

Chapter 1

A Brief History of Risk and Return

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Selected Web Sites

- ▶ finance.yahoo.com (basic financial information – all free)
 - ▶ www.globalfinancialdata.com (reference for historical financial market data —not free)
 - ▶ robertniles.com/stats (review of basic statistics)
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Annotated Chapter Outline

1.1 Returns

This chapter uses financial market history to provide information about risk and return. In general, two key observations emerge:

- There is a reward for bearing risk and, on average, the reward has been considerable.
- Greater rewards are accompanied by greater risks.

The important point is that risk and return are always linked together.

A. Dollar Returns

Total dollar return: the return on an investment measured in dollars that accounts for all cash flows and capital gains or losses.

When you buy an asset, your gain or loss is called the return on your investment. This return is made up of two components:

- The cash you receive while you own the asset (interest or dividends), and
- The change in value of the asset, the capital gain or loss.

The total dollar return is the sum of the cash received and the capital gain or loss on the investment. Whether you sell the stock or not, this is a real gain because you had the opportunity to sell the stock at any time.

B. Percentage Returns

Total percent returns: the return on an investment measured as a percentage of the original investment that accounts for all cash flows and capital gains or losses.

When you calculate percent returns, your return doesn't depend on how much you invested. Percent returns tell you how much you receive for every dollar invested. There are two components of the return:

- Dividend yield, the current dividend divided by the beginning price
- Capital gains yield, the change in price divided by the beginning price

C. A Note on Annualizing Returns

To compare investments, we need to “annualize” the returns, which we refer to as the Effective Annual Return (or EAR).

$$1 + \text{EAR} = (1 + \text{holding period return})^m$$

Where m is the number of holding periods in a year.

1.2 The Historical Record

The year-to-year historical rates of return on five important categories of investments are analyzed in this section. These categories are:

- Large-company stocks, which is based on the Standard & Poor's 500 index (S&P 500).
- Small-company stocks, where "small" corresponds to the smallest 20% of the companies listed on the major U.S. exchanges, as measured by the market value of outstanding stock.
- Long-term corporate bonds, which is a portfolio of high-quality bonds with 20 years to maturity.
- Long-term U.S. government bonds, which is a portfolio of U.S. government bonds with 20 years to maturity.
- U.S. Treasury bills (T-bills) with a three-month life.

The annual percentage changes in the Consumer Price Index (CPI) are also calculated as a comparison to consumer goods price inflation.

A. A First Look

When we examine the returns on these categories of investments from 1926 through 2021, we see that the small-company investment grew from \$1 to \$56,034, the large-company stock portfolio to \$14,086. At the other extreme, the T-bills only grew to \$22. Inflation caused the price of an average consumer good to grow from \$1 to \$15.58. An obvious question resulting from examining this graph would be, "Why would anyone invest in anything other than small-company stocks?" The answer lies in the higher volatility of the small-company stocks. This topic will be discussed later in the chapter.

B. A Longer Range Look

When we look at a longer term, back to 1801, we see that the return from investing in stocks is much higher than investing in bonds or gold. Over this 221-year period, one dollar invested in stocks grew to an astounding \$57.2 million, whereas gold has slightly outperformed inflation. The moral is, "Start investing early."

C. A Closer Look

As you examine the bar graphs, you can observe that the return on stocks, especially small-company stocks, was much more variable than bonds or T-bills. The returns on T-bills were much more predictable than stocks. Although the largest one-year return was 153% for small-company stocks and 53% for large-company stocks, the largest T-bill return was only 14.6%. The largest historical return for long-term government bonds was 47.14%, which occurred in 1982.

D. 2008: The Bear Growled and Investors Howled

The S&P 500 index plunged -37 percent in 2008, which is behind only 1931, which was at -44 percent. Moreover, there were 18 days during 2008 on which the value of the S&P changed by more than 5 percent. From 1956 to 2007, there were only 17 such days.

1.3 Average Returns: The First Lesson

This section provides simple measures to accurately summarize and describe all these numbers, starting with calculating average returns.

A. Calculating Average Returns

The simplest way to calculate average returns is to add the annual returns and divide by the number of years. This will provide the historical average. So, the average return for the large-company stocks over the 96 years is 12.3%.

B. Average Returns: The Historical Record

Table 1.2 also shows that small-company stocks had an average return of 16.3%, government bonds returned 6.0%, and T-bills only returned 3.3%. Note that the return on T-bills is slightly more than the inflation rate of 3.0%.

