CHAPTER 10
Financial Risk and Required Return

- Financial risk basics
- Stand-alone risk
- Portfolio risk
  - Corporate risk
  - Market risk
- Risk and required return

Financial Risk Basics

- **Financial risk is present whenever there is some chance of earning a return on an investment that is *less* than the amount expected.**
- **In general, the greater the probability of a return *far below* that anticipated, the greater the risk.**

Risk Aversion

- In their attitude toward investment risk, investors can be:
  - Risk neutral
  - Risk averse
  - Risk seeking
- Most investors are risk averse.
  - This means that higher risk investments require higher rates of return.
  - It is risk aversion that makes risk concepts so important to financial decision making.

Probability Distributions

- **The chance that an event will occur is called its probability of occurrence, or just probability.**
- **A probability distribution lists all possible event outcomes along with their probabilities. For example, a coin toss:**

Outcome	Probability
Head	0.50 or 50%
Tail	0.50 or 50%

Expected and Realized Rates of Return

Estimated Returns for Two Proposed Projects

Economic State	Probability of Occurrence	Rate of Return MRI	Rate of Return Clinic
Very poor	0.10	-10%	-20%
Poor	0.20	0	0
Average	0.40	10	15
Good	0.20	20	30
Very good	0.10	30	50
	1.00		

? **Where do these estimates come from?**

Expected Rate of Return, E(R)

E(R) = Expected rate of return

$= (P_1 \times R_1) + (P_2 \times R_2) +$ and so on.

$E(R_{MRI}) = (0.10 \times [-10\%]) + (0.20 \times 0\%)$
$+ (0.40 \times 10\%) + (0.20 \times 20\%)$
$+ (0.10 \times 30\%)$
$=$ 10.0%.

? What is $E(R_{Clinic})$?

Realized Rate of Return

- **The expected rate of return is estimated *before* an investment is made.**
- ***After the fact*, the return that is actually achieved is called the realized rate of return.**
- **When risk is present, the realized rate of return rarely equals the expected rate of return.**

Stand-Alone Risk

- **Stand-alone risk is defined and measured assuming an investment will be held in *isolation*.**
- **Stand-alone risk can be measured by the degree of "tightness" of the return distribution.**
- **One common measure of stand-alone risk is the standard deviation of the return distribution, usually repre-sented by a lowercase sigma, σ.**

Standard Deviation (σ) and Variance (V)

