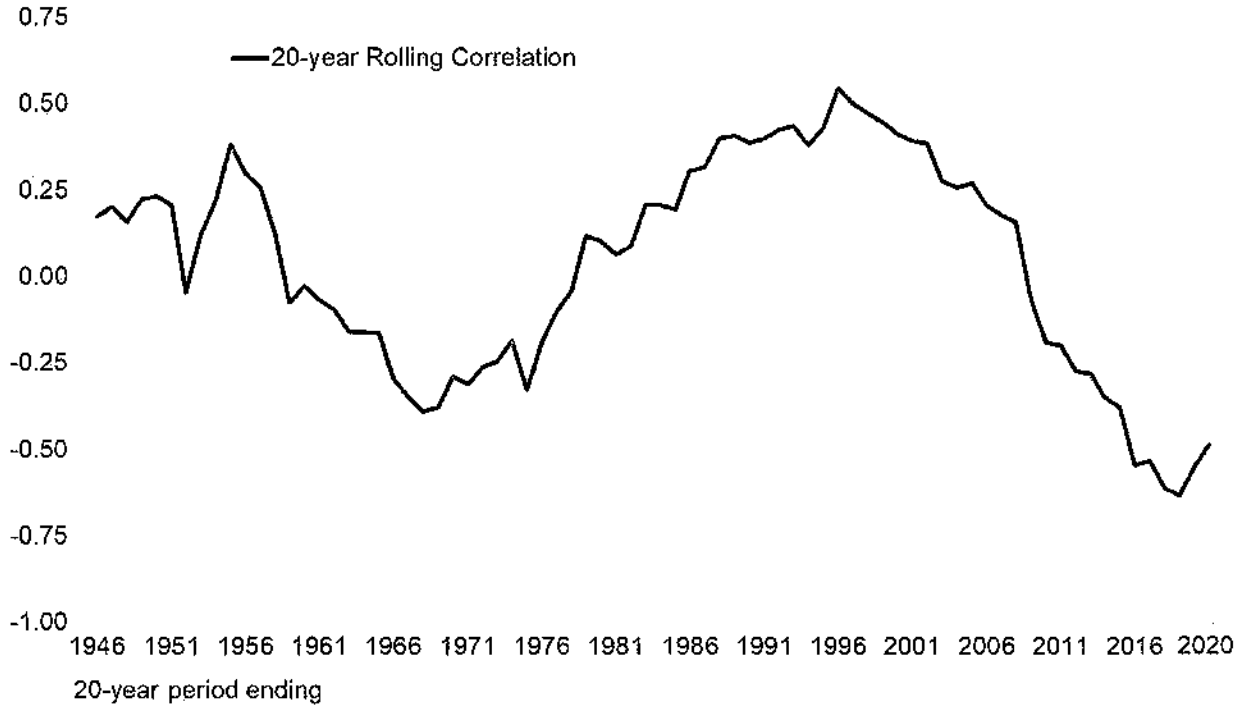
Exhibit 10.2: 20-Year Rolling-Period Correlations of Annual Returns of Large-Cap Stocks and Long-term Government Bonds 1926–2020



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, and (ii) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

Using Inputs to Form Other Portfolios

In Exhibit 10.3, inputs are provided that can be used in forming portfolios.[190]

190 *Precalculated* "Building Blocks for Expected Return Construction" are presented in table format in the full-version *2020 SBBI® Yearbook* as of December 31, 2020 for the following: (i) **Yields** (Long-term (20-year) U.S. Treasury Coupon Bond Yield; Intermediate-term (5-year) U.S. Treasury Coupon Note Yield; Short-term (30-day) U.S. Treasury Bill Yield), (ii) **Fixed Income Risk Premiums** (Expected default premium; Expected long-term horizon premium; Expected intermediate-term horizon premium, (iii) **Equity Risk Premiums** (Long-horizon expected equity risk premium; Intermediate-horizon expected equity risk premium; Short-horizon expected equity risk premium; Small-cap premium). For more information, visit: dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

Exhibit 10.3: Optimization Inputs: Year-end 2020 Large-Cap Stocks, Long-term Government Bonds, and U.S. Treasury Bills (%)

			Correlation		
	Expected Return (%)	**Standard Deviation (%)**	**Stocks**	**Bonds**	**Bills**
Stocks	8.6	19.7	1.00		
Bonds	1.4	11.7	0.01	1.00	
Bills	0.1	3.4	-0.02	0.17	1.00

Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD, and (iii) U.S. (30-day) Treasury Bills: IA SBBI® US 30 Day TBill TR USD. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

Given a complete set of inputs, the expected return and standard deviation of any portfolio (efficient or other) of the asset classes can be calculated. The expected return of a portfolio is the weighted average of the expected returns of the asset classes:

$$r_p = \sum_{i=1}^{n} x_i r_i$$

Where:

r_p = The expected return of the portflio p

n = The number of asset classes

x_i = The portfolio weight of asset class i, scaled such that:

$$\sum_{i=1}^{n} x_i = 1$$

Where:

r_i = The expected return of asset class i

For example, referring to the inputs in Exhibit 10.3, a portfolio comprised of large-cap stocks only would have an expected return of 9.4% and a standard deviation of 19.8%. If the portfolio mix is changed to, say, 60.0% large-cap stocks, 35.0% long-term government bonds, and 5.0% U.S. Treasury Bills, the expected return of this new portfolio mix can be calculated by applying the above formula (again, using the inputs in Exhibit 10.3):

5.7% = (60.0% x 8.6%) + (35.0% x 1.4%) + (5.0% x 0.1%)

The standard deviation of the portfolio depends not only on the standard deviations of the asset classes, but also on all of the correlations. It is given by:

$$\sigma_p = \sqrt{\sum_{i=1}^{n} \sum_{i=1}^{n} x_i x_j \sigma_i \sigma_j p_{ij}}$$

Where:

σ_p	=	The standard deviation of the portfolio
x_i and x_j	=	The portfolio weights of asset classes *i* and *j*
σ_i and σ_j	=	The standard deviations of returns on asset classes *i* and *j*
p_{ij}	=	The correlation between returns on asset classes *i* and *j*
		(note that r_{ij} equals one and that r_{ij} is equal to r_{ji}).

The standard deviation of the new portfolio (60.0% large-cap stocks, 35.0% long-term government bonds, and 5.0% U.S. Treasury Bills) can be calculated using the inputs from Exhibit 10.3 as shown in Exhibit 10.4:

Exhibit 10.4: Calculation of Example Portfolio Comprised of 60.0% Large-cap stocks, 35.0% Long-term Government Bonds, and 5.0% U.S. Treasury Bills

Stocks (asset class 1)	**Bonds (asset class 2)**	**Bills (asset class 3)**
Stocks & Stocks	Stocks & Bonds	Stocks & Bills
$x_1^2\sigma_1^2 p_{1,1} =$	$x_1 x_2 \sigma_1 \sigma_2 p_{1,2} =$	$x_1 x_3 \sigma_1 \sigma_3 p_{1,3} =$
$0.60^2 \times 0.197^2 \times 1.00 =$	$0.60 \times 0.35 \times 0.197 \times 0.117 \times 0.015 =$	$0.60 \times 0.05 \times 0.197 \times 0.034 \times -0.024 =$
=0.013923	=0.000070	=-0.000005
Bonds & Stocks	Bonds & Bonds	Bonds & Bills
$x_1 x_2 \sigma_1 \sigma_2 p_{1,2} =$	$x_2^2\sigma_2^2 p_{2,2} =$	$x_2 x_3 \sigma_2 \sigma_3 p_{2,3} =$
$0.35 \times 0.60 \times 0.117 \times 0.197 \times 0.015 =$	$0.35^2 \times 0.117^2 \times 1.00 =$	$0.35 \times 0.05 \times 0.117 \times 0.034 \times 0.168 =$
=0.000070	=0.001689	=0.000012
Bills & Stocks	Bills & Bonds	Bills & Bills
$x_1 x_3 \sigma_1 \sigma_3 p_{1,3} =$	$x_2 x_3 \sigma_2 \sigma_3 p_{2,3} =$	$x_3^2\sigma_3^2 p_{3,3} =$
$0.05 \times 0.60 \times 0.034 \times 0.197 \times -0.024 =$	$0.05 \times 0.35 \times 0.034 \times 0.117 \times 0.168 =$	$0.05^2 \times 0.034^2 \times 1.00 =$
=-0.000005	=0.000012	=0.000003

By summing these terms and taking the square root of the total, the result is a standard deviation of 12.6%.

$$\sqrt{\begin{array}{l}0.013923+0.000070+-0.000005+\\0.000070+0.001689+0.000012+\\-0.000005+0.000012+0.000003\end{array}}=12.6\%$$

Enhancements to Mean-Variance Optimization

Ibbotson Associates was an early adopter of mean-variance optimization to develop asset class model guidelines and continues to assist the industry in the development of enhancements to the traditional mean-variance approach as well as the state-of-the-art techniques described later in the chapter. Over the last half century, the Markowitz mean-variance optimization (MVO) framework has become the textbook approach for creating these optimal asset allocations, but the approach has several shortcomings.

Shortcomings of Traditional Optimization Techniques

One notable shortcoming is that the output (optimal asset allocation weights) is very sensitive to the inputs (expected returns, standard deviations, and correlations). Input sensitivity often leads to highly concentrated allocations in only a small number of the available asset classes. For example, if a typical optimization starts with an opportunity set of about 10 asset classes, just a few of these asset choices might end up in the resulting optimal allocation with the remaining asset choices not even getting a mention.

Mean-variance optimization is a powerful tool, but it needs to be used with caution. For instance, basing mean-variance optimization inputs on shorter periods can contribute to extreme results. Basing the mean-variance optimization inputs on longer periods, such as those presented elsewhere in this book, can help mitigate the extreme asset allocations mixes. Also, there is usually a more consistent ratio of return to risk amongst the different asset classes when using longer periods.

Placing maximum and minimum allocation constraints on each asset is the most common solution to the problem of highly concentrated asset allocations. For instance, we could specify a minimum allocation of 5% and a maximum allocation of 15% for each of the nine asset choices. This would ensure that each asset gets represented in the final allocation and that no single asset completely dominates in the final allocation mix. Unfortunately, these artificial minimums and maximums are arbitrary and usually end up limiting the ability of the optimizer to properly act on the information contained in the inputs.

Black-Litterman and Resampling Techniques

Two popular enhancements to traditional optimization techniques have emerged in recent years that can help overcome these difficulties. While both of these methods can help develop well diversified asset allocations, they approach the problem in very different ways. The first of these, the Black-Litterman model, attempts to create better inputs. The second, resampled mean variance optimization, attempts to build a better optimizer.

The Black-Litterman model was created by Fischer Black and Robert Litterman in the late 1980s. The Black-Litterman model combines investors' views regarding expected returns and the expected returns predicted by the capital asset pricing model to form a single blended estimate of expected returns. When this new combined estimate is used as an input within a traditional mean-variance optimization framework, it produces well-diversified portfolios that include not only market-based asset allocations but also allocations in assets that received favorable views.

The second approach, resampled mean-variance optimization, grew out of the work of a number of authors, but it is most closely associated with the work of Richard Michaud. While traditional mean-variance optimization treats the capital market assumptions as if they were known with complete certainty, resampled mean-variance optimization recognizes that the capital market assumptions are forecasts and are therefore not known with complete certainty.

Conceptually, resampled mean-variance optimization is a combination of Monte Carlo simulation and the more traditional Markowitz mean-variance optimization approach.[191] The simulation randomly resamples possible returns from a forecasted return distribution or randomly resamples possible returns from a historical distribution. The simulated returns lead to a simulated set of capital market assumptions that are used in a traditional mean-variance optimizer, and the asset allocations are recorded. After combining the asset allocations from the numerous intermediate optimizations, the resulting asset allocations are those that, on average, are predicted to perform best over the range of potential outcomes implied by the capital market assumptions. Research has shown that asset allocations selected from a resampled efficient frontier may outperform those from a traditional efficient frontier.[192]

In addition to the problem of getting results that are highly concentrated in just a few of the assets available, there are two more criticisms of the traditional mean-variance optimization framework.

First, the traditional approach focuses on a subset of the total portfolio. Traditionally, the focus is on finding a mix of asset classes that maximizes the expected return, subject to a risk constraint. However, because the purpose of most asset portfolios is to fund a specified future cash-flow

[191] Monte Carlo simulation is a problem-solving technique utilized to approximate the probability of certain outcomes by performing multiple trial runs, called simulations, using random variables. The probability distribution of the results is calculated and analyzed in order to infer which outcomes are most likely to be produced.

[192] See Markowitz, H. & Usmen, N. 2003. "Resampled Frontiers vs. Diffuse Bayes: An Experiment." *Journal of Investment Management*, Vol. 1, No. 4.

stream – a liability – the true risk for the portfolio is not the standard deviation of the assets or the performance of the assets relative to that of peers, but not being able to fund the future liability. An asset allocation approach that takes the future liability into account is called liability-relative optimization (or surplus optimization). The usual method employed to accomplish this is to constrain the optimizer to hold short an asset class representing the liability.

Second, the traditional mean-variance optimization framework assumes that the returns of the assets in the optimization are normally distributed. As illustrated in Exhibit 2.3, the return distributions of different asset classes do not always follow a standard, symmetrical bell-shaped curve. Some assets have distributions that are skewed to the left or right, while others have distributions that are skinnier or fatter than others. These more complicated characteristics are called skewness and kurtosis, respectively. The next wave of enhancements to the traditional mean-variance optimization are frameworks that incorporate these additional types of abnormalities into the optimization.

Markowitz 1.0

In 1952, Harry Markowitz, invented portfolio optimization. His genius was based on three principles: risk, reward and the correlation of assets in a portfolio. Over the years, technologies advanced, markets crashed, but the portfolio optimization models used by many investors did not evolve to compensate. This is surprising in light of the fact that Markowitz was a pioneer of technological advancement in the field of computational computer science. Furthermore, he did not stand by idly in the area of portfolio modeling but continued to make improvements in his own models and to influence the models of others. Few of these improvements, however, were picked up broadly in practice.

Because Markowitz's first effort was so simple and powerful, it attracted a great number of followers. The greater the following became, the fewer questioners debated its merits. Markowitz's original work is synonymous with modern portfolio theory and has been taught in business schools for generations and, not surprisingly, is still widely used today.

Then came the crash of 2008, and people started to ask questions. The confluence of the economic trauma and the technological advances of recent decades made the post-crash environment the perfect moment to upgrade to a new model built around Markowitz's fundamental principles of risk, reward and correlation. We dub our updated model "Markowitz 2.0." This section is an adaptation of a 2009 article, "The New Efficient Frontier," by Paul D. Kaplan, Morningstar Canada's director of research, and Sam L. Savage, consulting professor at Stanford University.

Markowitz 2.0

The Flaw of Averages

The 1952 mean-variance model of Harry Markowitz was the first systematic attempt to cure what Savage (2009) called the “flaw of averages.” In general, the flaw of averages is a set of systematic errors that occur when people use single numbers (usually averages) to describe uncertain future quantities. For example, if you plan to rob a bank of $10 million and have one chance in 100 of getting away with it, your average take is $100,000. If you described your activity beforehand as “making $100,000” you would be correct on average. But this is a terrible characterization of a bank heist. Yet as Savage discussed, this very “flaw of averages” is made all the time in business practice and helps explain why everything is behind schedule, beyond budget, and below projection. This phenomenon was an accessory to the global financial crisis that culminated in 2008.

Markowitz’s mean-variance model distinguished between different investments that had the same average (expected) return but different risks, measured as variance or its square root (standard deviation). This breakthrough systematic attempt to cure the flaw of averages ultimately garnered a Nobel Prize for its inventor. However, the use of standard deviation and covariance introduces a higher order version of the flaw of averages in that these concepts are themselves a version of averages.

Making a Great Idea Better

By taking advantage of the very latest in economic thought and computer technology, we can, in effect, add more thrust to the original framework of the Markowitz portfolio optimization model. The result is a dramatically more powerful model that is more aligned with 21st century investor concerns, markets, and financial instruments, such as options.

Our discussion here will focus on five practical enhancements to traditional portfolio optimization that can be made with current technology:

1. First, we use a scenario-based approach to allow for fat-tailed distributions. “Fat-tailed” return distributions are not possible within the context of traditional mean-variance optimization where return distributions are assumed to be adequately described by mean and variance.

2. Second, we replace the single-period expected return with the long-term forward-looking geometric mean as this takes into account accumulation of wealth.

3. Third, we substitute conditional value at risk, or CVaR, which focuses on tail risk for standard deviation, which looks at average variation.

4. Fourth, the original Markowitz model used a covariance matrix to model the distribution of returns on asset classes; we replace this with a scenario-based model that can be generated with Monte Carlo simulation and can incorporate any number of distributions.

5. Finally, we exploit new statistical technologies pioneered by Savage in the field of probability management. Savage invented an astonishing new technology called the Distribution String, or DIST, which encapsulates thousands of trials as a single data element or spreadsheet cell, thus eliminating the main disadvantage of the scenario-based approach – the need to store and process large amounts of data.

The Scenario Approach vs. Lognormal Distributions

One of the limitations of the traditional mean-variance optimization framework assumes the distribution of returns of the assets in the optimization can be adequately described simply by mean and variance alone. The most common depiction of this assumption is to draw the distribution of each asset class as a symmetrical bell-shaped curve, but asset class returns do not always fall into normal distributions.

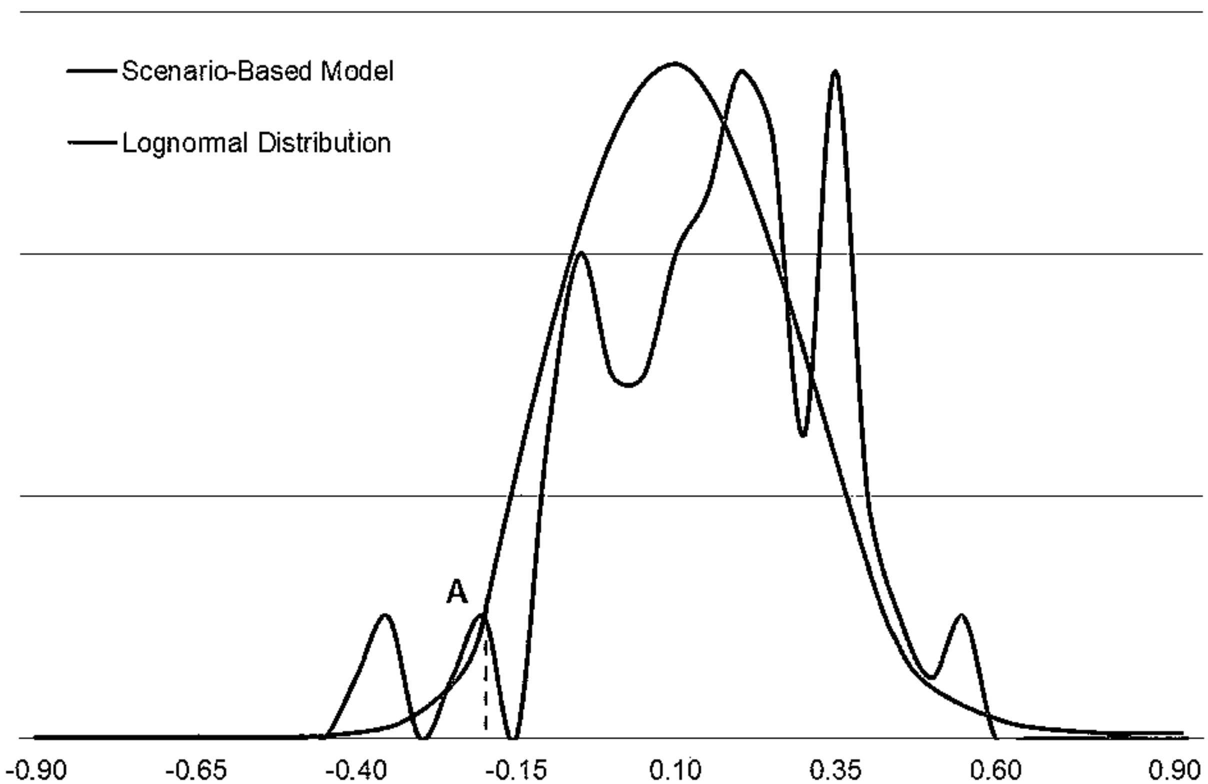
Over the years, various alternatives have been put forth to replace mean-variance optimization with an optimization framework that takes into account the non-normal features of return distributions. Some researchers have proposed using distribution curves that exhibit skewness and kurtosis (i.e., have fat tails) while others have proposed using large numbers of scenarios based on historical data, or Monte Carlo simulation.

The scenario-based approach has two main advantages over a distribution curve approach: (i) It is highly flexible. For example, nonlinear instruments such as options can be modeled in a straightforward manner; and (ii) it is mathematically manageable. For example, portfolio returns under the scenarios are simply weighted averages of asset class returns within the scenarios. In this way, the distribution of a portfolio can be derived from the distributions of the assets classes without working complicated equations that might lack analytical solutions; only straightforward portfolio arithmetic is needed.

In standard scenario analysis there is no precise graphical representation of return distributions. Histograms serve as approximations, such as those shown in Exhibit 2.3. We augment the scenario approach by employing a smoothing technique so that smooth curves represent return distributions. For example, Exhibit 10.5 shows the distribution curve of annual returns of large-cap stocks under our scenario-based approach. Comparing Exhibit 10.5 with the large-cap stock histogram in Exhibit 2.3, we can see that the smooth distribution curve retains the properties of the historical distribution making it more esthetically pleasing and precise. Further, our model can bring all of the power of continuous mathematics to the scenario approach. This was previously enjoyed only by models based on continuous distributions.

In Exhibit 10.5, the solid gray line represents the distribution of annual returns of large-cap stocks when our smoothed scenario-based approach is used, and the red line represents the distribution curve of annual returns of large-cap stocks when traditional mean-variance analysis is used and we assume that returns follow a lognormal distribution.

Exhibit 10.5: Distribution of Annual Returns: Large-cap Stocks (%) Lognormal Distribution vs. Scenario-Based Model



If we extend a vertical line from Point A down to the x-axis, the area to the left (and underneath) each of the curves represents the occurrences of annual returns equal to or less than, in this case, negative 26%. Because these are cumulative distributions, we can calculate the probability that the annual returns of large cap stocks will be less than or equal to negative 26% by dividing the area underneath each of the smaller curves (to the left of Point A) by the total area underneath each of the entire curves.

For example, looking to the scenario-based model, the area to the left of the vertical line under the scenario-based distribution represents 5% of the total area underneath this entire distribution line. This implies that the probability of large cap stocks having a loss of 26% or more is 5%. Correspondingly, the area to the left of the vertical line for the lognormal distribution represents 1.6% of the total area under the entire lognormal distribution line. This implies that the probability of large-cap stocks returning negative 26% or less using the traditional mean-variance model is 1.6%.

As Kaplan et al. (2009) discuss, "tail events" have occurred often throughout the history of capital markets all over the world, but the probabilities associated with them may be systematically underestimated within the context of traditional mean-variance analysis where return distributions are assumed to be lognormal. The scenario-based model proposed by Kaplan and Savage is a real step forward as it better models the nontrivial probabilities associated with tail events.

For a more detailed discussion of tail events and their nontriviality, see Chapter 11, where Kaplan introduces a set of monthly real stock market total returns going back a full 150 years. Using these new returns, we demonstrate that the severity of the financial crisis of 2008 was not unique but was merely the latest chapter in a long history of market meltdowns.

Geometric Mean vs. Single-Period Expected Return

In mean-variance optimization, reward is measured by expected return, which is a forecast of arithmetic mean. However, over long periods, investors are not concerned with simple averages of return rather they are concerned with the accumulation of wealth. We use forecasted long-term geometric mean as the measure of reward because investors who plan on repeatedly reinvesting in the same strategy over an indefinite period would seek the highest rate of growth for the portfolios as measured by geometric mean.[193]

Conditional Value at Risk vs. Standard Deviation

As for risk, much has been written about how investors are not concerned merely with the degree of dispersion of returns (as measured by standard deviation), but rather with how much wealth they could lose. A number of downside risk measures, including value at risk, conditional value at risk, and maximum drawdown, have been proposed to replace standard deviation as the measure of risk in strategic asset allocation. While any one of these could be used, our preference is to use conditional value at risk.

CVaR is related to value at risk. VaR describes the left tail in terms of how much capital can be lost over a given period of time. For example, a 5% VaR answers a question of the form: Having invested $10,000 there is a 5% chance of losing $X or more in 12 months. (The "or more" implications of VaR are sometimes overlooked by investors with serious implications.) Applying this idea to returns, the 5% VaR is the negative of the 5th percentile of the return distribution. CVaR is the expected or average loss of capital should VaR be breached. Therefore CVaR is always greater than VaR.

Scenarios vs. Correlation

In mean-variance analysis, the covariation of the returns of each pair of asset classes is represented by a single number, the correlation coefficient. This is mathematically equivalent to assuming that a simple linear regression model is an adequate description of how the returns on

[193] Ranking investment strategies by forecasted geometric mean is sometimes described as applying the Kelly Criterion, an idea promoted by William Poundstone in his 2005 book, *Fortune's Formula*.

the two asset classes are related. In fact, the R-squared statistic of a simple linear regression model for two series of returns is equal to the square of the correlation coefficient.

However, for many pairs of asset classes, a linear model misses the most important features of the relationship. For example, during normal times, non-U.S. equities are considered to be good diversifiers for U.S. equity investors. But during global crises, all major equity markets move down together.

Furthermore, suppose that the returns on two asset class indices were highly correlated, but instead of including direct exposures to both in the model, one was replaced with an option on itself. Instead of having a linear relationship, we now have a nonlinear relationship which cannot be captured by a correlation coefficient. Fortunately, these sorts of nonlinear relationships between returns on different investments can be handled in a scenario-based model. For example, in scenarios that represent normal times, returns on different equity markets could be modeled as moving somewhat apart from each other, while scenarios that represent global crises could model the markets as moving downward together.

