

FINANCIAL MANAGEMENT

REFRESHER MODULE



AN OVERVIEW OF FINANCIAL MANAGEMENT

Forms of Business Organization

Creating Value for Investors

Stockholder-Manager Conflicts

Stockholder-Debtholder Conflicts

Balancing Interests of Shareholders and Society

Forms of Business Organization

Proprietorship

Partnership

Corporation

STOCK PRICES AND INTRINSIC VALUE

- IN EQUILIBRIUM, A STOCK'S PRICE SHOULD EQUAL ITS "TRUE" OR INTRINSIC VALUE.
- INTRINSIC VALUE IS A LONG-RUN CONCEPT.
- TO THE EXTENT THAT INVESTOR PERCEPTIONS ARE INCORRECT, A STOCK'S PRICE IN THE SHORT RUN MAY DEVIATE FROM ITS INTRINSIC VALUE.
- IDEALLY, MANAGERS SHOULD AVOID ACTIONS THAT REDUCE INTRINSIC VALUE, EVEN IF THOSE DECISIONS INCREASE THE STOCK PRICE IN THE SHORT RUN.

TYPES OF FINANCIAL MARKETS

Physical assets
vs. Financial
assets

Spot vs. Futures

Money vs.
Capital

Primary vs.
Secondary

Public vs.
Private

TYPES OF FINANCIAL INSTITUTIONS

- INVESTMENT BANKS
- COMMERCIAL BANKS
- FINANCIAL SERVICES CORPORATIONS
- PENSION FUNDS
- MUTUAL FUNDS
- EXCHANGE TRADED FUNDS
- HEDGE FUNDS
- PRIVATE EQUITY FUNDS

BALANCE SHEET

- Reports the assets, liabilities, and stockholders' equity at a specific date (i.e., for one day in time).
- Lists assets at the top, followed by liabilities and stockholder's equity.
- Total assets must equal total liabilities and stockholder's equity.
- Is a snapshot of the company's financial condition at a specific moment in time (usually the month-end or year-end).

INCOME STATEMENT

- REPORTS THE PROFITABILITY OF THE COMPANY'S OPERATIONS OVER A SPECIFIC PERIOD OF TIME (E.G., BY MONTH, QUARTER, YEAR).
- LISTS REVENUES FIRST, FOLLOWED BY EXPENSES.
- SHOWS NET INCOME (OR NET LOSS).
- DOES NOT INCLUDE INVESTMENT AND DIVIDEND TRANSACTIONS BETWEEN THE STOCKHOLDERS AND THE BUSINESS

ANALYSIS OF FINANCIAL STATEMENTS

- RATIOS STANDARDIZE NUMBERS AND FACILITATE COMPARISONS.
- RATIOS ARE USED TO HIGHLIGHT WEAKNESSES AND STRENGTHS.
- RATIO COMPARISONS SHOULD BE MADE THROUGH TIME AND WITH COMPETITORS.
 - INDUSTRY ANALYSIS
 - BENCHMARK (PEER) ANALYSIS
 - TREND ANALYSIS

FIVE MAJOR CATEGORIES OF RATIOS AND THE QUESTIONS THEY ANSWER

Liquidity: Can we make required payments?

Asset management: Right amount of assets vs. sales?

Debt management: Right mix of debt and equity?

Profitability: Do sales prices exceed unit costs, and are sales high enough as reflected in PM, ROE, and ROA?

Market value: Do investors like what they see as reflected in P/E and M/B ratios?

CONCEPTS IN VALUATION (TIME VALUE)

TYPES OF CASH FLOWS:

- LUMP SUM = A SINGLE FLOW
- ANNUITY = A SERIES OF EQUAL CASH FLOWS OCCURRING OVER EQUAL INTERVALS
- UNEVEN = AN IRREGULAR SERIES OF CASH FLOWS WHICH DO NOT CONSTITUTE AN ANNUITY

ANNUITIES

- ORDINARY ANNUITY
 - PAYMENTS ARE MADE AT THE END OF EACH PERIOD (END MODE ON CALCULATOR)
- ANNUITY DUE
 - PAYMENTS ARE MADE AT THE BEGINNING OF EACH PERIOD (BEGIN MODE ON CALCULATOR)
 - AN ANNUITY DUE HAS ITS FIRST PAYMENT TODAY

TIME VALUE OF MONEY

- FUTURE VALUE
 - COMPOUNDING
- PRESENT VALUE
 - DISCOUNTING

WHAT'S THE FV OF AN INITIAL \$100 AFTER 3 YRS IF I/YR=10%, ANNUAL COMPOUNDING

- TIME LINE
- CASH FLOW STREAM: LUMP SUM
 - USE TVM FUNCTION (END MODE)
- PERIODS PER YEAR
 - COMPOUNDING PERIOD = PAYMENTS PER YEAR = 1

TVM KEY STROKES

- ^ CLEAR
- SHOULD NOT SEE 'BEG' ON SCREEN
- 1 ^ P/YR
- 3 N
- 10 I/YR
- -100 PV
- 0 PMT
- FV = 133.10

EFFECTS OF COMPOUNDING: LENGTH OF MATURITY

- WHEN $N=3$ THEN $FV = 133.10$
- WHEN $N=5$ THEN $FV = 161.05$
- WHEN $N=20$ THEN $FV = 672.75$
- THE LONGER THE TIME TO MATURITY (N), THE GREATER THE FUTURE VALUE.

TVM KEY STROKES

- ^ CLEAR
- SHOULD NOT SEE 'BEG' ON SCREEN
- 1 ^ P/YR
- 3 N
- 15 I/YR
- -100 PV
- 0 PMT
- FV = 133.10

EFFECTS OF COMPOUNDING: INTEREST RATE

- WHEN $I/YR=10$ THEN $FV = 133.10$
- WHEN $I/YR=15$ THEN $FV = 152.09$
- WHEN $I/YR=50$ THEN $FV = 337.50$
- THE GREATER THE INTEREST RATE (I/YR), THE GREATER THE FUTURE VALUE.

WHAT'S THE PV OF \$100 TO BE RECEIVED IN 3 YRS IF I\YR=10%, ANNUAL CMPDING

- TIME LINE
- CASH FLOW STREAM: LUMP SUM
 - USE TVM FUNCTION (END MODE)
- PERIODS PER YEAR
 - COMPOUNDING PERIOD = PAYMENTS PER YEAR = 1

TVM KEY STROKES

- ^ CLEAR
- SHOULD NOT SEE 'BEG' ON SCREEN
- 1 ^ P/YR
- 3 N
- 10 I/YR
- 100 FV
- 0 PMT
- PV = -75.13

EFFECTS OF DISCOUNTING: LENGTH OF MATURITY

- WHEN $N=3$ THEN $PV = -75.13$
- WHEN $N=5$ THEN $PV = -62.09$
- WHEN $N=20$ THEN $PV = -14.86$
- THE LONGER YOU HAVE TO WAIT TO RECEIVE THE MONEY (N), THE SMALLER THE PRESENT VALUE.

TVM KEY STROKES

- ^ CLEAR
- SHOULD NOT SEE 'BEG' ON SCREEN
- 1 ^ P/YR
- 3 N
- 10 I/YR
- 100 FV
- 0 PMT
- PV = 75.13

EFFECTS OF DISCOUNTING: INTEREST RATE

- WHEN $I/YR=10$ THEN $PV = -75.13$
- WHEN $I/YR=15$ THEN $PV = -65.75$
- WHEN $I/YR=50$ THEN $PV = -29.63$
- THE GREATER THE INTEREST RATE (I/YR), THE SMALLER THE PRESENT VALUE.

PV OF 3 YR ORDINARY ANNUITY OF \$100 IF I/YR=10% ANNUAL COMPOUNDING

- TIME LINE
- CASH FLOW STREAM: ANNUITY
 - USE TVM FUNCTION (END MODE)
- PERIODS PER YEAR
 - COMPOUNDING PERIOD = PAYMENTS PER YEAR = 1

TVM KEY STROKES

- ^ CLEAR
- SHOULD NOT SEE 'BEG' ON SCREEN
- 1 ^ P/YR
- 3 N
- 10 I/YR
- 0 FV
- 100 PMT
- PV = -248.69

PV OF 3 YR ANNUITY DUE OF \$100 IF I/YR=10%, ANNUAL COMPOUNDING

- TIME LINE
- CASH FLOW STREAM: ANNUITY
 - USE TVM FUNCTION (BEGIN MODE)
- PERIODS PER YEAR
 - COMPOUNDING PERIOD = PAYMENTS PER YEAR = 1

TVM KEY STROKES

- ^ CLEAR
- ^ BEG (SHOULD SEE 'BEG' ON SCREEN)
- 1 ^ P/YR
- 3 N
- 10 I/YR
- 0 FV
- 100 PMT
- PV = -273.55

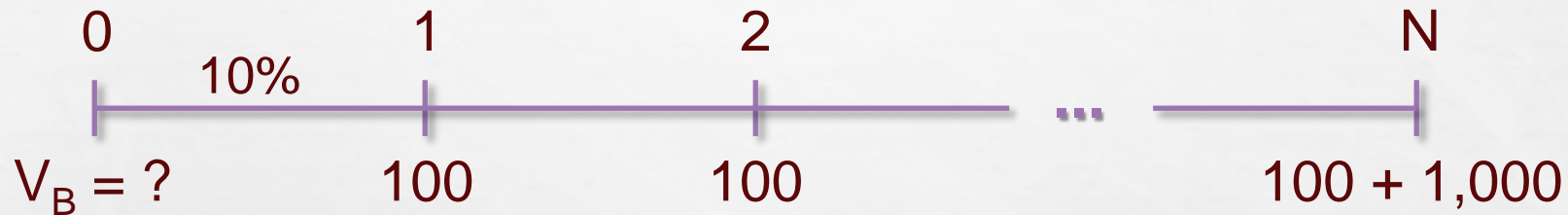
ANNUITY DUE vs. ORDINARY ANNUITY

- PV (ANNUITY DUE) = \$273.55
- PV (ORDINARY ANNUITY) = \$248.69
- WHY?
- YOU GET THE FIRST PAYMENT SOONER (TODAY) WITH THE ANNUITY DUE.

BOND VALUATION

- **A BOND IS A LONG-TERM DEBT INSTRUMENT IN WHICH A BORROWER AGREES TO MAKE PAYMENTS OF PRINCIPAL AND INTEREST, ON SPECIFIC DATES, TO THE HOLDERS OF THE BOND.**
- **PAR VALUE: FACE AMOUNT OF THE BOND, WHICH IS PAID AT MATURITY (ASSUME \$1,000).**
- **COUPON INTEREST RATE: STATED INTEREST RATE (GENERALLY FIXED) PAID BY THE ISSUER. MULTIPLY BY PAR VALUE TO GET DOLLAR PAYMENT OF INTEREST.**
- **MATURITY DATE: YEARS UNTIL THE BOND MUST BE REPAYED.**
- **ISSUE DATE: WHEN THE BOND WAS ISSUED.**
- **YIELD TO MATURITY: RATE OF RETURN EARNED ON A BOND HELD UNTIL MATURITY (ALSO CALLED THE “PROMISED YIELD”).**

WHAT IS THE VALUE OF A 10-YEAR, 10% ANNUAL COUPON BOND, IF $R_D = 10\%$?



$$V_B = \frac{\$100}{(1.10)^1} + \dots + \frac{\$100}{(1.10)^{10}} + \frac{\$1,000}{(1.10)^{10}}$$

$$V_B = \$90.91 + \dots + \$38.55 + \$385.54$$

$$V_B = \$1,000$$

CALCULATING THE VALUE OF A BOND

- THIS BOND HAS A \$1,000 LUMP SUM (THE PAR VALUE) DUE AT MATURITY ($T = 10$), AND ANNUAL \$100 COUPON PAYMENTS BEGINNING AT $T = 1$ AND CONTINUING THROUGH $T = 10$. THE PRICE OF THE BOND CAN BE FOUND BY SOLVING FOR THE PV OF THESE CASH FLOWS.

EXCEL

INPUTS	10	10		100	1000
	N	I/YR	PV	PMT	FV
OUTPUT	(10, 100, 1000)		-1000		

WHAT'S THE VALUE OF A 10-YEAR BOND OUTSTANDING WITH THE SAME RISK BUT A 13% ANNUAL COUPON RATE?

- THE ANNUAL COUPON PAYMENT IS \$130. SINCE THE RISK IS THE SAME IT HAS THE SAME YIELD TO MATURITY AS THE PREVIOUS BOND (10%). THIS BOND SELLS AT A PREMIUM BECAUSE THE COUPON RATE > THE YIELD TO MATURITY.

INPUTS	10	10		130	1000
	N	I/YR	PV	PMT	FV
OUTPUT			-1184.34		

EXCEL: =PV(.10,10,130,1000)

WHAT'S THE VALUE OF A 10-YEAR BOND OUTSTANDING WITH THE SAME RISK BUT A 7% ANNUAL COUPON RATE?

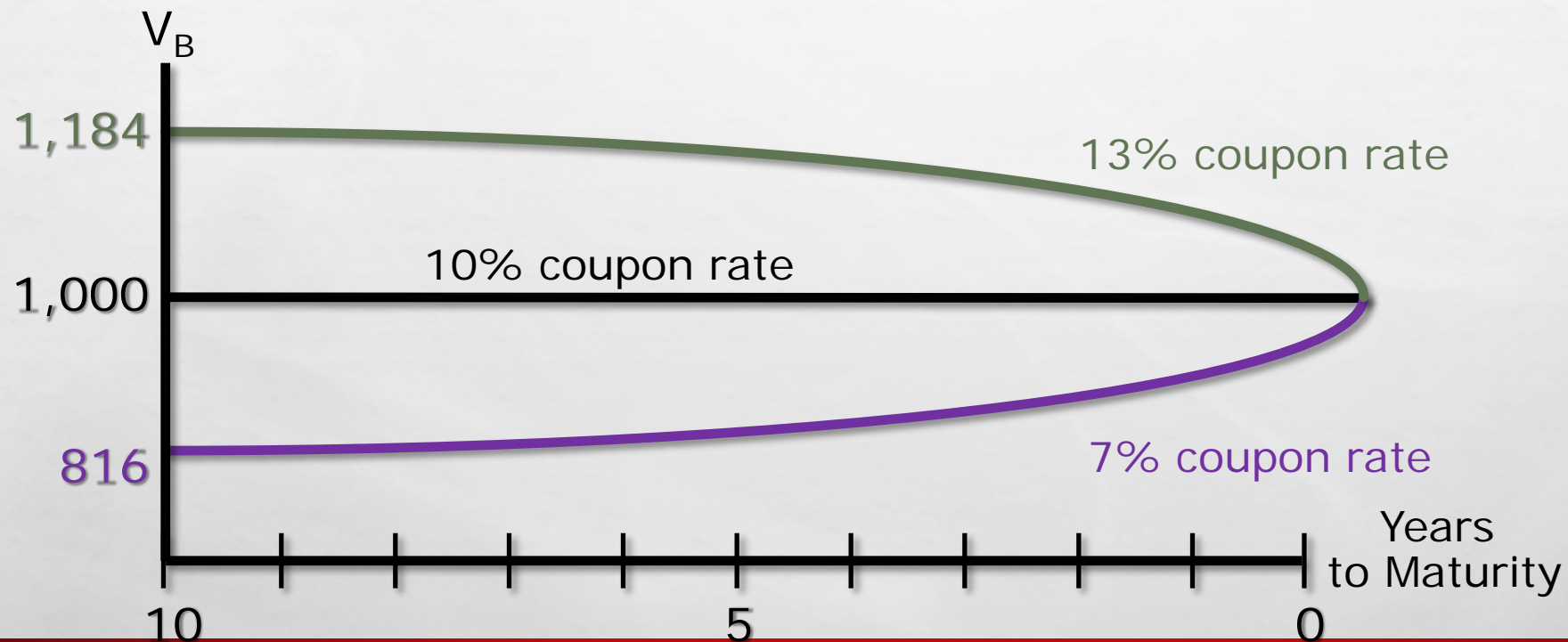
- THE ANNUAL COUPON PAYMENT IS \$70. SINCE THE RISK IS THE SAME IT HAS THE SAME YIELD TO MATURITY AS THE PREVIOUS BONDS (10%). THIS BOND SELLS AT A DISCOUNT BECAUSE THE COUPON RATE < THE YIELD TO MATURITY.

