	3.10%	50.84	18.74%	1.96%

PEG ratio

Advisor › Investing

Understanding The PEG Ratio

By Rob Berger, Benjamin Curry
Editor, Editor

What Is the PEG Ratio?

The PEG ratio compares a company's P/E ratio to its expected rate of growth, a key factor for assessing its value. A company that's expected to grow its revenue, earnings and cash flow at a high rate is, all other things being equal, more valuable than a company with little growth opportunity.

Growth companies tend to have higher P/E ratios than value companies for this reason. Investors are willing to pay more for potential growth: When they see the potential for growth, high near-term prices aren't necessarily a problem.

The question remains, however, how much an investor should be willing to pay for growth. A "growth at any cost" approach can result in paying too much even for a great company. The PEG ratio can help an investor put a price on a company's rate of growth.

How to Calculate the PEG Ratio

The math behind the PEG ratio is straightforward. One simply divides a company's P/E ratio by its expected rate of growth.

A company with a P/E ratio of 20 and an expected growth rate of 10%, for example, would have a PEG ratio of 2 (20

https://www.forbes.com/advisor/investing/peg-ratio/#:~:text=The%20math%20behind%20the%20PEG,2%20(20%20%2F%2010).

Valuation using comparables or Relative valuation - Steps

Step 1: Identify similar or comparable investments (companies) and recent market prices for each

Step 2: Calculate the *valuation metric* for use in valuing asset

Step 3: Calculate initial estimate of value

Step 4: Check for underpricing or overpricing based on estimates

Valuing by Comparables

- Comparables are used to value companies based primarily on multiples. Comparable firms are assumed to have similar multiples.

- Common multiples include:
  - Price-to-Earnings
  - Enterprise Value Ratios

Price-Earnings Ratio

- The price-earnings ratio is calculated as the current stock price divided by annual EPS.
  - *The Wall Street Journal* uses last 4 quarter's earnings

$$\text{P/E ratio} = \frac{\text{Price per share}}{EPS}$$

PE and NPVGO

- Recall, $$P = \frac{EPS}{R} + NPVGO$$
- Dividing every term by EPS provides the following description of the PE ratio:

$$PE = \frac{1}{R} + \frac{NPVGO}{EPS}$$

- So, a firm's PE ratio is positively related to growth opportunities and negatively related to risk (*R*)

Enterprise Value Ratios

- The PE ratio focuses on equity, but what if we want the value of the firm?

- Use Enterprise Value:

  EV = market value of equity + market value of debt – cash

- Like PE, we compare the value to a measure of earnings. From a firm level, this is EBITDA, or earnings before interest, taxes, depreciation, and amortization.
  - EBITDA represents a measure of total firm cash flow

- The Enterprise Value Ratio = EV / EBITDA

1. Kalkem, a pharma company is planning to hit the market with IPO issue. Kalkem posted consolidated revenues of ₹3,964 crore and a profit (net income) of ₹468.75 crore in FY15. The pharma industry companies are having a bad time on the bourses with the US Food and Drugs Administration (FDA) becoming stricter on products entering its shores. The PE ratio of pharma companies is around 32 after the correction of prices due to the stricter norms. What should be the valuation of the company Kalkem?
   a) ₹5000 crore
   b) ₹15000 crore
   c) ₹12000 crore
   d) ₹20000 crore
   e) None of the above………What is your answer?

2. If EV/EBITDA benchmark for jute industry is 20. What is the price of stock X (a Jute company) if X co. posted an EBITDA of ₹30 crore in FY15 (latest). X co. has a market value of debt as ₹100 crores and no cash balance. The no. of shares outstanding is 100 million shares.

   EV = 20*30 CRORES = 600 crores

   Market value of equity = 600-100 = 500 crores

   Share price = 500*10^7/100*10^6 = 5000/100 = 50 RS.

Relative valuation in Python using PE ratio - Optional

https://colab.research.google.com/drive/1SsIkWWHj4PQGEZiL7YU6ZiHsOiHKiuaL?usp=sharing

Thank you!

BITS Pilani
Hyderabad Campus

BITS Pilani presentation

Dr. Nivedita Sinha
Department of Economics & Finance

BITS Pilani
Hyderabad Campus

SAPM

Session 29

- Cash flows – What are the free cash flows?

FCFF and FCFE

- **Project free cash flow (FCFF):** Focuses on the CF available for distribution to both the firm's creditors and equity holder

$FCFF_{\text{levered firm}}$ = EBIT (1-T) + DA – Change in WC – CAPEX

- **FCFE (Free cash flow to equity) or EFCF:** Focusses on the CF available for distribution to firms common equity holders

$FCFE_{\text{levered firm}}$ = (EBIT – I)(1-T) +DA-CAPEX – Change in WC – P+NP-Preferred dividends

Depreciation and amortization

- Do not represent cash payments
- They arise due to matching principle in accounting (expenses be matched with revenues whenever it is reasonable), firms use it to match expenditures made for long-lived assets against the revenues they help generate
- These expenses are tax deductible
- EBIT(1-T)+ DA can be written as (EBITDA-DA)(1-T) + DA = EBITDA(1-T) –DA+DA*T +DA which is like taking Depreciation tax shield in our calculation

CAPEX

- To sustain a firm's productive capacity and provide for growth in future cash flows, firms must periodically make investments in long-lived assets
- Investments made for expanding plant capacity and replacing old equipment
- CAPEX (t) = Net PPE (t)- Net PPE (t-1) + Depreciation (t)
- CAPEX(t) = Gross PPE (t) – Gross PPE (t-1)

Changes in Operating Net Working capital

- Just as firm must invest in PPE (Property , Plant and equipment) as it is growing, it must invest in current assets such as inventories and accounts receivable.
- This investment is partially financed by increases in accounts payable and other current liabilities.
- So this additional investment is taken as change in net operating working capital
- Operating Net Working capital (t) = [Current Assets – Cash and marketable securities) – (Current Liabilities – Current portion of interest bearing debt)]
- Change in WC (t)= Operating Net WC (t) – Operating Net WC (t-1)

Thank you!

