

Trading the Crude Light CL 5min Bars With The Repeated Median Velocity Strategy

1/2/2008 to 6/10/2019

Working Paper June 2019
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In previous working papers we examined a trading system that used the velocity of prices fit by a least squares straight line through “N” past prices, to determine buy and sell points. The reasoning behind this type of system was to only trade when the straight-line slope or velocity was above a certain threshold. Many times, during the day prices meandering around without a notable trend. At these times we do not wish to trade because of the whipsaws losses that occur from this type of price action. When a price trend finally starts, the velocity of that price trend moves above some minimum threshold value. Thus, the velocity system would only issue a trade when certain velocity barriers were crossed.

The Least Squares polynomial is determined by minimizing the sum of the squares of the difference between the N prices and the value of the polynomial line.

$$\text{err}^2(t) = [\text{Price}(t) - (a + b * t)]^2 = \text{error squared}$$

$$\text{Minimize}(a, b) \sum_{t=1}^{t=N} \text{err}^2(t)$$

This mathematical technique has an exact solution and dates back to Gauss in the 1800's.

Recently much work has been done in what is called robust regression and outlier detection techniques, Ref [1]. Robust regression techniques are now defined by a measure called the “breakdown point”. The breakdown point is loosely defined as the smallest amount of bad data points that can cause the regression coefficient solutions to take on values some distance from their true values. Unfortunately, the Least Squares technique has a breakdown point of 1/N. In other words, only one bad data point can significantly change the computation of the velocity or slope of a straight line. The median of a set of numbers has a breakdown point of 50%. This is because when 50% of the numbers are bad then there is no way of telling which are the bad numbers and which are the good numbers. 50% is the highest breakdown point.

The least absolute deviation (LAD) regression estimator from Ref [1] is

$$\text{Minimize}(a, b) \sum_{i=1}^{i=N} \text{absolute value} [\text{err}(i)]$$

and has a breakdown point of 29.8% . For the LAD this means around ¼ of the price points can be bad before the computations of a and b become erroneous. Siegel Ref [2], in his paper

“Robust regression using repeated medians”, introduced a technique for finding the slope that has a 50% breakpoint. The repeated median is also described in Ref [1].

While the repeated median technique may sound complicated it is quite easy to compute. Here’s how. For demonstration purposes let’s suppose we have 15 data points on an x, y graph such that,

X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Y	1	2	10	4	5	6	7	8	9	18	11	12	13	18	15	20

We’ve added two bad Y points at X positions 3,10, 14 and 16. To calculate the repeated median slope we would take the slope of every pair of y values and then find the median of all the pairs of slopes. For this example, we would take

slope	1	$y(2)-y(1)/(2-1) =$	1.00
slope	2	$y(3)-y(1)/(3-1)=$	4.50
slope	3	$y(4)-y(1)/(4-1)=$	1.00
slope	4	$y(5)-y(1)/(5-1)=$	1.00
slope	5	$y(6)-y(1)/(6-1)=$	1.00
slope	6	$y(7)-y(1)/(7-1)=$	1.00
slope	7	$y(8)-y(1)/(8-1)=$	1.00
slope	8	$y(9)-y(1)/(9-1)=$	1.00
slope	9	$y(10)-y(1)/(10-1)=$	1.89
slope	10	$y(11)-y(1)/(11-1)=$	1.00
slope	11	$y(12)-y(1)/(12-1)=$	1.00
slope	12	$y(13)-y(1)/(13-1)=$	1.00
slope	13	$y(14)-y(1)/(14-1)=$	1.31
slope	14	$y(15)-y(1)/(15-1)=$	1.00
slope	14	$y(16)-y(1)/(16-1)=$	1.27
		Median =	1.00

The median slope of the above is 1. The above process is repeated for:

$$(y(2)-y(i))/(2-i), i=1 \text{ to } 15 \ i \neq 2,$$

$$(y(3)-y(i))/(3-i), i=1 \text{ to } 15 \ i \neq 3,$$

.....

$$(y(16)-y(i))/(16-i), i=1 \text{ to } 16 \ i \neq 16.$$

The final slope is then the **median of all the medians calculated above**. While the repeated median looks redundant because the very first calculation produced the correct slope, price data is not so nicely distributed as our example and the extra calculations are needed to assure that the outliers are eliminated.

The mathematical formula for the above is

$$\text{Slope}(t) = \text{median}_i \{ \text{median}_{j \neq i} [\text{price}(t) - \text{price}(t-i) / (i-j)] \}$$

$i=1 \text{ to } N$ $j=1 \text{ to } N$

Figure 1 below shows a plot of the x,y numbers above with the repeated median line and the least squares line on the graph. Notice how the bad points draw the least squares line towards them while the repeated median line is completely unaffected by the outliers. The least Squares line is given by the formula $y = -0.65 + 1.1074 * x$. The true line is given by the formula $y = x$. From this simple example we can observe how noise has distorted the least squares estimates of **a** and **b**, where $y = a + bx$.

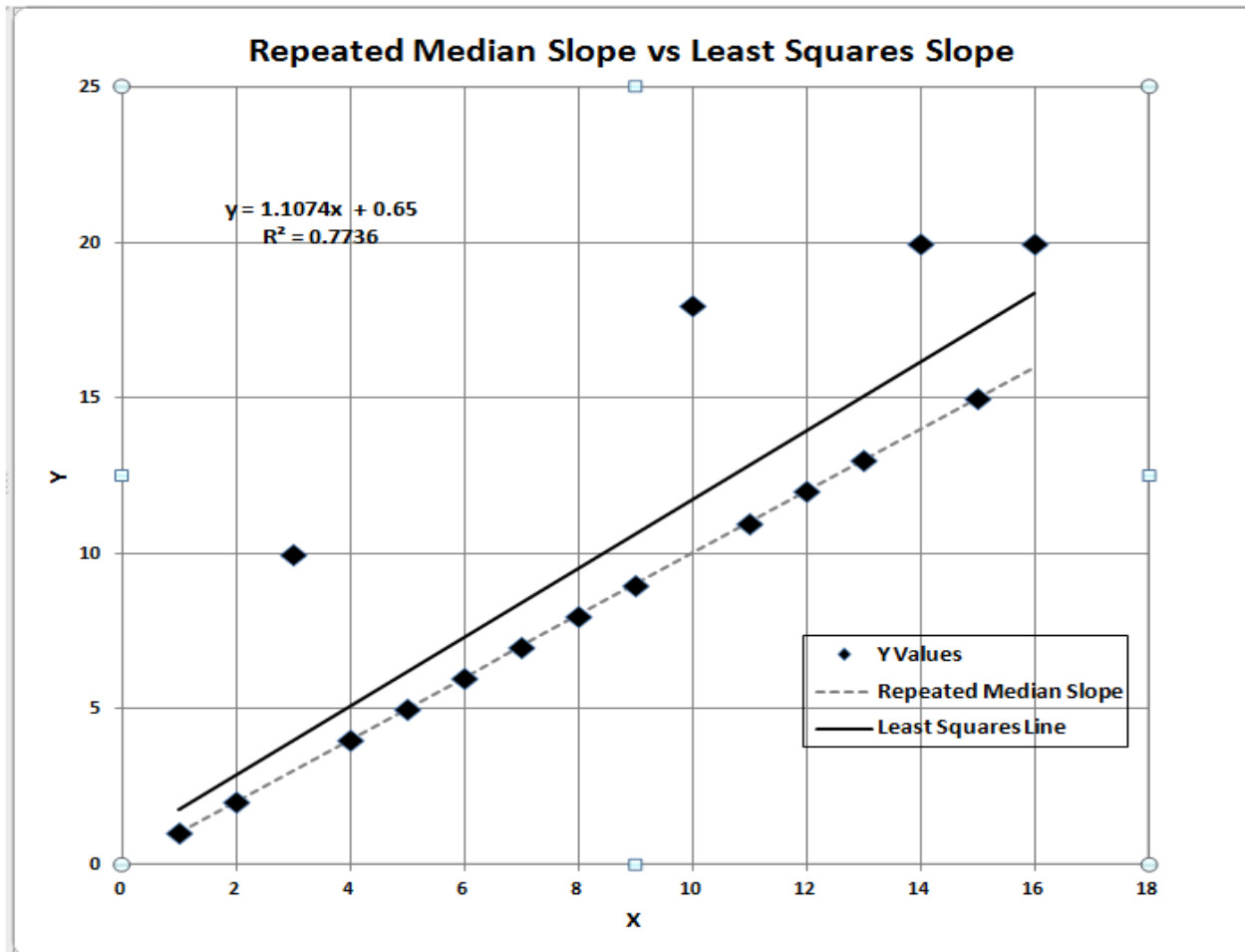


Figure 1 Repeated Median Slope vs Least Squares Slope.

