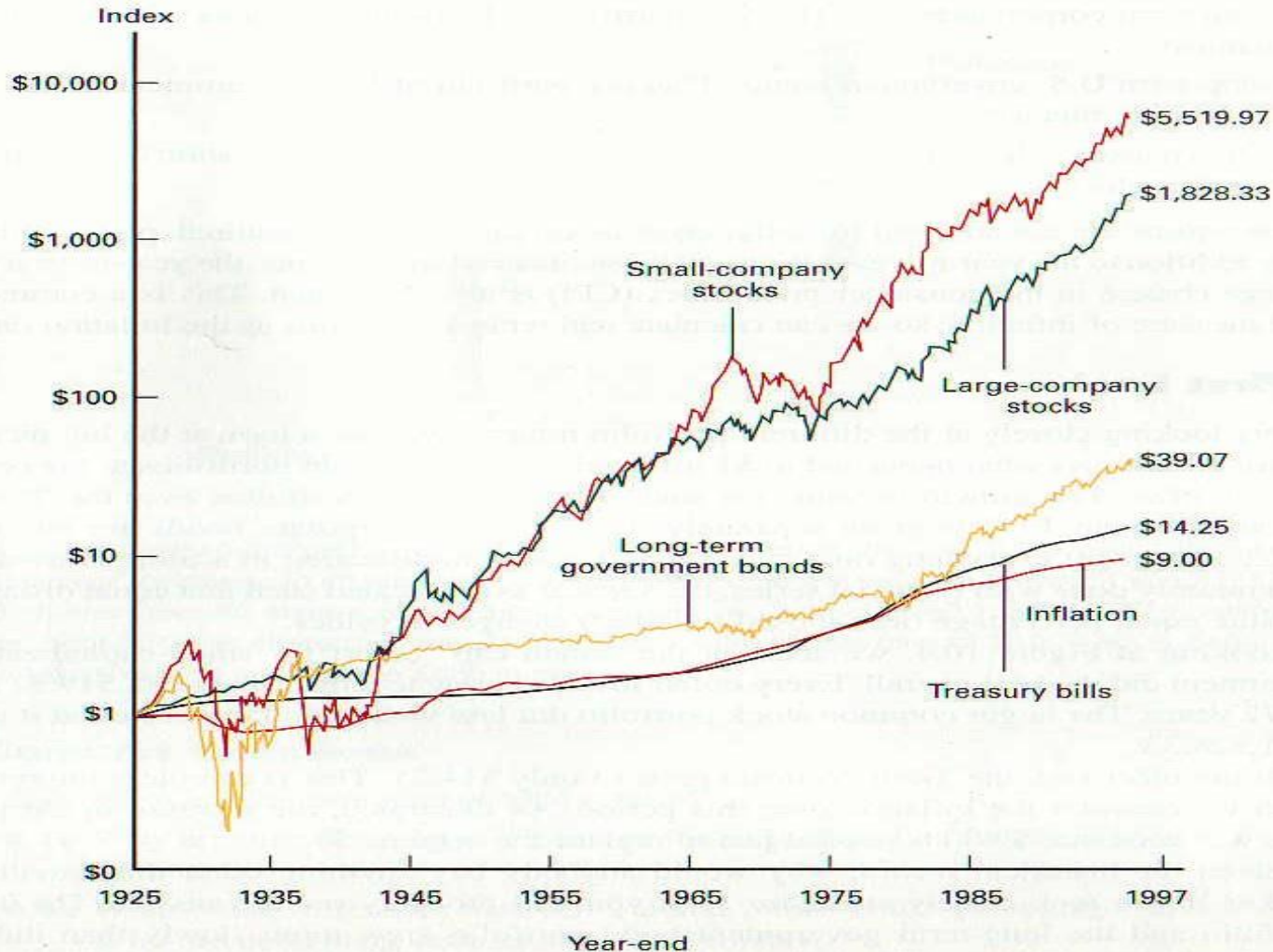# Risk and Return

1. **What rate of return do you expect on your investment (savings) this year?**

2. **What rate will you actually earn?**

3. **Does it matter if it is a bank FD or a share of a mobile VAS player (say, Onmobile India)?**

A $1 Investment in different types of portfolios: 1926-1997 (Year end 1925 = $1)

SOURCE: *Stocks, Bonds, Bills, and Inflation 1997 Yearbook™*, Ibbotson Associates, Inc., Chicago (annually updates work by Roger G. Ibbotson and Rex A. Sinquefield). All rights reserved.

Annual Average Returns 1926-1997

Investment	Average Return
Common stocks	13.0%
Small stocks	17.7
Long-term corporate bonds	6.1
Long-term government bonds	5.6
U.S. Treasury bills	3.8
Inflation	3.2

SOURCE: *Stocks, Bonds, Bills, and Inflation 1997 Yearbook*™, Ibbotson Associates, Inc., Chicago (annually updates work by Roger G. Ibbotson and Rex A. Sinquefield). All rights reserved.

Annual Average Returns in India

- Large Cap Shares (say, Sensex) 1➜137 (28 years, 1979-2007)

- Bank Fixed Deposits (say, 5-year) 1➜14 (28 years, 1979-2007)

- But, try looking at the yearly rates of return in each of the cases

- The most fluctuating will be stocks i.e., stock returns vary widely over time.

Introduction

- **Unfortunately, if we try for future, the graph is expected risk and return (a.k.a. security market line)**
- **Investors demand for more from a riskier project**
- **Unfortunately, it is (really) difficult -- if not impossible -- to make such predictions with any degree of certainty.**
- **As a result, investors often use history as a basis for predicting the future.**
- **We will begin by evaluating the risk and return characteristics of individual assets, and end by looking at portfolios of assets.**
- **How do we find the risk of an individual asset (say, a equity share)**

Ram/XLRI/Jamshedpur/PMIR/BFM

Risk and Return Defined

- In the context of business and finance, risk is defined as the chance of suffering a financial loss.

- Assets (real or financial) which have a greater chance of loss are considered more risky than those with a lower chance of loss.

- Risk may be used interchangeably with the term uncertainty to refer to the variability of returns associated with a given asset.