INPUTS	10	10		70	1000
	N	I/YR	PV	PMT	FV
OUTPUT			-815.66		

EXCEL: =PV(.10,10,70,1000)

CHANGES IN BOND VALUE OVER TIME

- WHAT WOULD HAPPEN TO THE VALUE OF THESE THREE BONDS IF THE REQUIRED RATE OF RETURN REMAINED AT 10%?



BOND VALUES OVER TIME

- AT MATURITY, THE VALUE OF ANY BOND MUST EQUAL ITS PAR VALUE.
- IF R_D REMAINS CONSTANT:
 - THE VALUE OF A PREMIUM BOND WOULD DECREASE OVER TIME, UNTIL IT REACHED \$1,000.
 - THE VALUE OF A DISCOUNT BOND WOULD INCREASE OVER TIME, UNTIL IT REACHED \$1,000.
 - THE VALUE OF A PAR BOND STAYS AT \$1,000.

WHAT IS THE YTM ON THE FOLLOWING BOND?

- 10-YEAR; 9% ANNUAL COUPON; \$1,000 PAR VALUE; SELLING FOR \$887.
- MUST FIND THE R_D THAT SOLVES THIS MODEL.

$$V_B = \frac{\text{INT}}{(1+r_d)^1} + \dots + \frac{\text{INT}}{(1+r_d)^N} + \frac{M}{(1+r_d)^N}$$
$$\$887 = \frac{90}{(1+r_d)^1} + \dots + \frac{90}{(1+r_d)^{10}} + \frac{1,000}{(1+r_d)^{10}}$$

SOLVING FOR THE YTM

- SOLVING FOR I/YR, THE YTM OF THIS BOND IS 10.91%. THIS BOND SELLS AT A DISCOUNT, BECAUSE YTM > COUPON RATE.

INPUTS	10		-887	90	1000
	N	I/YR	PV	PMT	FV
OUTPUT		10.91			

EXCEL: =RATE(10,90,-887,1000)

FIND YTM IF THE BOND PRICE IS \$1,134.20

- SOLVING FOR I/YR, THE YTM OF THIS BOND IS 7.08%. THIS BOND SELLS AT A PREMIUM, BECAUSE $YTM < \text{COUPON RATE}$.

INPUTS	10		-1134.20	90	1000
	N	I/YR	PV	PMT	FV
OUTPUT		7.08			

EXCEL: =RATE(10,90,-1134.20,1000)

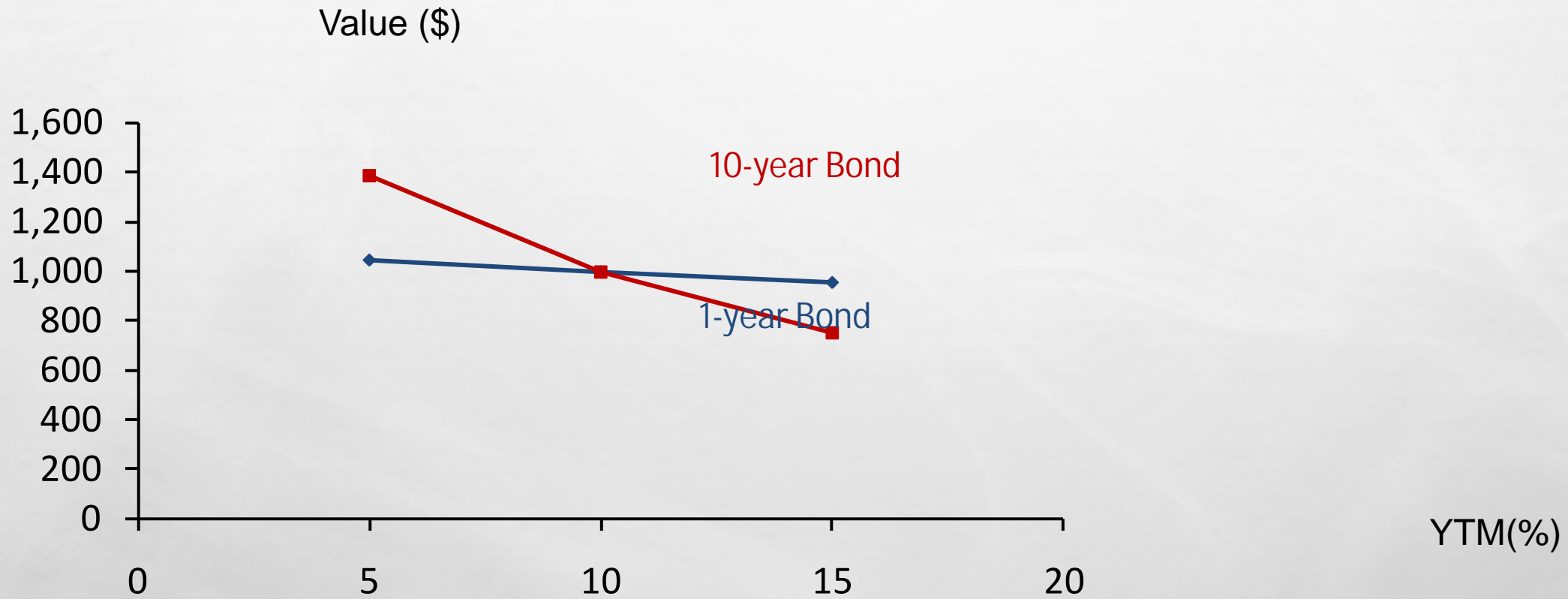
WHAT IS PRICE RISK? DOES A 1-YEAR OR 10-YEAR BOND HAVE MORE PRICE RISK?

- PRICE RISK IS THE CONCERN THAT RISING R_D WILL CAUSE THE VALUE OF A BOND TO FALL.

<u>R_D</u>	<u>1-YEAR</u>	<u>CHANGE</u>	<u>10-YEAR</u>	<u>CHANGE</u>
5%	\$1,048	> +4.8%	\$1,386	> +38.6%
10%	1,000	> -4.4%	1,000	> -25.1%
15%	956		749	

- THE 10-YEAR BOND IS MORE SENSITIVE TO INTEREST RATE CHANGES, AND HENCE HAS MORE PRICE RISK.

ILLUSTRATING PRICE RISK



WHAT IS REINVESTMENT RISK?

- REINVESTMENT RISK IS THE CONCERN THAT R_D WILL FALL, AND FUTURE CFS WILL HAVE TO BE REINVESTED AT LOWER RATES, HENCE REDUCING INCOME.

EXAMPLE: SUPPOSE YOU JUST WON \$500,000 PLAYING THE LOTTERY. YOU INTEND TO INVEST THE MONEY AND LIVE OFF THE INTEREST.

REINVESTMENT RISK EXAMPLE

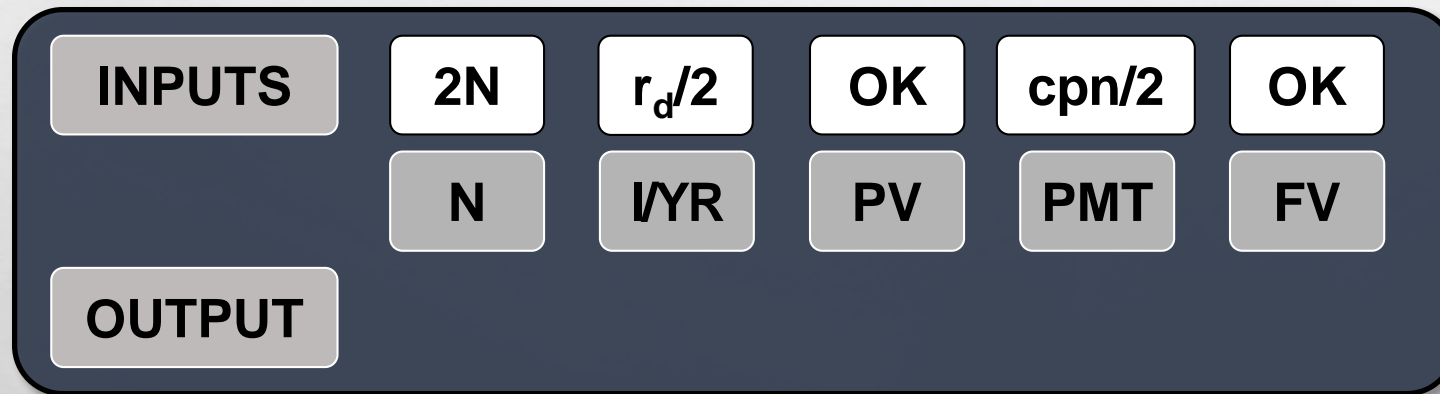
- YOU MAY INVEST IN EITHER A 10-YEAR BOND OR A SERIES OF TEN 1-YEAR BONDS. BOTH 10-YEAR AND 1-YEAR BONDS CURRENTLY YIELD 10%.
- IF YOU CHOOSE THE 1-YEAR BOND STRATEGY:
 - AFTER YEAR 1, YOU RECEIVE \$50,000 IN INCOME AND HAVE \$500,000 TO REINVEST. BUT, IF 1-YEAR RATES FALL TO 3%, YOUR ANNUAL INCOME WOULD FALL TO \$15,000.
- IF YOU CHOOSE THE 10-YEAR BOND STRATEGY:
 - YOU CAN LOCK IN A 10% INTEREST RATE, AND \$50,000 ANNUAL INCOME FOR 10 YEARS, ASSUMING THE BOND IS NOT CALLABLE.

CONCLUSIONS ABOUT PRICE RISK AND REINVESTMENT RISK

	Short-term AND/OR High-coupon Bonds	Long-term AND/OR Low-coupon Bonds
Price risk	Low	High
Reinvestment risk	High	Low

SEMIANNUAL BONDS

1. MULTIPLY YEARS BY 2: NUMBER OF PERIODS = $2N$
2. DIVIDE NOMINAL RATE BY 2: PERIODIC RATE (I/YR) = $R_D/2$
3. DIVIDE ANNUAL COUPON BY 2: $PMT = \text{ANNUAL COUPON}/2$



WHAT IS THE VALUE OF A 10-YEAR, 10% SEMIANNUAL COUPON BOND, IF $R_D = 13\%$?

1. MULTIPLY YEARS BY 2: $N = 2 \times 10 = 20$
2. DIVIDE NOMINAL RATE BY 2: $I/YR = 13/2 = 6.5$
3. DIVIDE ANNUAL COUPON BY 2: $PMT = 100/2 = 50$

INPUTS	20	6.5		50	1000
	N	I/YR	PV	PMT	FV
OUTPUT			-834.72		

EXCEL: =PV(.065,20,50,1000)

WOULD YOU PREFER TO BUY A 10-YEAR, 10% ANNUAL COUPON BOND OR A 10-YEAR, 10% SEMIANNUAL COUPON BOND, ALL ELSE EQUAL?

The semiannual bond's effective rate is:

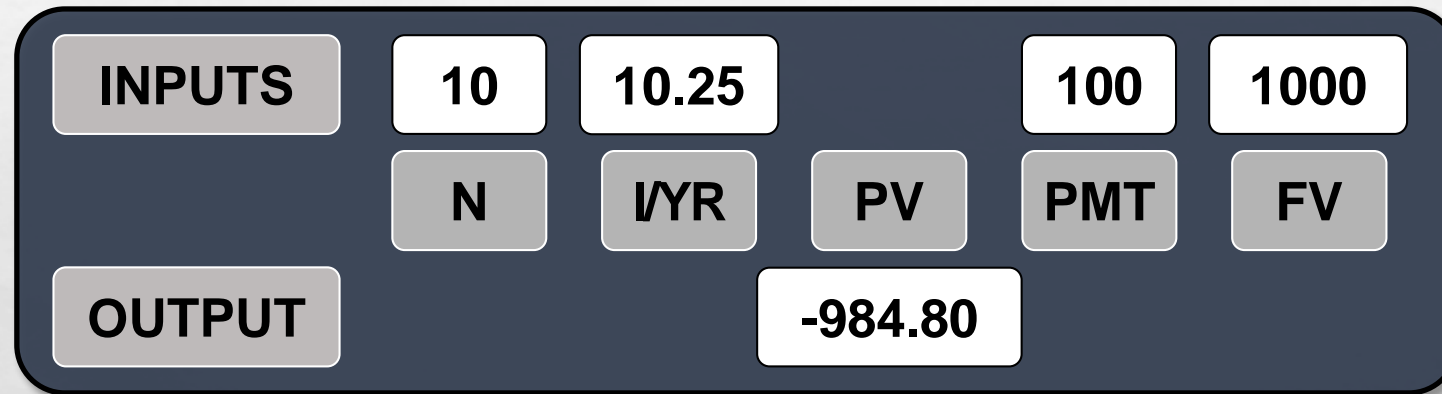
$$\text{EFF}\% = \left(1 + \frac{r_{\text{NOM}}}{M}\right)^M - 1 = \left(1 + \frac{0.10}{2}\right)^2 - 1 = 10.25\%$$

Excel: =EFFECT(.10,2)
= 10.25%

10.25% > 10% (the annual bond's effective rate), so you would prefer the semiannual bond.

IF THE PROPER PRICE FOR THIS SEMIANNUAL BOND IS \$1,000, WHAT WOULD BE THE PROPER PRICE FOR THE ANNUAL COUPON BOND?

- THE SEMIANNUAL BOND HAS A 10.25% EFFECTIVE RATE, SO THE ANNUAL BOND SHOULD EARN THE SAME EAR. AT THESE PRICES, THE ANNUAL AND SEMIANNUAL BONDS ARE IN EQUILIBRIUM.



EXCEL: =PV(.1025,10,100,1000)

A 10-YEAR, 10% SEMIANNUAL COUPON BOND SELLING FOR \$1,135.90 CAN BE CALLED IN 4 YEARS FOR \$1,050, WHAT IS ITS YIELD TO CALL (YTC)?

- THE BOND'S YIELD TO MATURITY IS 8%. SOLVING FOR THE YTC IS IDENTICAL TO SOLVING FOR YTM, EXCEPT THE TIME TO CALL IS USED FOR N AND THE CALL PREMIUM IS FV.

INPUTS	8	-1135.90	50	1050	
	N	I/YR	PV	PMT	FV
OUTPUT	3.568				

EXCEL: =RATE(8,50,-1135.90,1050)

STOCK VALUATION

- REPRESENTS OWNERSHIP
- OWNERSHIP IMPLIES CONTROL
- STOCKHOLDERS ELECT DIRECTORS
- DIRECTORS ELECT MANAGEMENT
- MANAGEMENT'S GOAL: MAXIMIZE THE STOCK PRICE

DIFFERENT APPROACHES FOR ESTIMATING THE INTRINSIC VALUE OF A COMMON STOCK

Discounted dividend model

Corporate valuation model

Models based on market multiples

DISCOUNTED DIVIDEND MODEL

$$\hat{P}_0 = \frac{D_1}{(1+r_s)^1} + \frac{D_2}{(1+r_s)^2} + \frac{D_3}{(1+r_s)^3} + \dots + \frac{D_\infty}{(1+r_s)^\infty}$$

- VALUE OF A STOCK IS THE PRESENT VALUE OF THE FUTURE DIVIDENDS EXPECTED TO BE GENERATED BY THE STOCK.

