UNIT NO. 3

Learning Objectives

- Explain the concept of Risk and return
- Measure the concept of return and return of the portfolio
- Discuss the concept of efficient Frontier
- Discuss the CAPL and Arbitrage Pricing theory Concepts.
- Explain how the sensex and Nifty is constructed

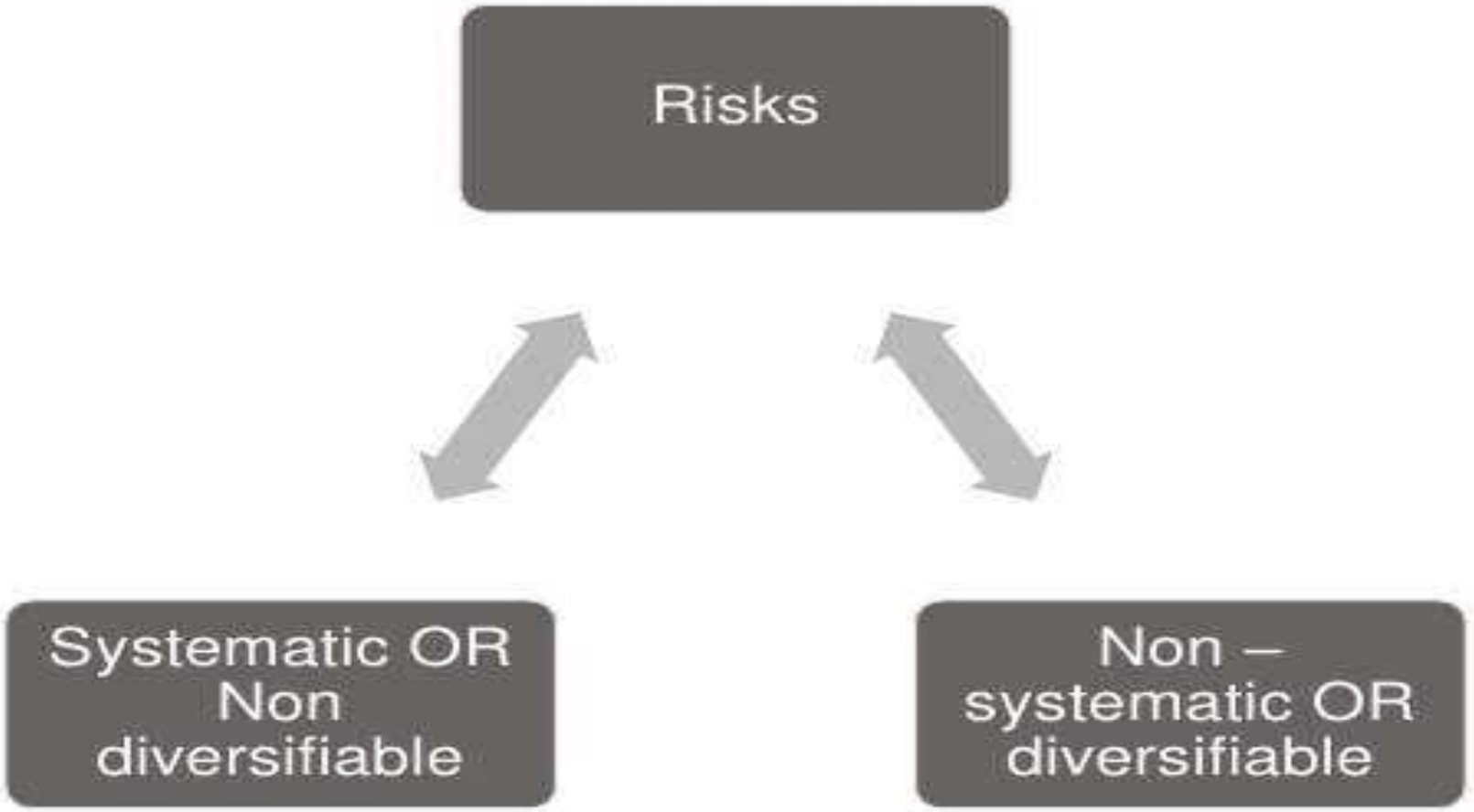
OTAL RISK

The total variability in returns of a security repre
he total risk of that security. Systematic risk
nsystematic risk are the two components of
isk. Thus

Total risk

= Systematic risk + Unsystematic risk

Risks associated with investments



YSTEMATIC RISK

e portion of the variability of return o
curity that is caused by external factors
lled systematic risk.

is also known as market risk or n
versifiable risk.

conomic and political instability, econo
cession, macro policy of the government,
ect the price of all shares systematically. T
e variation of return in shares, which is cau
these factors, is called systematic risk.

Systematic Risks

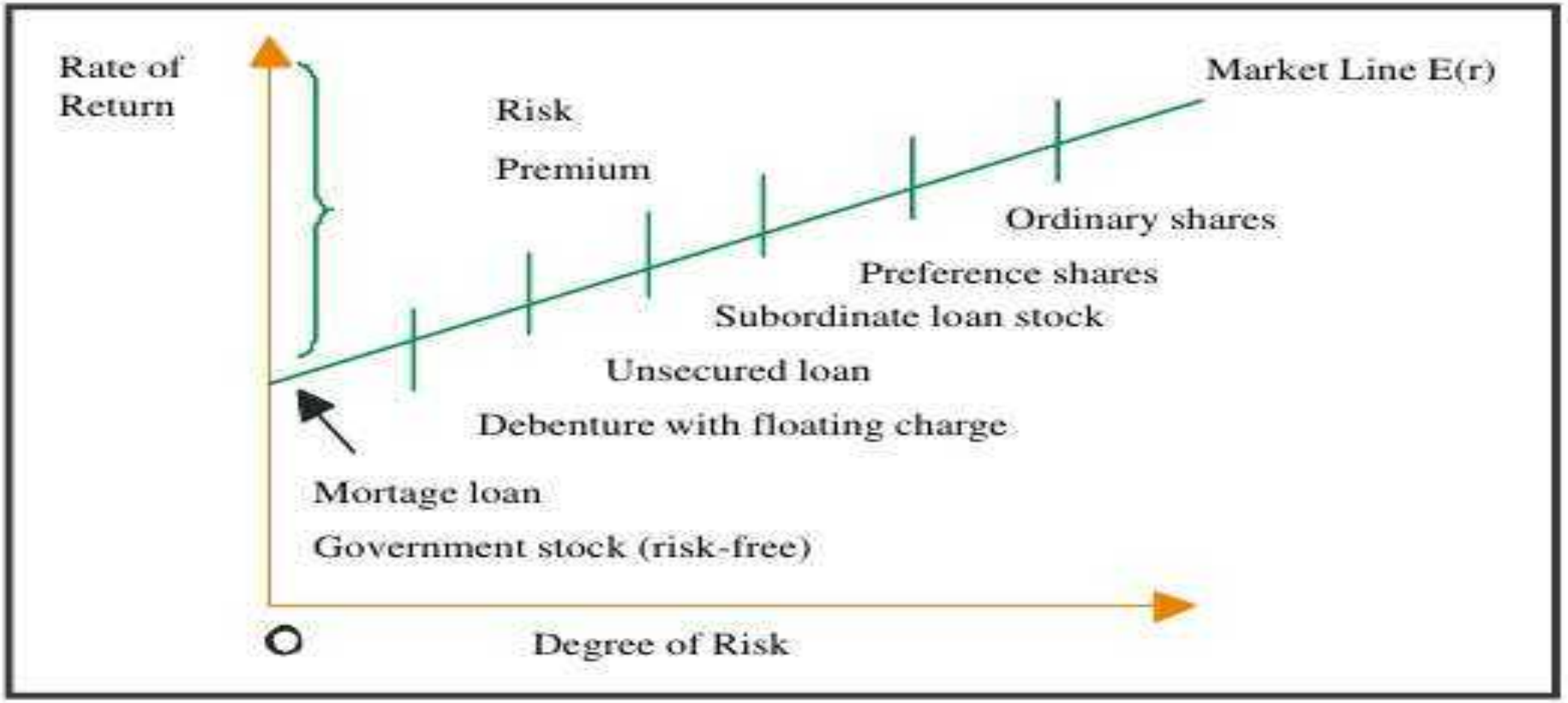
NON - SYSTEMATIC RISK:

The return from a security sometimes va
because of certain factors affecting only
company issuing such security. Examples
raw material scarcity, Labour st
management efficiency etc.

When variability of returns occurs becaus
such firm-specific factors, it is known
unsystematic risk.

Non – Systematic Risks

RISK RETURN RELATIONSHIP O DIFFERENT STOCKS



Risk return relationship of different stocks

Risk & Return Analysis

Return on security(single asset) consists of wo parts:

Return = dividend + capital gain rate

$$R = \frac{D_1 + (P_1 - P_0)}{P_0}$$

WHERE R = RATE OF RETURN IN YEAR 1
D1 = DIVIDEND PER SHARE IN YEAR 1
P0 = PRICE OF SHARE IN THE BEGINNING OF THE YE
P1 = PRICE OF SHARE IN THE END OF THE YEAR

Average rate of return

$$\bar{R} = \frac{1}{n}[R_1 + R_2 + \ldots\ldots + R_n]$$

$$= \frac{1}{n}\sum_{t=1}^{n} R_t$$

here

= average rate of return.

= realised rates of return in periods 1,2, ...