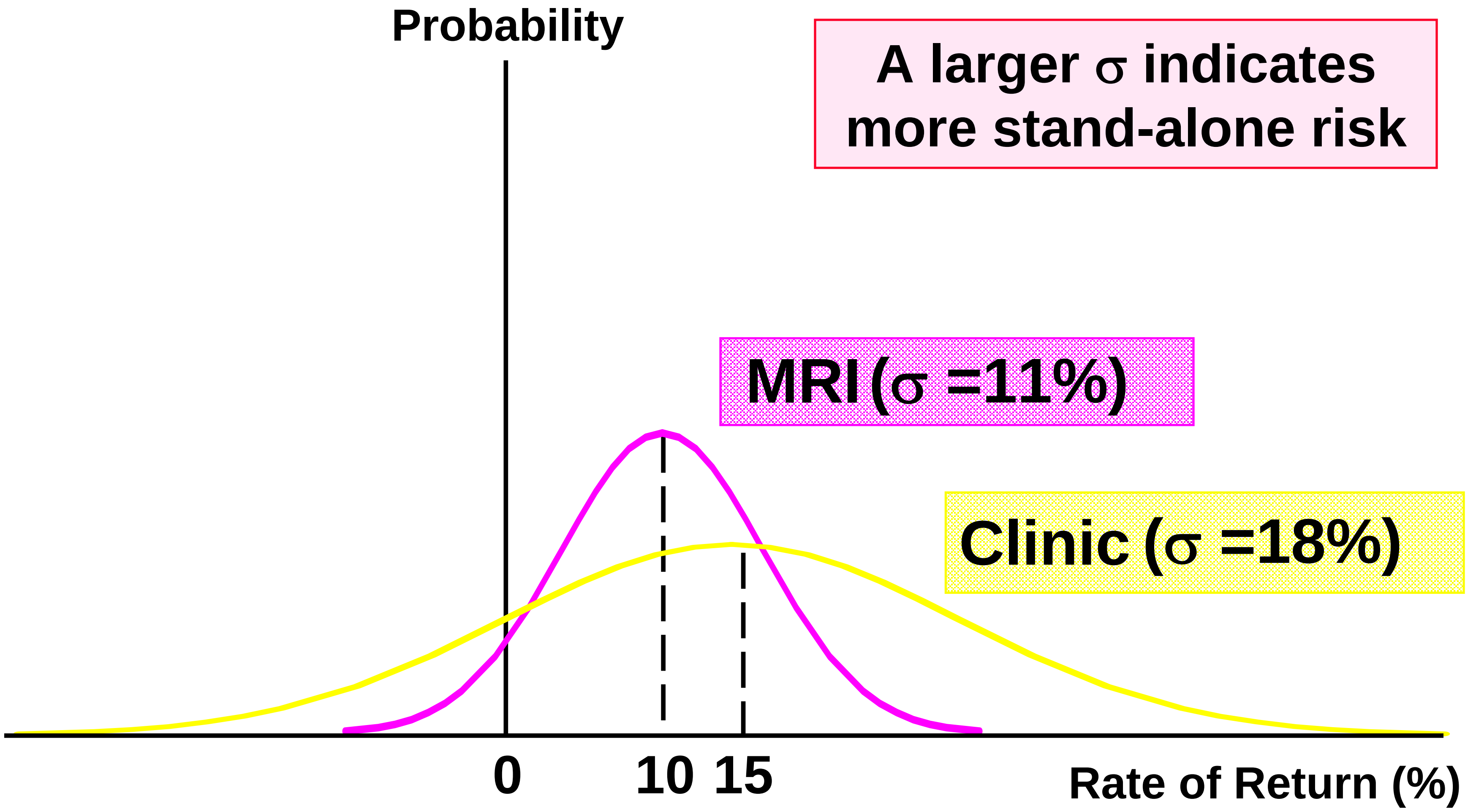
$$\sigma = \sqrt{\text{Variance}}\ .$$

$$V = P_1 \times (R_1 - E[R])^2 + P_2 \times (R_2 - E[R])^2$$
$$+ \text{ and so on.}$$

$$V_{MRI} = 0.10 \times (-10\% - 10\%)^2 + \ldots = 120.$$

$$\sigma_{MRI} = \sqrt{120} = 11.0\%.$$

$$\sigma_{Clinic} = 18.0\%.$$


Probability
A larger σ indicates more stand-alone risk
MRI (σ =11%)
Clinic (σ =18%)
0
10
15
Rate of Return (%)

Discussion Item

- Here are the expected returns and standard deviations of the two investment alternatives:

	E(R)	σ
MRI	10%	11%
Clinic	15%	18%

? Assuming the two projects are mutually exclusive, which one should be chosen?

Coefficient of Variation (CV)

- The coefficient of variation (CV) is defined as the standard deviation divided by the expected rate of return. It is a *standardized* measure of stand-alone risk.
  - CV_{MRI} = 11% / 10% = 1.1.
  - CV_{Clinic} = 18% / 15% = 1.2.
- Both the standard deviation and the CV indicate that the clinic investment is riskier than the MRI investment.
- CV is most useful when comparing investments with widely differing returns.