- Return represents the total gain or loss on an investment

Example

	Risk and Return	
	Return	
year	**Stock A**	**Stock B**
1	6%	20%
2	12%	30%
3	8%	10%
4	-2%	-10%
5	18%	50%
6	6%	20%

Single Financial Assets

Historical Risk

Standard Deviation

| year	Observed Return for Stock A	Observed Return for Stock B	year	Observed Return for Stock A	Observed Return for Stock B
1	0.06	0.2	1	6%	20%
2	0.12	0.3	2	12%	30%
3	0.08	0.1	3	8%	10%
4	**What you type**		4	**What you see**	0%
5			5		0%
6	0.06	0.2	6		20%
Average	=AVERAGE(B4:B9)	=AVERAGE(C4:C9)	Average	8.00%	20.00%
Standard Deviation	=STDEV(B4:B9)	=STDEV(C4:C9)	Standard Deviation	6.69%	20.00%

Single Financial Assets

Historical Risk

Normal Distribution

| R-2σ | | R-1σ | | R | | R+1σ | | R+2σ |

68%

95%
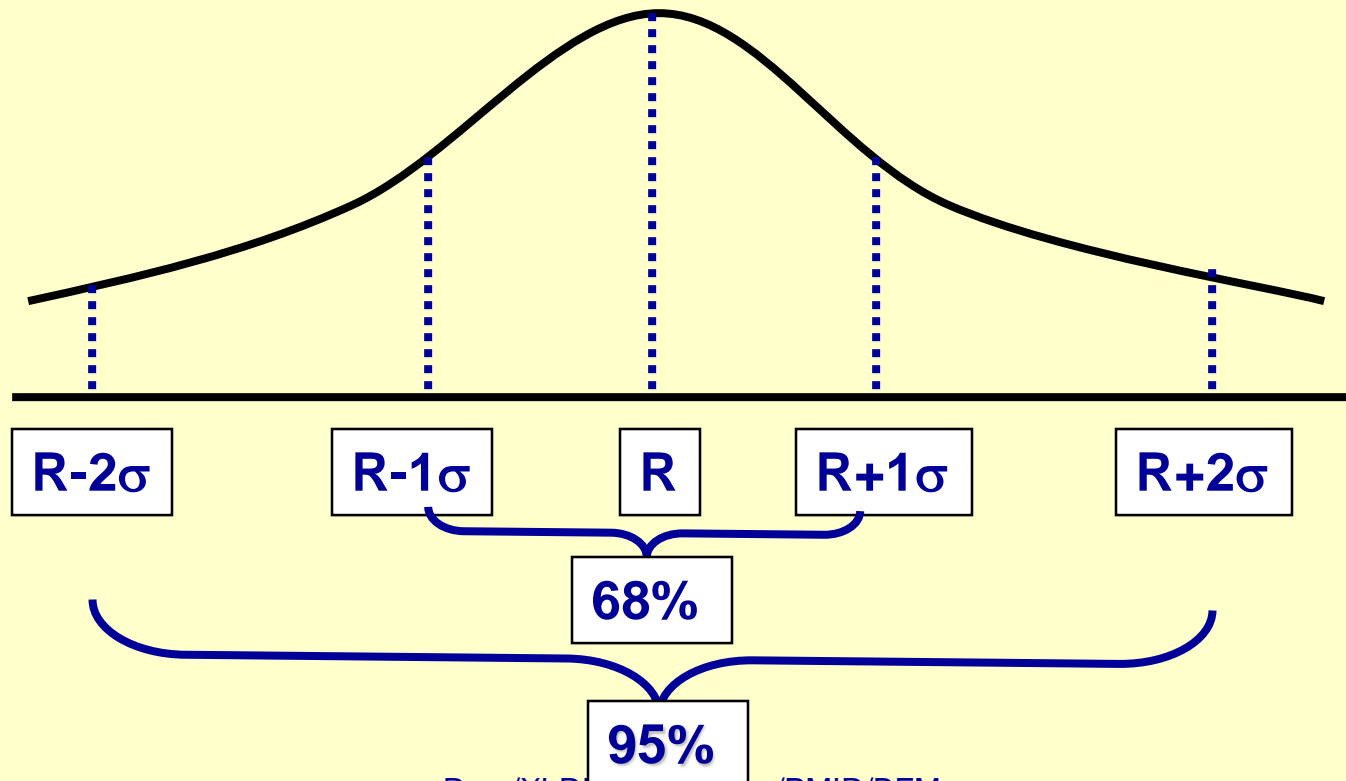
Single Financial Assets

Expected Return & Risk

• Investors and analysts often look at historical returns as a starting point for predicting the future.

• However, they are much more interested in what the returns on their investments will be in the future.

• For this reason, we need a method for estimating future or "ex-ante" returns.

• One way of doing this is to assign probabilities for future states of nature and the returns that would be realized if a particular state of nature would occur.

Single Financial Assets

Expected Return & Risk

Expected Return E(R) = Σ $p_i R_i$,

where p_i = probability of the *i*th scenario, and

R_i = the forecasted return in the *i*th scenario.

Also, the variance of E(R) may be computed as:

$$\sigma^2 = \Sigma pi[Ri - E(R)]^2$$

and hence the standard deviation as:

$$\sqrt{\sigma^2} = \sqrt{\Sigma pi[Ri - E9R)]^2}$$

Single Financial Assets

Expected Return & Risk

Expected Return			
State	Probability	Stock A	Stock B
Boom	30%	17%	29%
Normal	50%	12%	15%
Bust	20%	5%	-2%
Expected Return		12.1%	15.8%

Single Financial Assets

Expected Return & Risk

Risk, Variance, & Standard Deviation			
State	Pi	Stock A	$pi[A_i - E(R)]^2$
Boom	0.30	17	7.203
Normal	0.50	12	0.005
Bust	0.20	5	10.082
Expected Return		12	
Variance = Sum of $pi[A_i - E(R)]^2$			17.290
Standard Deviation = $(Var)^{1/2}$			4.158

Single Financial Assets

Coefficient of Variation

- One problem with using standard deviation as a measure of risk is that we cannot easily make risk comparisons between two assets.

- The coefficient of variation overcomes this problem by measuring the amount of risk per unit of return.