= total no. of periods

Risk

- Risk refers to dispersion of a variable.
- It is measured by variance or SD.
- Variance is the sum of squares of the deviations of actual returns from average returns .

$$\text{Variance} = \Sigma (R_i - \bar{R})^2$$

$$\text{SD} = (\text{variance}^2)^{1/2}$$

Expected rate of return

- It is the weighted average of all possible returns multiplied by their respective probabilities.

$$E(R) = R_1P_1 + R_2P_2 + \ldots\ldots\ldots + R_nP_n$$

$$E(R) = \sum_{i=1}^{n} R_i P_i$$

Where R_i is the outcome i, P_i is the probabilit of occurrence of i.

Variance is the sum of squares of the deviations of actual returns from expected returns weighted by the associated probabilities.

$$\text{Variance} = \sum_{i=1}^{n} (R_i - E(R))^{2*} P_i$$

$$SD = (\text{variance}^2)^{1/2}$$

Portfolio

- A portfolio is a bundle of individual assets securities.
- All investors hold well diversified portfolio assets instead of investing in a single asse
- If the investor holds well diversified portfoli assets, the concern should be expected of return & risk of portfolio rather t individual assets.

Portfolio **return**- two asset case

The expected return from a portfolio of two or r securities is equal to the weighted average of expected returns from the individual securities.

$$\Sigma(R_p) = W_A (R_A) + W_B (R_B)$$

Where,

$\Sigma(R_p)$ = Expected return from a portfolio of securities

W_A = Proportion of funds invested in Securit

W_B = Proportion of funds invested in Securit

R_A = Expected return of Security A

R_B = Expected return of Security B

$W_A + W_B = 1$

Portfolio **risk**- two asset

- Since the securities associated in a portf
  are associated with each other, portfolio ris
  associated with covariance between return
  securities.

$$\text{Covariance}_{xy} = \sum_{i=1}^{n} (R_{xi} - E(R_x)) (R_{yi} - E(R_y))$$

Correlation

To measure the relationship between returns o
securities.

$$Cor_{xy} = \frac{Cov_{xy}}{SD_X \, SD_Y}$$

the correlation coefficient ranges between −1
+1.

The diversification has benefits when correlati
between return of assets is less than 1.

'ERSIFICATION OF RISK

Ve have seen that total risk of an indiv
ecurity is measured by the standard devi
σ), which can be divided into two parts
ystematic risk and unsystematic risk

otal Risk (σ) = Systematic Risk + Unsyste
sk

Figure 1: Reduction of Risk through Diversification

Only to increase the number of securities in the portfolio wil diversity the risk. Securities are to be selected carefully.

If two security returns are less than perfectly correlated investor gains through diversification.

If two securities M and N are perfectly negatively correlated, t risk will reduce to zero.

Suppose return are as follows:

	t_1	t_2	t_3	t_4
M	10%	20%	10%	20%
N	20%	10%	20%	10%
Mean Return	15%	15%	15%	15%

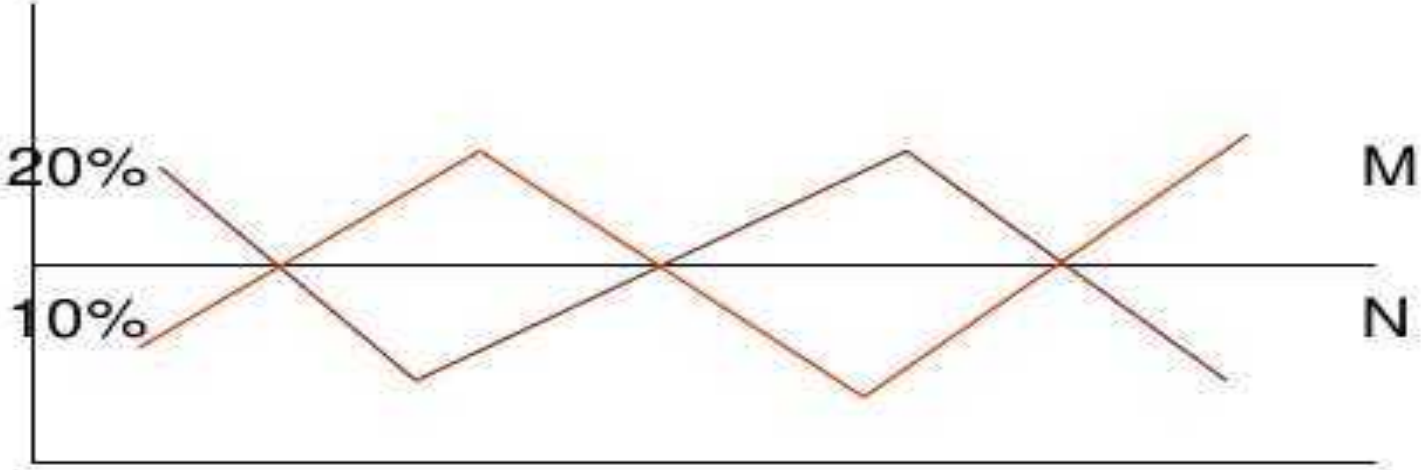


Figure 2

If r = -1 (perfectly negatively correlated), risk is completely eliminated ($\sigma = 0$)

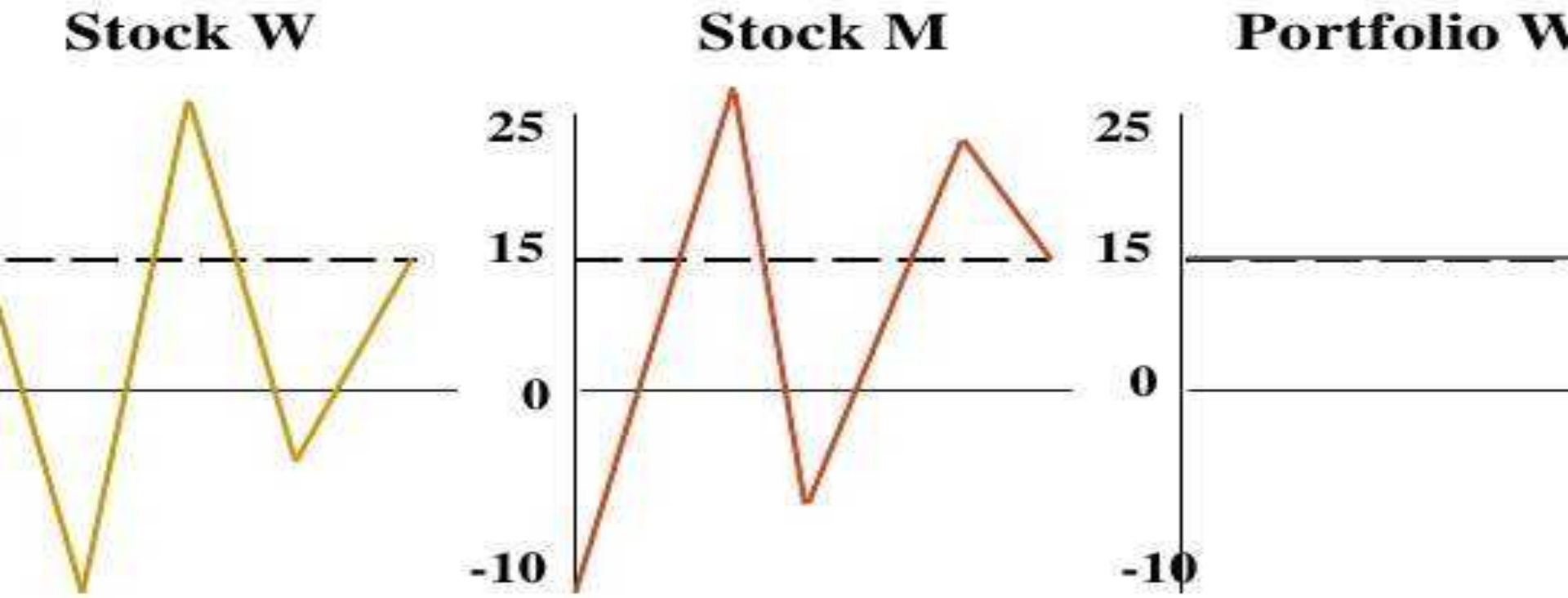
If r = 1, risk can not be diversified away

If r < 1 risk will be diversified away to some extent.

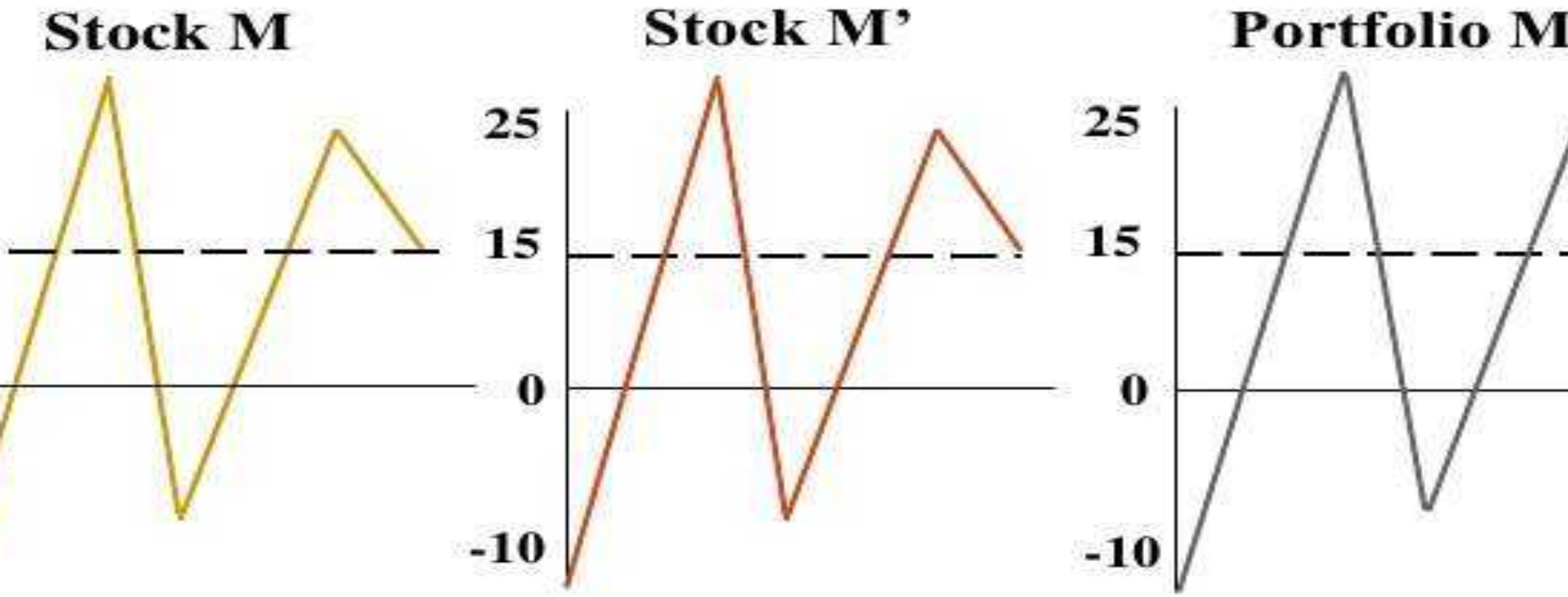
TWO IMPORTANT FINDINGS:

