The Basic Tools of Finance

Finance

- *Finance* is the field that studies how people make decisions regarding
  - the allocation of resources over time, and
  - the handling of risk.

Finance: Questions

- Would you rather have $100 today or $115 a year from today?
- Would you rather have $100 or a lottery ticket that has a 60% chance of winning nothing and a 40% chance of winning $150?
- What do people do in situations like these?
- How is the economy affected by people's willingness to postpone fun and by their willingness to take risks?

An easy question

- Q. Which would you rather have: $100 today or $100 ten years later?
- A. That's easy. You want it today.
- Lesson: Money today is more valuable than the same amount of money in the future.

A not-so-easy question

- Which would you rather have: $100 today or $103 two years later?
  - Should you take the second option just because 103 is more than 100?

Present Value

- Economists believe that people compare sums of money to be received at different dates by calculating the **present value** of each sum of money and then choosing the one with the highest present value.
- Economists believe that this is also the smart thing to do
- So, what is this present value?

FUTURE VALUE

- *Future value* of a given amount of money is the amount that that amount of money would become in the future, assuming it accumulates interest.
- Example: If $2 grows at 5% per year for 20 years, it will become $5.31. Therefore, the future value of $2.00 is $5.31.
  - See calculator.

PRESENT VALUE: MEASURING THE TIME VALUE OF MONEY

- *Present value* of a given future amount of money is the amount of money *today* that would grow, at prevailing interest rates, to the given future amount of money.
- Example: If $2 grows at 5% per year for 20 years, it will become $5.31. Therefore, the 20-year present value of $5.31 is $2.

Choices

- Suppose you know that $2.00 will become $5.31 after 20 years.
  - That is, $2.00 is the *present value* of $5.31 received 20 years later
- If you had to choose between $2.00 today and $5.31 twenty years later, which would you choose?

Choices I

- Alan claims that getting $5.31 twenty years later is better than getting $2.00 today.
- Had he instead taken $2.00 today, he could've put it in a bank. In that case, 20 years later Alan would've had the same $5.31
- Therefore, for Alan, choosing to receive $5.31 twenty years later is *equally attractive* as choosing to receive $2.00, the present value of $5.31, today!

Choices II

- Betty claims that getting $5.31 twenty years later is worse than getting $2.00 today.
- Had she instead chosen to receive $5.31 twenty years later, she wouldn't have had to wait 20 years for the fun to begin. She could borrow $2.00 today and spend it!
  - Sure, the $2.00 borrowed today would require a payment of $5.31, after 20 years, to her lender. But as Betty has chosen to receive $5.31 twenty years later, she would have enough money to repay her loan.
- Therefore, once again, choosing to receive $5.31 twenty years later is equally attractive as choosing to receive $2.00, the present value of $5.31, today!

Choice and present value

- Therefore, whichever way you look at it, **the prospect of receiving a given amount of money in the future is as attractive as receiving today the present value of that amount**.

Using present value to make choices

- Suppose **the present value of $5.31 to be received 20 years from today is $2.00 to be received today**. Then
- Which is better: $5.31 twenty years later or $2.00 today?
- Answer: they are equally good.
- Which is better: $5.40 twenty years later or $2.00 today?
- Answer: $5.40 twenty years later
- Which is better: $5.15 twenty years later or $2.00 today?
- Answer: $2.00 today
- Which is better: $5.31 twenty years later or $2.50 today?
- Answer: $2.50 today
- Which is better: $5.31 twenty years later or $1.80 today?
- Answer: $5.31 twenty years later

Using present value to make choices

- Suppose **the present value of $5.31 to be received 20 years from today is $2.00 to be received today**. Then
- Which is better: $200 twenty years later or $80 today?
- We know that $5.31 twenty years later is equally attractive as $2.00 today. Therefore,
- $5.31 $\times$ 40 twenty years later must be equally attractive as $2.00 $\times$ 40 today.
- Therefore, $212.40 twenty years later must be equally attractive as $80 today. Therefore
- Answer: $80 today is better than $200 twenty years later.
- In this way, any amount receivable 20 years later can be compared to any amount receivable today

