Are Stock Prices High or Low?

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Abstract

A model of S&P 500 stock prices based on five variables that theory indicates will impact both future earnings and stock prices is developed and tested. The model explains slightly more than 88 percent of the monthly fluctuations in the cyclically adjusted price-earnings ratio (CAPE) of the S&P 500 observed during 1965-2017. The projected CAPE estimated by the model is compared with the actual CAPE to determine whether stock prices are high or low. Investors purchasing when stock prices are low (high) can expect a higher (lower) future return. Testing this proposition, the returns during the subsequent one to five years were found to be highly attractive for purchases when the projected value of the CAPE was high relative to the actual value. In contrast, the returns were relatively low for purchases made when the projected CAPE was low compared to the actual. The data for all the variables of the model are available monthly and therefore the model can be utilized to track the projected and actual CAPE for the S&P 500 in the future.

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Investors seek to buy when prices are low and sell when they are high. But how can one know whether the current price is low or high? Using five readily available variables that can be updated monthly, this paper develops a model that predicts the movement of the cyclically adjusted prices of the S&P 500 stock index over the past half century with a high degree of accuracy. In turn, the model provides a prediction for the cyclically adjusted price earnings ratio of the S&P 500, which can then be compared with the actual ratio to provide insight on whether current stock prices are high or low.

Asset Values, Interest Rates, and Stock Prices

The fundamental relationship between the expected future income stream and the present value of an asset provides the foundation for the price determination model of this paper. The present value of an asset is equal to the expected revenue stream generated by the asset discounted by the interest rate. Mathematically, the following relationship holds:

$$PV = \sum_{t=1}^{T} \frac{E_t}{(1+r)^t} \tag{1}$$

Where the present value, *PV*, is equal to the sum of the expected earnings, E_t, for each period, *t*, discounted each year by the interest rate, r.

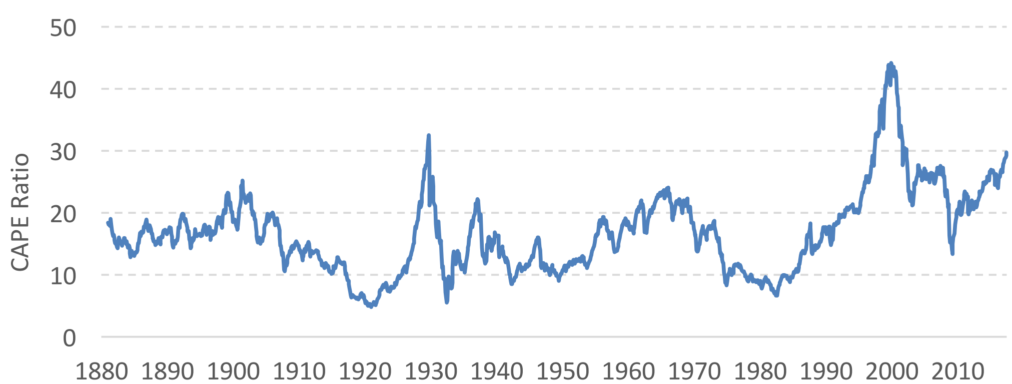
As this formula indicates, an increase in the net earnings the asset is expected to generate in the future will increase the current market value of the asset. On the other hand, higher interest rates will reduce the present value of the future income and therefore the market value of the asset generating the income stream. Lower interest rates will exert the opposite impact. Thus, the market value of an asset will be directly related to the future net income stream it is expected to generate and inversely related to the interest rate.

Applying the present value equation to stocks, the formula indicates that the price of a stock (or group of stocks) will depend on both the interest rate and the expected future earnings of the stock. The price-earnings ratio for a stock provides some information, but the ratio of price to current earnings is often a misleading indicator because of the fluctuations in corporate earnings over the business cycle. Corporate earnings generally fall sharply during a recession, and this will push the price-earnings ratio upward, making it look like stocks are really expensive. In turn, corporate earnings generally increase substantially during an economic boom. This will reduce the price earnings ratio, making it appear that stocks are cheap. Because of the fluctuations in corporate earnings over the business cycle, the current price-earnings ratio is often misleading. In many cases, it provides investors with precisely the wrong signal. Therefore, instead of focusing on the current price-earnings ratio, it makes sense to focus on the relationship between the stock price and earnings over a more lengthy time frame such as a decade.

This is precisely what Robert Shiller, the 2013 Nobel prize winner, has done. Schiller has popularized a cyclically adjusted price-earnings (CAPE) ratio [Campbell & Shiller 1988; Campbell & Shiller 1998; Shiller 2015]. Shiller's methodology averages the inflation-adjusted earnings figures over a ten-year period in order to minimize the distortions resulting from both business cycle and inflation effects. Schiller then compares the current price of a stock, or group of stocks such as the S&P 500 with the inflation-adjusted real earnings over the past ten years. Because the CAPE is adjusted for inflation and reflects earnings over a more lengthy time frame, it is a more reliable indicator of how the current price of a stock (or group of stocks) compares with earning potential.

Exhibit 1 presents Shiller's cyclically-adjusted price-earnings ratio for the S&P 500 during 1881-2017. This CAPE ratio is a weighted average of the current stock price divided by the ten-year average of earnings adjusted for inflation of the 500 stocks in the S&P index. Other things constant, when this ratio is high, it indicates that stocks are relatively expensive. In contrast, when the ratio is low, it signals that stocks are relatively cheap.

