# An Automated Trading Strategy using Earnings Date Movements from Wall Street Horizon

*By: The Deltix Quantitative Research Team*

## Introduction

This study examines whether revisions of earnings announcement dates are a source of information for generating alpha in the universe of S&P500 stocks.

Wall Street Horizon (WSH) provides dates for future company earnings announcements as snapshots published daily at 16:00 ET. For each company, the future date on which earnings are announced is published by the company or inferred by WSH well before the actual announcement of the earnings per share (EPS). Sometimes companies change a previously published or inferred earnings date and it is such changes that we assess for opportunities to generate alpha through trading.

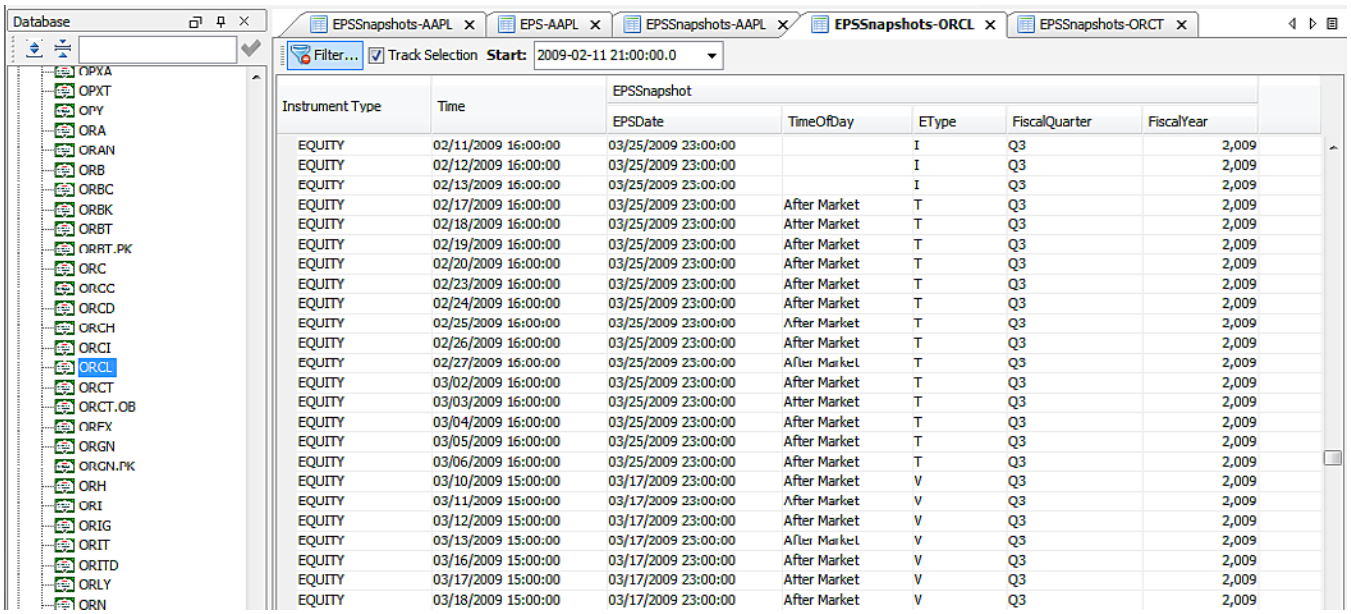
The WSH earnings announcement data set was loaded into Deltix TimeBase, the time-series data warehouse, for the period January 3, 2006 to September 2, 2015. Candidate trading strategies were developed, tested and refined in Deltix QuantOffice.

## Daily Earnings Date Snapshots

The WSH earnings announcement data set features a set of fields:

| | |
|---|---|
| **Stock Symbol** | This is the company's ticker symbol. |
| **Next ED** | This field indicates the next earnings date. |
| **Time of Day** | This field indicates the time of the announcement ("Before Market", "During Market", "After Market" or "Unspecified"). |
| **Next ED Quarter** | This is the quarter for the next earnings announcement (Q1, Q2, Q3 or Q4). Note that this is the company's financial quarter, not necessarily the calendar quarter. Relates to fiscal year. |
| **EType** | This is the state of the earnings date confirmation ("V" for Verified as a firm date or "T" for Tentative or "I" for Inferred (WSH forecast) |
| **Fiscal year** | This is the reporting fiscal year, relates to Next ED Quarter. |

