Porter, White & Company

Projecting Long Term Portfolio Returns

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Answering the following questions requires a view on future investment returns:

- "How much can an endowment disburse and maintain its value?"
- "How much do I need to save for retirement?"
- "What is the likelihood of doubling my account in 5 years? 10 years?"

It is very difficult to predict market returns in the short term. However, we are forced into making long term projections in order to make sound investment decisions today. Most financial professionals and academicians believe that there is a rational approach to predicting portfolio returns over longer horizons as a basis for answering the important questions posed above.

Historically, stocks have outperformed bonds over time, but with much greater volatility in the returns achieved during each period. For an investor with an infinite or near infinite investment horizon, interim variability does not pose a challenge (other than emotional) as the stock market undergoes its normal ups and downs. For other investors, those with horizons of 5, 10, or even 30 years, the variability of returns can have a significant impact on the actual results achieved.

How does one plan for the future when equity returns, even over a 30-year period, are uncertain? It takes a solid understanding of both risk and return.

I. Risk

We employ Modern Portfolio Theory to capture the risks in investing, which relies on volatility of prices as a proxy for risk. Specifically, we use standard deviation and correlation to estimate the risks in the markets. Standard deviation is a measure of the degree to which returns of an asset vary from period to period, with a higher standard deviation indicating a higher degree of risk. Historically, stocks have had much higher standard deviations, or variability of returns, than fixed income.

Correlation is the extent to which one asset moves in a linear relationship to another asset. A correlation of 1.0 indicates that two assets exhibit a 1:1 linear relationship in returns. Thus, if one asset increases 10% in value, the other asset would be expected to increase by the same percentage. A correlation of minus 1.0 indicates that two assets exhibit a 1:1 linear relationship, but in opposite directions. Thus, if one asset increases 10% in value, the other asset would be expected to decrease by the same percentage. A portfolio of assets having correlations of less than 1.0 has lower volatility than that of the individual assets, which is the cornerstone behind the rationale for diversification.

Standard deviation and correlation can be estimated based on history. We use 15 years of history to estimate these risk parameters as it is a period long enough to smooth out anomalies yet short enough to reflect more recent market conditions. These risk parameters can change unexpectedly in the future, but recent history is at least an unbiased predictor.

To determine the expected standard deviation and correlation of a portfolio, we derive the estimate from a similar portfolio composed of representative indexes using the following approach:

- First, we obtain the standard deviation and correlation of indexes that are representative of the assets within a client's portfolios. For stocks, these include large cap, small cap and value indexes in US, international developed and emerging markets. For bonds, these include indexes of varying duration and credit risk.

- Second, we form representative index portfolios for each of the major portfolio components: US stocks, international developed stocks, emerging markets stocks and bonds. For stocks, the representative index portfolio has similar market capitalization and book-to-market characteristics. For bonds, the duration, credit risk and geographic characteristics are considered.

- Third, with the representative index portfolio weights, we can calculate the standard deviation of the entire portfolio using the modern portfolio theory equations. We can also calculate standard deviation and correlations of the major portfolio components.

The portfolio risk calculated with Modern Portfolio Theory is generally lower than the simple weighted average as long as the portfolio components are not perfectly correlated. It is important to note, however, that models using this approach to forecasting returns do not do well at predicting extreme events in financial markets that tend to occur more frequently than expected.

II. Bond Returns

Bond (or fixed income) returns are more straightforward to predict than stocks (or equities). A bond is just an I.O.U. where the issuer promises to pay the money back plus interest. The interest is the only return the holder can reasonably expect to return. The return can be lower, of course, if the issuer does not pay back the money with interest as promised. Bond returns do have uncertainty over time as interest rates change, forcing the proceeds to be reinvested at an uncertain rate. The current value of the bond also changes based on fluctuations in interest rates, but we assume bonds are held to maturity over the time horizon.

Studies have shown that the current yield on a 10-year fixed income security is the best predictor of the actual return earned over the ensuing 10 years. The current yield on a 10-year Treasury has been to shown to account for 92% of the actual return earned over the next 10 years.[1] In our projection of 10-year portfolio returns, we assume that the current yield on the 10-year Treasury equals the return earned on Treasuries over the next 10 years. Utilizing the current yield curve,

[1] "How to Predict the Next Decade's Bond Returns," The Wall Street Journal Online Edition, Chris Gay, March 3, 2014.

we make adjustments for securities with shorter or longer durations. For non-Treasury securities, we also adjust for the credit risk using the current spread in yields between comparable duration treasuries and corporates.