Exhibit 1: Shiller's CAPE Ratio, 1881-2017



During the past 137 years, the CAPE has risen above 30 only three times: 1929, 1997-2000, and June of 2017. The high level of 1929 preceded the stock market crash and declining stock prices of the Great Depression. Similarly, the high CAPE in the late 1990s was followed by the bursting of the Dot.com bubble and a more than 40 percent decline in stock prices during 2001-2002.

As Exhibit 1 shows, the CAPE signaled that stock prices were exceedingly high on two other occasions: 1965-1966 and 2006-2007. In both cases, the CAPE rose to the 24 to 27 range. These two cases were also soon followed by major reductions in stock prices.

In contrast, a low CAPE ratio signaled that stocks were relatively cheap during 1918-1923, 1932, 1942-1944, and 1978-1984. Each of these periods was followed by a substantial move upward in stock prices.

As of mid-year 2017, the CAPE ratio stood at 30. Compared to historic levels, this is an exceedingly high ratio. Does this mean that stock prices are high and therefore likely to fall substantially in the near future? Some analysts fear that this will be the case and the high CAPE ratio provides reason for caution.

However, there is also another potentially important factor to consider. Interest rates are low and they may continue to be low in the future. A recent paper by Walker [2016] argues that demographic changes in high-income developed economies are pushing interest rates downward. Walker shows that the share of population in developed countries age 50 to 75 years has increased relative to the share under age 50. Because the expanding age grouping tends to be savers and the contracting group borrowers, these changes are increasing the supply of loanable funds relative to the demand, thereby placing downward pressure on interest rates.

Interest rates in high-income developed economies have been exceedingly low for almost a decade. Given the continued growth of developed economies, albeit at a slow rate, the low interest rates of the past decade are unprecedented. The demographic trends increasing the size of the population in high saving age groupings relative to those with a strong demand for loanable funds is almost sure to continue for at least another decade.[1] To the extent this factor is pushing interest rates downward, the low worldwide interest rates of the past decade may continue for many years. If so, the discounted value of the future income stream generated by stocks will be high, and this may continue to result in high stock prices relative to their expected future earnings. All of these factors elevate the importance of accurate information about the relationship between interest rates and stock prices.

In addition to interest rates, this paper incorporates recent findings from the behavioral finance literature. The field of behavioral finance has grown significantly over the past two decades highlighting psychological explanations for deviations from outcomes predicted by the efficient markets hypothesis.[2] Specifically, our empirical model captures the impact that investor sentiment has on market outcomes. From a theoretical model, Barberis, Shleifer, and Vishny [1998] show that sentiment in the market helps to explain the under and overreactions of investors to news and new information. Baker and Wurgler [2006] find that investor sentiment influences the returns of stocks that are highly subjective and difficult to arbitrage. Thus, our model incorporates the investor sentiment measure of Baker and Wurgler in order to control for the natural tendency of human psychology to influence investment decisions.

Model and Data

In this section, a model of the cyclically adjusted S&P 500 index of stock prices based on the discounted present value of the asset will be presented. The key variables of the model are designed to reflect the impact of changes in the expected net future earnings of stocks and the interest rate on their present value. Shiller's CAPE for the S&P 500 is the dependent variable of the model. Five independent variables are included: (1) the interest rate, (2) growth of RGDP during the past five years, (3) a short-term index of investor sentiment, (4) a long-term index of investor sentiment, and 5) the maximum tax rate on capital gains. The empirical model is shown here.

$$\ln(CAPE) = \beta_0 + \beta_1 Int\ Rate + \beta_2 GDP\ Growth + \beta_3 Sent + \beta_4 Longrun\ Sent + \beta_5 Cap\ Gains\ Tax + \epsilon \quad (2)$$

It is expected that the interest rate will negatively impact stock prices as will a higher tax on capital gains, thus β_1 and β_5 are expected to be negative. The other three independent variables, RGDP growth and the two sentiment measures, will increase the expected net future earnings and thereby exert a positive impact on the CAPE. Thus, β_2, β_3, and β_4 are expected to be positive.

We now turn to a more detailed description for each of the five independent variables.

The interest rate measure is the five-year treasury bill interest rate. The data set includes this rate on the first business day of each month.

The quarterly real GDP annual growth rate data from the BEA are used to construct a five-year moving average. The average annual real growth rate is then applied to each month of the quarter. Thus, the three months of each quarter have the same average real GDP growth figure. Given, the delay in the reporting of quarterly real GDP, the data is lagged by one quarter. When the real growth rate is higher, this will exert a positive impact on the expected growth of future earnings.

Of course, higher future earnings will increase asset values. Thus, this variable is expected to exert a positive impact on the CAPE.

The investor sentiment measure of Baker and Wurgler [2006] is used as the short-run measure of investor sentiment. This index is comprised of five sub-components: the dividend premium, the average closed end fund discount, the equity share of new issues, the gross number of IPOs, and the average first day return on IPOs.[3] Each of these five components is a proxy for investor sentiment in the market. The investor sentiment measure is the first principle component of the five standardized measures of investor sentiment. This index is derived monthly. The original data series of Baker and Wurgler [2006] was updated to the present by the authors using data from a Bloomberg terminal. A higher level of short-term optimism will increase the demand for stocks, pushing their price upward. Thus, this variable is expected to exert a positive impact on the CAPE ratio. The figures are lagged one month so the data for the past month are available on the first day of the following month.

