Shiller PE's and Modeling Stock Market Returns

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One of the most popular assumptions used in investment modeling is that stock prices follow a random walk. However, a growing body of evidence shows that this is a bad assumption, and that stock prices go through periods of over-pricing and under-pricing that affect future returns. Many of the models used by financial planners are based on the random walk assumption. This naturally raises the question of whether we can usefully build investment models based on more realistic assumptions. In this article, I propose that we can build better models and provide some initial suggestions on how to do so.

Last fall I wrote two articles for *Advisor Perspectives* (see here and here) discussing the use of stock market valuations to predict long-term stock market performance. The particular valuation measure I used was a price/earnings ratio that smoothes out cyclical earnings by including ten-year average earnings in the denominator. I referred to this measure as the Shiller PE because the main proponent of its use has been Professor Robert Shiller of Yale University who highlighted it in his book, "Irrational Exuberance," and in earlier research. This measure is also known as "Normalized Price Earnings Ratio," "PE 10," and "Cyclically Adjusted PE (or CAPE)." All references below to PE ratios are to Shiller PE's.

Recently I examined this measure more deeply with the goal of building a simple stochastic model based on the interaction of PE's and stock market rates of return. A stochastic model of this type could be useful in improving the Monte Carlo projections of investment returns, and making improvements to one of the principal tools used by financial planners.

My working hypothesis is that PE's are inversely correlated with future returns, but, on a year-to-year basis, any impact is mostly drowned out by random influences. Over time these PE effects accumulate and significantly affect performance. So I'm assuming that the stock market almost – but not completely – follows a random walk and that long-term investors can benefit by adjusting portfolios based on current levels of PE's.

I began by examining historic stock market performance data going back to 1928 alongside Professor Shiller's data on historic PE's. Tests of the relationship between beginning-of-year PE's and one-year returns produced the expected negative correlation with a coefficient of -.26 and an R-square measure of .067. A rough translation is that the beginning-of-year PE explains about 6.7% of that year's stock market return. The variation of the yearly returns around the regression line was considerable – equivalent to a standard deviation of 20%, about the same as expected overall stock market volatility. For modeling one-year stock returns as a function of the beginning-of-year PE, I approximated the relationship with the equation:

$$\text{Return} = (.26)*(.95)^{PE} + N(0, .20)$$

where N(0, .20) is a randomly generated normally distributed variable with 0 mean and a standard deviation of 20%. For example, at a PE of 7—the lowest experienced since 1928—the expected return is 18% plus or minus the random term. At the all-time high PE of 42, experienced just before the bursting of the dot-com bubble, the expected return is 3% plus the random term. Basically, the model reflects the data, which show that the beginning PE exerts an influence on the expected return for the year, but with considerable random noise.

Completing the model requires another equation to generate the end-of-year PE's. As one might expect, each annual change in PE is closely related to that year's rate of return. Based on this relationship and the historic data, I developed the following equation to generate the ending PE's:

$$PE(t+1) = PE(t)*(1+.90*\text{Return}(t)-.084+N(0,.07))$$

These equations can be combined in an Excel model, and repeated simulations can be run using Excel's random number generator.

Table 1 provides a comparison of actual versus test results. Each of the tests involved 10 runs of 81-year (1928 – 2008) versions of the model, so the average of all tests is based on 50 simulations. Overall, the model produced a good fit with the actual data. The average PE from the model came in slightly higher than the actual average PE, but it's unclear whether we need to fine-tune the model or accept that the actual numbers will contain some statistical variation. (The actual historic numbers are really just a sample, and may or may not represent a best estimate of numbers going forward.)

What is perhaps most interesting in the comparison is that the correlations and R-squares are higher for the actual than for the average of the tests. My guess is that there are likely closer ties between PE's and subsequent performance than are captured by my simple model, but I have no way of proving this. In general, it looks like this model provides a good start toward building a workable simulation model to show the effect of PE's on performance.

Table 2 provides a comparison of test results with the asset allocation results I developed in the first article referenced above. Based on a small sample of just 10 cases, the results for the test cases are similar to the actuals, although the actuals show a bigger impact from incorporating PE's in the asset allocation. This result is consistent with the lower correlations for the test results shown in Table 1.

The behavioral influence on stock prices has been described in the popular press as an excess of greed when stock prices are high, and an excess of fear when prices are low. The result is stock price movements that do not follow a random walk. This model also rejects the random walk assumption, but it is based on a different characterization of investor behavior – some fear (but not enough) when prices are high, and some greed (but not enough) when prices are low. To the extent we can improve our understanding of investor behavior and build simulation models that reflect its effect on investment returns, we can provide more useful tools for financial planners and their clients.

Table 1 - Shiller PE's and Returns--Actual versus Test Results

Averages	PE	Return	Std Dev of Return	Lowest PE	Highest PE	Correlation PE and 10-Yr Returns	R-Square
Test #1	19.46	10.74%	20.47%	7.9	43.2	-0.57	0.34
Test #2	16.44	11.21%	21.09%	6.1	33.8	-0.53	0.32
Test #3	18.15	11.07%	20.84%	7.1	40.2	-0.64	0.42
Test #4	16.32	11.41%	19.87%	6.8	33.8	-0.61	0.39
Test #5	21.08	11.42%	20.41%	7.2	44.9	-0.61	0.38
Average All Tests	18.29	11.17%	20.54%	7.0	39.2	-0.59	0.37
Actual 1928-2008	17.37	11.09%	20.39%	7.4	42.5	-0.69	0.47

Table 2 - Asset Allocation Results--Test versus Actual

	50/50 Bond/Stock Buy and Hold	50/50 Annual Rebalance	PE-Based Allocation Buy and Hold	PE-Based Allocation Annual Rebalance
Average of 10 test Cases	7.84%	7.99%	8.40%	8.71%
Difference vs. 50/50 Buy and Hold	0.00%	0.15%	0.56%	0.87%
Based on Actual 1928-2008	8.30%	8.41%	9.45%	9.65%
Difference vs. 50/50 Buy and Hold	0.00%	0.11%	1.15%	1.35%