CHAPTER 7[§]

A First Look at Investments

Historical Rates of Returns

THE subject of investments is so interesting that I first want to give you a quick tour, instead of laying all the foundations first and showing you the evidence later. I will give you a glimpse of the world of historical returns on the three main asset classes of stocks, bonds, and "cash," so that you can visualize the main patterns that matter—patterns of risk, reward, and covariation.

7·1 Stocks, Bonds, and Cash, 1970–2004

Common categories.

Financial investment opportunities are often classified into just a few broad **asset classes**. The three most prominent such classes are cash, bonds, and stocks.

1. **Cash:** The name *cash* here is actually a misnomer, because it does not designate physical dollar bills under your mattress. Instead, it means debt securities that are very liquid, very low-risk, and very short-term. Other investments that are part of this generic asset class may be certificate of deposits (CDs), savings deposits, or commercial paper. (These are briefly explained in Appendix B.2·5.) Another common designation for cash is **money-market**. To make our life easy, we will just join the club and also use the term cash.

Bonds: These are debt instruments that are of longer maturity than cash. You already know much about bonds and their many different varieties. I find it easiest to think of this class as representing primarily long-term Treasury bonds. You could also broaden this class to include bonds of other varieties, such as corporate bonds, municipal bonds, foreign bonds, or even more exotic debt instruments.

Stocks: Stocks are sometimes all lumped together, and sometimes themselves further categorized into different asset classes. The most common sub-classification for U.S. domestic stocks is as follows.

- ➤ There are a few hundred stocks issued by the largest firms that are quite visible and trade very frequently. Though not exact, you can think of the largest 500 firms as the constituents of the popular **S&P500** stock market index. This asset class is also often called **large-cap stocks**. (Cap is an abbreviation for capitalization.) Our chapter will focus only on these large-cap stocks, and call them "stocks."
- ➤ There are a few thousand other stocks. They are also sometimes put into multiple categories, such as "mid-cap" or "small-cap." Inevitably, these stocks tend to trade less often, and some seem outright neglected.

There are also other stock-related subclasses, such as industry stock portfolios, or a classification of stocks into "value firms" and "growth firms," and so on. We shall ignore everything except the large-cap stock portfolio.

Categories hide a lot of variation. They are only broadly indicative.

These three asset classes are useful and reasonably representative for many assets that are similar even if they are not members of the class themselves—but don't take these categories too literally. Yes, most bonds behave more like other bonds than they behave like stocks, but there are bonds for which this is not the case. The same holds true for stocks and cash—most, but not all stocks behave more like other stocks (even small-cap stocks behave more like large-cap stocks than bonds or cash), and most, but not all money market instruments behave more like other money market instruments. It would also be perfectly reasonable to include more or fewer investments in these three asset classes. (We would hope that this modification would alter our results only a little bit.) And, there are also many other asset classes that we do not even have time to consider, such as financial derivatives, real-estate, foreign investments, or art. But cash, bonds, and stocks are the three most studied asset classes. So let us begin our examination of investments by looking at their historical performances.

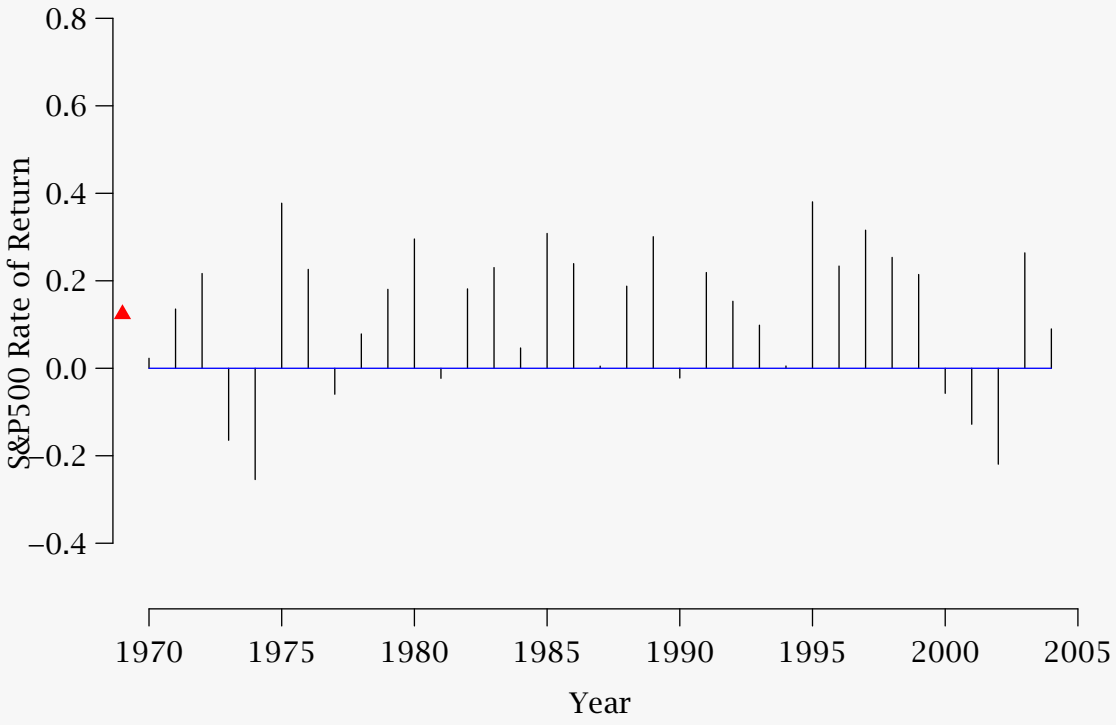
7·1.A. Graphical Representations of Historical Returns

The time series diagram.

Start with Figure 7.1. It shows the year-by-year rates of return of the S&P500. The table and the plot give the same data: you would have earned 2.3% in 1970, 13.5% in 1971, and so on. The average rate of return over all 35 years was 12.3% per annum—also marked by the red triangle in the graph on the left side.