The long-term investor sentiment measure is simply the ten-year total percentage change in the S&P 500 price index, also retrieved using a Bloomberg terminal. When the stock market has performed at a high level over a lengthy time period such as a decade, this positive long-term performance will cause investors to become more optimistic, which will lead to higher current stock prices. In contrast, lengthy periods of poor stock market performance will breed pessimism, which will place downward pressure on the current price of stocks. Thus, this variable is expected to exert a positive impact on the CAPE.

The capital gains tax rate will exert an impact on the net gains derived from capital gains. A higher capital gains tax rate will reduce the net earnings of stock investors, while a lower capital gains tax will increase net earnings. Moreover, a lower capital gains tax rate will also increase the attractiveness of equity investments compared to bonds, which are taxed as ordinary income. The data series for the maximum capital gains tax rate from the Tax Policy Center was derived and integrated into the model.[4] This variable is expected to be inversely related to the CAPE. Thus, a negative sign is expected.

These variables were compiled for the period July 1965 and running through June 2017. The CAPE data is from Robert Shiller and is available at various time periods.[5] We use monthly data recorded on the first business day of each month. Thus, the data cover a time frame of 52 years, containing 624 monthly observations. Exhibit 2 provides the descriptive statistics, including the mean, standard deviation, and range for each of the variables included in the model.

During 1965-2017, the mean value of the CAPE ratio was 19.94 and the standard deviation 8.17. These figures provide additional evidence that the CAPE value of 30 observed in the first half of 2017 was quite high. The mean of the five-year treasury bill interest rate was 6.08 and the standard deviation 3.15. This illustrates that the interest rates, generally around 2 percent, observed during 2010-2017 were exceedingly low compared to the average during 1965-2017. The short-run investor sentiment measure of Baker and Wurgler [2006] has a mean of zero and a standard deviation of 1. This is by construction. Once the first principle component is generated from the standardized data it is then subsequently standardized.

Exhibit 2: Summary Statistics, July 1, 1965 to June 1, 2017

	Obs	Mean	Std. Dev.	Min	Max
Shiller's CAPE Ratio	624	19.94	8.17	6.64	44.19
Interest Rate, 5-Year Treasury Bill	624	6.08	3.15	0.62	15.93
RGDP Annual Growth Rate, 5-Year Ave	624	3.06	1.18	0.5	6.275
Investor Sentiment Index	624	0	1	-2.3	3.04
Long-run Sentiment (10-Year % Change S&P 500)	624	105.73	89.73	-40.93	365.44
Top Marginal Capital Gains Tax Rate	624	25.42	7.01	15	39.875

Results

Exhibit 3 presents the results of the regression model for 1965-2017, 1970-2017, and 1975-2017. The dependent variable is the log of CAPE and the five independent variables are the five-year Treasury bill interest rate, the average annual growth of real GDP during the past five years, the short-term sentiment index, the long-term sentiment index, and the maximum capital gains tax rate. All of the independent variables have the expected sign and they are significant at the 99 percent level in the regressions for each of the three time frames, except the short-run sentiment measure in the last regression which is significant at the 95 percent level. The interest rate (t-ratio of more than 45 in the model for the entire 52-year time frame) and long-term sentiment (t-ratio of more than 30 in the full time frame model) exert a particularly strong impact on the CAPE. Remarkably, the regression model explains slightly more than 88 percent of the variation in the CAPE during each of the three time frames. This provides powerful evidence that the five variable model is an excellent predictor of the CAPE.

The interpretation of the coefficient values is slightly different from a standard linear model because the dependent variable is the natural log of the CAPE ratio. As a result, the marginal impact is a percentage change instead of an additive factor.[6] For the 52-year model, column 1, the -0.1044 coefficient for the 5-year Treasury bill interest rate indicates that a one unit (1 percentage point) increase in this interest rate will reduce the CAPE ratio by 10.44 percent. During the first half of 2017, the CAPE ratio was almost 30. Thus, a one percentage point reduction in the 5-year Treasury bill interest rate would reduce the projected CAPE by three units. Moreover, the five-year Treasury bill interest rate during the first half of 2017 was persistently less than 2 percent. This is approximately 4 percentage points below the average of this interest rate during 1965-2017.

Exhibit 3: Regression Results of CAPE Ratio Model, 1965-2017

Dependent Variable: Natural Log of CAPE Ratio

	1965-2017 (1)		1970-2017 (2)		1975-2017 (3)	
Independent Variables	**Coef.**	**t-value**	**Coef.**	**t-value**	**Coef.**	**t-value**
5-Year T-Bill Rate	-0.1044	45.94	-0.1040	40.49	-0.0997	34.60
Ave Growth of RGDP	0.0535	8.83	0.0519	5.39	0.0410	3.94
Investor Sentiment	0.0402	5.59	0.0363	3.93	0.0225	1.93
Long-Run Sentiment	0.0024	30.56	0.0024	25.84	0.0026	23.77
Cap. Gains Tax Rate	-0.0051	4.89	-0.0053	4.50	-0.0086	6.17
Intercept	3.2521	129.79	3.2550	122.60	3.3103	112.47
No. of Obs.	624		570		510	
Adj. R^2	0.8836		0.8829		0.8875	

Notes: The growth rate of RGDP is the 5-year moving average of the annual growth rate of RGDP for each quarter. It is lagged 1 quarter. The investor sentiment measure is from Baker and Wurgler [2006] and is lagged 1 month. The long-run investor sentiment measure is the 10-year percentage change in the S&P 500. The capital gains taxes are the top marginal capital gains tax rate.