CONSTANT GROWTH STOCK

- A STOCK WHOSE DIVIDENDS ARE EXPECTED TO GROW FOREVER AT A CONSTANT RATE, G .

$$D_1 = D_0(1 + G)^1$$

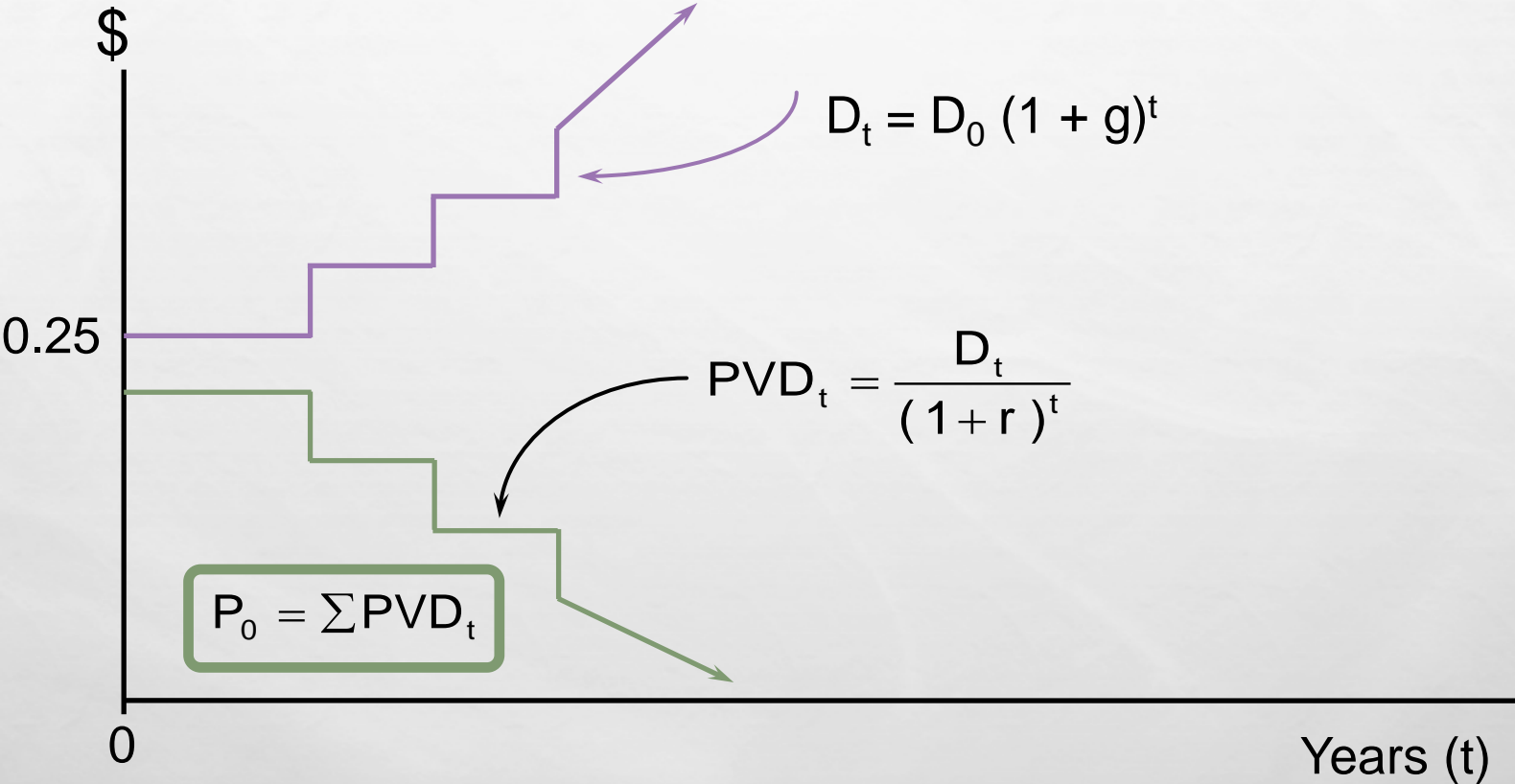
$$D_2 = D_0(1 + G)^2$$

$$D_T = D_0(1 + G)^T$$

- IF G IS CONSTANT, THE DISCOUNTED DIVIDEND FORMULA CONVERGES TO:

$$\hat{P}_0 = \frac{D_0(1+g)}{r_s - g} = \frac{D_1}{r_s - g}$$

FUTURE DIVIDENDS AND THEIR PRESENT VALUES

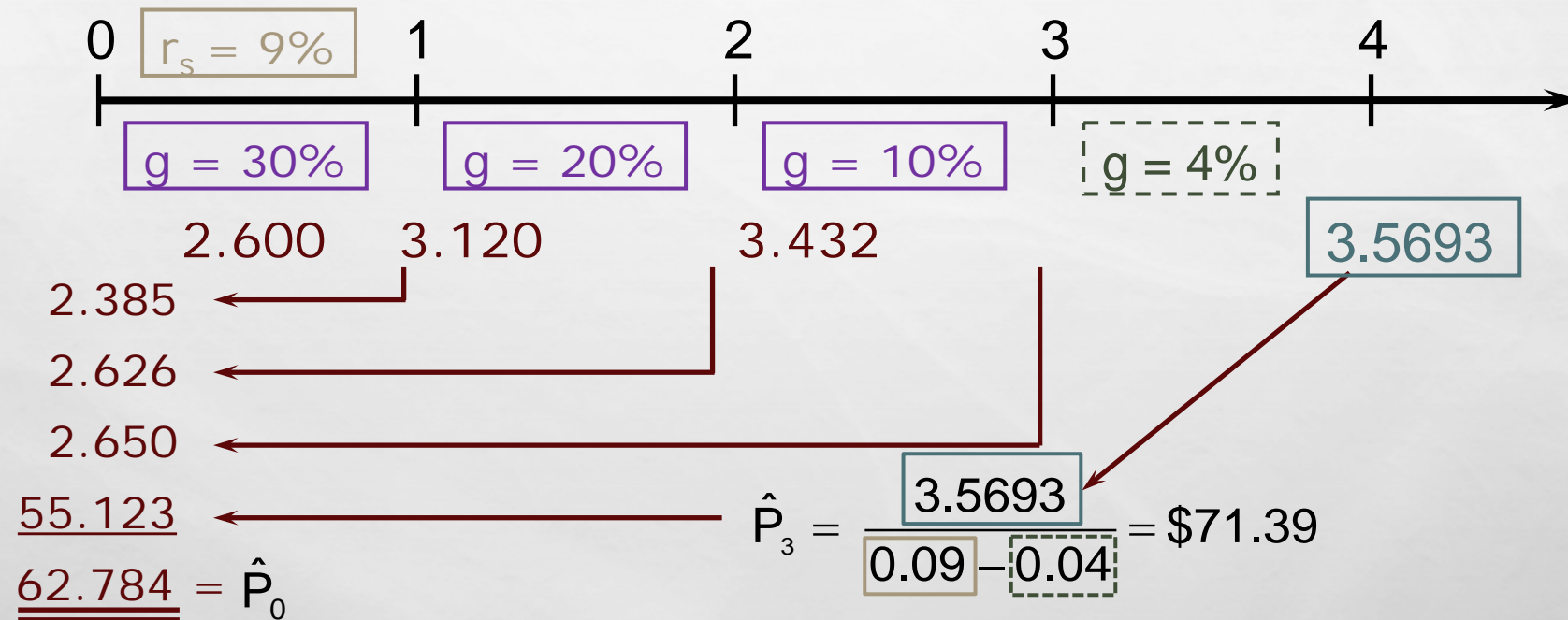


SUPERNORMAL GROWTH

- WHAT IF $G = 30\%$ FOR 1 YR, 20% FOR 1 YR, AND 10% FOR 1 YR BEFORE ACHIEVING LONG-RUN GROWTH OF 4% ?
 - CAN NO LONGER USE JUST THE CONSTANT GROWTH MODEL TO FIND STOCK VALUE.
 - HOWEVER, THE GROWTH DOES BECOME CONSTANT AFTER 3 YEARS.

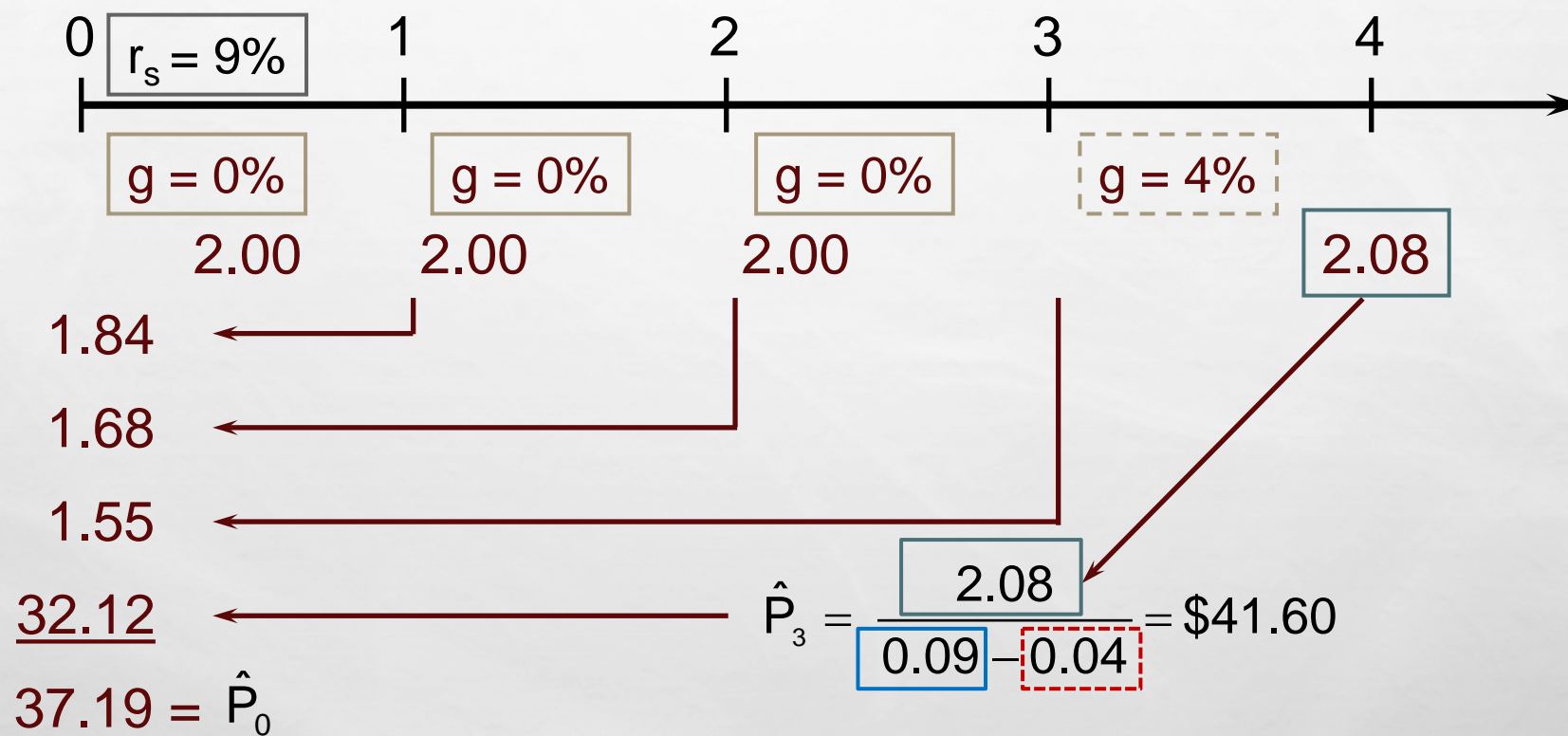
VALUING COMMON STOCK WITH NONCONSTANT GROWTH

$$D_0 = \$2.00.$$



NONCONSTANT GROWTH: WHAT IF $G = 0\%$ FOR 3 YEARS BEFORE LONG-RUN GROWTH OF 4% ?

$D_0 = \$2.00.$



FIND EXPECTED DIVIDEND AND CAPITAL GAINS YIELDS DURING THE FIRST AND FOURTH YEARS

- DIVIDEND YIELD (FIRST YEAR)

$$= \$2.00/\$37.19 = 5.38\%$$

- CAPITAL GAINS YIELD (FIRST YEAR)

$$= 9.00\% - 5.38\% = 3.62\%$$

- AFTER $T = 3$, THE STOCK HAS CONSTANT GROWTH AND DIVIDEND YIELD = 5%, WHILE CAPITAL GAINS YIELD = 4%.

FIND EXPECTED ANNUAL DIVIDEND AND CAPITAL GAINS YIELDS

- CAPITAL GAINS YIELD

$$= G = -4.00\%$$

- DIVIDEND YIELD

$$= 9.00\% - (-4.00\%) = 13.00\%$$

- SINCE THE STOCK IS EXPERIENCING CONSTANT GROWTH, DIVIDEND YIELD AND CAPITAL GAINS YIELD ARE CONSTANT. DIVIDEND YIELD IS SUFFICIENTLY LARGE (13%) TO OFFSET NEGATIVE CAPITAL GAINS.

FIRM MULTIPLES METHOD

- ANALYSTS OFTEN USE THE FOLLOWING MULTIPLES TO VALUE STOCKS.
 - P/E
 - P/CF
 - P/SALES
- EXAMPLE: BASED ON COMPARABLE FIRMS, ESTIMATE THE APPROPRIATE P/E. MULTIPLY THIS BY EXPECTED EARNINGS TO BACK OUT AN ESTIMATE OF THE STOCK PRICE.
- ENTERPRISE-BASED MULTIPLES
 - EV/EBITDA

PREFERRED STOCK

Hybrid security

Like bonds, preferred stockholders receive a fixed dividend that must be paid before dividends are paid to common stockholders.

However, companies can omit preferred dividend payments without fear of pushing the firm into bankruptcy.

IF PREFERRED STOCK WITH AN ANNUAL DIVIDEND OF \$5 SELLS FOR \$100, WHAT IS THE PREFERRED STOCK'S EXPECTED RETURN?

$$V_p = \frac{D}{r_p}$$

$$\$100 = \frac{\$5}{r_p}$$

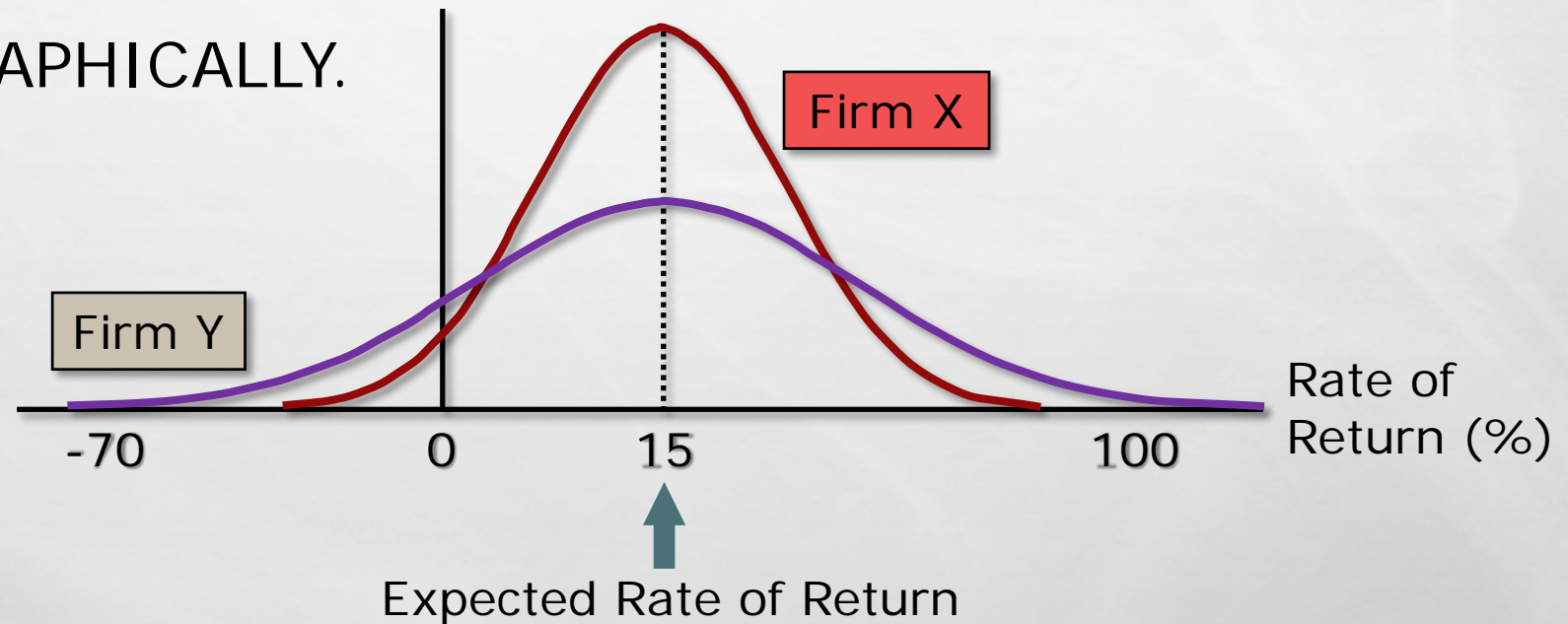
$$\begin{aligned}\hat{r}_p &= \frac{\$5}{\$100} \\ &= 0.05 = 5\%\end{aligned}$$

CAPM – SML – RISK vs RETURN

- TWO TYPES OF INVESTMENT RISK
 - STAND-ALONE RISK
 - PORTFOLIO RISK
- INVESTMENT RISK IS RELATED TO THE PROBABILITY OF EARNING A LOW OR NEGATIVE ACTUAL RETURN.
- THE GREATER THE CHANCE OF LOWER THAN EXPECTED, OR NEGATIVE RETURNS, THE RISKIER THE INVESTMENT.