Portfolio Risk and Return

- **Standard deviation (or CV) is an applicable risk measure *only* when an investment is held in isolation.**
- **Most investments are held as part of a collection, or portfolio, of investments.**
- **When investments are held in portfolios, the relevant return, and hence risk, is that of the *entire portfolio*.**

Portfolio Illustration

State	Prob	A	B	C	D	AB	AC	AD
Very poor	0.10	-10%	30%	-25%	15%	10%	-17.5%	2.5%
Poor	0.20	0	20	-5	10	10	-2.5	5.0
Average	0.40	10	10	15	0	10	12.5	5.0
Good	0.20	20	0	35	25	10	27.5	22.5
Very good	0.10	30	-10	55	35	10	42.5	32.5
	1.00							
E(R)		10.0%	10.0%	15.0%	12.0%	10.0%	12.5%	11.0%
σ		11.0%	11.0%	21.9%	12.1%	0.0%	16.4%	10.1%

Note: A, B, C, and D are single assets; AB, AC, and AD are equal weighted (50/50) portfolios of those single assets.

Portfolio Return

The expected rate of return on a portfolio, $E(R_p)$, is merely the *weighted average* of the components' expected returns:

$E(R_{AB}) = (0.5 \times 10\%) + (0.5 \times 10\%) = 10.0\%$.

$E(R_{AC}) = 12.5\%$.

? **What is $E(R_{AD})$?**

Portfolio Risk

- **A *portfolio's return* is simply the weighted average of the returns of the components.**
- **However, a *portfolio's risk*, which typically is measured by standard deviation, is not the weighted average of the component standard deviations. It depends on the *relationships* among the returns of the portfolio's components.**

Portfolio Risk (Cont.)

- **Consider Portfolio AB.**
- **Each component is risky when held in isolation (σ = 10%), yet the portfolio has *zero* risk (σ = 0%).**

? **Why can Investments A and B be combined to form a riskless portfolio?**

Portfolio Risk (Cont.)

- Consider Portfolio AC.
- There is no risk reduction in this portfolio. Its standard deviation (16.4%) is the weighted average of the σs of each component:

(0.50 x 11.0%) + (0.5 x 21.9%) = 16.4%.

? Why is there no risk reduction here?

Portfolio Risk (Cont.)

- **Consider Portfolio AD.**
- **There is some risk reduction in this portfolio. The standard deviation (10.1%) is somewhat less than either of the component σs and of the weighted average:**

(0.50 x 11.0%) + (0.5 x 12.1%) = 11.6%.

? **Why is there some risk reduction here?**

Correlation

- **The movement relationship between two variables is called correlation.**
- **Correlation is measured by the correlation coefficient, r:**
  - **r = +1 = *perfect positive correlation*, such as in Portfolio AC.**
  - **r = -1 = *perfect negative correlation*, such as in Portfolio AB.**
  - **r = 0 = *zero correlation*.**