- More number of securities will reduce port risk
- Securities should not be perfectly correlated.

Returns distribution for two perfectly negatively correlated stocks ($\rho = -1.0$)



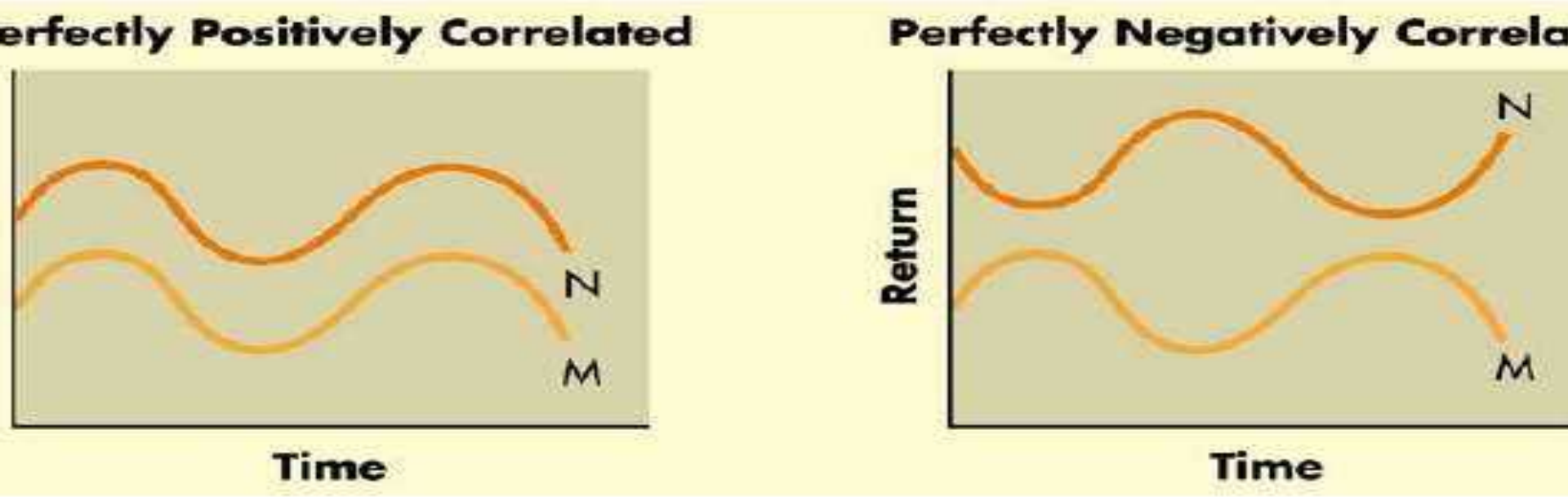
Returns distribution for two perfectly positively correlated stocks ($\rho = 1.0$)



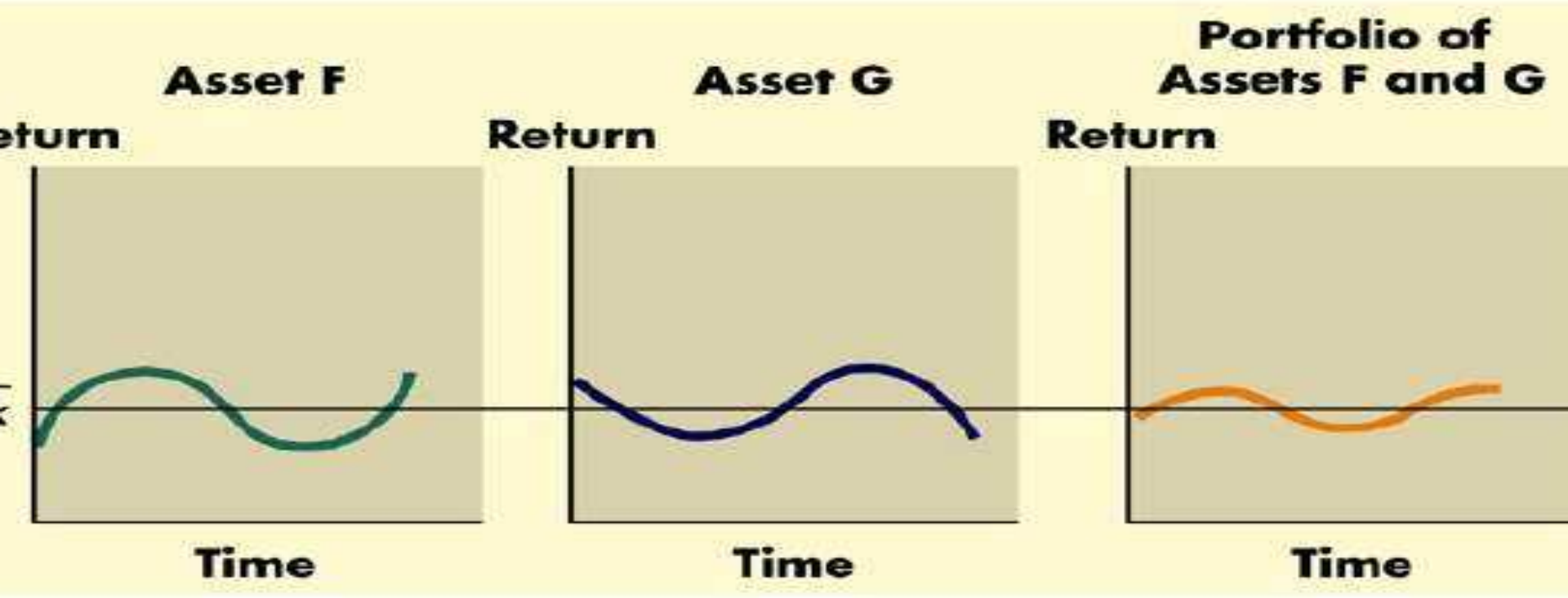
rsification....does it always work?

sification is enhanced depending upon the extent
the returns on assets "move" together.

novement is typically measured by a statistic
n as *"correlation"* as shown in the figure below.



ven if two assets are not perfectly negative
related, an investor can still realize *diversificat*
efits from combining them in a portfolio as sho
he figure below.



Capital Market Theory

It describes how securities are priced in the marketplace.

Markowitz theory was more based on theoretical , CAPM aims at a more practical approach to stock valuation .

Based on mean-variance approach to risk for assessment of investment as developed by Markowitz .

It explain the behavioral pattern of investors in building up portfolio .

Assumptions

- To maximize the utility of terminal wealth.
- Choice on the basis of risk and return.
- Homogeneous expectations of risk and return
- Identical time horizon
- Information is freely and simultaneously available to investors.
- There is risk free asset , and investor can borrow and lend unlimited amount at risk free rates.
- There is no taxes, transaction costs, and restrictions on short rates or other market imperfections.
- Total asset quantity is fixed , and all assets are marketable and divisible

Learning Objectives

- Explain capital market theory and the Capital As
Pricing Model (CAPM).
- Discuss the importance and composition of the
market portfolio.
- Describe two important relationships in CAPM a
represented by the capital market line and the
security market line.
- Describe how betas are estimated and how beta
used.
- Discuss the Arbitrage Pricing Theory as an
alternative to the Capital Asset Pricing Model.

