Chapter 7

Risk and Return: History

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Overview

1. Calculate Realized and Expected Rates of Return and Risk.
2. Describe the Historical Pattern of Financial Market Returns.
3. Compute Geometric and Arithmetic Average Rates of Return.
4. Explain Efficient Market Hypothesis
Realized Return from an Investment

- Realized return or cash return measures the gain or loss on an investment.

\[
\text{Cash Return} = \frac{\text{Ending Price}}{\text{Beginning Price}} + \frac{\text{Cash Distribution}}{(\text{Dividend})} - \frac{\text{Beginning Price}}{\text{Beginning Price}}
\]

\[
\text{Rate of Return} = \frac{\text{Cash Return}}{\text{Beginning Price}} = \frac{\text{Ending Price}}{\text{Beginning Price}} + \frac{\text{Cash Distribution}}{(\text{Dividend})} - \frac{\text{Beginning Price}}{\text{Beginning Price}}
\]
Example

- **Example 1**: You invested in 1 share of Apple (AAPL) for $95 and sold a year later for $200. The company did not pay any dividend during that period. What will be the cash return on this investment?

  - Cash return (dollar return) = $200 + 0 - $95 = $105
  - Rate of return = 105/95 = 1.1053 = 110.54%.
<table>
<thead>
<tr>
<th>Company</th>
<th>Beginning Price</th>
<th>Ending Price</th>
<th>Dividend</th>
<th>Dollar P&amp;L</th>
<th>Rate of Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>DKS</td>
<td>$ 15.32</td>
<td>$ 22.69</td>
<td>$ -</td>
<td>$ 7.37</td>
<td>48.11%</td>
</tr>
<tr>
<td>DUK</td>
<td>$ 16.38</td>
<td>$ 15.82</td>
<td>$ 1.16</td>
<td>$ 0.60</td>
<td>3.66%</td>
</tr>
<tr>
<td>EMR</td>
<td>$ 32.73</td>
<td>$ 37.75</td>
<td>$ 1.32</td>
<td>$ 6.34</td>
<td>19.37%</td>
</tr>
<tr>
<td>SHLD</td>
<td>$ 57.74</td>
<td>$ 67.86</td>
<td>$ -</td>
<td>$ 10.12</td>
<td>17.53%</td>
</tr>
<tr>
<td>WMT</td>
<td>$ 55.81</td>
<td>$ 49.68</td>
<td>$ 1.06</td>
<td>$(5.07)</td>
<td>-9.08%</td>
</tr>
</tbody>
</table>
Table 7-1 indicates that the returns from investing in common stocks can be positive or negative.

Past performance is not an indicator of future performance.
Expected Return from an Investment

- **Expected return** is what you expect to earn from an investment in the future.

- It is estimated as the average of the possible returns, where each possible return is weighted by the probability that it occurs.

\[
\text{Expected Rate of Return} = \left( \frac{\text{Rate of Return 1}}{(r_1)} \times \frac{\text{Probability of Return 1}}{(Pb_1)} \right) + \left( \frac{\text{Rate of Return 2}}{(r_2)} \times \frac{\text{Probability of Return 2}}{(Pb_2)} \right) + \cdots + \left( \frac{\text{Rate of Return } n}{(r_n)} \times \frac{\text{Probability of Return } n}{(Pb_n)} \right)
\]
<table>
<thead>
<tr>
<th>State of the Economy</th>
<th>Probability of the State of the Economy(^a) (P(_b))</th>
<th>End of Year Selling Price for the Stock</th>
<th>Beginning Price of the Stock</th>
<th>Cash Return from Your Investment</th>
<th>Percentage Rate of Return = Cash Return/Beginning Price of the Stock</th>
<th>Product = Rate of Return (\times) Probability of State of the Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recession</td>
<td>20%</td>
<td>$9,000</td>
<td>$10,000</td>
<td>$(1,000)</td>
<td>(-10% = -\frac{1,000}{10,000})</td>
<td>(-2.0%)</td>
</tr>
<tr>
<td>Moderate growth</td>
<td>30%</td>
<td>11,200</td>
<td>10,000</td>
<td>1,200</td>
<td>(12% = \frac{1,200}{10,000})</td>
<td>3.6%</td>
</tr>
<tr>
<td>Strong growth</td>
<td>50%</td>
<td>12,200</td>
<td>10,000</td>
<td>2,200</td>
<td>(22% = \frac{2,200}{10,000})</td>
<td>11%</td>
</tr>
<tr>
<td>Sum</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.6%</td>
</tr>
</tbody>
</table>

\(^a\)The probabilities assigned to the three possible economic conditions have to be determined subjectively, which requires management to have a thorough understanding of both the investment cash flows and the general economy.
Risk

- In the example on Table 7-2, the expected return is 12.6%; however, the return could range from -10% to +22%.