Figure 7.1: The Time Series of Rates of Returns on the S&P500, 1970–2004

	0	1	2	3	4	5	6	7	8	9
1970	+2.3%	+13.5%	+21.7%	−16.5%	−25.4%	+37.7%	+22.6%	−5.9%	+7.8%	+18.0%
1980	+29.6%	−2.3%	+18.2%	+23.0%	+4.6%	+30.8%	+23.9%	+0.5%	+18.8%	+30.1%
1990	−2.2%	+21.9%	+15.3%	+9.8%	+0.5%	+38.0%	+23.4%	+31.6%	+25.3%	+21.4%
2000	−5.7%	−12.8%	−21.9%	+26.4%	+9.0%					



The time-series graph is a representation of the rate of return of the S&P 500 index, as shown in the table above. The mean rate of return is 12.3%; the standard deviation is 16.7%.

The histogram shows how spread out returns are.

Figures 7.2 and 7.3 take the same data as Figure 7.1, but present it differently. Figure 7.2 shows a histogram that is based on the number of returns that fall within a range. This makes it easier to see how spread-out returns are—how common it was for the S&P to perform really badly, perform just about ok, or perform really well. For example, the table in Figure 7.1 shows that only 1971, 1979, 1982, 1988, and 1992 had rates of return between 10% and 20%. In our 35 years, the most frequent return range was between 20% and 30%. Yet there were also other years that had rates of return below 10%—and even two years in which you would have lost more than 20% of your money (1974 and 2002). Again, the red triangle shows the average rate of return of 12.3%.

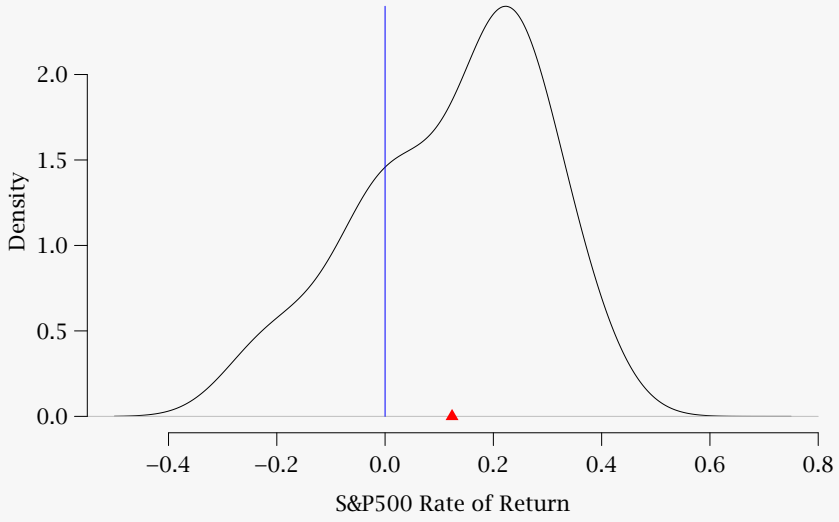
The compound rate of return graph shows how long-run investments would have fared.

The compound return graph in Figure 7.3 offers yet another perspective. It plots the compounded annual returns (on a logarithmic scale). For example, by the end of 1973, the compound return of $1 invested in 1970 would have been

$$\$1 \cdot (1 + 2.3\%) \cdot (1 + 13.5\%) \cdot (1 + 21.7\%) \cdot (1 - 16.5\%) \approx \$1.18$$

$$I_{1970} \cdot (1 + r_{1970}) \cdot (1 + r_{1971}) \cdot (1 + r_{1972}) \cdot (1 + r_{1973})$$

Figure 7.2: The Distribution Function of S&P500 Rates of Return, 1970–2004



Return Range	$< -20\%$	$(-20\%, -10\%)$	$(-10\%, 0\%)$	$(0\%, 10\%)$	$(10\%, 20\%)$	$(20\%, 30\%)$	$(30\%, 40\%)$	$> 40\%$
Number of Years	2	2	4	7	5	10	5	0

The graph and table are just different representations of the data in Figure 7.1. Formally, this type of graph is called a density function. It is really just a smoothed histogram.

The annualized compound rate of return is also called a **geometric average rate of return**. It is most relevant to a long-term buy-and-hold investor.

Watch out whether you are being quoted average or annualized returns.

Such an investor would find the more common arithmetic average rate of return—commonly just called the mean or average—outright misleading. For example, a rate of return of -50% (you lose half) followed by $+100\%$ (you double) has the intuitively correct geometric net return of zero. However, the average rate of these two returns is a positive $(-50\% + 100\%)/2 = +25\%$. Yikes. You can also see the discrepancy between the arithmetic and geometric rates of return in our S&P500 data. For example, with an 18% holding rate of return over these first four years, your annualized rate of return would have been

$$(1+r)^4 = (1+18\%) \quad \Leftrightarrow \quad r = \sqrt[4]{(1+18\%)} - 1 = 4.22\%$$

Th arithmetic rate of return is much higher:

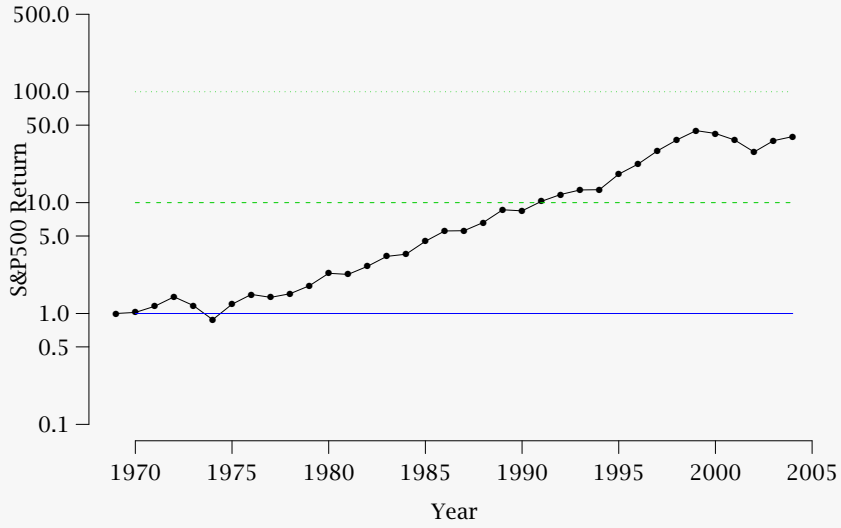
$$r = \frac{2.3\% + 13.5\% + 21.7\% + (-16.5\%)}{4} = 5.25\%$$

Looking longer term, Figure 7.3 shows that an investment in the stock market of \$1 at the start of 1970 would have ended up as \$39.45 at the end of 2004—of course, ignoring all taxes.

