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SPY Sample Regression Function

A Mid-Term Forecast for Trading the SPY

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This paper offers an estimation of the price level of the SPY State Street Global Advisors SPDR S&P 500 exchange traded fund using a linear Sample Regression Function for the purpose of increasing profitability of future, mid-term trades in the face of the "Fiscal Cliff".

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Introduction

The purpose of this paper is to offer a framework for the possible value of the State Street Global Advisors SPDR S&P 500 exchange traded fund, ticker SPY. This estimation is designed for mid-term trading, and, carefully, considers financial products from all major financial markets.

The Model

This theoretical model estimates the value of the State Street Global Advisors SPDR S&P 500 exchange traded fund. It includes variables such as the price per barrel of oil, the aggregate price of banking stocks, currency exchange rates, a moving average of the SPY, volatility, as well as, measures of the debt market.

The function utilized in this paper is shown below:

$$SPY = f(p_{qi}, e_{ri}, e_{si}, p_{ti}, p_{ui}, t_{vi}, p_{wi}, s_{xi}, s_{zi}, \mathcal{E}_i)$$

where for observation i: p_y is the price of the equity market Y; p_q is the price level of bank index Q; e_r is the rate of exchange for currency cross R; e_s is the rate of exchange for currency cross S; p_t is the price of good T; p_u is the price of good U; t_v is the lagged, simple, moving average, V, of the dependent variable; p_w is the price of financial instrument W; s_x is the yield spread, X, between two debt instruments; s_z is the yield spread, Z, between two debt instruments; and, $\mathcal{E}$ is the stochastic error term.

The expected sign of p_q is positive given that equity markets and their respective financial sectors move in a positively correlated fashion. This is due, in part, to the leverage made available to both firms and households

through financing. An increase in financing results in increased profits for the banking sector, and increased leverage allows for an increase in consumption. An increase in consumption results in higher expected future profits for firms, which will increase the stock prices comprising the S&P 500, and therefore, the index itself.

The expected signs of e_r and e_s are both positive given that when the exchange rates for currency pairs R and S increase, so, too does the price level of equity market Y. Money will flow out of the denominated currencies for each cross and into their respective equity markets as the appetite for riskier assets such as equities increases.

Variables p_t and p_u have positive expected signs given that when equity markets increase in price, so to do the input costs for businesses, as well as, the consumption associated with these particular goods T and U. As the equity markets increase due to an increase in expected profits, the demand for these goods increases, pushing the prices up due to supply and demand.

The positive sign of t_v is expected due to the fact that technical indicator V is a moving average of equity market Y. The price level of Y will track its short-term moving average more often than not, given the fact that it has a high, positive correlation with the price level of Y of 0.98.

Variable p_w has a negative expected sign. This is in-line with financial market expectations given that when the price level of Y increases, that of financial instrument W decreases. The correlation between the data used for the variables Y and W in this model is -0.5475.

The signs of both s_x and s_z are initially unknown given the multiple possible scenarios that involve the price movements of the underlying securities. In all, there are six possible scenarios for the price movement of the underlying securities that affect the yield spread X, as well as, six possible scenarios that affect the yield spread Z.

The Estimated Model

This paper estimates the level of the State Street Global Advisors SPDR S&P 500 ETF, ticker SPY, using the following function:

$$y_t = \alpha_0 + \alpha_1 q_t - \alpha_2 r_t + \alpha_3 s_t + \alpha_4 t_t + \alpha_5 u_t + \alpha_6 v_t - \alpha_7 w_t - \alpha_8 x_t - \alpha_9 z_t + \varepsilon_t$$

where the estimated equation is:

$$SPY = f(BKX, EURCHF, EURUSD, BRENT, WTI, SPY3SMA, VIX, TIPSPREAD, YIELDCURVE),$$

Here, q_t is the weekly price of the KBW Bank Index, ticker BKX; r_t is the weekly exchange rate between the Euro and the Swiss Franc; s_t is the weekly exchange rate between the Euro and the USD; t_t is the weekly price level of Brent crude oil; u_t is the weekly price level of WTI oil; v_t is the 3 week simple moving average of the SPY data set used as the dependent variable lagged by 1 week; w_t is the weekly price level of the Volatility Index, ticker VIX; x_t is the yield spread between the 5 Year U.S. Treasury Bond rate and the 5 Year TIPS rate; z_t is the yield spread between the 3 Month U.S. Treasury Bill and the 10 Year U.S. Treasury Bond; and, ε_t is the stochastic error term.