PROBABILITY DISTRIBUTIONS

- A LISTING OF ALL POSSIBLE OUTCOMES, AND THE PROBABILITY OF EACH OCCURRENCE.
- CAN BE SHOWN GRAPHICALLY.



SELECTED REALIZED RETURNS, 1926-2016

Selected Realized Returns, 1926–2016

	Average Return	Standard Deviation
Small-cap stocks	16.6%	31.9%
Large-cap stocks	12.0	19.9
Long-term corporate bonds	6.3	8.4
Long-term government bonds	6.0	9.9
U.S. Treasury bills	3.4	3.1
Portfolios:		
90% stocks/10% bonds	11.3%	17.9%
70% stocks/30% bonds	10.1	14.2

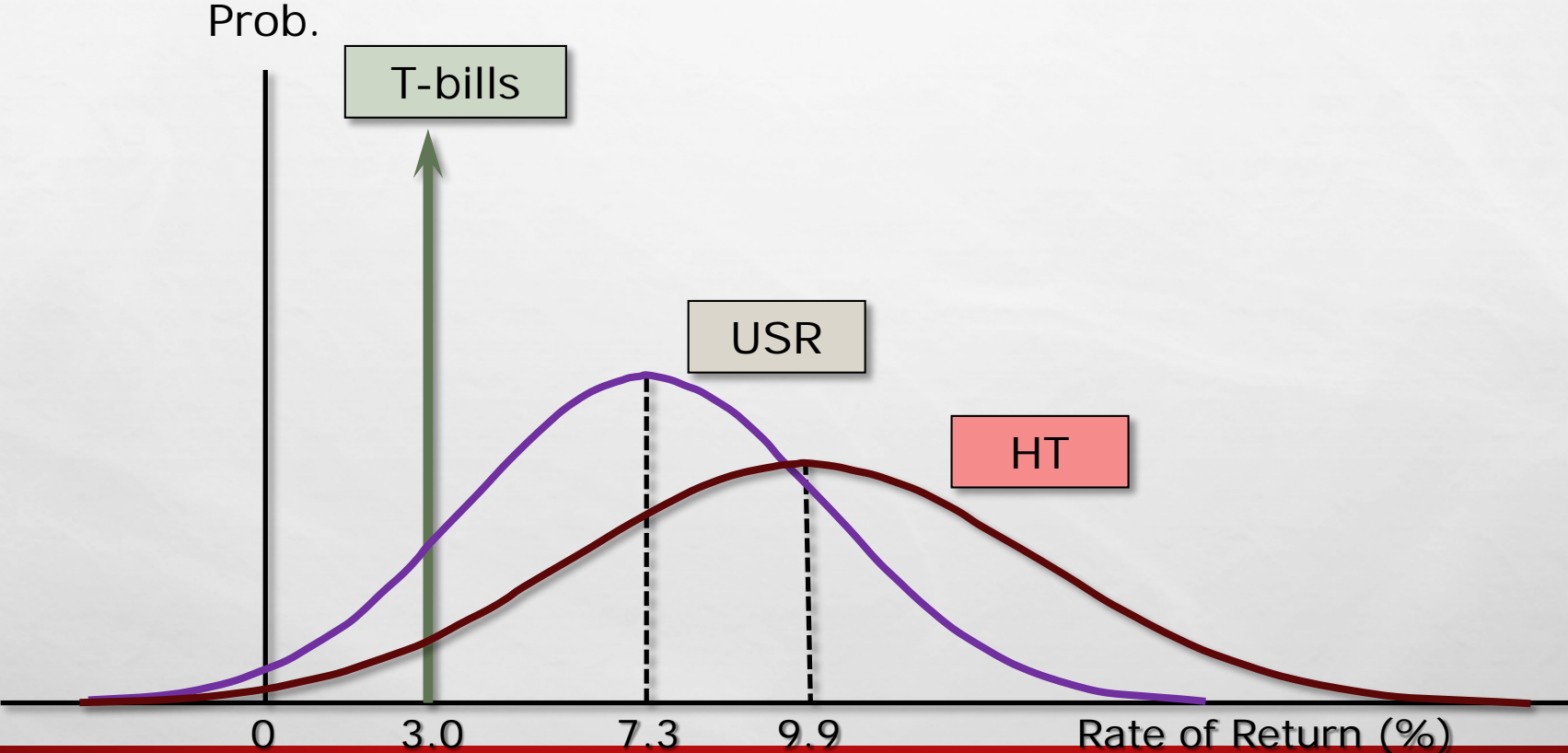
Source: Based on Roger G. Ibbotson and Duff & Phelps, *Stocks, Bonds, Bills, and Inflation: 2017 Yearbook* (Hoboken, NJ: John Wiley & Sons, Inc., 2017), pp. 2–6, 2–23.

SUMMARY OF EXPECTED RETURNS

	<u>EXPECTED RETURN</u>
HIGH TECH	9.9%
MARKET	8.0%
US RUBBER	7.3%
T-BILLS	3.0%
COLLECTIONS	1.2%

- HIGH TECH HAS THE HIGHEST EXPECTED RETURN, AND APPEARS TO BE THE BEST INVESTMENT ALTERNATIVE, BUT IS IT REALLY?
- HAVE WE FAILED TO ACCOUNT FOR RISK?

COMPARING STANDARD DEVIATIONS



COMMENTS ON STANDARD DEVIATION AS A MEASURE OF RISK

- STANDARD DEVIATION (Σ_1) MEASURES TOTAL, OR STAND-ALONE, RISK.
- THE LARGER Σ_1 IS, THE LOWER THE PROBABILITY THAT ACTUAL RETURNS WILL BE CLOSE TO EXPECTED RETURNS.
- LARGER Σ_1 IS ASSOCIATED WITH A WIDER PROBABILITY DISTRIBUTION OF RETURNS.

COMPARING RISK AND RETURN

Security	Expected Return, \hat{r}	Risk, σ
T-bills	3.0%	0.0%
High Tech	9.9	20.0
Collections*	1.2	11.2
US Rubber*	7.3	18.8
Market	8.0	15.2

*Seems out of place.

SHARPE RATIO

- THE SHARPE RATIO IS AN ALTERNATIVE MEASURE OF STAND-ALONE RISK. IT LOOKS AT EXCESS RETURN RELATIVE TO RISK.
 - HIGH TECH'S SHARPE RATIO = $(9.9\% - 3\%) / 20.0\% = 0.345$
 - U.S. RUBBER'S SHARPE RATIO = $(7.3\% - 3\%) / 18.8\% = 0.229$
 - MARKET PORTFOLIO'S SHARPE RATIO = $(8\% - 3\%) / 15.2\% = 0.329$
 - COLLECTIONS' SHARPE RATIO = $(1.2\% - 3\%) / 11.2\% = -0.161$
 - T-BILLS' SHARPE RATIO = 0.

- EXCESS RETURN IS ASSET'S RETURN MINUS THE RISK-FREE RATE.

- RISK IS MEASURED AS THE STANDARD DEVIATION OF THE ASSET'S RETURN.

- A RISK-FREE ASSET WILL HAVE A SHARPE RATIO = 0.

INVESTOR ATTITUDE TOWARDS RISK

Risk premium: the difference between the return on a risky asset and a riskless asset, which serves as compensation for investors to hold riskier securities.

Risk aversion: assumes investors dislike risk and require higher rates of return to encourage them to hold riskier securities.

PORTFOLIO CONSTRUCTION: RISK AND RETURN

- ASSUME A TWO-STOCK PORTFOLIO IS CREATED WITH \$50,000 INVESTED IN BOTH HIGH TECH AND COLLECTIONS.
- A PORTFOLIO'S EXPECTED RETURN IS A WEIGHTED AVERAGE OF THE RETURNS OF THE PORTFOLIO'S COMPONENT ASSETS.
- STANDARD DEVIATION IS A LITTLE MORE TRICKY AND REQUIRES THAT A NEW PROBABILITY DISTRIBUTION FOR THE PORTFOLIO RETURNS BE CONSTRUCTED.

CALCULATING PORTFOLIO EXPECTED RETURN

\hat{r}_p is a weighted average :

$$\hat{r}_p = \sum_{i=1}^N w_i \hat{r}_i$$

$$\hat{r}_p = 0.5(9.9\%) + 0.5(1.2\%) = 5.5\%$$

AN ALTERNATIVE METHOD FOR DETERMINING PORTFOLIO EXPECTED RETURN

Economy	Prob	HT	Coll	Port
Recession	0.1	-29.5%	24.5%	-2.5%
Below avg	0.2	-9.5%	10.5%	0.5%
Average	0.4	12.5%	-1.0%	5.8%
Above avg	0.2	27.5%	-5.0%	11.3%
Boom	0.1	42.5%	-20.0%	11.3%

$$\begin{aligned}\hat{r}_p &= 0.10 (-2.5\%) + 0.20 (0.5\%) + 0.40 (5.8\%) \\ &\quad + 0.20 (11.3\%) + 0.10 (11.3\%) = 5.5\%\end{aligned}$$

CALCULATING PORTFOLIO STANDARD DEVIATION AND CV

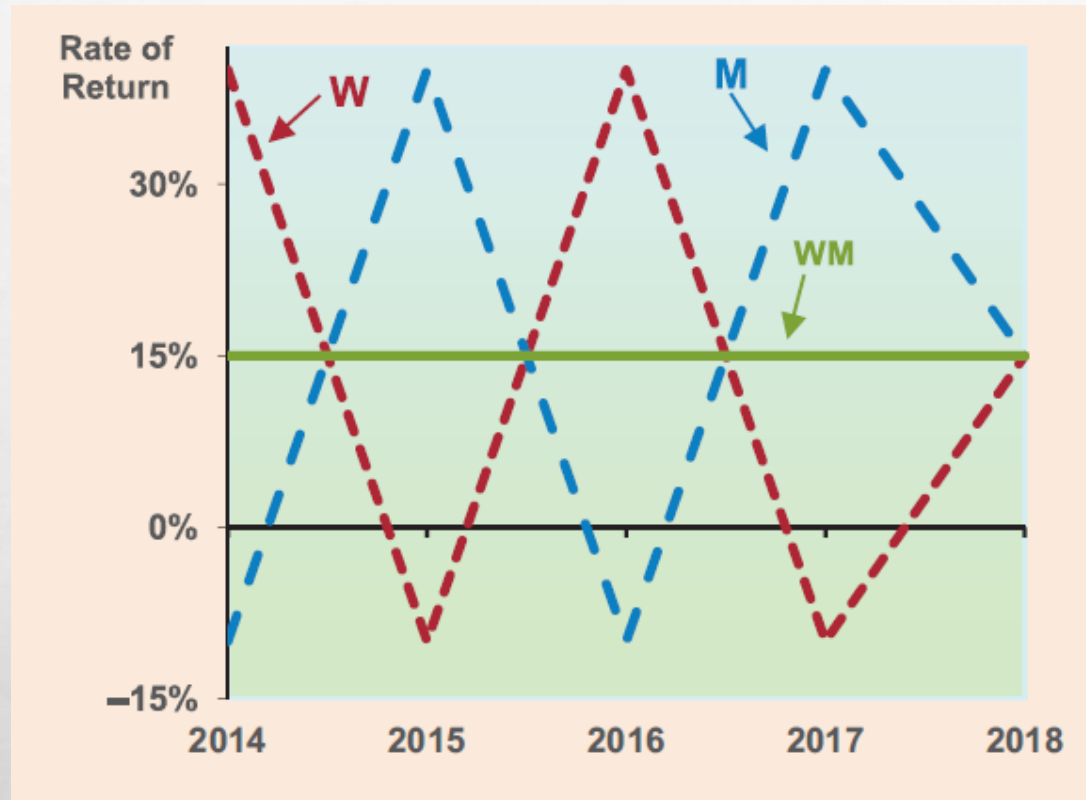
$$\sigma_p = \left[\begin{array}{l} 0.10 (-2.5 - 5.5)^2 \\ + 0.20 (0.5 - 5.5)^2 \\ + 0.40 (5.8 - 5.5)^2 \\ + 0.20 (11.3 - 5.5)^2 \\ + 0.10 (11.3 - 5.5)^2 \end{array} \right]^{1/2} = 4.6\%$$

$$CV_p = \frac{4.6\%}{5.5\%} = 0.84$$

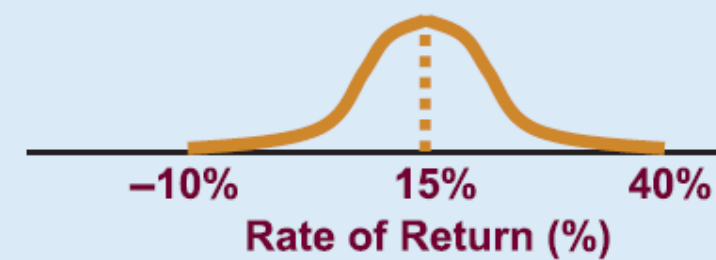
GENERAL COMMENTS ABOUT RISK

- $\Sigma \sim 35\%$ FOR AN AVERAGE STOCK.
- MOST STOCKS ARE POSITIVELY (THOUGH NOT PERFECTLY) CORRELATED WITH THE MARKET (I.E., ρ BETWEEN 0 AND 1).
- COMBINING STOCKS IN A PORTFOLIO GENERALLY LOWERS RISK.