Choices and present value: examples

- You have to choose between
  - $428.72 after 8 years,
  - $659.12 after 12 years, and
  - $1379.14 after 20 years.
- Which would you choose?
- Suppose the present values of your three choices are $200, $210, and $205, respectively. That is,
  - $200 will become $428.72 after 8 years,
  - $210 will become $659.12 after 12 years, and
  - $205 will become $1379.14 after 20 years.
    - This happens if the interest rate is 10%. See calculator.

Choices and present value: examples

- Therefore,
  - $200 is as attractive as $428.72 after 8 years,
  - $210 is as attractive as $659.12 after 12 years, and
  - $205 is as attractive as $1379.14 after 20 years.
- Therefore, comparing the three original amounts can be seen as equivalent to the much simpler problem of comparing $200, $210, and $205 today.
- Clearly, $210 is best.
- Therefore, you should choose to receive $659.12 after 12 years
  - This is the option that has the highest present value

Choices and present value

- So, choosing between different amounts of money at different points in the future is easy if you know the present values of the various future amounts.
- But if you are *not* told the present values, you'll need to calculate them yourself
- How can present value be calculated?
- What formula do the present value calculators use?

Decimal notation of interest rate

- Suppose people can freely lend and/or borrow at the interest rate of 5%.
- Recall that “5 percent” is “5 out of 100” or 5/100 = 0.05.
- The decimal form of 5% is 0.05.
- We will use the symbol *r* to denote the interest rate in decimal form.
- If the interest rate is 5%, we will write *r* = 0.05.

Compounding: One year

- If $r = 0.05$, then \$200 deposited in a bank today will grow in one year to:
  - The original amount (or, *principal*) of \$200, *plus*
  - The *interest earned*, which is $0.05 \times 200 = \$10$.
- That is, if $r = 0.05$, then \$200 will grow in one year to $200 + 0.05 \times 200 = (1 + 0.05) \times 200 = \$210$
- Suppose this amount is immediately reinvested for yet another year.

Compounding: Two years

- Then \$ $(1 + 0.05) \times 200$ deposited at the end of the first year will grow at the end of the second year to:
  - The original amount (or, *principal*) of \$ $(1 + 0.05) \times 200$, *plus*
  - The *interest earned*, which is $0.05 \times [(1 + 0.05) \times 200]$.
- That is, \$100 will grow in *two* years to $(1 + 0.05) \times 200 + 0.05 \times [(1 + 0.05) \times 200] = (1 + 0.05) \times (1 + 0.05) \times 200 = (1 + 0.05)^2 \times 200 =$ \$220.50.
- That is, if $r = 0.05$, then \$200 will grow in two years to $(1 + 0.05)^2 \times 200 =$ \$220.50.

Compounding

- We've just seen that \$200 becomes
  - \$ $(1 + 0.05) \times 200$ after 1 year
  - \$$(1 + 0.05)^2 \times 200$ after 2 years
- In this way, it can be shown that \$200 becomes $(1 + 0.05)^3 \times 200$ = \$231.53 after 3 years.
- And after *N* years, \$200 will grow to $(1 + 0.05)^N \times 200$
- Therefore, for any given interest rate, *r*, \$200 deposited today will in *N* years become \$ $(1 + r)^N \times 200$
- Therefore, \$*P* deposited today at the interest rate *r* for *N* years will become \$ $(1 + r)^N \times P$

Future Value Formula

- That is, if $\$P$ deposited today at the interest rate r becomes $\$F$ after N years, then $\boldsymbol{F = (1 + r)^N \times P}$
- Recall from the definitions of future value and present value, that if $\$P$ deposited today becomes $\$F$ after N years, then,
  - $\$F$ is the future value of $\$P$, and
  - $\$P$ is the present value of $\$F$.