Session on Technical analysis

Instructor: Dr. Nivedita Sinha

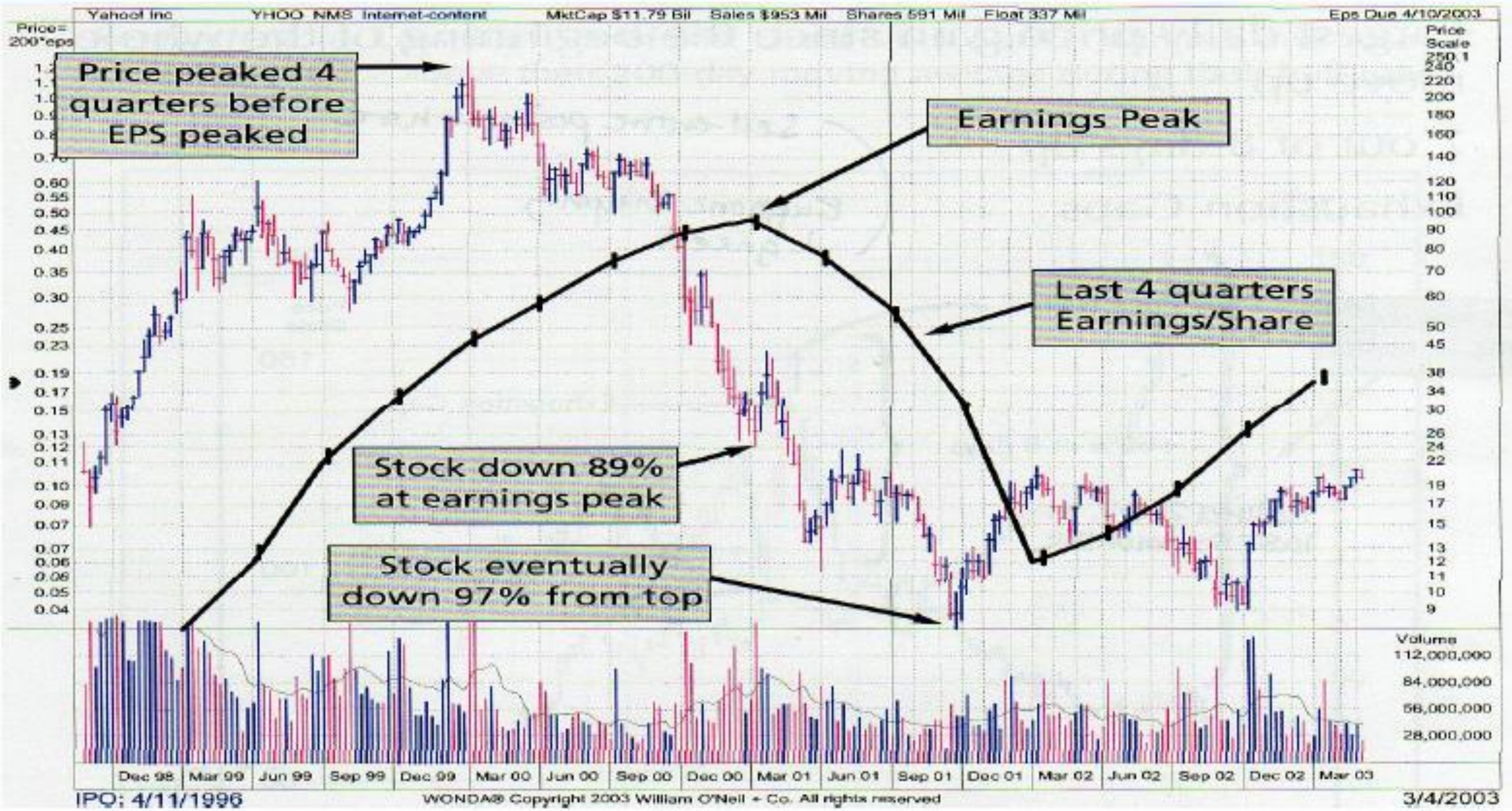
Agenda

- ✓ Technical analysis
- ✓**Indicator formulas will be provided if asked**

Fundamental Analysis (FA)

Advantages	Disadvantages
▪ Identify sound stocks ▪ Get rich through FA ▪ Develop thorough understanding of the company and industry ▪ Price Targets can be predicted	▪ Time consuming ▪ Majority of the FA information comes from company ▪ Disregards momentum ▪ Many fundamental data available after the fact ▪ Many fundamental changes take place immediately

Fundamentals can look great at the TOP!!!, So....



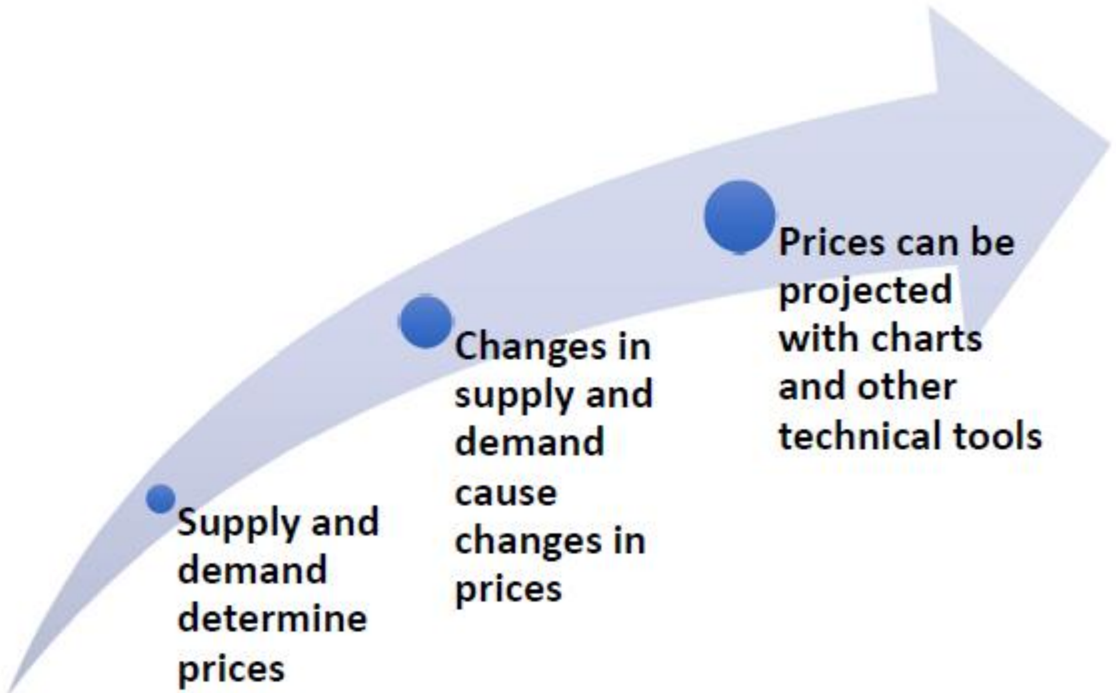
...the need for doing Technical Analysis

What is Technical Analysis?