After running the function in both linear and log-linear form, the chosen form is the linear equation. The expected signs of the linear form of the function are favorable to those of the log-linear form. The log-linear function has a negative expected sign for the variable BKX. Economic theory and market expectations would suggest a positive correlation between the BKX and the SPY. The magnitudes of the partial slopes of the linear function are in-line with economic and financial market theory, and are therefore, favorable. Those of the log-linear form do not match expectations.

The statistical significances of the variables are greater in the linear form of the function with the exception of the EUR/CHF cross (Q). It offers a considerably favorable R-squared of 0.979427 versus 0.956982 for the log-linear form. It also has a lower standard error of regression of 2.570265 versus 3.527850. The F-statistic is much greater at 2586.620 versus 1072.754 from the log-linear function. The coefficient of variation for the log-linear form is 0.0297 compared to 0.0215 for the preferred linear form.

The Data

The data for the dependent variable (SPY) were sourced from Yahoo Finance (finance.yahoo.com). They are weekly data which range from 01/06/2003 to 07/30/2012. The data for the independent variables are from a variety of sources. The U.S. equities data (BKX, VIX) were sourced from Yahoo Finance (finance.yahoo.com). Each observation is a weekly closing price running from 01/06/2003 to 07/30/2012. The 3 period simple moving average of the SPY was calculated using the data set for the dependent variable. Data for WTI oil, Brent oil, the 5 Year U.S. Treasury, the 5 Year TIPS, the 3 Month U.S. Treasury, the 10 Year U.S. Treasury, and the EUR/USD exchange rate are from the Federal Reserve (research.stlouisfed.org). The figures used for WTI and Brent are weekly and run from 01/03/2003 to 07/27/2012. Those of the U.S. Treasuries start at 01/10/2003 and stop at 08/03/2012, and are also weekly. The yield spreads are calculated using those same data. The data for the EUR/CHF cross are from Forex Forum (global-view.com). They are weekly and run from 01/10/2003 to 07/27/2012. Summary Statistics for each series utilized in the sample regression function can be found below:

Summary Statistics			
Variable	**# Observations**	**Mean**	**Standard Deviation**
SPY	499	132.73	6.01
BXK	499	45.41	2.42
EUR/CHF	499	1.20	0.01
EUR/USD	499	1.29	0.04
BRENT	499	111.71	10.14
WTI	499	68.78	25.04
SPY3SMA	499	119.56	17.72
VIX	499	18.64	2.88
TIPSPREAD	499	1.87	0.13
YIELDCURVE	499	1.79	0.24

Results

The sign for the variable BKX (q_t) is positive and it has a partial slope of 0.070919. The positive correlation, as well as, the magnitude of the coefficient matches expectations. It is statistically significant where the t-stat, $|t|$ = 4.469492. The EUR/CHF cross (r_t) has a positive sign with a slope of 1.291260. It has a t-stat of 0.507905. This is not significant but, it is still worth keeping in the equation given the fact that economic and market theory would

suggest that as money flows out of the Euro into the safety of the Swiss Franc, money would, also be flowing out of the Euro denominated equity market. This would be a risk-off move in the European markets. If European equity markets are experiencing weakness, or expectations are that they will in the future, U.S. equity markets should be affected negatively given that the European Union accounts for 19 percent of total U.S. exports. "Europe in 2010 accounted for 25 percent of world trade… Europe also is the biggest trading partner for China and the United States. Loss of this market would ripple worldwide and slow global growth."[1] Therefore, theory suggests that the EUR/CHF cross is significant enough to leave in the overall function. The EUR/USD (s_t) has a positive sign with a magnitude of 10.21263. This variable has a much greater t-stat of 4.652110. The expected sign for Brent Oil (t_t) is positive and has a magnitude of 0.199665. Its t-stat is 5.544470. WTI Oil (u_t) has a negative partial slope with a magnitude of 0.149880. Its |t| = 4.431160. The negative partial slope does not match economic theory which would suggest that because the equity markets, here the SPY, go up due to higher profits, and higher expected future profits, demand for resources, and therefore, the prices of resources such as oil would increase alongside the increase in consumption. It comes down to supply and demand. As for the 3 period simple moving average of the SPY (v_t), it has a positive coefficient with a magnitude of 0.820601. It has a t-stat of 42.15633. This very high t-stat is expected. The VIX (w_t) has a negative partial slope and a magnitude of 0.427540. This negative sign is certainly expected given that the VIX is considered by many to be the "fear index". Essentially, the VIX is a measure of the cost to insure a long equity position, such as one in the SPY, against a potential drop in price. That insurance increases in price as the equity markets decline. Therefore, the price of the VIX increases as equity markets decline. It has a t-stat of 19.03907. The signs for the TIPS Spread (x_t) and the 3 Month/10 Year U.S. Treasury Yield Curve (z_t) are negative. For the TIPS Spread, this is likely due to the fact that the yields for both the 5 Year U.S. Treasury Bond and the 5 Year TIPS Bond are highly correlated at 0.861231 according to the weekly data used in this sample regression function. This reveals that the two yields move up and down in tandem more often than not. This means that those scenarios in which they could diverge occur infrequently. Because they move up and down together more often than not, it can be expected that when the yield spread increases, the SPY will go down in price. This is because when money flows into U.S. Treasuries in a risk-on move, the expectation is that the U.S. economy is moving into a deflationary period. This results in a decreased appetite for the inflation protected securities versus the treasuries that are not indexed to inflation. A divergence of the two rates could cause a different expected sign. The