III. Stock Returns

Stock (or equity) returns are more difficult to predict. Unlike a bond that has a stated interest rate, the expected return on a stock cannot be observed from market data. We must rely on other calculation models to make a prediction.

The theoretical derivation of the expected return on an asset has been a constant in the financial world since 1964, when William Sharpe, building on the work of others, developed the Capital Asset Pricing Model (CAPM) for the Expected Return on Equity. The challenge is in determining the key inputs into the model, particularly the Equity Risk Premium (ERP).

$$\mathrm{E}[Equity\ Return] = Risk\ Free\ Rate + (Beta \times Equity\ Risk\ Premium)$$

The combination of Beta and the ERP is often referred to as the "Market Factor."

Subsequent academic research has explored additional factors that explain performance. The small cap factor was first documented by Rolf Banz in 1981. Fama and French documented the value factor in 1993. Recently, Novy-Marx published analysis supporting profitability as a factor explaining stock performance. There are a number of other factors such as liquidity, momentum and others that are still being debated in the academic community. For the purposes of our projection, in part due to the availability of data, we will only consider the size and value factors (the "Factor Premiums"). Our resulting model for the Expected Return on Equity is as follows:

$$\mathrm{E}[Equity\ Return] = Risk\ Free\ Rate + Market\ Factor + Factor\ Premium$$

A. Risk Free Rate

For a U.S. investor, we assume that the Risk Free Rate should be the yield on a US Treasury security with a maturity equal to the investor's time horizon, but not greater than 10 years. Shorter term bonds reinvested in the future should yield the same result, as implied by the expectation theory of interest rates.

B. Market Factor

There are two components required to determine the market factor: beta and the equity risk premium of the market.

1. Beta

Beta is a measure of the extent to which a stock changes in value relative to the overall market, with the overall market having a Beta of 1.0. For example, if the broad stock market is up 10%, an individual stock with a Beta of 0.7 would be expected to be up by 7% (assuming a risk-free rate of 0%). Utility stocks tend to have Beta's below 1.0 while high technology stocks tend to have Beta's in excess of 1.0. Just as individual stocks have Beta's, so do equity market sub-classes, such as small cap stocks. Small cap stocks individually tend to have Beta's in excess of 1.0; thus, a portfolio of small cap stocks would have a Beta in excess of 1.0.

If we were only using a single factor model and not considering other "factor premiums," it would be important to estimate betas. However, when a model includes the small cap and value premiums, the market beta factor tends to revert to 1.0. One notable expectation is the asset class relating to regulated utilities. Utilities have an element of regulatory risk that is not well explained by the factor model. For this reason we assume beta is 1.0 for all other classes and use Damodaran's estimated beta for utility stocks of 0.7.

2. Equity Risk Premium

Some of the early pioneers in developing the Equity Risk Premium were Roger Ibbotson and Rex Sinqeufield with their study of the historical returns in the U.S. from stocks, bonds, and bills dating back to 1926. Since then, there has been work by Ibbotson and many others to further refine the Equity Risk Premium for the U.S. market as well as the Equity Risk Premiums for non-U.S. markets.

There are at least two broad approaches generally used to estimate Equity Risk Premiums: historical and implied. We use the implied Equity Risk Premiums for the reasons explained below.

a) Historical Method (Ibbotson)

For the U.S. equity market, the historical data stream that is perhaps most often referenced is the period from 1926 forward, based on Ibbotson's work**.** With almost 90 years of history, the average historical Equity Risk Premium is now fairly constant from year to year**.** However, the value of the equity portions of our clients' portfolios are anything but constant, with the S&P 500 being down 38% in 2008 and up 32% in 2013**.** As Victor Modugno notes in his article, Estimating Equity Risk Premiums, "Implicit or market based Equity Risk Premium methods have the advantage of reflecting current market conditions. When pension plan stocks are valued at market as of the date of valuation, it would be consistent to have an Equity Risk Premium calculated as of the same day. Implied Equity Risk Premiums fall in bull markets and rise in bear markets, while historical Equity Risk Premiums do the opposite."[2]

b) Implied Method (Damodaran)