An example of this data as loaded into TimeBase is shown below:




| Instrument Type | Time | EPSSnapshot | | | | |
|---|---|---|---|---|---|---|
| | | EPSDate | TimeOfDay | EType | FiscalQuarter | FiscalYear |
| EQUITY | 02/11/2009 16:00:00 | 03/25/2009 23:00:00 | | I | Q3 | 2,009 |
| EQUITY | 02/12/2009 16:00:00 | 03/25/2009 23:00:00 | | I | Q3 | 2,009 |
| EQUITY | 02/13/2009 16:00:00 | 03/25/2009 23:00:00 | | I | Q3 | 2,009 |
| EQUITY | 02/17/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 02/18/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 02/19/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 02/20/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 02/23/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 02/24/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 02/25/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 02/26/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 02/27/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 03/02/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 03/03/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 03/04/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 03/05/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 03/06/2009 16:00:00 | 03/25/2009 23:00:00 | After Market | T | Q3 | 2,009 |
| EQUITY | 03/10/2009 15:00:00 | 03/17/2009 23:00:00 | After Market | V | Q3 | 2,009 |
| EQUITY | 03/11/2009 15:00:00 | 03/17/2009 23:00:00 | After Market | V | Q3 | 2,009 |
| EQUITY | 03/12/2009 15:00:00 | 03/17/2009 23:00:00 | After Market | V | Q3 | 2,009 |
| EQUITY | 03/13/2009 15:00:00 | 03/17/2009 23:00:00 | After Market | V | Q3 | 2,009 |
| EQUITY | 03/16/2009 15:00:00 | 03/17/2009 23:00:00 | After Market | V | Q3 | 2,009 |
| EQUITY | 03/17/2009 15:00:00 | 03/17/2009 23:00:00 | After Market | V | Q3 | 2,009 |
| EQUITY | 03/18/2009 15:00:00 | 03/17/2009 23:00:00 | After Market | V | Q3 | 2,009 |

## Basis of Research using Wall Street Horizon Data

The purpose of the research described in this paper is to determine if there are opportunities to generate trading alpha in US equities using WSH data as a basis for market movement prediction on the day close prior to an EPS announcement (the holding period is about 19 hours).

We show how with the use of a regression model, we can exploit WSH earnings date announcement snapshots to generate excess returns.

In this research, we not only use official data issued by a company itself but also rely on WSH forecasts (designated "I" in data attribute EType) as a significant data source.

## Multinomial Logistic Regression

In statistics, logistic regression ("logit regression") predicts the probabilities of the different possible outcomes of a categorically distributed dependent variable based on one or more predictor variables (features) which may be real-valued, binary-valued, categorical-valued, etc.

The probabilities describing the possible outcomes of a single trial are modeled, as a function of the explanatory (predictor) variables, using a logistic function. Frequently logistic regression is used to refer specifically to the problem in which the dependent variable is binary — that is, the number of available categories is two — and problems with more than two categories are referred to as multinomial logistic regression.

Multinomial logistic regression is known by a variety of other names, including multiclass LR, multinomial regression, softmax regression, multinomial logit, maximum entropy (MaxEnt) classifier and conditional maximum entropy model.

As in other forms of linear regression, multinomial logistic regression uses a linear predictor function *f(k,i)* to predict the probability that observation *i* has outcome *k*, of the following form:

$$f(k,i) = \beta_{0,k} + \beta_{1,k}x_{1,i} + \beta_{2,k}x_{2,i} + \cdots + \beta_{M,k}x_{M,i}$$

where $\beta_{m,k}$ is a regression coefficient associated with the *m-th* explanatory variable and the *k-th* outcome. The regression coefficients and explanatory variables are normally grouped into vectors of size M+1, so that the predictor function can be written more compactly:

$$f(k,i) = \beta_k \cdot x_i$$

where $\beta_k$ is the set of regression coefficients associated with outcome *k*, and $x_i$ (a row vector) is the set of explanatory variables associated with observation *i*.

The unknown parameters in each vector $\beta_k$ are found using iteratively reweighted least squares (IRLS).

