

Chapter 5

Understanding Risk

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Risk

Risk

- is a measure of uncertainty about the future payoff of an investment, measured over some time horizon and relative to a benchmark.

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Measuring Risk

Measuring Risk requires:

- List of all possible outcomes
- Chance of each one occurring.

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Measuring Risk

Table 5.1 A Simple Example: All Possible Outcomes of a Single Coin Toss

Possibilities	Probability	Outcome
#1	$\frac{1}{2}$	Heads
#2	$\frac{1}{2}$	Tails

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Measuring Risk

Case 1

An Investment can rise or fall in value. Assume that an asset purchased for \$1000 is equally likely to fall to \$700 or rise to \$1400

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Measuring Risk

Table 5.2 Investing \$1,000: Case 1

Possibilities	Probability	Payoff	Payoff \times Probability
#1	$\frac{1}{2}$	\$700	\$350
#2	$\frac{1}{2}$	\$1,400	\$700

Expected Value = Sum of (Probability times Payoff) = \$1,050

$$\text{Expected Value} = \frac{1}{2}(\$700) + \frac{1}{2}(\$1400) = \$1050$$

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Measuring Risk

Case 2

The \$1000 investment might pay off \$100 (prob=.1) or \$2000 (prob=.1) in addition to \$700 (prob=.4) or \$1400 (prob=.4)

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Measuring Risk

Table 5.3 Investing \$1,000: Case 2

Possibilities	Probability	Payoff	Payoff × Probability
#1	0.1	\$100	10
#2	0.4	\$700	280
#3	0.4	\$1,400	560
#4	0.1	\$2,000	200

Expected Value = Sum of (Probability times Payoff) = \$1,050

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Measuring Risk

Though both cases have the same expected return, \$50 on a \$1000 investment, or 5%, the two investments have different levels or risk.

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Measuring Risk

A risk-free asset is an investment whose future value is known with certainty, and whose return is the risk-free rate of return.

If the risk-free return is 5 percent, a \$1000 risk-free investment will pay \$1050, its expected value, with certainty. If there is a chance that the payoff will be either more or less than \$1050, the investment is risky.

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Measuring Risk

The *variance* is defined as the probability weighted average of the squared deviations of the possible outcomes from their expected value

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Measuring Risk

Compute the expected value:

$$(\$1400 \times \frac{1}{2}) + (\$700 \times \frac{1}{2}) = \$1050.$$

Subtract this from each of the possible payoffs:

$$\$1400 - \$1050 = \$350$$

$$\$700 - \$1050 = -\$350$$

Square each of the results:

$$\$350^2 = 122,500(\text{dollars})^2$$

$$(-\$350)^2 = 122,500(\text{dollars})^2$$

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Measuring Risk

Multiply each result times its probability and add up the results:

$$\begin{aligned} & \frac{1}{2} [122,500(\text{dollars})^2] + \\ & \frac{1}{2} [122,500(\text{dollars})^2] = \\ & 122,500(\text{dollars})^2 \end{aligned}$$

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Measuring Risk

$$\begin{aligned} \text{Variance} &= \frac{1}{2}(\$1400-\$1050)^2 + \frac{1}{2}(\$700-\$1050)^2 \\ &= 122,500(\text{dollars})^2 \end{aligned}$$

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Measuring Risk

The standard deviation is the square root of the variance, or:

$$\text{Standard Deviation (case 1)} = \$350$$

$$\text{Standard Deviation (case 2)} = \$528$$

The greater the standard deviation, the higher the risk.

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Risk Aversion

A risk-averse investor will always prefer an investment with a certain return to one with the same *expected* return, but any amount of uncertainty.

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Risk Premium

The riskier an investment – the higher the compensation that investors require for holding it – the higher the risk premium.

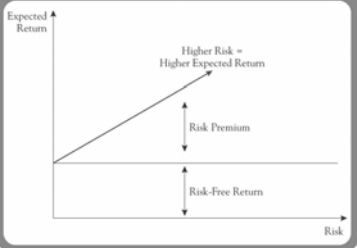
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Risk and Expected Return

Figure 5.2 The Trade-off between Risk and Expected Return

The higher the risk, the higher the expected return. The risk premium equals the expected return on the risky investment minus the risk-free return.



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Sources of Risk

Idiosyncratic – Unique Risk

Systematic – Economy-wide Risk

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Reducing Risk through Diversification

Hedging Risk

Hedging is the strategy of reducing overall risk by making two investments with opposing risks. When one does poorly, the other does well, and vice versa. So while the payoff from each investment is volatile, together their payoffs are stable.

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Reducing Risk through Diversification

Table 5.6 Payoffs on Two Separate Investments of \$100

Possibility	Payoff from Owning Only		Probability
	GE	Texaco	
Oil prices rise	\$100	\$120	$\frac{1}{2}$
Oil prices fall	\$120	\$100	$\frac{1}{2}$

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Reducing Risk through Diversification

Let's compare three strategies for investing \$100, given the relationships shown in the table:

1. Invest \$100 in GE
2. Invest \$100 in Texaco
3. Invest half in each company – \$50 in GE and \$50 in Texaco

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Reducing Risk through Diversification

Table 5.7 Results of Possible Investment Strategies:
Hedging Risk
Initial Investment = \$100

Investment Strategy	Expected Payoff	Standard Deviation
GE only	\$110	\$10
Texaco only	\$110	\$10
$\frac{1}{2}$ and $\frac{1}{2}$	\$110	\$0

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Reducing Risk through Diversification

Spreading Risk

To spread your risk, all you need to do is find investments whose payoffs are completely unrelated.

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Chapter 5

End of Chapter

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