C. Risk Premiums

Risk-free rate: the rate of return on a riskless investment.

Risk premium: the extra return on a risky asset over the risk-free rate.

The rate of return on T-bills is essentially risk free because there is no risk of default. So, we will use T-bills as a proxy for the risk-free rate, our investing benchmark. If we consider T-bills as risk-free investing and investing in stocks as risky investing, the difference between these two returns would be the risk premium for investing in stocks. This is the additional return we receive for investing in the risky asset, or the reward for bearing risk.

The U.S. Equity Risk Premium: Historical and International

Perspectives: Earlier periods suggest a lower risk premium than in recent periods, while international risk premiums also tend to be slightly lower. Based on evidence and expectations, 7 percent seems to be a reasonable estimate for the risk premium.

D. The First Lesson

When we calculate the risk premium for large-company stocks (stock return minus the T-bill return) we get 9.0% and for government bonds 2.7%. Of course, the risk premium for T-bills is zero. So, we see that risky assets, on average, earn a risk premium, or "there is a reward for bearing risk." The next question is, "Why is there a difference in the risk premiums?" This is addressed in the next section and relates to the variability in returns.

1.4 Return Variability: The Second Lesson

A. Frequency Distributions and Variability

Variance: a common measure of volatility.

Standard deviation: the square root of the variance.

Variance and standard deviation provide a measure of return volatility or how much the actual return differs from this average in a typical year. This is the same variance and standard deviation discussed in statistics courses.

B. The Historical Variance and Standard Deviation

The variance measures the average squared difference between the actual returns and the average return. The larger this number, the more the actual returns differ from the average return. Note how the stocks have a much larger standard deviation than the bonds and were therefore more volatile.

Lecture Tip: Although all students should have been exposed to calculating variance and standard deviation, many still have difficulty with it. Another method to illustrate how to calculate the variance is to structure it in the form of a table where each step is a separate column. This is illustrated below using the data in the text.

For 1926-1930, the average return for large-company stocks (as represented by the S&P 500)

$$= (11.14\% + 37.13\% + 43.31\% - 8.91\% - 25.26\%) / 5$$

$$= 57.41\% / 5$$

$$= 11.48\%$$

R_N	$R_N - R_A$	$(R_N - R_A)^2$		
11.14%	$11.14 - 11.48 = -.34$	$(-.34)^2 = .12$		
37.13%	$37.13 - 11.48 = 25.65$	$(25.65)^2 = 657.82$		
43.31%	$43.31 - 11.48 = 31.83$	$(31.83)^2 = 1,013.02$		
-8.91%	$-8.91 - 11.48 = -20.39$	$(-20.39)^2 = 415.83$		
-25.26%	$-25.26 - 11.48 = -36.74$	$(-36.74)^2 = 1,349.97$		
		Sum of squares =	3,436.77	
	$(R_N - R_A)^2 / (N - 1) =$	$3,436.77 / (5 - 1) =$	859.19	Variance
		Square root =	29.31%	Standard deviation

Lecture Tip: Note the difference between using N-1 and N as the divisor when calculating variance and standard deviation. You use N when you have the entire population, as opposed to N-1 when you have a sample of the population.

Lecture Tip: After calculating variance and standard deviation, ask what units are attached to each. The students will most likely have to puzzle on this. Of course, variance is percent squared, whereas standard deviation is percent. This provides a starting point for the discussion on how to interpret the resulting value for standard deviation.

Lecture Tip: You may want to point out that this example calculates variance and standard deviation using historical data. When expected futures values are used, there is another method that must employ probabilities. This method will be discussed in a later chapter.

C. The Historical Record

The standard deviation for the large-company stock portfolio is more than six times the standard deviation for the T-bill portfolio. Also notice that the

distribution is approximately normal. This allows us to use the fact that plus or minus one standard deviation from the mean return gives us the range of returns that would result 2/3 of the time. If we take plus or minus two standard deviations from the mean, there is a 95% probability that our investment will be within this range of returns.

D. Normal Distribution

Like most statistical concepts, students will struggle remembering the concept of a normal distribution. In our experience, this is mostly because they are unsure of their understanding—not that they have not “seen” the material before.