[1] Stella Dawson, "What would Greek exit mean for the U.S. economy?", Reuters, May 24, 2012

same is true of the 3 Month/10 Year U.S. Treasury Yield Curve. These two yields are, also highly correlated at 0.759947. The magnitude of the TIPS Spread is 4.358158, and that of the Yield Curve is 0.242343. The t-stat for the TIPS Spread is 11.19597, and is 1.548690 for the Yield Curve.

As for the sample regression function overall, it performed well. It has a coefficient of variation of 0.0215. It has an F-stat of 2586.62, an R-squared of 0.979427, and an adjusted R-squared of 0.979048. The results of the equation, as well as, a chart which plots the actual and predicted values, as well as, the residual can be found below:

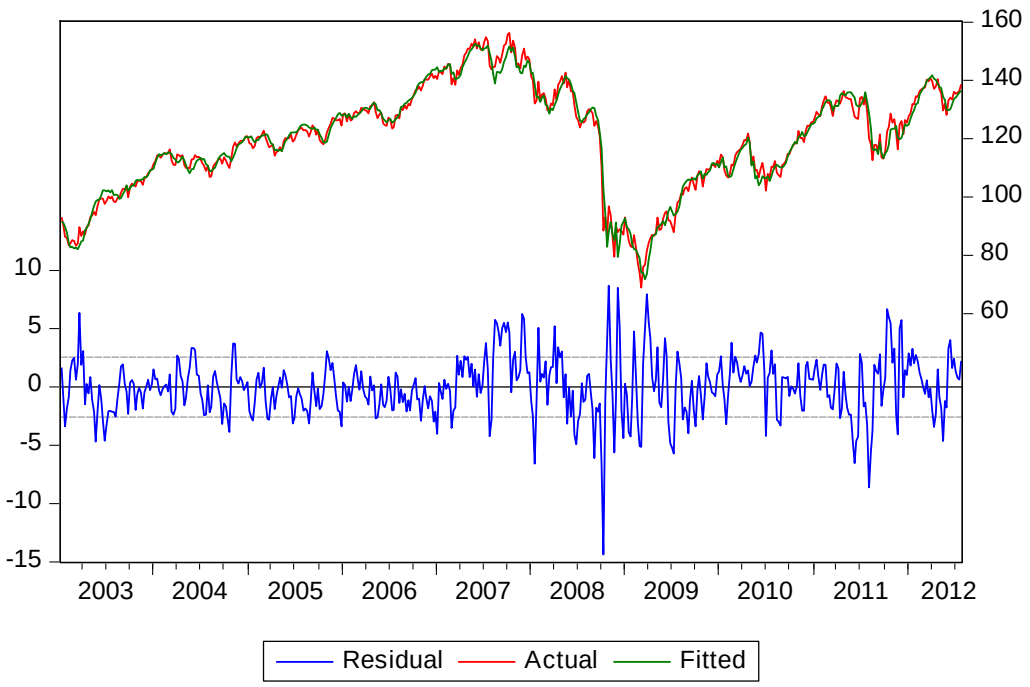
State Street Global Advisors SPDR SPY: 01/10/2002 to 07/27/2012

$$\hat{y}_t = \underset{(5.1)}{15.17} + \underset{(4.5)}{0.07}q_t + \underset{(0.5)}{1.29}r_t + \underset{(4.7)}{10.21}s_t + \underset{(5.5)}{0.20}t_t - \underset{(4.4)}{0.15}u_t + \underset{(42.2)}{0.82}v_t - \underset{(19.0)}{0.43}w_t - \underset{(11.2)}{4.36}x_t - \underset{(1.6)}{0.24}z_t$$