'Regressors' is an N-by-P design matrix with N observations on P predictor variables:

$$X = \begin{bmatrix} x_{0,0} & \cdots & x_{0,P-1} \\ \vdots & \ddots & \vdots \\ x_{N-1,0} & \cdots & x_{N-1,P-1} \end{bmatrix}$$

'Regressands' is an N-by-K matrix, where Regressands(i,j) is the number of outcomes of the multinomial category j for the predictor combinations given by Regressors.Rows(i):

$$Y = \begin{bmatrix} y_{0,0} & \cdots & y_{0,K-1} \\ \vdots & \ddots & \vdots \\ y_{N-1,0} & \cdots & y_{N-1,K-1} \end{bmatrix}$$

The result β is a (P+1)-by-(K-1) matrix of estimates, where each column corresponds to the estimated intercept term and predictor coefficients, one for each of the first (K-1) multinomial categories. The estimates for the K-th category are taken to be zero:

$$\beta = \begin{bmatrix} \beta_{1,0} & \cdots & \beta_1, P \\ \vdots & \ddots & \vdots \\ \beta_{K-1,0} & \cdots & \beta_{K-1,P} \end{bmatrix}$$

Multinomial logistic regression is implemented by the MultinomialRegression class of the FinMath numerical library.

## Model Implementation

Firstly, we need to categorize company behavior prior to the EPS announcement date. We will consider two independent variables:

- EPS date shift: we will denote it by $\Delta D_{EPS}$;
- Total days from last EPS date update: we will denote it by $\Delta U_{EPS}$.

Each of them can be categorized using baskets for its values; in our simple case we will consider two baskets for each of them:

- $\Delta D_{EPS}$: < 0 or >0;
- $\Delta U_{EPS}$: < 1/2 of quarter or ≥ 1/2 of quarter.

45 days is taken as the boundary for half of the quarter.

The dependent variable will be the stock's return:

$$Return = Ln\left(\frac{Price\ after\ EPS\ announcement}{Price\ before\ EPS\ announcement}\right)$$

Companies make their EPS announcements after the market close so we take the day close price prior to the EPS announcement and the day open price after the announcement date to calculate the return. The dependent variable can be categorized similarly into baskets of values. In our case we will take two baskets: Return <0 and >0, which makes our regression model into a logistic regression.

The following algorithm is applied:

1. Collect data for companies' behavior and returns;
2. Calculate number of possible cases to form the matrix of regressors; in our simple case there will be 4 cases and matrix will contain 4 rows:

$$X = \begin{bmatrix} \Delta D_{EPS} > 0 & \Delta U_{EPS} < 45 \\ \Delta D_{EPS} < 0 & \Delta U_{EPS} < 45 \\ \Delta D_{EPS} > 0 & \Delta U_{EPS} \geq 45 \\ \Delta D_{EPS} < 0 & \Delta U_{EPS} \geq 45 \end{bmatrix}$$

3. Calculate number of outcomes for each row;
4. Calculate the estimates matrix (using QuantOffice's FinMath numerical library);
5. Compare the estimates and decide which row provides the highest probability for each of the dependent variable outcomes. For example, we get the following estimates matrix:

$$\beta = \begin{bmatrix} 0.49552 & 0.50448 \\ 0.55181 & 0.44819 \\ 0.44748 & 0.55252 \\ 0.50376 & 0.49624 \end{bmatrix}$$

   First column indicates probabilities for positive return, second column for negative one. We can see that the highest probability of positive return is for row 2 and negative return is for row 3 of matrix X.

6. We will also choose the significance level equal to 10%, which means that one outcome must be at least 10% more probable than the other one for a single row of independent variables.
7. Recalculate estimates every 90 days (duration of a quarter) for a sliding window of 1500 observations, where each observation represents data pertaining to an EPS announcement for a particular stock.

If we look at the report with categories that were chosen as most probable by the logistical regression method, we can see the following:

- Positive returns most likely happen for the case $\Delta D_{EPS} < 0$, $\Delta U_{EPS} < 45$;
- Negative returns most likely happen for the case $\Delta D_{EPS} > 0$, $\Delta U_{EPS} \geq 45$;

We can hypothesize possible reasons for such results as the following:

- If a company shifts the EPS announcement date up (brings the date forward) in the second half of the quarter, it is more likely to report positive news as it already has positive information to report;
- Conversely, if a company delays its EPS announcement date thereby increasing the time before the EPS announcement (not less than 45 days), most likely negative news will be reported.