Present Value Formula

- But $F = (1 + r)^N \times P$ implies that $P = F / (1 + r)^N$.
- Therefore, the present value of $\$F$ to be received N years in the future is $\boldsymbol{P = F / (1 + r)^N}$

Future value and present value

- To repeat,
  - If we know P, the present value, we can calculate its future value as $F = (1 + r)^N \times P$.
  - And if we know F, the future value, we can calculate its present value as $P = F / (1 + r)^N$.

Examples: future values and present values

- If the interest rate is $r = 0.10$ (or 10%), the future value of \$200 after 8 years can be calculated as $F = (1 + r)^N \times P = (1.10)^8 \times 200 =$ \$428.72
- If the interest rate is $r = 0.08$ (or 8%), the present value of \$500 to be received after 10 years can be calculated as $P = F / (1 + r)^N = 500/(1.08)^{10} =$ \$231.60

Choice

- If the interest rate is 8%, the present value (PV) of $500 to be received after 10 years is $231.60 today, according to the previous slide
- If the interest rate is 8%, the PV of $400 to be received after 8 years is $400/(1.08)^8 = $216.11 today
- Therefore, if you had to choose between getting $500 ten years later and $400 eight years later, choose the former option

Choice

- If you had to choose between
  - Getting $500 ten years later *plus* $400 eight years later, or
  - Getting $450 today,
- Which option would you choose?
- If $r = 0.08$, the total PV of the first option is 231.60 + 216.11 = $447.71 and the PV of the second option is, obviously, $450.
- So, choose the second option because it has the higher PV.

Choice: costs

- Suppose you had to choose between
  - *Paying* $500 ten years later (PV: $231.60), or
  - *Paying* $400 eight years later (PV: $216.11),
- What would you do?
- As paying less is better than paying more, you should choose the option that has the *smallest* PV.
- That is, choose to pay $400 eight years later

Choice: investments

- Suppose you were offered the following investment opportunity by your friend:
  - You pay $440 today (PV: $440) to your friend
  - Your friend will pay you $400 eight years later (PV: $216.11), plus
  - $500 ten years later (PV: $231.60).
- Should you accept his offer?
- If $r = 0.08$, the total PV of the receipts is 231.60 + 216.11 = $447.71, which exceeds the PV of your costs.
- So, you should accept the offer.

PRESENT VALUE: MEASURING THE TIME VALUE OF MONEY

- The concept of *present value* demonstrates the following:
- Receiving a given sum of money in the present is preferred to receiving the same sum in the future.
- In order to compare values at different points in time, compare their present values.
- Firms undertake investment projects if the present value of the project exceeds the cost.

Present value and the interest rate

- Recall the present value formula: $P = F / (1 + r)^N$.
- Therefore, when either *r* or *N* increases, the present value decreases.
  - The bigger the delay in the receipt of an amount of money, the less attractive it is to you today
  - The higher the interest rate, the less attractive it is to have to wait because you know that if you had the money now you could have put it in a bank and earned the higher interest rate.

Present value and the interest rate

- Returning to your friend's offer, if the interest rate is not 8% but 10%, the present value of his offer becomes a mere $379.37, considerably less than the $440 he is asking you to pay today.
- Therefore, you should refuse his offer. Politely!
- This shows why business investment decreases when interest rates increase.

FYI: Rule of 70

- According to the rule of 70, if some variable grows at a rate of *x* percent per period, then that variable doubles in approximately 70/*x* periods.
- Example: If the interest rate is 5%, the money in your bank account doubles approximately every 70/5 = 14 years
- Example: If the population of a country increases at the rate of 2% per year, the population will double approximately every 70/2 = 35 years