"Real World" Correlations

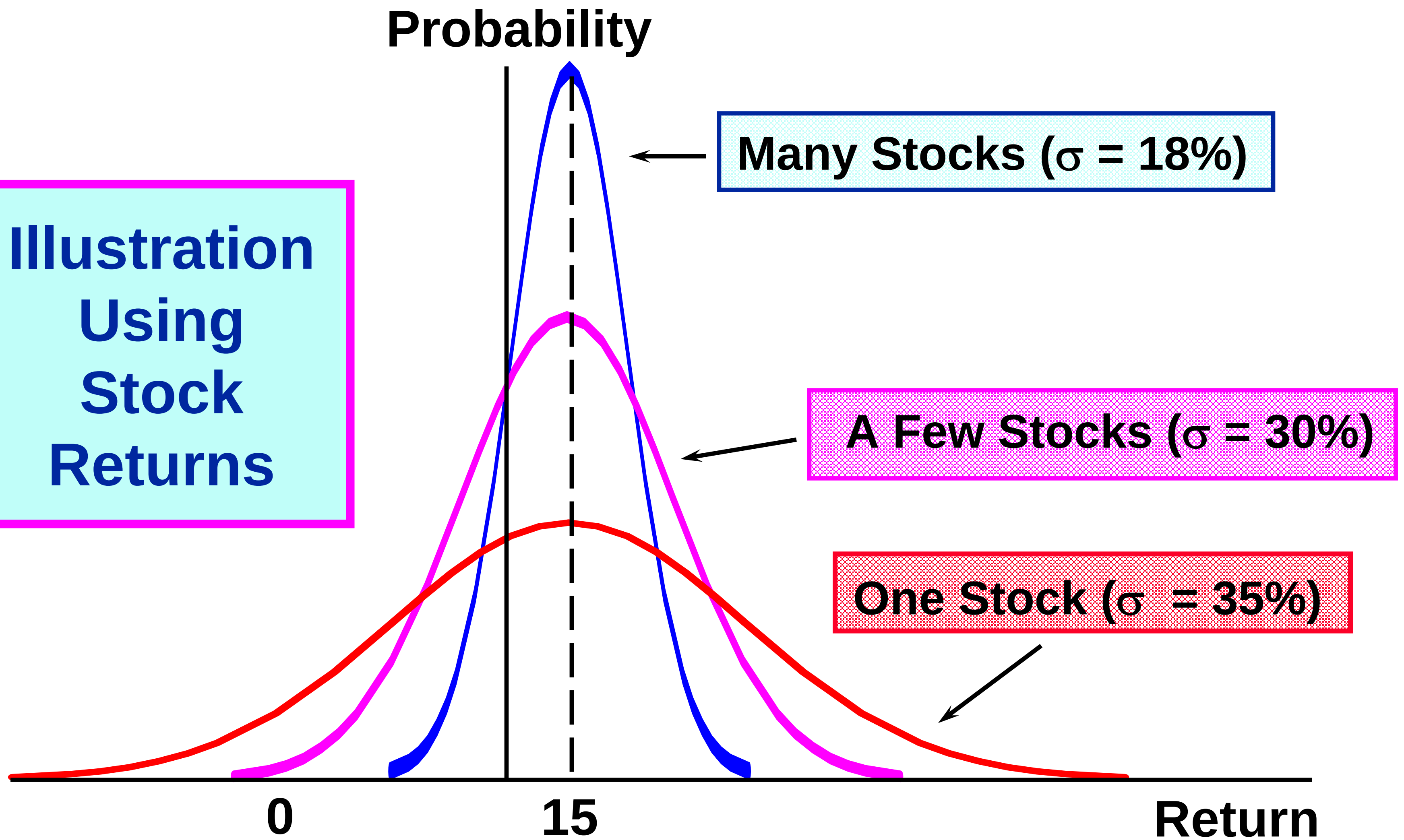
- It is difficult to generalize about correlations among investment returns.
- However, it is rare (if not impossible) to find r = +1, r = -1, or even r = 0.
- The correlation between two randomly chosen investments is likely to range from +0.4 to +0.8.