RETURNS DISTRIBUTION FOR TWO PERFECTLY NEGATIVELY CORRELATED STOCKS ($P = -1.0$)



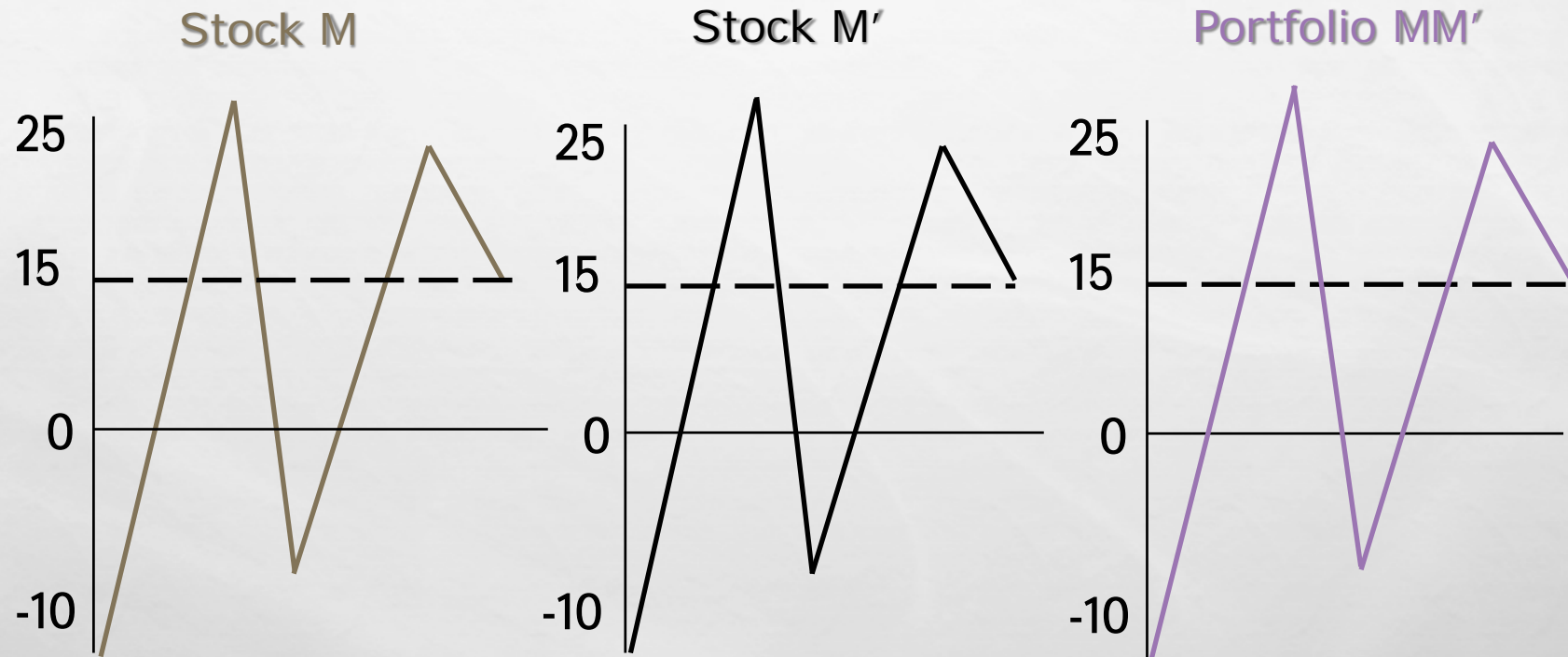
Stocks W and M, held separately



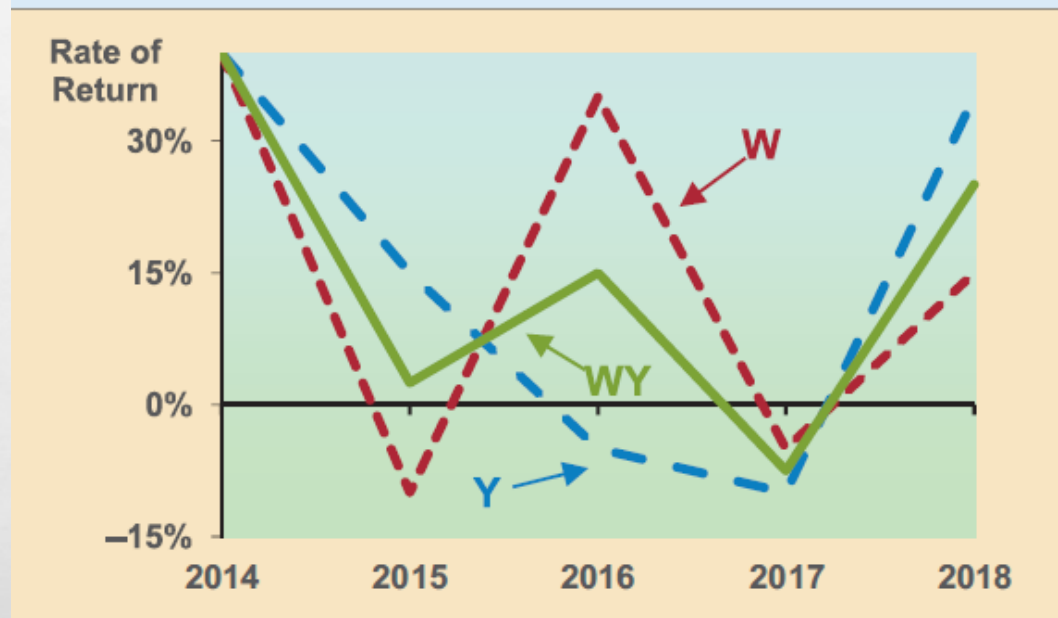
Portfolio WM



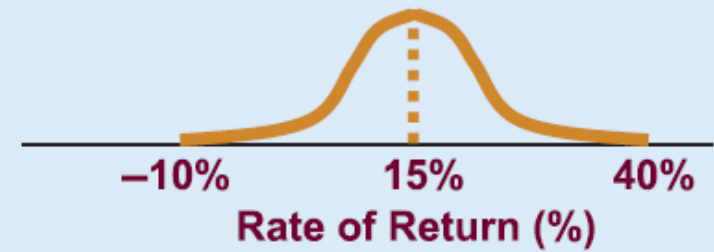
RETURNS DISTRIBUTION FOR TWO PERFECTLY POSITIVELY CORRELATED STOCKS ($\rho = 1.0$)



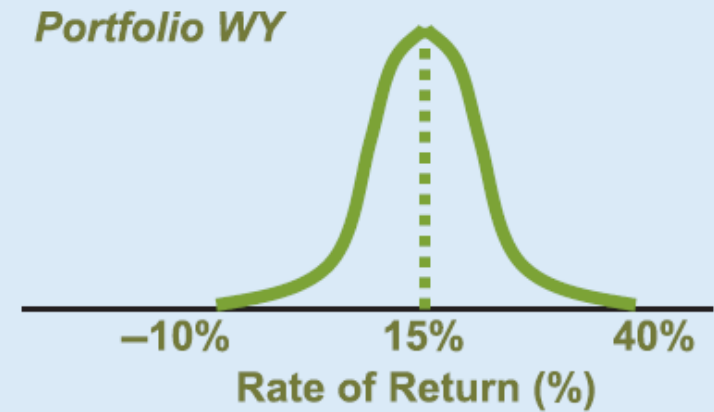
PARTIAL CORRELATION, $P = +0.35$



Stocks W and Y, held separately



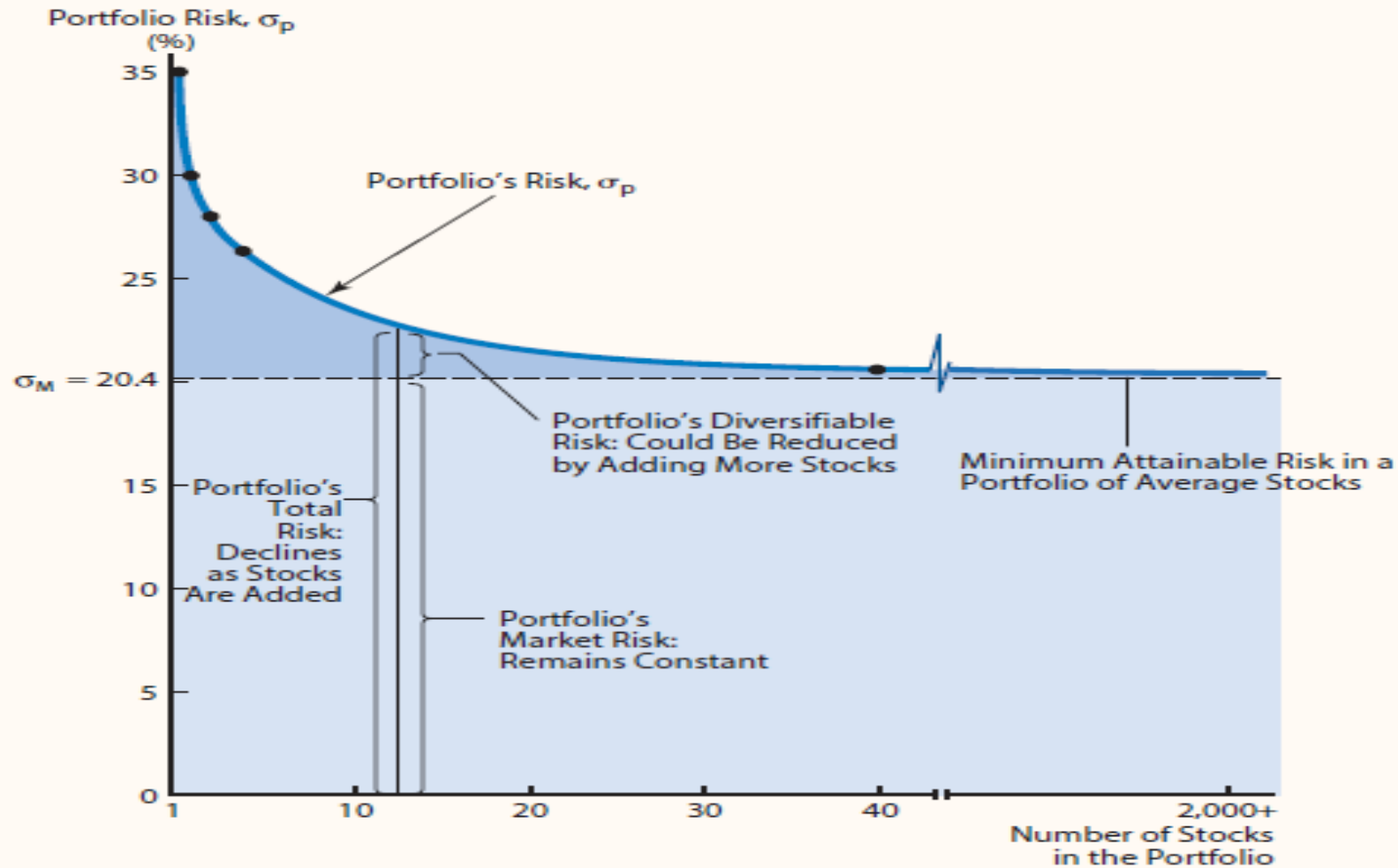
Portfolio WY



CREATING A PORTFOLIO: BEGINNING WITH ONE STOCK AND ADDING RANDOMLY SELECTED STOCKS TO PORTFOLIO

- Σ_p DECREASES AS STOCKS ARE ADDED, BECAUSE THEY WOULD NOT BE PERFECTLY CORRELATED WITH THE EXISTING PORTFOLIO.
- EXPECTED RETURN OF THE PORTFOLIO WOULD REMAIN RELATIVELY CONSTANT.
- EVENTUALLY THE DIVERSIFICATION BENEFITS OF ADDING MORE STOCKS DISSIPATES (AFTER ABOUT 40 STOCKS), AND FOR LARGE STOCK PORTFOLIOS, Σ_p TENDS TO CONVERGE TO $\approx 20\%$.

ILLUSTRATING DIVERSIFICATION EFFECTS OF A STOCK PORTFOLIO



BREAKING DOWN SOURCES OF RISK

$$\text{Stand-alone risk} = \text{Market risk} + \text{Diversifiable risk}$$

- MARKET RISK: PORTION OF A SECURITY'S STAND-ALONE RISK THAT CANNOT BE ELIMINATED THROUGH DIVERSIFICATION. MEASURED BY BETA.
- DIVERSIFIABLE RISK: PORTION OF A SECURITY'S STAND-ALONE RISK THAT CAN BE ELIMINATED THROUGH PROPER DIVERSIFICATION.

FAILURE TO DIVERSIFY

- IF AN INVESTOR CHOOSES TO HOLD A ONE-STOCK PORTFOLIO (DOESN'T DIVERSIFY), WOULD THE INVESTOR BE COMPENSATED FOR THE EXTRA RISK THEY BEAR?
 - NO!
 - STAND-ALONE RISK IS NOT IMPORTANT TO A WELL-DIVERSIFIED INVESTOR.
 - RATIONAL, RISK-AVERSE INVESTORS ARE CONCERNED WITH Σ_p , WHICH IS BASED UPON MARKET RISK.
 - THERE CAN BE ONLY ONE PRICE (THE MARKET RETURN) FOR A GIVEN SECURITY.
 - NO COMPENSATION SHOULD BE EARNED FOR HOLDING UNNECESSARY, DIVERSIFIABLE RISK.

CAPITAL ASSET PRICING MODEL (CAPM)

- MODEL LINKING RISK AND REQUIRED RETURNS. CAPM SUGGESTS THAT THERE IS A SECURITY MARKET LINE (SML) THAT STATES THAT A STOCK'S REQUIRED RETURN EQUALS THE RISK-FREE RETURN PLUS A RISK PREMIUM THAT REFLECTS THE STOCK'S RISK AFTER DIVERSIFICATION.

$$R_i = R_{RF} + (R_M - R_{RF})B_i$$

- PRIMARY CONCLUSION: THE RELEVANT RISKINESS OF A STOCK IS ITS CONTRIBUTION TO THE RISKINESS OF A WELL-DIVERSIFIED PORTFOLIO.

BETA

- MEASURES A STOCK'S MARKET RISK, AND SHOWS A STOCK'S VOLATILITY RELATIVE TO THE MARKET.
- INDICATES HOW RISKY A STOCK IS IF THE STOCK IS HELD IN A WELL-DIVERSIFIED PORTFOLIO.

COMMENTS ON BETA

- IF BETA = 1.0, THE SECURITY IS JUST AS RISKY AS THE AVERAGE STOCK.
- IF BETA > 1.0, THE SECURITY IS RISKIER THAN AVERAGE.
- IF BETA < 1.0, THE SECURITY IS LESS RISKY THAN AVERAGE.
- MOST STOCKS HAVE BETAS IN THE RANGE OF 0.5 TO 1.5.

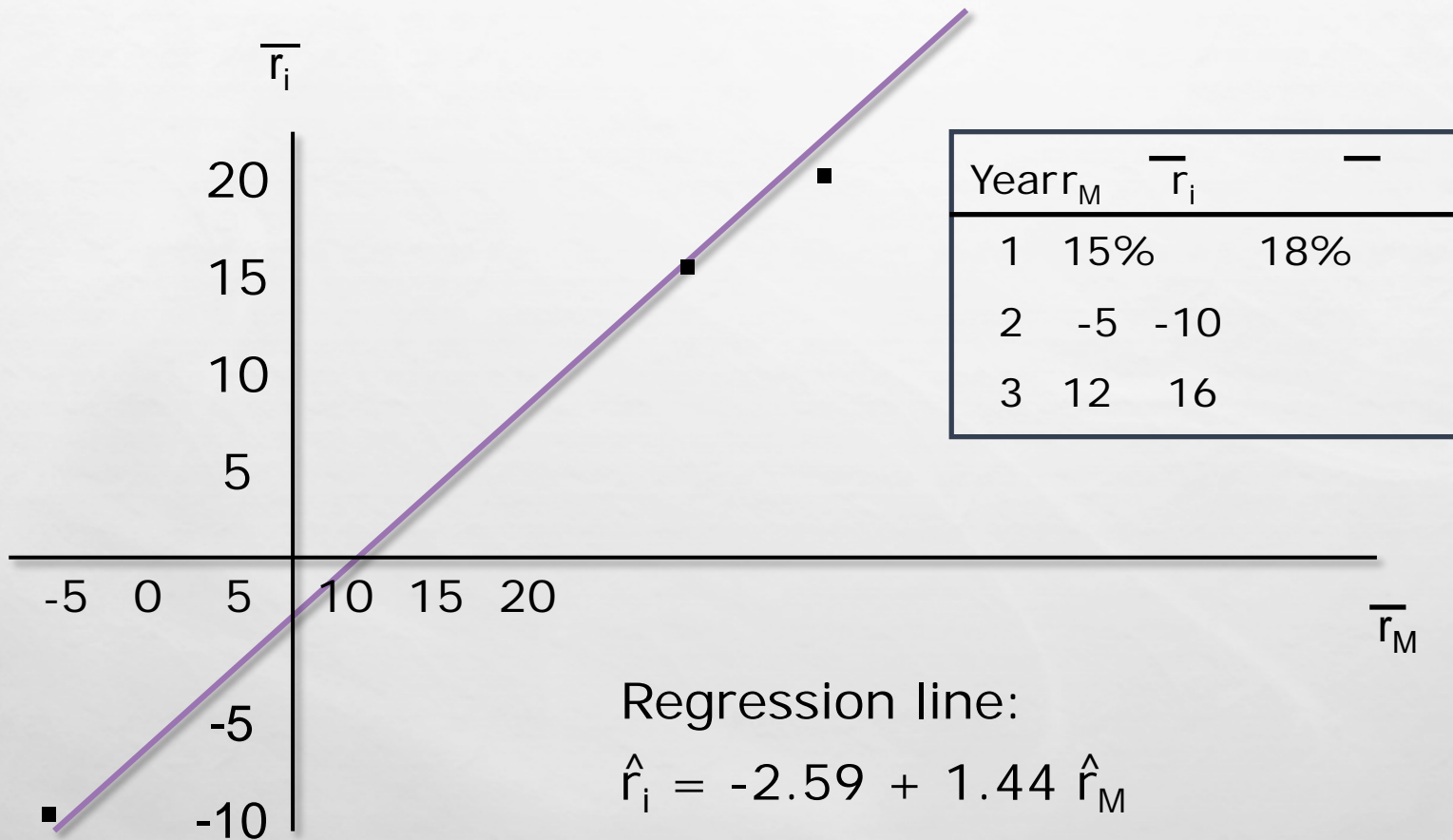
CAN THE BETA OF A SECURITY BE NEGATIVE?