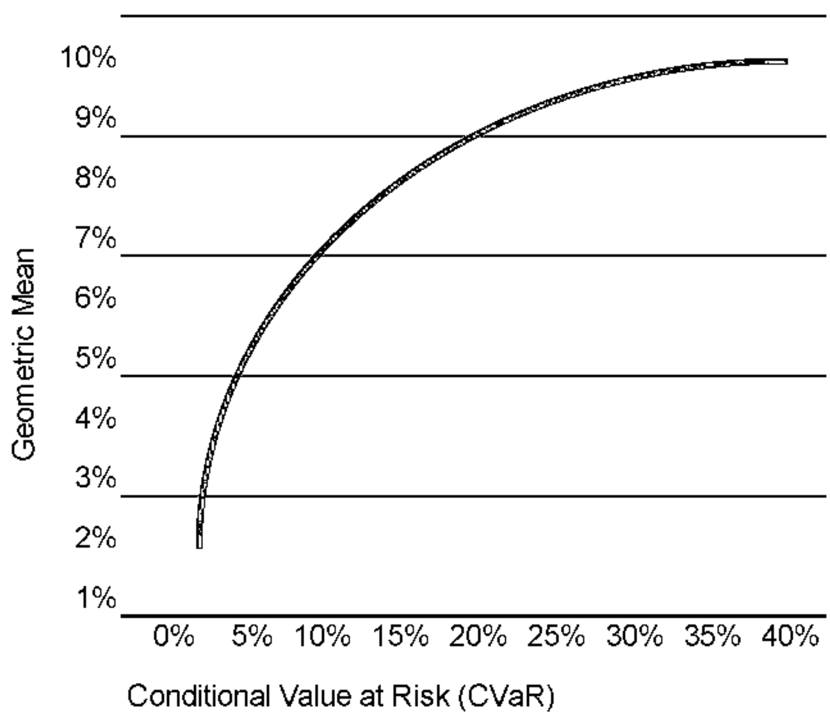
Probability Management Enables Scenario Analysis

Because it may take thousands of scenarios to adequately model return distributions, until recently, a disadvantage of the scenario-based approach has been that it requires large amounts of data to be stored and processed. Even with the advances in computer hardware, the conventional approach of representing scenarios with large tables of explicit numbers remained problematic. The phenomenal speed of computers has given rise to the field of probability management, an extension of data management to probability distributions, rather than numbers. The key component of probability management is the Distribution String, or DIST, that can encapsulate thousands of trials as a single data element. The use of DISTs greatly saves on storage and speeds up processing time so that a Monte Carlo simulation consisting of thousands of trials can be performed on a personal computer in an instant. Monte Carlo simulations that use DISTs are also very adaptable, allowing for almost any return distribution or underlying probability model rather than being contained by parameters. While not all asset management organizations are prepared to create the DISTs needed to drive geometric mean-CVaR optimization, some outside vendors, such as Ibbotson Associates/Morningstar, can fulfill this role. Another facet of probability management is interactive simulation technology, which can run thousands of scenarios through a model before the sound of your finger leaving the <Enter> key reaches your ear. These supersonic models allow much deeper intuition into the sensitivities of portfolios and encourage the user to interactively explore different portfolios, distributional assumptions, and potential black swans. For more information visit: http://www.ProbabilityManagement.org.

Finale: The New Efficient Frontier

Putting it all together, we form an efficient frontier of forecasted geometric mean and conditional value at risk as shown in Exhibit 10.6,[194] incorporating our scenario approach to covariance and new statistical technology. We believe that this efficient frontier is more relevant to investors than the traditional expected return versus standard deviation frontier of MVO because it shows the trade-off between reward and risk that is meaningful to investors, namely, long-term potential growth versus short-term potential loss.

Exhibit 10.6: Geometric Mean – Conditional Value at Risk Efficient Frontier (%)



Approaches to Calculating the Equity Risk Premium

Researchers have estimated the expected outperformance of stocks over risk-free bonds – the equity risk premium – using many approaches. Such studies can be categorized into four groups based on the approaches they have taken, using:

- Historical returns between stocks and bonds
- Fundamental information such as earnings, dividends, or overall productivity (supply-side models)

[194] Other researchers have also proposed using GM and CVaR as the measures or reward and risk in an efficient frontier. See, for example: Sheikh, A.Z. & Qiao, H. 2009. "Non-Normality of Market Returns: A Framework for Asset Allocation Decision Making". Whitepaper, J.P. Morgan Asset Management.

- Payoffs demanded by equity investors for bearing the additional risk (demand-side models)

- Broad surveys of opinions of financial professionals.

The rest of this chapter will focus on the historical and supply-side methods.

The Historical Equity Risk Premium

The expected equity risk premium (ERP) can be defined as the additional return an investor expects to receive to compensate for the additional risk associated with investing in equities as opposed to investing in riskless assets.

Unfortunately, the expected equity risk premium is unobservable in the market and therefore must be estimated. Typically, this estimation is arrived at using historical data. The historical equity risk premium can be calculated by subtracting the long-term average of the income return on the riskless asset (Treasuries) from the long-term average stock market return (measured over the same period as that of the riskless asset).

In using a historical measure of the equity risk premium, one assumes what has happened in the past is representative of what might be expected in the future. In other words, the assumption one makes when using historical data to measure the expected equity risk premium is the relationship between the returns of the risky asset (equities) and the riskless asset (Treasuries) is stable.

The Stock Market Benchmark

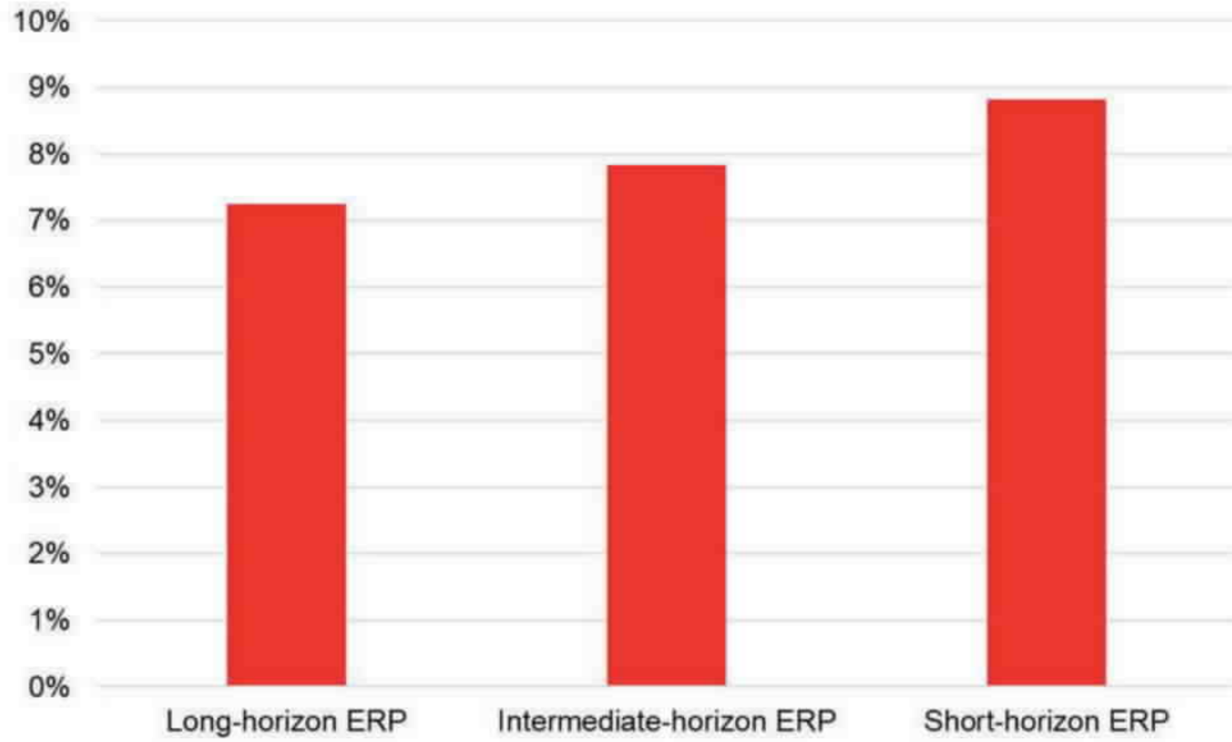
The stock market benchmark chosen should be a broad index that reflects the behavior of the market as a whole. Commonly used indexes include the S&P 500 and the Russell 3000. Although the Dow Jones Industrial Average is a popular index, it would be inappropriate for calculating the equity risk premium because it is too narrow.

We use the total return of our large-cap stock index (currently represented by the S&P 500) as our market benchmark when calculating the equity risk premium.[195] The S&P 500 was selected as the appropriate market benchmark because it is representative of a large sample of companies across a large number of industries. The S&P 500 is also one of the most widely accepted market benchmarks and is a good measure of the equity market as a whole.

Exhibit 10.7 illustrates the equity risk premium calculated using the S&P 500 and the income return on three government bonds of *different* horizons.

[195] The SBBI Large-cap Stocks total return series is essentially the S&P 500 Index.

Exhibit 10.7: Equity Risk Premia Calculated Using the S&P 500 and the Income Return on Three Government Bonds of Different Horizons (%) 1926–2020



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Long-Term (i.e. 20-year) Government Bonds income return series: IA SBBI® US LT Govt IR USD, (v) Intermediate-term (i.e., 5-year) Government Bonds income return series: IA SBBI® US IT Govt IR USD, (vi) U.S. (30-day) Treasury Bills: IA SBBI® US 30 Day TBill TR USD (for U.S. Treasury Bills, the income return and total return are the same). For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

Note that the long-horizon ERP is *lower* than the intermediate-horizon ERP, which in turn is *lower* than the short-horizon ERP. This is because the equity risk premium is calculated by subtracting the arithmetic mean of the government bond *income* return from the arithmetic mean of the stock market total return. When calculating the ERPs in these examples:

- The average income return of a *long*-term (20-year) government bond is used when calculating the *long*-horizon ERP. The average annual income return of 20-year government bonds will be *greater* than the average income return of a 5-year government bond.

- The average income return of an *intermediate*-term (5-year) government bond is used when calculating the *intermediate*-horizon ERP. The average annual income return of 5-year government bonds will be *greater* than the average income return of a 30-day Treasury bill.

- The average income return of a *30-day* Treasury bill is used when calculating the *short-*horizon ERP.

Because the ERPs in these examples are calculated as:

ERP = (Avg. Annual Total Return of the S&P 500) – (Avg. Annual Income Return of Risk-Free Security)

It follows that the ERP would *increase* as the value subtracted from the average annual total return of the stock market benchmark *decreases*.

The Market Benchmark and Firm Size

Although not restricted to the 500 largest companies, the S&P 500 is considered a large-cap index. The returns of the S&P 500 are market cap-weighted. The larger companies in the index therefore receive the majority of the weight. If using a large-cap index to calculate the equity risk premium, an adjustment is usually needed to account for the different risk and return characteristics of small stocks, as discussed in Chapter 7.

The Risk-Free Asset

The equity risk premium can be calculated for a variety of time horizons when given the choice of risk-free asset to be used in the calculation. The long-horizon, intermediate-horizon, and short-horizon equity risk premia calculated in Exhibit 10.7 use the income return from (i) a 20-year Treasury bond, (ii) a 5-year Treasury bond, and (iii) a 30 day Treasury bill, respectively.[196]

20-Year vs. 30-Year Treasuries

The U.S. Treasury periodically changes the maturities it issues. For example, in April 1986 the U.S. Treasury stopped issuing 20-year Treasuries, and from October 2001 through January 2006 the U.S. Treasury did not issue 30-year bonds (it resumed issuing 30-year Treasury bonds in February 2006), making the 10-year bond the longest-term Treasury security issued over the October 2001 January 2006 period. Most recently, on January 16, 2020 the U.S. Department of the Treasury announced it plans to issue a 20-year nominal coupon bond in the first half of calendar year 2020, the first time a 20-year maturity will be offered since March 1986.[197,198]

Our methodology for estimating the long-horizon equity risk premium makes use of the income return on a 20-year Treasury bond. While a 30-year bond is theoretically more correct when

[196] For U.S. Treasury Bills, the income return and total return are the same.

[197] To learn more, visit the U.S. Department of the Treasury website at: https://home.treasury.gov/news/press-releases/sm878.

[198] See Kate Davidson, "Treasury to Issue New 20-Year Bond in First Half of 2020", *The Wall Street Journal*, January 16, 2020 at: https://www.wsj.com/articles/treasury-to-issue-new-20-year-bond-in-first-half-of-2020-11579217450

dealing with the long-term nature of business valuation,[199] 30-year Treasury securities have an issuance history that is on-again-off-again. Ibbotson Associates creates a series of returns using bonds on the market with approximately 20 years to maturity because Treasury bonds of this maturity are available over a long history, while Treasury bonds of 30-years are not.

Income Return Another point to keep in mind when calculating the equity risk premium is the income return on the appropriate-horizon Treasury security, rather than the total return, is used in the calculation.

The total return comprises three return components: the income return, the capital appreciation return, and the reinvestment return. The income return is defined as the portion of the total return that results from a periodic cash flow or, in this case, the bond coupon payment. The capital appreciation return results from the price change of a bond over a specific period. Bond prices generally change in reaction to unexpected fluctuations in yields. Reinvestment return is the return on a given month's investment income when reinvested into the same asset class in the subsequent months of the year. The income return is thus used in the estimation of the equity risk premium because it represents the truly riskless portion of the return.

Arithmetic vs. Geometric Mean

The equity risk premium data presented in this book are arithmetic average risk premiums as opposed to geometric average risk premiums. The arithmetic average equity risk premium can be demonstrated to be most appropriate when discounting future cash flows. For use as the expected equity risk premium in either the CAPM or the building-block approach, the arithmetic mean or the simple difference of the arithmetic means of stock market returns and riskless rates is the relevant number.

This is because both the CAPM and the building-block approach are additive models, in which the cost of capital is the sum of its parts. The geometric average is more appropriate for reporting past performance because it represents the compound average return.

Appropriate Historical Period

The equity risk premium can be estimated using any historical time period. For the U.S., market data exist at least as far back as the late 1800s. Therefore, it is possible to estimate the equity risk premium using data that covers roughly the past 125 years.

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[199] An equity risk premium is an input in developing cost of capital estimates (i.e., "expected return", "required return", or "discount rate") for use in a discounted cash flow model. **Note**: The D&P/Kroll "Cost of Capital Navigator" guides financial professionals through the process of estimating the cost of capital, a key component of any valuation analysis. The Cost of Capital Navigator can be used to estimate country-level cost of equity capital globally, for approximately 180 countries, from the perspective of investors based in any one of up to 56 countries. For more information, visit dpcostofcapital.com.

Our equity risk premium covers 1926 to the present. The original data source for the time series comprising the equity risk premium is the Center for Research in Security Prices (CRSP).[200] CRSP chose to begin its analysis of market returns with 1926 for two main reasons. CRSP determined that 1926 was approximately when quality financial data became available. They also made a conscious effort to include the period of extreme market volatility from the late 1920s and early 1930s; 1926 was chosen because it includes one full business cycle of data before the market crash of 1929.

Implicit in using history to forecast the future is the assumption that investors' expectations for future outcomes conform to past results. This method assumes that the price of taking on risk changes only slowly, if at all, over time. This "future equals the past" assumption is most applicable to a random time-series variable. A time-series variable is random if its value in one period is independent of its value in other periods.

Choosing an Appropriate Historical Period

The estimate of the equity risk premium depends on the length of the data series studied. A proper estimate of the equity risk premium requires a data series long enough to give a reliable average without being unduly influenced by very good and very poor short-term returns. When calculated using a long data series, the historical equity risk premium is relatively stable. Furthermore, because an average of the realized equity risk premium is quite volatile when calculated using a short history, using a long series makes it less likely that the analyst can justify any number he or she wants. The magnitude of how shorter periods can affect the result will be explored later in this chapter.

Some analysts estimate the expected equity risk premium using a shorter, more recent period on the basis that recent events are more likely to be repeated in the near future; furthermore, they believe that the 1920s, 1930s, and 1940s contain too many unusual events. This view is suspect because all periods contain unusual events. Some of the most unusual events of the last 100 years took place quite recently, including the inflation of the late 1970s and early 1980s, the October 1987 stock market crash, the collapse of the high-yield bond market, the major contraction and consolidation of the thrift industry, the collapse of the Soviet Union, the development of the European Economic Community, the attacks of Sept. 11, 2001, the global financial crisis of 2008– 2009, and most recently, the market crash in the first quarter of 2020 that was precipitated by the spread of the COVID-19 virus.

It is even more difficult for economists to predict the economic environment of the future. For example, if one were analyzing the stock market in 1987 before the crash, it would be statistically improbable to predict the impending short-term volatility without considering the stock market crash and market volatility of the 1929-1931 period.

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Without an appreciation of the 1920s and 1930s, no one would believe that such events could happen. The 95-year period starting with 1926 represents what can happen: It includes high and low returns, volatile and quiet markets, war and peace, inflation and deflation, and prosperity and depression. Restricting attention to a shorter historical period underestimates the amount of change that could occur in a long future period. Finally, because historical event-types (not specific events) tend to repeat themselves, long-run capital market return studies can reveal a great deal about the future. Investors probably expect unusual events to occur from time to time, and their return expectations reflect this.

A Look at the Historical Results

It is interesting to look at the realized returns and realized equity risk premium in the context of the above discussion, since a longer historical period provides a more stable estimate of the equity risk premium. The reason is that any unique period will not be weighted heavily in an average covering a longer historical period. It better represents the probability of these unique events occurring over a long period of time.

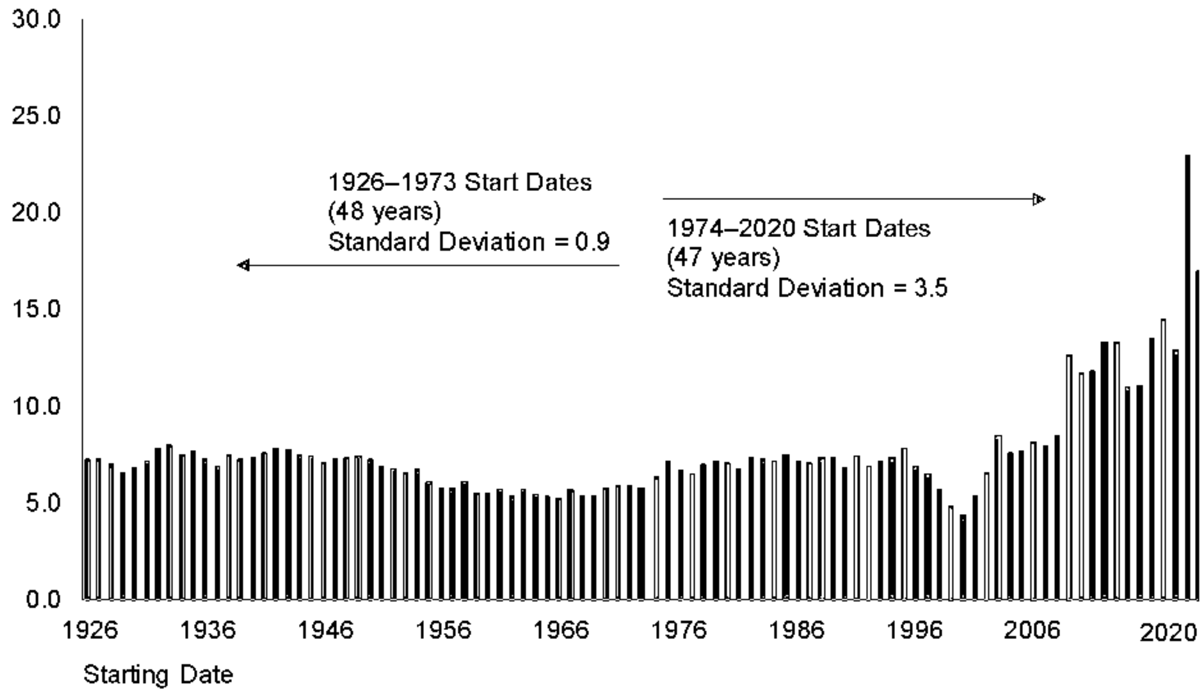
Exhibit 10.8 helps to clarify this point. Exhibit 10.8 shows the realized equity risk premium for a series of periods through 2020, starting with 1926. In other words, the first value on the graph represents the average realized equity risk premium over the period 1926–2020. The next value on the graph represents the average realized equity risk premium over the period 1927–2020, and so on, with the rightmost value representing the average for a single year, 2020.

Concentrating on the left side of Exhibit 10.8, one notices that the realized equity risk premium when measured over *longer* periods is relatively stable and has a standard deviation of 0.9.

Alternatively, the realized equity premia on the right side of Exhibit 10.8 are measured over *shorter* periods are less stable and have a standard deviation of 3.5.[201]

[201] If the unusually large realized equity risk premia measured over the years 2019–2020 (23.0) and the single year 2020 (17.0) are excluded (the rightmost two bars in Exhibit 10.8), the standard deviation of the realized equity risk premia measured with starting dates 1973–2018 drops to 2.5. This is still more than twice the standard deviation of the realized equity risk premia measured with starting dates 1926–1972 (the left side of Exhibit 10.8) of 0.9.

Exhibit 10.8: Average Long-Horizon Equity Risk Premium Calculated Using Variable Start Dates (1926–2020), and Fixed End Date (2020) (%)



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, and (ii) Long-Term (i.e. 20-year) Government Bonds income return series: IA SBBI® US LT Govt IR USD. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

Some practitioners argue for a shorter historical period, such as 30 years, as a basis for the equity risk premium estimation. The logic for the use of a shorter period is that historical events and economic scenarios present before this time are unlikely to be repeated. However, the impact of adding one additional year of data to a historical average is *lessened* the *greater* the initial period of measurement. As is demonstrated in Exhibit 10.8, shorter-term averages can be affected considerably by one or more unique observations, while longer term averages tend to produce more stable results.

A dramatic example of this is the second rightmost point in Exhibit 10.8, which is the "average" ERP as measured over a single year (2019). In 2019 large-cap stocks (represented by the S&P 500) produced a total return of over 31.49% and the income return of long-term government bonds was 2.55%, implying an "average" ERP of 28.94% (31.49% - 2.55%). Using an estimate of the ERP developed over such a short time horizon is logical only to the extent that one believes that stocks will outperform the risk-free instrument by nearly 29% per year, in perpetuity.

Having said that, the effect of "adding one additional year" when using historical data to estimate the ERP can still lead to counterintuitive conclusions, even when the average is taken over *longer* periods. A very recent example of a result that was "counterintuitive" occurred in the December 2008–2009 Financial Crisis. The historical ERP at the end of 2007 (as calculated over the time period 1926–2007) was over 7%. A year later at the end of 2008, at the height of the financial crisis and risks were likely at an all-time *high*, the historical ERP (as calculated over the time period 1926– 2008) *declined* to less than 7%, implying that risks were actually *lower* than they were a year earlier.

What happened? In 2008 the S&P 500 declined nearly 37%, an unusually large decline for a single year. This single period's unusually large decline caused the average annual return of the S&P 500 to fall from *over* 12% (as calculated over the 1926–2007 time period) to *less* than 12% (as calculated over the 1926–2008 time period). The historical ERP is calculated as the average annual equity return minus the average annual risk-free rate, so a decline in the average equity return causes a 1 for 1 decline in the ERP, all other things held the same. Such large moves in a single year can produce a "tail wagging the dog" effect.

The Supply-Side Equity Risk Premium

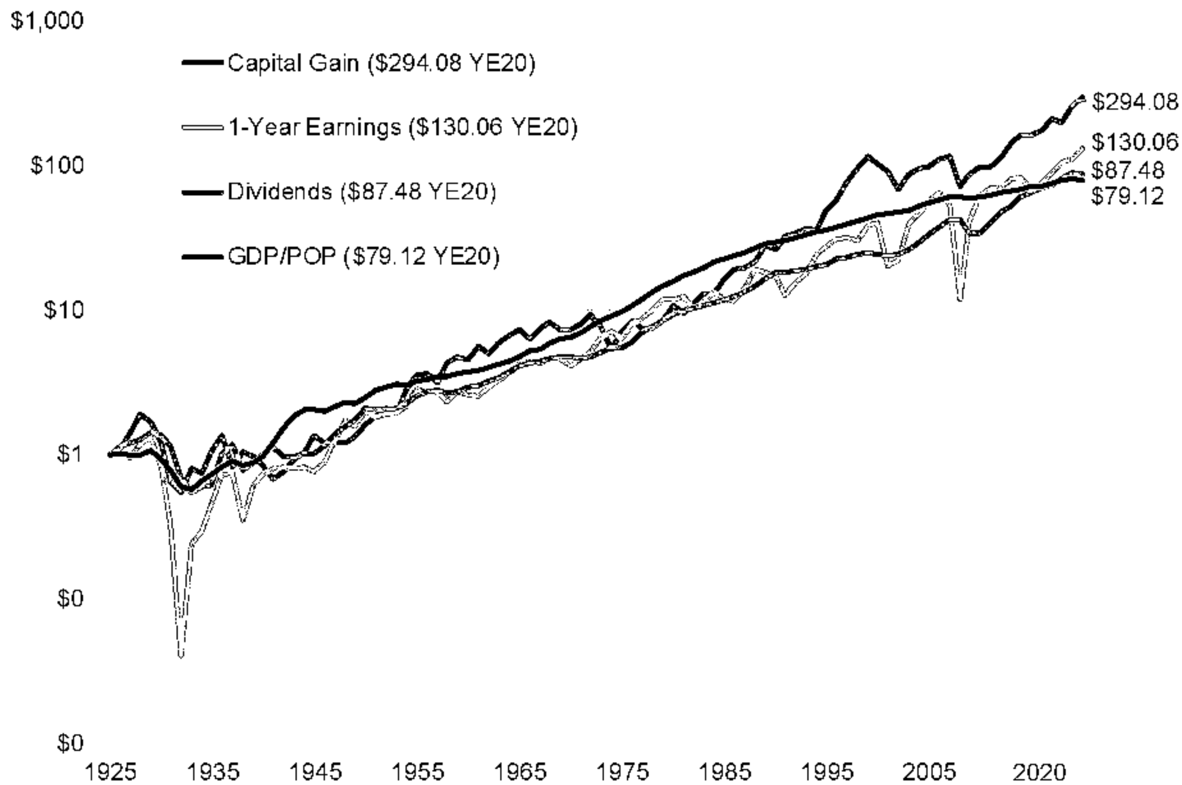
This section is based on the work by Roger G. Ibbotson and Peng Chen, who combined the first and second approaches to arrive at their forecast of the equity risk premium.[202] By proposing a new supply-side methodology, the Ibbotson-Chen study challenges current arguments that future returns on stocks over bonds will be negative or close to zero. The results affirm the relationship between the stock market and the overall economy.

Long-term expected equity returns can be forecasted by the use of supply-side models. The supply of stock market returns is generated by the productivity of the corporations in the real economy. Investors should not expect a much higher or lower return than that produced by the companies in the real economy. Thus, over the long run, equity returns should be close to the long-run supply estimate.

Earnings, dividends, and capital gains are supplied by corporate productivity. Exhibit 10.9 illustrates that earnings and dividends have historically grown in tandem with the overall economy (GDP per capita). However, GDP per capita did not outpace the stock market. This is primarily because the 3-year average P/E ratio increased 2.7 times during the same period. So, assuming the economy will continue to grow, all three should continue to grow as well.

[202] Ibbotson, R.G., & Chen, P. 2003. "Long-Run Stock Returns: Participating in the Real Economy". *Financial Analysts Journal*, Vol. 59, No. 1, P. 88.