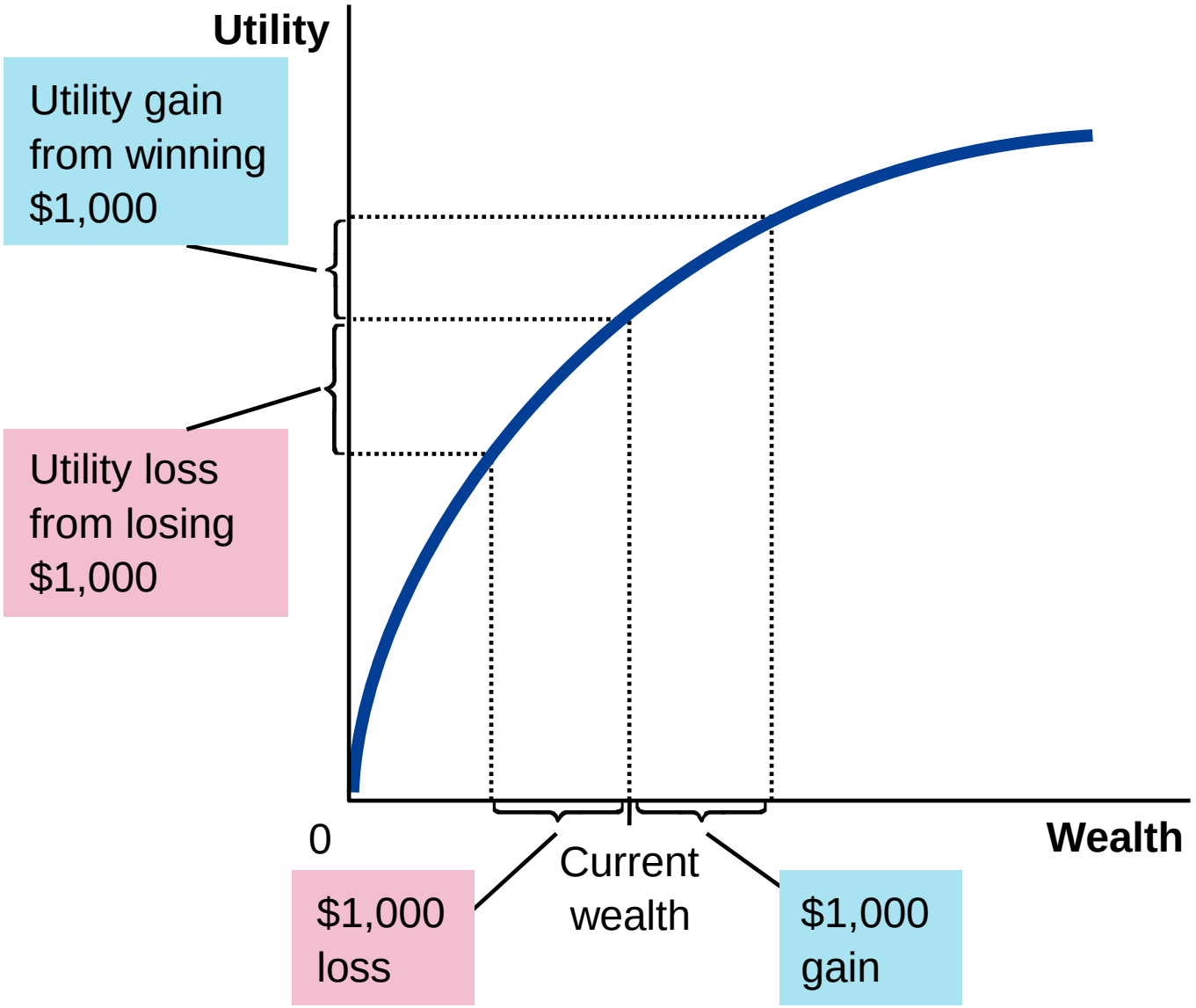
MANAGING RISK

- A person is said to be *risk averse* if she exhibits a dislike of uncertainty.

MANAGING RISK

- Individuals can reduce risk by choosing to do any of the following:
  - Buy insurance
  - Diversify the assets they own
  - Accept a lower return on their investments

Figure 1 Risk Aversion



The Markets for Insurance

- One way to deal with risk is to buy insurance.
- The general feature of insurance contracts is that a person facing a risk pays a fee to an insurance company, which in return agrees to accept all or part of the risk.