You can't learn from the arithmetic average how good an investment was.

Unfortunately, there is no easy way to convert an arithmetic rate of return into a geometric rate of return (or an annualized rate of return). It is even easy to find examples in which the geometric rate of return is negative, and the average rate of return is positive.

Figure 7.3: Compound Rates of Return For the S&P500, 1970–2004



	0	1	2	3	4	5	6	7	8	9
1970	$1.02	$1.16	$1.41	$1.18	$0.88	$1.21	$1.49	$1.40	$1.51	$1.78
1980	$2.31	$2.25	$2.66	$3.27	$3.43	$4.48	$5.55	$5.58	$6.63	$8.62
1990	$8.43	$10.28	$11.85	$13.02	$13.08	$18.06	$22.28	$29.31	$36.74	$44.62
2000	$42.06	$36.68	$28.64	$36.19	$39.45					

This graph and table are again just different representations of the same data in Figure 7.1.

IMPORTANT: The annualized holding rate of return cannot be inferred from the average annual rate of return and vice-versa. The two are identical only if all rates of return are the same (i.e., when there is no risk). Otherwise, the geometric rate of return is always less than the arithmetic rate of return. (And the more risk, the bigger the difference.)

7·1.B. Historical Investment Performance

Explore the complex figure first. Stare at it.

What does history tell you about rate-of-return patterns on the three major investment categories—stocks, bonds, and cash? You can find out by plotting exactly the same graphs as those in Figures 7.1–7.3. Figure 7.4 repeats them for a set of historical investment choices *all on the same scale*. The mini-graphs display a lot of information about the performance of these investments. Do not expect to understand everything at first glance: you need to stare at the elements of Figure 7.4 for a while to comprehend them. Each tells its own story.

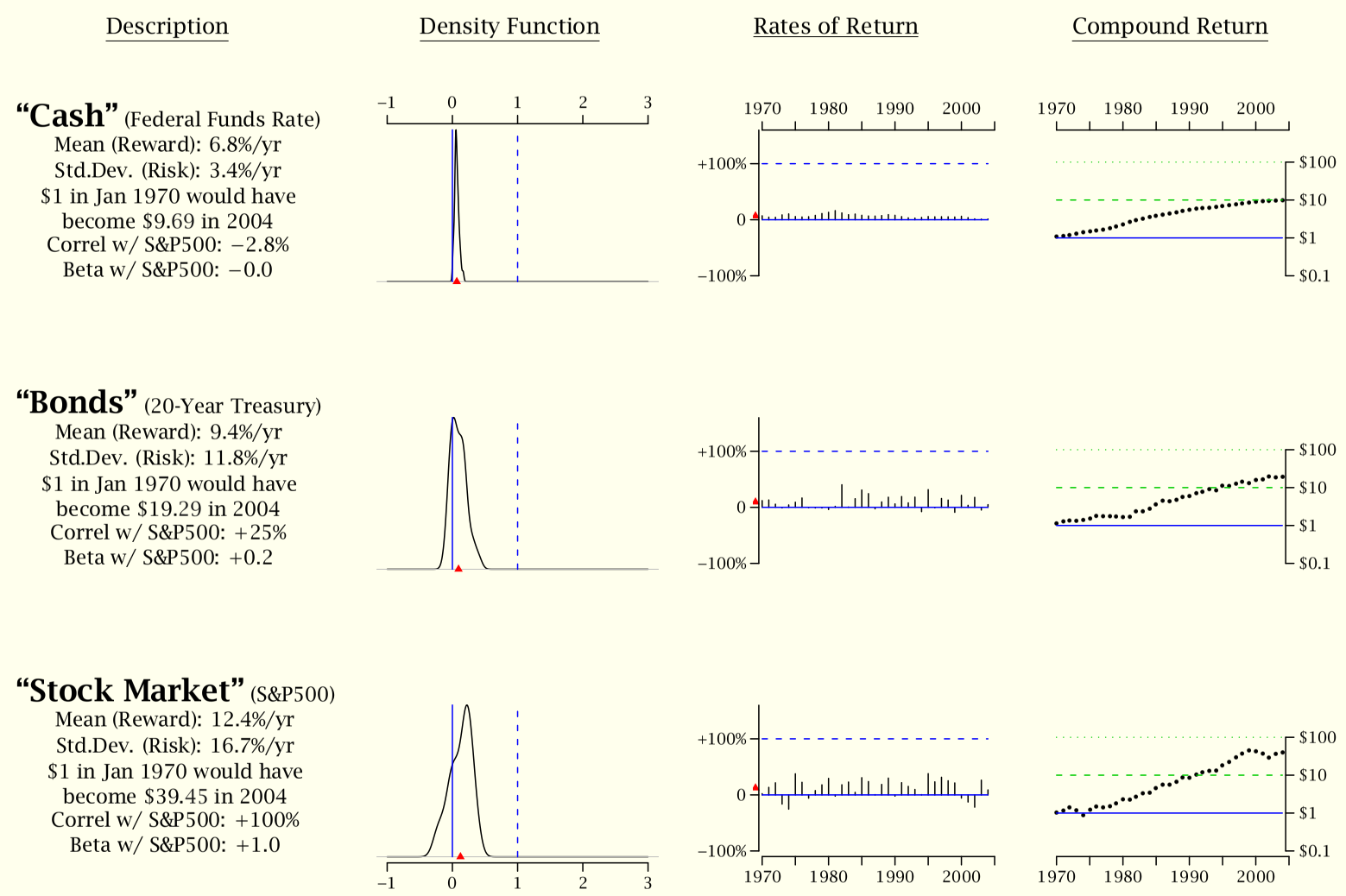
The three asset classes I promised you...