Technical Analysis is the study of collective investor psychology forecasting the direction of prices through the study of past market data, primarily price and volume

- Market discounts everything
  - Based on the premise that all relevant information is already reflected by prices, technical analysts believe it is important to understand what investors think of that information, known and perceived.
- Patterns exist
  - Technical analysts believe that prices trend directionally, i.e., up, down, or sideways (flat) or some combination. The basic definition of a price trend was originally put forward by Dow theory.
- History repeats itself
  - Technical analysts believe that investors collectively repeat the behaviour of the investors that preceded them

The Logic of Technical Analysis



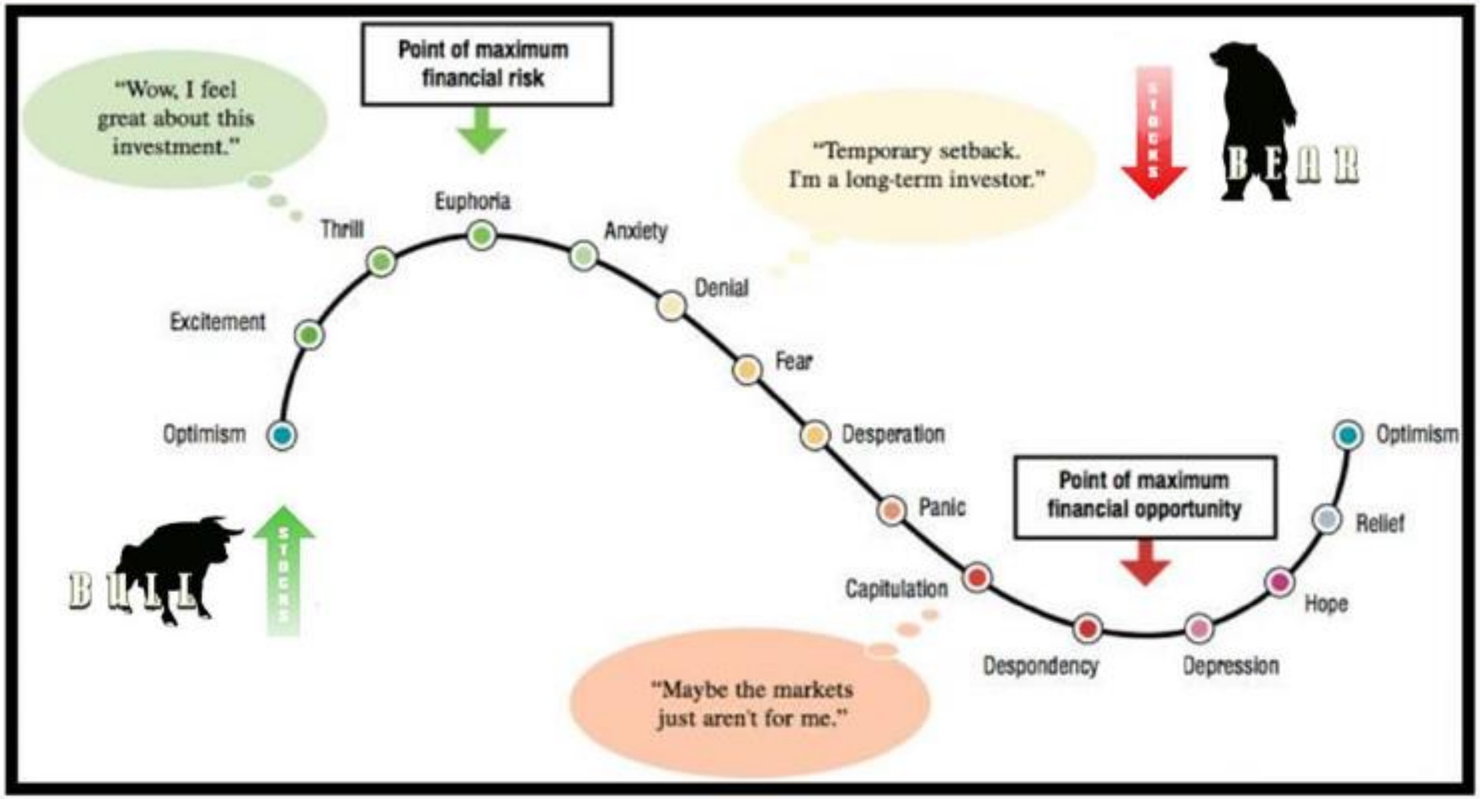
Is the logic of Technical analysis "technically" flawed?

- **Efficient Market Hypothesis**
  - Weak form efficiency: Prices reflect **all past** market information such as price and volume
  - Semi-strong form: Prices reflect **all publicly available** information including trading information, annual reports, press releases, etc
  - Strong form: prices reflect **all information**, including public and private
- **Random Walk Hypothesis**
  - Financial theory stating that stock market prices evolve according to a random walk and thus cannot be predicted. It is consistent with the efficient-market hypothesis

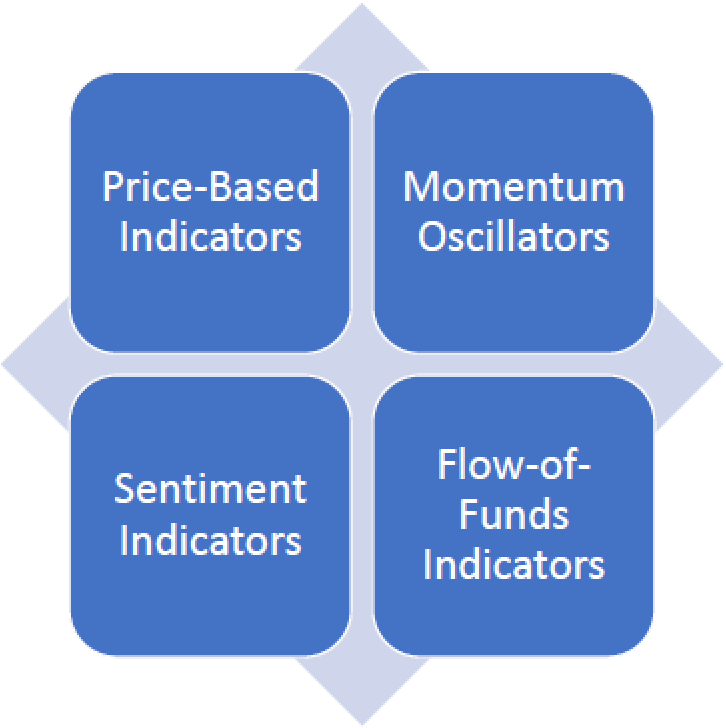
Assumptions of Technical analysis

- Human behavior is often erratic and driven by emotion.
- Market trends and patterns reflect irrational human behavior.
- Trends and patterns repeat themselves and are thus predictable.