Damodaran is one of the leading proponents of using an implied approach to estimate the Equity Risk Premium. He tested the correlations between his implied Equity Risk Premium methodology and several other approaches, including the historical approach of Ibbotson. Below in **Table** 1 are the correlations he calculated for the implied and historical Equity Risk Premiums. While neither of the correlations in the right hand column below suggest a strong link between the projected and actual Equity Risk Premium, it is noteworthy that the correlation using the historical approach is actually negative.

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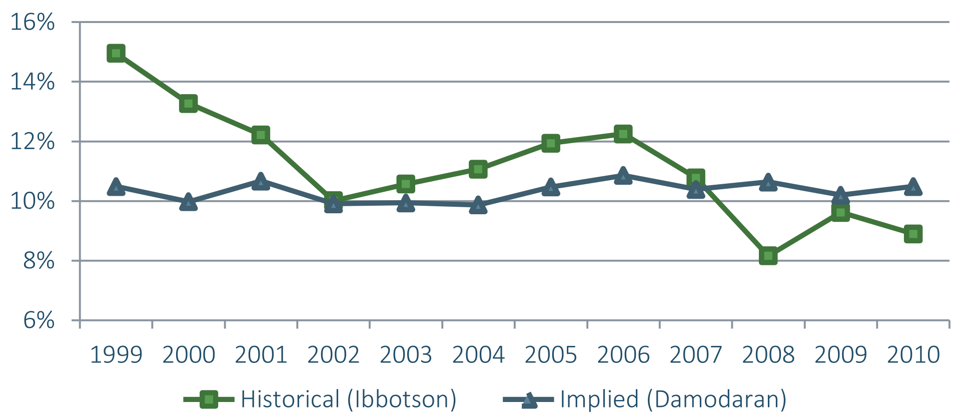
[2] "Estimating Equity Risk Premiums," Society of Actuaries' Pension Section Research Committee, Victor Modugno, October, 2012.

Table 1: Correlations Between Expected and Actual Equity Risk Premiums[3]

Predictor	Correlation with estimated premium next year	Correlation with actual risk premium next 10 years
Implied Premium	0.758	0.425
Historical Premium	-0.286	-0.480

Figure 1 below shows the historical Projected Equity Returns for the period 1999-2010 as calculated using the Ibbotson historical approach and the Damodaran implied approach.

Figure 1: Projected Equity Risk Premiums, 1999-2010



Note that the Ibbotson projected equity return moved counter to what might be expected following the crash of 2008, when the projected equity return was lower than at the end of 2007 (8.16% vs. 10.78%). On the other hand, the Damodaran projected equity return increased slightly (10.64% vs. 10.39%). The same holds true for the downturn in 2000-2002. The Ibbotson projected equity return was 14.95% at the end of 1999 and declined to 10.01% at the end of 2002. The projected equity return from Damodaran declined during that same time period, but only from 10.49% to 9.91%. Interestingly, by using an implied Equity Risk Premium, the projected equity return is more stable than under the Ibbotson approach of strictly relying on history.

Foreign equities are generally considered to be riskier than those in the U.S., with some exceptions for countries such as Switzerland in which typically only the very largest companies are listed on the market and the country itself is stable. In his 2012 book, Investment Valuation, 3rd Edition, Damodaran provides several alternatives to adjust for the differences in risk from the U.S. market, including adjustments based either on the credit default spreads or the ratings which S&P and Moody's give the countries' government securities. We use the ratings from S&P and Moody's to adjust for differences in country risk.

Using the implied equity premium approach, we determine the equity risk premium for the US market as well as for international developed and emerging markets based on credit-rating based adjustments for different country risk.

[3] Equity Risk Premiums (ERP): Determinants, Estimation and Implications- The 2015 Edition, Aswath Damodaran, March, 2015.

C. Factor Premiums

In addition to the "market factor," there are other variables or "factor premiums" that influence expected returns. Our model considers the size and value premiums. Unlike the market factor, these factor premiums are more difficult to predict and do not have developed academic literature supporting different approaches to predicting them. We are left using long term historical averages as the best predictors of the future.