You have already seen the third row in Figure 7.4—the performance of an investment in the S&P500. I only changed the scale to make it easier to make direct comparison to the other investments in the graphs below. So let's compare the first three rows:

The first row is again "cash."

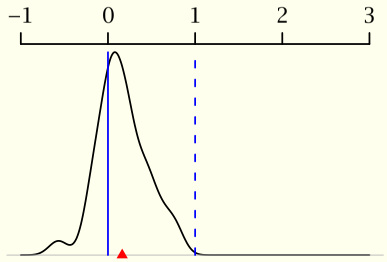
"Cash" in row 1 is the overnight Federal Funds interest rate. Note how tight the distribution of cash returns is around its 7% mean. You would never have lost money, but would rarely have earned much more than 7%. Your total investment portfolio would have steadily

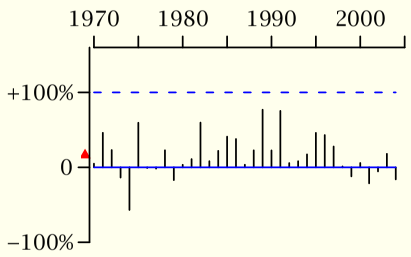
Figure 7.4: Comparative Investment Performance, 1970–2004

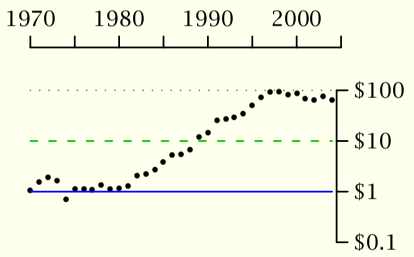


CocaCola (KO)

Mean (Reward): 16.3%/yr
Std.Dev. (Risk): 28.5%/yr
$1 in Jan 1970 would have become $63.71 in 2004
Correl w/ S&P500: +63%
Beta w/ S&P500: +1.0

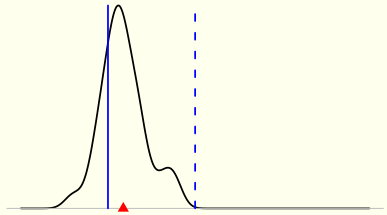


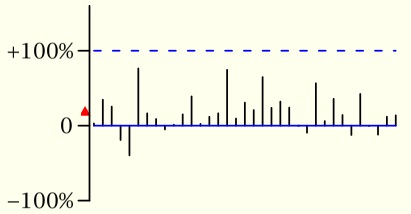


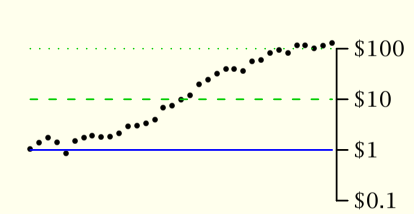


PepsiCo (PEP)

Mean (Reward): 17.6%/yr
Std.Dev. (Risk): 25.5%/yr
$1 in Jan 1970 would have become $128.78 in 2004
Correl w/ S&P500: +59%
Beta w/ S&P500: +0.9

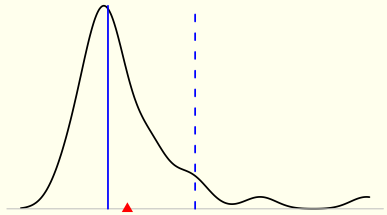


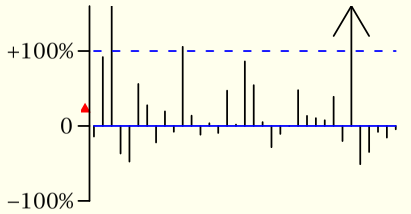


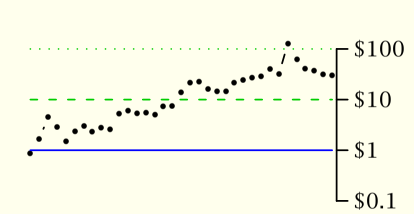


Sony (SNE)

Mean (Reward): 22.3%/yr
Std.Dev. (Risk): 66.9%/yr
$1 in Jan 1970 would have become $29.94 in 2004
Correl w/ S&P500: +37%
Beta w/ S&P500: +1.5

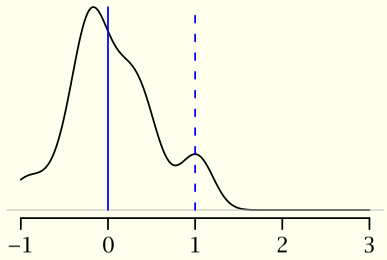


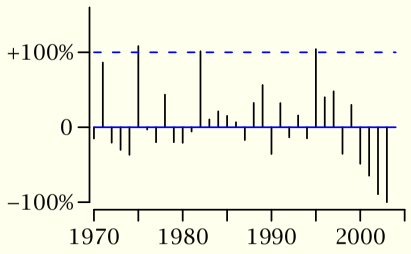


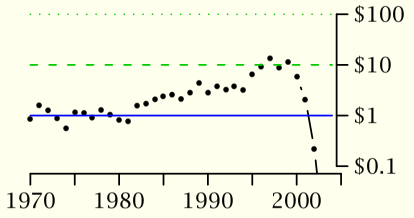


United (UAL)

Mean (Reward): 4.7%/yr
Std.Dev. (Risk): 51.x%/yr
$1 in Jan 1970 would have become $0.00 in 2004
Correl w/ S&P500: +57%
Beta w/ S&P500: +1.7







Description | Density Function | Time Series | Compound Return

marched upwards—although pretty slowly. Each dollar invested in 1970 would have become $9.69 at the end of 2004.