Stock Market Cycle – Bullish and Bearish Phases



Technical Indicators



Price based - Moving Averages

Moving averages smooth the price data to form a trend following indicator.
They also form the building blocks for many other technical indicators and overlays, such as Bollinger Bands

- Simple Moving Average
  - A simple moving average is formed by computing the average price of a security over a specific number of periods. Most moving averages are based on closing prices.
  - equal weighting is given to each daily price.

  Daily Closing Prices: 11,12,13,14,15,16,17

  First day of 5-day SMA: (11 + 12 + 13 + 14 + 15) / 5 = 13

  Second day of 5-day SMA: (12 + 13 + 14 + 15 + 16) / 5 = 14

  Third day of 5-day SMA: (13 + 14 + 15 + 16 + 17) / 5 = 15

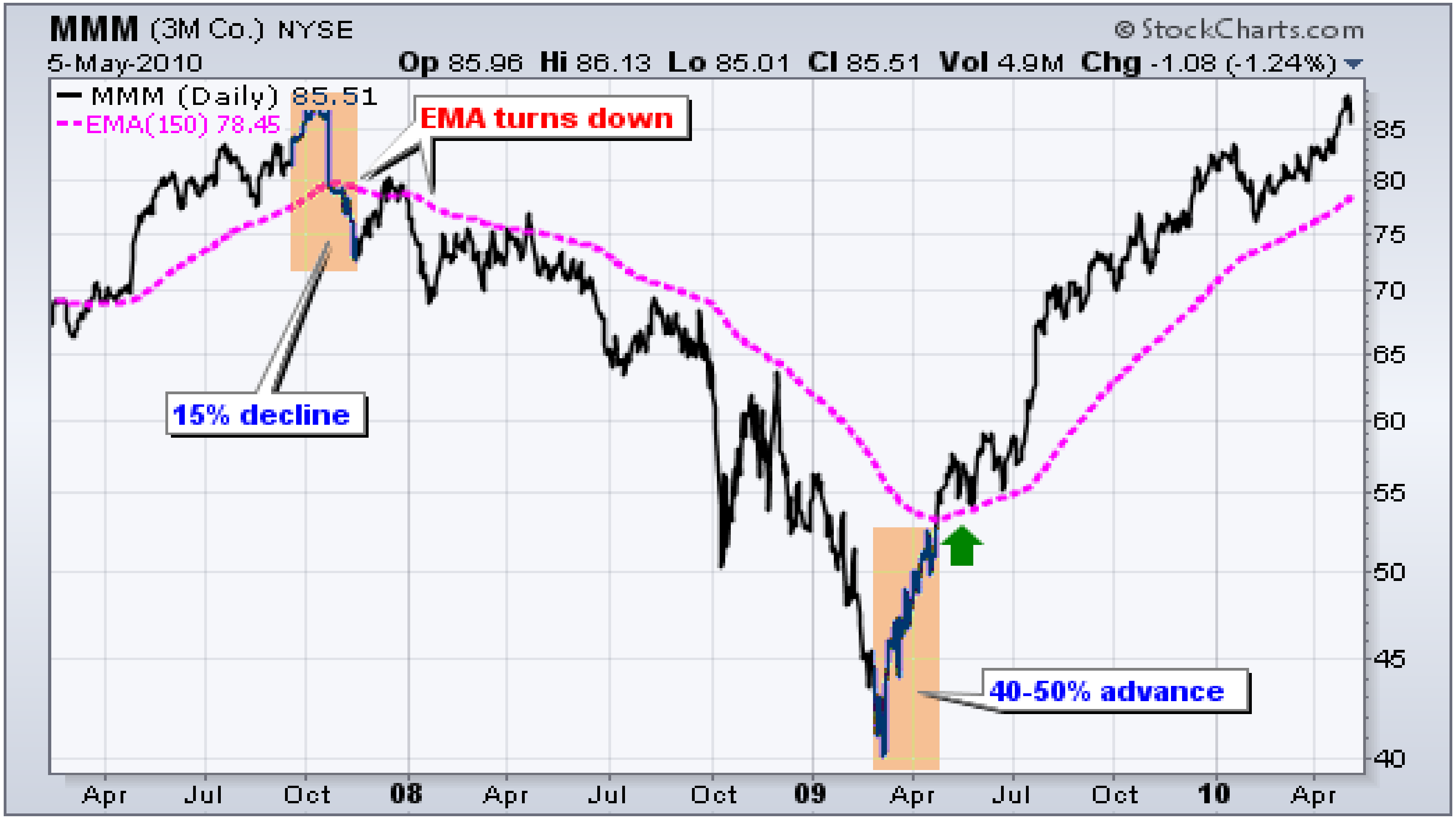
Moving Averages

- Exponential Moving average
  - Exponential moving averages reduce the lag by applying more weight to recent prices. The weighting applied to the most recent price depends on the number of periods in the moving average.

    10 day EMA

    SMA: 10 period sum / 10
    Multiplier: (2 / (Time periods + 1)) = (2 / (10 + 1)) = 0.1818 (18.18%)
    EMA: {Close - EMA(previous day)} x multiplier + EMA(previous day).