- The higher the coefficient of variation then more is the risk per return.

- So, an investor would prefer selecting the asset with the lower coefficient of variation.

Single Financial Assets

Coefficient of Variation

| Coefficient of Variation			
State	**Pi**	**Stock A**	**Stock B**
Boom	**0.3**	**17**	**30**
Normal	**0.5**	**12**	**15**
Bust	**0.2**	**5**	**-5**
Expected Return		**12.1**	**15.5**
Standard Deviation		**4.16**	**10.517**
Coefficient of Variation		**0.344**	**0.679**

Portfolios of Assets

- An investment portfolio is any collection or combination of financial assets.

- If we assume all investors are rational and therefore risk averse, that investor will ALWAYS choose to invest   in portfolios rather than in single assets.

- Investors will hold portfolios because he or she will *diversify* away a portion of the risk

- If an investor holds a single asset, he or she will fully suffer the consequences of poor performance.

Portfolios of Assets

• Diversification is enhanced depending upon the extent to which the returns on assets "move" together.

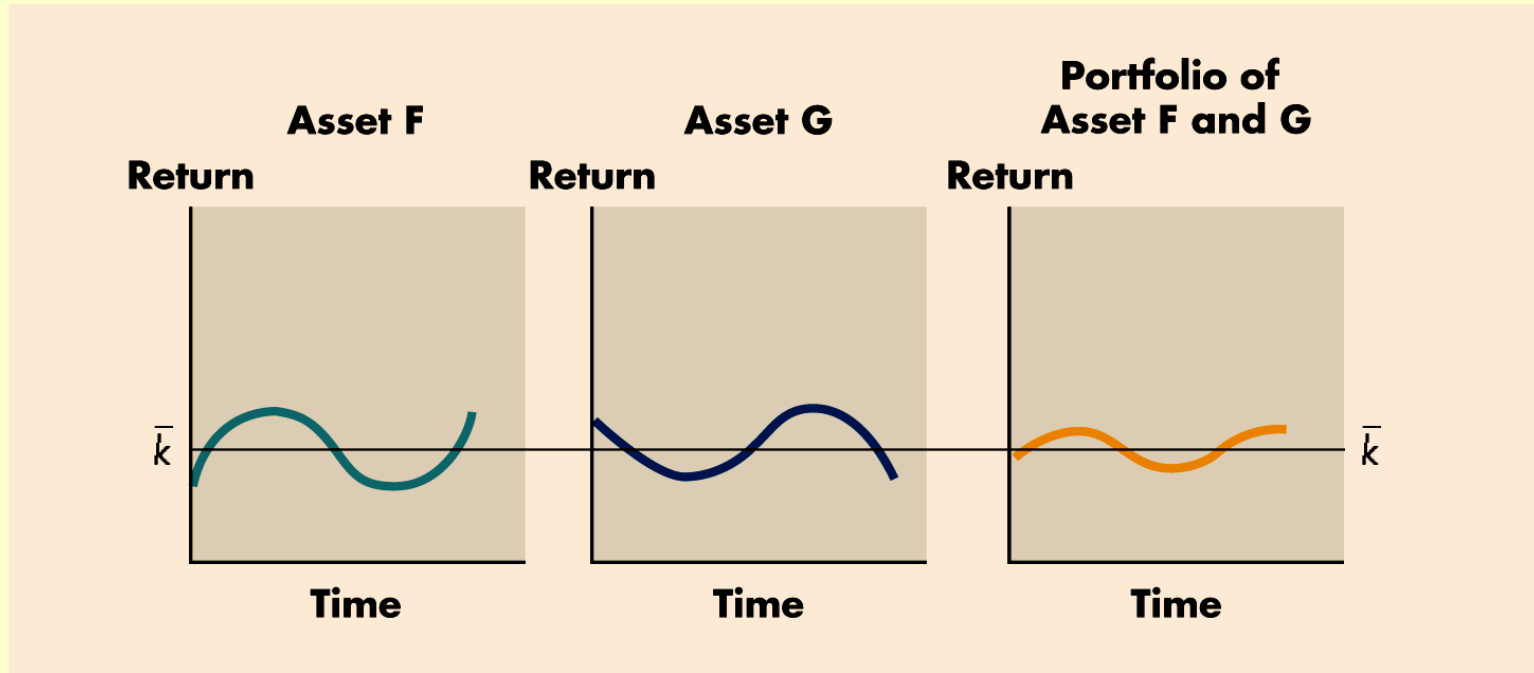•This movement is typically measured by a statistic known as "correlation" as shown in Figures below

Perfectly Positively Correlated
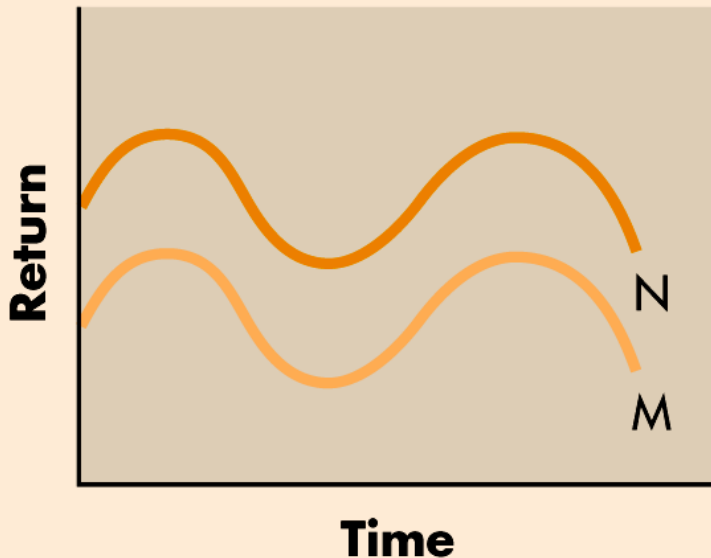
Perfectly Negatively Correlated
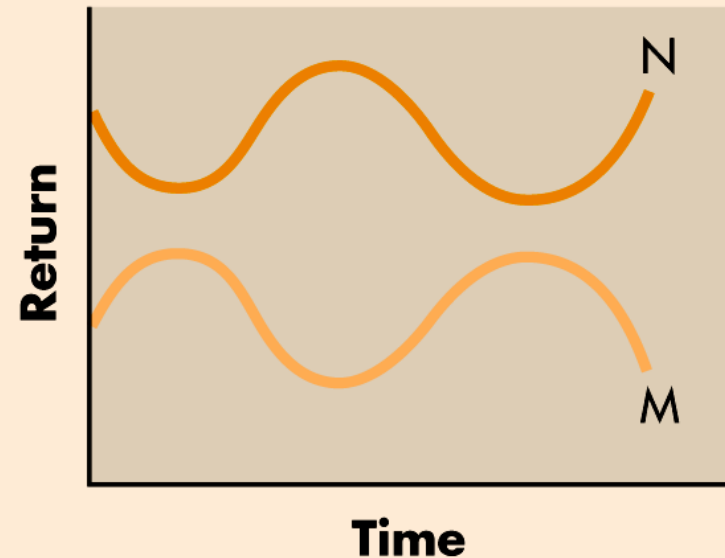
Portfolios of Assets