The second row, long-term bonds, offered more reward, but was more risky, too.

↦ *Chapter 6 on Page 117*

"Bonds" in row 2 is the 20-year Treasury bond. The graph in the third column shows that the bars are now sometimes slightly negative (years in which you would have earned a negative rate of return)—but there are now also years in which you would have done *much* better than cash. This is why the histogram is much wider for bonds than it is for cash: Bonds are riskier than cash. If you computed the standard deviation (remember Chapter 6?) it would tell you that bond risk was 12% per year, much higher than the 3.4% cash risk. Fortunately, in exchange for carrying more risk, you would have also enjoyed an average rate of return that was 10% per year, and not just the 6.8% that cash offered. And by 2004, your $1 invested in 1970 would have become $19.29.

The third row, stocks overall, offered even more reward, but was even more risky.

"Stocks" in row 3 are the S&P500 firms. The first graph on this row shows that large stocks would have been even more risky than bonds. The stock histogram is more "spread out" than the bond histogram. The second graph shows that there were years in which the negatives of stocks could be quite a bit larger than those for bonds, but that there were also many years that were outright terrific. The higher risk of stocks also came with more reward. The risk of 17% per year was compensated with a mean rate of return of 12% per year. Your $1 invested on January 1, 1970 would have ended up being worth $39.45 on December 31, 2004!

Individual stocks can offer more reward, or be even more risky.

Instead of holding entire asset classes, you could also have purchased just an individual stock. How would this holding have differed from an investment in the broader asset class "stocks"? The remaining four rows represent the rates of returns for four stalwarts: Coca Cola [KO], PepsiCo [PEP], Sony [SNE], and United Airlines [UAL]. Their histograms are really wide: investing in a single stock would have been a rather risky venture, even for these four household names. Indeed, it is not even possible to plot the final year for UAL in the right-most compound return graph, because UAL stock investors lost *all* invested money in the 2003 bankruptcy, which on the logarithmic scale would have been minus infinity.

How much extra real inflation-adjusted value were these nominal returns really?

↦ *Inflation: Chapter 5 on Page 79*

The story does not end here. Inflation eroded the value of each dollar. Thus, $1 in 1970 was about equivalent to $5 in 2004. Therefore, the $9.69 investment result in cash would have only been worth about $9.69/$5 ≈ $1.94 in 1970-inflation-adjusted dollars. Over 30 years, you would have not even doubled your real purchasing power. You can easily compute equivalent real returns for the other investment opportunities.

Fixed income was actually worse for taxable investors.

Furthermore, the difference between $39.45 in stocks and $9.69 in cash or $19.29 in bonds is an understatement *for you* as a retail investor. Interest was taxable each year, while the capital gain on stocks was not (the dividend gain would have been taxable). Very roughly, a highly taxed investor would have ended up with about $5 in "cash," $13 in bonds, and $33 in stocks. Therefore, in real *and* after-tax terms, from 1970 to 2004, a highly taxed investor would have ended up just about even if invested in "cash," doubled or tripled if invested in bonds, and quintupled if invested in stocks. This was a great and perhaps even unusually great 30 years for stocks! Not every historical 30 year period would have indicated as large a difference between stocks and bonds.

The following numbers are the major asset classes' returns according to Morningstar, a prominent financial data provider. All numbers are in percent per annum. Geometric averages are annualized, arithmetic averages are simple annual means. The 1970–2006 period is similar to the 1970–2004 period from Figure 7.4, and thus gives a good comparison.

	1926–2006			1970–2006		
	"Reward"		Risk	"Reward"		Risk
Asset Class	Geo	Ari	SDV	Geo	Ari	SDV
Large Firm (S&P500) Stocks	10.4	12.3	20.1	11.2	12.5	16.8
Small Firm Stocks	12.7	17.4	32.7	14.0	16.2	22.6
Long Term Corporate Bonds	5.9	6.2	8.5	9.1	9.6	10.6
Long Term Government Bonds	5.4	5.8	9.2	8.9	9.4	11.4
Intermediate Government bonds	5.3	5.4	5.7	8.2	8.3	6.7
30 Day T-Bills	3.7	3.8	3.1	6.0	6.0	2.9
U.S. Inflation	3.0	3.1	4.3	4.6	4.7	3.1

SIDE NOTE

7·1.C. Comovement, Market-Beta, and Correlation

Figure 7.5 highlights the rates of return on the S&P500 and one specific stock, Coca-Cola (KO). The left column redraws the time series graphs for these two investments from the third column in Figure 7.4. Do you notice a correlation between these two series of rates of return? Are the years in which one is positive (or above its mean) more likely to also see the other be positive (or above its mean), and vice-versa? It does seem that way. For example, the worst rates of return for both are 1974. Similarly, 1973, 2000, and 2001 were bad years for investors in either the S&P500 or Coca-Cola. In contrast, 1989 and 1975 were good years for both. The correlation is not perfect: in 1979, the S&P500 had a good year, but Coca-Cola had a bad one. It is very common for all sorts of investments to move together with the stock market: in years of malaise, almost everything tends to be in malaise. In years of exuberance, almost everything tends to be exuberant. This tendency is called comovement.

What is the correlation mentioned in the figure?

The comovement of investments is very important if you do not like risk. An investment that increases in value whenever the rest of your portfolio decreases in value is practically like "insurance" that pays off when you need it most. You might buy into such an investment even if it offers only a very low expected rate of return. In contrast, you might not like an investment that does very badly whenever the rest of your portfolio also does badly. To be included in your portfolio, such an investment would have to offer a very high expected rate of return.

Why do you care about comovement?