The Markets for Insurance

- But some of the biggest risks in life cannot be insured away
  - An expectant mother cannot buy insurance for bad future outcomes of her child
  - A young person in middle school cannot buy insurance for bad college grades
- This is the result of
  - Adverse selection (hidden characteristics), and
  - Moral hazard (hidden actions)

Diversification of Firm-Specific Risk

- *Diversification* refers to the replacement of a single large risk with a large number of smaller unrelated risks.
- This leads to lower risk

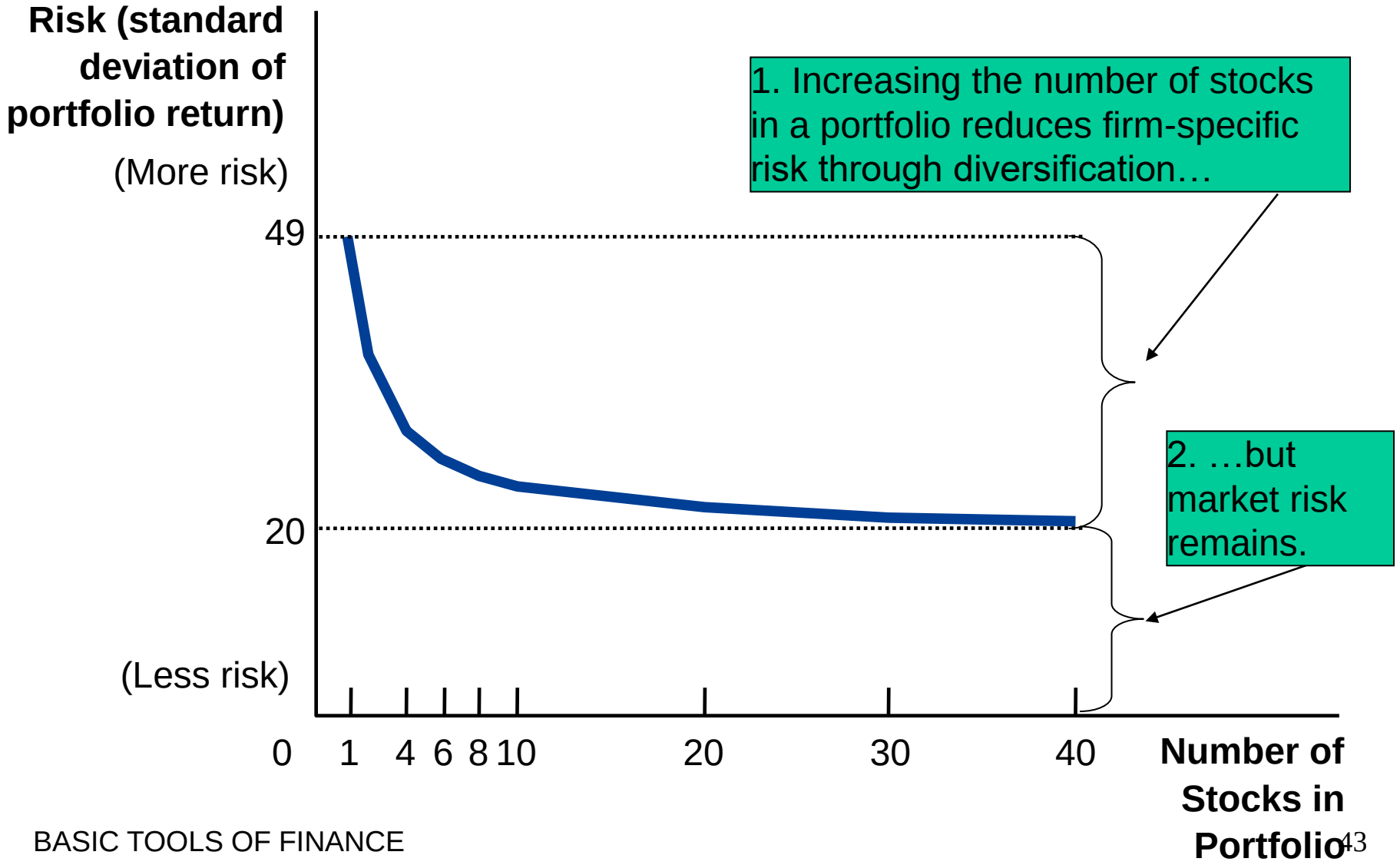
Diversification of firm-specific risk

- *Firm-specific risk* is the risk that affects only a single asset.
  - This is the uncertainty associated with specific companies.
- Diversification can reduce firm-specific risk

Diversification and Market Risk

- *Market risk* is the risk that affects all economic actors at once
  - This is the uncertainty associated with the entire economy.
- Diversification *cannot* remove market risk.