Portfolios of Assets
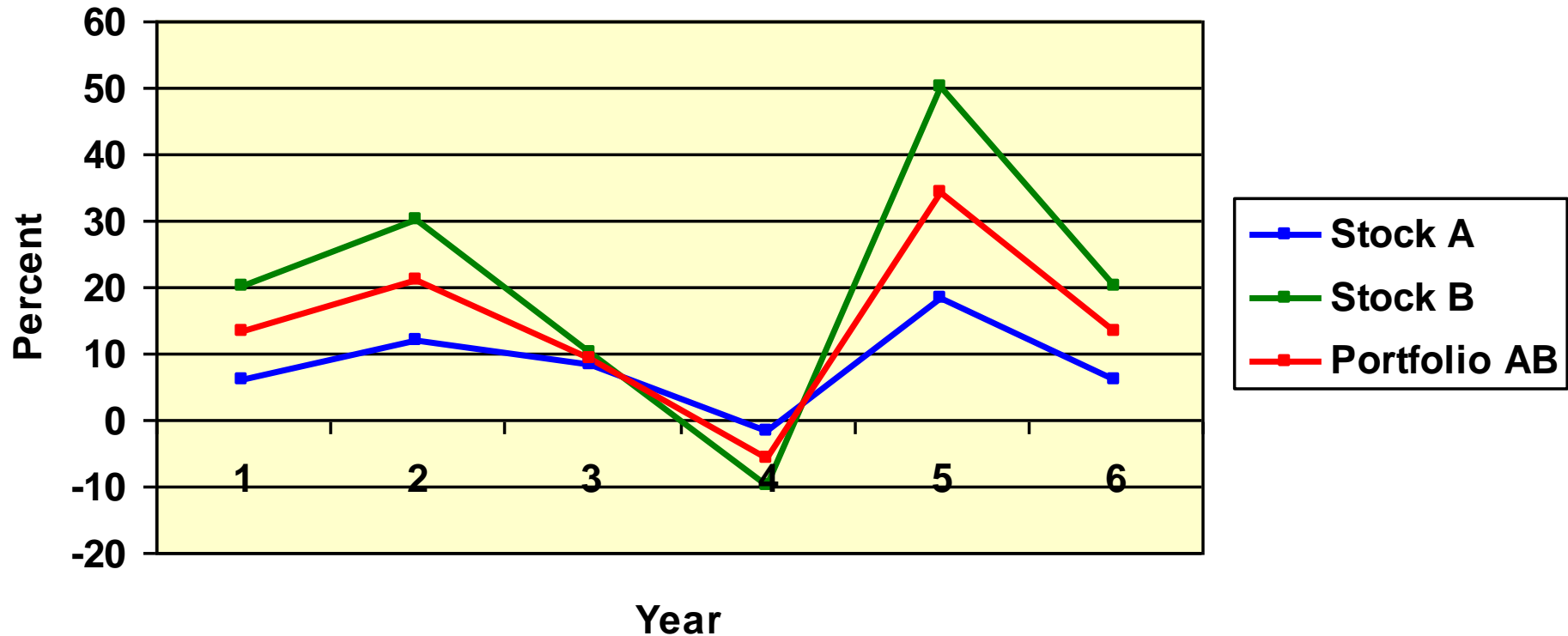
Portfolio AB

(50% in A, 50% in B)

| Year | Stock A | | Stock B | | Portfolio AB |
	Percent Weight	Percent Return	Percent Weight	Percent Return	Weighted Return
1	50%	6	50%	20	13
2	50%	12	50%	30	21
3	50%	8	50%	10	9
4	50%	-2	50%	-10	-6
5	50%	18	50%	50	34
6	50%	6	50%	20	13
Weight A	50%		Sum of Weighted Returns		84
Weight B	50%		Portfolio Average Return		14

Ram/XLRI/Jamshedpur/PMIR/BFM

Portfolios of Assets

Portfolio AB
(50% in A, 50% in B)

Investment Returns

Portfolios of Assets

Portfolio AB

(40% in A, 60% in B)

| Year | Stock A | | Stock B | | Portfolio AB |
	Percent Weight	Percent Return	Percent Weight	Percent Return	Weighted Return
1	40%	6	60%	20	14.4
2	40%	12	60%	30	22.8
3	40%	8	60%	10	9.2
		-2	60%	-10	-6.8
		18	60%	50	37.2
6	40%	6	60%	20	14.4
Weight A	40%		Sum of Weighted Returns		91.2
Weight B	60%		Portfolio Average Return		15.2

Changing the weights

Ram/XLRI/Jamshedpur/PMIR/BFM

Portfolios of Assets

Portfolio AB
(20% in A, 80% in B)

Year	Stock A		Stock B		Portfolio AB
	Percent Weight	Percent Return	Percent Weight	Percent Return	Weighted Return
1	20%	6	80%	20	17.2
2	20%	12	80%	30	26.4
3	20%	8	80%	10	9.6
		-2	80%	-10	-8.4
		18	80%	50	43.6
6	20%	6	80%	20	17.2
Weight A	20%		Sum of Weighted Returns		105.6
Weight B	80%		Portfolio Average Return		17.6