$N = 499$ $R^2 = 0.979$ $F = 2586.62$ $\hat{\sigma}_\varepsilon = 3.49$ $\hat{\mu}_y = 132.73$ $CV = 0.022$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.17932	2.950842	5.144062	0.0000
BKX	0.070919	0.015867	4.469492	0.0000
BRENT	0.199665	0.036012	5.544470	0.0000
EURCHF	1.291260	2.542325	0.507905	0.6117
EURUSD	10.21263	2.195269	4.652110	0.0000
SPY3SMA	0.820601	0.019466	42.15633	0.0000
TIPSPREAD	-4.358158	0.389261	-11.19597	0.0000
VIX	-0.427540	0.022456	-19.03907	0.0000
WTI	-0.149880	0.033824	-4.431160	0.0000
YIELDCURVE	-0.242343	0.156482	-1.548690	0.1221

R-squared	0.979427	Mean dependent var	119.7151
Adjusted R-squared	0.979048	S.D. dependent var	17.75681
S.E. of regression	2.570265	Akaike info criterion	4.745732
Sum squared resid	3230.462	Schwarz criterion	4.830153
Log likelihood	-1174.060	Hannan-Quinn criter.	4.778861
F-statistic	2586.620	Durbin-Watson stat	0.864367
Prob(F-statistic)	0.000000		



Conclusions

In conclusion, the estimated equation for the price level of the SPY is a useful tool for trading the SPY in the mid-term. It can be relied upon given its respectable R-squared, as well as, the fact that it considers critical components of all of the major financial markets. The movement of these markets move in relation to one another, and, that money flow needs to be considered as it is in this function.

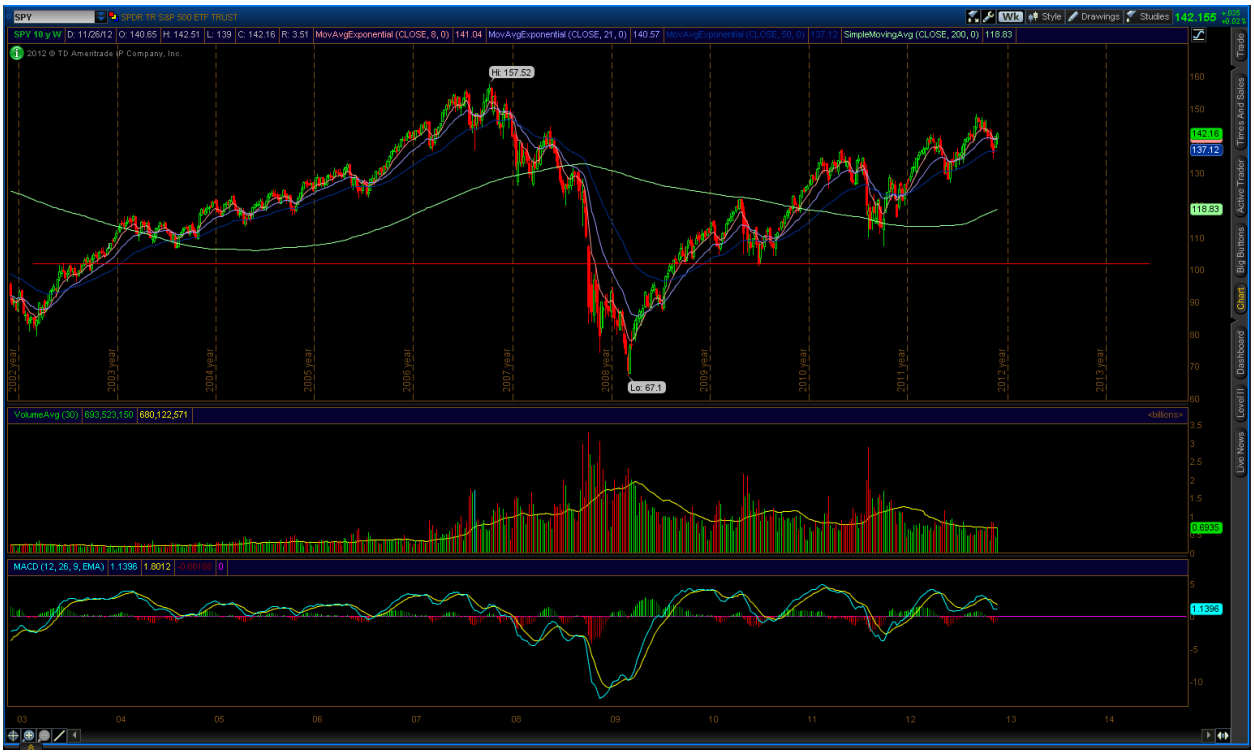
Looking forward, the so-called "Fiscal Cliff" looms overhead. This equation should give a reliable outlook for the SPY as a proxy for the overall U.S. equity market whether the U.S. falls off of the cliff for an extended period of time, for a short few months, or if elected officials find common ground and are able to work out a compromise, altogether allowing for the complete avoidance of the tax hikes and spending cuts that have so many investors worried. Always optimistic, this paper will consider the best case scenario.