The coefficient for the interest rate variable in our model indicates that the low interest rates of recent years are a major reason why the current CAPE is so high. If the five-year Treasury bill rate was at the mean for the entire period, the projected CAPE ratio would be approximately 10 units lower. Clearly, our analysis indicates that the interest rate exerts a sizeable impact on the CAPE. This finding stands in stark contrast with the views of Schiller, the primary developer of the CAPE. When examining the relationship between the CAPE ratio and long-term interest rates for the period 1881-2014, Shiller [2015] noted that the relationship between the two was weak. Our findings suggest that the relationship between the five-year Treasury interest rate and the CAPE ratio is much stronger than was alluded to by Shiller.[7]

The coefficients also provide information on the impact of the other variables on the CAPE. A one percentage point increase in the five-year growth rate increases the CAPE ratio by an estimated 5.4 percent. A unit increase in the short-run and long-run sentiment variables increases the CAPE by 4.0 percent and 0.24 percent, respectively. Finally, a one unit increase in the capital gains tax reduces the CAPE by an estimated 0.51 percent.

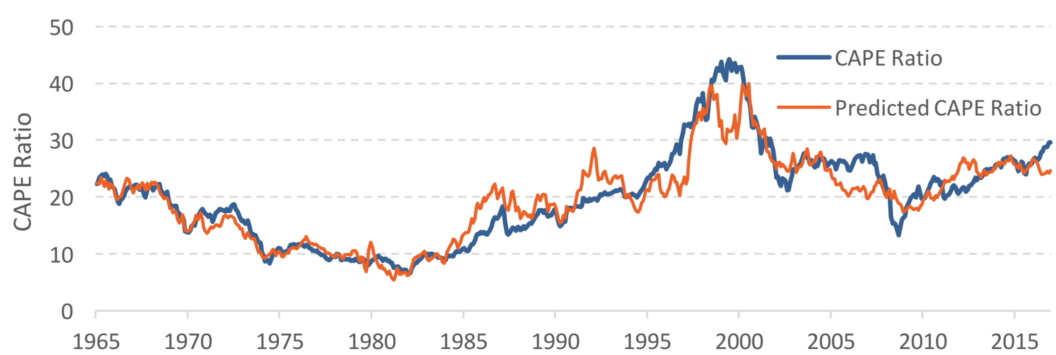
Columns 2 and 3 of exhibit 3 present the results of the model for different time periods. The results are nearly identical indicating that the model is not driven by a particular time period. Potential bias resulting from homoscedasticity was also examined. The regressions were run using robust standard errors and the t-ratios and explanatory power of the model were virtually unchanged.

Given the values of the five independent variables, the model can be used to compare the actual value of the CAPE with the value predicted by the model. When the predicted value of the CAPE is high compared to the actual value, this indicates that current stock prices are low. In turn, the low stock prices imply that it is now a good time to buy. In contrast, when the actual value of the CAPE is high relative to the predicted value, this indicates that stock prices are currently high and therefore that it is a poor time to buy. When the actual and predicted values of the CAPE are relatively close to each other, this indicates that current prices are in line with the variables of the model. Put another way, this situation implies that current prices are neither high nor low, and therefore investments in the S&P 500 index are likely to yield approximate normal returns.

Exhibit 4 tracks the actual and predicted values of the CAPE throughout the 1965-2017 time frame. It is highly revealing to compare the actual and projected CAPE throughout these 52 years. The actual and predicted CAPE ratios track each other closely from 1965 to 1984. However, during 1985-1989, the predicted value of the CAPE exceeds the actual value. This indicates that the S&P 500 was undervalued and therefore this was an excellent time to buy. This was indeed the case, as the S&P index rose substantially during the decade that followed.

During 1991-1994, the predicted CAPE once again rose above the actual CAPE ratio. Note, the actual CAPE during this period ranged from 17.8 to 20.6, while the predicted rose from 17.8 in the early part of the period to a peak of 28.7 before receding to 20.6 in 1994. Again, the high predicted value of the CAPE relative to the actual indicates that this was a good time to purchase S&P stocks.

Exhibit 4: Actual and Predicted CAPE Ratio, 1965-2017



But the situation changed dramatically during the latter half of the 1990s. During 1996-1998, the actual value of the CAPE was persistently above the predicted value, indicating that the S&P stocks were over-valued. Following a brief six month period where the two were approximately equal, the actual CAPE once again rose well above the predicted value during 1999-2000. During this period, the actual value of the CAPE soared to a peak of 44, while the predicted declined to 30, indicating that the S&P stocks were substantially overvalued. Note, the standard deviation of the difference between the predicted and the actual CAPE ratio is 3.17. Thus, the difference during this period was larger than four standard deviations. Not surprisingly, this powerful sell signal was soon followed by the Dot.com crash and the more than 40 percent decline in stock prices.

During 2000-2005, the actual and predicted CAPE track each other relatively well. But, this was followed by another period of substantial over-valuation during 2005-2007. During these years, the actual CAPE ratio was generally in the 25-27 range compared to a predicted value of around 21. Once again, this excess of the actual CAPE relative to the predicted was soon followed by a major downturn in the stock market during 2008-2009.