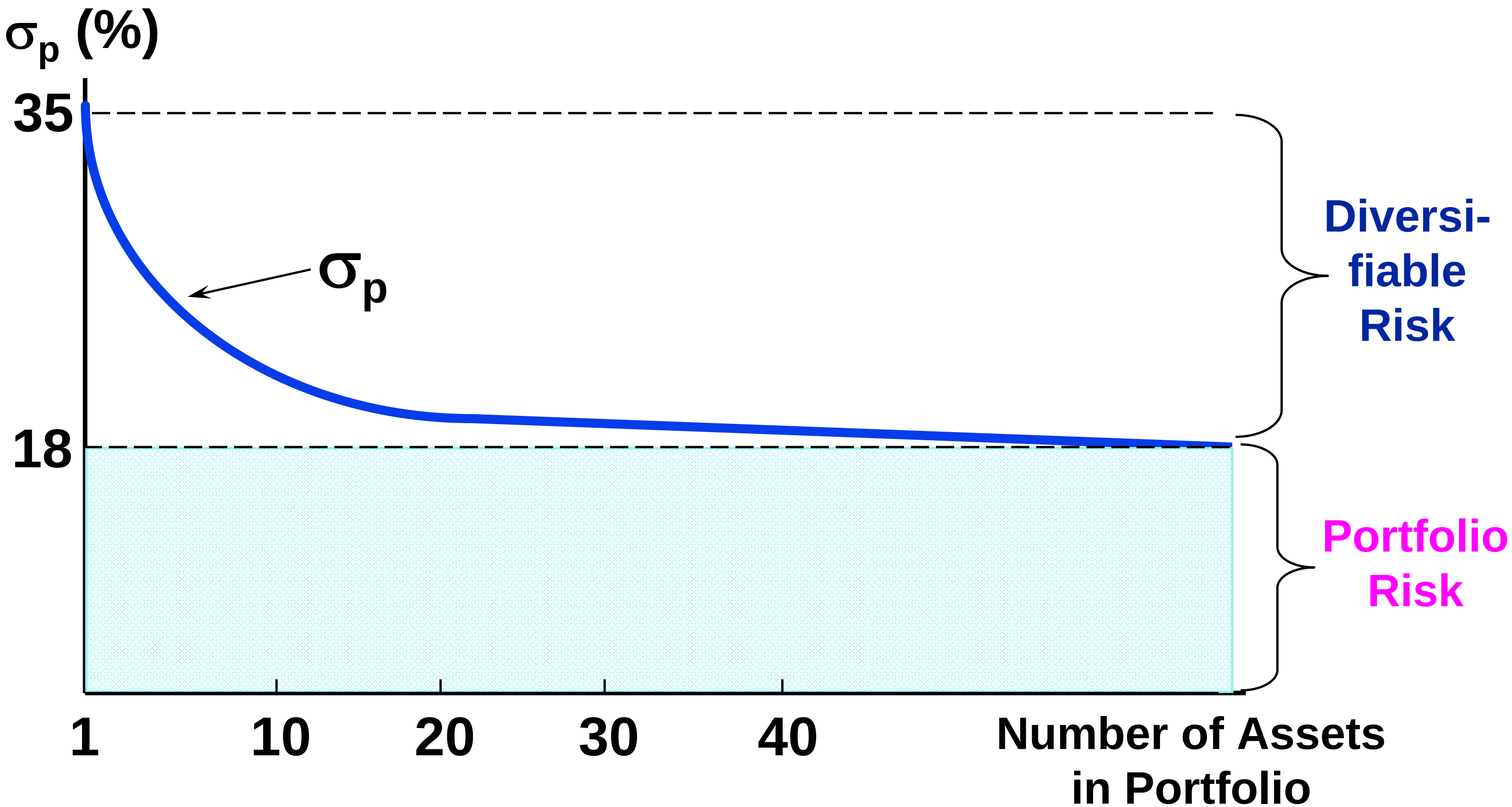
? Why?

Impact of Portfolio Size

- The risk of a portfolio (σ_p) ***decreases*** as more and more investments are randomly added.
- However, the incremental risk reduction from each new investment ***decreases*** as more assets are added.
- Considerable risk remains regardless of the number of assets added.
- ? Why?

Illustration Using Stock Returns





Note: The standard deviations shown are for an average one-asset,
two-asset, three-asset, and so on, portfolio.

Stand-alone risk is the risk of an individual investment when it is held in isolation.

Diversifiable risk is that part of the stand-alone risk that *can* be eliminated by diversification.

Portfolio risk is that part of the stand-alone risk that *cannot* be eliminated by diversification.

Stand-alone risk = Portfolio risk + Diversifiable risk.