Exhibit 10.9: Capital Gains, GDP Per Capita, Earnings, and Dividends Index (Year-end 1925 = $1.00) 1926–2020

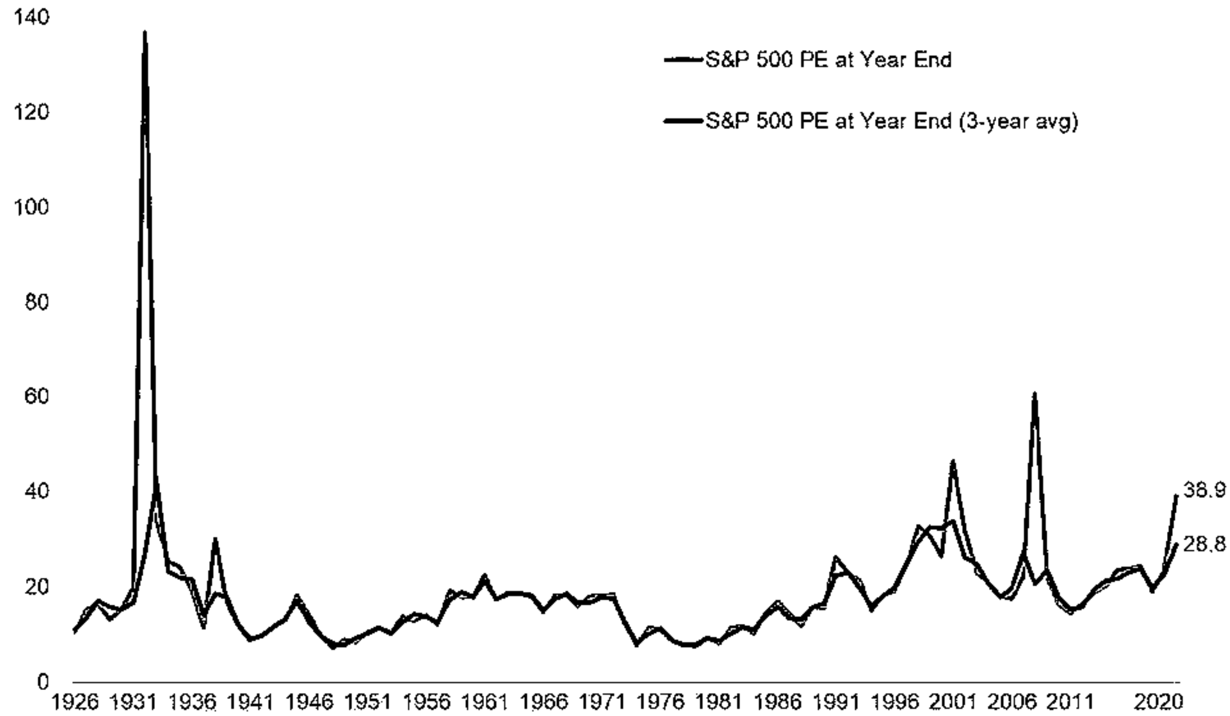


Forward-Looking Earnings Model

Ibbotson and Chen forecast the equity risk premium through a supply-side model using historical data. They used an earnings model as the basis for their supply-side estimate. The earnings model breaks the historical equity return into four pieces, with only three historically being supplied by companies: inflation, income return, and growth in real earnings per share. The growth in the P/E ratio, the fourth piece, reflects investors' changing prediction of future earnings growth. The past supply of corporate growth is forecasted to continue; however, a change in investors' predictions is not. P/E rose dramatically from 1980 through 2001 because people believed that corporate earnings were going to grow faster in the future. This growth in P/E drove a small portion of the rise in equity returns over the same period.

Exhibit 10.10 illustrates the price-to-earnings ratio from 1926 to 2020. The P/E ratio, using one-year average earnings, was 10.23 at the beginning of 1926 and ended the year 2020 at estimated 38.94, an average increase of 1.40% per year. The highest P/E was 136.69 recorded in 1932, while the lowest was 7.08 recorded in 1948. Ibbotson Associates revised the calculation of the P/E ratio from a one-year to three-year average earnings for use in equity forecasting.

Exhibit 10.10: Large-cap Stocks P/E Ratio 1926–2020



This is because reported earnings are affected not only by the long-term productivity, but also by one-time items that do not necessarily have the same consistent impact year after year. The three-year average is more reflective of the long-term trend than the year-by-year numbers. The P/E ratio calculated using the three-year average of earnings had an increase of 0.96% per year.

The historical P/E growth factor, using three-year earnings, of 0.96% per year is subtracted from the equity forecast because it is not believed that P/E will continue to increase in the future. The market serves as the cue. The current P/E ratio is the market's best guess for the future of corporate earnings and there is no reason to believe, at this time, that the market will change its mind. Using this top-down approach, the geometric supply-side equity risk premium is slightly more than 4% which equates to an arithmetic supply-side equity risk premium of approximately 6%.

Another approach in calculating the premium would be to add up the components that constitute the supply of equity return, excluding the P/E component. Thus, the supply of equity return only includes inflation, the growth in real earnings per share, and income return:

$$SR = \left[(1+CPI)\times(1+g_{REPS})+Inc+Rinv\right]$$

Where:

SR = The supply of the equity return

CPI = Consumer Price Index (inflation)

g_{REPS} = The growth in real earning per share

Inc = The income return

$Rinv$ = The reinvestment return

The equity risk premium, based on the supply-side earnings model, is calculated on a geometric basis as follows:

$$SERP = \frac{(1+SR)}{(1+CPI)\times(1+RRf)} - 1$$

Where:

$SERP$ = The supply-side equity risk premium

SR = The supply of the equity return

CPI = Consumer Price Index (inflation)

RRf = The real risk-free rate

The geometric estimate can be converted into an arithmetic estimate as follows:[203]

[203] The 1926–present supply-side equity risk premia estimate is calculated by D&P/Kroll for the full-version *2021 SBBI® Yearbook* using (i) the same methodologies and (ii) the same data sources as were used in previous editions of this book, based upon the work by Roger G. Ibbotson and Peng Chen; see: Ibbotson, R.G., & Chen, P. 2003. "Long-Run Stock Returns: Participating in the Real Economy". *Financial Analysts Journal*, Vol. 59, No. 1, P. 88. An update of this work has been published that considers stock buybacks in addition to dividends; see: Philip U. Straehl and Roger G. Ibbotson, "The Long-Run Drivers of Stock Returns: Total Payouts and the Real Economy", *Financial Analysts Journal*, Third Quarter 2017, Volume 73 Number 3. The *Financial Analysts Journal* is a publication of CFA Institute. For more information, visit www.cfainstitute.org.

$$R_A = R_G + \frac{\sigma^2}{2}$$

Where:

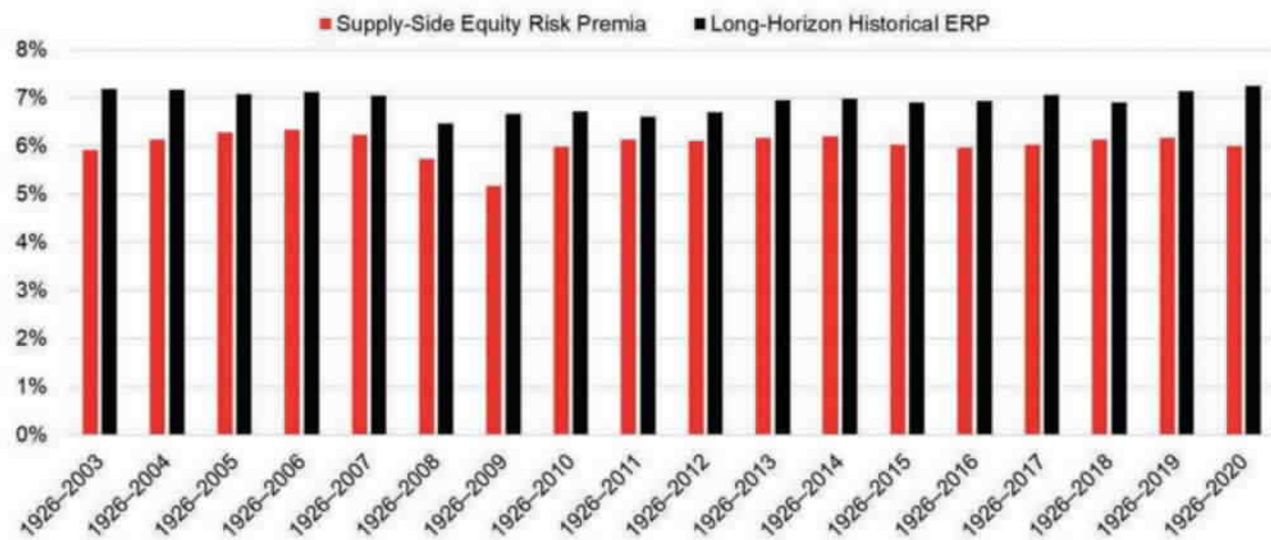
R_A = The arithmetic average

R_G = The geometric average

σ = The standard deviation of equity returns

Exhibit 10.11 presents an illustration of the supply-side equity risk premium, on an arithmetic basis, beginning in 1926 and ending in each of the years from 2003 through 2020.[204]

Exhibit 10.11: Supply-Side Equity Risk Premia and Long-Horizon Historical Equity Risk Premia over Time.



Source of underlying data: Morningstar, Inc. and S&P Global Market Intelligence. All rights reserved. Used with permission. Calculations by D&P/Kroll.

In every year since 2003 the supply-side ERP has been less than the long-term historical ERP. The difference has varied between approximately 0.5% and 1.5% over the course of the 18 observations in Exhibit 10.11.

204 As published in (i) the *2004–2013 SBBI® Valuation Yearbooks*, (ii) the 2014–2017 *Valuation Handbook – U.S. Guide to Cost of Capital*, and (iii) the Cost of Capital Navigator at dpcostofcapital.com beginning in 2018.

Long-Term Market Predictions

As of December 31, 2020, the supply-side model estimates that stocks will continue to provide significant returns over the long run, averaging more than 9% per year, assuming historical inflation rates. The equity risk premium, based on the top-down supply-side earnings model, is calculated to be just over 4% on a geometric basis and approximately 6% on an arithmetic basis.

Ibbotson and Chen predict future increased earnings growth that will offset lower dividend yields. The fact that earnings will grow as dividend payouts shrink is in line with the Modigliani-Miller theorem which here refers to the irrelevance over whether a firm pays a dividend or reinvests its returns.

The forecasts for the market are in line with both the historical supply measures of public corporations (i.e., earnings) and overall economic productivity (GDP per capita).

Stock Buybacks and Return

Note: This section is updated through December 2018.

In recent decades a new source of stock market supply has emerged as companies increasingly use share buybacks instead of dividends to return cash to shareholders. The impact of buybacks on stock returns has been largely ignored in practice because many practitioners continue to rely on traditional supply models that use dividends as the sole source of corporate payout.

In a 2017 article, Philip U. Straehl and Roger G. Ibbotson developed three total payout models of stock returns showing that US stock returns between 1871 and 2014 can be attributed almost entirely to the supply of both dividends and buybacks.[205,206,207]

Although Straehl and Ibbotson introduced buybacks into the supply-side model, they did not dispute that there are many supply-side approaches that can be taken. Rather they updated and back dated the Ibbotson and Chen 2003[208] paper to cover the period 1871-2014, decomposing historical returns by six different methods each containing an inflation component:

1. Building Blocks: risk-free rate and equity risk premium

2. Capital Gains and Income

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206 Philip U. Straehl and Roger G. Ibbotson, "The Long-Run Drivers of Stock Returns: Total Payouts and the Real Economy", *Financial Analysts Journal* (a publication of CFA Institute), Third Quarter 2017, pages 32–52.

207 This section is a summary of Philip U. Straehl and Roger G. Ibbotson, "The Long-Run Drivers of Stock Returns: Total Payouts and the Real Economy", *Financial Analysts Journal* (a publication of CFA Institute), Third Quarter 2017, pages 32–52. The original article was through 2014; Straehl and Ibbotson updated the commentary herein through 2018.

208 Ibbotson, Roger G., and Peng Chen. 2003, "Long-Run Stock Returns: Participating in the Real Economy." *Financial Analysts Journal*, vol. 59, no. 1 (January/February).

3. Earnings growth, PE ratio, rate of change, and income
4. Dividends growth, payout ratio rate of change, PE ratio rate of change, and income
5. Book Equity growth, growth in ROE, PE ratio rate of change, and income
6. GDP per capita growth, increase in equity factor share of economy

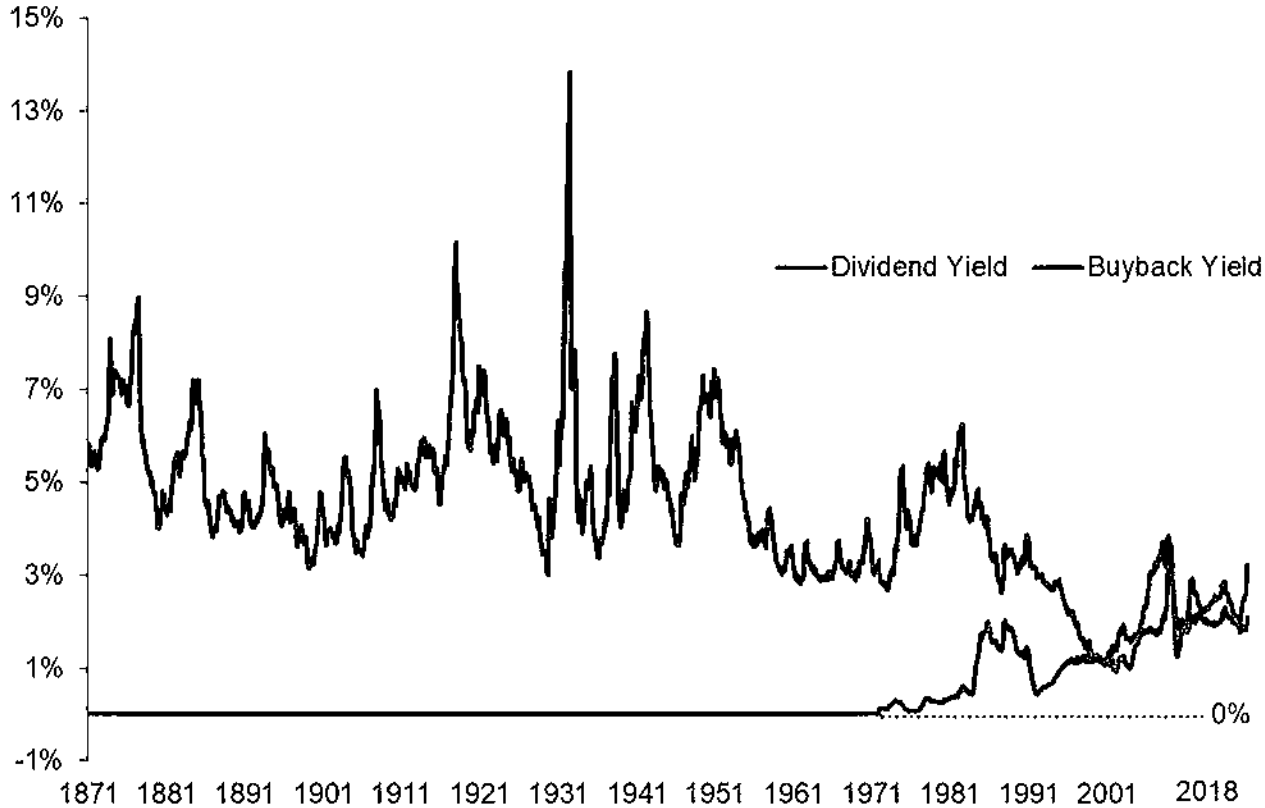
Straehl and Ibbotson focus in particular on method #4, which concentrates on dividend growth, and method #6 which links the stock market to the overall economy. But they make a major departure from Ibbotson and Chen because they include not only dividends but buybacks into the analysis.

The Rise of Buybacks

A primary objective of Straehl and Ibbotson's study was to shed light on the impact of buybacks on the return generation process. They started by documenting the rise of buybacks as a form of corporate payout relative to dividends.

In 1982, SEC Rate 106-18 provided a safe harbor for firms to conduct share buybacks without the suspicion of share price manipulation. Here we update Exhibit 10.12 from Straehl and Ibbotson to include data through 2018. As can be seen in Exhibit 10.12, there is a major increase in buyback activity starting in the early 1980s. Prior to 1970, buyback activity was so low that it was not included in the study.

Exhibit 10.12: Dividend Yield and Buyback Yield, 1871– 2018



In recent decades, companies increasingly prefer to make payouts in the form of buybacks instead of dividend payments. There are several reasons for this. Most important, the amount of buybacks is completely flexible. A company can aggressively buyback one year and skip the next year without major signaling effects, unlike dividend policy. Also, if a company does not have a good use for its cash, buybacks can increase earnings per share by decreasing the number of shares outstanding. Furthermore, companies can buyback shares when they believe the price is attractive, both potentially boosting the price and benefitting the holding shareholders. Finally, through much of history, the tax treatment of buybacks was more favorable than it was for dividend payouts.

Dividend payout models are typically wrongly applied in the era of buybacks. They often estimate the future returns to be the sum of the current dividend yield plus historical dividend growth. This is wrong for two reasons: the current yield is artificially too low since it only includes one source of income, and the historical growth rate is too low because it ignores the shift in payouts away from dividends.

Thus, the advent of buybacks has created a need for models that can explicitly take into account buybacks. Although buybacks are similar to dividends in that they are a way of paying out cash, buybacks have a different impact on the return generating process than dividends do. For example, the buy and hold investor receives dividends in the form of income, while investors receive buybacks as a price increase because the buy and hold investor's share of the company is increased. Prior studies, including Ibbotson and Chen's 2003 paper, disregarded the fact that return components are sensitive to a company's payout method (i.e., dividends versus buybacks).

Three Total Payout Models of Stock Returns

Miller and Modigliani[209] proved that in a perfect capital market the total return of stocks should be independent of the payout method. The Dividend Per Share Model as typically applied is not independent since higher buybacks make for less historical growth and lower current dividend yields. This is not to say the dividend model is incorrect because it is the future growth that becomes higher as the number of shares diminishes. However, by taking the buybacks explicitly into account, past payout growth can once again be an indicator of future growth, and current yields can reflect the full payouts.

Straehl and Ibbotson present three payout models, all of which include inflation:

1. The Dividend Per Share Model, where the investor gets a dividend yield plus a growth in total payouts, plus the change in payout per share, plus the change in price to total payout. Here, the buy and hold investor gets higher future growth to offset the lower dividend yield.

2. Dividend and Cash Buyback Model, where the investor gets the total yield (dividend plus buyback), plus growth in payout per share adjusted for share decrease, plus change in price to total payout. Here, the buy and hold investor gets the full payouts.

3. Dividend Less Net Issuance Model, where the investor gets the net total yield (dividend plus buyback but diluted by issuance), plus aggregate payout growth, plus rate of change in total payout. Here, the investor gets diluted by issuance but increased ownership by the buybacks.

In all three cases, the historical return is the sum of the components are all equal no matter which of the three methods are used. In the Straehl and Ibbotson historical samples, the total return from 1871-2018 was 9.02%, the total return from 1901-2018 was 9.58%, and the total return from 1970-2018 was 10.20%.

In all three supply-side models the realized return was the same, and most of the real return came from the payouts and the payout growth. However, the nature of the payouts explains what portion of the return comes from the payouts versus the payout growth.

[209] Miller, Merton H., and Franco Modigliani 1961, "Dividend Policy, Growth, and the Valuation of Shares" Journal of Business, Vol.34, no.4 (October): 411-433.

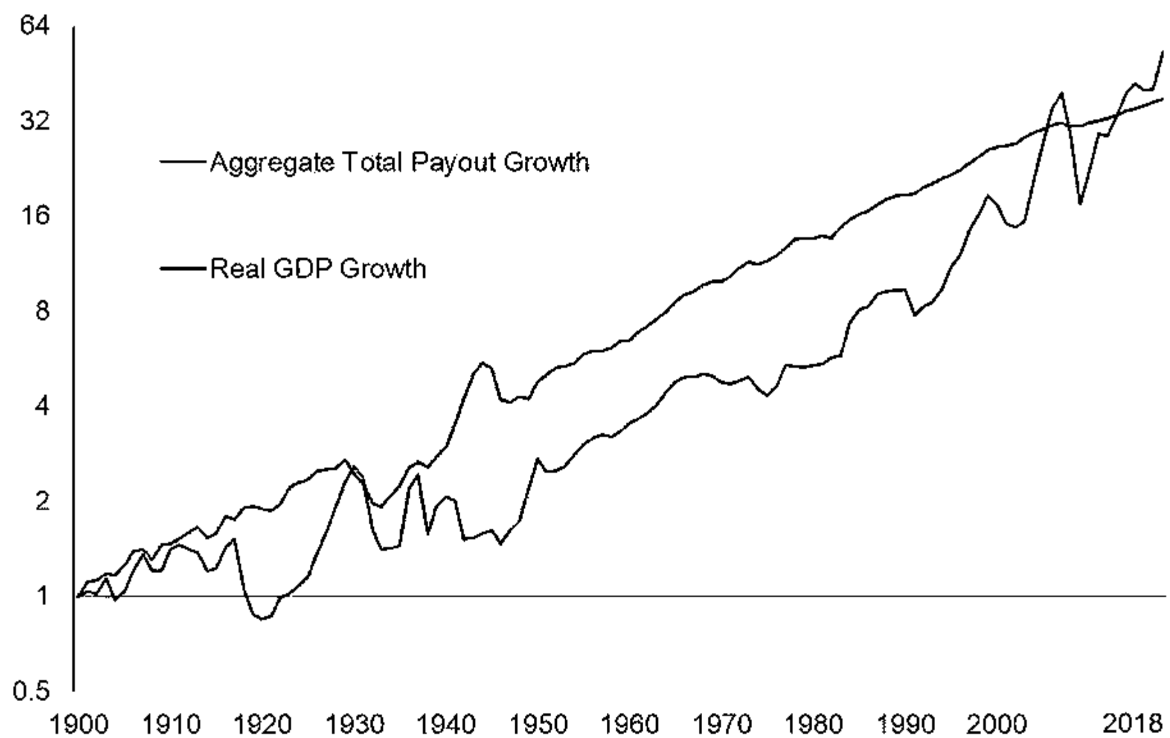
Total Payouts and the Real Economy

The stock market should link to the real economy over the long run. More generally, Diermeier, Ibbotson, and Siegel (1984)[210] measured the full scope of financial assets and stressed the importance of capital markets being "macro consistent" with the real economy. In the long run, financial assets cannot continually outgrow the real economy, or financial assets would eventually become the whole economy. On the other hand, financial assets cannot continually underperform, or they would become a smaller and smaller part of the economy. For example, Ibbotson and Chen (2003) showed that earning per share growth for the U.S. stocks were comparable to U.S. GDP per capita growth.

In attempting to link the U.S. stock market to the U.S. real economy, Straehl and Ibbotson focus on growth rates rather than the payouts themselves. In particular, the long-term growth rate of aggregate stock payouts should link to the aggregate GOP growth, and the long-term growth rate of per share payout growth rates should link to the GDP per capital growth rate.

Exhibit 10.13 is an updated chart from Straehl and Ibbotson. It shows that the growth in aggregate stock market (as measured by the S&P Composite Index) roughly matches the aggregate real GDP growth. This link up is better than dividend growth by itself, which would have underestimated payout growth.

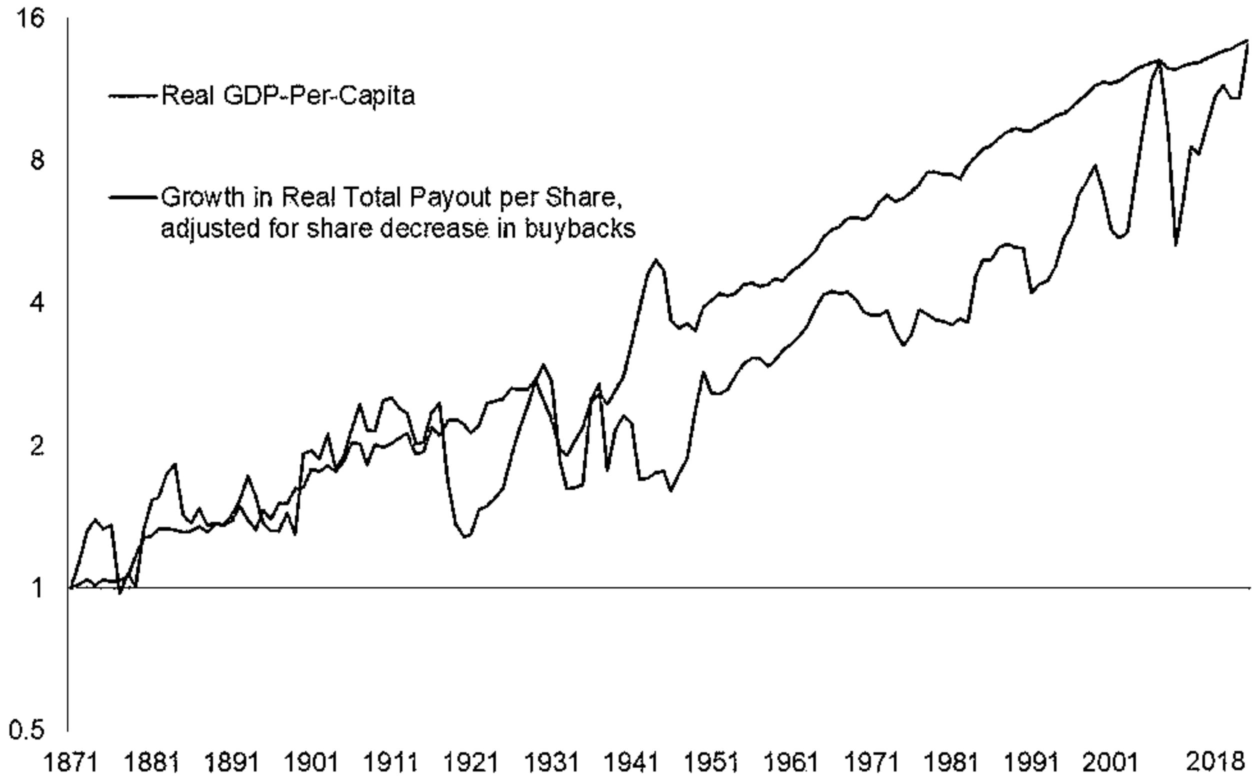
Exhibit 10.13: Growth in Aggregate Total Payout vs. GDP Growth 1901–2018



210 Diermeier, Ibbotson, and Siegel, 1984 "The Supply of Capital Market Returns" Financial Analysts Journal, Vol.40 no.2 (March/April).

Exhibit 10.14 similarly shows real GDP per capital growth is linked to real total payout per share growth. In this case the data goes all the way back to 1871, and again is an updated version of an exhibit in the Straehl and Ibbotson article.

Exhibit 10.14: Growth in Total Payout per Share vs. Growth in GDP per Capita 1872–2018



Overall, these results indicate that total payout growth in the stock market is roughly equal to GDP growth over the long run. Of course, this is not necessarily true over shorter intervals, but still total payouts are a useful tool in explaining long run stock returns and their interaction with the overall economy. We now look specifically at forecasting the stock market with supply-side models.

Forecasting Equity Returns

This chapter of the Yearbook is concerned with using historical data to forecast returns which can potentially be used for long-term planning and optimizing portfolios. The long-term historical data that Straehl and Ibbotson provide can be useful in forecasting.