Capital Market Theory

escribes the pricing of capital assets in
financial markets

Capital Asset Pricing Model

- Relates the required rate of return for any security with the market risk for the security a measured by beta
- Focus on the equilibrium relationship betwee the risk and expected return on risky assets
- Builds on Markowitz portfolio theory
- Each investor is assumed to diversify his or h portfolio according to the Markowitz model, choosing a location on the efficient frontier th matches his/her return-risk preferences

CAPM Assumptions

All investors:

- Use the same information to generate an efficient frontier (i.e., identical inputs: E(R), σ, ρ)
- Have the same one-period time horizon
- Can borrow or lend money at the risk-free rate of return
- No transaction costs
- No personal income (i.e., indifferent between dividends an capital gains) taxes
- No inflation
- No single investor can affect the price of a stock (i.e., price-takers
- Capital markets are in equilibrium

CAPM Assumptions

- ese assumptions appear unrealistic
- e important issue is how well the theory pred scribes) reality
- e CAPM is robust since most of its assumpti be relaxed without significant effects on the del
- all of the CAPM assumptions are unrealisti
  - Some institutional investors are tax-exempt
  - Significant reduction in transaction costs by usin liscount brokers and/or internet
  - For the one-period horizon of the model, inflatio nay be fully (or mostly) anticipated

Market Portfolio

st important implication of the CAPM

All investors hold the same optimal portfolio of ri
ssets

- As a result of the assumption that all investors ha
  the same time horizon and homogenous expecta
  regarding the expected returns and risks for any g
  risky asset

The optimal portfolio is at the highest point of
angency between RF and the efficient frontier

The portfolio of all risky assets is the optimal risk
ortfolio

- Called the market portfolio

racteristics of the Market Portfolio

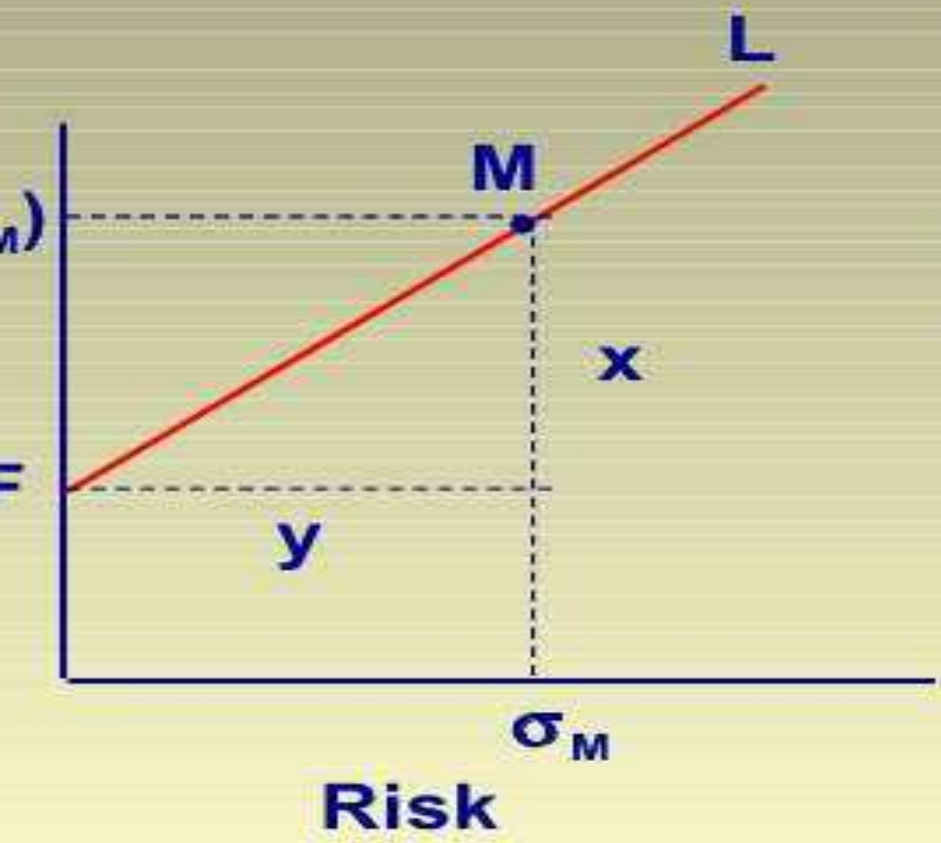
- risky assets must be in portfolio, so it is mpletely diversified
- Contains only systematic risk (cannot be elimina
- securities included in proportion to their ma ue
- observable, but proxied by S&P/TSX Compo lex in Canada (or the S&P 500 in the US)
- theory, should contain all risky assets worldw th financial and real, in their proper proportio
- found by determining which efficient portfolio ers the highest risk premium, given the stence of a risk-free asset

e Equilibrium Risk-Return trade-

he CAPM is an equilibrium model that ncompasses two important relationship

- The capital market line (CML), specifies the equilibrium relationship between expected return and *total risk* for efficient portfolios
- The security market line (SML), specifies th equilibrium relationship between expected return and *systematic risk*

Capital Market Line



- Line from RF to L is capital market line (CM
- x = risk premium
  = $E(R_M)$ - RF
- y = risk = σ_M
- Slope = x/y = market price of risk for efficient portfolios
  = $[E(R_M) - RF]/\sigma_M$
- y-intercept = RF = price of forgone consumption

Example: Capital Market Line

(Pg 247) Assume that the expected return on portfolio M is 13%, with a standard deviation 25%, and that RF is 7%

Calculate the slope of the CML

Capital Market Line

Slope of the CML is the market price of risk f
efficient portfolios, or the equilibrium price of
n the market

Relationship between risk and expected retu
for portfolio P (Equation for CML):

$$E(R_p) = RF + \frac{E(R_M) - RF}{\sigma_M} \sigma_p$$

Capital Market Line

e following should be noted about the CML:

Only efficient portfolios consisting of the risk-free asset and portfolio M lie on the CML

t indicates the optimal expected returns associa with different portfolio risk levels

t must always be upwards sloping because the price of risk must always be positive

Although, it must be upward sloping *ex ante* (be he fact), it can be, and sometimes is, downward sloping *ex post* (after the fact). This merely indic hat the returns actually realized differed from th hat were expected

Security Market Line

L Equation only applies to markets in equilib
d efficient portfolios (i.e., cannot be used to
ess the expected return on individual securi
nefficient portfolios)

e Security Market Line depicts the tradeoff
ween risk and expected return for individual
urities

der CAPM, all investors hold the risky portio
ir portfolio in the market portfolio

How does an individual security contribute to the
of the market portfolio?

Security Market Line

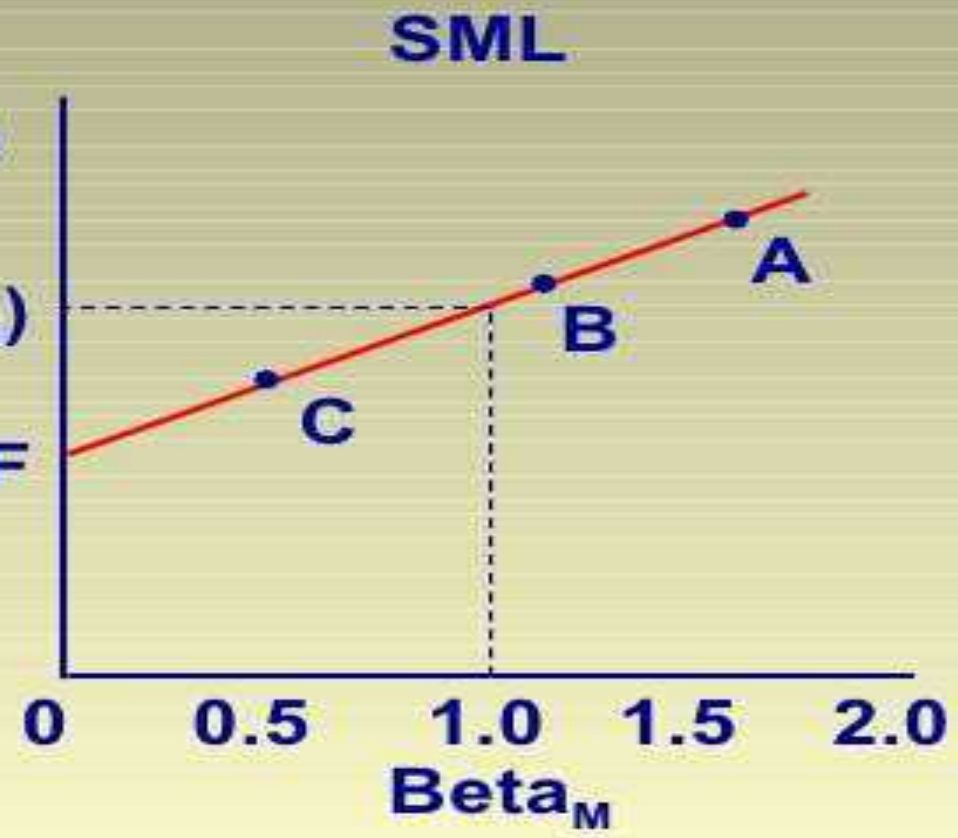
The expected return on any risky asset is direct proportional to its covariance with the market portfolio

Equation for expected return for an individual s similar to CML Equation

$$E(R_i) = RF + \frac{E(R_M) - RF}{\sigma_M} \frac{\sigma_{i,M}}{\sigma_M}$$

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

Security Market Line



- Beta = 1.0 implies as risky as market
- Securities A and B are more risky than the market
  - Beta > 1.0
- Security C is less risky than the market
  - Beta < 1.0

Security Market Line

e SML represents the trade-off between systema
(β) and the expected return for all assets, whet
vidual securities, inefficient portfolios, or efficien
tfolios

a measures systematic risk

Measures relative risk compared to the market portf
ll stocks

Volatility of security *i* is different (higher or lower) tha
hat of the market if $\beta_i > 1$ or $\beta_i < 1$ and is equal to
f the market if $\beta_i = 1$

$\beta_i = 1$ means that for every 1% change in the mark
eturn, on average security *i*'s returns change 1%