The Repeated Median Velocity (RMedV) System Defined

Here we will use the repeated median slope to create a trading system. For a straight line the velocity is equal to the slope. The repeated median velocity, also called the **robust velocity**, has the advantage that it is a natural random price noise inhibitor. We can create a system such that unless the repeated median velocity using N past price bars is greater than some threshold value we will not buy or sell. A large percentage of price movements are just noise which generates a lot of back and forth movements of small magnitudes. This back and forth movement creates many false buy and sell signals. However, using the repeated median velocity over N past prices, we will attempt to filter out many of the small price noise movements by requiring that the repeated median velocity to be greater than some threshold before we act.

At each price bar we calculate the repeated median velocity (**RMedV**) from the formula above. When the velocity is greater than the threshold amount *vup* we will go long. When the velocity is less than the threshold amount *-vdn* we will go short.

The Repeated Median Velocity Trading Strategy

Buy Rule:

IF RMedV is greater than the threshold amount *vup* then buy at the market.

Sell Rule:

IF RMedV is less than the threshold amount *-vdn* then sell at the market.

Intraday Bars Exit Rule:

Close the position at 1429 EST when the open outcry pit session ends. (no trades will be carried overnight).

First Trade of Day Entry Rule:

All trade signals before the 9am EST open outcry pit session are ignored. We've included this rule because we observed that overnight Globex trading mostly consists of price movements with few sustainable trends. 60-70% of sustainable trends usually occur during the open outcry pit session hours.

Data Discussion

To test this strategy, we will use 5-minute bar prices of the Crude Light futures contract traded on the NYMEX WTI and Globex and known by the symbol **CL** for the 592 weeks from January 2, 2008 to June 7, 2019.

We will test this strategy with the above CL 5min bars on a walk forward basis, as will be described below. In TradeStation (TS) or MultiCharts(MC), we will run the RMedV Strategy on the CL 5 min bar data from January 3, 2008 to June 8, 2018. We will breakup and create 30-day calendar *in-sample* sections along with their corresponding one calendar week *out-of-sample* sections from the 592 weeks of CL (see Walk forward Testing below) creating 592 out-of-sample weeks. To create our walk forward files we will use the *add-in* software product called the Power Walk Forward Optimizer (PWFO) <http://meyersanalytics.com/Walk-Forward-Optimization.html>. In TS/MC, we will run the PWFO strategy *add-in* along with the RMedV Strategy on the CL 5min data from 1/3/2008 to 6/7/2019 The PWFO will breakup and create 30-day calendar in-sample sections along with their corresponding one calendar week out-of-sample sections from the 592 weeks of CL (see Walk Forward Testing below) creating 592 out-of-sample weeks. Note the first in-sample week will be from 1/3/2008 to 2/1/2008 and the first out-of-sample week will be from 02/03/2008 to 02/08/08.

Testing the Repeated Median Velocity System (RMedV) Using Walk Forward Optimization

There are three strategy inputs to determine:

1. *N*, the lookback period to calculate the **RMedV**.
2. *vup*, the threshold amount that RMedV must be greater than to issue a buy signal
3. *vdn*, the threshold amount that RMedV must be less than to issue a sell signal

We will test the RMedV strategy with the above CL 5 min bars on a *walk forward basis*, as will be described below.

What Is A Walk Forward Optimization with In-Sample Section and Out-Of-Sample Sections?

Whenever we do a TradeStation(TS) or MultiCharts(MC) optimization on a number of different strategy inputs, TS/MC generates an *in-sample* report of performance metrics (total net profits, number of losing trades, etc.) vs these different strategy inputs. If the report is sorted on say the total net profits(*tnp*) performance metric column then the highest *tnp* would correspond to a certain set of inputs. This is called an *in-sample (IS) section*. If we choose a set of strategy inputs from this report based upon some performance metric, we have no idea whether these strategy inputs will produce the same results on future price data or data they have not been tested on. Price data that is not in the in-sample section is defined as *out-of-sample (OOS) data*. Since the performance metrics generated in the in-sample section are usually mostly due to “curve fitting” or “data mining” it is important to see how the strategy inputs chosen from the in-sample section perform on out-of-sample price data.

What do we mean by “*curve fitting*” or “*data mining*”? As a simple example, suppose you were taking a subway to work. In the subway car you are in, suppose you counted the number of blond women in that car and suppose the percent of blond women vs all other women hair colors was 80%. Being that you can't observe what is in the other subway cars, you would assume that all the other subway cars and perhaps all women in general had the same percentage of blond hair. This observation was due to chance. That is an example of curve fitting. The same goes for combinatorial searches. You are observing results from a finite sample of data without knowing the data outside the sample you examined.

Walk forward analysis attempts to minimize the curve fitting of price noise by using the law of averages from the Central Limit Theorem on the out-of-sample performance. In walk forward analysis the data is broken up into many in-sample and out-of-sample sections. Usually for any strategy, one has some performance metric selection procedure, which we will call a *filter*, used to select the input parameters from the in-sample optimization run. For instance, a *filter* example might be all cases that have a profit factor (PF) greater than 1 and less than 3. For the number of cases left, we might select the case that had the best percent profit. This procedure would leave you with one case in the in-sample section and its associated strategy input parameters. Now suppose we ran our optimization on each of our many in-sample sections and applied our filter to each in-sample section. We would then use the strategy input parameters found by the *filter* in each in-sample section on the out-of-sample section immediately following that in-sample section. The strategy input parameters found in each in-sample section and applied to each out-of-sample section would produce independent net profits or losses for each of the out-of-sample sections. Using this method, we now have “x” number of independent out-of-sample section profit and losses from our filter. If we take the average of these out-of-sample section net profits and losses, then we will have an estimate of how our strategy will perform on average. Due to the Central Limit Theorem, as the number of out-of-sample sections increases, the spurious noise results in the out-of-sample section performance tend to average out to zero in the limit, leaving us with what to expect from our strategy and filter on average. *Mathematical note: This assumption assumes that the out-of-sample returns are from probability distributions that have a finite variance.*

Why use the walk forward technique? Why not just perform an optimization on the whole price series and choose the input parameters that give the best total net profits or profit factor? Surely the price noise cancels itself out with such a large number of in-sample trades. Unfortunately, nothing could be farther from the truth! Optimization is a misnomer and should really be called combinatorial search. As stated above, whenever we run a combinatorial search over many different combinations of input parameters on noisy data on a fixed number of prices, *no matter how many*, the best performance parameters found are guaranteed to be due to “*curve fitting*” the noise and signal. The price series that we trade consists of random spurious price movements, which we call noise, and repeatable price patterns (*if they exist*). When we run, for example, 5000 different inputs parameter combinations, the best performance parameters will be from those strategy input variables that are able to produce profits from the price pattern *and* the random spurious movements. While the price patterns will repeat, the same spurious price movements will not. If the spurious price movements that were captured by a certain set of input parameters were a large part of the total net profits, as they are in real intraday price series, then choosing these input parameters will produce losses when traded on future data. These losses occur because the spurious price movements will not be repeated in the same way. This is why strategy optimization or combinatorial searches with no out-of-sample testing cause losses when traded in real time from something that looked great in the in-sample section.