How can you measure the extent to which securities covary with others? For example, you might want to know how Coca-Cola performs if your current portfolio is the S&P500 (a common stand-in for the market portfolio). Will Coca-Cola also go down if the market goes down (and make a bad situation worse), or will it go up and thereby serve as useful insurance? How can you quantify such comovement?

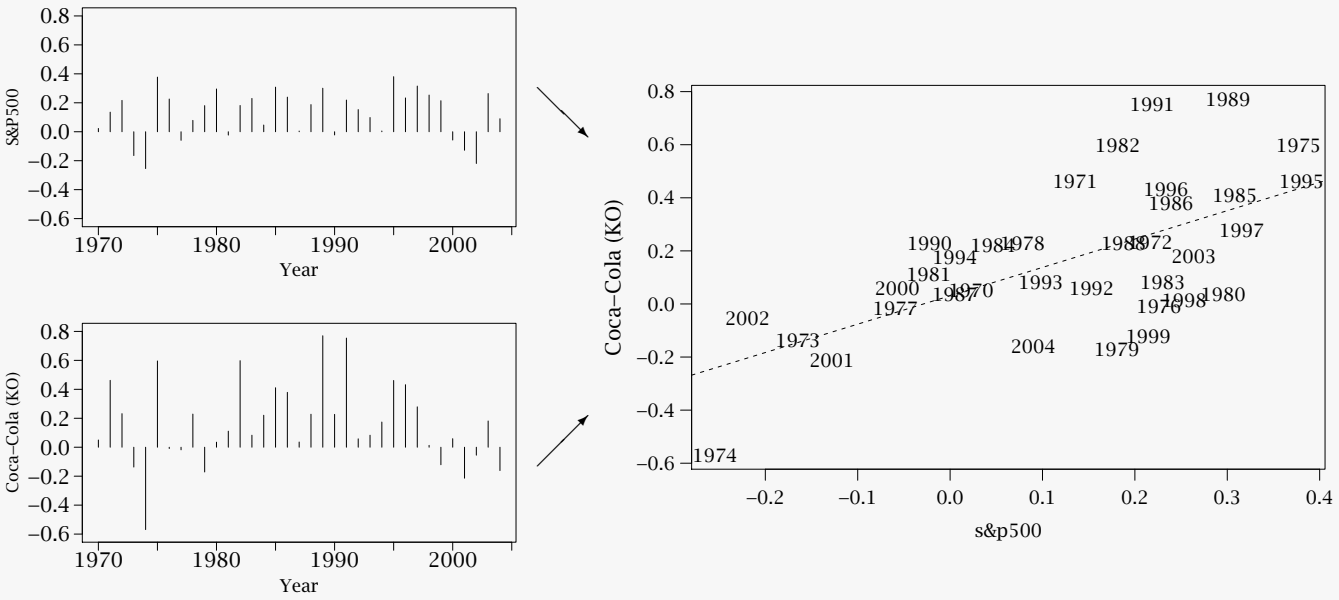
Quantifying comovement.

The answer is actually graphical. Plot the two return series against one another, as is done in the lower plot in Figure 7.5. Then find the line that best fits between the two series. (You will learn later how to compute it.) The slope of this line is called the **market beta** of a stock, and it is a measure of comovement between the rate of return on the stock with the rate of return on the market. It tells an investor whether this stock moves with or against the market. It carries great importance in financial economics.

Market-beta, the slope of the best-fitting line.

➤ If the best-fitting line has a slope that is steeper than the diagonal (well, if the X and Y axes are drawn with the same scale), then the market beta is greater than 1. Such a line would imply that when the stock market does better (the X axis), on average your stock does *a lot better* (the Y axis). For example, if a stock has a very steep positive slope, say +3, then (assuming you hold the market portfolio) if the market drops by an additional 10%, this stock would be expected to drop by an additional 30%—if you primarily hold the market portfolio, this new stock would make a bad situation worse for you.

Figure 7.5: Rate of Returns on The S&P500 and Coca-Cola (KO)



The top graph plots the annual rate of return on the S&P500; the bottom graph plots the annual rate of return on Coca-Cola. The graph on the right combines the information from the two graphs on the left. The stock market rate of return is on the X-axis, the Coca-Cola rate of return is on the Y-axis. The figure shows that in years when the stock market did well, Coca-Cola tended to do well, too, and vice-versa. This can be seen in the slope of the best fitting line, which is called the market-beta of Coca-Cola. The market beta will play an important role in investments.

Reality Check: In practice, it is better to compute a market-beta from the most recent three years of daily stock return data, and not from thirty years of annual stock return data.

- If the slope is less than 1 (or even 0, a plain horizontal line), it means that on average your stock does not move as much (or not at all) with the stock market.
- If a stock has a very negative slope, say −1, then if the market drops by 10%, this investment would "rescue" you, earning a positive 10% rate of return on average. Adding such a stock to your market portfolio would be like getting insurance.

Coca Cola's particular line has a slope of 1.07. This means that it is a little steeper than a diagonal line. In effect, this means that Coca-Cola is not great insurance for an investor who mostly owns the overall stock market portfolio, but it also is not the kind of stock that really punishes the investor many times over if the stock market underperforms.

Market-beta, the best-fit line, is related to correlation, too.

Instead of beta, you could measure comovement with another statistic that you may already have come across: the so-called **correlation**. Correlation and beta are cousins. The correlation has a feature that beta does not. A correlation of 100% indicates that two variables always perfectly move together; a correlation of 0% indicates that two variables move about independently; and a correlation of −100% indicates that two variables always perfectly move in opposite directions. (A correlation can never exceed +100% or −100%.) In this case, one can work that the correlation is +63%. The correlation's limited range from −1 to +1 is both an advantage and a disadvantage. On the positive side, the correlation is a number that is often easier to judge than beta. On the negative side, the correlation has no concept of scale. It can be 100% even if the Y variable moves only very, very mildly with X (e.g., if every $Y = 0.0001 \cdot X$, the correlation is still a positive 100%). In contrast, beta can be anything from minus infinity to plus infinity.