In the best case scenario, elected officials will find a way to avoid the cliff. According to the Congressional Budget Office:

> "... U.S. gross domestic product would increase by 0.4% and employment by 400,000 in the fourth quarter of 2013 if lawmakers avoid $55 billion in defense spending cuts required next year by the earlier debt deal. A similar boost in growth and employment would occur if the $55 billion in cuts to other domestic spending is avoided, CBO added.

> Extending tax provisions set to expire next year and keeping the alternative minimum tax from hitting more taxpayers would boost GDP and generate 1.8 million jobs, the CBO said. Increasing taxes on just wealthier Americans—while sparing all other taxpayers from higher taxes—would increase GDP by 1.3% by the fourth quarter of 2013 and create an additional 1.6 million new jobs.
>
> The CBO also said that if the individual's share of an expiring payroll tax cut and an expanded federal jobless benefits program are both continued there would be 0.7% increase to economic output and 800,000 jobs created."[2]

If this were to occur, risk would be on, and new highs would likely be made on the SPY. The chart below shows a recent high of $157.52 set on 10/08/2007. If figures for the variables with the three greatest coefficients are taken from just before the financial crisis, it could be expected that the SPY would gain $12.00. The expectation would be that this would take the market from the 11/27/2012 close of $141.46 to $153.46, all other things being equal. This would be just shy of the $157.52 high set in 2007. This assumes that the EUR/USD and EUR/CHF crosses, as well as, the TIPS Spread each return to their 10/03/2008 levels. It is easy to see that it would certainly be possible to reach new highs given a return to pre-recession levels for each of the independent variables.



[2] Corey Boles, "CBO: 'Fiscal Cliff' Could Trigger Recession", Wall Street Journal, November 08, 2012

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Appendix

A.1 Dummy Variable

Using a dummy variable in this new equation that codes any predicted values of the dependent variable that are greater than two standard deviations from the mean as 1 and any that are within that range as 0 has advantages. With the addition of this new variable, the overall "fit" of the equation is improved.

The dummy coefficient is significant with a t-stat of 2.497780. Overall, the new equation has a higher R-squared of 0.979686 compared to that of the original equation of 0.979427. The standard error of regression has decreased from 2.570265 to 2.556606 for the equation with the dummy variable. The F-stat has decreased to 2353.523 from 2586.620, and the coefficient of variation is lower at 0.0214 from 0.0215. These changes are all slightly better.

It is for these reasons that the new equation with the dummy variable is the preferred equation. The output from this equation can be found below:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.54752	2.938861	5.290323	0.0000
BKX	0.066566	0.015879	4.192136	0.0000
BRENT	0.196165	0.035848	5.472184	0.0000
EURCHF	1.478206	2.529922	0.584289	0.5593
EURUSD	9.980930	2.185572	4.566735	0.0000
SPY3SMA	0.822613	0.019379	42.44874	0.0000
TIPSPREAD	-4.320729	0.387483	-11.15077	0.0000
VIX	-0.438474	0.022762	-19.26383	0.0000
WTI	-0.148669	0.033648	-4.418377	0.0000
YIELDCURVE	-0.243773	0.155652	-1.566139	0.1180
DUM1	1.369392	0.548244	2.497780	0.0128

R-squared	0.979686	Mean dependent var	119.7151
Adjusted R-squared	0.979270	S.D. dependent var	17.75681
S.E. of regression	2.556606	Akaike info criterion	4.737036
Sum squared resid	3189.683	Schwarz criterion	4.829899
Log likelihood	-1170.890	Hannan-Quinn criter.	4.773478
F-statistic	2353.523	Durbin-Watson stat	0.877211
Prob(F-statistic)	0.000000		