During 2009-2013, there were two relatively brief periods where the predicted value rose above the actual CAPE. Finally, the first six months of 2017 indicate that the S&P 500 stocks are overvalued. The actual CAPE rose to 30, while the predicted lagged behind near 25. The monthly data shown in Exhibit 4 is listed in the online appendix table A1.[8]

Given the high explanatory power of the model, one would expect that the relationship between the actual and predicted CAPE would provide valuable insight about the future direction of stock prices. Indeed, this has been the case. During the past 50 years, when the predicted value of the CAPE has risen substantially above the actual CAPE, the stock market has performed well in the years that followed. Similarly, when the actual value of the CAPE rose substantially above the predicted value, a stock market decline soon followed. The following section will take a closer look at this relationship.

The Buy, Sell, and Hold Signals and the Rate of Return

Comparisons between the actual and predicted CAPE can be used to construct buy, sell, and hold signals for stocks. When the actual CAPE is low relative to the predicted value of the model, this signals that the S&P 500 stocks are cheap and therefore it would be an attractive time to buy. In contrast, when the actual CAPE is high relative to the value predicted by the model, this signals that the S&P stocks are expensive and therefore one might want to consider selling. Finally, when the two ratios are in a similar range, normal returns from stocks can be expected. Therefore, this can be thought of as a signal to "hold".

Exhibit 5 presents the 1 year, 2 year, 3 year, and 5 year historic annual returns for the buy, sell, and hold signals during 1965-2017.[9] In the top part of this exhibit, if the actual CAPE is more than one standard deviation (3.17) below the predicted CAPE, this is designated as a "buy" signal. There were 72 months when this was the case for the 1, 2, and 3-year return and 64 months for the 5-year return. (Note: the smaller number of observations for the five-year time frame is because eight of the buy signals occurred in recent years and therefore the five-year time frame has not yet been completed.)

Similarly, if the actual CAPE exceeds the predicted CAPE by more than one standard deviation, this is designated as a "sell" signal. There were 72 months when a sell signal was present. When the two ratios are within the plus or minus one standard deviation range of each other, this is considered a "hold" signal.

Exhibit 5: Average Annual Return of the S&P 500 Using Predicted CAPE, 1965-2017

Buy/Sell Threshold = 1 standard deviation (3.170)				
Nominal Returns	**1-Year Ave. Return**	**2-Year Ave. Annual Return**	**3-Year Ave. Annual Return**	**5-Year Ave. Annual Return**
Buy (CAPE is undervalued)	18.15%	13.28%	13.95%	15.16%
Sell (CAPE is overvalued)	9.20%	2.02%	3.46%	4.33%
Hold	9.89%	11.95%	11.65%	11.64%
Real Returns				
Buy (CAPE is undervalued)	15.40%	10.32%	10.86%	11.77%
Sell (CAPE is overvalued)	6.41%	-0.63%	1.03%	1.92%
Hold	5.38%	7.40%	7.01%	6.94%
Buy/Sell Threshold = 0.8 standard deviation (2.536)				
Nominal Returns				
Buy (CAPE is undervalued)	16.56%	13.03%	13.82%	14.93%
Sell (CAPE is overvalued)	9.32%	4.26%	4.83%	5.72%
Hold	9.76%	11.98%	11.70%	11.58%
Real Returns				
Buy (CAPE is undervalued)	13.45%	9.87%	10.60%	11.49%
Sell (CAPE is overvalued)	6.35%	1.35%	2.01%	2.97%
Hold	5.17%	7.33%	6.95%	6.76%

Notes: For the 1 std. dev. threshold, the 1, 2, 3, and 5 year returns of the Buy had 72, 72, 72, and 64 observations. For the Sell there were 72, 72, 72, and 72 observations. For the Hold there were 468, 457, 445, and 429 observations. For the .8 std. dev. threshold, the 1, 2, 3, and 5 year returns of the Buy had 98, 98, 98, and 88 observations. For the Sell there were 96, 96, 96, and 96 observations. For the Hold there were 418, 407, 395, and 361 observations.

Note the pattern of returns over the various time frames for the buy, sell, and hold signals. When the S&P stocks were purchased during a buy period, double-digit average annual nominal returns were earned during each of the time frames. The average annual returns were 18.15, 13.28, 13.95, and 15.16 percent for 1, 2, 3, and 5-year time frames, respectively. Moreover, there were no buy observations that resulted in negative returns when the S&P was held for 2 or more years.

In contrast, when stocks were purchased during a sell signal, the nominal returns were much lower. During the 1, 2, 3, and 5-year time frames, the annual returns earned on stock purchases during a month when a sell signal was present were 9.20, 2.02, 3.46, and 4.33 percent, respectively. These results indicate that, on average, buying and holding a stock for more than one year when a sell signal is present results in an average annual nominal return of less than 4.5 percent. Moreover, compared to the returns for purchases when a buy signal was present, the returns for stocks purchased when a sell signal was present were about ten percentage points lower for each of the four time frames.

The returns for stocks purchased during months when the hold signal was present were between the two extremes. The annual returns during the hold months were generally between 9.89 and 11.95 percent, which is approximately the average annual return of the S&P 500 during 1965-2017. This annual nominal return in the 10 to 11 percent range is also quite similar to the long-run returns of the S&P index when held for even more lengthy time periods, such as a century.