And Again

Portfolios of Assets

Portfolio Risk & Return

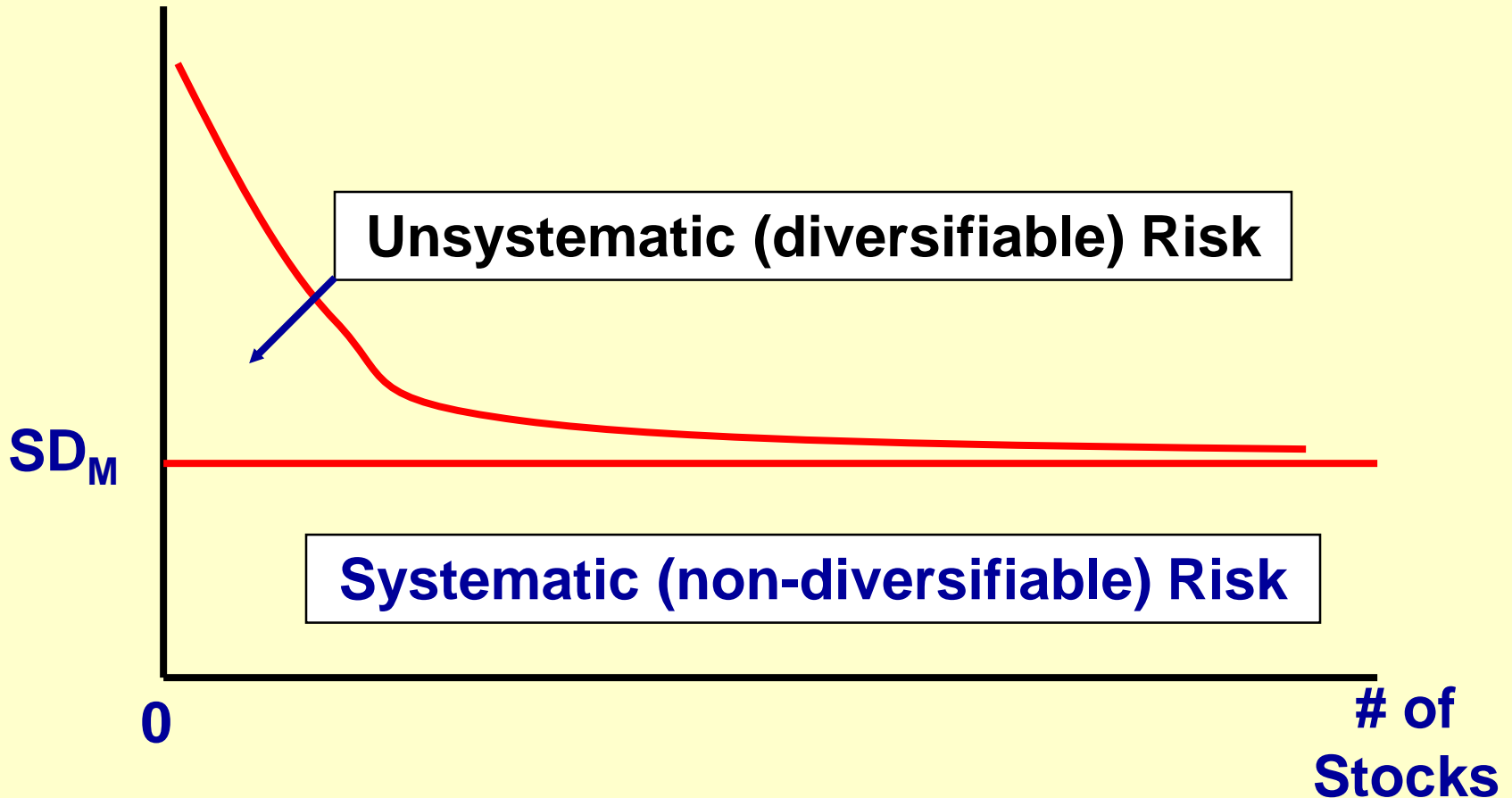Summarizing changes in risk and return as the composition of the portfolio changes.

Weight A	Return A (%)	Return B (%)	Return AB (%)	SD-A (%)	SD-B (%)	SD-AB (%)
100%	8.0	20.0	8.0	6.7	20.0	6.7
80%	8.0	20.0	10.4	6.7	20.0	9.3
60%	8.0	20.0	12.8	6.7	20.0	11.9
40%	8.0	20.0	15.2	6.7	20.0	14.6
20%	8.0	20.0	17.6	6.7	20.0	17.3
0%	8.0	20.0	20	6.7	20.0	20.0

Ram/XLRI/Jamshedpur/PMIR/BFM

Portfolios of Assets

Portfolio Risk

(Adding Assets to a Portfolio)

Portfolio Risk (SD)

Unsystematic (diversifiable) Risk

SD_M

Systematic (non-diversifiable) Risk

0

# of Stocks

Portfolios of Assets

Portfolio Risk (SD)