- YES, IF THE CORRELATION BETWEEN STOCK I AND THE MARKET IS NEGATIVE (I.E., $\rho_{I,M} < 0$).
- IF THE CORRELATION IS NEGATIVE, THE REGRESSION LINE WOULD SLOPE DOWNWARD, AND THE BETA WOULD BE NEGATIVE.
- HOWEVER, A NEGATIVE BETA IS HIGHLY UNLIKELY.

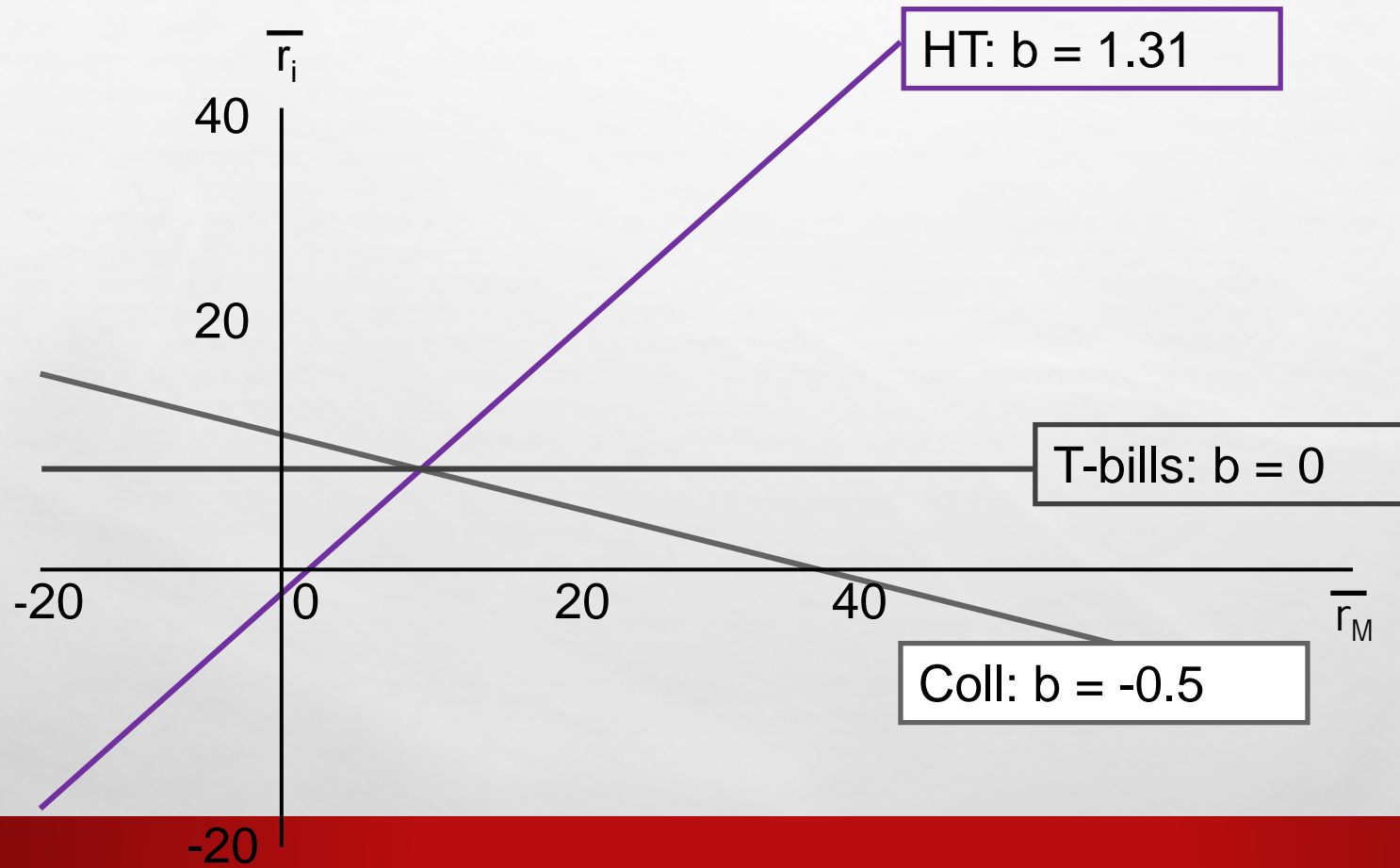
CALCULATING BETAS

- WELL-DIVERSIFIED INVESTORS ARE PRIMARILY CONCERNED WITH HOW A STOCK IS EXPECTED TO MOVE RELATIVE TO THE MARKET IN THE FUTURE.
- WITHOUT A CRYSTAL BALL TO PREDICT THE FUTURE, ANALYSTS ARE FORCED TO RELY ON HISTORICAL DATA. A TYPICAL APPROACH TO ESTIMATE BETA IS TO RUN A REGRESSION OF THE SECURITY'S PAST RETURNS AGAINST THE PAST RETURNS OF THE MARKET.
- THE SLOPE OF THE REGRESSION LINE IS DEFINED AS THE BETA COEFFICIENT FOR THE SECURITY.

ILLUSTRATING THE CALCULATION OF BETA



BETA COEFFICIENTS FOR HIGH TECH, COLLECTIONS, AND T-BILLS



COMPARING EXPECTED RETURNS AND BETA COEFFICIENTS

<u>Security</u>	<u>Expected Return</u>	<u>Beta</u>
High Tech	9.9%	1.31
Market	8.0	1.00
US Rubber	7.3	0.88
T-Bills	3.0	0.00
Collections	1.2	-0.50

Riskier securities have higher returns, so the rank order is OK.

THE SECURITY MARKET LINE (SML): CALCULATING REQUIRED RATES OF RETURN

$$\text{SML: } r_i = r_{RF} + (r_M - r_{RF})b_i$$

$$r_i = r_{RF} + (RP_M)b_i$$

- Assume the yield curve is flat and that $r_{RF} = 3.0\%$ and

$$RP_M = r_M - r_{RF} = 8.0\% - 3.0\% = 5.0\%.$$

WHAT IS THE MARKET RISK PREMIUM?

- ADDITIONAL RETURN OVER THE RISK-FREE RATE NEEDED TO COMPENSATE INVESTORS FOR ASSUMING AN AVERAGE AMOUNT OF RISK.
- ITS SIZE DEPENDS ON THE PERCEIVED RISK OF THE STOCK MARKET AND INVESTORS' DEGREE OF RISK AVERSION.
- VARIES FROM YEAR TO YEAR, BUT MOST ESTIMATES SUGGEST THAT IT RANGES BETWEEN 4% AND 8% PER YEAR.

CALCULATING REQUIRED RATES OF RETURN

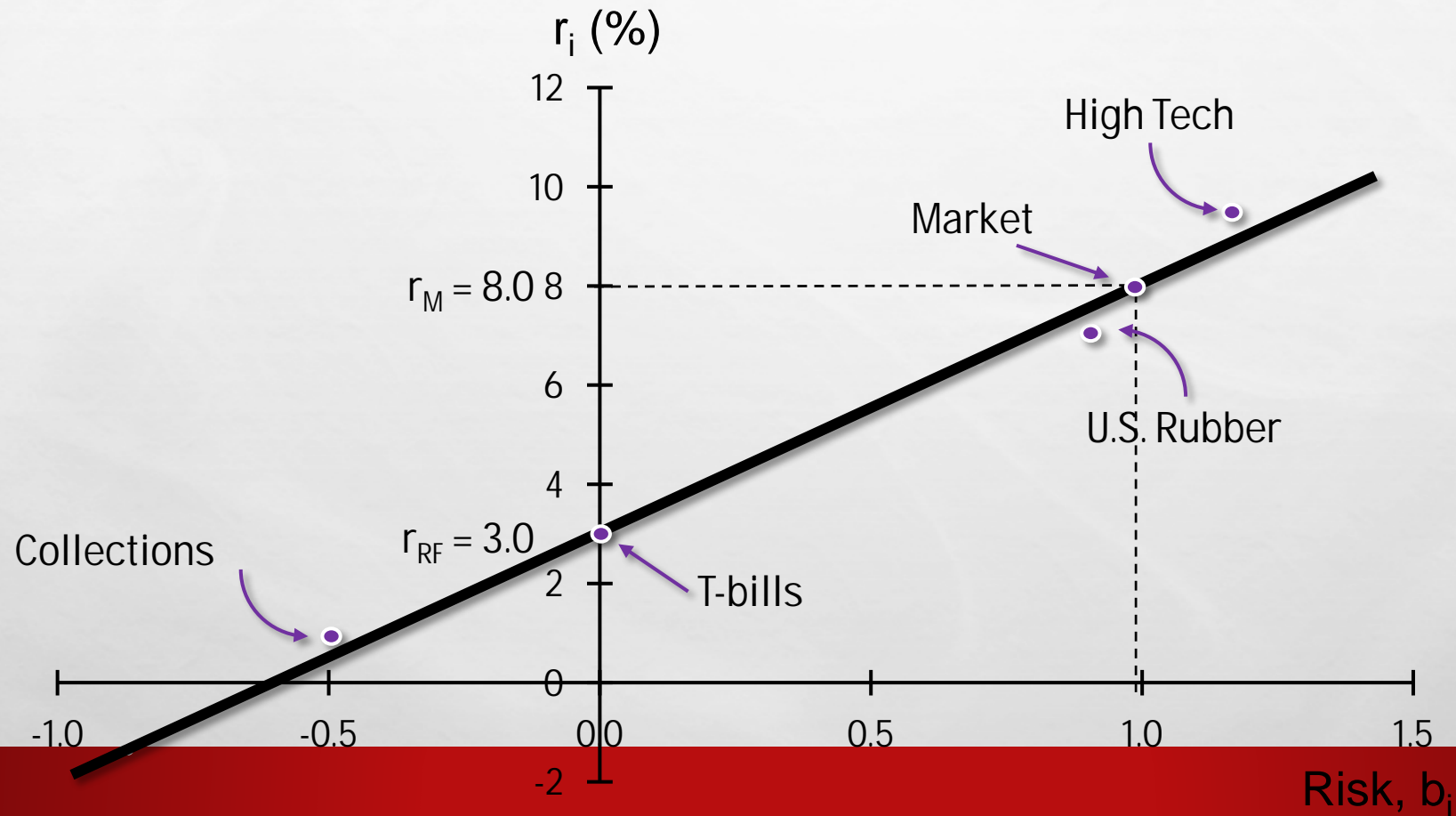
$$\begin{aligned}r_{HT} &= 3.0\% + (5.0\%)(1.31) \\ &= 3.0\% + 6.55\% &= 9.55\% \\ r_M &= 3.0\% + (5.0\%)(1.00) &= 8.00\% \\ r_{USR} &= 3.0\% + (5.0\%)(0.88) &= 7.40\% \\ r_{T\text{-bill}} &= 3.0\% + (5.0\%)(0.00) &= 3.00\% \\ r_{Coll} &= 3.0\% + (5.0\%)(-0.50) &= 0.50\%\end{aligned}$$

EXPECTED VS. REQUIRED RETURNS

	\hat{r}	r	
High Tech	9.9%	9.55%	Undervalued
Market	8.0	8.00	Fairly valued
US Rubber	7.3	7.40	Overvalued
T-bills	3.0	3.00	Fairly valued
Collections	1.2	0.50	Undervalued

ILLUSTRATING THE SECURITY MARKET LINE

$$\text{SML: } r_i = 3.0\% + (5.0\%)b_i$$



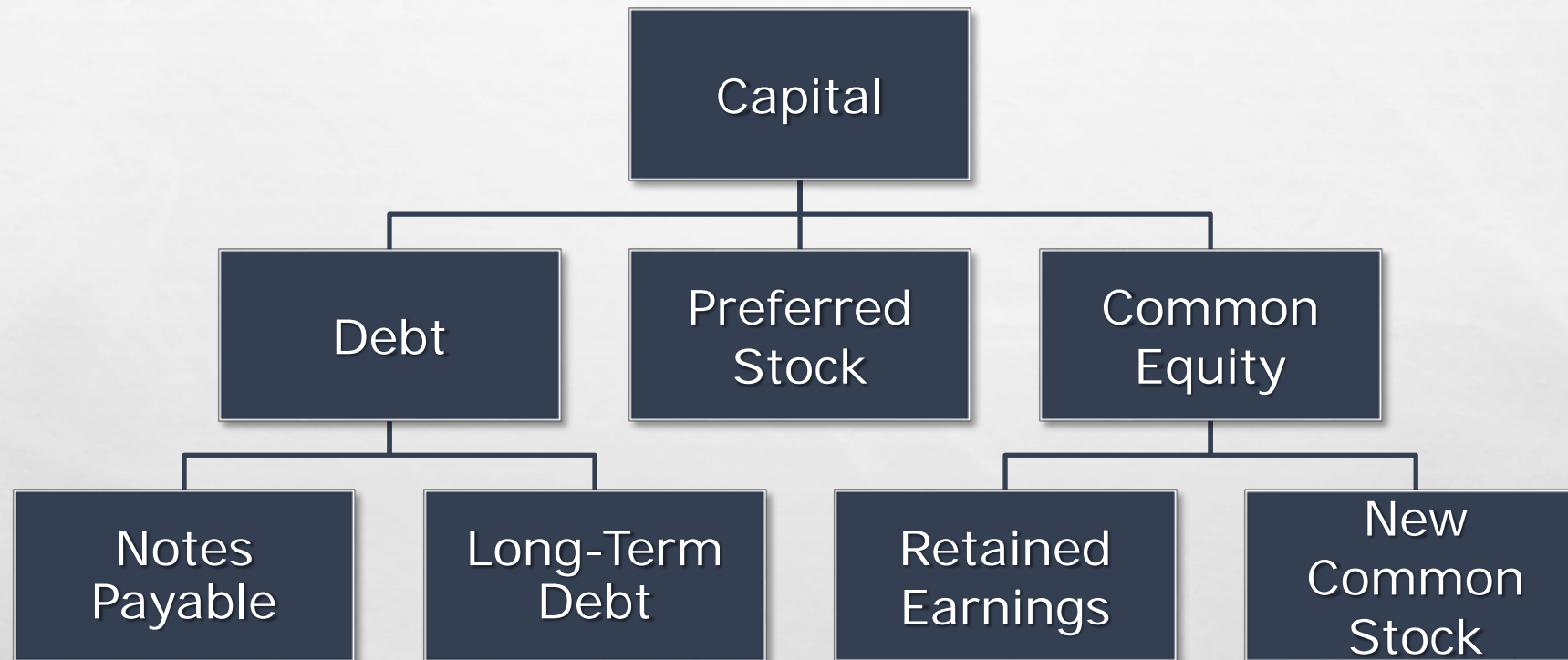
VERIFYING THE CAPM EMPIRICALLY

The CAPM has not been verified completely.

Statistical tests have problems that make verification almost impossible.

Some argue that there are additional risk factors, other than the market risk premium.

WEIGHTED AVERAGE COST OF CAPITAL



CALCULATING THE WEIGHTED AVERAGE COST OF CAPITAL

$$WACC = W_D R_D (1 - T) + W_P R_P + W_C R_S$$

- THE W'S REFER TO THE FIRM'S CAPITAL STRUCTURE WEIGHTS.
- THE R'S REFER TO THE COST OF EACH COMPONENT.

WHAT FACTORS INFLUENCE A COMPANY'S COMPOSITE WACC?

FACTORS THE FIRM CANNOT CONTROL:

- MARKET CONDITIONS SUCH AS INTEREST RATES AND TAX RATES.