In order to gain confidence that our input parameter selection method using the optimization output of the in-sample data will produce profits, we must test the input parameters we found in the in-sample section on out-of-sample data. In addition, we must perform the in-sample/out-of-sample analysis many times. Why not just do the out-of-sample analysis once or just 10 times? Well just as in Poker or any card game, where there is considerable variation in luck from hand to hand, walk forward out-of-sample analysis gives considerable variation in week-to-week out-of-sample profit “luck”. That is, by pure chance we may have chosen some input parameter set that did well in the in-sample section data *and* the out-of-sample section data. In order to minimize this type of “luck”, statistically, we must repeat the walk forward out-of-sample (oos) analysis over many (>50) in-sample/out-of-sample sections and take an average over all out-of-sample sections. This average gives us an expected out-of-sample return and a standard deviation of out-of-sample returns which allows us to statistically estimate the expected equity and its range for N out-of-sample periods in the future

Finding the Strategy Parameters Using Walk Forward Optimization

There are three strategy parameters to find N , vup , vdn .

For the test data we will run the Multicharts64 optimization engine on **CL 5** min price bars from 1/3/2008 to 6/9/2019 with the below optimization ranges for the RMedV strategy inputs. I will create a 30-calendar day in-sample periods each followed by a 7 day out-of-sample period (See Table 1 for the in-sample/out-of-sample periods). This will create 592 in-sample 30-day periods followed by 592 out-of-sample 7-day periods from 1/3/2008 to 6/7/2019.

We will use the following strategy input optimization ranges.

N from 1 to 24 in steps of 1

vup from 0.25 to 3.5 steps of 0.25

vdn from 0.25 to 3.5 in steps of 0.25

Intraday Bars Exit Rule:

Close the position at 1429 EST when the open outcry pit session ends. (no trades will be carried overnight).

First Trade of Day Entry Rule:

All trade signals before the 9am EST open outcry pit session are ignored. We've included this rule because we observed that overnight Globex trading mostly consists of price movements with few sustainable trends. 60-70% of sustainable trends usually occur during the open outcry pit session hours.

Mult= $7*\sqrt{N}$. Note: this normalizes the RMedV Velocity range for each N to one standard deviation. Else the Velocity would have different ranges for different N, and it would be difficult to find a vup and vdn that worked for all N ranges. See Appendix 1 for a detailed explanation.

This will produce 4704 different input combinations or cases of the strategy input parameters. for each of the 592 in-sample/out-of-sample files for the approximately 11+ years of 5 min bar CL prices from 1/3/2008 to 6/8/2019.

The question we are attempting to answer statistically is which performance metric or combination of performance metrics (which we will call a *filter*) applied to the in-sample section will produce in-sample strategy inputs that produce statistically valid average profits in the out-of-sample section. In other words, we wish to find a performance metric *filter* that we can apply to the in-sample section that can give us strategy inputs that will produce, on average, good trading results in the future.

When TS/MC does an optimization over many combinations of inputs, it creates an output page that has as its rows each strategy input combination and as its columns various trading performance measures such as Profit Factor, Total Net Profits, etc. An example of a simple filter would be to choose the strategy input optimization row in the in-sample section that had the highest Net Profit or perhaps a row that had the best Profit Factor with their associated strategy inputs. Unfortunately, it was found that this type of simple metric performance filter very rarely produces good out-of-sample results. More complicated metric filters can produce good out-of-sample results minimizing spurious price movement biases in the in-sample selection of strategy inputs.

The combination metric filters are found by a program called WFME64v8x. Details of this program can be found at <https://meyersanalytics.com/wfme.html>.

All PWFO file metrics used by the WFME64v8x are described at <https://meyersanalytics.com/Walk-Forward-Optimization.html>.

We will use the WFME64 v8x program to find one in-sample combination-metric filter applied to each in-sample section which gives a set of strategy inputs which are then applied to each following out-of-sample section. This will consist of 540 in-sample and out-of-sample sections. From 2/8/2008 to 6/8/2018. We will leave the 52 sections of CL data from 6/15/18 to 6/8/2018 out of the WFME64 calculations so that we can see how the metric filters found by the WFME64

performed on these 52 following *future* weeks which was not included in the original WFME64 run.

Here is a metric combination **filter** found by the WFME64 v8x program that was used in this paper. High profit factors (**pf**) in the in-sample section usually mean poor performance in the out-of-sample-section. This is a kind of reversion to the mean. So, in the in-sample(IS) section we eliminate all strategy input rows that have a **pf**>4 . We also wish to limit the number losing trades in a row (**lr**) in the IS period to 3 or less (**lr**≤3). Using the **pf-lr** elimination screen, as described, there can still be 100's of rows left in the in-sample section. The PWFO generates the performance metric named **t**. This metric, **t**, is the **Student t-statistic**. used to determine the probability that the Average Trade Profit (tnp/nT) ≠ 0 for a given set of strategy inputs. Let us choose the 50 rows in the in-sample section that contain the **maximum t** values from the rows that are left from the **pf-lr** screen. In other words, we sort **t** from high to low, eliminate the rows that have **lr**>3, **pf**>4 and then choose the largest **t** 50 rows of whatever is left. This filter will now leave 50 cases or rows in the in-sample section that satisfy the above filter conditions. We call this filter **t20t |p≤4|lr≤3** where **t20t** means the top or maximum 50 **t** rows left *after* the **pf-lr** in-sample row elimination. Suppose for this filter, within the 50 in-sample rows that are left, we want the row that has the highest value of the metric called **mDev**. **mDev** = Median of the Absolute Values of {The Equity at Each Trade Minus the Equity Regression Trend Line}. We abbreviate this final filter as **t20t|p≤4|lr≤3-mDev**. For each in-sample section this filter leaves only one row in the in-sample section with its associated strategy inputs and following out-of-sample net profit in the out-of-sample section using the strategy inputs found in the in-sample section. This **t20t|p≤4|lr≤3-mDev filter** is then applied to each of the 540 in-sample sections which give 540 sets of strategy inputs that are used to produce the corresponding 540 out-of-sample performance results. The average out-of-sample performance is calculated from these 540 out-of-sample performance results. In addition, many other important out-of-sample performance statistics for this filter are calculated and summarized.

Figure 2 shows such a computer run along with a small sample of other WFME64 filter combinations that are constructed in a similar manner. **Row 3** of the sample output in **Figure 2** shows the results of the filter discussed above.

Bootstrap Probability of Filter Results.

Using modern "Bootstrap" techniques, we can calculate the probability of obtaining our filter's total out-of-sample *net* profits by chance. Here's how the bootstrap technique is applied. Suppose as an example, we have 500 files of in-sample/out-of-sample data. A mirror random filter is created. Instead of picking an out-of-sample net profit (OSNP) from a **filter** row as before, the mirror filter picks a **random** row's OSNP in each of the 500 files. We repeat this random picking in each of the 500 files 5000 times. Each of the 5000 mirror filters will choose a random row's OSNP of their own in each of the 500 files. At the end, each of the 5000 mirror filters will have 500 **random** OSNP's picked from the rows of the 500 files. The sum of the 500 random OSNP picks for each mirror filter will generate a random total out-of-sample net profit (**toNP**) or final random equity for each of the 5000 mirror filters. The average and standard deviation of the 5000-mirror filter's different random **toNPs** will allow us to calculate the chance probability of our above chosen filter's **toNP**. Thus, given the 5000 mirror filter's bootstrap random **toNP** average and standard deviation, we can calculate the probability of obtaining our chosen filter's **toNP** by pure chance alone. **Figure 2** lists the 5000-mirror filter's bootstrap average for our 540 out-of-sample files of (**\$12.0**) with a bootstrap standard deviation of **\$60.9**.