$\beta_M = 1$ and $\beta_{RF} = 0$

Security Market Line

s useful for comparing the relative systemati
k of different stocks and, in practice, is used
estors to judge a stock's riskiness

may vary widely across companies in differe
ustries and within a give industry (e.g., β for
rrick Gold Corp. is 0.63 and for Eldorado Go
rp. is 1.2)

securities should lie on the SML

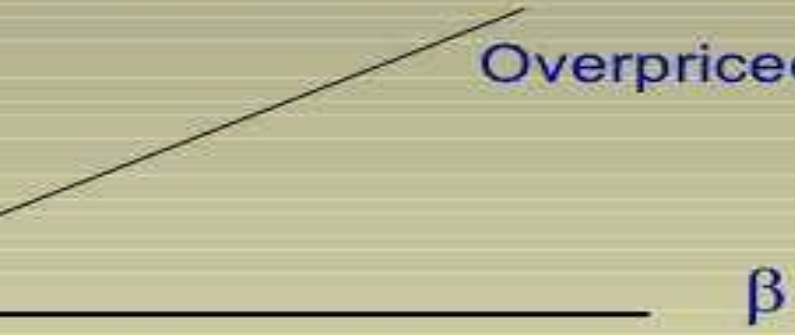
The expected return on the security should be c
that return needed to compensate for systemati
risk

SML and Asset Values

Underpriced

SML: $E_r = r_f + \beta\,(E_m - r_f)$

Overpriced



erpriced ⇒ expected return > required return according to
⇒ lie "above" SML

rpriced ⇒ expected return < required return according to
⇒ lie "below" SML

ectly priced ⇒ expected return = required return according to
⇒ lie along SML

CAPM's Expected Return-Beta Relationship

Required rate of return on an asset (k_i) is composed of

- risk-free rate (RF)
- risk premium (β_i [$E(R_M)$ - RF])
  - Market risk premium adjusted for specific security

$$k_i = RF + \beta_i [E(R_M) - RF]$$

- The greater the systematic risk, the greater the required return

Example: Expected Return-Beta Relationship

(Pg 252) If the β estimate for security *i* is 1.0
the RF is 0.0241, and the expected return on
market is estimated to be 0.10.

Calculate the required return on security *i*

Estimating the SML

use the SML, an investor needs estimates o
urn on the risk-free asset, the expected retur
market index, and the β for an individual
curity

asury Bill rate used to estimate RF

pected return for the market index in not
servable

Estimated using past market returns and taking
expected value

imating individual security betas is difficult

β is only company-specific factor in CAPM

Requires asset-specific forecast

Estimating Beta

rket model

- Relates the return on each stock to the return o
  market, assuming a linear relationship with an
  ntercept and slope

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it}$$

- t is identical to the single-index model except th
  does not make the assumption that the error ter
  of the different securities are uncorrelated
- The Market Model produces an estimate of retu
  for any stock

Estimating Beta

Characteristic line

- A regression equation used to estimate β by regressing stock returns on market returns
- Line fitted to total returns for a security relativ total returns for the market index (Fig 9.6 pg
- β is the slope of the characteristic line

ow Accurate Are Beta Estimates

Betas change with a company's situation (e
earnings & cash flows)

- Not stationary over time

Estimating a <u>future</u> beta

- May differ from the historical beta

R_{Mt} represents the total of all marketable as
the economy

- Approximated with a stock market index, wh
  turn, approximates return on all common sto

ow Accurate Are Beta Estimates

- one correct number of observations and
e periods for calculating beta. As a result,
imates of β will vary
- e regression estimates of the true α and β
m the characteristic line are subject to
imation error
- rtfolio betas more reliable than individual
curity betas
- for large portfolios are stable (show less
ange from period to period) because of the
eraging effect (i.e., errors involved in
imating βs tend to cancel out)

Test of CAPM

vious empirical results indicate that:

$$R_i = a_1 + \beta_i a_2$$

- The SML appears to be linear (i.e., the trade-ff between expected return and risk is an upward sloping straight line
- The intercept term, a_1, is generally found to be higher than RF
- The slope of the CAPM, a_2, is generally found to ess steep than predicted by the theory (i.e., overpredicts returns for low-β stocks and underpredicts returns for high-β stock)

Arbitrage Pricing Theory

Based on the Law of One Price

- Two otherwise identical assets cannot sell a different prices
- Equilibrium prices adjust to eliminate all arbitrage opportunities

Unlike CAPM, APT does not assume

- single-period investment horizon, absence o personal taxes, riskless borrowing or lendin mean-variance decisions

Factors

APT assumes returns generated by a factor model

Factor Characteristics

- Each risk must have a pervasive influence o stock returns
- Risk factors must influence expected return a have nonzero prices
- Risk factors must be unpredictable to the ma

APT Model

Most important are the deviations of the factors from their expected values

The expected return-risk relationship for the APT can be described as:

$R_{it}) = a_0 + b_{i1}$ (risk premium for factor 1) $+ b_{i2}$ (ri premium for factor 2) +… $+ b_{in}$ (risk premium for factor n)

APT Model

Reduces to CAPM if there is only one factor and that factor is market risk

Roll and Ross (1980) Factors:

- Changes in expected inflation
- Unanticipated changes in inflation
- Unanticipated changes in industrial productio
- Unanticipated changes in the default risk premium
- Unanticipated changes in the term structure interest rates

Problems with APT

Factors are not well specified ex ante

- To implement the APT model, the factors th account for the differences among security returns are required
  - CAPM identifies market portfolio as single factor

Neither CAPM or APT has been proven superior

- Both rely on unobservable expectations

Risk Management and Derivatives

Presented By
Prof. Chetana Soni

Content

- Impact Cost
- Index and its application
- Construction and composition – Sensex and Nifty
- Calculation of Index
- Free Flow Market Capitalization

Impact Cost

- Cost of executing a transaction in given stock for specific predefined order size , at any given point of time.
- It can vary for different transaction size
- It change and depends on the no. of outstanding order

Procedure For Calculation of Impact Cost

- Ideal Price = Best Buy + Best Sell/ 2
- Actual Buy Price = Total Value of Buy Shares/ Numbers of Shares.
- Impact Cost = Actual Buy Price- Ideal Price/ Ideal Price* 100

Index

Diversified Portfolio created to represent market index.

- Reflect the future performance by capturing the market information.
- Statistical tool – measures the change in variables.
- Rising index- Optimistic expectation.
- Falling index – Pessimistic expectations.

- Measures how much a variables change over a period of time and is calculated by finding the ratio of current value to the base value.

e.g. :- BSE Sensex – 30 companies

e.g. :- Closing price of share 1st Day- 50/-

2nd Day Closing Price - 52/-

It means an increase of 4%(2Rupees on 50/-)

Considering 50/- as 100 % (Base Year)

Then 52/- will be 104 %(Current Period)

- If the prices of share quoted on third day 47/-

  then in terms of percentage

  50/- - 100%

  then 47/- - ?

  47*100/50

  = 94%

Application of Stock Index

- Provide a historical comparison of return on money invested in stock market against other form of investment such as gold and debts securities.
- Use as benchmark against comparing the performance of equity funds
- Lead indicator of the performance of the overall economy or a sector of the economy
- Stock reflects highly up to date information

- Study the long term growth pattern in the economy
- Forecast business cycle patterns
- Use of market index in Portfolio Analysis

SENSEX

- Basket of 30 leading and representative stock traded on stock exchange
- Compiled for the first time in 1986 taken as a base year 1978-1979
- Initially Calculation methodology was based on Full market capitalization
- In the year 2003 full market capitalization methodology was replaced with Free Market Capitalization methodology

SENSEX Scrips Selection Criteria

- Listed History
- Trading Frequency
- Final Rank on Some of the Criteria
- Limit on Market Capitalization Weightage
- Track Record

NSE – 50 Index (NIFTY)

- Built by India Index Service Product Ltd. (IISL) and CRISIL (Credit Rating Information Service of India Ltd.)
- Introduced on April 22,1996
- OBJECTIVES

✓ Reflect market movement more accurately

✓Provide tool for measuring market return and Portfolio Return

✓ Provide a basis for introducing index based derivatives

NIFTY Selection Criteria

- Market Capitalization (Rs 5 billion) or more
- Liquidity (Weights in proportions to market capitalization)

Market Capitalization

Market Capitalization =

(Market Price Per Share * Numbers of Shares issued by the company)

Construction and Composition of Sensex and Nifty

- Market Capitalization Based Method Formula

$$\text{Index Value} = \left(\frac{\text{Current Date Market Capitalization}}{\text{Base Date Market Capitalization}} \right) * \text{Base Date Index Value}$$

Simple Average Base Formula

Index Value

$$\left[\frac{\text{Current Date Average of the Prices}}{\text{Base Date Average of the Prices}}\right] * \text{Base Date Index Value}$$

Index Calculation

- Scrips –X, Y and Z (Par Value of Equity Rs 10/-
- Numbers of Share

  X- 100

  Y- 200

  Z- 250

Market Price of Scrip (Per Share)

Scrips	Base Year	Current Year
X	20	25
Y	30	40
Z	40	50

	Base Date Market Capitalization			Current Date Market Capitalization		
Name of Scrip	No. of Share	Price Per Share	Market Capitalization	No. of Share	Price Per Share	Market Capitalization
X	100	20	2000	100	25	2500
Y	200	30	6000	200	40	8000
Z	250	40	10000	250	50	12500
Total			18000	Total		23000