The lower part of Exhibit 5 presents the returns for the three signals when the cutoff for the buy and sell signal is 0.8 of a standard deviation (2.536) rather than a standard deviation of 1.0. Because the cutoff value is lower, there are now more observations in the buy and sell groups and less in the hold group. There are now 98 buy observations (except again for the five-year return when there are 88) and 96 sell observations. The pattern of the returns for the three categories are similar to when the more restrictive cutoff was used for the buy and sell categories. The average annual nominal returns when the buy signal is present are 16.56, 13.03, 13.82, and 14.93 percent for the 1, 2, 3, and 5-year time periods, respectively. The average annual returns when the sell signal is present are once again almost ten percentage points lower. They are 9.32, 4.26, 4.83, and 5.72, for the 1, 2, 3, and 5-year time frames, respectively. The overall pattern of exhibit 5 demonstrates that the average annual returns of the S&P 500 are higher when the predicted CAPE ratio is significantly higher than the actual ratio and are lower when the predicted CAPE ratio is significantly lower than the actual ratio.

Exhibit 5 also contains the average annual returns adjusted for inflation. The difference in the annual real returns between the buy and the sell observations are striking. The 1, 2, 3, and 5 year average real annual returns when the buy signal is present are 15.40, 10.32, 10.86, and 11.77 percent, respectively. This shows that during the past 52 years, investors purchasing when the buy signal was present, on average, earned double digit real returns. Compare these returns to those earned by investors purchasing when the sell signal was available. The average real annual returns of investors buying when the sell signal was present were 6.41, –0.63, 1.03, and 1.92 percent respectively for the 1, 2, 3, and 5-year time periods. As was the case for the nominal returns, the real average returns when the buy signal was on were about ten percentage points greater than the real returns when the sell signal was present.

The bottom part of exhibit 5 shows the average annual real returns when the lower threshold is used to determine the buy, sell, or hold signal. Again, the pattern is the same. The one-year real return is 13.45% for the buy signals compared to 6.35 percent for the sell signals. The average real returns for the 2-year through 5-year when the buy signal is present range from 9.87% to 11.49 percent. By way of comparison, the two-year to five-year average real annual returns when the sell signal is present ranged from 1.35 percent to 2.97 percent. Thus, while double-digit annual real returns are present during the two to five year time horizon for investments when the buy signal is on, the real annual returns during this time frame are in the 1 to 3 percent range for investments undertaken during sell periods.

A Robust Check: Iterative Approach

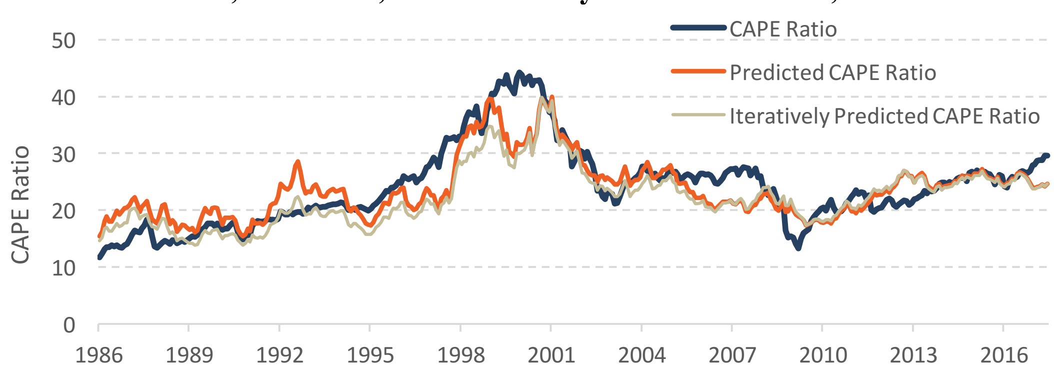
The comparisons of the actual and projected CAPE of Exhibit 4 are based on data for the entire 1965-2017 time frame. At the time the projected CAPE was estimated in the earlier years (for example, the 1980s and 1990s), the data for the later years would not have been available. Are the projected CAPE estimates of Exhibit 4 biased as a result of using later data to help predict earlier values?

In order to answer this question, an iterative method was used to re-estimate the projected CAPE for 1986-2017. The iterative approach uses only the data that would have actually been available when the estimate for each month was derived. The period 1965-1985 was used as a base period and the iterative approach then was used to predict the CAPE ratio for each month beginning in January 1986, using only data that would have been available at the time. For example, the predicted value of the CAPE ratio for January 1986 is based on our model using only the data for 1965 through January 1986. Similarly, the predicted

CAPE ratio for February 1986 is based on our model using only data through that month. The same procedure was used to derive the projected CAPE successively for each month through June 2017.

Exhibit 6 is similar to Exhibit 4, except the projected CAPE derived by the iterative approach is now shown alongside the projected CAPE derived via the model for the entire time period, as well as the actual CAPE. This exhibit covers only 1986-2017, as this is the time frame for which the CAPE is estimated via the iterative approach. The pattern of the graph is similar to that of exhibit 4, but there are a few observable differences. During 1986-1993, the predicted CAPE based on the iterative model tracks the actual CAPE a little better than the predicted CAPE based on the data for the entire period. But, the opposite was the case during 1994-2000. After 2000, the two predicted ratios track each other very closely. This is an expected result because each iteration is getting closer to the regression of the whole sample.

Exhibit 6: Actual, Predicted, and Iteratively Predicted CAPE, 1986-2017



The predicted CAPE derived by the iterative method is highly correlated with the predicted value derived from the full data set. The correlation between the two is 0.982 for the 378 over-lapping observations from January 1986 through June 2017. This close relationship enhances our confidence in the information provided by our model regarding whether current S&P stock prices are high or low, compared to the fundamentals underlying asset prices.