Moving Averages – Trend Identification



Trend Analysis

Trend Analysis: China Mobile Weekly Price Chart,
2002–2010 (prices in Hong Kong dollars)

Uptrend	Downtrend
Higher Highs, Higher Lows	Lower Highs, Lower Lows
Demand Exceeds Supply	Supply Exceeds Demand

Moving Averages – Trend Identification

Shorter MA lines – Reflect Shorter trends

Comparison between stock prices and Shorter MA line:-

MA line lying above the current prices – Overall price trend of a market has been down

If prices reverse and break through the MA line from below (accompanied by heavy trading volume) – it is a positive change – preliminary signal of a reversal of declining trend

If prices were rising – MA will also be rising but lie below the current prices –

If prices declined and broke through the MA line from above, - with heavy trading volume – preliminary bearish pattern

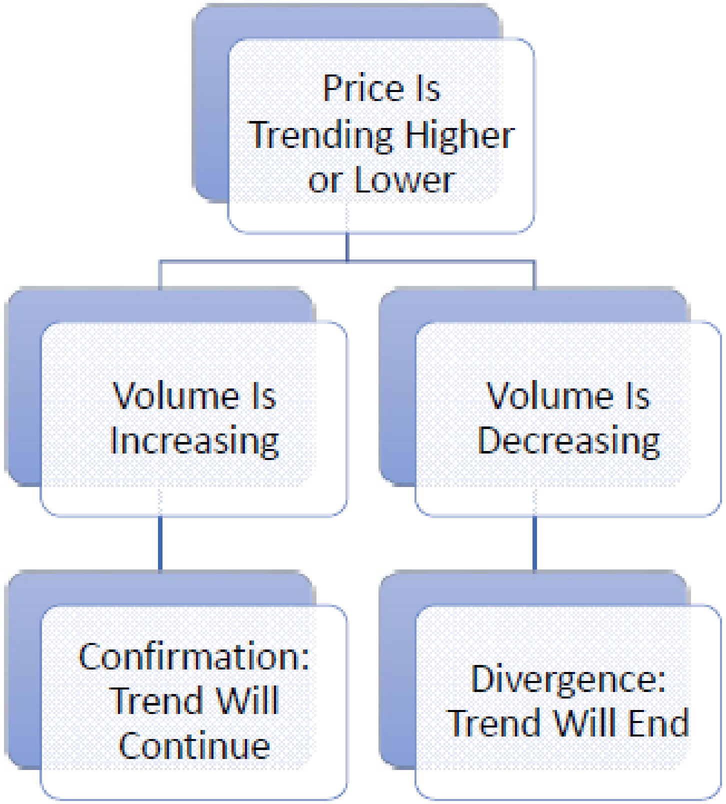
Moving Averages – Trend Identification

Double Crossovers

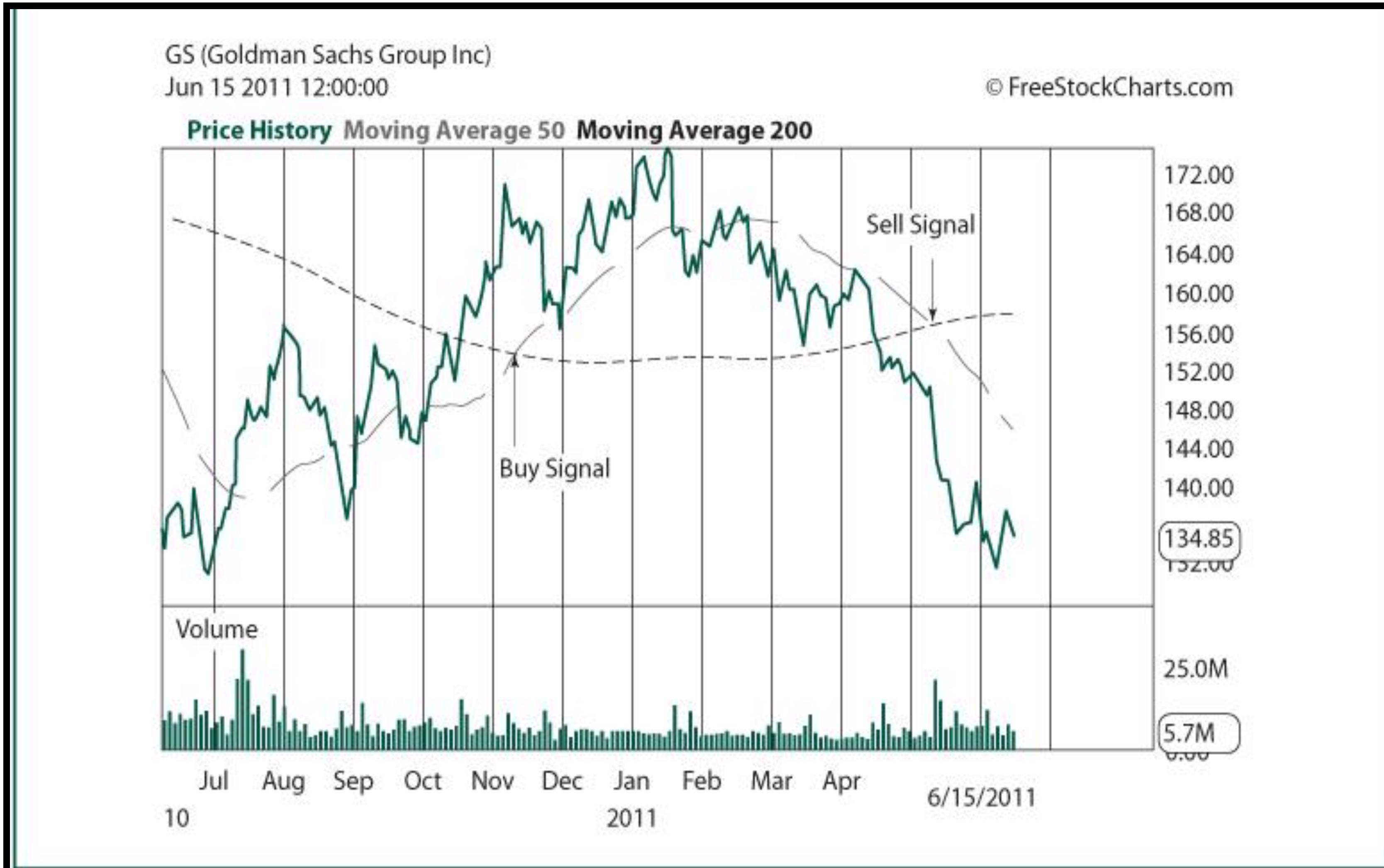
Comparison between Shorter MA line and Longer MA line:-

50 Day MA crosses 200 day MA lines from below on good volume – bullish indicator (buy signal) – confirms reversal in trend from negative to positive – Golden cross
50 Day MA crosses 200 day MA line from above on good volume confirms change to a negative trend – sell signal – this is known as a death cross