Portfolio Risk

(Adding Assets to a Portfolio)
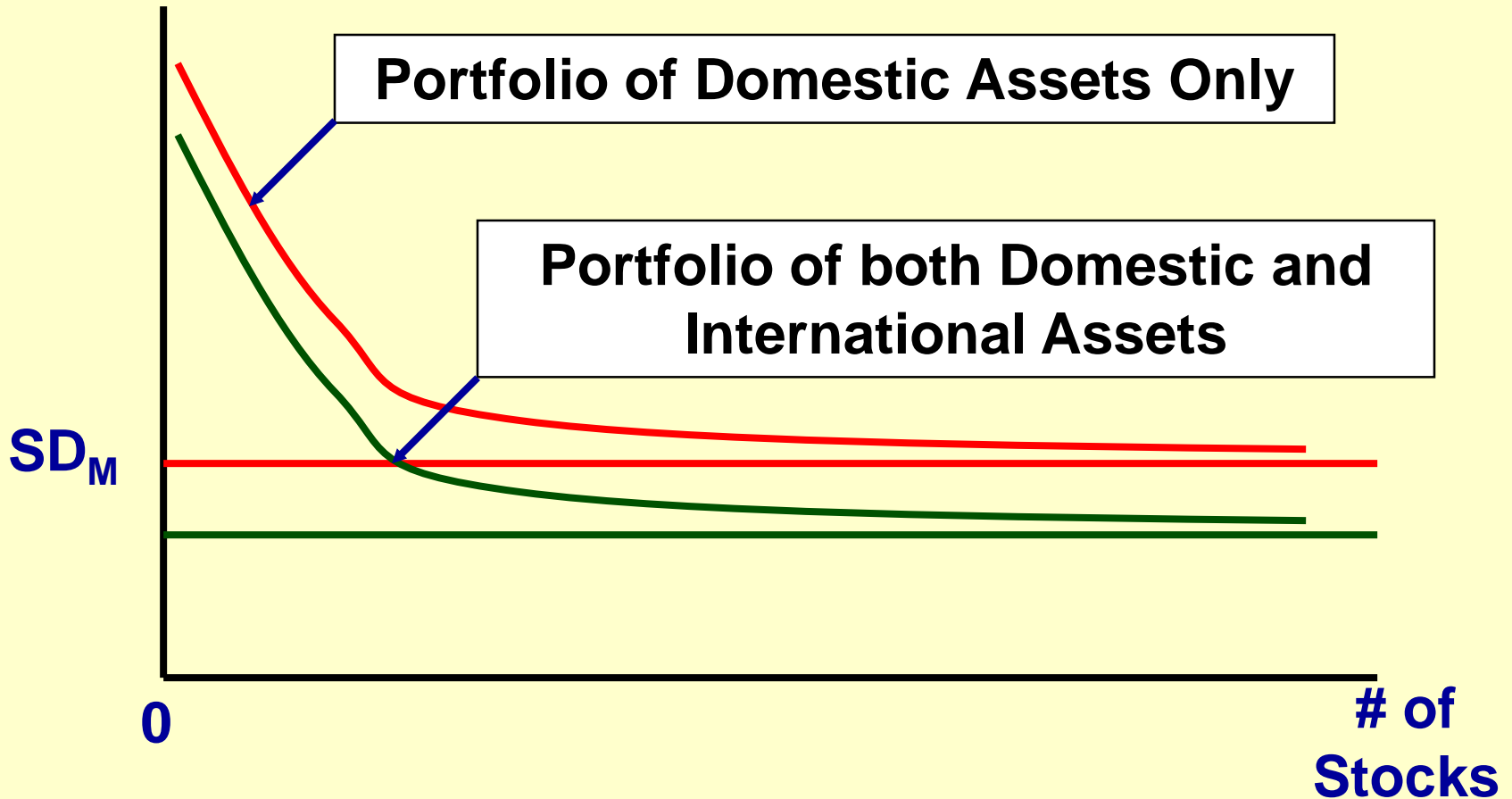
Portfolio of Domestic Assets Only

Portfolio of both Domestic and International Assets

SD_M

0

# of Stocks

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

• If you notice, a good part of a portfolio's risk (the standard deviation of returns) can be eliminated simply by holding a lot of stocks.

• The risk you can't get rid of by adding stocks (systematic) cannot be eliminated through diversification because that variability is caused by events that affect most stocks similarly.

• Examples would include changes in macroeconomic factors such interest rates, inflation, and the business cycle.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- In the early 1960s, Sharpe & co developed an asset pricing model that measures only the amount of systematic risk a particular asset has.

- In other words, they noticed that most stocks go down when interest rates go up, but some go down a whole lot more.

- They reasoned that if they could measure this variability -- the systematic risk -- then they could develop a model to price assets using only this risk.

- The unsystematic (company-related) risk is irrelevant because it could easily be eliminated simply by diversifying.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

• To measure the amount of systematic risk an asset has, they simply regressed the returns for the "market portfolio" -- the portfolio of ALL assets -- against the returns for an individual asset.

• The slope of the regression line -- beta -- measures an assets systematic (non-diversifiable) risk.

• In general, cyclical companies like auto companies have high betas while relatively stable companies, like public utilities,have low betas.

• Let's look at an example to see how this works.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.993698

This slide is the result of a regression using the Excel. The slope of the regression (beta) in this case is 1.92. Apparently, this stock has a considerable amount of systematic risk.

	F	*ignificance F*
	235.7556	0.0006

Total		2000

	Coeffi...	*...ard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*...ower 95.0%*	*Upper 95.0%*
Intercept	-3.7751	2.018166	-1.87057	0.158163	-10.1978	2.64758	-10.1978	2.64758
10	1.917349	0.124873	15.35433	0.0006	1.519946	2.314753	1.519946	2.314753

What is Beta?

An index of systematic risk.

It measures the sensitivity of a stock's returns to changes in returns on the market portfolio.

The beta for a portfolio is simply a weighted average of the individual stock betas in the portfolio.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- The **required return** for *all* assets is composed of two parts: the risk-free rate and a risk premium.

The risk premium is a function of both market conditions and the asset itself.	**The risk-free rate (r_f) is usually estimated from the return on Govt. Treasury bills**

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- The **risk premium** for a stock is composed of two parts:

  - The **Market Risk Premium** which is the return required for investing in any risky asset rather than the risk-free rate

  - **Beta**, a risk coefficient which measures the sensitivity of the particular stock's return to changes in market conditions.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

- After estimating beta, which measures a specific asset's systematic risk, it is relatively easy to estimate other variables (may be obtained to calculate an asset's required return) …

$$K_e = R_f + ß [R_m - R_f], \text{ where}$$

K_e = an asset's expected or required return,

R_f = the risk free rate of return,

$ß$ = an asset or portfolio's beta

R_m = the expected return on the market portfolio.