One additional consideration when estimating the factors is that indexes do not always best explain the historical returns. Due to problems in index construction and reconstitution, there are "market impact costs" that reduce the observed size of the factor premiums. For this reason, we rely on actual mutual fund returns that are built to deliver certain factor exposure to determine the factor premiums. We also know that the factor premiums are not linear and are not additive. Using various estimates of factor premiums for different size and value exposures, we develop non-linear equations that best fit the historical data points and use them to predict the factor premiums based on the size and value exposures of the actual portfolios in the three market segments: US, international developed and emerging markets.

IV. Monte Carlo Simulations

A. Overview

To understand how the risks in the markets might play out in a real-world context, we use our long-term risk and return projections in Monte Carlo simulations. This is a modeling technique that was invented at the Los Alamos National Laboratory in the 1940's and generates a large number of potential outcomes using simulation. We can use this data to answer the question, "Over a 10-year period, what is the probability that a client with a diversified portfolio of 64% stocks/36% fixed income will achieve an annualized return of at least 7%?"

B. Geometric vs. Arithmetic Returns

Before setting our assumed returns and standard deviations for a Monte Carlo simulation, we must consider the difference between geometric and arithmetic averages. The formula for approximating arithmetic returns, given geometric returns, is as follows:

$$Arithmetic\ Return = Geometric\ Return + \frac{Variance}{2}$$

The example below illustrates the difference between the geometric and arithmetic return. Our clients ultimately care about the annualized return they earn over time, which is the geometric return. In the example below, over the 4-year period, the portfolio declined from $100 to $92, or 8%. The annualized, or geometric, return was a negative 2%. However, the arithmetic average of the returns over the 4-year period was 0%.

Table 2: Geometric vs. Arithmetic Return Example

Year	**0**	**1**	**2**	**3**	**4**	**Cum.**
Portfolio Value	$100	80	96	77	92	**-$8**
Return		-20%	20%	20%	20%	**-8%**
Geometric Average						*-2%*
Arithmetic Average						*0%*

In running Monte Carlo simulations, there is some debate in the literature as to whether it is more appropriate to use geometric or arithmetic returns, with the great majority of academicians favoring the use of arithmetic returns. To test this, we ran multiple instances of a 100,000 scenario, 30-year projection. In each instance, we input the arithmetic return for the S&P 500 from 1926-2012 and the annual standard deviation for the same period. What one would expect is that on average the scenarios would produce a projected geometric return equal to the actual geometric return of the S&P 500 over the 1926-2012 period. Our results produced a geometric return only slightly higher than the actual historical geometric return, which validates the use of arithmetic returns in running Monte Carlo simulations.

V. Summary

For a diversified portfolio of 64% equities and 36% fixed income, we project as of December 31, 2014, a 10-year annualized portfolio return of 6.75%, with a standard deviation of 10.67%. Over the 10-year projection period, our Monte Carlo simulation shows that there is a 57% probability that the investor will achieve a return in excess of 5.74% (or ~4% after inflation). The assumptions for expected return and volatility underlying this result are shown in Table 3.

Table 3: Projected Portfolio Risk and Return as of December 31, 2014

Category	Weight	Equity Weight	Geometric Return	Standard Deviation
US	43%	67%	8.6%	16.3%
International	15%	24%	10.4%	19.6%
Emerging Markets	6%	9%	10.4%	23.6%
Subtotal Equity	*64%*	*100%*	*9.18%*	*16.85%*
Fixed Income	36%		2.4%	3.8%
Total	*100%*		*6.75%*	*10.67%*

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Important Notes:

- Past performance is not necessarily an indication of future results.
- Diversification is not a guarantee against portfolio losses.
- Financial models relying on modern portfolio theory do not do a good job predicting extreme events.
- The S&P 500 (or any index) is not "investible."
- Historical performance results for investment indexes, or categories, generally do not reflect market impact, the deduction of transaction or custodial charges or the deduction of an investment management fee, the incurrence of which would have the effect of decreasing historical performance results.
- Economic factors, market conditions, and investment strategies will affect the performance of any portfolio and there are no assurances that a portfolio will match or outperform any particular index or benchmark.