For many different random events in nature, a particular frequency distribution, the normal distribution (or bell curve) is useful for describing the probability of ending up in a given range. For example, the idea behind “grading on a curve” comes from the fact that exam scores often resemble a bell curve.

Figure 1.10 illustrates a normal distribution and its distinctive bell shape. As you can see, this distribution has a much cleaner appearance than the actual return distributions illustrated in Figure 1.8. Even so, like the normal distribution, the actual distributions do appear to be at least roughly mound shaped and symmetric. When this is true, the normal distribution is often a very good approximation.

Also, you will have to remind students that the distributions in Figure 1.8 are based on only 96 yearly observations, while Figure 1.10 is, in principle, based on an infinite number. So, if we had been able to observe returns for, say, 1,000 years, we might have filled in a lot of the irregularities and ended up with a much smoother picture. For our purposes, it is enough to observe that the returns are at least roughly normally distributed.

The usefulness of the normal distribution stems from the fact that it is completely described by the average and the standard deviation. If you have these two numbers, then there is nothing else to know. For example, with a normal distribution, the probability that we end up within one standard deviation of the average is about 2/3. The probability that we end up within two standard deviations is about 95 percent. Finally, the probability of being more than three standard deviations away from the average is less than 1 percent.

E. The Second Lesson

Observing that there is variability in returns from year-to-year, we see that there is a significant chance of a large change in value in the returns. So, the second lesson is: The greater the potential reward, the greater the risk.

1.5 More on Average Returns

A. Arithmetic versus Geometric Averages

The geometric average return answers the question: “What was your average compound return per year over a particular period?”

The arithmetic average return answers the question: “What was your return in an average year over a particular period?”

B. Calculating Geometric Average Returns

Let us use data from the example above to calculate an arithmetic average and a geometric average:

	R_N	$1 + R_N$	$1 + R_{N,1} \times 1 + R_{N,2} \times \dots$
	11.14%	1.1114	1.1114
	37.13%	1.3713	1.5241
	43.31%	1.4331	2.1841
	-8.91%	.9109	1.9895
	-25.26%	.7474	1.4870
Sum:	57.41	Raised to $1/5^{\text{th}}$	
		Power:	1.0826
Arithmetic		Geometric	
Average:	11.48%	Average:	8.26%

C. Arithmetic Average Return or Geometric Average Return?

Two points are worth stressing:

First, generally, when one sees a discussion of “average returns,” the return in question is an arithmetic return.

Second, there is a nettlesome problem concerning forecasting future returns using *estimates* of arithmetic and geometric returns. The problem is: arithmetic average returns are probably too high for longer periods, and geometric average returns are probably too low for shorter periods. Fortunately, Blume’s formula provides a way to weight arithmetic and geometric averages for a T-year average return forecast using arithmetic and geometric averages which have been calculated for an N-year period (T cannot exceed N).

Blume’s formula is:

$$R(T) = \frac{T-1}{N-1} \times \text{Geometric Average} + \frac{N-T}{N-1} \times \text{Arithmetic Average}$$

As is clear from this formula, as T (the length of time of the forecast) increases, the geometric average receives a higher weight relative to the arithmetic average. That is, if $N = T$, the arithmetic average receives no weight, and the resulting forecast stems entirely from the geometric average. If $T = 1$, then the

geometric average receives a zero weight. In this case, the resulting forecast comes only from the arithmetic average.

D. Dollar-Weighted Average Returns

If an investor adds money to or subtracts money from an account, his actual return will likely be different than either the arithmetic or geometric average. The dollar weighted return (or internal rate of return, IRR) captures the impact of cash flows, giving the average compound rate of return earned per year.

1.6 Risk and Return

A. The Risk-Return Trade-off

If we are unwilling to take on any risk, but we are willing to forego the use of our money for a while, then we can earn the risk-free rate. We can think of this as the time value of money. If we are willing to bear risk, then we can expect to earn a risk premium, on average. We can think of these two factors as the "wait" component and the "worry" component.

Notice that the risk premium is not guaranteed; it is "on average." Risky investments by their very nature of being risky do not always pay more than risk-free investments. Also, only those risks that are unavoidable are compensated by the risk premium. There is no reward for bearing avoidable risk.

B. A Look Ahead

The remainder of the text focuses on financial assets only: stocks, bonds, options and futures. Remember that to understand the potential reward from an investment, you must understand the risk involved.

1.7 Summary and Conclusions