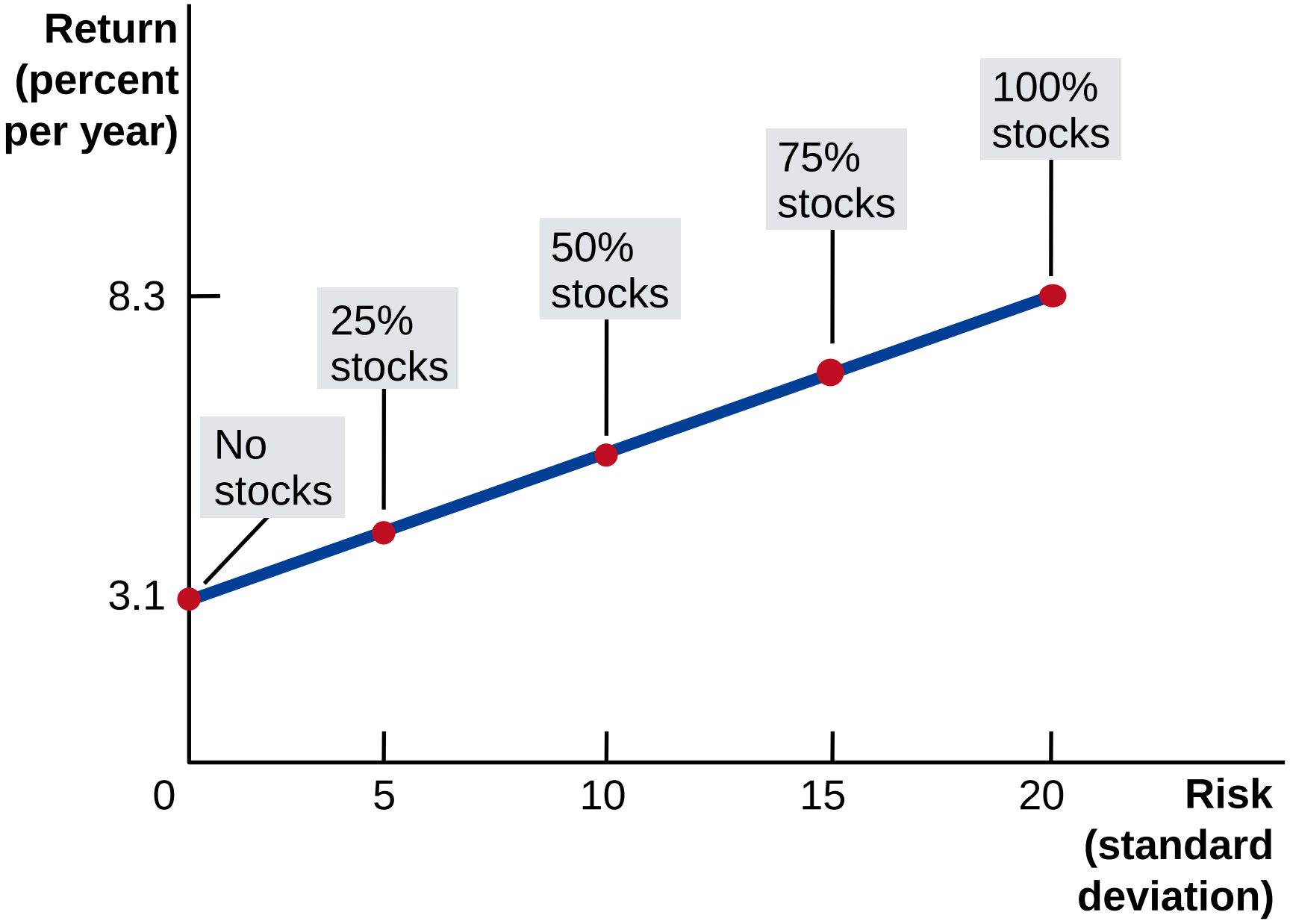
Figure 2 Diversification



Market Risk and the Rate of Return

- People can reduce market risk by accepting a lower rate of return.
- Stocks are riskier than bonds
- A portfolio of assets has less market risk, the lower the share of stocks in it

Figure 3 The Tradeoff between Risk and Return



Which Stocks?

- Now that you have decided *how many stocks* to buy and *how much of your wealth to spend on stocks*, how will you decide *which* stocks to buy?

ASSET VALUATION

- *Fundamental analysis* is the study of a company's accounting statements and future prospects to determine its value.

ASSET VALUATION

- People can employ fundamental analysis to try to determine if a stock is *undervalued, overvalued,* or *fairly valued.*
- The goal is to buy *undervalued stock*.
- Unfortunately, fundamental analysis requires a lot of work and, indeed, a lot of guesswork
- There's an easier way!

Efficient Markets Hypothesis

- The *efficient markets hypothesis* is the theory that asset prices reflect all publicly available information about the value of an asset.

Efficient Markets Hypothesis

- A market is *informationally efficient* when it reflects all available information in a rational way.
- If markets are efficient, the only wise thing an investor can do is buy a diversified portfolio

CASE STUDY: Random Walks and Index Funds

- *Random walk* refers to the path of a variable whose changes are impossible to predict.
- If markets are efficient, all stocks are fairly valued and no stock is more likely to appreciate than another.
  - Thus stock prices follow a random walk.
- Available evidence shows that asset markets are indeed efficient: the correlation between how well a stock does one year and how well it does the following year is almost exactly zero

Index funds are the best mutual funds