A.2 Ex-Post Forecast

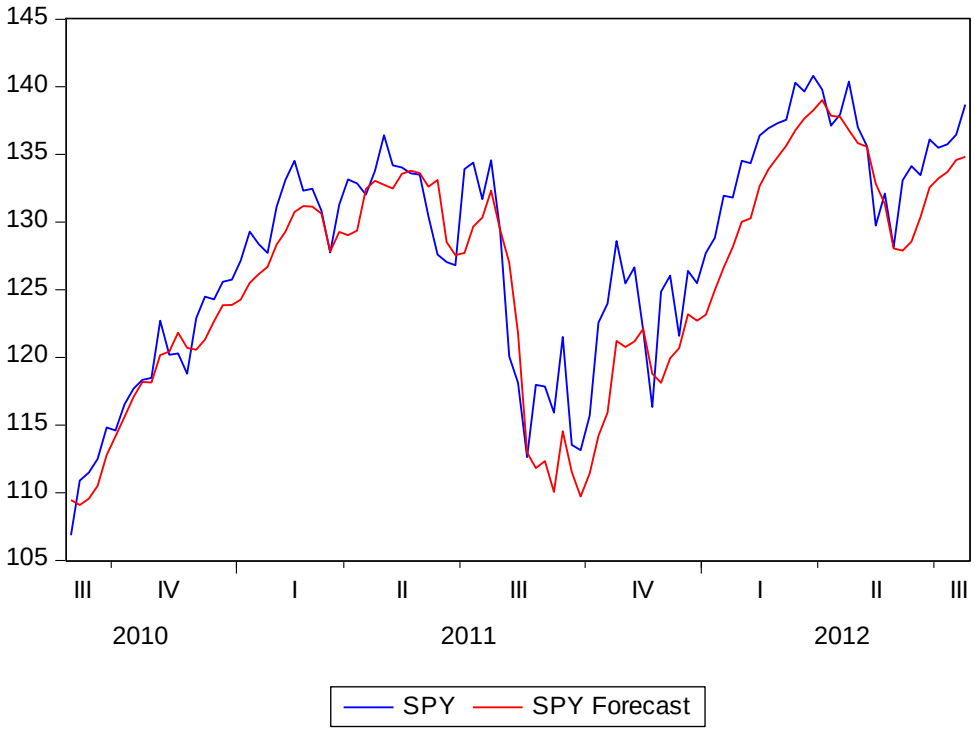
Performing an ex-post forecast using the equation above offers the ability to compare actual values to predicted values. Here, the first 398 observations, roughly 80% serve as the sample period.

The standard error of regression for the estimation period is 2.578882 while the root mean squared error (RMSE) for the forecast period is 3.426012. While this is a significant difference, it is not a great cause for concern given the amount of volatility seen in the independent variable during the forecast period which had a standard deviation of 8.097156. Also, the sample period used for this forecast includes the financial crisis in 2008 that roiled global markets. This should have a negative impact on the ability of the sample period to generate forecasts. Given the extra volatility, it would be expected that the differences between the predicted values and the actual values during the forecast period would be greater than those from the sample period. The output from the sample period can be found below:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.784362	4.451320	1.524124	0.1283
BRENT	0.081674	0.064777	1.260842	0.2081
EURCHF	8.141438	3.408962	2.388246	0.0174
EURUSD	7.292485	2.187954	3.333016	0.0009
SPY3SMA	0.886522	0.016956	52.28297	0.0000
TIPSPREAD	-3.427087	0.416090	-8.236401	0.0000
VIX	-0.419365	0.026648	-15.73748	0.0000
WTI	-0.070293	0.063483	-1.107274	0.2689
YIELDCURVE	-0.300200	0.171436	-1.751093	0.0807
DUM1	1.613061	0.663147	2.432434	0.0154

R-squared	0.981850	Mean dependent var	117.6617
Adjusted R-squared	0.981429	S.D. dependent var	18.92411
S.E. of regression	2.578882	Akaike info criterion	4.757393
Sum squared resid	2580.445	Schwarz criterion	4.857555
Log likelihood	-936.7213	Hannan-Quinn criter.	4.797067
F-statistic	2332.176	Durbin-Watson stat	0.956231
Prob(F-statistic)	0.000000		