Slope and correlation are cousins—in fact, a positive correlation implies a positive beta and vice-versa. Of course, beta and correlation are only measures of *average* comovement: even for investments with positive beta, there are individual years in which the investment and stock market do not move together. For example, in 1979 and 2000, Coca-Cola and the S&P500 went their different ways. Stocks with negative betas, i.e., where a negative market rate of return *on average* associates with a positive stock return (and vice-versa), are rare. There are only a very few investment categories that are generally thought to be negatively correlated with the market—principally gold and other precious metals.

The sign of the correlation and beta are always the same.

Solve Now!

Q 7.1 What are the annualized holding rate of return and the average rate of return

(a) for an asset that returns 5% each year?

(b) for an asset that returns 0% and 10% in alternate years?

(c) for an asset that returns –10% and 20% in alternate years?

(d) Is the distance between the two returns larger when there is more risk?

Q 7.2 What can you see in a time-series graph that is lost in a histogram?

Q 7.3 What can you see in a histogram that is more difficult to see in the time-series graph?

Q 7.4 What can you see in a compound return graph that is difficult to see in the time-series graph?

Q 7.5 How do you graph a "market-beta"? What should be on the X-axis, and what should be on the Y-axis? What is an individual data point?

Q 7.6 What is the market beta of the market?

7·1.D. The Big Picture Take-aways

What can you learn from these graphs? Actually, almost everything that there is to learn about investments! I will explain these facts in much more detail soon. In the meantime, here are the most important points that the graphs show:

The main empirical regularities.

- History tells us that stocks offered higher average rates of return than bonds, which in turn offered higher average rates of return than "cash." However, keep in mind that this was only *on average*. In any given year, the relationship might have been reversed. For example in 2002, stock investors lost 22% of their wealth, while cash investors gained about 1.7%.
- Although stocks did well (on average), you could have lost your shirt investing in them, especially if you had bet on just one individual stock. For example, if you had invested $1 into United Airlines in 1970, you would have had only 22 cents left in 2002—and nothing the following year.
- Cash was the safest investment—its distribution is tightly centered around its mean, so there were no years with negative returns. Bonds were riskier. Stocks were riskier yet. (Sometimes, stocks are called "noisy," because it is really difficult to predict what they will turn out to offer.)
- There seems to be a relationship between risk and reward: the riskiest investments tended to have higher mean rates of return. (However, the risk has to be looked at "in context." Thus, please do not overread the simple relationship between the mean and the standard deviation here.)
- Large portfolios consisting of many stocks tended to have less risk than individual stocks. The S&P500 fund had a risk of 17%, less than the risk of most individual stocks (e.g., PepsiCo had a risk of about 25.5%). This is due to the phenomenon of diversification.
- A positive average rate of return usually, but not always, translates into a positive compound holding rate of return. United Airlines had a positive average rate of return, despite having lost all investors' money. (You already know why: A stock that doubles and then halves has rates of return of +100% and –50%. It would have earned you a 0%

total compound rate of return. But the *average* rate of return would have been positive $[100\% + (-50\%)]/2 = +25\%$.)

- Stocks tend to move together. For example, if you look at 2001–2002, not only did the S&P500 go down, but the individual stocks also tended to go down. In 1998, on the other hand, most tended to go up (or at least not down much). The mid-1990s were good to all stocks. In contrast, money market returns had little to do with the stock market. Long-term bonds were in between.
- On an annual frequency, the correlation between cash and the stock market (the S&P500) was about zero; the correlation between long-term bond returns and stock market was around 30%; and the correlation between individual stocks and the stock market was around 40% to 70%. The fact that investment rates of return tend to move together is important. It is the foundation for the market-beta, a measure of risk that we have touched on and that will be explained in detail in Chapter 9.

↦ *Chapter 9 on Page 187*

7·1.E. Will History Repeat Itself?

History is only useful over longer horizons, not over just a few years.

As a financier, you are not interested in history for its own sake. Instead, you really want to know more about the future. History is useful only because it is your best available indicator of the future. But which history? One year? Thirty years? One hundred years? I can tell you that if you had drawn the graphs beginning in 1926 instead of 1970, the big conclusions would have remained the same. However, if you had started in 2001, things would have been different. What would you have seen? Two awful years for stock investors. You should know intuitively that this would not have been a representative sample period. To make any sensible inferences about what is going on in the financial markets, you need many years of history, not just one, two, or three—and certainly not the 6-week investment performance touted by some funds or friends (who also often display remarkable selective memory!). The flip side of this argument is that you cannot reliably say what the rate of return will be over your next year. It is easier to forecast the *average* annual rate of return over 5 to 10 years than over 1 year. Your investment outcome over any single year will be very noisy.

Still, history can be rather misleading. The Nikkei is a good example.

Instead of relying on just one year, relying on statistics computed over many years is much better. However, although 20 to 30 years of performance is the minimum number necessary to learn something about return patterns, this is still not sufficient for you to be too confident. Again, you are really interested in what will happen in the next 5 to 10 years, not what did happen in the last 5 to 10 years. Yes, the historical performance can help you judge, but you should not trust it blindly. For example, an investor in UAL in 2000 might have guessed that the average rate of return for UAL would have been positive—and would have been sorely disappointed. Investors in the Japanese stock market in 1990 had seen the Nikkei-225 stock market index rise from 10,000 to 40,000—a four fold increase in just four years—a 40% rate of return every year. If they had believed history, they would have expected $40,000 \cdot 1.40^{13} \approx 3.2$ million by the end of 2002. Instead, the Nikkei had fallen below 8,000 in April 2003, and has only recently recovered to 12,000. History would have been a terrible guide.

But you do not have much choice other than to use some history.

Nevertheless, despite the intrinsic hazards in using historical information to forecast future returns, having historical data is a great advantage. It is a rich source of forecasting power, so like everyone else, you will have to use historical statistics. But please be careful not to rely too much on them. For example, if you look at an investment that had extremely high or low past historical rates of return, you may not want to believe that this is likely to continue.