The payout expected real return models presented here have two components: Payout Yield and Real Payout Growth. It is also necessary to add a small interaction term to match up with the historical rates.

Taking the full historical 1871-2018 period that Straehl and Ibbotson studied, we can compare the annual dividend yield growth (1.59%) to the total payout growth (1.79%). We can also compare a recent current dividend yield (1.83%) to a recent payout yield (4.21%). Adding the historical interaction term to both series (0.25% and 0.23% respectively) gives us the two forecasts. The expected real return using the Dividend Yield method is 3.67%. The expected real return using the Total Payout method (which includes buybacks) is 6.23%.

Exhibit 10.15: Long-Run Expected Returns Based On the Current Payout Yield and Historical Growth Over 1871–2018

	Recent Yield	**Historical Growth**	**Interaction**	**Expected Real Return**
Dividend Yield Method	1.83%	1.59%	0.25%	3.67%
Total Payout Method	4.21%	1.79%	0.23%	6.23%

The dividend yield model (the dividend discount model, DDM) is often incorrectly applied, using the current yield with historical growth rates. As can be seen above, both the current payout and the historical growth are too low. The DDM is a theoretically correct model, but a proper interpretation would be to increase the future growth rate caused by today's artificially low yields. The total payout method makes it clear what is going on. Payouts are switching from dividend yields to buybacks, but the overall total payout yields are relatively constant over time. The switch, however, leads to low historical dividend yield growth and low current dividend yields.

Conclusion

The total payout models presented here are useful in forecasting equity returns.

1. Changing payout policies should not change expected returns, as shown by Miller and Modigliani.

2. Payout growth should be linked long-term to the real economy.

3. Using the dividend discount model, although theoretically correct, is often incorrectly implemented with low current yields and low historical dividend growth rates.

4. Total Payout Models give more reasonable supply-side forecasts of returns.

Chapter 11
Stock Market Returns From 1815–2020

Studies on the long-horizon predictability of stock returns, by necessity, require a database of return information that dates as far back as possible. Since the late 1970s, Ibbotson Associates has produced a broad set of historical returns on asset classes dating back to 1926. Researchers interested in the dynamics of the U.S. capital markets prior to 1926 had to rely on indexes of uneven quality. In 2000, Roger G. Ibbotson and William N. Goetzmann, professors of finance, and Liang Peng, then a Ph.D. candidate in finance, all at Yale School of Management, assembled a New York Stock Exchange database of annual returns for the periods prior to 1926. The first part of this chapter covers the sources and construction of this annual return database extending back to 1815.

The second part of this chapter introduces a new set of monthly real stock market total returns developed by Paul Kaplan, now director of research at Morningstar Canada. Kaplan used these new returns to demonstrate that the severity of the financial crisis of 2008 was not unique but was merely the latest chapter in a long history of market meltdowns.

While we firmly believe that a 1926 starting date was approximately when quality financial data came into existence, our hope is that the continuing development of these data sets will allow modern researchers of pre-1926 stock returns, along with future researchers, to test a broad range of hypotheses about the U.S. capital markets as well as open up new areas for more accurate analysis.

1815–1925 Data Series Sources and Collection Methods

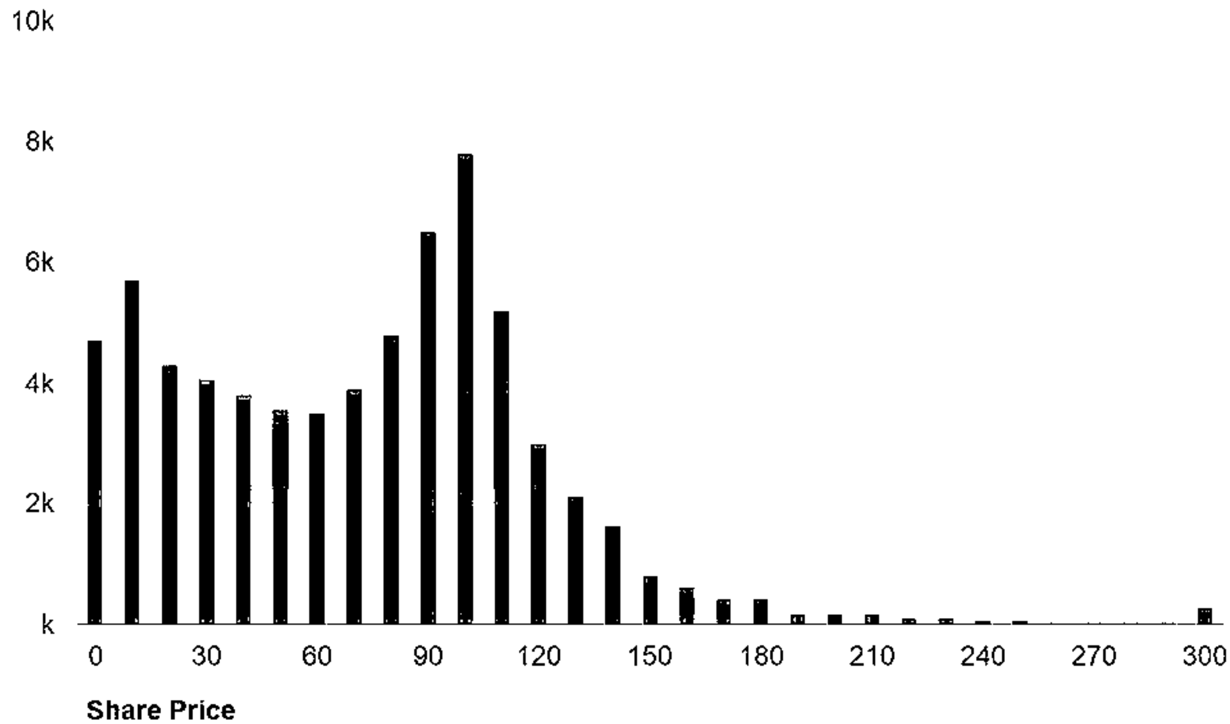
Share Price Collection

End-of-month equity prices for companies listed on the New York Stock Exchange were hand collected from three sources published January 1815 to December 1870. For the period 1871 through 1925, end-of-month NYSE stock prices were collected from the major New York newspapers. *The New York Shipping List,* later called *The New York Shipping and Commercial,* served as the "official" source for NYSE share price collection up until the early 1850s. In the mid-1850s, *The New York Shipping List* reported prices for fewer and fewer stocks. This led to the collection of price quotes from *The New York Herald* and *The New York Times.* While neither claimed to be the official list for the NYSE, the number of securities quoted by each far exceeded the number quoted by *The New York Shipping List.*

It is important to note that in instances where no transaction took place in December, the latest bid and ask prices were averaged to obtain a year end price. In total, at least two prices from 664 companies were collected. From a low number of eight firms in 1815, the number of firms in the index reached a high point in May of 1883 with 114 listed firms.

Share prices for much of the period of analysis remained around $100. Exhibit 11.1 illustrates this point. The graph shows that the most common price of a share of stock was around $100. The distribution of stock prices is significantly skewed to the left with only a few trading above $200. Such a distribution suggests that management maintained a ceiling on stock prices by paying out most earnings as dividends. No reports of stock splits over the period of data were discovered.

Exhibit 11.1: Distribution of Raw Stock Prices 1815–1925



Source of underlying data: Morningstar, Inc. Used with permission.

Dividend Collection

Dividend data was collected for the period 1825 to 1870 by identifying the semiannual dividend announcements for equity securities as reported in *The New York Shipping and Commercial*, *The Banker's Magazine*, *The New York Times*, and *The New York Herald*. From 1871 to 1925, aggregate dividend data from the Alfred Cowles[211] series was used. Whether the above publications reported dividends for all NYSE stocks is unknown; as a result, there is no way of knowing whether missing dividends meant that they were not paid or possibly not reported. Dividend records were collected for more than 500 stocks in the sample and most stocks paid dividends semiannually.

Two approaches were used to estimate the income return for each year. The first approach, the low-dividend return estimate, consisted of the summation of all the dividends paid in a given year

[211] Cowles, A. 1939. *Common Stock Indices* (Bloomington, Ind.: Principia Press).

by firms whose prices were observed in the preceding year. This number is then divided by the sum of the last available preceding year prices for those firms. The second approach, the high-dividend return estimate, focused solely on firms that paid regular dividends and for which price data was collected. The sample is restricted to firms that have two years of dividend payments (four semiannual dividends) and for which there was a price observation. Using the second approach, dividend yields tend to be quite high by modern standards. It is important to note that when both a high- and a low-income return series were present, the average was computed. This holds true for the summary statistics table in this chapter as well as the graphs/tables presented throughout. Also, due to missing income return data for 1868, an average of the previous 43 years was computed.

Price Index Estimation

Index Calculation Concerns

When attempting to construct an index without having market capitalization data readily available, one is left with one of two options: an equal-weighted index or a price-weighted index. One key concern with an equal weighted index is the effect of a bid-ask bounce. Take for example an illiquid stock that trades at either $1.00 or $2.00 per share. When it rises in price from $1.00 to $2.00, it goes up by 100%. When it decreases in price from $2.00 to $1.00, it drops by 50%. Equally weighting these returns can produce a substantial upward bias. This led us to the construction of a price-weighted index.

Calculation of the Price-Weighted Index

The procedure used for calculating the price-weighted index is rather simple. For each month, returns are calculated for all stocks that trade in two consecutive periods. These returns are weighted by the price at the beginning of the two periods. The return of the price-weighted index closely approximates the return to a "buy-and-hold" portfolio over the period. Buy-and-hold portfolios are not sensitive to bid-ask bounce bias. We believe that the price-weighted index does a fairly good job of avoiding such an upward bias. Companies were rather concentrated into specific industries. In 1815, the index was about evenly split between banks and insurance companies. Banks, transportation firms (primarily canals and railroads), and insurance companies made up the index by the 1850s. By the end of the sample period, the index was dominated by transport companies and other industrials.

A Look at the Historical Results

It is important to note that there are a few missing months of data that create gaps in the analysis. The NYSE was closed from July 1914 to December 1914 due to World War I. This is obviously an institutional gap. There are additional gaps; we are missing returns for 1822, part of 1848 and 1849, parts of 1866, all of 1867 and January 1868. We do not know whether the records missing from the late 1860s are due to the Civil War, but the NYSE was certainly open at that time –

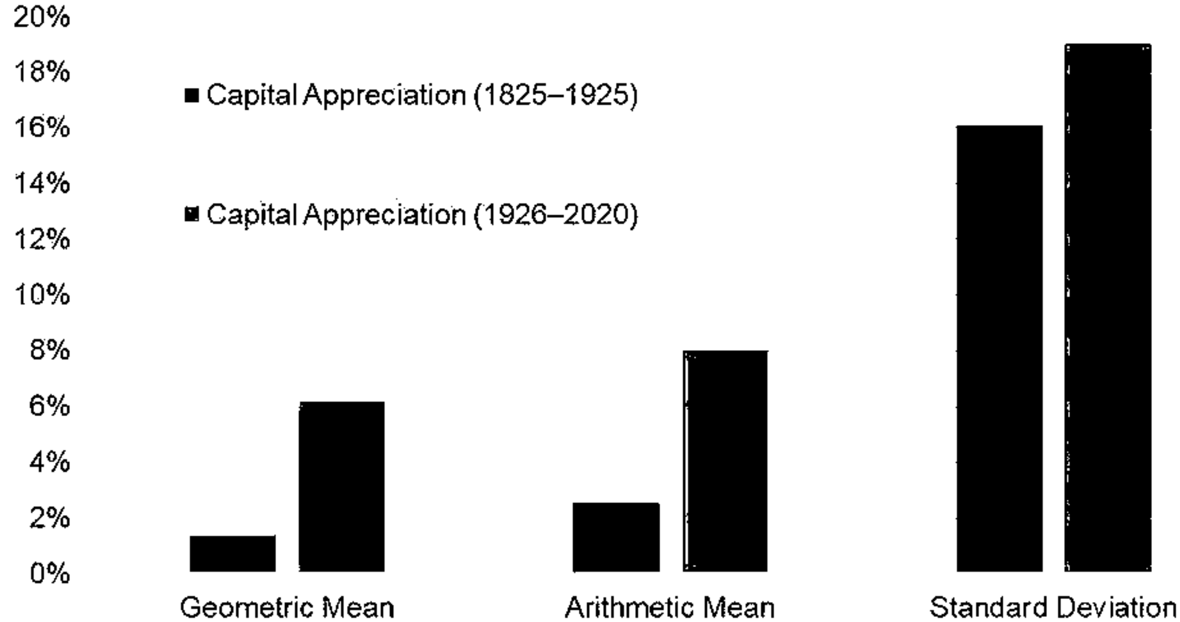
among other things, it was the era of heated speculation and stock price manipulation by legendary financiers Gould, Fisk, and Drew.

The number of available security records was quite lower after 1871. A change in the range of coverage by the financial press is the likely culprit for this. Further data collection efforts hopefully will allow these missing records to be filled in.

Price Return

Exhibit 11.2 illustrates the annual geometric mean, arithmetic mean, and standard deviation of large-cap stock capital appreciation (i.e., price) returns as measured over two different time horizons: 1825–1925, and 1926–2020. It is interesting to note that large-cap stocks had an annual geometric capital appreciation return from 1825 through 1925 of slightly more than 1%. This number is significantly *lower* when compared to the annual geometric capital appreciation return experienced by large-cap stocks from 1926 to 2020 (slightly more than 6%). This once again alludes to the suggestion that dividend policies have evolved over the past two centuries, and that managers of old companies most likely paid out earnings to keep their stock prices lower. In today's financial world, capital appreciation is accepted as a substitute for dividend payments.

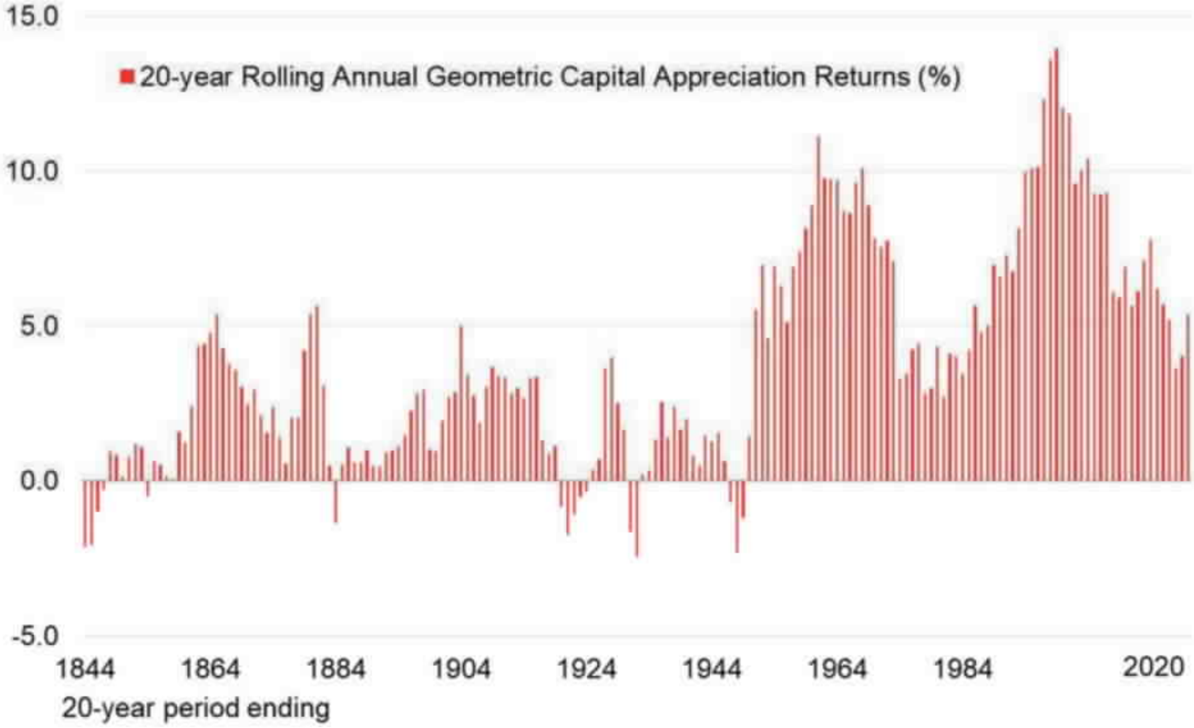
Exhibit 11.2: Large-Cap Stocks Capital Appreciation (i.e., "Price") Returns; Annual Geometric Mean, Geometric Mean, and Standard Deviation (%)
1825–1925 and 1926–2020



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll.

The rise in capital appreciation returns over the years is more evident when viewing returns on a 20-year rolling period basis as Exhibit 11.3 demonstrates. In Exhibit 11.3, the annual geometric (i.e., compound) capital appreciation return is calculated for all 20-year periods ending 1844 through 2020. For example, the leftmost bar in Exhibit 11.3 represents the annual compound rate of return over the period 1825–1844, and the rightmost bar in Exhibit 11.3 represents the annual compound rate of return over the period 2001–2020.

Exhibit 11.3: Large-Cap Stocks: 20-year Rolling Annual Geometric Capital Appreciation Returns (%) 1825–2020

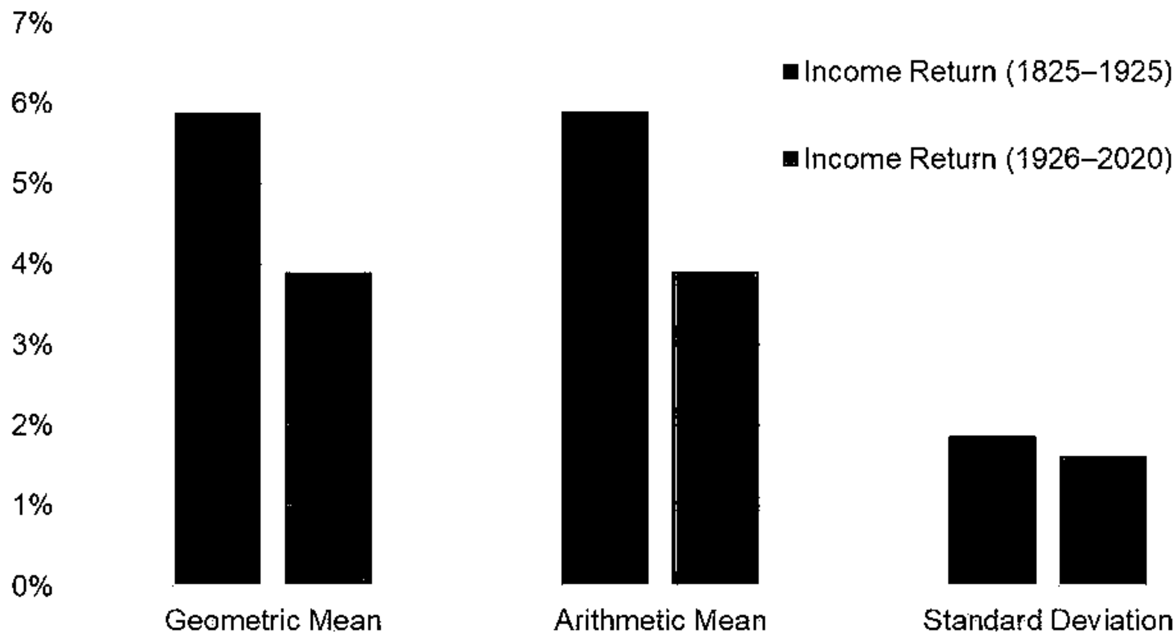


Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll.

Income Return

Exhibit 11.4 illustrates the annual geometric mean, arithmetic mean, and standard deviation of large-cap stock income returns as measured over two different time horizons: 1825–1925, and 1926–2020. The *higher* income return of nearly 6% in the earlier period (1825–1925) compared to the *lower* income return in the later period (1926–2020) of less than 4%, and the fact the many stocks traded near par, once again suggest that most companies paid out a large share of their profits rather than retaining them.

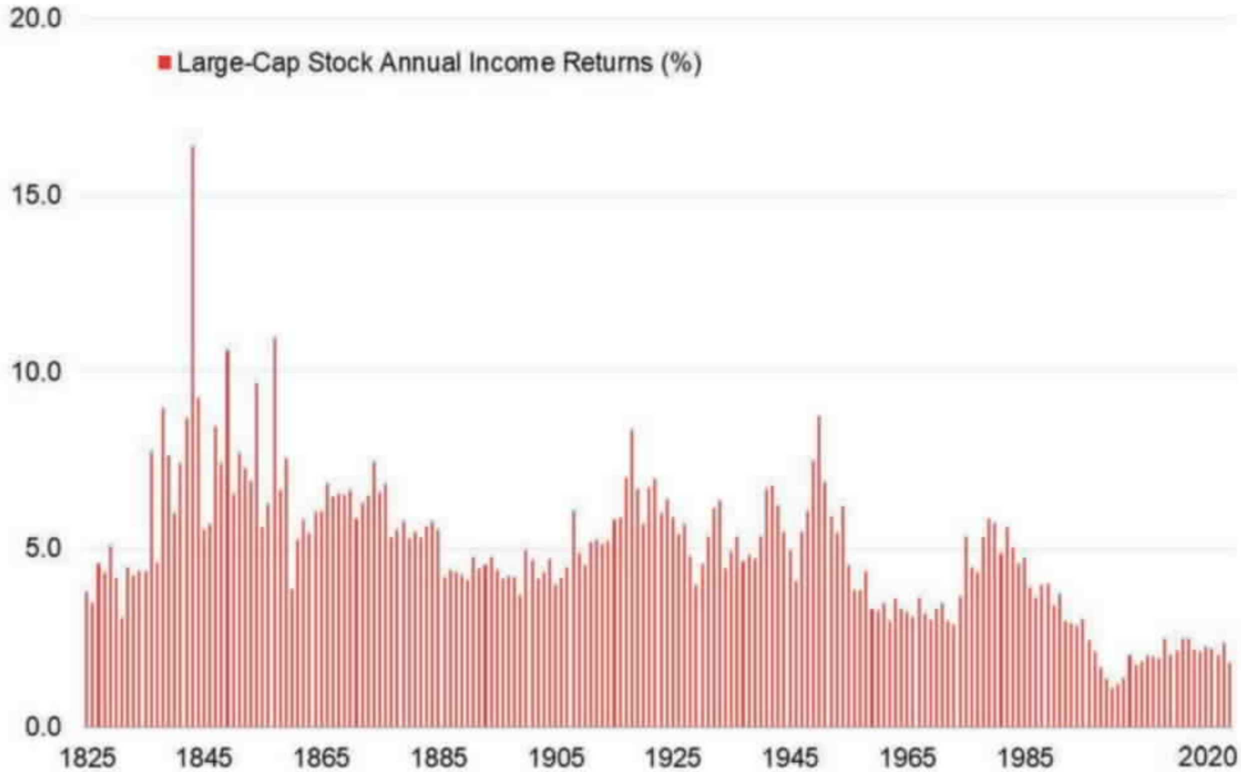
Exhibit 11.4: Large-Cap Stocks Income Returns; Annual Geometric Mean, Geometric Mean, and Standard Deviation (%)
1825–1925 and 1926–2020



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll.

Exhibit 11.5 shows large-cap stock annual income returns for 1825 to 2020. In fact, when looking at the time distribution of dividend changes over the new period, dividend decreases were only slightly less common than increases, suggesting that managers may have been less averse to cutting dividends than they are today. Perhaps in the pre-income tax environment of the 19th century, investors preferred income return as opposed to capital appreciation.

Exhibit 11.5: Large-Cap Stocks Annual Income Returns (%) 1825–2020



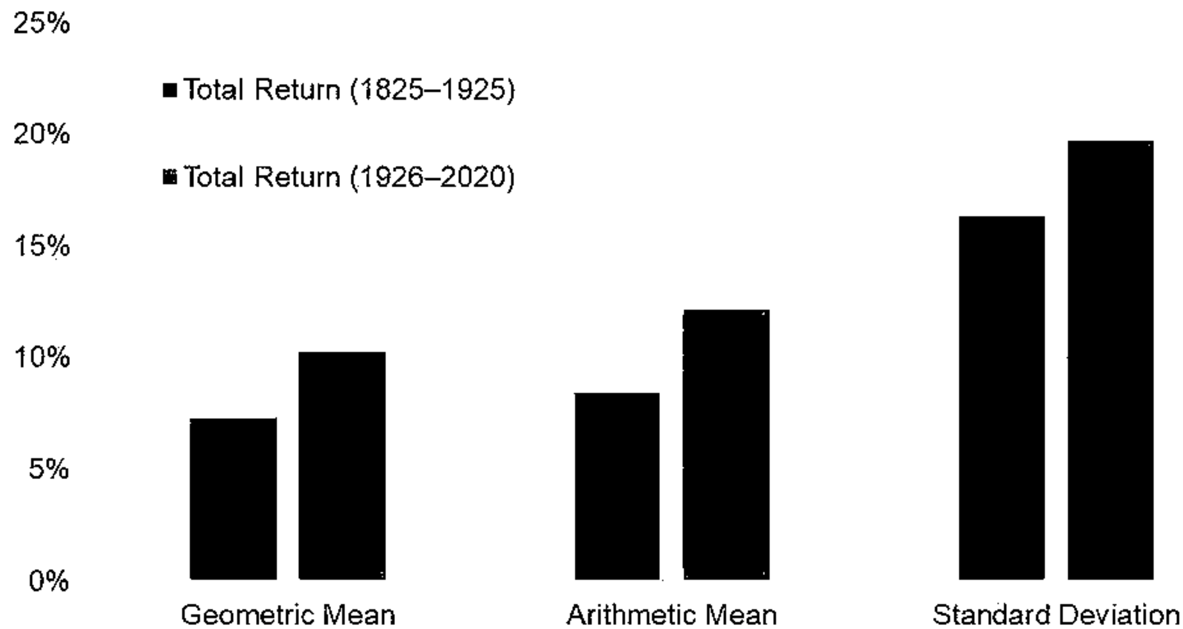
Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll.

Total Return

Exhibit 11.6 illustrates the annual geometric mean, arithmetic mean, and standard deviation of large-cap stock total returns as measured over two different time horizons: 1825–1925, and 1926–2020.

It is interesting to notice that the annual geometric total return for large-cap stocks from 1825 to 1925 was a little over 7%. This is quite low when compared to the annual geometric total return of the commonly used 1926 to 2020 period (a little over 10%).