Implications for Investors

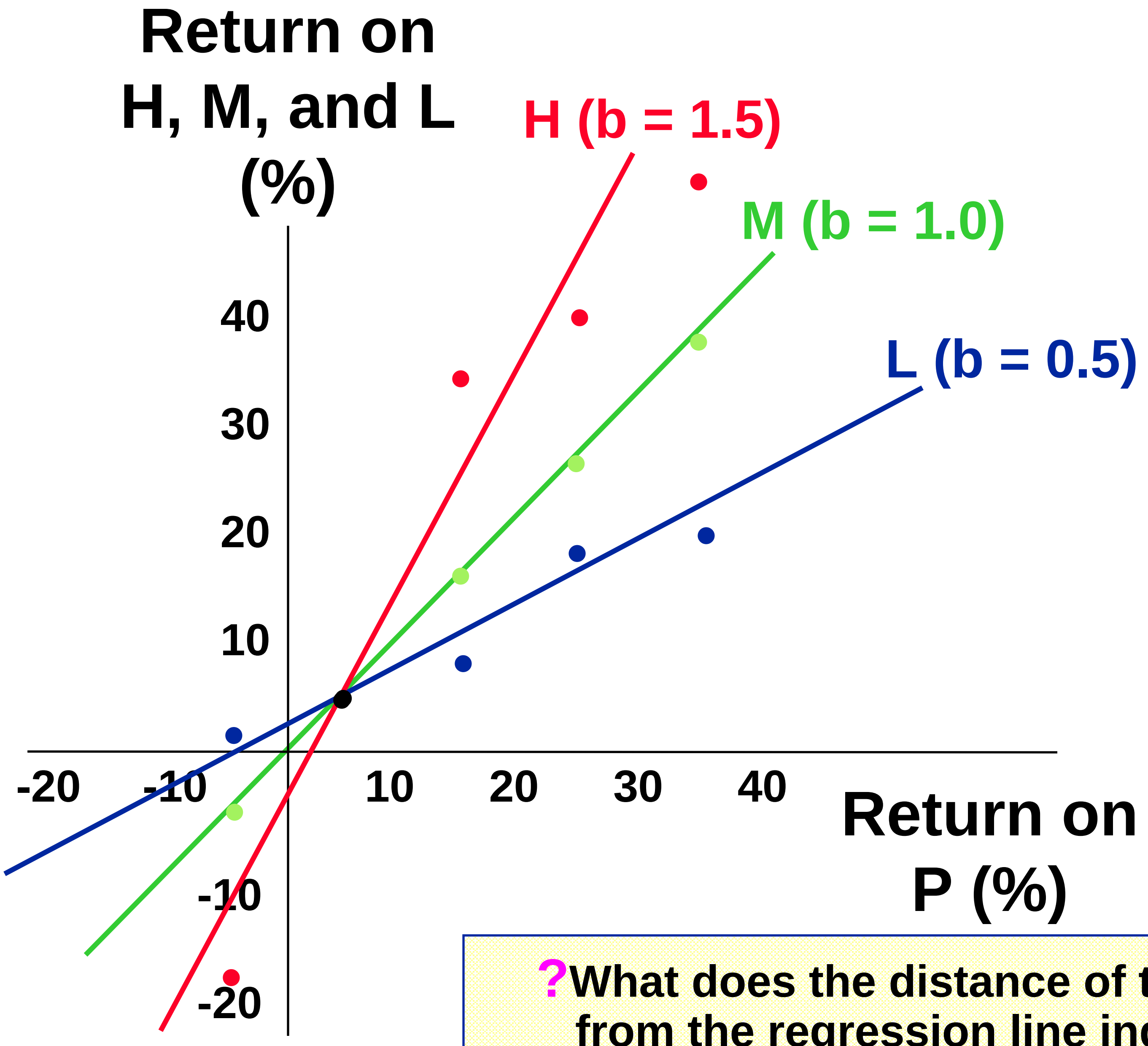
- **It is *not* rational for an investor, whether an individual or a business, to hold a single investment.**
- **Because an investment held in a portfolio is less risky than when held in isolation, stand-alone risk measures (i.e., σ) are *not* relevant for investments held in portfolios.**

Beta Coefficients

- The most widely used measure of risk for investments held in portfolios is the **beta coefficient**, or just **beta**.
- Beta measures the volatility of the investment's returns *relative* to the returns on the portfolio.
- Because beta is a relative measure of risk, it depends on *both* the investment and the portfolio.