Trust historical standard deviations and variances most in predicting future standard deviations and variances.

In relative terms, what historical information can you trust and what historical information should you be suspicious about?

Historical risk: Correlations (how stock movements tend to be related or unrelated) and risk (explained in the following chapters) tend to be fairly stable. That is, you can reasonably believe that PepsiCo will continue to have a risk of around 25% to 30% per year, and that its correlation with the S&P500 will be around 60%.

Historical mean reward: The historical average rate of return is not a very reliable predictor of future expected rates of return. That is, you should not necessarily believe that PepsiCo will continue to earn an expected rate of return of 18% over the long run.

Realizations: You should definitely not believe that realizations are good predictors of future realizations. Just because PepsiCo had a rate of return of x% last year does not make it likely that it will have a rate of return of x% next year.

A lottery analogy may help you understand the last two points better. If you have played the lottery many times, your historical average rate of return is unlikely to be predictive of your future expected rate of return—especially if you have won it big at least once. Yes, you could trust it if you had millions of historical realizations, but you inevitably do not have so many. Consequently, your average historical payoff is only a mediocre predictor of your next week's draw's payoff. And you should definitely not trust your most recent realization to be indicative of the future. Just because "5,10,12,33,34,38" won last week does not mean that it will likely win again.

Assume you know today the *expected* statistics for the future.

Henceforth, I will just assume that we know the statistical distributions from which future investment returns will be drawn, and that they are the same as the historical distributions. This is primarily an expositional device. It is a lot easier to pretend that history gives guidance for the future so that we can work with historical data. However, be aware that you should not trust this blindly. Historical statistics are only an imperfect guide to the future.

Solve Now!

Q 7.7 Rank the following asset categories in terms of risk and reward: money-market, long-term bonds, the stock market, and a typical individual stock.

Q 7.8 Is the average individual stock safer or riskier than the stock market?

Q 7.9 Is it possible for an investment to have a positive average rate of return, but still lose you every penny?

7·2 Summary

The chapter covered the following major points:

- Figure 7.4 showed an analysis of historical rate-of-return patterns of investments in cash, bonds, stock indexes, and individual stocks.
  - Stocks, on average, had higher average rates of return than bonds, which in turn had higher average rates of return than cash investments.
  - Individual stocks were most risky. Large stock market portfolios had lower risk than individual stock holdings. Bonds had lower risk yet, and cash was least risky.
- Stocks (and many other investments) tended to correlate: when the stock market overall had a good year, most stocks also had a good year.
- Historical data can help you in predicting the future and are especially useful and reliable in predicting future risk and correlation.
- Section 8·1 explains the institutional arrangements governing publicly traded equity securities.

↦ *Section 8·1 on Page 168*

50 Key Terms

ADR; American Depository Receipt; Asset Classes; Auction Market; Big Board; CSFB; Closed-end Fund; Correlation; Credit Suisse First Boston; Crossing System; Dividend; ECN; Electronic Communications Network; Exchange; Fiduciary Obligation; Fund; Geometric Average Rate Of Return; IPO; Initial Public Offering; Insider Trading; Large-cap Stocks; Limit Order; Limit Order Book; Limited Liability; Liquidnet; Market Beta; Market Order; Market-maker; Money-market; Mutual Fund; NASD; NYSE; NYSE Euronext; Nasdaq; New York Stock Exchange; OTC; On Margin; Open-ended; Over-the-counter; Pink Sheets; Prime Broker; Retail Broker; Reverse Merger; SEO; S&P500; Seasoned Equity Offering; Securities And Exchange Commission; Share Repurchase; Specialist; Underwriter.

End of Chapter Problems

Q 7.10 Broadly speaking, what was the average rate of return on cash, bonds, and stocks? What time period are your numbers from?

Q 7.11 Broadly speaking, what was the average risk of cash, bonds, and stocks? What time period are your numbers from?

Q 7.12 Why does the market-beta of stocks in the market average out to zero?

Q 7.13 Give an example in which a stock had a positive average rate of return, even though it lost its investor money.

Q 7.14 Looking at the figures in this chapter, did 20-year bonds move with or against the U.S. stock market? Did bonds move more or less with the U.S. stock market than the foreign stock, Sony?

Q 7.15 Do individual stocks tend to move together? How could this be measured?

Q 7.16 How good are historical statistics as indicators of future statistics? Which kinds of statistics are better, which kinds are worse?

9 "Solve Now" Answers

1. Note that because these returns alternate, you just need to work out the safe two year returns—thereafter, they will remain the same.
   (a) 5% for both.
   (b) Over two years, you earn $1.00 \cdot 1.10 - 1 = 10.00\%$. This means that the annualized rate of return is $\sqrt{1.1} - 1 = 4.88\%$. This is lower than the average rate of return, which is still 5%.
   (c) Over two years, you earn $0.9 \cdot 1.20 - 1 = 8.00\%$. This means that the annualized rate of return is $\sqrt{1.08} - 1 \approx 3.92\%$. This is lower than the 5% average rate of return.
   (d) Yes—the more volatile an investment, the greater is the difference between its annualized and its average rate of return.
2. A time-series graph shows how individual years matter.
3. A histogram shows how frequent certain outcomes are—and thus, where the distribution is centered, and how spread out it is.
4. A compound return graph shows how many returns interact to produce long-run returns.
5. The rate of return on the market (e.g., the S&P500) should be on the X-axis, the rate of return on the investment for which you want to determine the market-beta should be on the Y-axis. A data point are the two same-time rates of return over a given time period, e.g., over a year.
6. It is 1—you are plotting the rate of return on the market on both the X axis and the Y-axis, so the beta is the diagonal line.
7. The risk is usually increasing. The reward is increasing for the first three, but this is not necessarily true for an individual stock.

8. Usually, individual stocks are riskier.
9. Yes. Look at UAL in Figure 7.4. It lost everything, but still had a positive average arithmetic rate of return.