The average annual returns using the iterative approach were also examined. Exhibit 7 shows the nominal and real average annual returns for the various investment periods using the iteratively predicted ratio. The standard deviation of the difference between the actual CAPE ratio and the iteratively predicted ratio is now 3.221. Thus, the threshold for the buy and sell observations are slightly different than those used in exhibit 5. However, the pattern of the results are similar. The nominal annual average returns for the buy observations range from 13.46 to 21.25 percent for all periods when either threshold is used. The returns for the sell observations are again much lower. They range from 6.90 to 14.03 percent for the various periods. It is interesting to note that the number of buy observations is much lower than that of exhibit 5. This is due to the shorter time period being analyzed in exhibit 7, 1986-2017.

The same pattern can be seen for the real average annual returns using the iteratively predicted CAPE ratio in exhibit 7. For the buy observations, the real average annual returns range from a low of 10.78 to a high of 19.25 percent for the various periods compared to the sell observations which range from a low of 4.52 to a high of 11.40 percent. When considering the returns for the two-year to five-year time frames, the average annual real returns average around 11 percent for the buy signal periods, but only 5 percent for the sell signals.

Using only data available in each month, the iteratively predicted ratio is nearly identical to that predicted using the full sample and the analysis of S&P

returns demonstrate similar patterns. This indicates that the original five variable model is a robust predictor for the actual CAPE ratio.

Exhibit 7: Average Annual Return of the S&P 500 Using Iterative Model, 1986-2017

Buy/Sell Threshold = 1 standard deviation (3.221)

Nominal Returns	**1-Year Ave. Return**	**2-Year Ave. Annual Return**	**3-Year Ave. Annual Return**	**5-Year Ave. Annual Return**
Buy (CAPE is undervalued)	21.19%	14.76%	13.46%	14.31%
Sell (CAPE is overvalued)	14.03%	8.06%	7.43%	6.90%
Hold	8.29%	11.70%	12.39%	12.71%
Real Returns				
Buy (CAPE is undervalued)	19.25%	12.29%	10.78%	11.10%
Sell (CAPE is overvalued)	11.40%	5.43%	4.95%	4.52%
Hold	5.52%	9.00%	9.61%	9.92%
Buy/Sell Threshold = 0.8 standard deviation (2.577)				
Nominal Returns				
Buy (CAPE is undervalued)	21.25%	14.83%	13.98%	14.45%
Sell (CAPE is overvalued)	12.86%	8.41%	7.73%	7.36%
Hold	7.92%	11.57%	12.38%	12.74%
Real Returns				
Buy (CAPE is undervalued)	19.05%	12.34%	11.32%	11.35%
Sell (CAPE is overvalued)	10.19%	5.76%	5.22%	4.96%
Hold	5.19%	8.87%	9.59%	9.94%

Notes: For the 1 std. dev. threshold, the 1, 2, 3, and 5 year returns of the Buy had 36, 36, 36, and 28 observations. For the Sell there were 105, 105, 105, and 105 observations. For the Hold there were 225, 214, 202, and 186 observations. For the .8 std. dev. threshold, the 1, 2, 3, and 5 year returns of the Buy had 46, 46, 46, and 37 observations. For the Sell there were 119, 119, 119, and 119 observations. For the Hold there were 201, 190, 178, and 163 observations.

Can the Signals of the Model Improve on Well Recognized Long-run Strategies?

Historically, regular contributions into a diverse set of stocks such as the S&P 500 have generally resulted in long-term nominal annual returns of around 11 percent and real annual returns of approximately 7 percent. Moreover, when followed over a lengthy time frame, such as 20 or 30 years, the variability of the returns has also been relatively low. This combination makes regular contributions into a diversified stock plan highly attractive for long-term investors, such as younger workers setting funds aside for retirement.

Can the model presented here improve on the long-run returns derived from regular contributions into a S&P 500 mutual fund? Could an investor do better if they only bought when our model signaled buy and then sell when a sell signal was present? There are two reasons why this strategy is unlikely to result in significantly higher returns for long-term investors. First, our model provides a "hold" signal about 70 percent of the time. During these time periods, the investor can expect to earn only average returns, that is, returns similar to the long-run returns earned by the regular contribution investor. Second, if one sells when the market is over-valued, the alternative investment options are not very attractive. Investments such as bonds and CDs are unlikely to yield a significantly higher return than would result from continuing to hold the stock, particularly after consideration of the transaction cost involved in switching.

One might be able to obtain a little higher return by investing larger amounts when a buy signal is present and smaller amounts when the sell signal is observed. But even these gains are likely to be modest. Thus, we believe the model is unlikely to result in significantly higher long-term returns than those generated by long-term strategies such as "buy and hold" or regular contributions into a S&P mutual fund.

Conclusion

What are the major implications of our analysis? Two points are particularly important. First, our model provides valuable information for those investing within a time frame of 1 to 5 years. If undertaken when the actual CAPE is one standard deviation or more below the projected CAPE, investments in a broad set of stocks such as the S&P 500 are highly likely to yield an attractive return. Moreover, the risk of significant loss is minimal. In contrast, if undertaken when the actual CAPE is one or more standard deviations above the projected CAPE, stock investments are likely to yield a low return within a time horizon of less than five years. Thus, those saving for a down payment on a house, the financing of college for a teenage child, or other items where the funds will be needed within a one to five-year time horizon would be wise to consider stocks during periods when our model signals under valuation, but avoid them when the model indicates the market is over-valued.