Below is the graph of the actual and predicted values for the forecast period:



Below is the table of actual, predicted, residual, and percent error values for the forecast period:

DATE	SPY	SPYF	RESID	PCTER
8/27/2010	106.86	109.4627	2.6	2.44%
9/3/2010	110.89	109.0773	-1.81	-1.63%
9/10/2010	111.48	109.5539	-1.93	-1.73%
9/17/2010	112.49	110.5021	-1.99	-1.77%
9/24/2010	112.64	112.974	0.33	0.30%
10/1/2010	113.15	109.7121	-3.44	-3.04%
10/8/2010	113.54	111.5357	-2	-1.77%
10/15/2010	114.61	114.1658	-0.44	-0.39%
10/22/2010	114.82	112.7988	-2.02	-1.76%
10/29/2010	115.71	111.4249	-4.29	-3.70%
11/5/2010	115.92	110.0577	-5.86	-5.06%
11/12/2010	116.34	118.8001	2.46	2.11%
11/19/2010	116.54	115.6005	-0.94	-0.81%
11/26/2010	117.7	117.0915	-0.61	-0.52%
12/3/2010	117.85	112.327	-5.52	-4.69%

DATE	SPY	SPYF	RESID	PCTER
8/19/2011	129.3	125.5098	-3.79	-2.93%
8/26/2011	129.33	129.4302	0.1	0.08%
9/2/2011	129.74	132.8441	3.1	2.39%
9/9/2011	130.42	132.6316	2.21	1.70%
9/16/2011	130.84	130.6402	-0.2	-0.15%
9/23/2011	131.15	128.3515	-2.8	-2.13%
9/30/2011	131.3	129.2685	-2.03	-1.55%
10/7/2011	131.69	130.3278	-1.36	-1.03%
10/14/2011	131.82	128.1489	-3.67	-2.78%
10/21/2011	131.95	126.6281	-5.32	-4.03%
10/28/2011	132.04	132.4409	0.4	0.30%
11/4/2011	132.1	131.3381	-0.76	-0.58%
11/11/2011	132.33	131.1759	-1.15	-0.87%
11/18/2011	132.47	131.1441	-1.33	-1.00%
11/25/2011	132.86	129.3635	-3.5	-2.63%