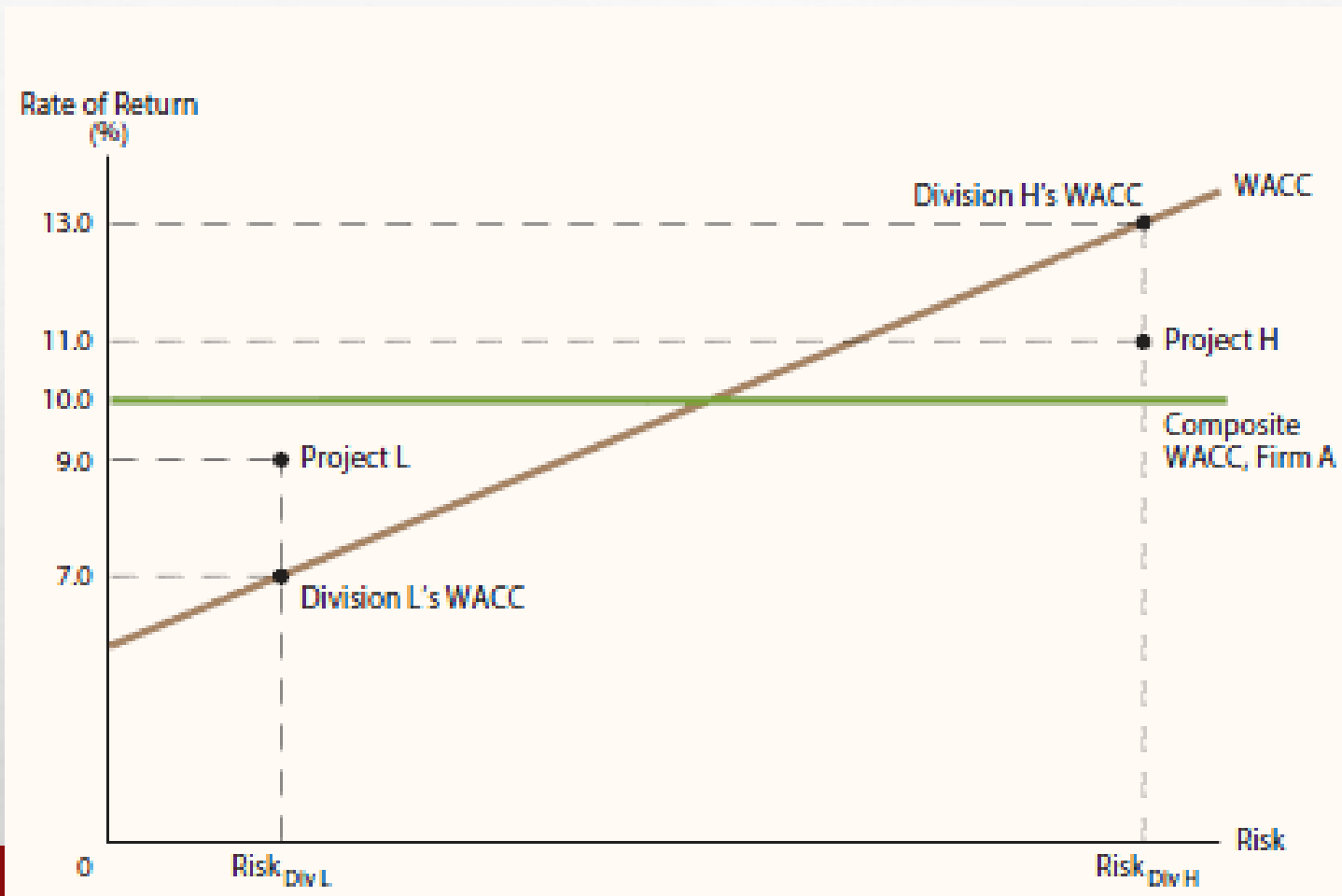
FACTORS THE FIRM CAN CONTROL:

- FIRM'S CAPITAL STRUCTURE.
- FIRM'S DIVIDEND POLICY.
- THE FIRM'S INVESTMENT POLICY. FIRMS WITH RISKIER PROJECTS GENERALLY HAVE A HIGHER WACC.

SHOULD THE COMPANY USE THE COMPOSITE WACC AS THE HURDLE RATE FOR EACH OF ITS PROJECTS?

- NO! THE COMPOSITE WACC REFLECTS THE RISK OF AN AVERAGE PROJECT UNDERTAKEN BY THE FIRM. THEREFORE, THE WACC ONLY REPRESENTS THE "HURDLE RATE" FOR A TYPICAL PROJECT WITH AVERAGE RISK.
- DIFFERENT PROJECTS HAVE DIFFERENT RISKS. THE PROJECT'S WACC SHOULD BE ADJUSTED TO REFLECT THE PROJECT'S RISK.
- THE NEXT SLIDE ILLUSTRATES THE IMPORTANCE OF RISK-ADJUSTING THE COST OF CAPITAL. NOTE, IF THE COMPANY CORRECTLY RISK-ADJUSTED THE WACC, THEN IT WOULD SELECT PROJECT L AND REJECT PROJECT H. ALTERNATIVELY, IF THE COMPANY DIDN'T RISK-ADJUST AND INSTEAD USED THE COMPOSITE WACC FOR ALL PROJECTS, IT WOULD MISTAKENLY SELECT PROJECT H AND REJECT PROJECT L.

DIVISIONAL COST OF CAPITAL



CAPITAL BUDGETING

- ANALYSIS OF POTENTIAL ADDITIONS TO FIXED ASSETS.
- LONG-TERM DECISIONS; INVOLVE LARGE EXPENDITURES.
- VERY IMPORTANT TO FIRM'S FUTURE.

STEPS TO CAPITAL BUDGETING

1. ESTIMATE CFS (INFLOWS & OUTFLOWS).
2. ASSESS RISKINESS OF CFS.
3. DETERMINE THE APPROPRIATE COST OF CAPITAL.
4. FIND NPV AND/OR IRR.
5. ACCEPT IF $NPV > 0$ AND/OR $IRR > WACC$.

WHAT IS THE DIFFERENCE BETWEEN INDEPENDENT AND MUTUALLY EXCLUSIVE PROJECTS?

- INDEPENDENT PROJECTS: IF THE CASH FLOWS OF ONE ARE UNAFFECTED BY THE ACCEPTANCE OF THE OTHER.
- MUTUALLY EXCLUSIVE PROJECTS: IF THE CASH FLOWS OF ONE CAN BE ADVERSELY IMPACTED BY THE ACCEPTANCE OF THE OTHER.

WHAT IS THE DIFFERENCE BETWEEN NORMAL AND NONNORMAL CASH FLOW STREAMS?

- NORMAL CASH FLOW STREAM: COST (NEGATIVE CF) FOLLOWED BY A SERIES OF POSITIVE CASH INFLOWS. ONE CHANGE OF SIGNS.
- NONNORMAL CASH FLOW STREAM: TWO OR MORE CHANGES OF SIGNS.
- MOST COMMON: COST (NEGATIVE CF), THEN STRING OF POSITIVE CFS, THEN COST TO CLOSE PROJECT. EXAMPLES INCLUDE NUCLEAR POWER PLANT, STRIP MINE, ETC.

NET PRESENT VALUE (NPV)

- SUM OF THE PVS OF ALL CASH INFLOWS AND OUTFLOWS OF A PROJECT:

$$NPV = \sum_{t=0}^N \frac{CF_t}{(1+r)^t}$$

EXAMPLE

Projects we'll examine:

Year	Cash Flow		ΔCF
	L	S	
0	-100	-100	0
1	10	70	-60
2	60	50	10
3	80	20	60

ΔCF is the difference between CF_L and CF_S . We'll use ΔCF later.

WHAT IS PROJECT L'S NPV?

<u>Year</u>	<u>CF_t</u>	<u>PV of CF_t</u>
0	-100	-\$100.00
1	10	9.09
2	60	49.59
3	80	60.11

WACC = 10%

NPV_L = \$ 18.79

Excel: =NPV(rate,CF₁:CF_n) + CF₀

Here, CF₀ is negative.

WHAT IS PROJECT S' NPV?

WACC = 10%

<u>Year</u>	<u>CF_t</u>	<u>PV of CF_t</u>
0	-100	-\$100.00
1	70	63.64
2	50	41.32
3	20	15.02
		<u>NPV_S = \$ 19.98</u>

Excel: =NPV(rate,CF₁:CF_n) + CF₀

Here, CF₀ is negative.

SOLVING FOR NPV: FINANCIAL CALCULATOR SOLUTION

- ENTER CFS INTO THE CALCULATOR'S CFLO REGISTER.

$$CF_0 = -100$$

$$CF_1 = 10$$

$$CF_2 = 60$$

$$CF_3 = 80$$

- ENTER I/YR = 10, PRESS NPV BUTTON TO GET $NPV_L = \$18.78$.

RATIONALE FOR THE NPV METHOD

$$\begin{aligned}\text{NPV} &= \text{PV OF INFLOWS} - \text{COST} \\ &= \text{NET GAIN IN WEALTH}\end{aligned}$$

- IF PROJECTS ARE INDEPENDENT, ACCEPT IF THE PROJECT $\text{NPV} > 0$.
- IF PROJECTS ARE MUTUALLY EXCLUSIVE, ACCEPT PROJECT WITH THE HIGHEST POSITIVE NPV, ONE THAT ADDS THE MOST VALUE.
- IN THIS EXAMPLE, ACCEPT S IF MUTUALLY EXCLUSIVE ($\text{NPV}_S > \text{NPV}_L$), AND ACCEPT BOTH IF INDEPENDENT.

INTERNAL RATE OF RETURN (IRR)

- SOLVING FOR IRR WITH A FINANCIAL CALCULATOR:

$$0 = \sum_{t=0}^N \frac{CF_t}{(1 + IRR)^t}$$

- ENTER CFS IN CFLO REGISTER.

- PRESS IRR; $IRR_L = 18.13\%$ AND $IRR_S = 23.56\%$.
- SOLVING FOR IRR WITH EXCEL:

=IRR(CF₀:CF_N, GUESS FOR RATE)

HOW IS A PROJECT'S IRR SIMILAR TO A BOND'S YTM?

- THEY ARE THE SAME THING.
- THINK OF A BOND AS A PROJECT. THE YTM ON THE BOND WOULD BE THE IRR OF THE "BOND" PROJECT.
- EXAMPLE: SUPPOSE A 10-YEAR BOND WITH A 9% ANNUAL COUPON AND \$1,000 PAR VALUE SELLS FOR \$1,134.20.
 - SOLVE FOR $IRR = YTM = 7.08\%$, THE ANNUAL RETURN FOR THIS PROJECT/BOND.

RATIONALE FOR THE IRR METHOD

- IF $IRR > WACC$, THE PROJECT'S RETURN EXCEEDS ITS COSTS AND THERE IS SOME RETURN LEFT OVER TO BOOST STOCKHOLDERS' RETURNS.

IF $IRR > WACC$, ACCEPT PROJECT.

IF $IRR < WACC$, REJECT PROJECT.

- IF PROJECTS ARE INDEPENDENT, ACCEPT BOTH PROJECTS, AS BOTH $IRR > WACC = 10\%$.
- IF PROJECTS ARE MUTUALLY EXCLUSIVE, ACCEPT S, BECAUSE $IRR_S > IRR_L$.

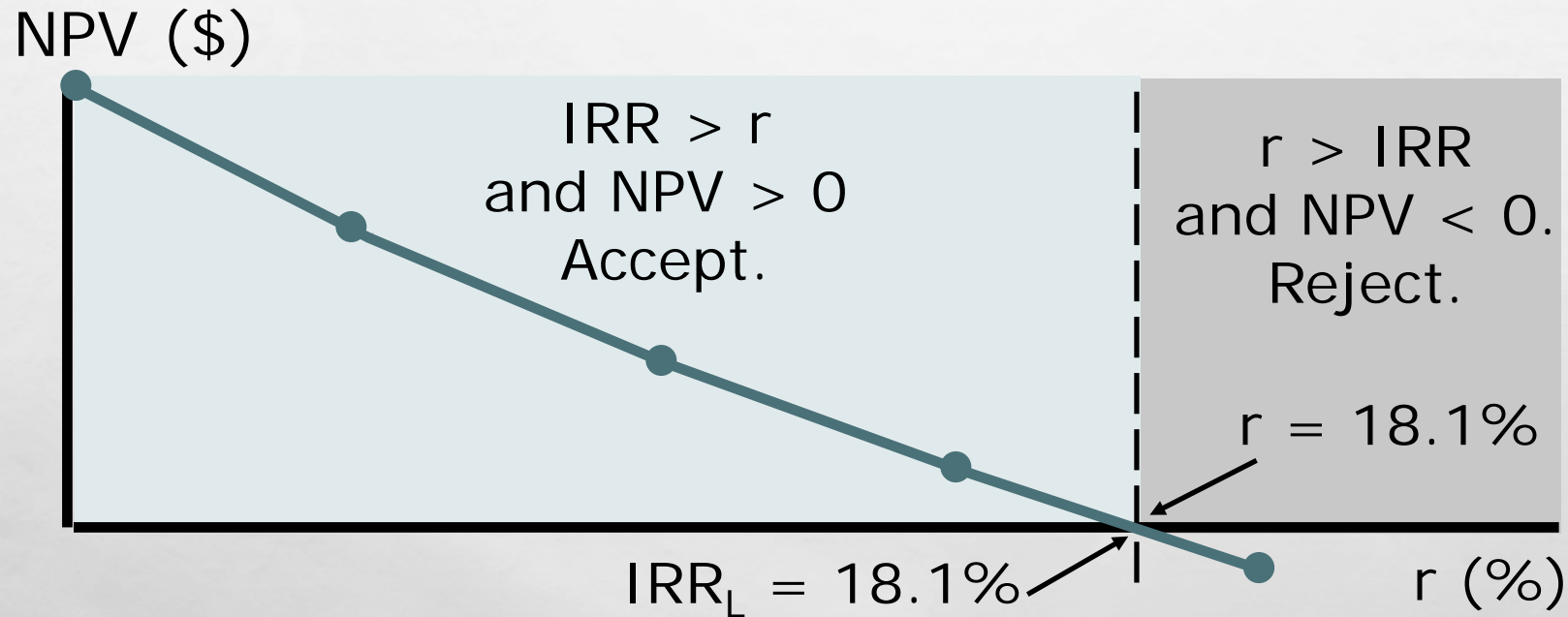
NPV PROFILES

- A GRAPHICAL REPRESENTATION OF PROJECT NPVS AT VARIOUS DIFFERENT COSTS OF CAPITAL.