Beta Illustration

Year	H	M	L	Portfolio (P)
	Rate of Return if State Occurs			
1	35%	15%	8%	15%
2	5	5	5	5
3	-18	-5	2	-5
4	40	25	18	25
5	50	35	19	35



?What does the distance of the points from the regression line indicate?

- **If beta = 1.0, investment has average risk, where *average* is defined as the *riskiness of the portfolio*.**
- **If beta > 1.0, investment has above-average risk.**
- **If beta < 1.0, investment has below-average risk.**
- **Most investments have betas in the range of 0.5 to 1.5.**

Beta Components

$$b = \frac{\sigma_i}{\sigma_M} r_{i,M} .$$

The beta of an investment depends on:

- **Its standard deviation *relative to* the standard deviation of the portfolio.**
- **Its correlation with the portfolio.**

Portfolio Risk

- **If the investor is an *individual*, the investments are *individual securities* (stocks), the portfolio is the market portfolio, and the relevant risk of each asset is called market risk.**
- **If the investor is a *business*, the investments are *real assets* (projects), the portfolio is the entire business, and the relevant risk of each asset is called corporate risk.**

Portfolio Risk (Cont.)

- **In for-profit businesses, projects have *both* corporate risk and market risk.**
  - **The risk of the project as seen by the *business's managers* (and other stakeholders) is corporate risk, which is measured by its corporate beta.**
  - **The risk of the project as seen by the *business's shareholders* is market risk, which is measured by market beta.**
- **This topic will be explored in more depth when we cover capital budgeting analysis.**

Portfolio Betas

- **The beta of portfolio is simply the *weighted average* of the betas of the component investments.**
- **This concept applies regardless of whether the portfolio is an individual investor's stock portfolio or a business's portfolio of projects.**
- **For example, combining H and L:**

$$b_p = (0.70 \times b_H) + (0.30 \times b_L)$$
$$= (0.70 \times 1.5) + (0.30 \times 0.5) = 1.20.$$

Risk and Required Return

- **Defining and measuring risk is of *no value* if we cannot relate risk to required rate of return.**
- **The relationship between risk and required rate of return on a stock investment is given by the Security Market Line (SML) of the Capital Asset Pricing Model (CAPM):**