(Side Note. The average is the average per out-of-sample period(weekly). So, the average for the random selection would be the random (Average Random toNP/540) and the average net weekly for the filter from **Figure 2, Row 3** would be the **filter toNP/ (# of OOS)** periods traded or **142670/522=273.31**. The probability of obtaining our filters average weekly net profit of **273.31** is **1.39x10⁻⁶** which is **4.7** standard deviations from the bootstrap average. For our filter, in Row 3, the expected number of cases that we could obtain by pure chance that would match or exceed **\$273.31** is **[1-(1- 1.39x10⁻⁶)¹⁷²⁹⁸⁰ ≈ 172980 x 1.39x10⁻⁶= 0.24** where **172980** is the total number of different filters we looked at in the WFME64v8x run. This number is much less than one, so it is improbable that our filters result of 142670 was due to pure chance

Results

Figure 1 presents a graph of the equity curve generated by using the WFME64 filter on the 540 weeks ending 2/8/2008 – 6/8/18 and the equity curve on the 52 weeks following until 6/7/2019 (note the starting date 1/2/2008 was part of the first 30 day in-sample period). The equity curves are plotted from Equity and Net Equity columns in Table 1. Plotted on the equity curves is the 2nd Order Polynomial curve. The blue line is the equity curve without commissions and the red dots on the blue line are new highs in equity. The brown line is the equity curve with commissions and the green dots are the new highs in net equity. The grey line is the CL weekly closing prices superimposed on the Equity Chart. The vertical dotted red line on the right separates the future excluded period equity from 6/8/18 to 6/7/19. This is what would have happened if you used the strategy inputs found by the filter **t20t|p≤4|lr≤3-mDev** on data not included in the initial run.

Figure 2 shows such a computer run along with a small sample of other WFME64 filter combinations that are constructed in a similar manner. **Row 3** of the sample output in **Figure 2** shows the results of the filter discussed above.

Figure 3 presents the out-of-sample CL 5-minute bar chart of all the buy and sell signals of the WFME64 filter 5/31/19 to 6/7/19 with the RMedV Indicator or those dates.

Table 1 below presents a table of the 540 plus the 52 future weeks in-sample and out-of-sample dates, the WFME **Filter** selected strategy inputs and the weekly out-of-sample profit/loss results using the **t20t|p≤4|lr≤3-mDev filter** described above.

Discussion of Strategy Performance of the WFME64 run

In **Figure 2, Row 3** is the filter chosen, **t20t|p≤4|lr≤3-mDev**. This Metric Filter produced \$142,670 net profits after costs in 540 weeks and \$10,780 net profits after costs in the withheld 52 weeks from the initial WFME run. The spreadsheet columns present some statistics that are of interest for the filter. An interesting statistic is **Blw**. **Blw** is the maximum number of weeks the **OOS** equity curve for this filter failed to make a new high. **Blw** is 46 weeks for this filter. This means that 46 weeks was the longest time that the equity for this strategy failed to make a new equity high in the 540 out-of-sample weeks. For this strategy, the **%P** (% of weekly oos periods that are positive) was **62%**, and the **%Wtr** (The % of all oos trades that are positive) was **51%**. This low **%Wtr** was made up for by **oW/oL** (average oos winning trades/average oos losing trades) equal to 1.29.

To see the effect of walk forward analysis, look at **Table 1**. Notice how the input parameters N , vup , vdn take sudden jumps from high to low and back. This is the walk forward process quickly adapting to changing volatility conditions in the in-sample sample. In addition, notice how often N changes from 1 to 24. When the data gets very noisy with a lot of spurious price movements, the look back period, N , should be higher. During other times when the noise level is not as much N can be lower to get onboard a trend faster.

Figure 1 presents a graph of the equity curve using the **t20|p≤4|lr≤3-mDev filter** on the 540 weeks of out-of-sample data. Notice how the equity curve follows the 2nd order polynomial trend line with an R^2 of 0.97. This R^2 dropped to 0.95 for the net equity curve.

Using this filter, the strategy generated a profit of \$147,750 net equity after commissions and slippage of \$20/trade trading one CL contract for the total 592 weeks. From **Table 1**, the largest losing week was -\$8420 on the week ending 10/31/2008. The largest drawdown was -\$13,270 from the week ending on 10/17/08 to 12/12/08. This drawdown lasted 8 weeks and took 6 weeks to recover and make a new equity. The second largest drawdown was -\$8860 from the week ending on 8/12/11 to 10/7/11. This drawdown lasted 8 weeks and took 19 weeks to recover and make a new equity. The *future* period that was not included in the WFME64 run from 6/8/18 to 6/7/19 was a volatile down market yet the RMedV strategy/WFME filter did well making a net profit of \$10,780 during that one-year time frame.

Lastly, as can be seen in **Figure 2**, the top 15 filters all did very well in the 52 *future* weeks from 6/8/18 to 6/7/19 following the original analysis.

In observing Table 1 we can see that this strategy and filter made trades from a low of no trades in 18 of the 540 weeks to a high of 20 trades/week with an average of 5.4 trades/week in the weeks it did trade.

References

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3. Efron, B., Tibshirani, R.J., (1993), “An Introduction to the Bootstrap”, New York, Chapman & Hall/CRC.
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Figure 1 Graph of RMedV Strategy OOS Net Equity Applying the WFME64 Filter Each Week to In-Sample RMedV CL5min Bar Prices 1/2/2008 to 6/7/2019

Note: The blue line is the equity curve without commissions and the red dots on the blue line are new highs in equity. The brown line is the equity curve with commissions of \$20/round trip trade and the green dots are the new highs in net equity. The grey line is the CL Weekly Closing prices superimposed on the Equity Chart. The vertical dotted red line on the right separates the future excluded period equity from 6/8/18 to 6/7/19. This is what would have happened if you used $t20t|p \leq 4|lr \leq 3$ -mDev filter on future data 6/8/18-6/7/19 which was not included in the WFME filter run.

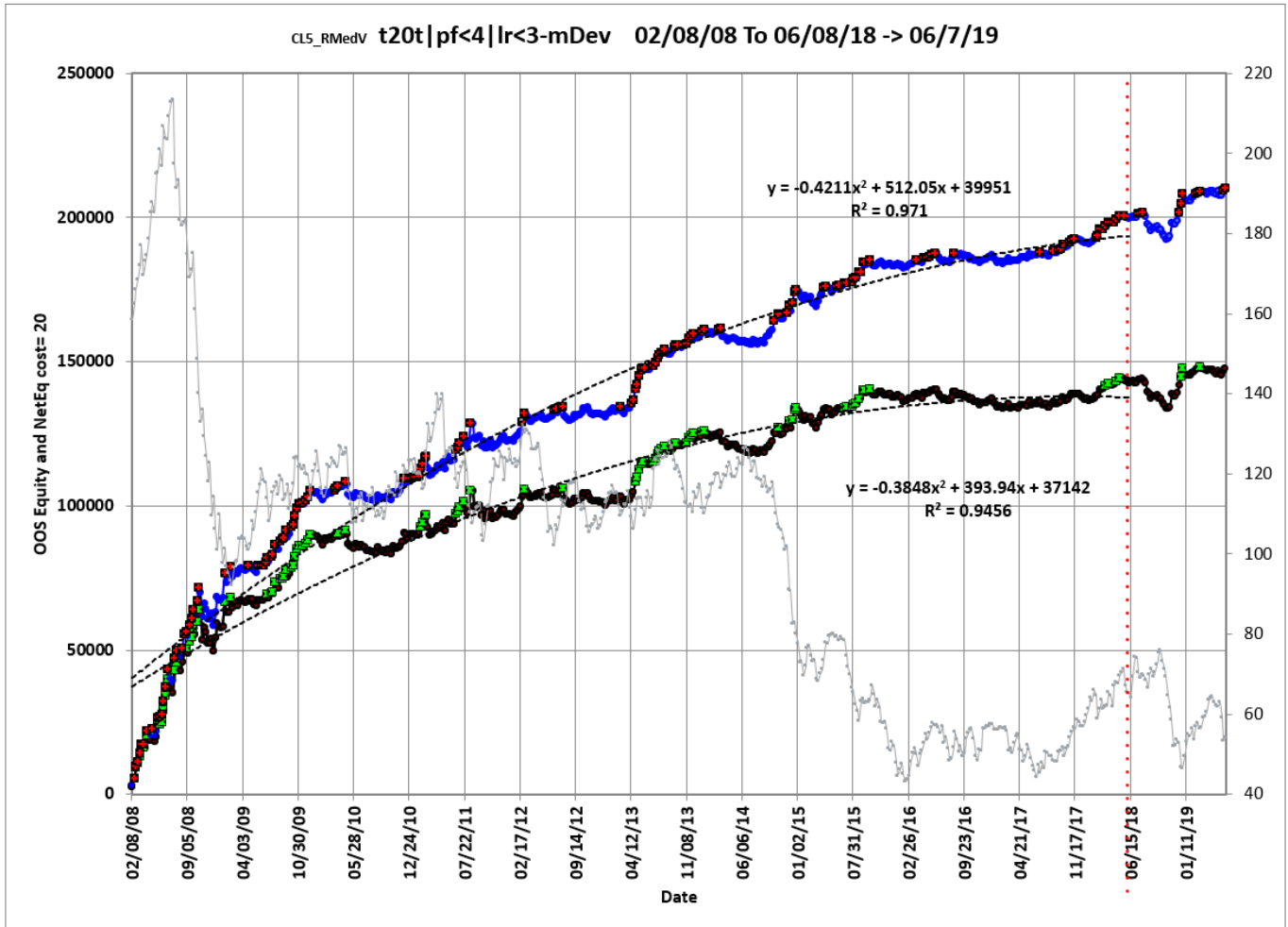


Figure 2 Partial output of the Walk Forward Metric Explorer (WFME64 v8X)
CL 5 min bars RMedV Velocity Strategy