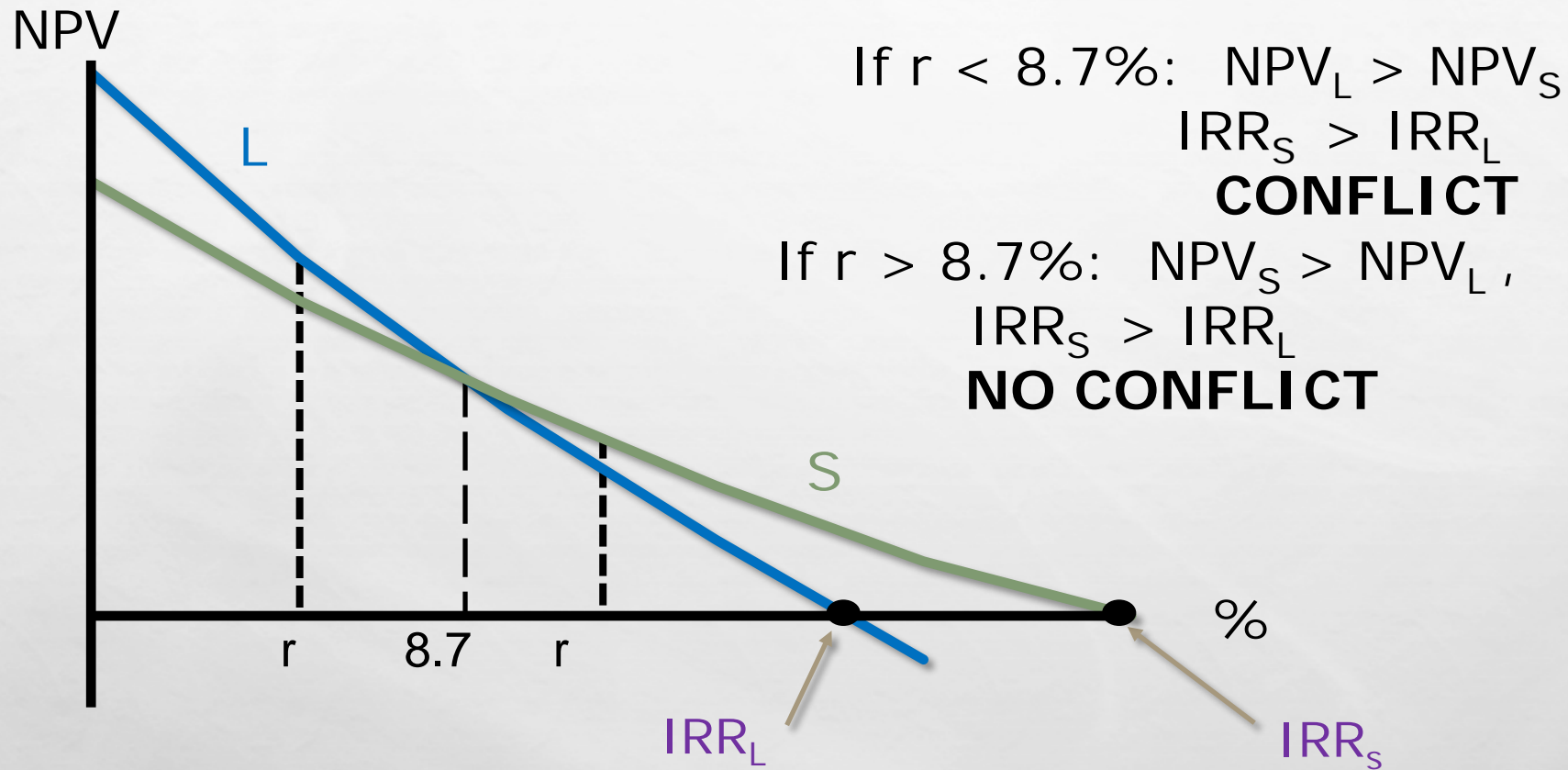
WACC	NPV _L	NPV _S
0	\$50	\$40
5	33	29
10	19	20
15	7	12
20	(4)	5

INDEPENDENT PROJECTS

NPV AND IRR ALWAYS LEAD TO THE SAME ACCEPT/REJECT DECISION FOR ANY GIVEN INDEPENDENT PROJECT.



MUTUALLY EXCLUSIVE PROJECTS



FINDING THE CROSSOVER RATE

- FIND CASH FLOW DIFFERENCES BETWEEN THE PROJECTS. SEE SLIDE 11-8.
- ENTER THE ΔCFS IN CF_j REGISTER, THEN PRESS
 - IRR. CROSSOVER RATE = 8.68%, ROUNDED TO 8.7%.
- IF PROFILES DON'T CROSS, ONE PROJECT DOMINATES THE OTHER.

REASONS WHY NPV PROFILES CROSS

- SIZE (SCALE) DIFFERENCES: THE SMALLER PROJECT FREES UP FUNDS AT $T = 0$ FOR INVESTMENT. THE HIGHER THE OPPORTUNITY COST, THE MORE VALUABLE THESE FUNDS, SO A HIGH WACC FAVORS SMALL PROJECTS.
- TIMING DIFFERENCES: THE PROJECT WITH FASTER PAYBACK PROVIDES MORE CF IN EARLY YEARS FOR REINVESTMENT. IF WACC IS HIGH, EARLY CF ESPECIALLY GOOD, $NPV_S > NPV_L$.

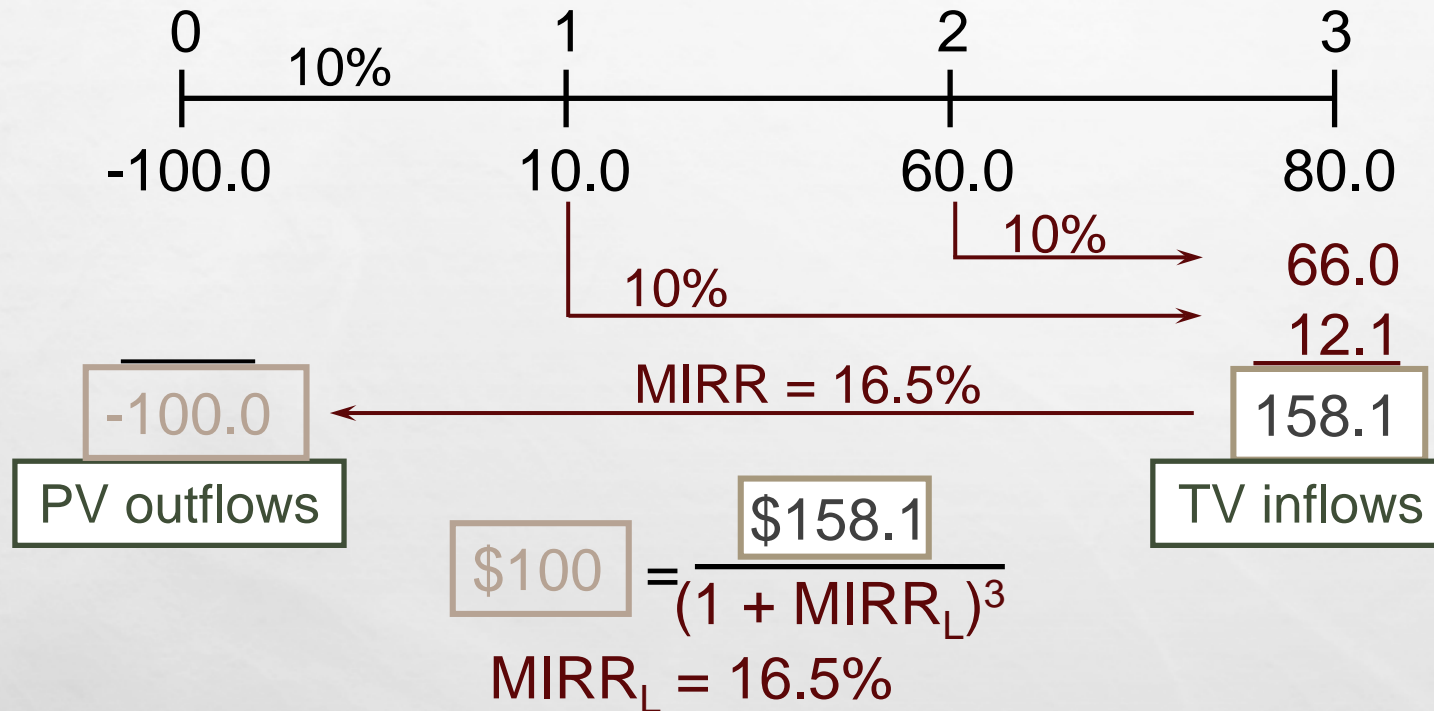
REINVESTMENT RATE ASSUMPTIONS

- NPV METHOD ASSUMES CFS ARE REINVESTED AT THE WACC.
- IRR METHOD ASSUMES CFS ARE REINVESTED AT IRR.
- ASSUMING CFS ARE REINVESTED AT THE OPPORTUNITY COST OF CAPITAL IS MORE REALISTIC, SO NPV METHOD IS THE BEST. NPV METHOD SHOULD BE USED TO CHOOSE BETWEEN MUTUALLY EXCLUSIVE PROJECTS.
- PERHAPS A HYBRID OF THE IRR THAT ASSUMES COST OF CAPITAL REINVESTMENT IS NEEDED.

MANAGERS PREFER THE IRR TO THE NPV METHOD; IS THERE A BETTER IRR MEASURE?

- YES, MIRR IS THE DISCOUNT RATE THAT CAUSES THE PV OF A PROJECT'S TERMINAL VALUE (TV) TO EQUAL THE PV OF COSTS. TV IS FOUND BY COMPOUNDING INFLOWS AT WACC.
- MIRR ASSUMES CASH FLOWS ARE REINVESTED AT THE WACC.

CALCULATING MIRR



EXCEL: `MIRR(CF0:CFN, FINANCE_RATE, REINVEST_RATE)`

WE ASSUME THAT BOTH RATES = WACC.

WHY USE MIRR VERSUS IRR?

- MIRR ASSUMES REINVESTMENT AT THE OPPORTUNITY COST = WACC. MIRR ALSO AVOIDS THE MULTIPLE IRR PROBLEM.
- MANAGERS LIKE RATE OF RETURN COMPARISONS, AND MIRR IS BETTER FOR THIS THAN IRR.

WHAT IS THE PAYBACK PERIOD?

- THE NUMBER OF YEARS REQUIRED TO RECOVER A PROJECT'S COST, OR "HOW LONG DOES IT TAKE TO GET OUR MONEY BACK?"
- CALCULATED BY ADDING PROJECT'S CASH INFLOWS TO ITS COST UNTIL THE CUMULATIVE CASH FLOW FOR THE PROJECT TURNS POSITIVE.

CALCULATING PAYBACK

Project L's Payback Calculation

	0	1	2	3
CF_t	-100	10	60	80
Cumulative	-100	-90	-30	50

$$\text{Payback}_L = 2 + \frac{30}{80}$$
$$= 2.375 \text{ years}$$

$$\text{Payback}_S = 1.600 \text{ years}$$

DISCOUNTED PAYBACK PERIOD

USES DISCOUNTED CASH FLOWS RATHER THAN RAW CFS.

	0	1	2	3
		10%		
CF_t	-100	10	60	80
PV of CF_t	-100	9.09	49.59	60.11
Cumulative	-100	-90.91	-41.32	18.79

$$\text{Disc Payback}_L = 2 + \frac{41.32}{60.11} = 2.7 \text{ years}$$

STRENGTHS AND WEAKNESSES OF PAYBACK

■ STRENGTHS

- PROVIDES AN INDICATION OF A PROJECT'S RISK AND LIQUIDITY.
- EASY TO CALCULATE AND UNDERSTAND.

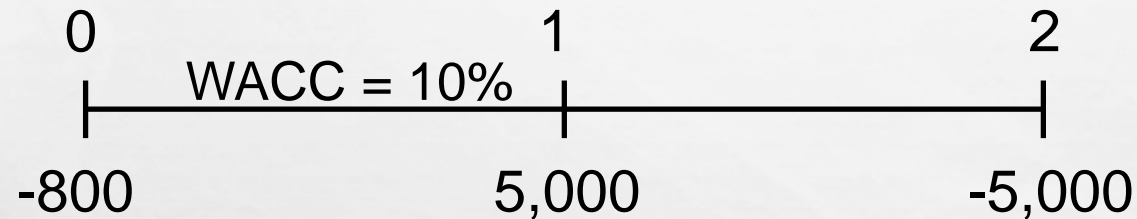
■ WEAKNESSES

- IGNORES THE TIME VALUE OF MONEY (TVM).
- IGNORES CFS OCCURRING AFTER THE PAYBACK PERIOD.
- NO RELATIONSHIP BETWEEN A GIVEN PAYBACK AND INVESTOR WEALTH MAXIMIZATION.

DISCOUNTED PAYBACK CONSIDERS TVM, BUT OTHER 2 FLAWS REMAIN.

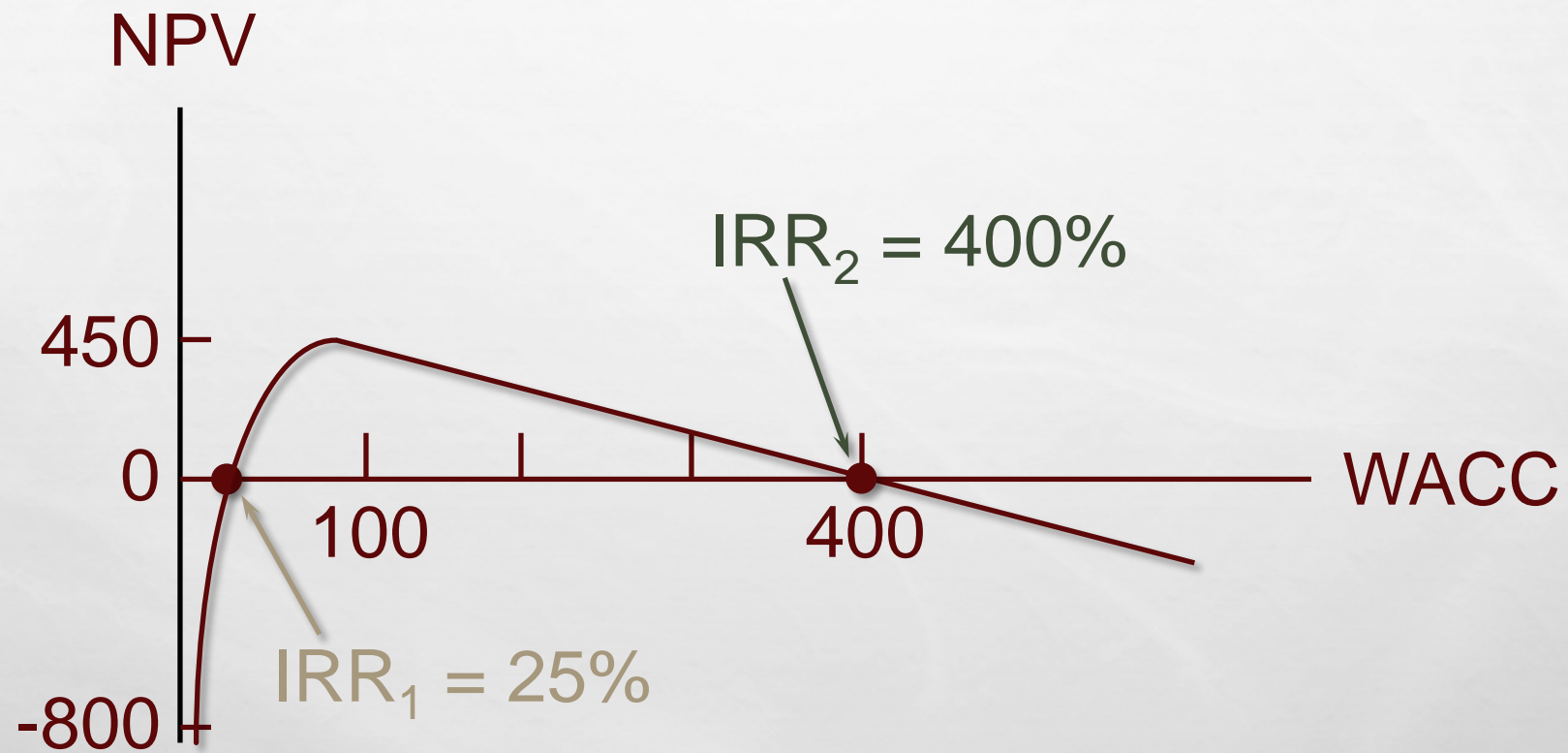
FIND PROJECT P'S NPV AND IRR

Project P has cash flows (in 000s): $CF_0 = -\$800$, $CF_1 = \$5,000$, and $CF_2 = -\$5,000$.



- Enter CFs into calculator CFLO register.
- Enter I/YR = 10.
- NPV = $-\$386.78$.
- IRR = ERROR Why?

MULTIPLE IRRS



WHY ARE THERE MULTIPLE IRRS?

- AT VERY LOW DISCOUNT RATES, THE PV OF CF_2 IS LARGE AND NEGATIVE, SO $NPV < 0$.
- AT VERY HIGH DISCOUNT RATES, THE PV OF BOTH CF_1 AND CF_2 ARE LOW, SO CF_0 DOMINATES AND AGAIN $NPV < 0$.
- IN BETWEEN, THE DISCOUNT RATE HITS CF_2 HARDER THAN CF_1 , SO $NPV > 0$.
- RESULT: 2 IRRS.

WHEN TO USE THE MIRR INSTEAD OF THE IRR? ACCEPT PROJECT P?

- WHEN THERE ARE NONNORMAL CFS AND MORE THAN ONE IRR, USE MIRR.
 - PV OF OUTFLOWS @ 10% = $-\$4,932.2314$.
 - TV OF INFLOWS @ 10% = $\$5,500$.
 - MIRR = 5.6%.
- DO NOT ACCEPT PROJECT P.
 - NPV = $-\$386.78 < 0$.
 - MIRR = 5.6% < WACC = 10%.