$$R(R_e) = RF + [R(R_M) - RF] \times b.$$

SML Illustration Using Asset H

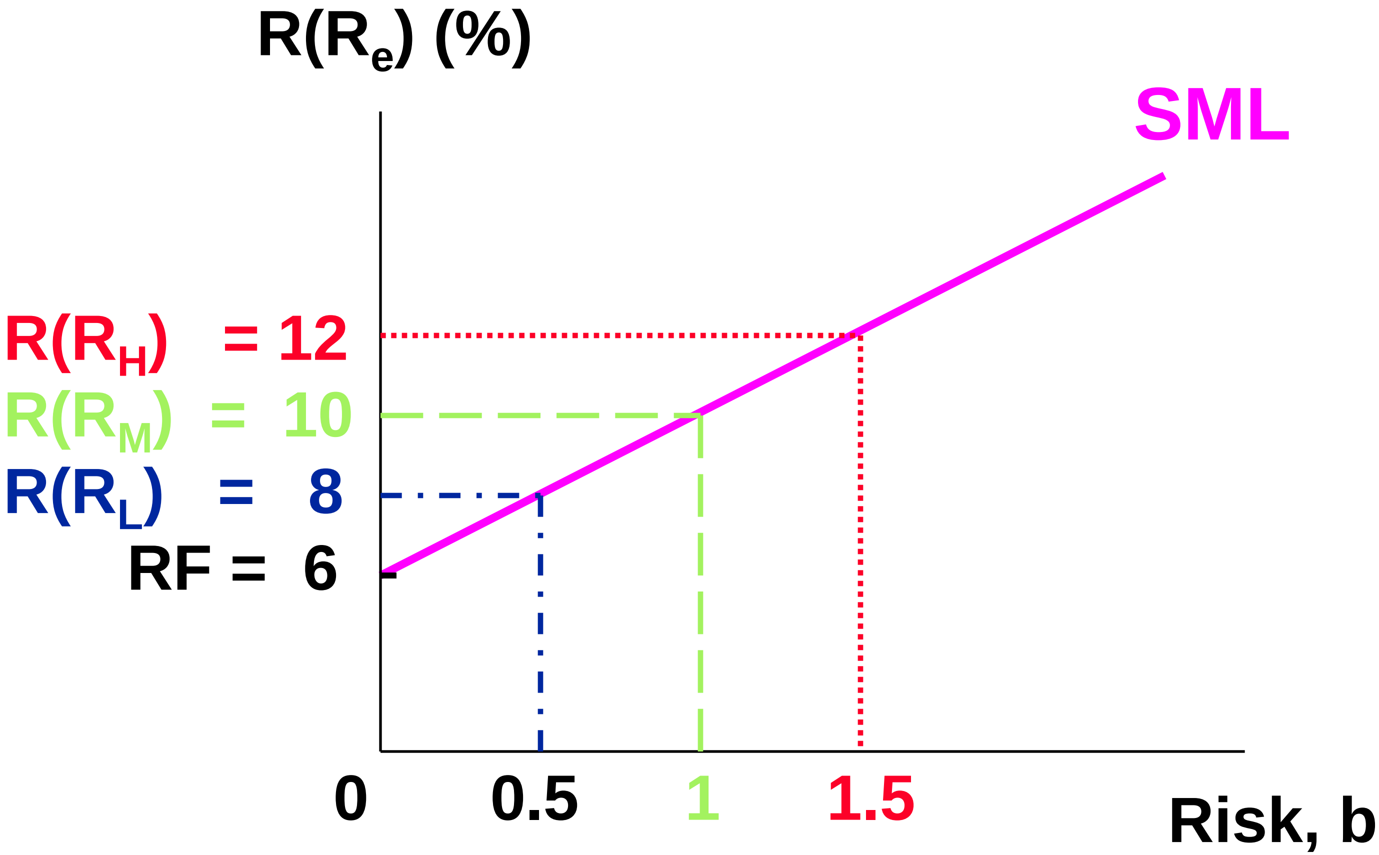
- Assume RF = 6%.
- Assume $R(R_M)$ = 10%.
- b = 1.5.

$$
\begin{aligned}
R(R_e) &= RF + [R(R_M) - RF] \times b \\
&= 6\% + (10\% - 6\%) \times 1.5 \\
&= 6\% + (4\% \times 1.5) \\
&= 6\% + 6.0\% = 12.0\%.
\end{aligned}
$$

SML Illustration (Cont.)

- What is the required rate of return on Investment L?
- What is the required rate of return on Investment M?
- Note that the term $[R(R_M) - RF]$ is called the **market risk premium**. It is the amount above the risk-free rate that investors require to assume average (b = 1) risk.

SML: $R(R_e) = 6\% + (10\% - 6\%) \times b$.



A Word of Caution About the CAPM

- **The CAPM is based on a *very restrictive* set of assumptions.**
- **It has *not* been empirically verified.**
- **It is based on investor *expectations*, but the inputs used in the model typically are based on *historical data*.**

Some Good News About the CAPM

- **The CAPM provides investors with a very rational way of thinking about required rates of return.**
- **$R(R_e)$ is composed of:**
  - **The *risk-free rate*, which compensates investors for the time value of money.**
  - **A *risk premium*, which compensates investors for the amount of *portfolio risk* assumed.**
- **Should an investor who holds a stock *in isolation* expect to receive his or her required rate of return?**

Conclusion

- **This concludes our discussion of *Chapter 10* (Financial Risk and Required Return).**
- **Although not all concepts were discussed in class, you are responsible for all of the material in the text.**

? **Do you have any questions?**