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	CL5-RMedV	s02/08/08	e06/08/18	#540	AnyTnp	#52							
2	Filter-Metric	toGP	toNP	aoGP	aoTr	ao#T	std	skew	kur	t	oW oL	%Wtr	%P
3	t20t pf<4 lr<3-mDev	199470	142670	382	70.2	5.4	1598	0.554	7.99	5.46	1.29	51	62
4	t50eq10 pf<2 lr<3-t	179840	131140	407	73.9	5.5	1914	1.257	9.28	4.47	1.49	47	56
5	t50eq10 pf<3 lr<3-mLb	163310	122910	388	80.8	4.8	1799	0.967	10.56	4.42	1.48	48	58
6	t50ktau pf<4 lr<3-tWb	184190	122190	396	59.4	6.7	1806	0.916	7.68	4.73	1.46	47	61
7	t10ktau pf<2 lr<3-t	168510	121910	423	72.3	5.9	1759	1.006	7.68	4.8	1.49	47	61
8	t50tnp pf<4 lr<3-eqR2	200880	120780	372	50.2	7.4	1779	0.414	8.21	4.86	1.35	48	61
9	t10tnp pf<2 lr<3-eqTrn	199330	120030	369	50.3	7.3	1949	0.424	7.81	4.4	1.35	48	58
10	t10eqR2 pf<2 lr<3-tnp	173420	116640	426	61.1	7	1910	0.728	6.61	4.5	1.55	45	61
11	t20tWb tLb pf<3 lr<5-m(ru-p)	163200	115340	342	68.2	5	1514	0.696	6.58	4.94	1.48	47	59
12	t20mKr pf<2 -tWb	154380	115220	327	78.8	4.1	1672	1.222	9.7	4.25	1.27	51	61
13	t20mKr pf<2 lr<5-tWb	153550	114230	325	78.1	4.2	1666	1.240	9.85	4.24	1.27	51	61
14	t20t pf<4 lr<3-eqR2	188500	113800	352	50.5	7	1710	0.363	9.24	4.76	1.35	48	62
15	t20tnp pf<4 lr<3-mWb	180670	113730	335	54.0	6.2	1776	0.233	6.38	4.38	1.22	50	59

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1	a(12.0)	s60.9	f172980					c=\$20							s06/15/18	e06/07/19	#52				t592
2	LLtr	LLp	eqDD	wpr	lpr	#	V20	Dev^2	KTau	eqR2	Blw	BE	tkr bl	toGPx	toNPx	aoTRx	aoNTx	#x	tOnpNet	Prob	
3	-3560	-8420	-13270	11	4	522	126	12033	94	93	46	76	1044	10780	5080	38	5.5	52	147750	1.39E-06	
4	-3550	-7240	-10380	9	5	442	94	15743	91	87	91	114	388	6550	3910	50	3.1	42	135050	1.99E-07	
5	-2560	-10550	-10580	11	6	421	122	11932	93	88	67	116	542	2060	(380)	17	3.7	33	122530	2.98E-07	
6	-3420	-6010	-9880	10	4	465	154	14046	92	86	84	101	446	9520	4360	37	6.1	42	126550	3.20E-06	
7	-3560	-7200	-8840	11	5	398	72	13194	93	88	59	98	666	16990	13610	101	5.1	33	135520	8.56E-08	
8	-3550	-8950	-20740	12	4	540	288	12208	90	92	90	96	445	18850	11750	53	6.8	52	132530	5.43E-05	
9	-3720	-8360	-19690	8	7	540	171	12830	93	92	51	117	741	23510	16110	64	7.1	52	136140	5.96E-05	
10	-3550	-7200	-12780	11	5	407	64	13767	89	86	76	112	454	9880	5820	49	6.2	33	122460	4.69E-07	
11	-2440	-4980	-10130	10	6	477	112	11954	94	89	52	93	791	15580	8720	45	7.6	45	124060	1.53E-05	
12	-3420	-6260	-17600	9	4	472	50	11052	93	91	101	126	355	3240	340	22	3.4	43	115560	1.30E-05	
13	-3420	-6260	-14760	9	4	472	50	11603	93	90	101	126	350	3300	480	23	3.3	43	114710	1.51E-05	
14	-3550	-8950	-16940	12	9	536	275	10695	92	92	88	100	460	18700	12120	57	6.3	52	125920	1.15E-04	
15	-2990	-8210	-14720	12	6	539	224	7767	95	96	38	118	1050	10980	4600	34	6.1	52	118330	1.25E-04	

The WFME64 v8X AVE File Output Cols are defined as follows

❖ **Row 1 Columns:**

A=The PWFO Stub, B=File Start Date, C=File End Date, D= Number of oos periods (in this example weeks), N= Bootstrap average, O= Bootstrap Standard Deviation, P=Number of filters run, U= Cost and slippage per trade

❖ **Row 1 and Row 2 Columns AA, AB,AC,AD,AE** Future Results Not Included in the WFME64 Run. These set of results show how it would turn out if the Strategy Inputs/Filter was used on pwfo files not included in the WFME64 run.

Row 1 Col AB: Future PWFO File Start Date

Row 1 Col AC: Future PWFO File End Date

Row 1 Col AD: Future Number of PWFO Files not included in the WFME64 run (in this example weeks)

Row 1 Col AH: Number of Total oos-future PWFO Files

❖ **Row 2 to Last Row Columns: A through AH**

Col A: **The Strategy Input/Filter Names** Example Row 3: t20t|p<4|lr<3-mDev:

Col B: *toGP* - Total out-of-sample(oos) gross profit for these 540 oos periods (= weeks).
Col C: *toNP* - Total out-of-sample(oos) Net profit (*toGP*-Number of Trade Weeks*cost) for the 540 oos periods.
Col D: *aoGP* - Average oos gross profit for the 540 oos periods
Col E: *aoTr* - Average oos profit per trade
Col F: *ao#T* - Average number of oos trades per week
Col G: *std* - he standard deviation of the 540 oos period profits and losses
Col H: *skew* - The Skew statistic of the 540 oos period profits and losses
Col I: *kur* - he kurtosis statistic of the 540 oos period profits and losses
Col J: *t* - The student t statistic for the 540 oos periods. The higher the t statistic the higher the probability that this result was not due to pure chance
Col K: *oW/oL* - Ratio of average oos winning trades divided by average oos losing trades.
Col L: *%Wtr* - he percentage if oos winning trades
Col M: *%P* - percent of all oos periods that were profitable.
Col N: *LLtr* - The largest losing oos trade in all oos periods
Col O: *LLp* - The largest losing oos period
Col P: *eqDD* - The oos equity drawdown
Col Q: *wpr* - The largest number of winning oos periods (weeks) in a row.
Col R: *lpr* - he largest number of losing oos periods in a row
Col S: *#* - The number of oos periods this filter produced any profit or loss. Note for some oos periods there can be no strategy inputs that satisfy a given filters criteria and no trades will be made during that period.
Col T: *eqA2* - The acceleration of a 2nd order polynomial fit to the oos equity curve.
Col U: *Dev^2* - measure of equity curve smoothness. The square root of the average (equity curve minus a straight line)^2)
Col V: *KTau^2* - The Kendall rank coefficient is often used as a test statistic in a statistical hypothesis test to establish whether two variables may be regarded as statistically dependent. This test is non-parametric, as it does not rely on any assumptions on the distributions of X or Y or the distribution of (X,Y)
Col W: *eqR2* - The correlation coefficient(R^2) of a straight-line fit to the equity curve.
Col X: *Blw* - The maximum number of oos periods the oos equity curve failed to make a new high.
Col Y: *BE* - Break even in oos periods. Assuming the average and standard deviation are from a normal distribution, this is the number of oos periods you would have to trade to have a 98% probability that your oos equity is above zero.
Col Z: *tkr/bl* = $t * ktau * eqR2 / Blw$ a measure of how good the filter fit is.
Col AB: *toGPx* Total gross profit for the 52 future excluded periods (for this run periods = weeks).
Col AC: *toNPx* Total Net profit {*toGP*-Number of Trade Weeks(#)*cost} for the 52 future excluded periods.
Col AD: *aoTrx* Average profit per trade for the 52 future excluded periods
Col AE: *aoNTx* Average number of trades per week for the 52 future excluded periods
Col AF: *#x* the number of the 52 future excluded periods this strategy/filter traded. Note for some periods there can be no strategy inputs/filter that satisfy the Strategy Inputs/Filter criteria and no trades will be made during that period.
Col AG: *tOnpNet* - *toNP*+*toNPx* = Total Net Profits of oos+future periods
Col AH: *Prob* - The probability that the filters *toNP* was due to pure chance.

**Figure 3 The out-of-sample 5-minute bar chart of all the RMedV Strategy buy and sell signals of the WFME64 filter with the RMedV Indicator.
5/31/19 to 6/7/19**



**Table 1 Walk Forward Out-Of-Sample Performance Summary
CL-5 min bars RMedV Strategy with WFME64 Filter**

CL 5 min bars 1/2/2008 - 6/7/19 OOS weekly performance using the below filter on each in-sample segment. The input values *N*, *vup*, *vdn* are the values found from applying the filter to the in-sample section and used on the following out-of-sample section.

In-sample Section Filter: $t20t|p \leq 4|lr \leq 3 - mDev$

Where:

ogp = Weekly Out-of-sample gross profit in \$

ont = The number of trades in the out-of-sample week.

ollt = The largest losing trade in the out-of-sample section in \$.

odd = The drawdown in the out-of-sample section in \$.

Equity = Running Sum of weekly out-of-sample gross profits \$

osnp\$20 = Weekly Out-Of-Sample Net Profit in \$ = **ogp-ont*20**

NetEq = running sum of the weekly out-of-sample net profits (osnp\$20) in \$

N = N the lookback period

vup, the threshold amount that velocity has to be greater than to issue a buy signal

vdn, the threshold amount that velocity has to be less than to issue a sell signal

Note: Blank rows indicate that no out-of-sample trades were made that week

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	ollt	odd	EQ	NetEq	N	vup	vdn
01/03/08	02/01/08	02/04/08	02/08/08	2870	2770	5	-220	-220	2870	2770	3	1.5	3.25
01/10/08	02/08/08	02/11/08	02/15/08	2690	2570	6	-340	-340	5560	5340	5	1.25	2.5
01/17/08	02/15/08	02/18/08	02/22/08	4060	3920	7	-530	-720	9620	9260	6	1.25	2.75
01/24/08	02/22/08	02/25/08	02/29/08	1770	1590	9	-390	-390	11390	10850	5	0.25	2.25
01/31/08	02/29/08	03/03/08	03/07/08	2710	2310	20	-1070	-2030	14100	13160	5	0.25	2.25
02/07/08	03/07/08	03/10/08	03/14/08	3080	2880	10	-960	-1160	17180	16040	6	1.25	2.5
02/14/08	03/14/08	03/17/08	03/21/08	310	10	15	-1360	-4270	17490	16050	6	1.25	2.5
02/21/08	03/21/08	03/24/08	03/28/08	0	0	0	0	0	17490	16050	1	3	3.25
02/28/08	03/28/08	03/31/08	04/04/08	4550	4510	2	0	0	22040	20560	1	3	3.25
03/06/08	04/04/08	04/07/08	04/11/08	0	0	0	0	0	22040	20560	1	2.75	3.25
03/13/08	04/11/08	04/14/08	04/18/08	-1990	-2010	1	-1990	-1990	20050	18550	1	2.75	3.5
03/20/08	04/18/08	04/21/08	04/25/08	2760	2480	14	-600	-1260	22810	21030	6	0.75	1.75
03/27/08	04/25/08	04/28/08	05/02/08	-2570	-2910	17	-720	-4400	20240	18120	6	1.25	1.75
04/03/08	05/02/08	05/05/08	05/09/08	1640	1560	4	-600	-600	21880	19680	2	3	2.25
04/10/08	05/09/08	05/12/08	05/16/08	4690	4390	15	-820	-1270	26570	24070	3	3	2.75
04/17/08	05/16/08	05/19/08	05/23/08	170	10	8	-1200	-2730	26740	24080	5	3.5	3
04/24/08	05/23/08	05/26/08	05/30/08	830	730	5	-1660	-1660	27570	24810	1	2	3.25
05/01/08	05/30/08	06/02/08	06/06/08	4630	4390	12	-940	-3560	32200	29200	14	0.25	2.25
05/08/08	06/06/08	06/09/08	06/13/08	4920	4780	7	-2000	-2180	37120	33980	18	2.25	1.5
05/15/08	06/13/08	06/16/08	06/20/08	6030	5910	6	-1280	-1670	43150	39890	22	2.25	1
05/22/08	06/20/08	06/23/08	06/27/08	-3090	-3250	8	-1350	-3190	40060	36640	22	2.25	1
05/29/08	06/27/08	06/30/08	07/04/08	-940	-1200	13	-1220	-2640	39120	35440	15	1	1
06/05/08	07/04/08	07/07/08	07/11/08	130	-170	15	-1860	-3470	39250	35270	5	3	3
06/12/08	07/11/08	07/14/08	07/18/08	7950	7830	6	-980	-1080	47200	43100	20	2.5	1.5
06/19/08	07/18/08	07/21/08	07/25/08	2730	2590	7	-1360	-1360	49930	45690	1	2.5	2.75
06/26/08	07/25/08	07/28/08	08/01/08	-2230	-2550	16	-1420	-6070	47700	43140	6	1.5	2.75
07/03/08	08/01/08	08/04/08	08/08/08	-260	-540	14	-1780	-4290	47440	42600	12	0.25	2.25
07/10/08	08/08/08	08/11/08	08/15/08	3300	3040	13	-1300	-1580	50740	45640	11	0.25	2.5
07/17/08	08/15/08	08/18/08	08/22/08	4670	4430	12	-1280	-3060	55410	50070	5	2.25	3.25
07/24/08	08/22/08	08/25/08	08/29/08	890	650	12	-1340	-3280	56300	50720	9	1.25	2.75
07/31/08	08/29/08	09/01/08	09/05/08	-1680	-1920	12	-1130	-2180	54620	48800	11	1.75	1
08/07/08	09/05/08	09/08/08	09/12/08	4140	3960	9	-230	-230	58760	52760	11	1.75	1.75
08/14/08	09/12/08	09/15/08	09/19/08	2020	1720	15	-1450	-5550	60780	54480	11	1.75	1.75
08/21/08	09/19/08	09/22/08	09/26/08	3160	2920	12	-1510	-2500	63940	57400	8	2.5	2.25
08/28/08	09/26/08	09/29/08	10/03/08	-1740	-2080	17	-1900	-6960	62200	55320	13	1.5	1.25
09/04/08	10/03/08	10/06/08	10/10/08	4850	4550	15	-1280	-1820	67050	59870	20	0.75	0.25
09/11/08	10/10/08	10/13/08	10/17/08	4670	4310	18	-740	-1830	71720	64180	19	1.25	0.5
09/18/08	10/17/08	10/20/08	10/24/08	-1640	-1920	14	-1210	-1640	70080	62260	19	1	0.25