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

Example

Calculate the required return for RIL shares assuming it has a beta of 1.1, the rate on T-bills is 8%, and the expected return for the BSE Sensex is 16%.
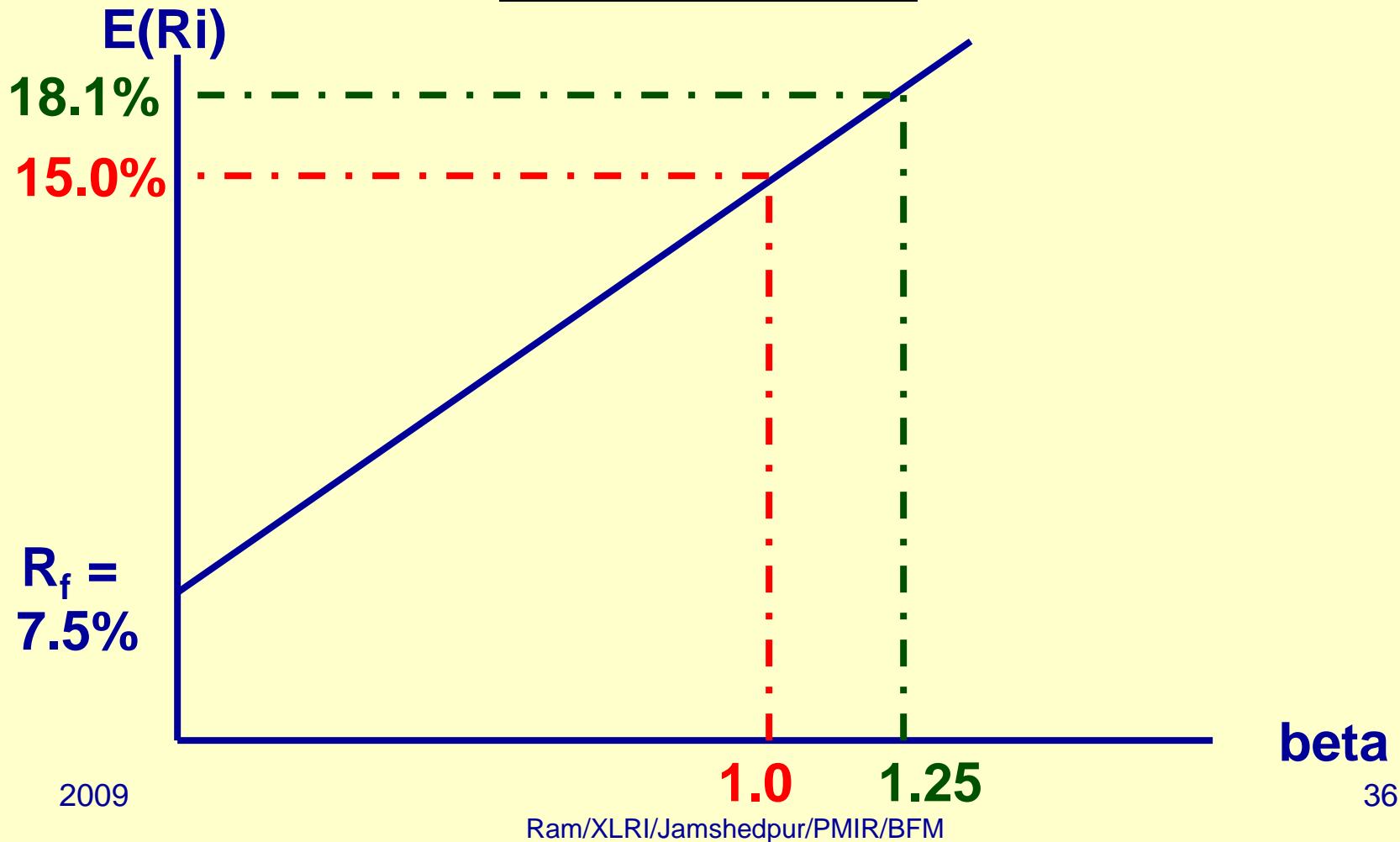
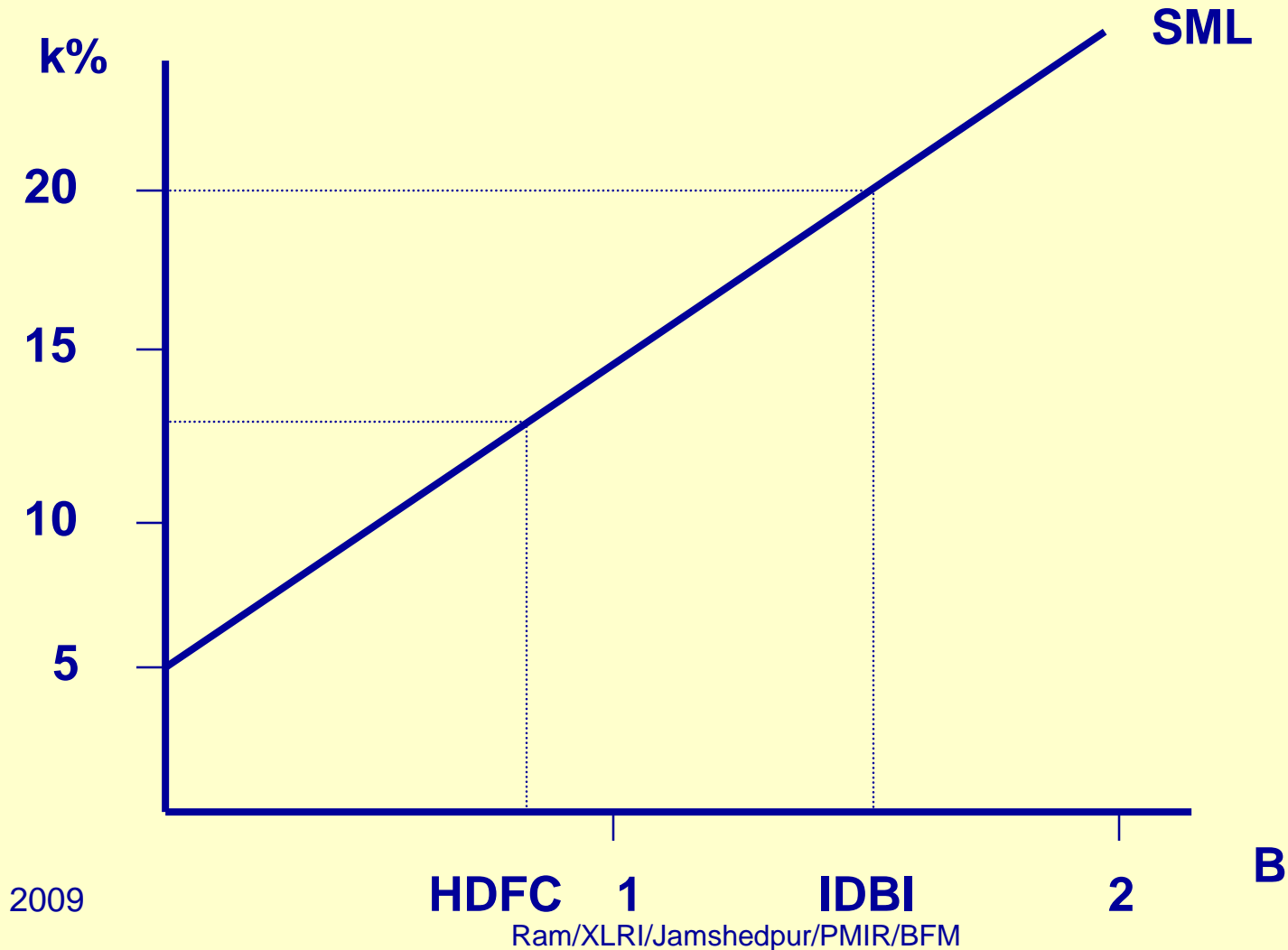$$K_e = 8 + 1.1 \, [16\% - 8\%]$$