Index Value = 23000/18000*100 = 127.78

Free Float Market Capitalization

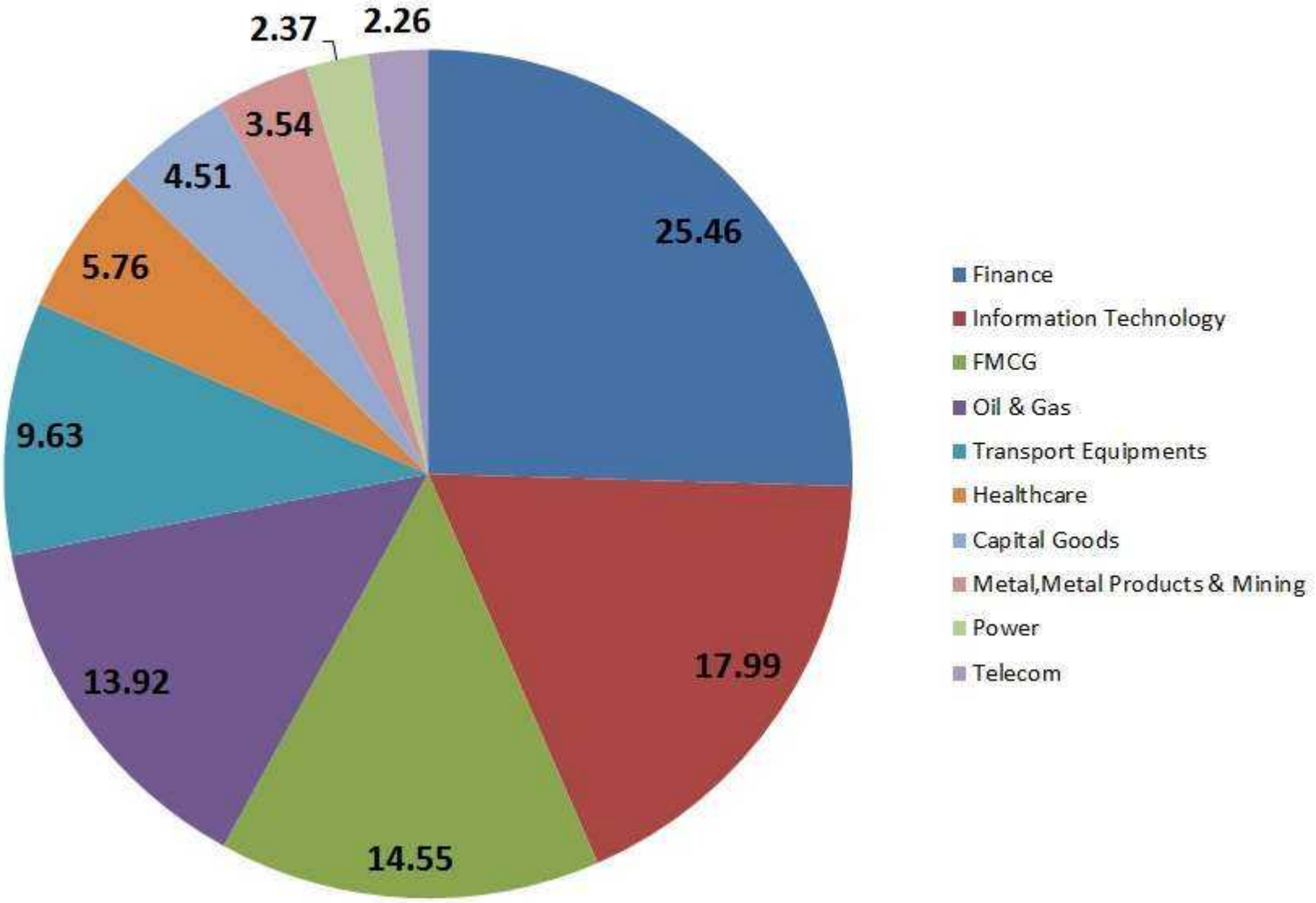
- Shares which are easily available for trading out of the total share issue by the company are consider for calculation purpose.
- E.g. :- out of 100% shares if only 65% of the shares of a company is available for trading then free float factor of that company will be 0.65

following Shares issues are not available easily or frequently for trading.

- Promoter of the Company
- Director of the Company
- Under Lock in Period
- other shares issues as preferential allotment
- Employees Welfare Trust
- . Government Holding
- Associate Group Companies Shares