- This variability in returns, or the risk in an investment, can be quantified by computing the Variance or Standard Deviation in investment returns.

- Variance = \[ \sum \left( \frac{\text{Rate of Return for State } n}{r_n} - \frac{\text{Expected Rate of Return}}{E(r)} \right)^2 \times \frac{\text{Probability of State } n}{Pb_n} \]

- Standard deviation is given by square root of the variance and is more commonly used.

\[ \text{Standard Deviation} = \sqrt{\text{Variance}} \]
Example

Let us compare two possible investment alternatives:

1. **U.S. Treasury Bill** – Treasury bill is a short-term debt obligation of the U.S. Government. Assume this particular Treasury bill matures in one year and promises to pay an annual return of 5%. U.S. Treasury bill is considered risk-free as there is no risk of default on the promised payments.

2. **Common stock of the Ace Publishing Company** – an investment in common stock will be a risky investment.
The probability distribution of an investment’s return contains all possible rates of return from the investment along with the associated probabilities for each outcome.

Figure 7-1 contains an assumed probability distribution for U.S. Treasury bill and Ace Publishing Company common stock.
The probability distribution for Treasury bill is a single spike at 5% rate of return indicating that there is 100% probability that you will earn 5% rate of return.

The probability distribution for Ace Publishing company stock includes returns ranging from -10% to 40%, suggesting the stock is a risky investment.
Expected return and variance calculation

- From Figure 7.1, we can compute the expected returns:
  - Treasury Bill: 5%
  - Stock: \(0.1 \times (-10\%) + 0.2 \times 5\% + 0.4 \times 15\% + 0.2 \times 25\% + 0.1 \times 40\% = 15\%\).

- We can also compute the variance and standard deviation:
  - Treasury: Variance = 0.
  - Stock: \(0.1 \times (-10\% - 15\%)^2 + 0.2 \times (5\% - 15\%)^2 + 0.2 \times (25\% - 15\%)^2 + 0.1 \times (40\% - 15\%)^2 = 0.0165\), Std Dev = \(\sqrt{0.0165} = 0.1285 = 12.85\%\).
Table 7.3  Measuring the Variance and Standard Deviation of an Investment in Ace Publishing’s Common Stock

Computing the variance and standard deviation in the rate of return earned from a stock investment can be carried out using the following five-step process:

**Step 1:** Calculate the expected rate of return.

**Step 2:** Subtract the expected rate of return from each of the possible rates of return and square the difference.

**Step 3:** Multiply the squared differences calculated in Step 2 by the probability that those outcomes will occur.

**Step 4:** Sum all the values calculated in Step 3 together to calculate the variance of the possible rates of return.

**Step 5:** Take the square root of the variance calculated in Step 4 to calculate the standard deviation of the distribution of possible rates of return.

<table>
<thead>
<tr>
<th>State of the World</th>
<th>Rate of Return</th>
<th>Chance or Probability</th>
<th>( d = b \times c )</th>
<th>( e = [b - E(r)]^2 )</th>
<th>( f = e \times c )</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
<td>e</td>
<td>f</td>
</tr>
<tr>
<td>1</td>
<td>-0.10</td>
<td>0.10</td>
<td>-0.01</td>
<td>0.0625</td>
<td>0.00625</td>
</tr>
<tr>
<td>3</td>
<td>0.05</td>
<td>0.20</td>
<td>0.01</td>
<td>0.0100</td>
<td>0.00200</td>
</tr>
<tr>
<td>4</td>
<td>0.15</td>
<td>0.40</td>
<td>0.06</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>4</td>
<td>0.25</td>
<td>0.20</td>
<td>0.05</td>
<td>0.0100</td>
<td>0.00200</td>
</tr>
<tr>
<td>5</td>
<td>0.40</td>
<td>0.10</td>
<td>0.04</td>
<td>0.0625</td>
<td>0.00625</td>
</tr>
</tbody>
</table>

**Step 1:** Expected Return (\( E(r) \)) = \( 0.15 \)

**Step 4:** Variance = \( \) \( 0.0165 \)

**Step 5:** Standard Deviation = \( \) \( 0.1285 \)
The publishing company stock offers a higher expected return but also entails more risk as measured by standard deviation. An investor’s choice of a specific investment will be determined by their attitude toward risk.
Figure 7-2 shows the historical returns earned on four types of investments (small stocks, large stocks, government bonds, treasury bills) over the period 1926-2008.