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	ollt	odd	EQ	NetEq	N	vup	vdn
09/25/08	10/24/08	10/27/08	10/31/08	-8420	-8760	17	-3560	-8420	61660	53500	19	1	0.25
10/02/08	10/31/08	11/03/08	11/07/08	4290	4190	5	-270	-270	65950	57690	18	3	2.75
10/09/08	11/07/08	11/10/08	11/14/08	-1590	-1670	4	-2070	-2630	64360	56020	21	2.75	3
10/16/08	11/14/08	11/17/08	11/21/08	-3430	-3510	4	-2690	-4160	60930	52510	22	1.75	3.25
10/23/08	11/21/08	11/24/08	11/28/08	-180	-320	7	-1770	-3750	60750	52190	14	3	2.25
10/30/08	11/28/08	12/01/08	12/05/08	1850	1810	2	0	0	62600	54000	10	3.25	3.5
11/06/08	12/05/08	12/08/08	12/12/08	-4150	-4310	8	-1870	-4450	58450	49690	13	2.5	2.5
11/13/08	12/12/08	12/15/08	12/19/08	4760	4600	8	-680	-680	63210	54290	1	2.25	2
11/20/08	12/19/08	12/22/08	12/26/08	5020	4860	8	-90	-90	68230	59150	5	2.5	1.25
11/27/08	12/26/08	12/29/08	01/02/09	-920	-1160	12	-1640	-2960	67310	57990	5	2.75	1.25
12/04/08	01/02/09	01/05/09	01/09/09	120	-220	17	-800	-1620	67430	57770	5	2.25	1.75
12/11/08	01/09/09	01/12/09	01/16/09	670	470	10	-830	-1630	68100	58240	1	1.5	2
12/18/08	01/16/09	01/19/09	01/23/09	8660	8460	10	-500	-760	76760	66700	3	0.25	3.5
12/25/08	01/23/09	01/26/09	01/30/09	-3550	-3770	11	-1420	-3550	73210	62930	2	1.5	3
01/01/09	01/30/09	02/02/09	02/06/09	350	250	5	-990	-1000	73560	63180	7	2.75	2.25
01/08/09	02/06/09	02/09/09	02/13/09	5290	5130	8	-590	-590	78850	68310	7	2.75	1.75
01/15/09	02/13/09	02/16/09	02/20/09	-3600	-3720	6	-1800	-3680	75250	64590	9	2.75	3
01/22/09	02/20/09	02/23/09	02/27/09	1700	1640	3	-60	-60	76950	66230	10	2.75	3.5
01/29/09	02/27/09	03/02/09	03/06/09	170	90	4	-440	-620	77120	66320	7	2.75	3.5
02/05/09	03/06/09	03/09/09	03/13/09	-790	-910	6	-1990	-2150	76330	65410	7	2	3.5
02/12/09	03/13/09	03/16/09	03/20/09	1650	1610	2	0	0	77980	67020	21	2.25	2.5
02/19/09	03/20/09	03/23/09	03/27/09	470	410	3	-90	-90	78450	67430	15	1.5	3
02/26/09	03/27/09	03/30/09	04/03/09	-580	-620	2	-470	-580	77870	66810	24	2.25	3.25
03/05/09	04/03/09	04/06/09	04/10/09	-290	-370	4	-600	-600	77580	66440	15	1.25	3
03/12/09	04/10/09	04/13/09	04/17/09	550	390	8	-460	-940	78130	66830	11	0.25	3.5
03/19/09	04/17/09	04/20/09	04/24/09	1060	980	4	-10	-10	79190	67810	15	0.75	3.25
03/26/09	04/24/09	04/27/09	05/01/09	-700	-840	7	-580	-990	78490	66970	15	0.75	3
04/02/09	05/01/09	05/04/09	05/08/09	630	490	7	-1510	-1690	79120	67460	1	0.5	3.5
04/09/09	05/08/09	05/11/09	05/15/09	-1470	-1570	5	-1600	-1680	77650	65890	24	0.75	3.5
04/16/09	05/15/09	05/18/09	05/22/09	-690	-730	2	-970	-970	76960	65160	15	1.75	1.5
04/23/09	05/22/09	05/25/09	05/29/09	2330	2230	5	0	0	79290	67390	9	0.25	3.5
04/30/09	05/29/09	06/01/09	06/05/09	-10	-170	8	-890	-1300	79280	67220	23	0.75	1.25
05/07/09	06/05/09	06/08/09	06/12/09	30	-30	3	-590	-590	79310	67190	18	1	2.25
05/14/09	06/12/09	06/15/09	06/19/09	100	-100	10	-1610	-1620	79410	67090	18	0.25	2
05/21/09	06/19/09	06/22/09	06/26/09	970	830	7	-680	-1470	80380	67920	10	0.75	1.75
05/28/09	06/26/09	06/29/09	07/03/09	1460	1360	5	-250	-250	81840	69280	15	0.75	2
06/04/09	07/03/09	07/06/09	07/10/09	-1320	-1440	6	-710	-1930	80520	67840	15	0.75	2.75
06/11/09	07/10/09	07/13/09	07/17/09	1960	1860	5	0	0	82480	69700	24	1	1.75
06/18/09	07/17/09	07/20/09	07/24/09	580	480	5	-140	-260	83060	70180	22	1	2
06/25/09	07/24/09	07/27/09	07/31/09	3450	3370	4	0	0	86510	73550	23	1	1.25
07/02/09	07/31/09	08/03/09	08/07/09	-1240	-1420	9	-1040	-1700	85270	72130	20	0.75	1.75
07/09/09	08/07/09	08/10/09	08/14/09	-600	-700	5	-490	-1090	84670	71430	9	0.5	2.5
07/16/09	08/14/09	08/17/09	08/21/09	3200	3120	4	-400	-400	87870	74550	7	1.25	3.5
07/23/09	08/21/09	08/24/09	08/28/09	460	280	9	-1080	-1490	88330	74830	10	0.5	2.5
07/30/09	08/28/09	08/31/09	09/04/09	710	650	3	-460	-880	89040	75480	13	2	1.75
08/06/09	09/04/09	09/07/09	09/11/09	2330	2230	5	-720	-720	91370	77710	17	2.25	0.75
08/13/09	09/11/09	09/14/09	09/18/09	-2250	-2370	6	-1490	-2490	89120	75340	13	2.25	0.5
08/20/09	09/18/09	09/21/09	09/25/09	1080	1040	2	0	0	90200	76380	19	1.75	3
08/27/09	09/25/09	09/28/09	10/02/09	2320	2240	4	-650	-650	92520	78620	9	1.75	3.5
09/03/09	10/02/09	10/05/09	10/09/09	920	820	5	-580	-580	93440	79440	24	0.75	2.25
09/10/09	10/09/09	10/12/09	10/16/09	3120	3060	3	0	0	96560	82500	12	1	2.75
09/17/09	10/16/09	10/19/09	10/23/09	2700	2500	10	-610	-610	99260	85000	11	1	1.25
09/24/09	10/23/09	10/26/09	10/30/09	1440	1260	9	-920	-2120	100700	86260	11	1	1.25
10/01/09	10/30/09	11/02/09	11/06/09	50	-130	9	-640	-1130	100750	86130	16	0.75	1.75
10/08/09	11/06/09	11/09/09	11/13/09	320	220	5	-520	-520	101070	86350	21	1.25	1.5
10/15/09	11/13/09	11/16/09	11/20/09	-630	-710	4	-890	-890	100440	85640	1	1.25	1.75
10/22/09	11/20/09	11/23/09	11/27/09	1330	1290	2	0	0	101770	86930	14	2.25	2.25
10/29/09	11/27/09	11/30/09	12/04/09	1170	1070	5	-730	-840	102940	88000	15	1	2
11/05/09	12/04/09	12/07/09	12/11/09	2190	2130	3	-70	-70	105130	90130	12	2	1.25
11/12/09	12/11/09	12/14/09	12/18/09	-580	-640	3	-390	-580	104550	89490	22	1.75	1.25
11/19/09	12/18/09	12/21/09	12/25/09	250	190	3	-290	-290	104800	89680	22	1.75	1.5