## Trading Strategy

We can now implement our findings as a trading strategy

1. On the day close prior to the EPS announcement
   Open **long position** if company falls into categories with highest probability of positive return ($\Delta D_{EPS} < 0$, $\Delta U_{EPS} < 45$).
   Open **short position** if company falls into categories with highest probability of negative return ($\Delta D_{EPS} > 0$, $\Delta U_{EPS} \geq 45$).
2. Close positions on next day open.
3. We calculate money value of the position as follows:

$$MV = \begin{cases} BetSize, & if\ BetSize * n \leq TradingCapital \\ \dfrac{TradingCapital}{n}, & if\ BetSize * n > TradingCapital \end{cases}$$

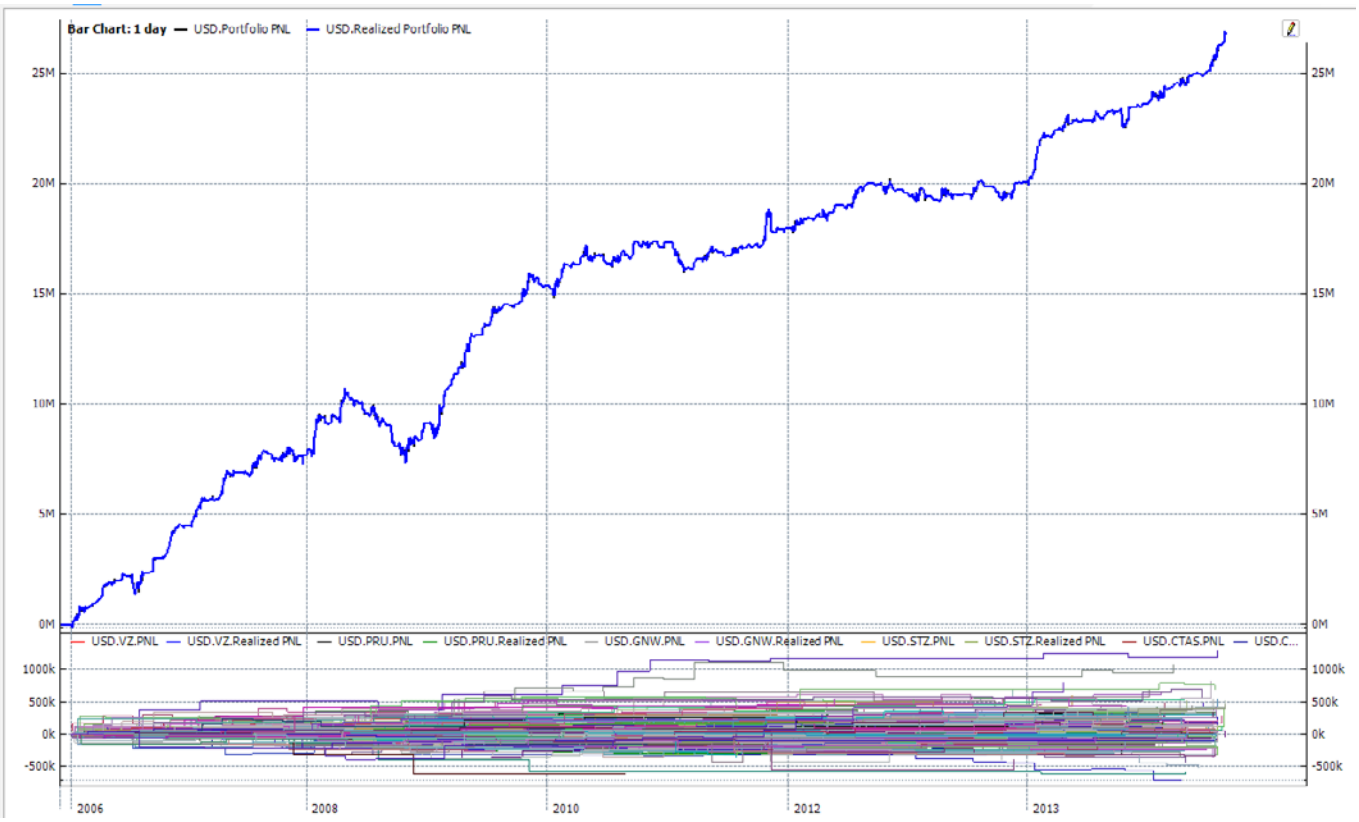
   where *n* is the number of positions to be opened on a particular day.