The graph shows the value of $1 investment made in each of these asset categories in 1926 and held until the end of 2008.

We observe a clear relationship between risk and return. Small stocks have the highest annual return but higher returns are associated with much greater risk.

<table>
<thead>
<tr>
<th>Annual</th>
<th>Small Stocks</th>
<th>Large Stocks</th>
<th>Government Bonds</th>
<th>Treasury Bills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return</td>
<td>11.7%</td>
<td>9.6%</td>
<td>5.7%</td>
<td>3.7%</td>
</tr>
<tr>
<td>S.D.</td>
<td>34.1%</td>
<td>21.4%</td>
<td>8.5%</td>
<td>0.9%</td>
</tr>
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</table>
Figure 7.2


The following graph provides historical insight into the performance characteristics of various asset classes over an 84-year period of time. This graph illustrates the hypothetical growth of inflation and a $1 investment in four traditional asset classes over the time period January 1, 1926, through December 31, 2009.

Legend:

- Compound annual return = the annual rate of return earned on an investment where returns are compounded once a year.
- Source: © 2010 Morningstar. All rights reserved. Used with permission.
Historical risk-return relation

- We observe a clear relationship between risk and return. Small stocks have the highest annual return but higher returns are associated with much greater risk.

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- The riskier investments have historically realized higher returns.

- The historical returns of the higher-risk investment classes have higher standard deviations
Geometric vs. Arithmetic Average Rates of Return

- Arithmetic average may not always capture the true rate of return on an investment. In some cases, geometric or compound average may be a more appropriate measure.

- Suppose you bought a stock for $25. After one year, the stock rises to $30 and in the second year, it falls to $15. What was the average return on this investment?
  - The stock earned +20% in the 1st year and -50% in the 2nd year.
  - Simple average = (20% - 50%) ÷ 2 = -15%
  - Geometric (compound) average: \( \left( \frac{15}{25} \right)^{1/2} - 1 \approx 22.54\% \)
Geometric vs. Arithmetic Average Rates of Return

- The geometric average rate of return answers the question, “What was the growth rate of your investment?”

\[
\text{Geometric Average Return} = \left[ \left( 1 + \text{Rate of Return for Year 1, } r_{Year\ 1} \right) \times \left( 1 + \text{Rate of Return for Year 2, } r_{Year\ 2} \right) \times \cdots \times \left( 1 + \text{Rate of Return for Year } n, r_{Year\ n} \right) \right]^{1/n} - 1
\]

= \left[ \frac{\text{Last Value}}{\text{Starting Value}} \right]^{1/n} - 1, \text{ when there is no dividend.}

- The arithmetic average rate of return answers the question, “what was the average of the yearly rates of return?”

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Example

Compute the arithmetic and geometric average for the following stock.

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Rate of Return</th>
<th>Value of the stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>$25</td>
</tr>
<tr>
<td>1</td>
<td>40%</td>
<td>$35</td>
</tr>
<tr>
<td>2</td>
<td>-50%</td>
<td>$17.50</td>
</tr>
</tbody>
</table>

- Arithmetic Average = \((40 - 50) ÷ 2\) = -5%
- Geometric Average
  \[
  = \left[\left(1 + R_{\text{year }1}\right) \times \left(1 + R_{\text{year }2}\right)\right]^{1/2} - 1
  \]
  \[
  = \left[\left(1.4\right) \times \left(0.5\right)\right]^{1/2} - 1 = -16.33\%
  \]
  \[
  = \left(\frac{17.5}{25}\right)^{1/2} - 1 = -16.33\%.
  \]
Choosing the Right “Average”

- Both arithmetic average geometric average are important and correct. The following grid provides some guidance as to which average is appropriate and when:

<table>
<thead>
<tr>
<th>Question being addressed:</th>
<th>Appropriate Average Calculation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>What annual rate of return can we expect for next year?</td>
<td>The <strong>arithmetic average</strong> calculated using annual rates of return.</td>
</tr>
<tr>
<td>What annual rate of return can we expect over a multi-year horizon?</td>
<td>The <strong>geometric average</strong> calculated over a similar past period.</td>
</tr>
</tbody>
</table>
What Determines Stock Prices?