$$K_e = 16.8\%$$

Portfolios of Assets

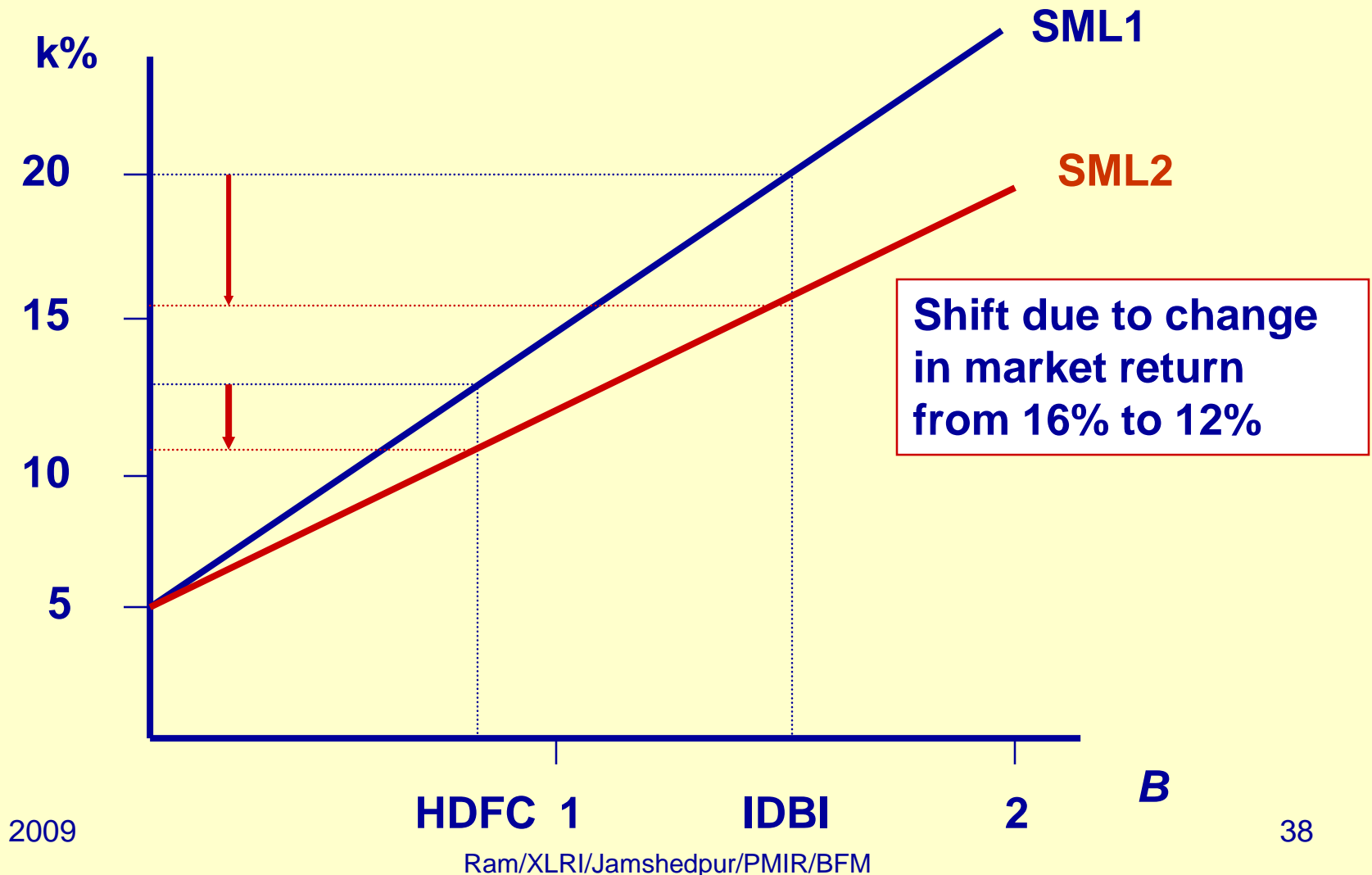## Capital Asset Pricing Model (CAPM)

Graphically

E(Ri)

18.1%

15.0%

$R_f = 7.5\%$

beta

1.0   1.25

Ram/XLRI/Jamshedpur/PMIR/BFM

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

Ram/XLRI/Jamshedpur/PMIR/BFM

Portfolios of Assets

Capital Asset Pricing Model (CAPM)

SML1

SML2

Shift due to change in market return from 16% to 12%

k%

20

15

10

5

HDFC 1   IDBI   2 B

Ram/XLRI/Jamshedpur/PMIR/BFM

Estimates of Beta for Selected Individual Indian Stocks (Source: NSE India)

Stock	Beta
BPCL	0.66
Grasim	1.14
Hero Honda	0.66
ITC	0.94
Mahindra & Mahindra	1.02
Reliance Industries	1.00
Suzlon Energy	1.25
VSNL	1.44

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