12/10/2010	117.97	111.8191	-6.15	-5.21%	12/2/2011	133.1	127.899	-5.2	-3.91%
12/17/2010	118.12	121.7987	3.68	3.11%	12/9/2011	133.11	129.2974	-3.81	-2.86%
12/24/2010	118.35	118.1775	-0.17	-0.15%	12/16/2011	133.15	129.0429	-4.11	-3.08%
12/31/2010	118.49	118.1508	-0.34	-0.29%	12/23/2011	133.46	130.3819	-3.08	-2.31%
1/7/2011	118.8	120.6975	1.9	1.60%	12/30/2011	133.51	133.6254	0.12	0.09%
1/14/2011	120.08	127.005	6.93	5.77%	1/6/2012	133.61	133.8028	0.19	0.14%
1/21/2011	120.2	120.4233	0.22	0.19%	1/13/2012	133.78	133.0518	-0.73	-0.54%
1/28/2011	120.29	121.8388	1.55	1.29%	1/20/2012	133.92	127.7221	-6.2	-4.63%
2/4/2011	121.52	114.5518	-6.97	-5.73%	1/27/2012	134.04	133.5733	-0.47	-0.35%
2/11/2011	121.59	120.6935	-0.9	-0.74%	2/3/2012	134.14	128.5598	-5.58	-4.16%
2/18/2011	121.98	122.1099	0.13	0.11%	2/10/2012	134.2	132.4824	-1.72	-1.28%
2/25/2011	122.57	114.2013	-8.37	-6.83%	2/17/2012	134.36	130.285	-4.08	-3.03%
3/4/2011	122.72	120.1811	-2.54	-2.07%	2/24/2012	134.4	129.6677	-4.73	-3.52%
3/11/2011	122.89	120.5727	-2.32	-1.89%	3/2/2012	134.53	130.7577	-3.77	-2.80%
3/18/2011	123.97	115.9214	-8.05	-6.49%	3/9/2012	134.54	130.032	-4.51	-3.35%
3/25/2011	124.3	122.6796	-1.62	-1.30%	3/16/2012	134.58	132.3291	-2.25	-1.67%
4/1/2011	124.48	121.3087	-3.17	-2.55%	3/23/2012	135.49	133.2389	-2.25	-1.66%
4/8/2011	124.86	118.124	-6.74	-5.39%	3/30/2012	135.61	135.5759	-0.03	-0.03%
4/15/2011	125.48	120.7688	-4.71	-3.75%	4/6/2012	135.75	133.7032	-2.05	-1.51%
4/22/2011	125.5	122.7216	-2.78	-2.21%	4/13/2012	136.1	132.5637	-3.54	-2.60%
4/29/2011	125.6	123.8491	-1.75	-1.39%	4/20/2012	136.41	132.6579	-3.75	-2.75%
5/6/2011	125.75	123.8856	-1.86	-1.48%	4/27/2012	136.43	132.7524	-3.68	-2.70%
5/13/2011	126.05	119.9349	-6.12	-4.85%	5/4/2012	136.47	134.5997	-1.87	-1.37%
5/20/2011	126.39	123.1972	-3.19	-2.53%	5/11/2012	136.93	133.8965	-3.03	-2.22%
5/27/2011	126.66	121.174	-5.49	-4.33%	5/18/2012	137	135.8362	-1.16	-0.85%
6/3/2011	126.81	127.5621	0.75	0.59%	5/25/2012	137.14	137.8638	0.72	0.53%
6/10/2011	127.05	128.5258	1.48	1.16%	6/1/2012	137.31	134.794	-2.52	-1.83%
6/17/2011	127.14	124.2739	-2.87	-2.25%	6/8/2012	137.57	135.6567	-1.91	-1.39%
6/24/2011	127.6	133.1233	5.52	4.33%	6/15/2012	137.95	137.7817	-0.17	-0.12%
7/1/2011	127.71	123.1444	-4.57	-3.57%	6/22/2012	138.68	134.828	-3.85	-2.78%
7/8/2011	127.72	126.7014	-1.02	-0.80%	6/29/2012	139.65	137.6629	-1.99	-1.42%
7/15/2011	127.76	127.8296	0.07	0.05%	7/6/2012	139.79	139.0273	-0.76	-0.55%
7/22/2011	128.16	128.0511	-0.11	-0.08%	7/13/2012	140.3	136.7699	-3.53	-2.52%
7/29/2011	128.37	126.1652	-2.2	-1.72%	7/20/2012	140.39	136.7884	-3.6	-2.57%
8/5/2011	128.6	121.2231	-7.38	-5.74%	7/27/2012	140.81	138.2549	-2.56	-1.81%
8/12/2011	128.84	124.9818	-3.86	-2.99%					

The predicted values were under the actual values 81 times out of 101 or 80.2% of the time. Because of this underestimation, it is worth comparing statistics from the predicted values with those from the actual values in order to evaluate the equation further. Those values can be found in the following table:

VARIABLE	MEAN	STD DEV	MAX	MIN
ACTUAL	127.81	8.08	140.81	106.86
PREDICTED	125.73	8.15	139.03	109.46

The average predicted value is around 98% of the mean of the actual values. The standard deviation of the predicted values is a little high at 101% of the actual values. Despite the slightly greater dispersion, it can be seen, here, that the equation still offers a fairly accurate forecast.

Another way to determine an equation's ability to forecast is to look at its mean absolute percent error (MAPE). The MAPE for this equation is 2.17%. This figure represents a fairly accurate equation.

Yet, another statistic to consider is the RMSE of an equation. The RSME for this equation is 3.43. This is a little high given that it is 125% of the standard deviation of $\hat{\varepsilon}$ which is 2.74. The root mean square percent error for this equation is 2.71%

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The equation that includes the dummy variable is the preferred equation. An important factor to consider when evaluating the ability of the first 80% of the predicted values to forecast the remaining 20% is the financial crisis of 2008 and the volatility that followed. The error for the sample period is higher for a few reasons. First, it includes the financial crisis. Second, the sample period has fewer observations. Finally, the set of actual values from the forecast period is more volatile than many of the other periods of the same duration. (NOTE: Only values that were beyond two standard deviations were re-coded—not any significant strings of values that may be within the second deviation, but may still affect the efficacy of the equation.)

Because the sample period has been reduced to 80% of the number of observations from the original equation, the negative effect that the financial crisis has on its ability to forecast is much greater than it would otherwise have been. Essentially, the weight that the observations from 2008 carry is much greater because the pool of observations is smaller. Now, when that pool is averaged, each observation has a much greater effect on the resulting figure.