Second, the high CAPE ratio of 2017 is less troublesome than the historic figures suggest. Asset prices and the discounted value of future income reflect interest rates. The low interest rates of recent years are a major contributing factor to the current historically high CAPE. Once the impact of the low interest rates is taken into account, the 2017 CAPE values are high, but not unprecedented. The actual CAPE is currently a little more than one standard deviation above the predicted value of our model. Overvaluations of this magnitude have been present about 10 percent of the time during the past half century. Clearly, this is a time to keep a close eye on interest rates. The lower interest rates of recent years have pushed the projected CAPE upward. If interest rates continue at the current low levels, the projected CAPE will continue to be high compared to historical levels. However, if interest rates rise significantly, this will lower the projected CAPE and increase the over-valuation of the stock market. Rising interest rates, should they occur, are likely to trigger a major stock market correction.

Finally, our model provides guidance to portfolio managers as they consider the size of their stock holdings within the portfolios under their control. When the actual S&P prices are low relative to their projected values, it makes sense to increase these stock holdings within one's portfolio. On the other hand, when actual stock prices are high compared to the projected values, some reduction in stock holdings may be in order. As we discussed above, the increase in long-term returns from adjustments like these are likely to be modest. However, our model does indicate that potential gains are possible if an investor can increase their holdings when stock prices are low rather than high. How large are the potential long-run gains from alternative strategies to achieve this objective? At this point, we have not explored the answer to this question, but it is certainly an interesting topic for future research.

References

Baker, M. and J. Wurgler. "Investor Sentiment and the Cross-Section of Stock Returns." *Journal of Finance*, Vol. 41, No. 4 (2006), pp.1645-1680.

Barberis, N., A. Shleifer, and R. Vishny. "A Model of Investor Sentiment." *Journal of Financial Economics*, Vol. 49, No. 3 (1998), pp. 307-343.

Campbell, J. and R. Shiller. "Stock Prices, Earnings, and Expected Dividends." *Journal of Finance*, Vol. 43, No. 3 (1988), pp. 661-676.

——. "Valuation Ratios and the Long-Run Stock Market Outlook." *Journal of Portfolio Management*, Vol. 24, No. 2 (1998), pp. 11-26.

Gwartney, J., R. Stroup, R. Sobel, and D. Macpherson. *Economics: Private and Public Choice*. 16th ed. Stamford, CT: Cengage, 2017.

Shefrin, H. *Beyond Greed and Fear: Understanding Behavioral Finance and the Psychology of Investing*. Boston, MA: Harvard Business School Press, 2000.

Shiller, R. *Irrational Exuberance*. 3rd ed. Princeton, NJ: Princeton University Press, 2015.

Shleifer, A. *Inefficient Markets*. Oxford: Oxford University Press, 2000.

Walker, M. "Why Are Interest Rates So Low?" Fraser Institute Research Paper, 2016.

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[1] By 2020, the share of the population from age 50 to 75 compared to those below the age of 50 will be above 60 percent in Japan and Italy. It will be above 45 percent for the United States, France, Spain, and the U.K. The pattern is the same for the other high income countries and the trend toward an aging population will continue for at least another decade. For more information see Gwartney et. al. 2017, pg. 298.

[2] See Shleifer, *Inefficient Markets* and Shefrin, *Beyond Greed and Fear: Understanding Behavioral Finance and the Psychology of Investing*, for explanations of a variety of topics in behavioral finance.

[3] The investor sentiment index used in Baker and Wurgler [2006] has 6 components. In subsequent analysis Baker and Wurgler dropped one of the variables, the NYSE share turnover. Due to the growing use of quantitative and high frequency trading, NYSE share turnover is no longer a reliable proxy for investor sentiment. Thus, the investor sentiment measure used here has five components.

[4] See http://www.taxpolicycenter.org/statistics/historical-capital-gains-and-taxes.

[5] See http://www.multpl.com/.

[6] To see this, start with a simple log-linear model: $\ln y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \epsilon$. One finds the marginal impact of a change in x_1, by solving for y and then differentiating with respect to x_1. Thus, $y = e^{(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \epsilon)}$ and $\frac{\partial y}{\partial x_1} = \beta_1 e^{(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \epsilon)}$, which simplifies to: $\frac{\partial y}{\partial x_1} = \beta_1 y$. Therefore, the marginal impact of a 1 unit change in the log-linear model is simply a percentage change.

[7] For the period of our sample (July, 1965 through June, 2017) the five-year Treasury bill interest rate alone explains over 51 percent of the variation in the log of the CAPE ratio. This corresponds to a correlation coefficient between the two variables of -0.716. Shiller notes that the relationship between the CAPE ratio and long-term interest rates is weak for the period 1881-2014, but stronger after 1960. "Over the whole period shown in figure 1.3, no strong relation is seen between interest rates and the price-earnings ratio [Shiller 2015, 12]."

[8] The appendix is located online at: http://myweb.fsu.edu/jsc07e/peratio.html.

[9] The returns in exhibit 5 are the total returns as they include dividends. The returns are annual and constructed by computing the 12-month percentage change of the S&P 500 price index and then adding the 12-month dividend yield. The total annual return of the S&P 500 can also be calculated using the total return index of the S&P 500 (SPXT or ^SP500TR), which adjusts the index for reinvested dividends. However, this total return index is limited to the period 1988 to the present, which covers approximately half of our dataset. Thus, the nominal returns shown here are the averages of the annual price change plus the 12-month dividend yield.