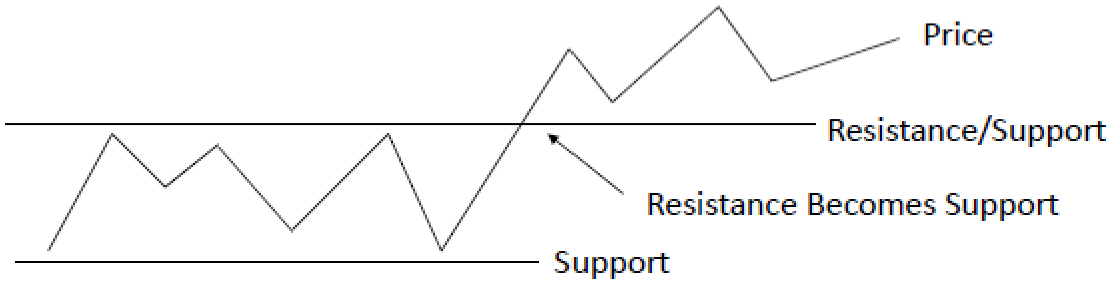
Price and Volume



Moving Averages (50-day and 200 day MA lines)



Support and Resistance



Support	• A low price range in which buying activity is sufficient to stop a decline in price
Resistance	• A high price range in which selling activity is sufficient to stop a rise in price
Change in Polarity	• Once a resistance (support) level is breached, it becomes a support (resistance) level

Bollinger Bands

Developed by John Bollinger, Bollinger Bands are volatility bands placed above and below a moving average.

•Middle Band = 20-day simple moving average (SMA)

•Upper Band = 20-day SMA + (20-day standard deviation of price x 2)

•Lower Band = 20-day SMA - (20-day standard deviation of price x 2)

•Bollinger suggests increasing the standard deviation multiplier to 2.1 for a 50-period SMA and decreasing the standard deviation multiplier to 1.9 for a 10-period SMA

Bollinger Bands

- Can be used to determine if prices are relatively high or low

- Technically, prices are relatively high when above the upper band and relatively low when below the lower band

- Upper band – Overbought territory, Lower band – Oversold territory

- Bollinger Bands are not meant to be used as a stand alone tool. Bollinger Bands should be combined with basic trend analysis and other indicators for confirmation

Example 1

INTC (Intel Corp.) Nasdaq GS
© StockCharts.com
10-Jan-2007
Open 20.98 High 21.51 Low 20.92 Close 21.41 Volume 76.8M Chg +0.49 (+2.33%)
INTC (Daily) 21.41
BB(20,2.0) 19.86 - 20.58 - 21.31
21.5
21.4
21.3
21.2
21.1
21.0
20.9
20.8
20.7
20.6
20.5
20.4
20.3
20.2
20.1
20.0
11 12 13 14 15 18 19 20 21 22 26 27 28 29 2007 4 5 8 9 10

Example 2


YHOO (Yahoo!, Inc.) Nasdaq GS
©StockCharts.com
11-Jan-2007
Open 28.76 High 29.37 Low 28.70 Close 29.20 Volume 28.9M Chg +0.50 (+1.74%)
YHOO (Daily) 29.20
BB(20,2.0) 24.39 - 26.61 - 28.83
29.25
29.00
28.75
28.50
28.25
28.00
27.75
27.50
27.25
27.00
26.75
26.50
26.25
26.00
25.75
25.50
25.25
13 14 15 18 19 20 21 22 26 27 28 29 2007 4 5 8 9 10 11

Example 3

IBM (International Business Machines) NYSE
© StockCharts.com
23-Mar-2007
Open 94.82 High 95.22 Low 94.65 Close 95.03 Volume 4.4M Chg -0.16 (-0.17%)
IBM (Daily) 95.03
BB(20,2.0) 91.10 - 93.71 - 96.32
99
98
97
96
95
94
93
92
91
90
89
20
26
Mar
5
12
19

Momentum Oscillator: Relative Strength Index

$$RSI = 100 - \frac{100}{1 + RS}$$

$$RS = \frac{\sum (\text{Up changes for the period under consideration})}{\sum (|\text{Down changes for the period under construction}|)}$$

Candlestick Chart with RSI: Ford, January–August 2009 (price in U.S. dollars)

Optional-Colab link to Technical analysis codes for some indicators

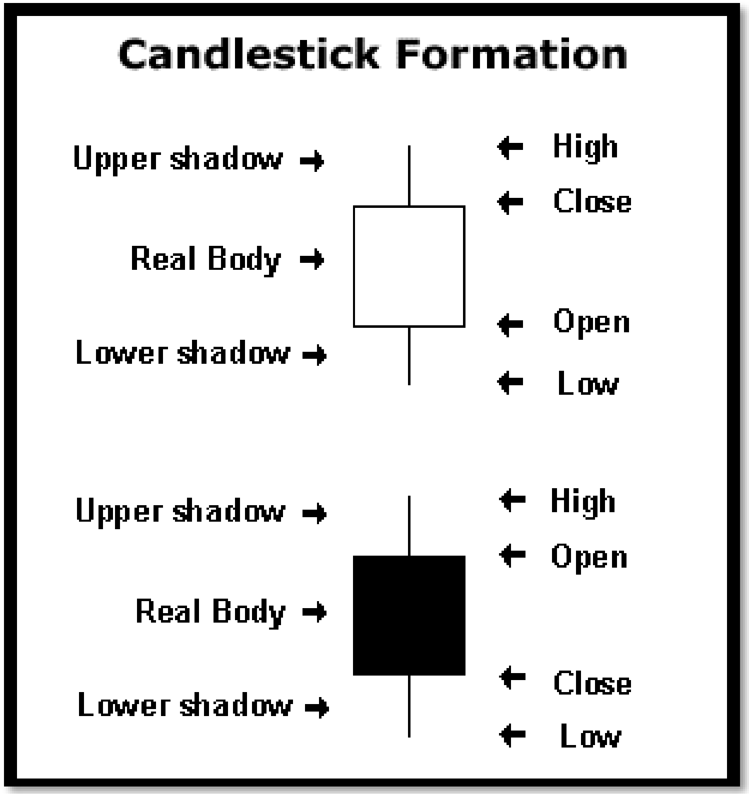
https://colab.research.google.com/drive/1FEu4mcXzst-beqsoWJAKN3fymZJbaGng#scrollTo=y8IWpIiSXC9D