We designed another version of the strategy, a dollar-neutral strategy, where the resultant portfolio is hedged with the SPY ETF in order to exclude market movement impact.

## Results

The strategies where implemented in QuantOffice and back-tested across S&P500 equities over the period from January 3, 2006 to September 2, 2015 using Trading Capital = $10M. The QuantOffice summary reports from the back-tests are shown below.

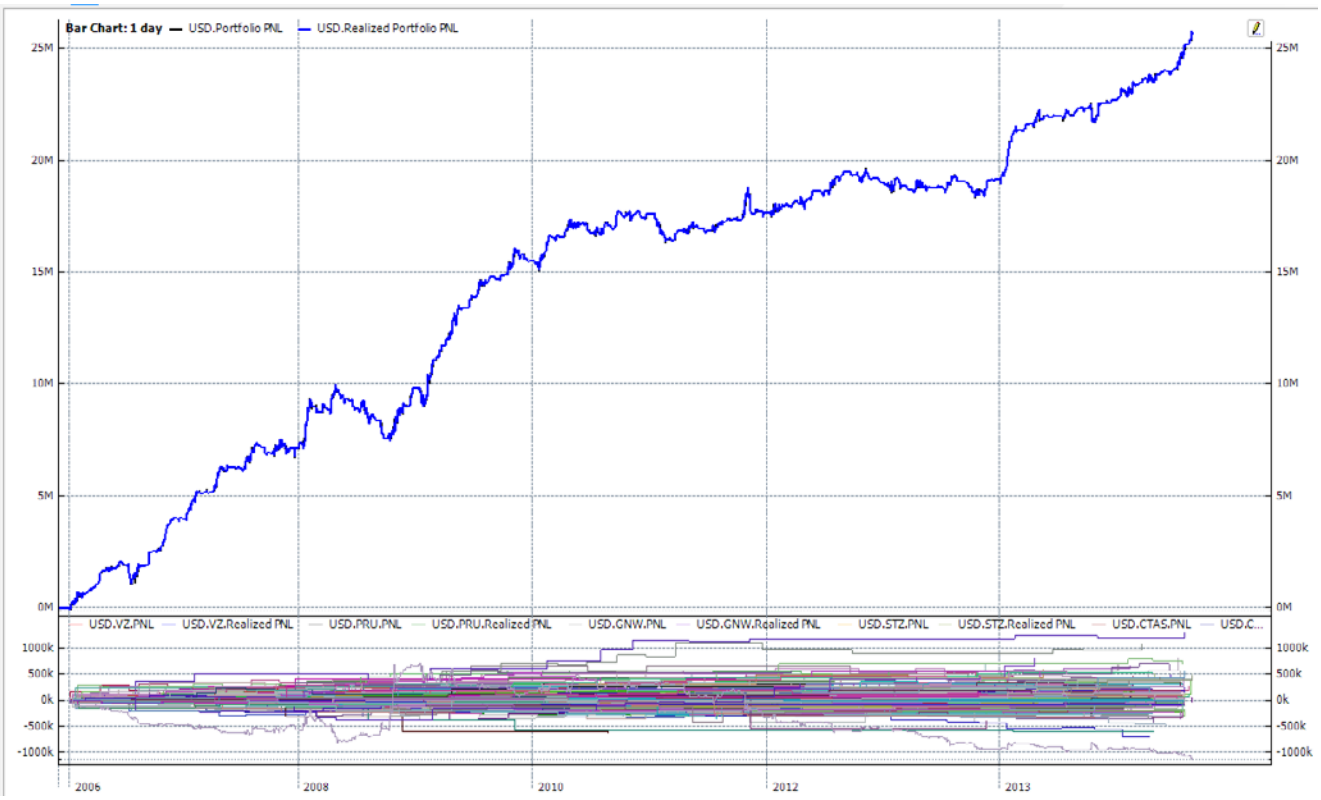
## Un-hedged strategy

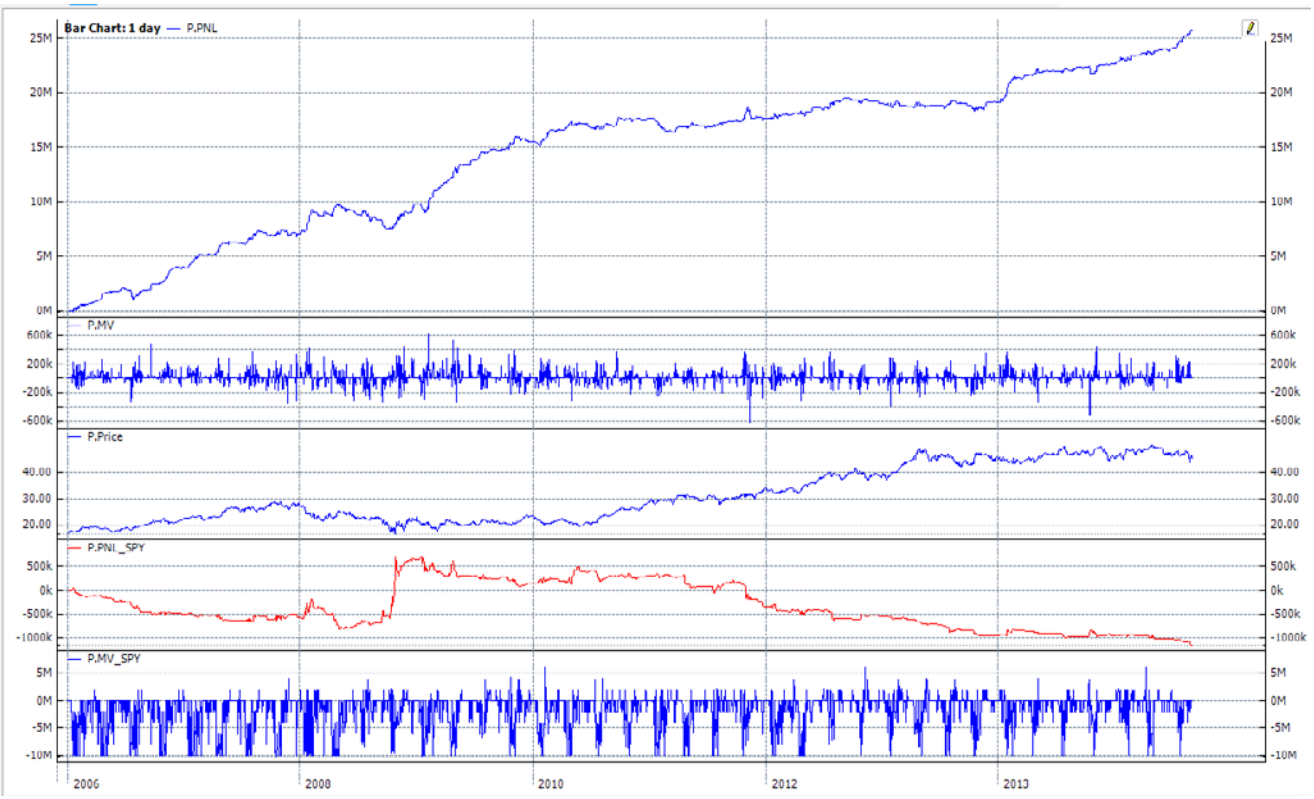



| Parameter | All Trades | Long Trades | Short Trades |
|---|---|---|---|
| Net Profit/Loss | 26,817,278.80 | 24,190,537.65 | 2,626,741.15 |
| Total Profit | 112,274,290.24 | 91,758,725.65 | 20,515,564.58 |
| Total Loss | -85,457,011.44 | -67,568,188.01 | -17,888,823.43 |
| Cumulated Profit % | 268.17 % | 241.91 % | 26.27 % |
| | | | |
| Max Drawdown | -3,308,125.45 | -2,249,528.60 | -1,595,384.68 |
| Max Drawdown % | -16.07 % | -11.06 % | -12.72 % |
| Max Drawdown Date | 10/24/2008 | 10/24/2008 | 11/13/2013 |
| Drawdown Days Percent | 77.15 % | 79.41 % | 88.37 % |
| Max Drawdown Duration | 222 | 224 | 753 |
| | | | |