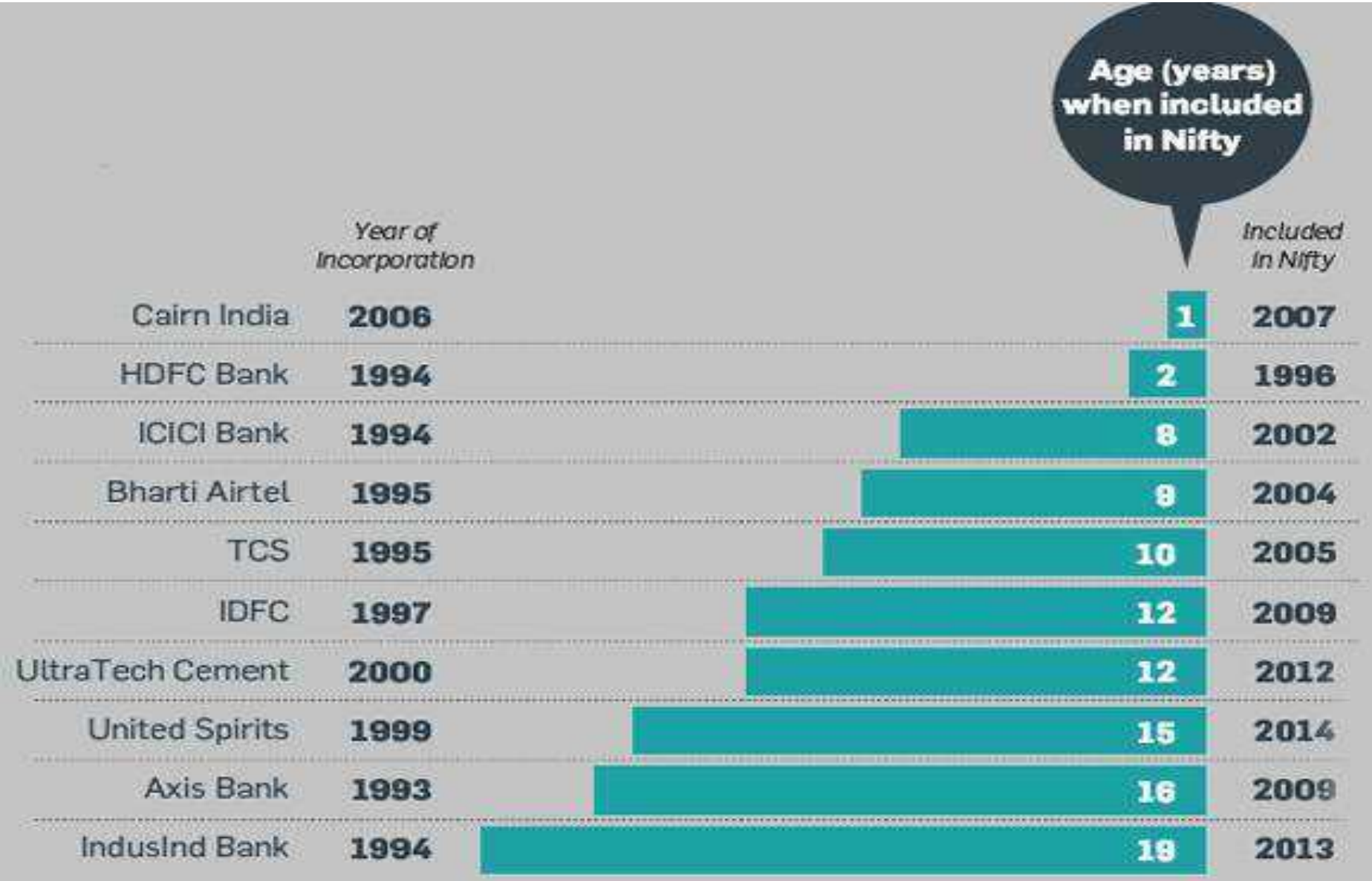

STOCK PRICE
STOCKS READILY AVAILABLE FOR TRADING
WEIGHTAGE IN SENSEX

SECTOR WEIGHTAGE

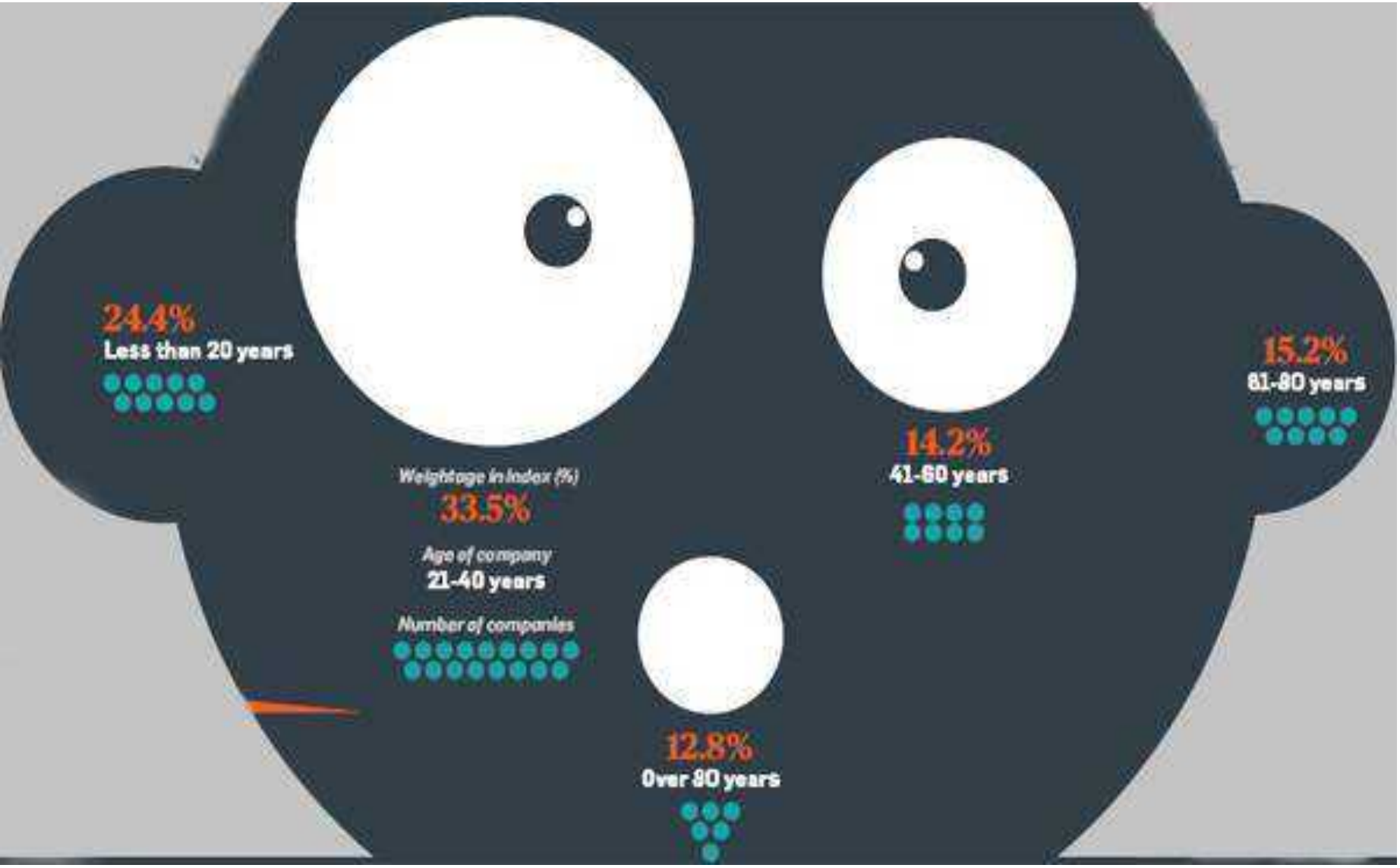


1			
2	Reliance	Refineries	7.85
3	ONGC	Oil Drilling And Exploration	7.65
4	ITC	Cigarettes	7.36
5	Infosys	Computers – Software	5.85
6	HDFC Bank	Banks – Private Sector	4.82
7	Coal India	Mining/Minerals	4.48
8	ICICI Bank	Banks – Private Sector	3.84
9	Wipro	Computers – Software	3.83
10	HDFC	Finance – Housing	3.68
11	Tata Motors	Auto – LCVs/HCVs	3.55
12	SBI	Banks – Public Sector	3.47
13	HUL	Personal Care	3.37
14	Bharti Airtel	Telecommunications – Service	3.36
15	Sun Pharma	Pharmaceuticals	3.33
16	Larsen	Infrastructure – General	3.16
17	NTPC	Power – Generation/Distribution	2.69
18	Axis Bank	Banks – Private Sector	1.85
19	M&M	Auto – Cars & Jeeps	1.70
20	Bajaj Auto	Auto – 2 & 3 Wheelers	1.59
21	Maruti Suzuki	Auto – Cars & Jeeps	1.47
22	Sesa Sterlite	Mining/Minerals	1.46
23	GAIL	Oil Drilling And Exploration	1.31
24	BHEL	Infrastructure – General	1.28
25	Dr Reddys Labs	Pharmaceuticals	1.26
26	Hero Motocorp	Auto – 2 & 3 Wheelers	1.12
27	Tata Steel	Steel – Large	0.93
28	Cipla	Pharmaceuticals	0.84
29	Hindalco	Aluminium	0.67
30	Tata Power	Power – Generation/Distribution	0.54

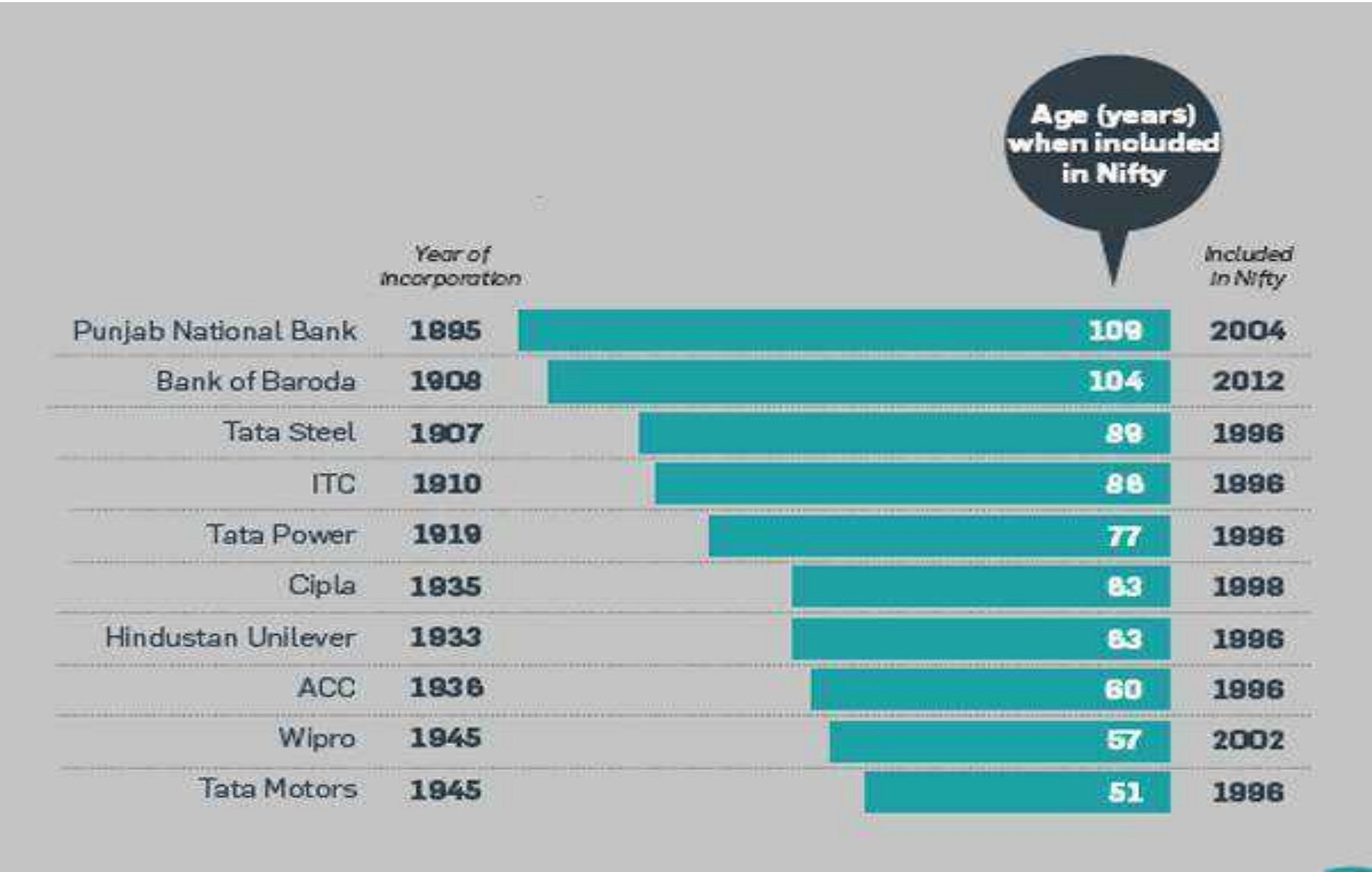
10 young firms that made a difference



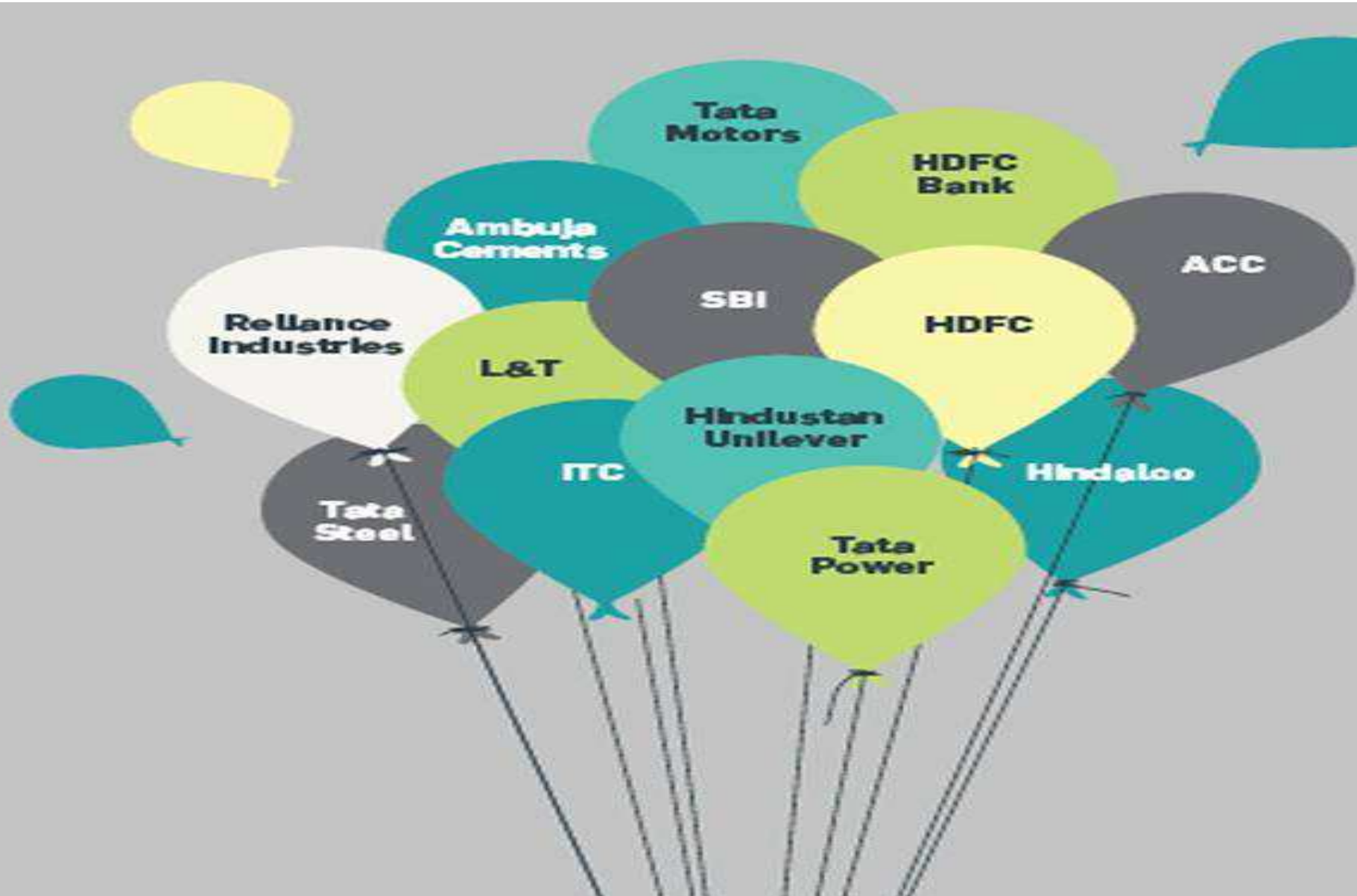
Young companies also carry more weight in index