- In short, stock prices tend to go up when there is good news about future profits, and they go down when there is bad news about future profits.

- The **efficient market hypothesis (EMH)** states that securities prices accurately reflect future expected cash flows and are based on information available to investors.

- An **efficient market** is a market in which all the available information is *fully* incorporated into the prices of the securities and the returns the investors earn on their investments cannot be predicted.
The Efficient Market Hypothesis

1. The Weak-Form Efficient Market Hypothesis
   - All past security market information is fully reflected in security prices. This means that all price and volume information is already reflected in a security’s price.

2. The Semi-Strong Form Efficient Market Hypothesis
   - All publicly available information is fully reflected in security prices. This is a stronger statement as it includes all public information, e.g., firm’s financial statements, analysts’ estimates, announcements about the economy.

3. The Strong Form Efficient Market Hypothesis
   - All information, regardless of whether this information is public or private, is fully reflected in securities prices.
Do We Expect Financial Markets To Be Perfectly Efficient?

- In general, markets are expected to be at least weak form and semi-strong form efficient.

- If there did exist *simple and obvious* profitable strategies, the strategies would attract the attention of investors, who by implementing the strategies would compete away the profits.

- We would not expect financial markets to be strong-form efficient. We expect the markets to partially, but not perfectly, reflect information that is privately collected.

- The markets will be inefficient enough to provide some investors with an opportunity to recoup their costs of obtaining information, but not so inefficient that there is easy money to be made in the stock market.
Efficient market hypothesis is based on the assumption that investors, as a group, are pretty rational. This view has been challenged.

What if investors are not rational?

If investors do not rationally process information, then markets may not accurately reflect even public information.
Example: Overconfidence

- For example, overconfident investors may under react when management announces earnings as they have too much confidence in their own views of the company’s true value and tend to place too little weight on new information provided by management.

- As a result, this new information, even though it is publicly and freely available, is not completely reflected in stock prices.
Market Efficiency – What does the Evidence Show?

- The degree of efficiency of financial markets is an important question and has generated extensive research.

- Historically, there has been some evidence of inefficiencies in the financial markets. This is summarized by three observations in Table 7-4.

- More recent evidence suggests that these patterns (as noted in Table 7-4) have largely disappeared after 2000.
<table>
<thead>
<tr>
<th>Anomaly</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1. Value stocks outperform growth stocks</td>
<td><em>Value stocks, which are stocks with tangible assets that generate current earnings, have tended to outperform growth stocks, which are stocks with low current earnings that are expected to grow in the future.</em> More specifically, stocks with low price-earnings ratios, low price-to-cash flow, and low price-to-book value ratios tend to outperform the market.</td>
</tr>
<tr>
<td>#2. Momentum in stock returns</td>
<td>Stocks that have performed well in the past six to twelve months tend to continue to outperform other stocks.</td>
</tr>
<tr>
<td>#3. Over- and under-reaction to corporate announcements</td>
<td><em>The market has tended to under-react to many corporate events.</em> For example, stock prices react favorably on dates when firms announce favorable earnings news, which is exactly what we would expect in an efficient market. However, on the days after favorable earnings news, stock returns continue to be positive on average. This is known as post-earnings announcement drift. Similarly, there is evidence of some degree of predictability in stock returns following other major announcements, such as the issuance of stock or bonds.</td>
</tr>
</tbody>
</table>
Trend

- Following the publication of academic research on market inefficiencies, institutional investors set up hedge funds to exploit these patterns. By trading aggressively on these patterns, the hedge funds have largely eliminated the inefficiencies.

- If there is a type of inefficiency that is publicly known and is easy to be traded against, it is hard for this efficiency to last.

- Some inefficiencies can last longer, e.g.,
  - Super high frequency, the implementation of which asks for heavy investment in infrastructure.
  - Super low frequency: Many investors do not have the patience, and it is hard to verify whether the strategy still works or not.
  - Strategies involving heavily quantitative information processing.