MACD Oscillator

(12 day EMA – 26 day EMA) = MACD

Reference: https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/macd-oscillator-technical-analysis/

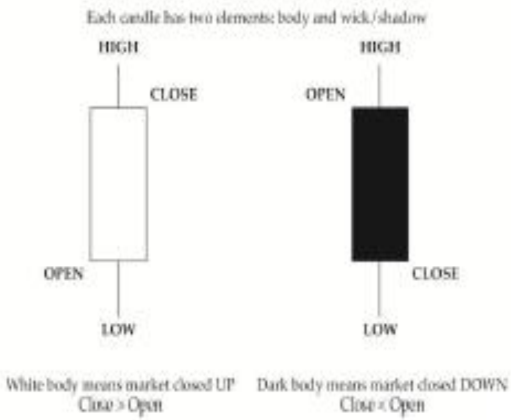
Candle- Stick charts

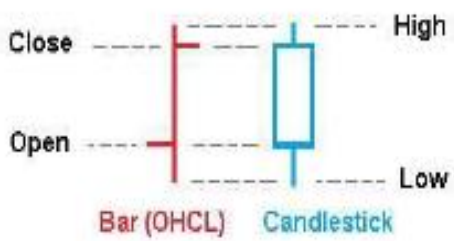


White/Hollow chart – Bullish candle stick (indicates buying pressure) – longer shows strong buying pressure

Black chart – Bearish candle stick (indicates selling pressure) –longer shows strong selling pressure

Candlestick Charts





Construction of a Candlestick Chart

Bond Characteristics

Instructor: Dr. Nivedita Sinha

Bonds

A bond is an instrument of debt issued by a business or government unit to raise capital to finance certain investments (say such as infrastructure development, etc.).

Bond issues are considered fixed income securities because they impose fixed financial obligations on the issuers :-

1. Pay a fixed amount of interest periodically to the holder.
2. Repay a fixed amount of principal at the date of maturity.

Bond Characteristics

Par value or Principal: It is the amount the entity borrows and promises to repay at maturity.

Coupon rate (Nominal yield): A bond carries a specific interest rate

Coupon rate= Coupon paid/Par value of the bond

Coupon: It is the income the bondholder will receive every period over the life (holding period) of the issue.

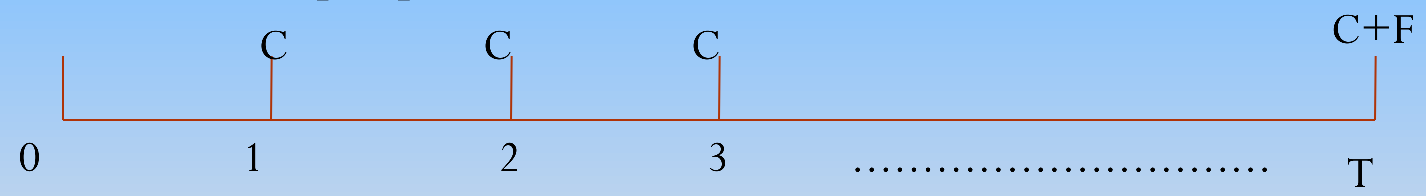
Time (term) to maturity: It is the date or the number of years before a bond matures (or expires). Time at which the par is payable to bond-holders.

Yield to maturity or Yield: The yield to maturity is the rate of return anticipated on a bond if held until maturity.

Bond Valuation

Given following bond characteristics:

1. Face value of bond is F paid at maturity
2. Coupon of C paid per period
3. T periods to maturity
4. Yield of r per period