| | | | |
|---|---|---|---|
| CAGR | 14.95 % | 14.04 % | 2.52 % |
| Sharpe Ratio | 2.08 | 2.07 | 0.40 |
| Annualized Volatility | 7.20 | 6.79 | 6.39 |
| Sortino Ratio | 3.64 | 3.59 | 0.62 |
| UPI | 0.34 | 0.44 | 0.03 |
| Information Ratio | 1.92 | 1.91 | 0.41 |
| Optimal f | 28.86 | 30.42 | 6.19 |
| Historical VaR 95% 1D | -122320.14 | -106943.31 | -48647.89 |
| Historical CVaR 95% 1D | -203305.82 | -191307.03 | -103653.41 |
| Theoretical VaR 95% 1D | -141084.42 | -128209.44 | -69553.14 |
| Theoretical CVaR 95% 1D | -386627.09 | -351225.22 | -183558.00 |
| | | | |
| All Trades # | 4924 | 4137 | 787 |
| Profitable Trades Ratio | 0.54 | 0.55 | 0.51 |
| Winning Trades # | 2678 | 2277 | 401 |
| Losing Trades # | 2246 | 1860 | 386 |
| | | | |
| Average Trade | 5446.24 | 5847.36 | 3337.66 |
| Average Winning Trade | 41924.68 | 40298.08 | 51161.01 |
| Average Losing Trade | -38048.54 | -36326.98 | -46344.10 |
| Avg. Win/ Avg. Loss Ratio | 1.10 | 1.11 | 1.10 |
| Average Profit per Share | 0.10 | 0.11 | 0.06 |
| | | | |
| Max Conseq. Winners | 18 | 16 | 9 |
| Max Conseq. Losers | 10 | 9 | 13 |
| Average Trade Holding Time | 00.19:58:09 | 00.19:53:37 | 00.20:21:59 |

## Dollar-neutral strategy hedged by SPY



| Parameter | All Trades | Long Trades | Short Trades |
|---|---|---|---|
| Net Profit/Loss | 25,670,826.80 | 24,355,551.75 | 1,315,275.05 |
| Total Profit | 123,573,691.62 | 92,714,320.51 | 30,859,371.11 |
| Total Loss | -97,902,864.82 | -68,358,768.76 | -29,544,096.06 |
| Cumulated Profit % | 256.71 % | 243.56 % | 13.15 % |
| | | | |
| Max Drawdown | -2,354,229.33 | -2,203,598.96 | -2,297,941.13 |
| Max Drawdown % | -11.85 % | -10.84 % | -18.86 % |
| Max Drawdown Date | 10/13/2008 | 10/24/2008 | 11/13/2013 |
| Drawdown Days Percent | 80.02 % | 79.94 % | 96.71 % |
| Max Drawdown Duration | 334 | 224 | 963 |
| | | | |
| CAGR | 14.56 % | 14.10 % | 1.33 % |
| Sharpe Ratio | 2.12 | 2.08 | 0.17 |
| Annualized Volatility | 6.87 | 6.79 | 7.95 |
| Sortino Ratio | 3.74 | 3.60 | 0.26 |
| UPI | 0.39 | 0.46 | 0.01 |
| Information Ratio | 1.93 | 1.92 | 0.17 |
| Optimal f | 30.82 | 30.59 | 2.11 |
| Historical VaR 95% 1D | -116150.49 | -106943.31 | -64414.12 |
| Historical CVaR 95% 1D | -192859.11 | -191432.42 | -122986.49 |
| Theoretical VaR 95% 1D | -134792.95 | -128425.64 | -83680.55 |
| Theoretical CVaR 95% 1D | -369418.85 | -351900.08 | -219614.76 |
| | | | |
| All Trades # | 6716 | 4527 | 2189 |
| Profitable Trades Ratio | 0.49 | 0.52 | 0.41 |
| Winning Trades # | 3276 | 2373 | 903 |