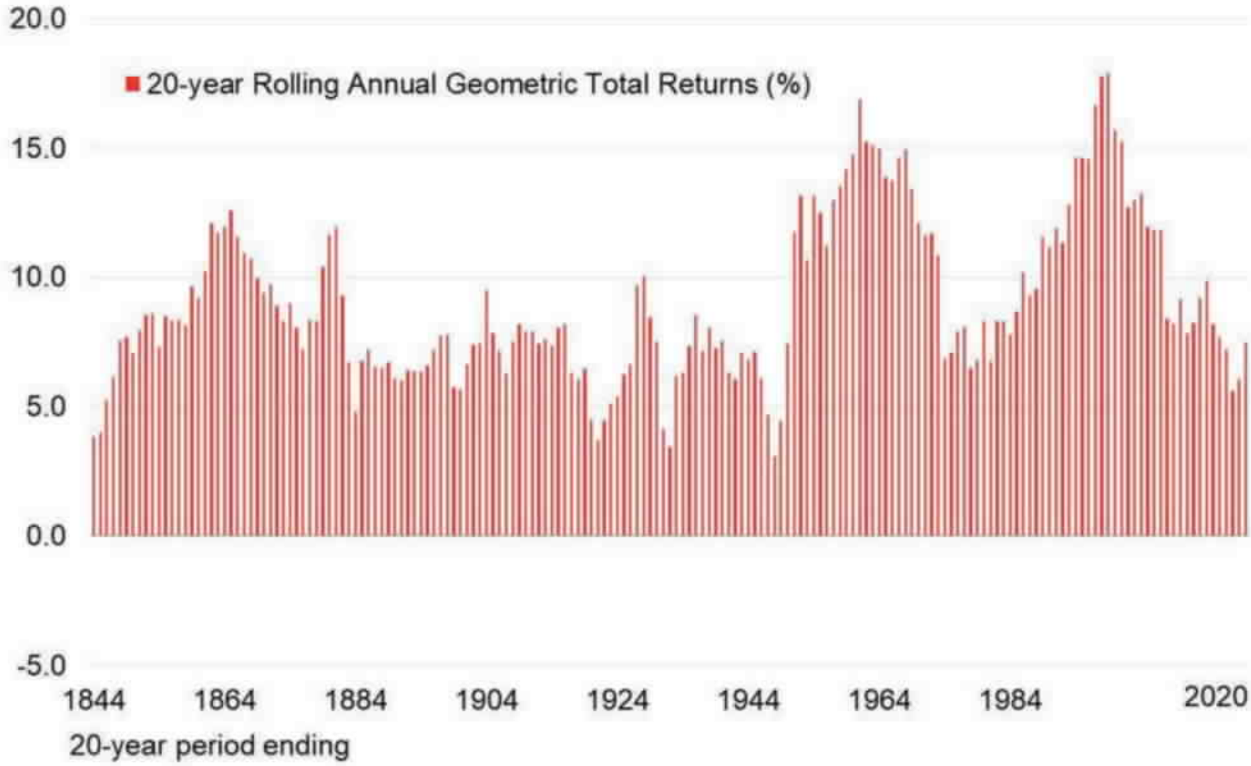
Exhibit 11.6: Large-Cap Stocks Total Returns; Annual Geometric Mean, Geometric Mean, and Standard Deviation (%)
1825–1925 and 1926–2020



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll.

In Exhibit 11.7, the annual geometric (i.e., compound) total return is calculated for all 20-year periods ending 1844 through 2020. For example, the leftmost bar in Exhibit 11.7 represents the annual compound rate of return over the period 1825–1844, and the rightmost bar in Exhibit 11.7 represents the annual compound rate of return over the period 2001–2020.

Exhibit 11.7: Large-Cap Stocks: 20-year Rolling Annual Geometric Total Returns (%) 1825–2020



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll.

150 Years of Stock Market Drawdowns

Those familiar with the history of U.S. capital markets as documented in this book may have found former Federal Reserve Chairman Alan Greenspan's characterization of the financial crisis of 2008 as a "once-in-a-century credit tsunami" quite surprising. A more appropriate statement may have been the one made by Leslie Rahl (founder of Capital Market Risk Advisors) more than a year before the crisis when she said, "We seem to have a once-in-a-lifetime crisis every three or four years."[212] Ms. Rahl was prescient – another "once in a lifetime" crisis occurred just 12 years later with the market crash in the first quarter of 2020 that was precipitated by the spread of the COVID-19 virus.

The contrast between Mr. Greenspan and Ms. Rahl's perspectives was the inspiration for an article in Morningstar magazine on the history of market meltdowns titled, "Déja Vu All Over Again."[213,214] In that article, Paul Kaplan, CFA, PhD (Director of Research, Morningstar Canada) illustrated the frequency and severity of the major drawdowns for various countries using time

212 Wright, C. 2007. "Tail Tales." *CFA Institute Magazine*, March/April.

213 Morningstar magazine is a publication for financial advisors and institutional investors. For more information about Morningstar magazine, call 312 384-4000 or visit us online: global.morningstar.com/MorningstarMagazine.

214 Kaplan, P.D. 2009. "Déjà Vu All Over Again." *Morningstar Advisor magazine*, February/March, P. 28.

series of stock market total returns. For the U.S., Kaplan naturally used the SBBI® large-cap stock index (the SBBI® large-cap stock index is essentially the S&P 500 index). The results of the study clearly demonstrate the severity of the financial crisis of 2008 was not unique but was merely the latest chapter in a long history of market meltdowns.

In 2009, a team of researchers at Morningstar expanded the analysis into a complete study on global equity market history as a contribution to the CFA Institute book on the global history of market crashes.[215] In this study, the research team used monthly *real* total returns that go back into history as far as was possible with reasonably reliable data.[216] The benefit of using real returns is to make meaningful return comparisons as our study spans such a long period. The benefit of going further back in history is, of course, to give a longer-term and more robust historical perspective on market crashes in terms of frequency, length, and magnitude.

To complete the study, the research team needed to find monthly data from before 1925 on both stock returns and inflation and calculate real returns. Because there was no such return series in existence, they had to create one out of readable available data.

Robert J. Shiller, 2013 Nobel laureate in economic sciences and the Sterling professor of economics at Yale University, posts monthly U.S. stock market returns and inflation data on his website that go back to 1871. Unfortunately, Shiller's stock data is based on monthly average prices rather than month-end prices. So, the research team could use his inflation data, but not his stock market data. Separately, Roger Ibbotson and some colleagues created an annual price and total return series for the NYSE that goes back to 1815 (as previously discussed in this chapter).[217] However, annual returns are at too low a frequency to measure the largest drawdowns of the period, such as the large drop in the stock market during the panic of 1907. Fortunately, there is a book that contains daily price data on the Dow Jones Averages going back to 1885.[218] The team estimated the monthly price returns in the broader NYSE price index from the monthly price returns on the Dow Jones Averages and then interpolated the total returns by assuming that the dividend levels remained constant during each year.

The Morningstar team produced a time series of U.S. stock market real total returns from 1871 to 2020. The first 15 years of this history (1871–1885) is *annual* real total returns, and the remaining 135 years (1886–2020) is *monthly* total real returns, for a total of 150 years.

Truth in Numbers

The significance of this data is in the lessons that we can learn from it. Over the entire 150-year period, the Real U.S. Stock Market Index grew from $1.00 to $22,214.26in 1870 dollars. This is a compound annual real total return of 6.9%, almost the same as the post-1925 compound annual

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215 Kaplan, P.D., Idzorek, T., Gambera, M., et al. 2009. "The History and Economics of Stock Market Crashes." In *Insights into the Global Financial Crisis*. Edited by Laurence B. Siegel (Charlottesville, Va.: *CFA Institute*).

216 That is, returns that include the reinvestment of dividends and are adjusted for inflation.

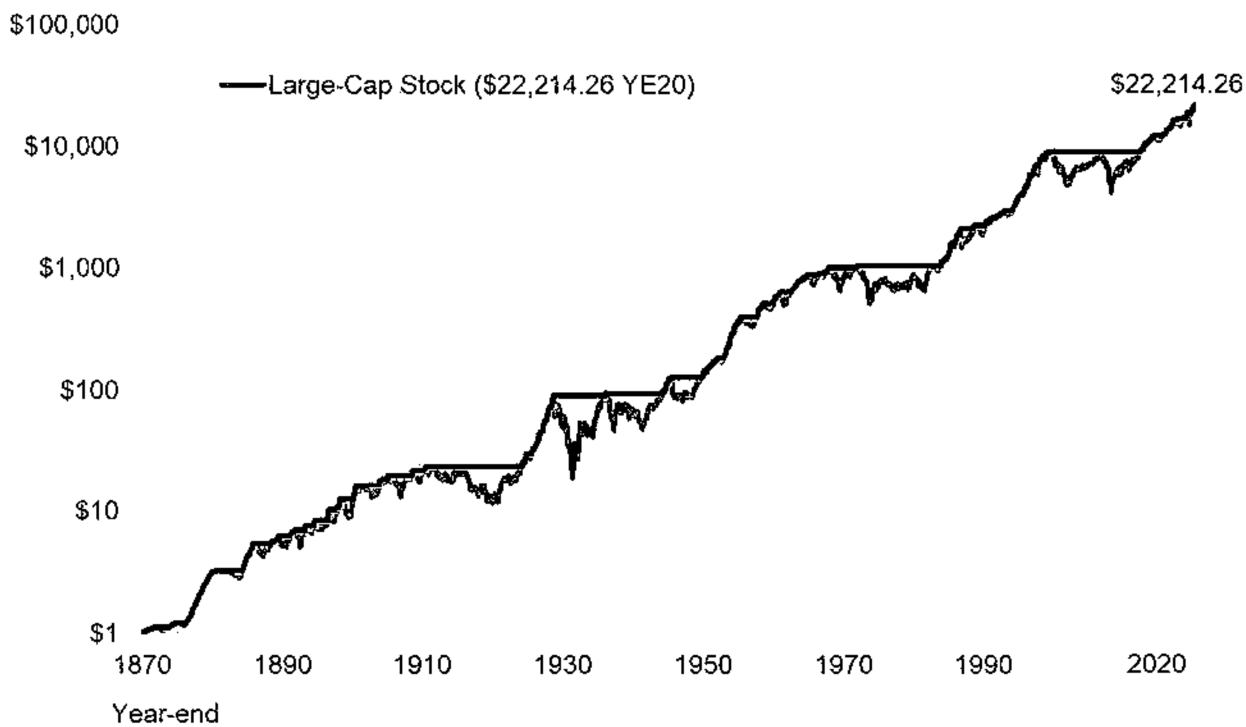
217 Goetzmann, W.N., Ibbotson, R.G., & Peng, L. 2000. "A New Historical Database for the NYSE 1815 to 1925: Performance and Predictability." *Journal of Financial Markets*, Vol. 4, No. 1, P. 1.

218 Pierce, P., ed. 1982. *The Dow Jones Averages 1885-1980* (Homewood, Ill.: Dow Jones-Irwin).

real total return of slightly over 7%. However, as Exhibit 11.8 shows, it was a very bumpy ride with a number of major drawdowns, some of which can be linked with specific economic and political events.

Exhibit 11.8 shows the growth of $1.00 invested in the U.S. stock market at the end of 1870 through December 2020 in *real* terms, along with a line that shows the highest level that the index had achieved as of that date (shown in gray).[219] Whenever this line is above the cumulative value line (shown in red), the index was below its most recent peak. The bigger the gap, the more severe the decline; the wider the gap, the longer the time until the index returned to its peak. Wherever this line coincides with the index line, the index was climbing to a new peak. The market crash in the first quarter of 2020 that was precipitated by the spread of the COVID 19 virus (when measured on a monthly basis) was significantly shorter and less acute than several of the drawdowns illustrated in Exhibit 11.8.

Exhibit 11.8: Large-cap Stocks: Real Return Index 1870–2020



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll.

[219] Beginning with the *2017 SBBI®* Yearbook, we changed Exhibit 11.8 compared to previous editions. The information in Exhibit 11.8 first appeared in the *2010 SBBI® Yearbook*. In the 2010 through 2016 *SBBI® Yearbooks*, the graph shown in Exhibit 11.8 included both *annual* returns (for years 1871–1885) and *monthly* data (for years 1886–present), which distorted the graph slightly. Beginning with the 2017 version, Exhibit 11.8 includes only *monthly* data points over the entire time horizon (1871–2020). For each of the first 15 years of the graph (1871–1885), the annual returns were converted to "monthly" returns by calculating the single monthly return that could be applied to each standard 12-month period (January through December) that would result in an annual geometric annual return matching the original study. For example, for year 1871 the original Morningstar study reported an annual return of 7.56%. The single value calculated for the imputed "monthly" returns for January 1871 through December 1871 was therefore 0.609% (1+7.56%)^(1/12).

Exhibit 11.9 lists all of the drawdowns that exceeded 20%. There were 17 such declines, including the most recent one that ended in May 2013. Not surprisingly, the largest of all market declines started just before the Crash of 1929 and did not recover until toward the end of 1936. The U.S. stock market lost 79% of its real value in less than three years and took more than five years to recover. The most recent drawdown, the global financial crisis, was the second greatest decline, and it lasted nearly a decade. The combined effect of the crash of the Internet bubble in 2000 and the global financial crisis of 2008 caused the U.S. stock market to lose 54% of its real value from August of 2000 to February 2009.

The history of stock market drawdowns presented here shows that investing in stocks can be very risky, and the most recent crisis was hardly a "once-in-a-century" event. We should use this long-run data to better gauge the potential risks and long-term rewards of investing in risky assets such as stocks.

Exhibit 11.9: Largest Declines in U.S. Stock Market History, in Real Total Return Terms 1870–2020

Peak	Trough	Decline (%)	Recovery	Event(s)
Aug. 1929	May 1932	79.00	Nov. 1936	Crash of 1929, 1st part of Great Depression
Aug. 2000	Feb. 2009	54.00	May 2013	Dot-com bubble burst (00-02), Crash 07-09
Dec.1972	Sep. 1974	51.86	Dec, 1984	Inflationary Bear Market, Vietnam, Watergate
Jun.1911	Dec. 1920	50.96	Dec. 1924	WWI, Post-war Auto Bubble Burst
Feb.1937	Mar. 1938	49.93	Feb. 1945	2nd part of Great Depression, WWII
May 1946	Feb. 1948	37.18	Oct. 1950	Post-war Bear Market
Nov.1968	Jun. 1970	35.46	Nov. 1972	Start of Inflationary Bear Market
Jan.1906	Oct. 1907	34.22	Aug. 1908	Panic of 1907
Apr.1899	Jun. 1900	30.41	Mar. 1901	Cornering of Northern Pacific Stock
Aug.1987	Nov. 1987	30.16	Jul. 1989	Black Monday
Oct.1892	Jul. 1893	27.32	Mar. 1894	Silver Agitation
Dec.1961	Jun. 1962	22.80	Apr. 1963	Height of the Cold War, Cuban Missile Crisis
Nov.1886	Mar. 1888	22.04	May 1889	Depression, Railroad Strikes
Apr.1903	Sep. 1903	21.67	Nov. 1904	Rich Man's Panic
Aug.1897	Mar. 1898	21.13	Aug. 1898	Outbreak of Boer War
Sep.1909	Jul. 1910	20.55	Feb. 1911	Enforcement of the Sherman Anti-Trust Act
May 1890	Jul. 1891	20.11	Feb. 1892	Baring Brothers Crisis

Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. In Exhibit 11.1, the Ibbotson Associates "Large Company Stocks" series represents U.S. equities for all dates from January 1926 forward. The Ibbotson Associates "Large Company Stocks" series is essentially the S&P 500 index.

In the fall of 2018, U.S. equity indices experienced significant declines. The S&P price index peaked at 2,930.75 on September 20, 2018; By December 24, 2018, the S&P 500 price index had declined to 2,351.10, or –19.8%, just short of the –20% threshold necessary to qualify it to appear in Exhibit 11.8.

Most recently, the market crash in the first quarter of 2020 that was precipitated by the spread of the COVID-19 virus (when measured on a monthly basis, as the analysis presented in Exhibit 11.8 is) also did not meet the 20% threshold. As of December 31, 2019 the S&P 500 total return index ($1.00 = December 31, 1925) was $9,243.90, a record high. By the end of March 2020 the index had fallen to $7,432.28, a drop of 19.6%. On a daily basis, however, the S&P price index was 3,386.15 on February 19, 2020. By March 23, 2020 this index had fallen to 2,237.40, representing a 33.9% decline.[220]

Traditional measures of risk, such as standard deviation, can underestimate the risk of drawdowns that are many standard deviations away from the mean (i.e., on the left tail of a distribution). We suggest that these traditional measures of risk be supplemented with measures that better capture the "fat tailed" nature of the historical returns and drawdowns as presented here. A complete discussion of incorporating fat-tailed distributions into risk measures is found in Chapter 10.

Reaching Back Beyond 1926

Collection efforts have yielded a comprehensive database of NYSE security prices for nearly the entire history of the exchange. The goal of these studies is to assemble a NYSE database for the period prior to 1926. The 1926 starting date was approximately when high-quality financial data came into existence. However, with a pre-1926 database assembled, researchers can expand their analyses back to the early 1800s. It is our hope that the long time series outlined in this chapter will lead to a better understanding of how the U.S. stock market evolved from an emerging market at the turn of the 18th century to the largest capital market in the world today.

The Origin of Market Bubbles

As we've seen so far in this chapter, we have witnessed many asset-price bubbles. In each case, the story seems to be the same: Positive feedback and herding among speculative investors produce runaway prices until the deviation from equilibrium is so large that the market becomes unstable, creating a high probability (or an inevitability) of a crash. This raises the question: Do asset-price bubbles typically share the same characteristics and do all bubbles originate in the same manner? If yes, can we identify these factors beforehand and predict when a bubble will burst? James Xiong, head of quantitative research at Morningstar Investment Management, addressed these questions in an article in Morningstar magazine, "The Chinese Art Market and the Origin of Bubbles."[221] The rest of this section has been written by Xiong and adapted from his article.

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220 Source of daily S&P 500 price index data: Yahoo Finance at https://finance.yahoo.com/.

221 Xiong, J. 2012. "The Chinese Art Market and the Origin of Bubbles." *Morningstar magazine*, August/September, P. 64.

Herd Behavior and Market Bubbles

A number of studies have considered herd behavior as a possible explanation for the excessive volatility observed in financial markets.[222] The thinking behind this approach is simple: Interaction of market participants through herding can lead to large fluctuations in aggregate demand, leading to heavy tails in the distribution of returns. In the popular literature, "crowd effects" often have been associated with large fluctuations in market prices of financial assets.

Robert Shiller provides evidence to support his argument that "irrational exuberance" played a role in producing the ups and downs of the stock and real estate markets.[223] He listed 12 precipitating factors that gave rise to the booms in the stock markets and housing markets. These factors are amplified via feedback loops and naturally occurring Ponzi schemes, aided by the media, and can ultimately lead to market crashes.

Shiller also demonstrates that psychological factors, such as herd behavior and epidemics, are exerting important effects. For example, the influence of authority over people can be enormous; people are ready to believe authorities even when they plainly contradict matter-of-fact judgment.

He cites many other factors, including that people tend to follow other people and choose not to exercise their own judgment about the market; also, most people purchase stocks based on direct interpersonal communication instead of independent research.

Rama Cont and Jean-Philippe Bouchaud[224] provide a mathematical model to link two well-known market phenomena: the heavy tails observed in the distribution of stock market returns on one hand and herding behavior in financial markets on the other hand.

Predicting Crashes

In the 1990s, two groups of researchers[225] independently discovered an apparent tendency of stock prices to exhibit log-periodic power laws (LPPL) before a crash. The fundamental hypothesis of the model is that financial crashes are macroscopic examples of critical phenomena. A critical phenomenon indicates a highly correlated unstable market. In other words, as some traders say, "In a market crisis, all correlations jump to one."

Collective behaviors in people emerge through the forces of imitation, which leads to herding. Herding behavior of investors can result in a significant deviation of financial prices from their

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[222] See three references: Bannerjee, A.V. 1992. "A Simple Model of Herd Behavior," *Quarterly Journal of Economics*, Vol. 107, P. 797. Topol, R. 1991. "Bubbles and Volatility of Stock Prices: Effect of Mimetic Contagion," *The Economic Journal*, Vol. 101, P. 786. Shiller, R.J. 1989. *Market Volatility* (Cambridge, Mass.: MIT Press).

[223] Shiller, R.J. 2005. *Irrational Exuberance*, 2nd ed. (Princeton, N.J: Princeton University Press).

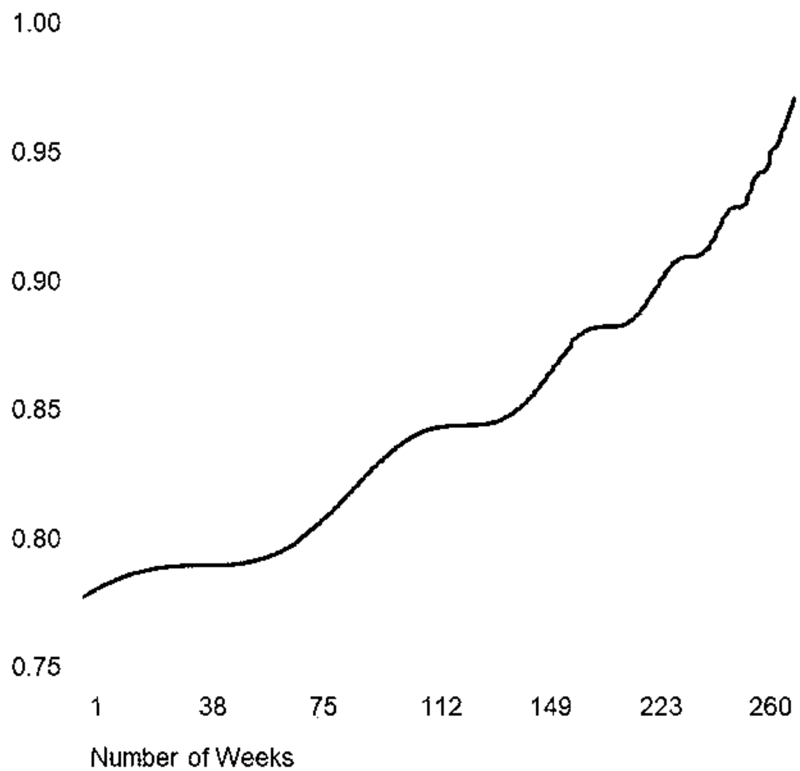
[224] Cont, R. & Bouchaud, J.-P. 2000. "Herd Behavior and Aggregate Fluctuations in Financial Markets," *Journal of Macroeconomic Dynamics*, Vol. 4, P. 170.

[225] See two references: Sornette, D., Johansen, A. & Bouchaud, J.-P. 1996. "Stock Market Crashes, Precursors and Replicas," *J. Phys. I.* (France), Vol. 6, P. 167. Feigenbaum, J. & Freund, P.G.O. 1996. "Discrete Scale Invariance in Stock Markets Before Crashes," *International Journal of Modern Physics B*, Vol. 10, P. 3737.

fundamental values. A speculative bubble, which is caused by a positive feedback investing style, also leads to a faster-than exponential power law growth of prices.[226] The competition between such nonlinear positive feedbacks and negative feedbacks contributes to nonlinear oscillations. For example, technical investors who have a positive view of the market bid up prices at the expense of fundamental investors, who view the market as ridiculously overpriced. The result is that a log-periodic modulation of the price accelerates up to the crash point. Exhibit 11.10 shows an example of what smooth log-periodic oscillations look like. Notice how the oscillations and the index value increase at an increasing rate as the date gets closer to the crash date.

Like any other models, the LPPL model has been debated and challenged, and we will not attempt to discuss that here. Major stock market crashes around the world, however, can be quantitatively explained by this model. These crashes include the 1929 crash, the 1987 crash, the crash of the Russian market in 1998, the 1990 Japanese Nikkei Index crash, several Hong Kong crashes in the 1990s, the Internet bubble crash in 2000, the financial crisis of 2008–2009, and more than 20 emerging-markets crashes. All of these market bubbles appeared to show the similar LPPL before they crashed.

Exhibit 11.10: Example of Log-Periodic Oscillations



[226] Sornette, D. 2003. *Why Stock Markets Crash: Critical Events in Complex Financial Systems* (Princeton, N.J.: Princeton University Press).

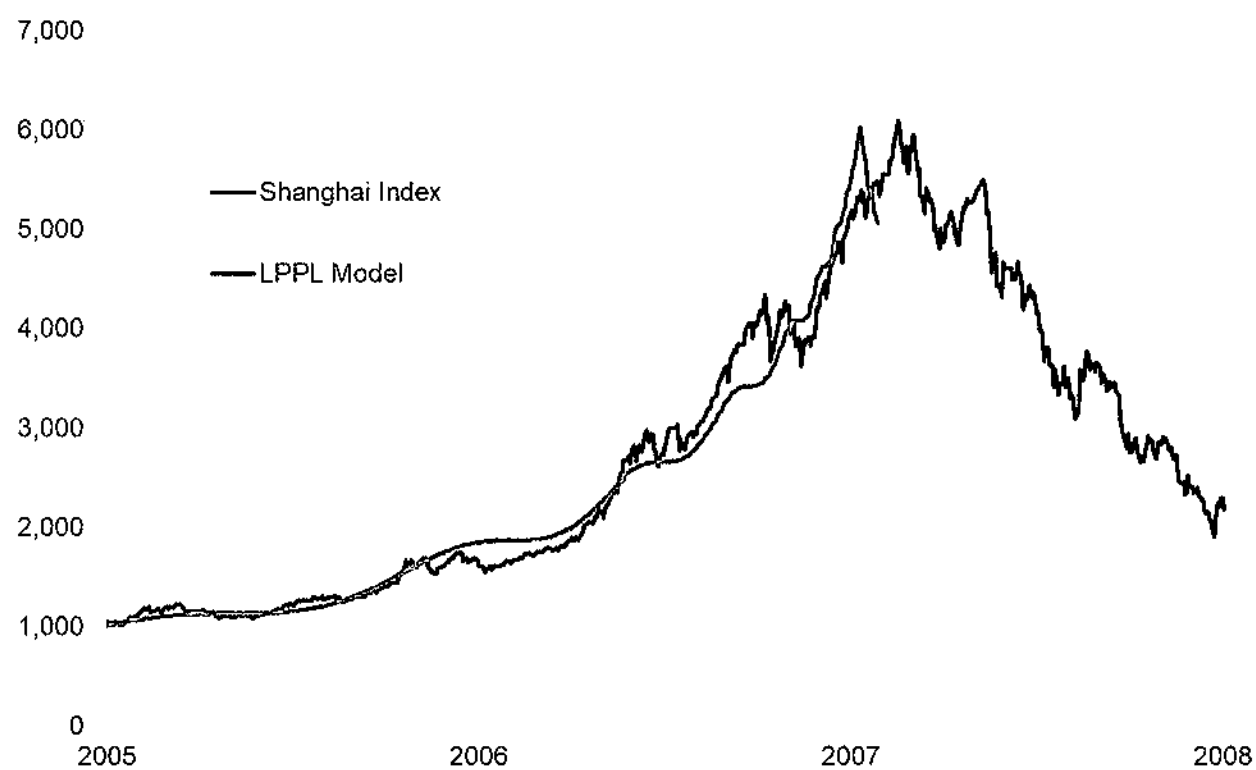
Chinese Stock Market Crash of 2007

Greed and fear are rooted in human nature, so it is unlikely that people will change anytime soon. Greediness and fear also drive herding and positive feedbacks, so investors should expect these factors to remain in markets. The latest herding example occurred not too long ago, in 2007. In particular, we'll look at the Chinese stock market crash.