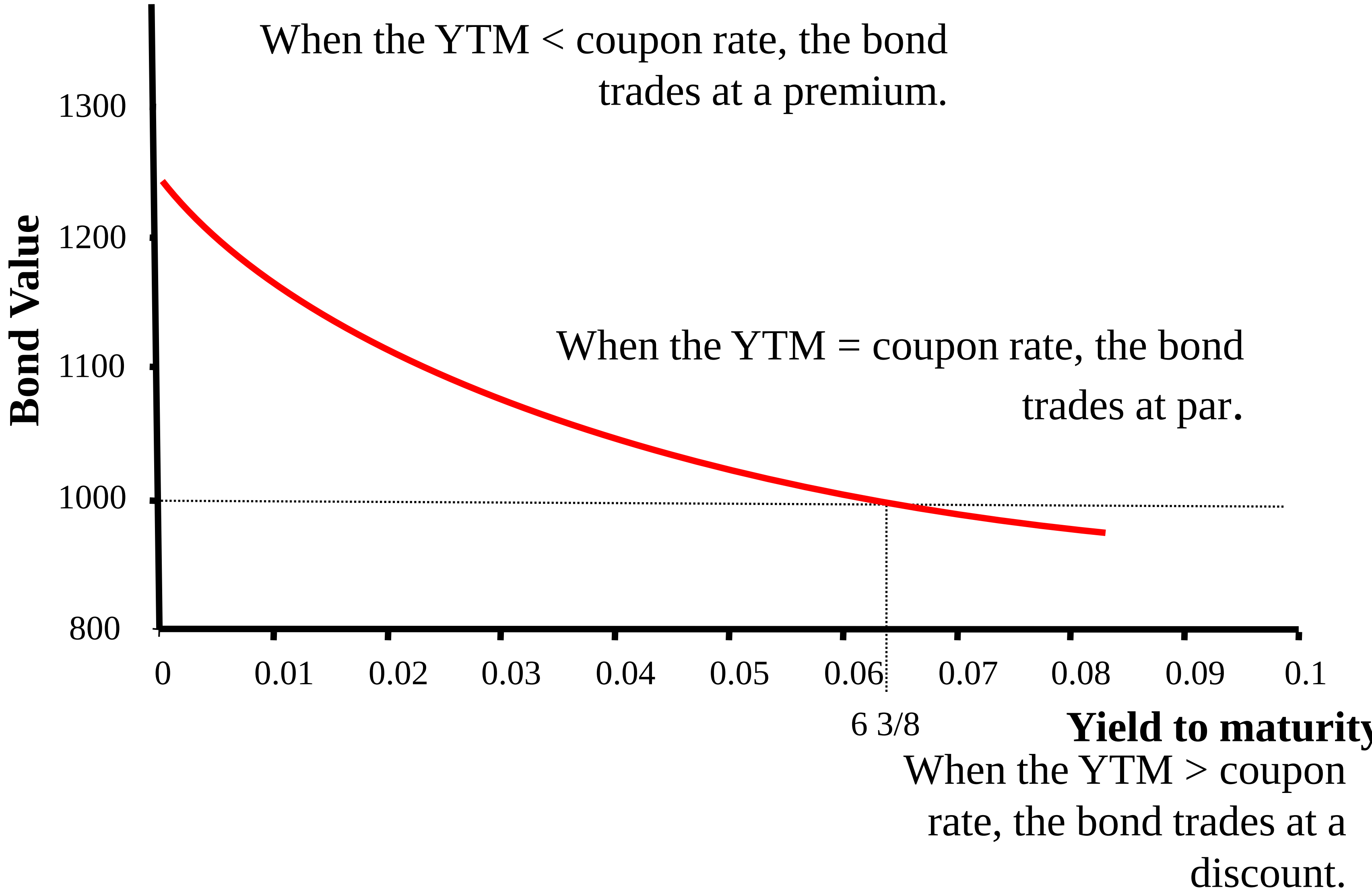


Bond Value = Present Value of coupons + Present value of the face amount

$= C/r\ [1-1/(1+r)^T] + F/(1+r)^T$

Relation between Yield and Price of bond:

Bond's price and its yield are inversely related.



Relation between Yield and Price of bond

- Interest rates are determined in the marketplace – demand and supply for bonds

- Interest rates change in the marketplace with changing macro-economic variables – because of a shift in the demand and supply curves for bonds

- When interest rates rise, the Present Value of bond's remaining cash flows declines and the bond is worth less (investors will be willing to lend something less than the promised repayment to compensate for the less coupon rate they will be receiving) – Bonds will be selling at discount

- When interest rates fall, the bond is worth more (investors will be willing to pay something more than the promised repayment to get this extra coupon amount they will be receiving) – Bonds will be selling at premium

Interest rate risk : How sensitive is the price to changes in the interest rates

Price sensitivity to interest rate changes depends on two factors:-

I. Coupon rate

All other things being equal, the lower the coupon rate, the greater is the interest rate risk (greater is the % change in price for a given change in interest rate)

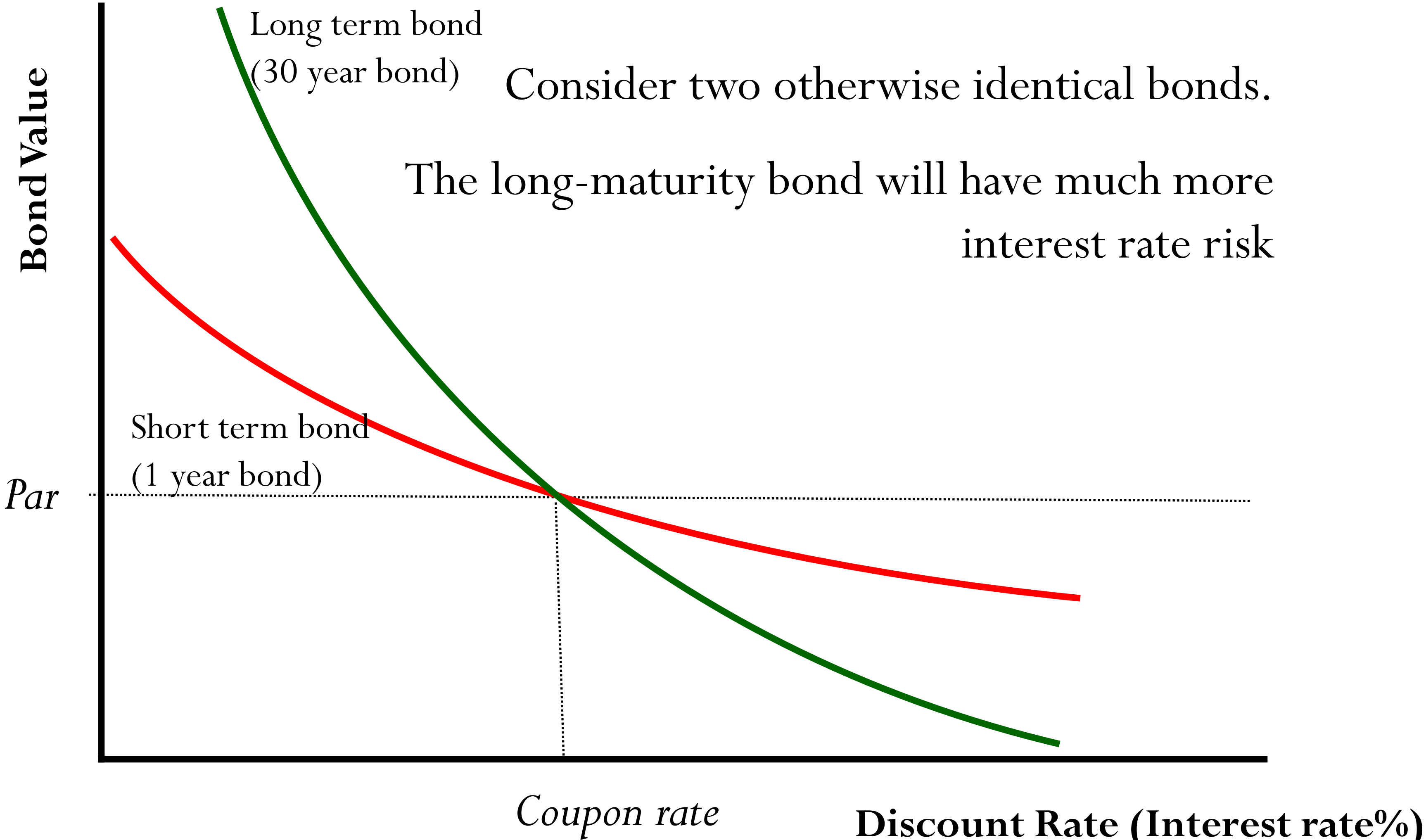
II. Time to Maturity

All other things being equal, the longer the time to maturity, the greater is the interest rate risk (greater is the % change in price for a given change in interest rate)

Interest rate risk and Term to maturity

Consider two otherwise identical bonds.

The long-maturity bond will have much more interest rate risk



Duration and Convexity

Please refer to the pdf