| | | | |
|---|---|---|---|
| Losing Trades # | 3440 | 2154 | 1286 |
| | | | |
| Average Trade | 3822.34 | 5380.06 | 600.86 |
| Average Winning Trade | 37720.91 | 39070.51 | 34174.28 |
| Average Losing Trade | -28460.14 | -31735.73 | -22973.64 |
| Avg. Win/ Avg. Loss Ratio | 1.33 | 1.23 | 1.49 |
| Average Profit per Share | 0.08 | 0.11 | 0.02 |
| | | | |
| Max Conseq. Winners | 17 | 16 | 9 |
| Max Conseq. Losers | 13 | 14 | 27 |
| Average Trade Holding Time | 00.18:38:01 | 00.19:03:45 | 00.17:44:50 |

## Consolidated Report

| Parameter | Un-hedged | Hedged by SPY |
|---|---|---|
| Net Profit/Loss | 26,817,278.80 | 25,670,826.80 |
| Total Profit | 112,274,290.24 | 123,573,691.62 |
| Total Loss | -85,457,011.44 | -97,902,864.82 |
| Cumulated Profit % | 268.17 % | 256.71 % |
| | | |
| Max Drawdown | -3,308,125.45 | -2,354,229.33 |
| Max Drawdown % | -16.07 % | -11.85 % |
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| | | |
| CAGR | 14.95 % | 14.56 % |
| Sharpe Ratio | 2.08 | 2.12 |
| Annualized Volatility | 7.20 | 6.87 |

| | | |
|---|---|---|
| Sortino Ratio | 3.64 | 3.74 |
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| Theoretical VaR 95% 1D | -141084.42 | -134792.95 |
| Theoretical CVaR 95% 1D | -386627.09 | -369418.85 |
| | | |
| All Trades # | 4924 | 6716 |
| Profitable Trades Ratio | 0.54 | 0.49 |
| Winning Trades # | 2678 | 3276 |
| Losing Trades # | 2246 | 3440 |
| | | |
| Average Trade | 5446.24 | 3822.34 |
| Average Winning Trade | 41924.68 | 37720.91 |
| Average Losing Trade | -38048.54 | -28460.14 |
| Avg. Win/ Avg. Loss Ratio | 1.10 | 1.33 |
| Average Profit per Share | 0.10 | 0.08 |
| | | |
| Max Conseq. Winners | 18 | 17 |
| Max Conseq. Losers | 10 | 13 |
| Average Trade Holding Time | 00.19:58:09 | 00.18:38:01 |

## Conclusion

We presented an approach in which WSH earnings (EPS) announcement date daily snapshots can serve as a strong predictive factor of stock price directionality. We developed a trading strategy that implements an algorithm based on this approach.

As the result, we found that the most probable positive returns are for shifts where the EPS announcement date is brought forward in the second half of the quarter; and negative returns for delays in the EPS announcement date when reported in the first half of the quarter.

Further, we developed a dollar-neutral version of the strategy to exclude market return impact. This approach demonstrates that the generated return is independent of market movement and as such represents alpha return.

In back-testing this strategy on stocks in the S&P500, back-testing shows that the strategy has an average Sharpe Ratio of 2.12 over the period 2006-2015, average profit per share of 0.08$, and about 15% of annual return.

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### About Deltix

Deltix is a leading provider of software and services for quantitative research, algorithmic and automated systematic trading. Deltix software enables a complete straight through processing environment for the development and deployment of closely-integrated alpha generation and/or execution strategies. Deltix has won nine industry awards since 2012 and was most recently recognized as the "Best Complex Event Processing (CEP) Platform" in November 2014. Deltix is headquartered in Natick, Massachusetts, and has offices in New York, Minsk and St. Petersburg, Russia. For more information, please visit http://www.deltixlab.com.

### About Wall Street Horizon

Wall Street Horizon provides institutional investors and traders with an ever expanding set of forward-looking and historical corporate event datasets including earnings dates, dividend dates, options expiration dates, splits, spinoffs and a wide variety of investor-related conferences. With access via machine-readable feeds or Enchilada, its easy-to-use online application, the company's data is widely recognized for its unmatched accuracy and timeliness. For more information, please visit www.WallStreetHorizon.com or email them at info@wallstreethorizon.com.