We use the Shanghai Stock Exchange Composite Index to represent the Chinese stock market. The Chinese stock market is dominated by individual investors, unlike equity markets in developed countries where a form of polarization exists between individual and institutional investors. Millions of new Chinese small investors flooded into the booming Chinese stock market from 2005 to 2007, indicating a strong herd behavior. The bubble burst in October 2007. A year after the crash, the Shanghai Composite had lost about 64% of its value, a classic example of herd behavior leading to a market crash in an emerging market.

Using the LPPL model, Exhibit 11.11 shows that the Chinese stock market crash in 2007 was predictable. The gray line charts the price of the index. The red line is the calculated curve based on the LPPL model. The out-of-sample test was made Sept. 25, 2007. The model predicted a crash date of Sept. 5, 2007. The actual crash started Oct. 17, 2007, 42 days later than predicted. The time series price index is reasonably fitted by the log periodic power law model; we can see the precursors of log periodic oscillations before the crash occurred.

Exhibit 11.11: Chinese Stock Market Crash Predicted by LPPL Model



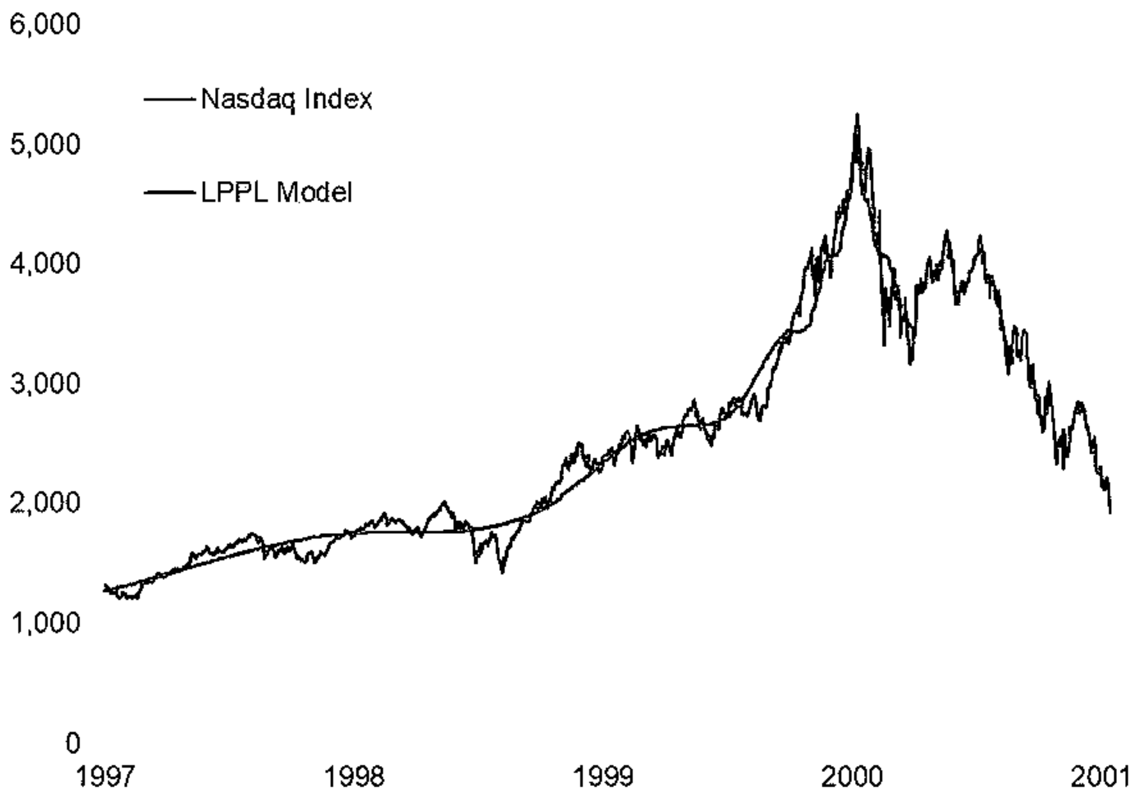
NASDAQ Crash of 2000

History provides many examples of bubbles driven by unrealistic expectations of future earnings. These types of bubbles do not just occur in developing markets. An example is the NASDAQ crash of 2000.

The NASDAQ Composite Index consists mainly of technology stocks, such as Internet, e-commerce, software, computer hardware, and telecommunications names. When the NASDAQ closed at a high of 5,049 on March 10, 2000, many stocks were trading at four-digit price/earnings (P/E) ratios.[227] Brocade Communications Systems, for example, had a P/E of 6,185; Trend Micro ADR had a P/E of 4,350; and SeaChange International traded at a P/E of 3,765. Investors in these companies seemed to be focusing on high future earnings and seemingly did not focus on other economic fundamentals.

Exhibit 11.12 shows the bubble phase of the NASDAQ. The red line stands for the price of the index. The red line is based on the LPPL model. Again, the model clearly picked up the signals of an impending crash and almost perfectly predicted it.

Exhibit 11.12: NASDAQ Market Crash Predicted by LPPL Model



[227] The March 10, 2000 closing level (5,049) was an all-time high close for the NASDAQ at the time. The NASDAQ did not close above this price until over 14 years later, April 23, 2014, when the index closed at 5,056.06.

The LPPL Model

The log-periodic power law can be quantified as:[228]

$$\ln\left[p(t)\right] = A - B\tau^m + C\tau^m \cos\left[\omega \ln(\tau) - \varphi\right]$$

Where:

$p(t)$ = price

A = The peak value of $\ln(p(t))$

B = Base for the slope of the logarithmic curve

τ = t_c - t; which is the distance to the end of the bubble

m = Growth accelerator; must be $0 < m < 1$

C = Base for the oscillations; must be > 0

ω = Angular log-frequency

φ = Arbitrary phase determining the unit of time

A geometric description for LPPL Model is that a log-periodic modulation of the ln(price) accelerates up to the crash point. The combination of *B* with a value greater than 0 and *m* with a value between 0 and 1 accelerates the slope so that it is faster than a typical exponential acceleration. The combination of *C* and the cosine segment determines the amplitude and frequency of the log-periodic oscillations.

We used the Levenberg Marquardt algorithm to predict the crash for the two bubbles (Exhibits 11.11 and 11.12). The fitted parameters are exhibited in Exhibit 11.13.

Exhibit 11.13: Best Fitted Parameters for the Shanghai Composite Index and the NASDAQ Index

Stock	t_c	***m***	***w***	ϕ	***A***	***B***	***C***
Shanghai Index	September 2007	0.64	10.90	4.91	2.17	0.15	-0.01
NASDAQ Index	March 2000	0.45	6.45	5.26	8.61	0.88	0.06

228 Sornette, D. 2003. *Why Stock Markets Crash: Critical Events in Complex Financial Systems* (Princeton, N.J.: Princeton University Press).

Power of the Model

We showed that two recent market bubbles displayed the same LPPL signature before they crashed. Our analyses indicate that all the bubbles have the same origins and similarly move toward a crash.

Positive feedback and herding produce runaway prices until the deviation from equilibrium is so large that the market is unstable and has a high probability to crash. When the stock price accelerates at a much faster rate than the exponential growth rate, the skyrocketing return will always come with an increased crash hazard rate.

Financial markets are complex systems. In such systems, a speculative bubble can easily be created through positive feedback. What is more challenging is that, as complex systems grow, two things happen.[229] These systems require exponentially greater amounts of energy to keep operating, and they become vastly more risky and prone to catastrophic failure.

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[229] Rickards, J. 2011. *Currency Wars: The Making of the Next Global Crisis* (New York: Portfolio/Penguin).

Chapter 12
International Equity Investing[230]

International investment opportunities are growing rapidly, encouraged by open markets and the accelerating economies of many nations. The evidence in favor of taking a global approach to investing is plentiful, as are the possible rewards an investor can reap.

However, significant risks are present as well – risks that apply strictly to the international marketplace. In this chapter, we consider both the rewards and the risks associated with international investments.

Construction of the International Indexes

Our analysis of international investing uses the indexes created by Morgan Stanley Capital International, Inc. The MSCI® indexes are designed to measure the performance of the developed and emerging stock markets, reflecting the performance of the entire range of stocks available to investors in each local market.[231,232]

From January 1970 to October 2001, inclusion in the MSCI indexes was based upon market capitalization. Stocks chosen for the indexes were required to have a target market representation of 60% of total market capitalization.

MSCI has enhanced its index construction methodology by free-float-adjusting constituents' index weights and increasing the target market representation. Target market representation increased

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230 This chapter is an overview of international equity investing that is limited to analyzing the relative historical performance of international (versus U.S.) equities, and does not include the much-expanded analyses of country-level risks and industry level risks (on a global scale) that are available in the D&P/Kroll online Cost of Capital Navigator platform's (i) International Cost of Capital Module, and (ii) International Industry Benchmarking Module. To learn more about the Capital Navigator, visit dpcostofcapital.com. These two resources are summarized as follows: International Cost of Capital Module: Provides measures of relative country risk for over 175 countries from the perspective of investors based in over 50 countries. Other data includes equity risk premia for 16 countries, risk-free rates for developed markets, industry betas for a global index as well as for developed markets, and long-term inflation expectations and corporate income tax rates for over 175 countries. Full country risk premia (CRPs) and relative volatility (RV) factor Tables by country (depending on subscription level). International Industry Benchmarking Module: Provides industry-level cost of capital estimates (cost of equity capital, cost of debt capital, and weighted average cost of capital, or WACC) plus detailed industry-level statistics for sales, market capitalization, capital structure, levered and unlevered betas, valuation multiples, financial and profitability ratios, equity returns, aggregate forward-looking earnings-per share (EPS) growth rates, and more. Over 300 critical industry-level data points are calculated for each industry (depending on data availability). Industries are organized by global industry classification standard (GICS) code. The International Industry Benchmarking Module can be used to benchmark, augment, and support the analyst's own custom analysis of the industry in which a subject business, business ownership interest, security, or intangible asset resides. The Cost of Capital Navigator also has two U.S.-centric modules: the U.S. Cost of Capital Module and the U.S. Industry Benchmarking Module. For more information about the Cost of Capital Navigator visit dpcostofcapital.com.

231 The international stock series presented throughout this chapter is represented by the MSCI EAFE® equities index. The MSCI EAFE Index is an equity index which captures large- and mid-cap representation across Developed Markets countries around the world, excluding the US and Canada. With 918 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country. To learn more about MSCI, visit msci.com.

232 All returns and statistics in this chapter are expressed in $USD, unless otherwise noted.

from 60% of total market capitalization to 85% of free-float-adjusted market cap within each industry group, within each country. MSCI defines the free float of a security as the proportion of shares outstanding that is deemed to be available for purchase in the public equity markets by international investors.

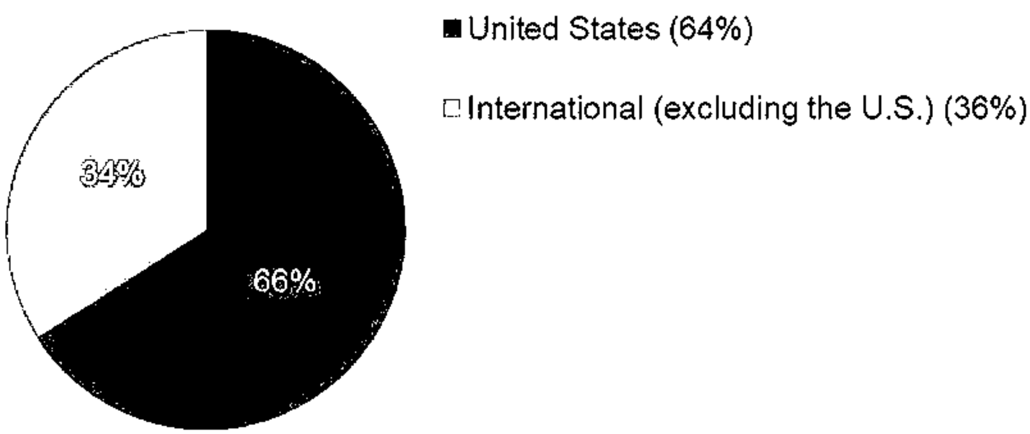
Benefits of Investing Internationally

The arguments for investing internationally can be powerful. Examples may include (i) participation in the more than half of the world's investable assets that exist outside the U.S., (ii) growth potential, (iii) diversification, and (iv) potential improvement of the risk/reward trade-off.

Investment Opportunities

An investor who chooses to ignore investment opportunities outside of the U.S. is missing out on a significant percentage of the investable developed stock market opportunities in the world. Exhibit 12.1 presents the relative size of international and domestic developed markets as of February 2021. As of February 2021, the total developed world stock market capitalization was $52.1 trillion, with $17.7 trillion representing international stock market capitalization.[233]

Exhibit 12.1: MSCI World Stock Market Capitalization: $52.1 Trillion
February 2021



[233] **Source:** MSCI World Index Equity Fact Sheet. For more information, visit: msci.com.

Growth Potential

Exhibit 12.2 Illustrates the growth of $1.00 invested in international stocks (as represented by the MSCI EAFE index), and U.S. large-cap stocks (i.e., the S&P 500 total return index), long-term government bonds, U.S. Treasury Bills, and a hypothetical asset returning the inflation rate over the period from the end of 1969 to the end of 2020.[234] Of the asset classes shown in Exhibit 12.2, the $1.00 invested at year-end 1969 in U.S. large-cap stocks grew the most by year-end 2020 (over $180), followed by International Stocks (over $90).

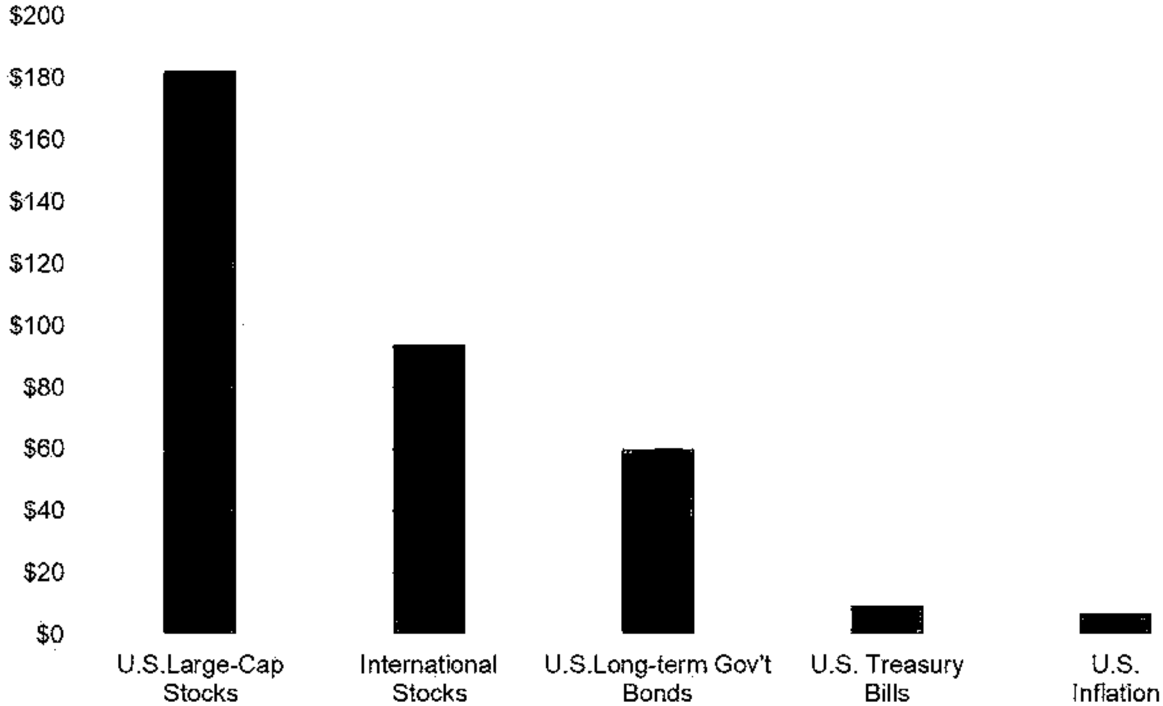
In the time horizon over which this analysis is performed (1970–2020), international stocks generally outperformed U.S. large-cap stocks from 1970 through the late 1990s, but in more recent years U.S. large-cap stocks have generally outperformed international stocks.

To illustrate this seeming reversal of relative performance in more recent years, consider that a $1.00 investment at year-end 1969 in U.S. large-cap stocks would have grown to nearly $19 by end of 1995, but the same dollar invested in international stocks would have grown to nearly $25. However, a $1.00 investment at year-end 1995 in U.S. large-cap stocks would have grown to nearly $10 by the end of 2020 (25 years), but the same dollar invested in international stocks would have grown to slightly a little more than $3.70.

Both U.S. and international stocks were affected by the 2008 financial crisis. In 2008, U.S. large-cap stocks fell nearly 37% and international stocks fell over 43%. In the twelve-year period after 2008, both U.S. large-cap stocks and international stocks have recovered, with U.S. large-cap stocks producing an approximate 15% annual return, significantly outperforming international stocks which produced an annual return of just over 8%.

[234] In this chapter, the "U.S." series used are the same "SBBI" series used throughout the rest of this book. "U.S." is added to these series' names in this chapter only to differentiate them from the MSCI EAFE equities index, which is used to represent "international" equities in this chapter.

Exhibit 12.2: Global Investing
Index (Year-end 1969 = $1.00) 1970–2020

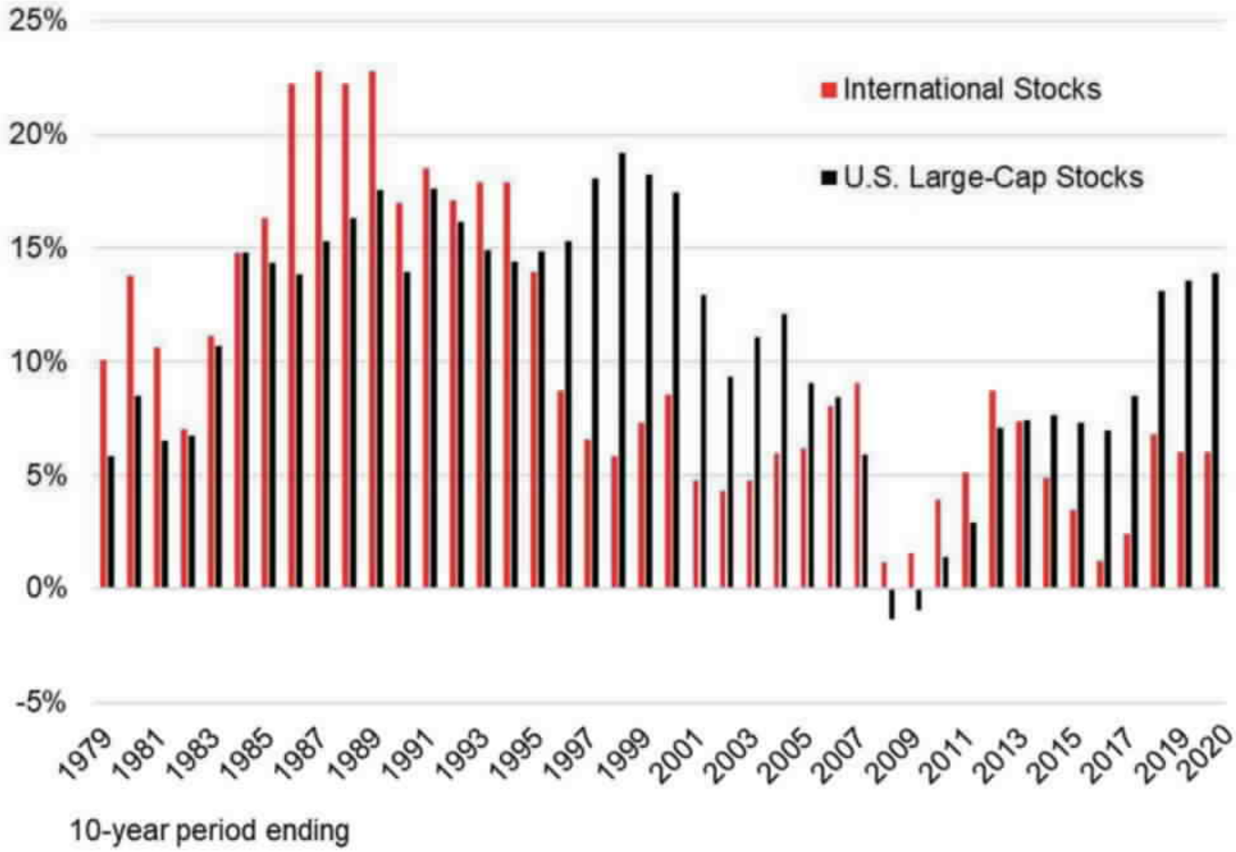


Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes and inflation represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD, (iii) (30-day) Treasury Bills: IA SBBI® US 30 Day TBill TR USD, and (vii) Inflation: IA SBBI® US Inflation. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** The international stock series is represented by the MSCI EAFE® equities index. To learn more about MSCI, visit msci.com.

An additional perspective of the relative returns of U.S. large-cap stocks and international stocks is provided in Exhibit 12.3, which shows the annual compound performance of international and U.S. large-cap stocks over rolling 10-year holding periods ending 1979 through 2020.

International stocks outperformed in each of the 10-year periods ending 1979 through 1994, but U.S. large-cap stocks outperformed International stocks in 20 out of the 26 10-year periods ending 1995 through 2020, sometimes quite significantly. For example, in the twelve-year period since 2008, U.S. large-cap stocks have outperformed international stocks by a factor of two (approximately 15% annual compound return versus just over 8% annual compound return, respectively).

Exhibit 12.3: U.S. Large-Cap Stocks and International Stocks, 10-Year Holding Period Compound Annual Total Returns (%) 1970–2020

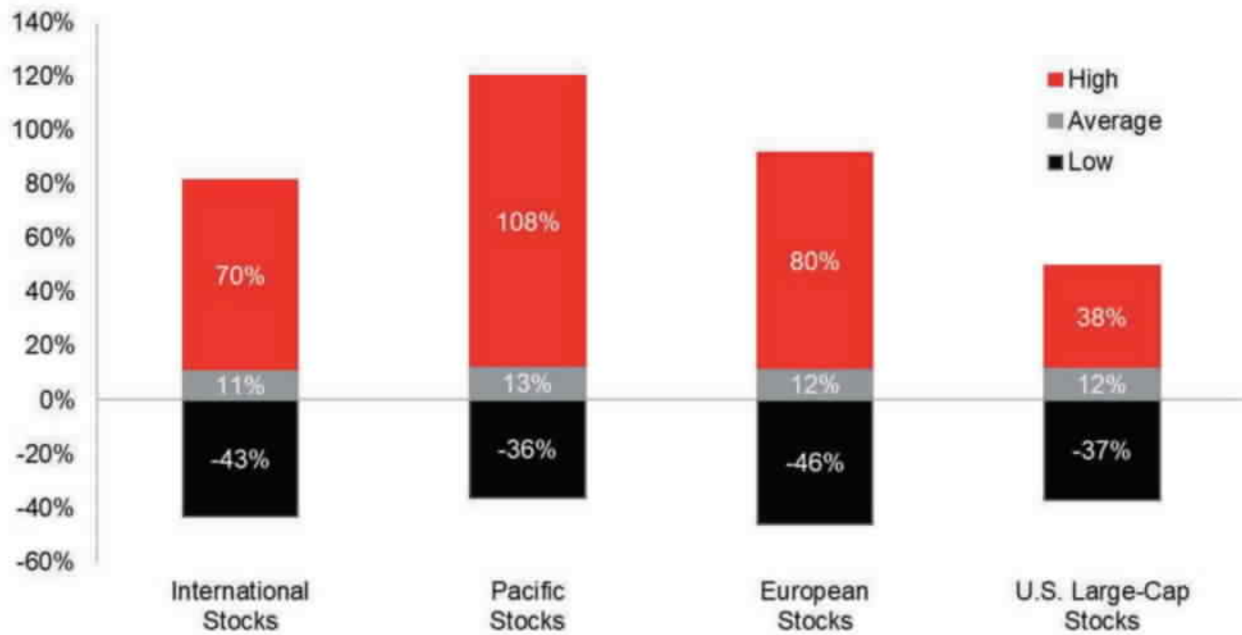


Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** The international stock series is represented by the MSCI EAFE® equities index. To learn more about MSCI, visit msci.com.

Just as U.S. stock prices fluctuate from one period to the next, prices of international stocks are subject to significant gains and declines. However, past returns from international stocks have fluctuated even more so than the returns of U.S. stocks. Annual ranges of returns provide an indication of the historical volatility (risk) experienced by investments in various markets.

Exhibit 12.4 illustrates the range of annual returns for U.S. large-cap stocks and international stocks, as well as European and Pacific regional equity composites, over the period 1970 through 2020. Although all of the composites have similar compound returns over the period, the three international composites exhibit greater volatility than the U.S. composite. All investments have the potential of dramatic ups and downs; however, a long-term approach to investing may help reduce the pain of volatility.

Exhibit 12.4: Global Stock Market Returns: Annual Ranges of Returns (%) 1970–2020



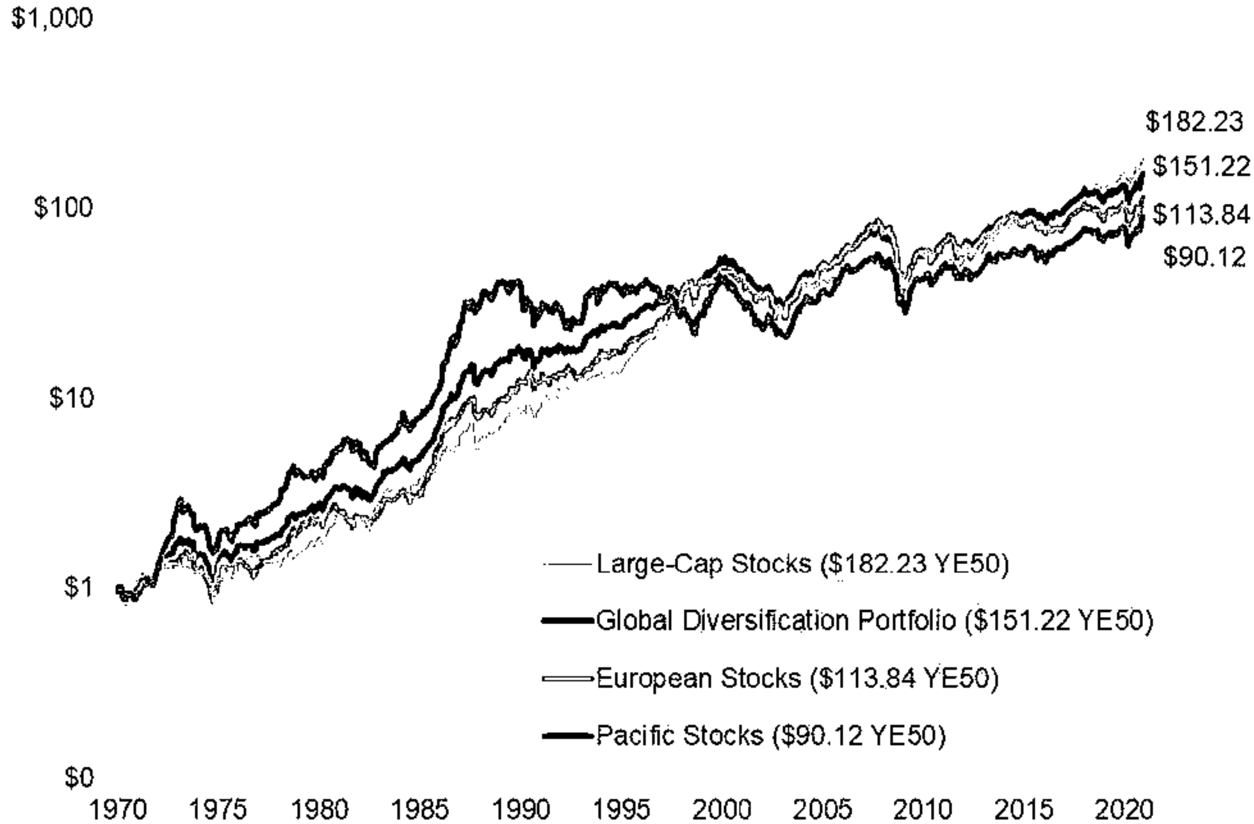
Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** International stocks are represented by the MSCI EAFE® equities index. Pacific stocks are represented by the MSCI Pacific GR USD index. European stocks are represented by the MSCI Europe GR USD index. To learn more about MSCI, visit msci.com.