- An index fund is a mutual fund that buys stocks according to what market participants in general are buying without trying to figure out which are the good stocks and which are the bad stocks
- A managed fund is a mutual fund in which the manager buys stocks according to his or her own views or analysis

Index funds are the best mutual funds

- In the 10 years ending July 2005, 80% of managed stock mutual funds failed to beat an index fund holding all 500 stocks in the S&P 500 Index
- The remaining 20% were probably just lucky.
  - Studies have shown that fund managers with good records usually fail to maintain it in subsequent periods

Index funds are the best mutual funds

- So, what's the best strategy?
- First, decide how much of your money you wish to put in stocks and in bonds
- Then spend those amounts on an index fund for stocks and an index fund for bonds.
- Done!
- Want to be more sophisticated? Buy a domestic index fund and a foreign index fund in each category
- Whatever you do, don't pay high fees for the advice of a so-called expert

Summary

- Because savings can earn interest, a sum of money today is more valuable than the same sum of money in the future.
- A person can compare sums from different times using the concept of present value.
- The present value of any future sum is the amount that would be needed today, given prevailing interest rates, to produce the future sum.

Summary

- Because of diminishing marginal utility, most people are risk averse.
- Risk-averse people can reduce risk using insurance, through diversification, and by choosing a portfolio with lower risk and lower returns.
- The value of an asset, such as a share of stock, equals the present value of the cash flows the owner of the share will receive, including the stream of dividends and the final sale price.