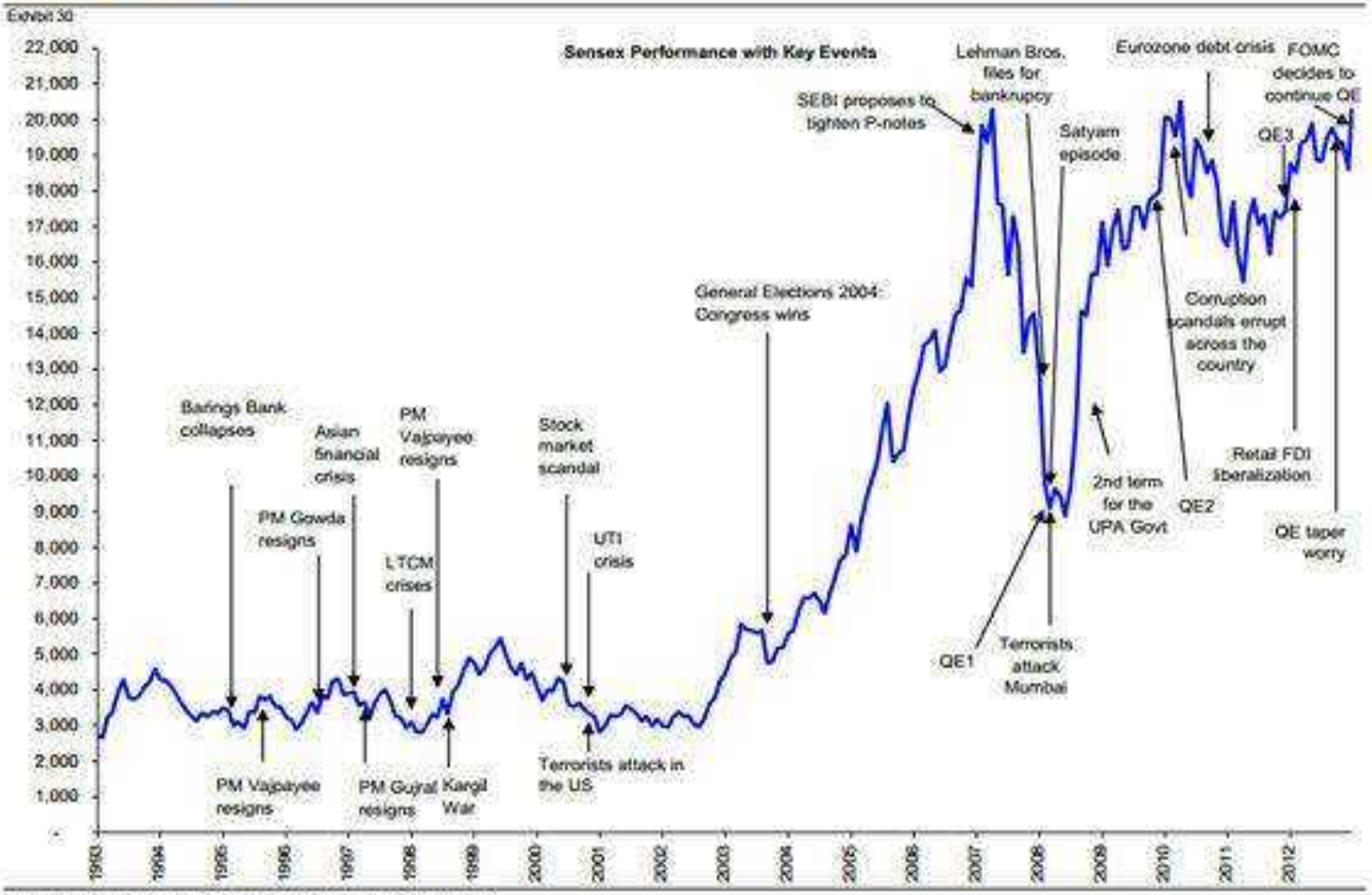
10 veterans that have pushed up the average



13 stocks that never went out of Nifty

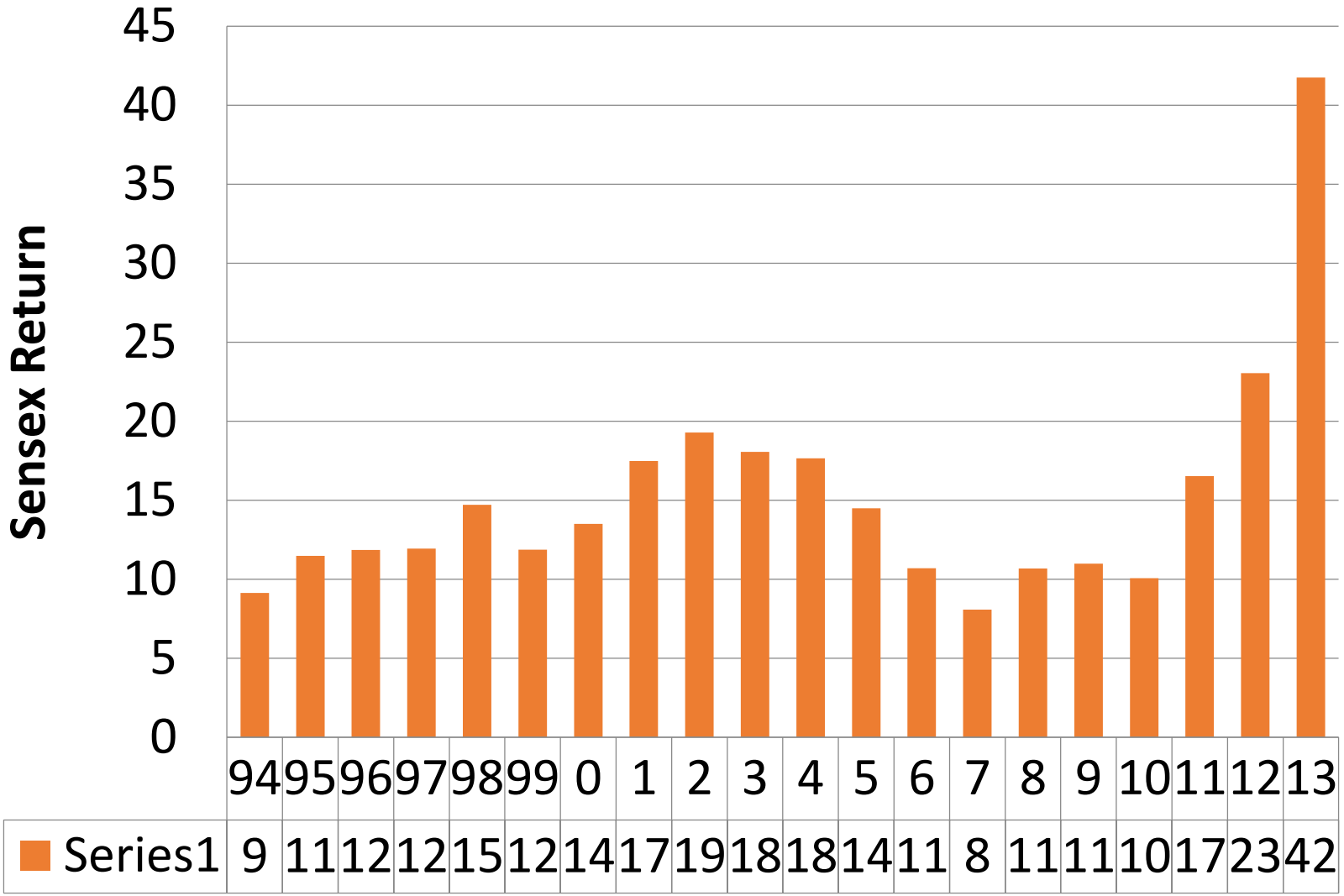


Major Events



Source: Bloomberg, Economic Times, Business Standard, Morgan Stanley Research

Sensex return for different tenure



Reference

- Investment Analysis and Portfolio Management By Prasanna Chandra
- Investment Management By Bhalla
- Security Analysis and Portfolio Management By Kevin