Diversification

Diversification can be another important benefit of international investing. By spreading risks among foreign and U.S. stocks, investors can potentially lower overall investment risk and/or improve investment returns. Fluctuations may occur at different times for different markets, and if growth is slow in one country, global investing provides a means of possibly participating in stronger market returns elsewhere. Investing abroad may help an investor balance such fluctuations. Because it is almost impossible to forecast which markets will be top performers in any given year, it can be very valuable to be invested in a portfolio diversified across several countries.

Exhibit 12.5 depicts the growth of $1.00 invested at year-end 1969 in U.S. large-cap stocks, European, and Pacific stocks as well as a "global diversification portfolio" that is comprised of an equally weighted mix of the U.S. large-cap stocks, European, and Pacific stocks. Notice that the U.S. large-cap stocks index was the top performer, followed (in order of performance) by the global diversification portfolio, Europe, and Pacific indexes at the end of the 51-year period.

Exhibit 12.5: Benefits of Global Diversification Index (Year-end 1969 = $1.00) 1970–2020

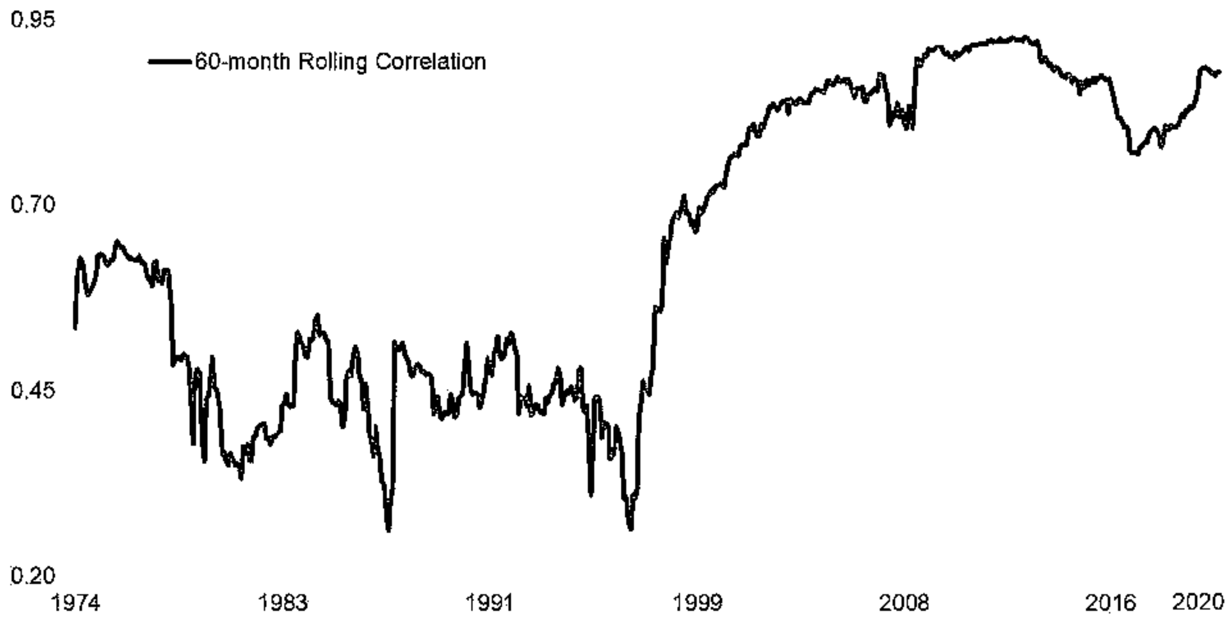


Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** International stocks are represented by the MSCI EAFE® equities index. Pacific stocks are represented by the MSCI Pacific GR USD index. European stocks are represented by the MSCI Europe GR USD index. To learn more about MSCI, visit msci.com.

The cross-correlation coefficient between two series, covered in Chapter 6, measures the extent to which they are linearly related. The correlation coefficient measures the sensitivity of returns on one asset class or portfolio to the returns of another.

Exhibit 12.6 examines the 60-month rolling period correlation between international and U.S. large-cap stocks. Exhibit 12.6 illustrates the recent rise in cross-correlation between the two, suggesting that the benefit of diversification has suffered in recent years. The maximum benefit to an investor would have come in the 60-month period ending July 1987 where the cross-correlation was 0.26. The least amount of diversification benefit would have come in the 60-month period ending February 2013 where the cross correlation was 0.93. The monthly average over the entire period was 0.65.

Exhibit 12.6: Rolling 60-Month Correlations: U.S. Large-Cap Stocks and International Stocks 1970–2020



Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** International stocks are represented by the MSCI EAFE® equities index. To learn more about MSCI, visit msci.com.

As discussed previously in regard to REITs (see Chapter 2), diversification is "spreading a portfolio over many investments to avoid excessive exposure to any one source of risk."[235] Put simply, diversification is "not putting all your eggs in one basket." Diversification offers the potential of higher returns for the same level of risk, or lower risk for the same level of return.

A low correlation between assets in a portfolio allows for the possibility of an increase in returns without a corresponding increase in risk, or alternatively, a reduction in risk without a corresponding decrease in return.

[235] Cara Griffith, "Practical Tax Considerations for Working with REITs," State Tax Notes (October 31, 2011): 315–320, quoting Jennifer Weiss: 316. In 2009, the IRS issued guidance that indicates that the distributions may be in the form of cash or stock in certain instances.

Risks Typically Associated with International Investment[236]

The risks associated with international investing can largely be characterized as *financial, economic,* or *political.* Many of these are the types of risks associated with investing in general – the possibility of loan default, the possibility of delayed payments of suppliers' credits, the possibility of inefficiencies brought about by the work of complying with unfamiliar (or burdensome) regulation, unexpected increases in taxes and transaction fees, differences in information availability, and liquidity issues, to name just a few. Some risks, however, are typically associated more with global investing – currency risk, lack of good accounting information, poorly developed legal systems, and even expropriation, government instability, or war.

Financial Risks

Financial risks typically entail an issue that is specifically money-centric (e.g., loan default, inability to easily repatriate profits to the home country, etc.). Among these types of risks, currency risk is probably the most familiar. Currency risk is the *financial* risk that exchange rates (the value of one currency versus another) will change unexpectedly.

For example, when a French investor invests in Brazil, he or she must first convert Euros into the local currency, in this case the Brazilian Real (BRL). The returns that the French investor experiences in local currency terms are identical to the returns that a Brazilian investor would experience, but the French investor faces an additional risk in the form of currency risk when returns are "brought home" and must be converted back to Euros.[237]

Expected changes in exchange rates can often be hedged. However, even when currency hedging is used, exchange rate risk often remains. To the extent the Euro unexpectedly *increases* in value versus the Real (i.e., the Euro appreciates against the Real), the French investor is able to purchase fewer Euros for each Real he realized in the Brazilian investment when returns from the investment are repatriated, and his return is thus *diminished.*[238,239]

Conversely, to the extent the Euro unexpectedly *decreases* in value versus the Real (i.e., the Euro depreciates against the Real), the French investor is able to purchase more Euros for each

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236 The following section is largely excerpted from the D&P/Kroll online Cost of Capital Navigator's International Cost of Capital Module's "Resources" section. For more information and to purchase the Cost of Capital Navigator's International Cost of Capital Module, visit dpcostofcapital.com.

237 For this example, we assume that the French and local investor are both subject to the same regulations, taxes, and local risks when investing in the same local asset.

238 We say "unexpectedly" for a reason. If the investor had been able to predict (at the time of investing) the precise exchange rate at which he/she would be repatriating his/her returns, these "expected" changes to the exchange rate would have been reflected in the expected cash flows of the investment at inception.

239 For example, say the French investor had achieved a 10% return in local (Brazilian) terms on his investment in a given year, but the Euro had unexpectedly appreciated by 3% in value relative to the Real over the same period. When the returns are repatriated, the French investor's overall return is diminished to approximately 6.7% [(1+10%)*(1-3%)-1] in Euro terms. Conversely, had the Euro depreciated in value versus the Real by 3%, the repatriated returns would be enhanced to approximately 13.3% [(1+10%)*(1+3%)-1]

Real he realized in the Brazilian investment when returns from the investment are repatriated, and his return is thus *enhanced*.

For example, in 2007 Brazilian equities returned an astonishing 50% return in local terms (see Exhibit 12.7). Because the Euro *depreciated* against the Real in 2007, French-based investors in Brazilian stocks experienced an even *higher* return (62%) when they repatriated their returns and converted them to Euros. Similarly, in 2009 the Euro *depreciated* relative to the South African Rand (ZAR), and French-based investors realized higher returns in Euros once again versus the local South African investors. In a more recent example, U.S.-based investors investing in U.S. equities realized an approximate return of just 1.0% in 2015, but French investors making a similar investment in the U.S. realized an approximate 13% return when they repatriated their returns and converted them to Euros (the Euro *depreciated* against the U.S. Dollar in 2015, so the French investors could purchase *more* Euros with their Dollars when they repatriated their returns).

It is important to note that currency conversion effects can also work to *diminish* realized returns. For example, in 2015 Brazilian equities returned -12% in local terms. Because the Euro *appreciated* against the Real in 2015, French-based investors in Brazilian stocks experienced an even *lower* return (-34%) when they repatriated their returns and converted them to Euros.

Exhibit 12.7: Currency Conversion Effects

Year	Currency	Return in Local Terms	Return to French Investors (EUR)	Currency Conversion Effect
2007	Brazil (BRL)	50%	62%	12%
2009	South Africa (ZAR)	26%	53%	27%
2015	Japan (JPY)	10%	22%	12%
2015	Switzerland (CHF)	2%	13%	11%
2015	Brazil (BRL)	-12%	-34%	-22%
2015	Argentina (ARS)	52%	11%	-41%
2015	United States (USD)	1%	13%	12%
2016	United Kingdom (GBP)	19%	3%	-16%

Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** Morgan Stanley Capital International (MSCI) Brazil, South Africa, Japan, Switzerland, Brazil, and Argentina, gross return (GR) equity indices. For more information about MSCI, visit msci.com.

A common misstep we often encounter is companies constructing forward looking budgets or projection analyses in local currencies, and then converting these projections to the currency of the parent company using the spot rate.

This mistakenly assumes that the exchange rate will not change in the future. Projections, which are inherently forward-looking, need to embody expected currency conversion rates. We are interested in currency risks over the period of the projected net cash flows, not just in the spot market. Even then, these are merely estimates of future currency exchange rates and the actual exchange rate can vary from these estimates.

Does currency risk affect the cost of capital? One team of researchers found that emerging market exchange risks have a significant impact on risk premiums and are time varying (for countries in the sample). They found that exchange risks affect risk premiums as a separate risk factor and represent more than 50% of total risk premiums for investments in emerging market equities. The exchange risk from investments in emerging markets was found to even affect the risk premiums for investments in developed market equities.[240]

While exchange rate volatility appears to be partly systematic, researchers have found that despite not being a constant, the currency risk premium is small and seems to fluctuate around zero.[241] A recently published academic paper set out to study whether corporate managers should include foreign exchange risk premia in cost of equity estimations. The authors empirically estimated the differences between the cost of equity estimates of several risk-return models, including some models that have an explicit currency risk premia and others that do not. They found that adjusting for currency risk makes little difference, on average, in the cost of equity estimates, even for small firms and for firms with extreme currency exposure estimates. The authors concluded that, at a minimum, these results applied to U.S. companies, but future research would still have to be conducted for other countries.[242]

Rather than attempting to quantify and add a currency risk premium to the discount rate, using expected or forward exchange rates to translate projected cash flows into the home currency will inherently capture the currency risk, if any, priced by market participants.[243]

Economic Risks

Global investors may also be exposed to *economic* risks associated with international investing. These risks may include the volatility of a country's economy as reflected in the current (and expected) inflation rate, the current account balance as a percentage of goods and services, burdensome regulation, and labor rules, among others. In the current environment, an economic risk that has come to the forefront is the sovereign debt crisis. The recent economic and financial crisis in Greece, for example, has prompted many governments around the world to re-think their

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240 Francesca Carrieri, Vihang Errunza, and Basma Majerbi, "Does Emerging Market Exchange Risk Affect Global Equity Prices?" *Journal of Financial Quantitative Analysis* (September 2006): 511–540.

241 Sercu, Piet (2009), *International Finance: Theory into Practice*, Princeton, NJ: Princeton University Press, Chapter 19.

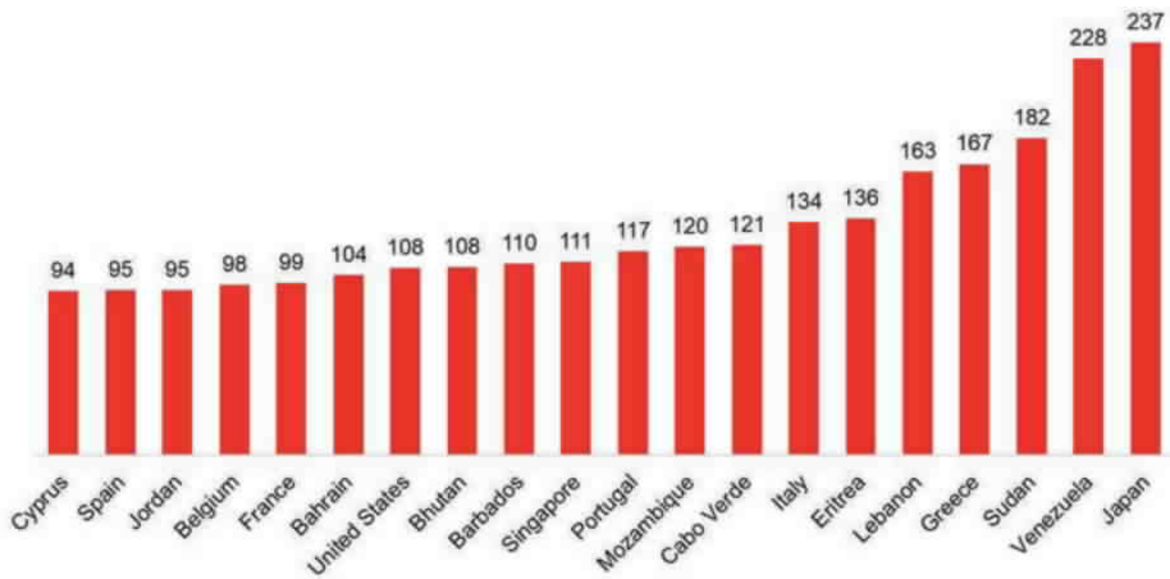
242 Krapl, A. and O'Brien, T. J. (2016), "Estimating Cost of Equity: Do You Need to Adjust for Foreign Exchange Risk?," *Journal of International Financial Management & Accounting*, 27: 5–25.

243 This assumes that the valuation is being conducted in the home currency, by discounting projected cash flows denominated in the home currency, with a discount rate also denominated in home currency. Alternatively, the analyst can conduct the entire valuation in foreign currency terms (projected cash flows and discount rate are both in foreign currency terms), in which case the estimated value would be translated into the home currency using a spot exchange rate.

own fiscal policies as it becomes evident that current debt loads are likely unsustainable in many of these countries.

In Exhibit 12.8a, the 20 countries with the *overall* highest estimated government debt-to-GDP ratios are shown (regardless of the size of their economies), as of 2020. For example, the United States has a debt-to-GDP ratio of 108% (i.e., the United States' government debt is 8% *larger* than the United States' annual GDP), and France has a debt-to-GDP ratio of 99% (i.e., France's government debt is 1% *less* than France's annual GDP).

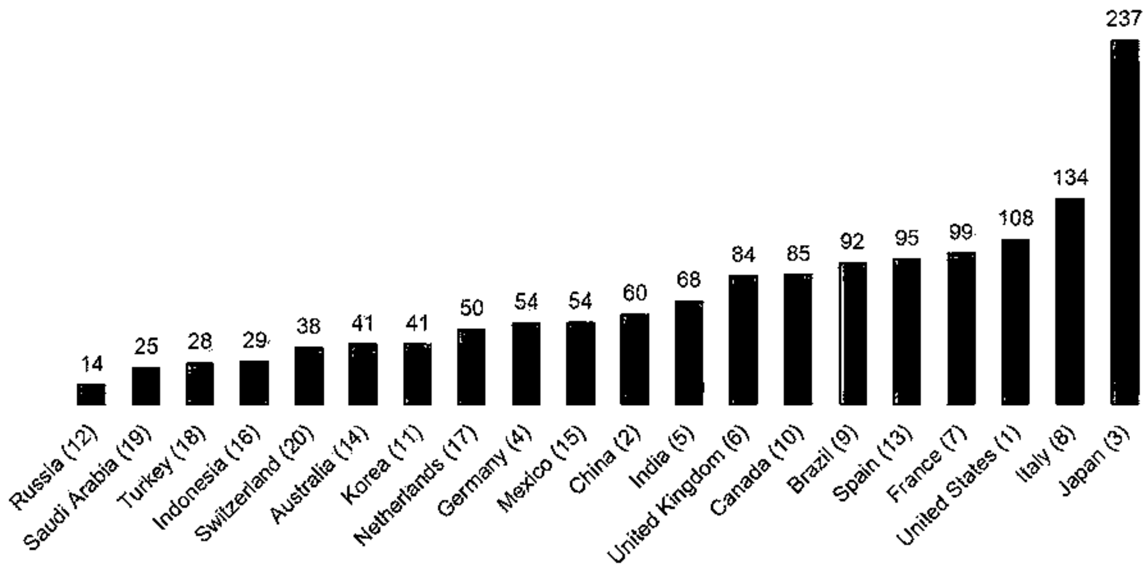
Exhibit 12.8a: 2020 Government Debt-to-GDP (in percent)



Source of underlying data: World Economic Outlook Database from the International Monetary Fund (IMF). For additional information, please visit: http://www.imf.org/external/pubs/ft/weo/2019/02/weodata/download.aspx.

In Exhibit 12.8b, the estimated government debt-to-GDP ratios for the 20 countries with the *largest* economies (as measured by GDP) are shown, also as of calendar year 2020. The rank of GDP size is shown in parentheses after each country's name. Switzerland (with a ranking of "20") is the smallest GDP, and the United States (with a ranking of "1") is the largest GDP.

Exhibit 12.8b: 2020 Government Debt-to-GDP (in percent), 20 countries with largest GDP



Source of underlying data: World Economic Outlook Database from the International Monetary Fund (IMF). For additional information, please visit: http://www.imf.org/external/pubs/ft/weo/2019/02/weodata/download.aspx.

There are costs that tend to go hand-in-hand with what might be considered unsustainable debt levels by governments. Lenders may demand a higher expected return to compensate them for additional default risk when investing not only in the country's sovereign debt, but also in businesses operating in those countries.

Governments may decide to increase the money supply in an effort to inflate their way out of debt. Ultimately, some governments may decide on outright currency devaluation or even a repudiation of debt (i.e., defaulting on their debt obligations). These risks are not entirely limited to less developed countries, but less developed countries may be more willing to resort to these extreme measures than developed countries.

Political Risks

Political risks can include government instability, expropriation, bureaucratic inefficiency, corruption, and even war. A relatively recent example of the effects of political risk is Venezuela's expropriation of various foreign owned oil, gas, and mining interests. These actions tend to reduce Venezuela's attractiveness to foreign investors who will likely demand a significantly higher expected return in exchange for future investment in the country – in effect raising their cost of capital estimates for projects located in Venezuela.

Exhibit 12.9 summarizes some of the risks that investors may view as unique or country-specific.

Exhibit 12.9: Reasons Typically Cited for Adding a Country Risk Premium Adjustment

Political Risks

- Repudiation of contracts by governments
- Expropriation of private investments in total or part through change in taxation
- Economic planning failures
- Political leadership and frequency of change
- External conflict
- Corruption in government
- Military in politics
- Organized religion in politics
- Lack of law-and-order tradition
- Racial and national tensions
- Civil war
- Poor quality of the bureaucracy
- Poorly developed legal system
- Political terrorism

Financial Risks

- Currency volatility plus the inability to convert, hedge, or repatriate profits
- Loan default or unfavorable loan restructuring
- Delayed payment of suppliers' credits
- Losses from exchange controls
- Foreign trade collection experience

Economic Risks

- Volatility of the economy
- Unexpected changes in inflation
- Debt service as a percentage of exports of goods and services
- Current account balance of the country in which the subject company operates as a percentage of goods and services
- Parallel foreign exchange rate market indicators
- Labor issues

International and Domestic Series Summary Data

Exhibit 12.10 shows summary statistics of annual total returns for various international regions and composites. The summary statistics presented are geometric mean, arithmetic mean, and standard deviation. From 1970 to 2020, the Pacific regional composite was the riskiest, with a standard deviation of 28.5 percentage points. The annual geometric mean of the Pacific regional composite over the 1920–2020 time period was 9.2%, less than the other composite analyzed, which were considerably less risky.[244]

[244] At the 2-digit level, the Pacific regional composite's annual geometric mean over the 1970–2020 time period was 9.17%, and Canada's annual geometric mean was 9.18%.

Exhibit 12.10: Summary Statistics of Annual Returns
1970–2020 (%)

Series	Geometric Mean	Arithemtic Mean	Standard Deviation
EAFE	9.3	11.4	21.5
Pacific	9.2	12.6	28.5
Europe	9.7	11.8	21.2
World	9.8	11.3	17.4
Canada	9.1	11.3	21.3
U.S.	10.7	12.1	16.9

Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes and inflation represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** Morgan Stanley Capital International (MSCI) Europe, Australasia and Far East (EAFE) index, and MSCI Pacific, Europe, World, and Canada GR indices. To learn more about MSCI, visit msci.com.

Exhibit 12.11 ranks the performance (as measured by compound annual rates of return) of U.S., EAFE, Pacific, Europe, World, and Canada equities for each decade from best performer (at top) to worst performer (at bottom). For example, in the 2010s the best performer was U.S. Large-Cap Stocks, and the worst performer was Canada.

Exhibit 12.11: The Relative Performance of U.S., EAFE, Pacific, Europe, World, and Canada Equities by Decade (Best Performer at Top, Worst Performer at bottom)

1970s	1980s	1990s	2000s	2010s
Pacific	Pacific	U.S.	Canada	U.S.
Canada	EAFE	Europe	Europe	World
EAFE	World	World	EAFE	Pacific
Europe	Europe	Canada	World	EAFE
World	U.S.	EAFE	Pacific	Europe
U.S.	Canada	Pacific	U.S.	Canada

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Exhibit 12.12 shows the annualized monthly standard deviations by decade for the various international regions and composites.

The World composite was the least risky in the 1970s, 1980s, and the 1990s. The Canadian index was the riskiest in the 2000s, while Europe was the riskiest in the most recent decade. The Pacific regional composite was the least risky in the most recent decade.[245]

Exhibit 12.12: Annualized Monthly Standard Deviation by Decade (%)

Series	1970s	1980s	1990s	2000s	2010s
EAFE	17.4	21.6	18.7	18.5	15.6
Pacific	22.1	26.6	24.8	18.2	14.1
Europe	18.6	21.5	16.8	20.4	17.5
World	15.1	17.6	15.7	16.9	14.4
Canada	20.6	24.8	18.6	25.9	16.3
U.S.	17.1	19.4	15.9	16.3	14.1

Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** Morgan Stanley Capital International (MSCI) Europe, Australasia and Far East (EAFE) index, and MSCI Pacific, Europe, World, and Canada GR indices. To learn more about MSCI, visit msci.com.

Exhibit 12.13 presents annual cross-correlations and serial correlations from 1970 to 2020 for the six basic SBBI® series and inflation as well as international stocks, as defined by the MSCI EAFE Index. International stocks, when compared to U.S. large-cap stocks, provided a higher cross-correlation than when compared to U.S. small-cap stocks. The serial correlation of international stocks suggests no pattern, and the return from period to period can best be interpreted as random or unpredictable.

[245] At the 2-digit level, the Pacific regional composite's annualized monthly standard deviation over the 1970–2019 time period was 14.11%, and the U.S. large stock composite's annualized monthly standard deviation was 14.14%.

Exhibit 12.13: Basic Series and International Stocks: Serial and Cross-Correlations of Historical Annual Returns 1970–2020

	Int'l Stocks	Large-Cap Stocks	Small-Cap Stocks	Long-term Corp Bonds	Long-term Gov't Bonds	Inter-term Gov't Bonds	U.S. Treasury Bills	Inflation
International Stocks	1.00							
Large-Cap Stocks	0.67	1.00						
Small-Cap Stocks	0.52	0.72	1.00					
Long-term Corp Bonds	0.06	0.27	0.09	1.00				
Long-term Gov't Bonds	-0.11	0.04	-0.13	0.89	1.00			
Inter-term Gov't Bonds	-0.11	0.03	-0.08	0.82	0.85	1.00		
U.S. Treasury Bills	0.03	0.03	0.04	0.04	0.08	0.43	1.00	
Inflation	-0.05	-0.12	0.06	-0.31	-0.26	-0.01	0.70	1.00
Serial Correlation	0.04	-0.02	-0.01	-0.11	-0.28	0.10	0.89	0.75

Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes and inflation represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Small-Cap Stocks: IA SBBI® US Small Stock TR USD, (iii) Long-term (i.e., 20-year) Corporate Bonds: IA SBBI® US LT Corp TR USD, (iv) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD, (v) Intermediate-term (i.e., 5-year) Government Bonds: IA SBBI® US IT Govt TR USD, (vi) U.S. (30-day) Treasury Bills: IA SBBI® US 30 Day TBill TR USD, and (vii) Inflation: IA SBBI® US Inflation. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** The international stock series is represented by the MSCI EAFE® equities index. The MSCI EAFE Index is an equity index which captures large- and mid-cap representation across Developed Markets countries around the world, excluding the US and Canada. With 918 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country. To learn more about MSCI, visit msci.com.

Conclusion

Country risk is generally described as financial, economic, or political in nature. These rules may create incremental complexities when developing cost of capital estimates for a business, business ownership interest, security, or an intangible asset based outside of a mature market such as the United States.

International investments are no different from any other investment when it comes to information gathering. Investors interested in or already taking part in the international marketplace should learn as much as possible about the corresponding significant rewards and risks. International investments are not for everyone, and the most appropriate mix for an individual investor depends on his or her risk tolerance, investment goals, time horizon, and financial resources.

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Schroders

10-year return forecasts (2023–32)

December 2022

Executive summary

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The Schroders Multi-Asset long-term capital market assumptions are forward-looking estimates of total returns which are an important component for the team's strategic asset allocation modelling and portfolio construction.

This note presents our latest 10-year capital market returns forecasts in local currency terms and provide a brief outline of our methodology. Our approach was developed using a framework predominantly based on market measures allowing for a transparent, timely and systematic process updated twice a year.

Return expectations across asset classes have been raised relative to our Jun-2022 forecasts largely due to further increases in government bond yields. The increased equity return forecasts have also been driven by continued falls in valuations since our last publication.

Cash returns

Developed market

On the basis that we are using the government bond return as an anchor, cash returns are estimated by determining an appropriate term premium. This has been distorted in recent years by central bank asset purchase programmes which have depressed the gap between short and long rates. Consequently, we have taken a pre-financial crisis term premium for the US and UK. For the eurozone and Japan where distortions still exist, and will continue to do so for some time in our view, we have used a smaller term premium than would be warranted by the historical data.

10-year forecast returns: 2023–2032 (p.a. %)

	US	EUR	UK	JP
Cash returns	2.6	1.8	2.2	0.3

Source: Schroders, Thomson Reuters DataStream.

Fixed income returns

Developed market and EM local government bonds

The yield to maturity (YTM) for a risk-free bond considers the coupon income and capital gain or loss that the investor will realise by holding the bond to maturity. However, this also assumes that all coupons can be re-invested at the YTM to the maturity date. Therefore, the relationship between initial yield on a 10-year US Treasury bond and its subsequent 10-year return will vary depending on the extent yields rise or fall in the subsequent 10 years. Despite this uncertainty in subsequent yield moves, Bogle (1991, 2015)[1] showed the strong empirical relationship between the initial yield on a 10-year US Treasury bond and its subsequent 10-year return since 1900.

We adopt this straightforward and intuitive approach to estimating 10-year returns expectations for government bonds in our framework. Specifically, we use the YTM on the 7–10 year Merrill Lynch index to estimate US, EUR, UK and JP bond returns for each calendar year. The return forecast for emerging market local debt was estimated by using the yield to maturity for the JPM GBI-EM Global Diversified Composite index. These estimates of 10-year government bonds act as a key 'anchor' for many of our other asset class return forecasts.

10-year forecast returns: 2023-2032 (p.a. %)

	US	EUR	UK	JP	EM local
Government bond forecasts	3.8	3.2	3.6	0.5	6.9

Source: Schroders, ICE indices, JP Morgan indices.

Inflation-linked government bonds

The yields on US Treasury Inflation Protected Securities (TIPS) have declined dramatically since they were first issued in 1997. TIPS transaction volume was very low relative to nominal Treasuries during an initial period between 1999 and 2004. A high liquidity premium explains why US TIPS have exhibited higher excess returns than nominal Treasuries over this initial period and during the financial crisis in 2008–09.

To mitigate the impact of the initial period after TIPS were first issued, we estimate the return basis between US Treasury bonds and inflation-linked bonds by taking an expanding average from 2004 of monthly excess returns (annualised) between MLX 7–10 year UST index and MLX 7–10 year TIPS index.

We use a similar methodology for the return basis for nominal gilts over inflation-linked gilts, ignoring the stellar returns earned by UK linkers in 2016 after the UK referendum.

10-year forecast returns: 2023–2032 (p.a. %)

	US	UK
Inflation-linked bond forecasts	4.2	4.1

Source: Schroders, ICE indices.

[1]Bogle, J.C., 1991. Investing in the 1990s: Occam's razor revisited. Journal of Portfolio Management, 18(1), pp.88–91.
Bogle, J.C. and Nolan, M.W., 2015. Occam's Razor Redux: Establishing Reasonable Expectations for Financial Market Returns. Journal of Portfolio Management, 42(1), p.119.

Credit returns

Investment grade, high yield and emerging market debt

In estimating 10-year credit total returns, we consider the following return components: government bond returns, returns due to additional spread yield and returns due to downgrades and defaults.

Returns due to the additional spread yield component are estimated using the current option-adjusted spread for a 7–10 year corporate bond index. For investment grade (IG) we take account of the effects of ratings downgrades in forecasting returns. Credit losses from defaults are estimated using long term S&P IG and high yield (HY) default and recovery rates.

10-year forecast returns: 2023–2032 (p.a. %)

	US	EUR	UK	EMD
Investment grade bond forecasts	5.1	4.4	4.9	6.6
High yield bond forecasts	6.6			

Source: Schroders, ICE indices, S&P.

Equity returns

We estimate equity returns by decomposing the country-level total return estimates into the following components:

$$equity\ return\ forecasts = bond\ yield + long\ term\ equity\ return\ premium$$
$$+ valuation\ adjustment$$

Long term country/ region-level equity risk premia (ERP) are estimated by taking an expanding window average of the rolling 12 month equity returns in excess of 10 year government yields. Given the lack of long term data in emerging markets over multiple cycles, we estimate the long-term emerging market ERP using a beta-adjustment to the long-term US ERP.

We believe valuations are an important return component for equities over a 10 year horizon and therefore adjust the long-term ERPs to account for valuations. The Cyclically-Adjusted Price Earnings (CAPE) ratio is a widely used metric that judges whether or not an equity market is fairly valued and forms the basis for our valuation adjustment. Theory supports the idea that valuations, and therefore the required return on equities, should vary with the macro environment. We therefore also estimate a 'macro-sensitive' CAPE for each country/ region and assume current CAPE levels will revert to their respective 'macro-sensitive' levels in order to determine each equity market's valuation adjustment. Given the lack of long term data in EM markets to estimate a robust 'macro-sensitive' CAPE, we assume emerging market country CAPE levels revert to their rolling 10 year average.

10-year forecast returns: 2023–2032 (p.a. %)

	Global	US	EUR	UK	JP	EM
Equity forecasts	9.3	9.1	8.3	9.7	8.2	11.8

Source: Schroders, MSCI indices, ICE indices.

Alternatives

Commodities

We decompose the total returns to commodities into the following components:

$$Commodity\ total\ return\ forecasts = cash\ return + roll\ return + spot\ return$$

The roll yield return reflects the return from rolling from the current futures contract to a longer-term contract to maintain exposure to the commodity after the current contract has expired. The spot return simply reflects the change in the price of the commodity futures for immediate delivery. We estimate the roll return through the long run historical difference between excess returns of the Bloomberg Commodity index, which includes the roll return, and the spot return, which measures only price return. Additionally we model the forecast spot return using the long-run annualised historical average of monthly spot returns of the Bloomberg Commodity index back to 1990.

Private equity

For private equities, we estimate the illiquidity premium by taking the long-term average excess returns over US equities and using the LPX50 index as our asset proxy.

Hedge funds

We use a 50/50 blend of the HFRI Fund of Funds composite index and the Credit Suisse Multi-Strategy Hedge Fund index as a proxy for the asset class returns. We estimate returns from hedge funds by taking the long-run average excess returns of this blended index over US cash.

10-year forecast returns: 2023–2032 (p.a. %)

	Commodities	US private equity	Hedge funds
Alternative asset forecasts	4.5	9.7	7.0

Source: Schroders, Bloomberg indices, HFRI indices, CS indices.

Volatility forecasts

For all assets we make an assumption that volatility will match that of the past 10 years. The measure we use is annualised monthly volatility of the asset's local currency returns, where available.

10-year local currency return and risk forecasts: 2023–2032 (p.a. %)

		Forecast return	Forecast volatility
Cash	US	2.6	0
	EUR	1.8	0
	UK	2.2	0
	JP	0.3	0
Government bonds	US	3.8	5.9
	EUR	3.2	5.5
	UK	3.6	6.7
	JP	0.5	1.9
	EM local (USD)	6.9	11.5
Inflation-linked bonds	US	4.2	6.1
	UK	4.1	6.7
Investment grade bonds	US	5.1	6.8
	EUR	4.4	7.3
	UK	4.9	7.9
High yield bonds	US	6.6	8.5
	EMD	6.6	9.0
Equity	Global	9.3	15.0
	US	9.1	15.0
	EUR	8.3	14.3
	UK	9.7	12.3
	JP	8.2	15.8
	EM	11.8	16.7
Alternatives	Commodities	4.5	14.1
	Private equity	9.7	21.3
	Hedge funds	7.0	8.8

Source: Schroders, Bloomberg indices, CS indices, HFRI indices, ICE indices, JP Morgan indices, MSCI indices, S&P.

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Schwab's 2023 Long-Term Capital Market Expectations

January 4, 2023 Eva A. XuSeth McMoore

Our current 10-year outlook highlights better opportunities for bonds and a steady outlook for stocks. We continue to project better return opportunities for international stocks.

To reach long-term financial goals, investors should have reasonable expectations for long-term market returns. Having overly optimistic expectations could lead investors to save too little, on the belief that their investments will grow fast enough to fund retirement or a child's college education. On the other hand, overly pessimistic expectations may cause an investor to save too much, at the expense of current spending and enjoyment.

To provide a guide for investors, our analysts at Charles Schwab Investment Advisory, Inc. annually update their long-term Capital Market Expectations (CMEs) to accommodate the ever-changing market environment and to provide investors with the most up-to-date projections. Schwab's long-term CMEs are quantitative forecasts that provide reasonable expectations for risks and returns over the next 10 years. These forecasts can play an essential role in a variety of decisions, such as determining optimal portfolio allocations and creating realistic retirement plans.

Our latest estimates are constructed using data as of October 31, 2022. These estimates, summarized in the chart below, cover the period from 2023 through 2032.

Over the next decade, we continue to expect market returns to fall short of long-term historical averages. Compared to last year's expectations, our outlook highlights better opportunities for bonds, driven primarily by higher starting yields. While expected stock returns were helped by more attractive starting valuations (i.e., lower market prices due to stock market declines during 2022), they were also hurt by company-level and macroeconomic headwinds, leading to slower-than-expected earnings growth. The net result may be a similar return outlook for stocks. As such, Schwab continues to project better return opportunities for international stocks over the next 10 years, relative to domestic stocks. Given recent market changes, now may be a good time for investors to review their long-term financial goals to ensure that they are based on projections grounded in disciplined methodology.

Historical and projected returns

Source: Charles Schwab Investment Advisory, Inc. Historical data from Morningstar Direct. All data as of 10/31/2022.

* Estimates published for 2022. Total return = price growth + dividend and interest income. The example does not reflect the effects of taxes or fees. Numbers rounded to the nearest one-tenth of a percentage point. Benchmark indexes: S&P 500® Total Return Index (U.S. Large-Company Stocks), Russell 2000® Total Return Index (U.S. Small-Company Stocks), MSCI EAFE Net Return Index® (International Large-Company Stocks), Bloomberg Barclays U.S. Aggregate Bond Total Return Index (U.S. Investment-Grade Bonds), and FTSE 3-Month U.S. Treasury Bill Index (Cash Equivalent). Note: U.S. Investment-Grade Bond return calculation starts in 1/30/1976 due to lack of prior data. **Past performance is no guarantee of future results.**

The past year proved to be challenging for investors as financial markets around the world, and across all major asset classes, suffered steep losses. The simultaneous decline of both stock and bond markets, a trend not frequently seen in the markets, was the result of myriad factors including rising interest rates, high inflation, slowing economic growth, and heightened geopolitical tensions. The volatility and asset repricing that occurred over this past year has led to some notable changes in our forecasts for 2023.

Macroeconomy. Inflation has been much higher and more persistent than many investors anticipated. Some factors fueling this are a decade of easy monetary policy, unexpected supply-chain disruptions, and tight labor markets. With the goal of lowering inflation, central banks, led by the Federal Reserve, have aggressively tightened monetary policy at the fastest pace in decades. A consequence of these interventions is an expectation of slower economic growth in the near term. When constructing our forecasts for inflation and real gross domestic product (GDP) growth over the next decade, we use a survey-based approach, which accounts for the entire 10-year path. This incorporates near-term effects of elevated inflation and dampened GDP prospects in our long-term estimate. Despite these disruptions in the short term, we expect inflation and GDP to return to a steady state. As such, inflation expectations remain similar to last year at 2.5% per year over the coming decade, while average annualized GDP growth expectations have come down from 2.3% to 1.8%.

Bonds. Bond yields surged in 2022 as central banks were forced to reassess their monetary policy, becoming more hawkish in response to high inflation. While bond investors incurred steep losses in 2022 due to asset repricing in response to rising interest rates, the resulting higher starting yields have doubled most of our bond expectations. For example, U.S. investment-grade bonds are expected to return 4.9% annually over the next decade, compared to our forecast last year of 2.3%. Similar to bonds, cash-equivalent investments such as Treasury bills also have benefited from these higher starting yields. A potential benefit of the shifting landscape is that real return forecasts (i.e., returns after removing the effect of inflation) are now positive for most bonds, providing a more attractive source of income.

Stocks. Stocks slumped worldwide during 2022, with the S&P 500® index down almost 20% by year end. Typically, a steep market decline would mean higher expected returns due to a lower and more attractive starting valuation. However, a lower market price isn't the only factor currently at play in the markets. Equity valuations are also driven by expected cash flows (i.e., earnings and dividends). Abrupt policy changes from central banks, going from supporting nominal growth at all costs to focusing on reining in inflation, have slowed economic growth expectations. The impact of all this feeds into our valuation model, suggesting that any potential attractiveness due to lower stock prices is offset by a more tepid earnings growth outlook. Note that while absolute return expectations remain similar to last year, the components that make up those returns have changed drastically. For example, expected equity risk premium, which indicates when stocks are expensive or cheap relative to a "risk-free" investment (such as a Treasury security), has steeply declined. This means that while stocks still tend to have higher expected returns than bonds, the spread has tightened greatly.

Historical and projected inflation and real GDP growth

Source: Charles Schwab Investment Advisory, Inc.

Historical inflation data from U.S. Bureau of Labor Statistics. Historical real GDP data from U.S. Bureau of Economic Analysis. Forecasted data from Consensus Economics. All data as of 10/31/2022.

* Estimates published for 2022. Numbers rounded to the nearest one-tenth of a percentage point. Annualized historical inflation based on monthly Consumer Price Index for All Urban Consumers. Annualized historical real GDP growth based on annual real Gross Domestic Product (Not Seasonally Adjusted). Note, real Gross Domestic Product (Not Seasonally Adjusted) for 2022 calculated using quarterly data through Q3 2022 (Second Estimate). **Past performance is no guarantee of future results.**

How do you calculate your long-term forecasts?

Schwab's long-term forecasts are constructed using a building-block approach, where return expectations are broken down into unique components. Each component is constructed using a quantitative and systematic approach, allowing for consistent forecasts across asset classes. To capture the broad movements of the market, we leverage reliable predictors such as equity valuations and bond yields when constructing the core return drivers of our framework. When possible, we use a forward-looking approach to forecasting returns, rather than basing our estimates solely on historical averages.

For **inflation and GDP** growth, we use a survey-based approach based on economist expectations. We find this approach beneficial for three reasons: (1) professional forecasters incorporate new, relevant information into their updated expectations; (2) these expectations tend to be consistent with prevailing views about economic policy; and (3) they provide a relatively stable forecast, which is a desirable feature for retirement planning and asset allocation models.

For **U.S. and international large-cap stocks**, we start with the belief that stock markets are a discounting mechanism, meaning the current price attempts to take into consideration all available information about present and future events. As such, we use a valuation-based model that discounts the future cash flows an investor is expected to receive to the current price of a stock. The effectiveness of this approach rests with the inputs that are used. We use forward-looking earnings estimates and macroeconomic forecast data to estimate two key cash-flow drivers: (1) recurring income (i.e., earnings) and (2) capital gains generated by selling the investment at the end of a predefined horizon, such as 10 years. To arrive at a return estimate, we answer the question: *What returns would investors make if they bought a stock at the current price and received these forecasted cash flows?*

For **U.S. small-cap stocks**, we leverage the valuation-based model used for large-company stocks as our base, then analyze and include a "size-risk premium." This is the return that investors in small-company stocks expect to earn over the returns on large-company stocks.

For **U.S. investment-grade bonds** (i.e., Treasuries, investment-grade corporate bonds, and securitized bonds), we believe the future level of return an investor will receive is anchored to a large extent by yields. For example, if an investor buys a 10-year Treasury note with a 3% yield-to-maturity and does not touch the investment until maturity, then the investor will realize a 3% return per year. Given this relationship, we consider the following components when forecasting bonds:

- ***Yield-to-maturity of a "risk-free" bond.*** Treasury notes are fixed-income securities issued by the U.S. government that generate what is considered a "risk-free" rate, because of the negligible chance of the U.S. government defaulting on its debt obligations. In determining a "risk-free" return, the U.S. Treasury does not provide yields for every maturity; therefore, we use a yield-curve-fitting model to account for the missing maturities. This fitted "risk-free" curve provides duration-matched yields for any fixed income asset class we need to model.

- ***Yield spread***. Riskier bonds typically yield more than a risk-free rate due to credit and/or default risk. This additional yield is called the yield spread. The yield spread compensates investors for the risk of default by the corporation that issued the bond, i.e., the possibility that a bond's issuer will be unable to pay its obligations on time, or at all. The lower the issuer's credit rating, the higher the credit risk premium investors typically require for accepting the risk of owning the issuer's debt. In a perfect world, the investor would receive the entire stated yield over the life of the bond, but due to possible default loss and other losses (such as downgrades in the case of investment-grade bonds), some bonds may only earn around 50% of the observed yield spread.

- ***Roll-down return.*** Because investors typically invest in bond portfolios designed to maintain an average duration, we include this additional return. To maintain a target duration, bond managers must periodically rebalance the portfolio by selling bonds as they move closer to their maturity dates. As there is an inverse relationship between bond yields and prices, this process typically results in a gain for an upward-sloping yield curve (where longer-term bonds have higher yields than shorter-term bonds). Note that the opposite holds true if the yield curve is downward-sloping.

For **cash investments,** because they are very short-term in nature (typically not exceeding three months), we assume reinvestment at the end of each period over a 10-year horizon. The expected return from this constant reinvestment is referred to as the expected short rate, which we forecast using a term-structure model.

Why do you expect long-term returns to be lower than historical averages?

When planning for the future, relying solely on historical returns can create unrealistic expectations. When actual returns do not match expectations, it can have big financial consequences—such as a delayed retirement or difficulty paying for big expenses such as a college education. Rather than base our forecasts solely on history, the CMEs leverage forward-looking information, such as consensus-driven earnings estimates and macroeconomic forecast data, to create a more robust picture of future returns. Over the next decade, Schwab expects market returns to fall short of long-term historical averages due to deviations from historical interest rates, economic growth prospects, and equity valuations.

- ***Interest rates.*** While current and expected interest rates are notably higher than they were just a year ago, they are still much lower than they have been historically, especially compared to the high-interest-rate environment of the 1980s. Although our estimates account for this higher-rate environment, they are still not likely to be as high as what we have seen historically.

- ***Economic growth.*** Stubbornly high inflation has led central banks to aggressively tighten monetary policy, slowing near-term economic growth worldwide. Additionally, consensus forecasts over the long term have also declined. A robust economy is fundamental to achieving healthy returns from financial markets. According to consensus forecasts, economists expect real GDP growth to be 1.8% per year, on average, over the next 10 years. This outlook is notably lower than its historical average growth rate of 2.6% per year since 1970.

- ***Equity valuations***. Any potential attractiveness due to price declines in 2022 seemed to be counteracted by a more tepid earnings growth outlook. While expected earnings growth slowed somewhat in the near term, growth rates came down most notably in the medium term (three to five years). The end result is a return outlook similar to last year's, as these lower earnings expectations already appear to be reflected by the current price. As such, Schwab continues to expect stock returns to remain below historical levels.

Why do you expect international stocks to outperform U.S. stocks?

We project U.S. large-company stocks to return 6.1% annually over the next 10 years, compared with 7.6% for international large-company stocks. This is mainly due to differences in valuations between U.S. stocks (as measured by the S&P 500 index) and international stocks (as measured by MSCI EAFE index). International stocks are generally riskier than U.S. stocks and investors expect to be compensated for taking on this additional risk. While we recognize that historical returns for international stocks have lagged domestic stocks, the expected cash flows given the current price suggest they have a better chance of outperforming over the next 10 years. This is still the case even after accounting for the additional risk.

What can investors do now?

Due to the power of compound returns—the cumulative effect that gains or losses have on an original investment—even relatively small differences can result in large changes over time. Therefore, what investors do (or don't do) today can have a sizeable impact on the likelihood of achieving their long-term investment goals. By incorporating realistic return assumptions into the financial-planning process, investors are better able to plan for their long-term financial goals.

If you don't have a long-term financial plan, now is a good time to start putting one together. If you already have one, then consider revising it based on Schwab's updated CMEs. As always, keep in mind that it is impossible to predict with 100% certainty what will happen with any individual investment. As such, CMEs should not be used for timing the market; instead, these estimates should be used as a guide to set reasonable long-term expectations for financial goals and asset allocation plans.

Our seven investing principles can help you get started and stay on track, but here are a few things to consider now.

- Establish a financial plan based on your goals. Be realistic about your goals and be prepared to change your plan as your life circumstances change. Use our updated expected returns to help you be more realistic when creating your financial plan.

- This year our expected returns for bonds went up, but that doesn't mean you should correspondingly reduce the amount you save. Expected returns fluctuate from year-to-year and are far from a guarantee. The more you save, the more cushion you can have in case actual returns don't meet what we expect.

- Build a diversified portfolio based on your tolerance for risk. Various asset classes—such as stocks, bonds, or cash—behave differently in changing market environments, and it has been nearly impossible to predict which asset classes will perform best in a given year. Instead of chasing past performance, create an appropriately diversified portfolio that can help minimize the effects of market ups and downs.

Has The Realized Equity Premium Been Shrinking?

Jun. 4, 2014 7:20 AM ET | 23 comments | by: Larry Swedroe

Disclosure: I have no positions in any stocks mentioned, and no plans to initiate any positions within the next 72 hours. **(More...)**

Summary

- Claude Erb has done a series of papers in which he examines the various premiums — size, value, momentum, and beta.
- His most recent one focused specifically on the equity risk premium.
- While it's certainly possible that the equity risk premium could revert to its historical mean, mean reversion of valuations is far from a certainty.

Tying up our two-part series on premiums, today we'll explore the equity premium.

Claude Erb has done a series of papers in which he examines the various premiums - size, value, momentum, and beta - and found that there's a demonstrable trend in each case of the premiums shrinking in terms of realized returns. His April 2014 paper, "The Incredible Shrinking Realized Equity Risk Premium," focused specifically on the equity risk premium.

To create a trend line Erb used a three-step process:

Step 1: He linked the monthly excess returns into a "growth of $1" cumulative. The "market" excess return is the monthly total return minus the monthly Treasury-bill return from Ken French's website.

Step 2: On a monthly basis, he calculated the 10-year annualized rate of return. The first calculation covered the 10 years from June 1926 to June 1936, the second from July 1926 to July 1936, etc. Part of the reason for using the 10-year time horizon was that it is the same time horizon that Campbell and Shiller used in their early CAPE ratio research.

Step 3: He created a trend line using an Excel/PowerPoint function that regressed the rolling 10-year return on time (the x axis). He found that a 4.3 percent equity risk premium (the stock market total return in excess of the return of the t-bill) was the best fit of the relationship between 10-year excess return and time as of April 2014. Or given the way that 10-year equity excess returns have evolved over time, the relationship that best captures the downtrend in this measure suggests that the trend equity risk premium is currently 4.3 percent.

It's worth noting that Erb's 4.3 percent estimate is very similar to the current *real* expected return using Shiller's adjusted CAPE 10. The CAPE 10 is now at about 25.9. That produces an earnings yield of about 3.9 percent. However, we need to make an adjustment to arrive at the forecasted real return to stocks because the earnings figure from the CAPE 10 is on average a lag of 5 years. With real earnings growing about 1.5 percent a year, we need to multiply the 3.9 percent earnings yield by 1.075 percent (1.5 percent x 5 years). That produces a real expected return to stocks of about 4.2 percent.

Having estimated the equity risk premium at 4.3 percent, Erb noted that "the realized 'equity risk premium' has been in a downward trend since 1925. He explained that while a constant equity risk premium, and mean reversion, leads to the view that the probability rises over time that stocks will outperform high quality bonds, a declining equity risk premium, and mean reversion, leads to the view that the probability increases over time that safe assets will outperform stocks. He suggests that the declining equity risk premium has created a conundrum for many investors: Is it stocks for the long run, or bonds for the long run?

Erb also noted that a simple extrapolation of the declining trend in the equity risk premium results in a 0 premium by 2050. Logically (not that markets are always rational - see March 2000 when the earnings yield was below the yield on TIPS), that world shouldn't exist since no one would buy riskier stocks if there was no expectation of earning a risk premium. In other words, Stein's Law applies: If something cannot go on forever, it will stop (usually ending badly when it comes to stocks). However, it's certainly possible that instead of reverting to its historical mean (as many, such as Jeremy Grantham, are predicting) the equity risk premium could remain where it is, or even decline somewhat further. There are several possible/likely explanations for why the equity risk premium has been falling:

- When risk capital is scarce, it earns high "economic rents." As national wealth increases, the equity risk premium tends to fall as more capital is available to invest in risky assets. All else equal our rising national wealth should be expected to lead to a fall in the equity risk premium.
- Over time, the SEC's regulatory powers have increased, and accounting rules and regulations have been strengthened. The result is that investors have should have more confidence to invest in risky assets. Again, all else equal, this should lead to a smaller required equity risk premium.
- Implementation costs of equity strategies have fallen. Both commissions and bid/offer spreads have come way down over time. In addition, mutual fund expense ratios and loads are also much lower. And, the Internet has made trading much easier/more convenient. All else equal, lower implementation costs should lead to a lower equity risk premium. Lower trading costs can also help explain the falling small cap premium that Erb had found.
- Longer life expectancies can lead investors to have a stronger preference for equities as they provide the higher expected returns that may be needed to allow portfolios to last for longer horizons.

The bottom line is that while it's certainly possible that the equity risk premium could revert to its historical mean, mean reversion of valuations is far from a certainty. Thus, investors shouldn't draw the conclusion that the market is overvalued, nor that it's ripe for a fall.

Literature Review

THE EQUITY RISK PREMIUM: A CONTEXTUAL LITERATURE REVIEW

Laurence B. Siegel

CFA Institute Research Foundation

Literature
Review

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CFA Institute
Research
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Statement of Purpose

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Editorial Staff

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