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	oltt	odd	EQ	NetEq	N	vup	vdn
11/26/09	12/25/09	12/28/09	01/01/10	-280	-300	1	-280	-280	104520	89380	10	1.5	2
12/03/09	01/01/10	01/04/10	01/08/10	50	-30	4	-520	-980	104570	89350	11	1.5	1.75
12/10/09	01/08/10	01/11/10	01/15/10	-670	-710	2	-630	-670	103900	88640	21	1	3.5
12/17/09	01/15/10	01/18/10	01/22/10	-770	-850	4	-1040	-1450	103130	87790	5	2	2.25
12/24/09	01/22/10	01/25/10	01/29/10	-1160	-1300	7	-1170	-2080	101970	86490	3	2	2
12/31/09	01/29/10	02/01/10	02/05/10	2420	2220	10	-1260	-1260	104390	88710	10	1.5	0.25
01/07/10	02/05/10	02/08/10	02/12/10	-750	-990	12	-910	-2440	103640	87720	9	1.75	0.5
01/14/10	02/12/10	02/15/10	02/19/10	830	790	2	-80	-80	104470	88510	11	2	3
01/21/10	02/19/10	02/22/10	02/26/10	410	370	2	0	0	104880	88880	16	1.75	2.25
01/28/10	02/26/10	03/01/10	03/05/10	-510	-650	7	-1220	-1220	104370	88230	9	0.25	2
02/04/10	03/05/10	03/08/10	03/12/10	830	670	8	-640	-640	105200	88900	5	1.25	1.75
02/11/10	03/12/10	03/15/10	03/19/10	1050	970	4	0	0	106250	89870	3	1.5	2.5
02/18/10	03/19/10	03/22/10	03/26/10	630	510	6	-550	-1110	106880	90380	8	0.75	1.75
02/25/10	03/26/10	03/29/10	04/02/10	-720	-860	7	-520	-1120	106160	89520	16	0.5	1
03/04/10	04/02/10	04/05/10	04/09/10	390	210	9	-370	-640	106550	89730	4	1	2
03/11/10	04/09/10	04/12/10	04/16/10	140	-100	12	-570	-1040	106690	89630	4	0.75	2
03/18/10	04/16/10	04/19/10	04/23/10	1810	1750	3	-230	-230	108500	91380	18	1.25	3.25
03/25/10	04/23/10	04/26/10	04/30/10	-1250	-1330	4	-940	-1470	107250	90050	24	1	2.75
04/01/10	04/30/10	05/03/10	05/07/10	-3160	-3260	5	-1750	-3160	104090	86790	17	1.5	3.25
04/08/10	05/07/10	05/10/10	05/14/10	-880	-960	4	-1010	-1030	103210	85830	23	1.25	3
04/15/10	05/14/10	05/17/10	05/21/10	20	-80	5	-1160	-1210	103230	85750	19	2.75	1.25
04/22/10	05/21/10	05/24/10	05/28/10	-440	-520	4	-1020	-1020	102790	85230	1	2.75	0.75
04/29/10	05/28/10	05/31/10	06/04/10	1510	1390	6	-1260	-2030	104300	86620	6	3.5	1.75
05/06/10	06/04/10	06/07/10	06/11/10	-360	-400	2	-210	-360	103940	86220	14	2.5	2
05/13/10	06/11/10	06/14/10	06/18/10	-500	-520	1	-500	-500	103440	85700	1	2.25	2.5
05/20/10	06/18/10	06/21/10	06/25/10	540	500	2	0	0	103980	86200	14	2.5	2
05/27/10	06/25/10	06/28/10	07/02/10	-500	-540	2	-470	-500	103480	85660	14	2.25	2.25
06/03/10	07/02/10	07/05/10	07/09/10	-130	-150	1	-130	-130	103350	85510	8	3.25	3.25
06/10/10	07/09/10	07/12/10	07/16/10	-1010	-1030	1	-1010	-1010	102340	84480	15	1.75	2.75
06/17/10	07/16/10	07/19/10	07/23/10	0	0	0	0	0	102340	84480	8	3.25	2.5
06/24/10	07/23/10	07/26/10	07/30/10	-340	-460	6	-690	-1170	102000	84020	3	2	2.5
07/01/10	07/30/10	08/02/10	08/06/10	110	10	5	-270	-300	102110	84030	2	0.5	2.5
07/08/10	08/06/10	08/09/10	08/13/10	-460	-480	1	-460	-460	101650	83550	13	2.25	1.75
07/15/10	08/13/10	08/16/10	08/20/10	0	0	0	0	0	101650	83550	1	1.5	1.5
07/22/10	08/20/10	08/23/10	08/27/10	1960	1920	2	0	0	103610	85470	22	2	1.25
07/29/10	08/27/10	08/30/10	09/03/10	-680	-940	13	-1040	-2340	102930	84530	13	0.5	0.75
08/05/10	09/03/10	09/06/10	09/10/10	-110	-210	5	-640	-990	102820	84320	24	1.25	1.25
08/12/10	09/10/10	09/13/10	09/17/10	70	-10	4	-450	-840	102890	84310	2	1.75	1.5
08/19/10	09/17/10	09/20/10	09/24/10	-360	-460	5	-400	-470	102530	83850	2	1.75	1.5
08/26/10	09/24/10	09/27/10	10/01/10	1110	1090	1	0	0	103640	84940	3	2	3
09/02/10	10/01/10	10/04/10	10/08/10	-320	-400	4	-170	-330	103320	84540	1	1	3.5
09/09/10	10/08/10	10/11/10	10/15/10	-1100	-1160	3	-1110	-1260	102220	83380	5	1.5	2.75
09/16/10	10/15/10	10/18/10	10/22/10	2700	2640	3	0	0	104920	86020	19	2.5	1
09/23/10	10/22/10	10/25/10	10/29/10	-820	-900	4	-600	-870	104100	85120	16	1.75	1.5
09/30/10	10/29/10	11/01/10	11/05/10	0	0	0	0	0	104100	85120	13	2.75	2
10/07/10	11/05/10	11/08/10	11/12/10	540	480	3	-160	-160	104640	85600	13	1.75	2
10/14/10	11/12/10	11/15/10	11/19/10	350	330	1	0	0	104990	85930	18	2.25	1.75
10/21/10	11/19/10	11/22/10	11/26/10	1570	1530	2	0	0	106560	87460	7	1.75	3
10/28/10	11/26/10	11/29/10	12/03/10	3100	3000	5	0	0	109660	90460	8	1	2.5
11/04/10	12/03/10	12/06/10	12/10/10	-140	-260	6	-530	-890	109520	90200	12	0.5	1.5
11/11/10	12/10/10	12/13/10	12/17/10	-1260	-1380	6	-510	-1270	108260	88820	17	0.5	1.5
11/18/10	12/17/10	12/20/10	12/24/10	1000	960	2	0	0	109260	89780	18	0.75	1.75
11/25/10	12/24/10	12/27/10	12/31/10	440	340	5	-980	-980	109700	90120	3	1.5	2.25
12/02/10	12/31/10	01/03/11	01/07/11	60	-80	7	-890	-1110	109760	90040	6	1	3
12/09/10	01/07/11	01/10/11	01/14/11	120	-60	9	-550	-890	109880	89980	5	1.25	1.25
12/16/10	01/14/11	01/17/11	01/21/11	60	20	2	-130	-130	109940	90000	8	1.75	1
12/23/10	01/21/11	01/24/11	01/28/11	480	420	3	-780	-780	110420	90420	15	2	1
12/30/10	01/28/11	01/31/11	02/04/11	2550	2430	6	-370	-520	112970	92850	8	2.25	1
01/06/11	02/04/11	02/07/11	02/11/11	1610	1510	5	-600	-600	114580	94360	12	2	0.75
01/13/11	02/11/11	02/14/11	02/18/11	2080	2000	4	-270	-270	116660	96360	19	2.5	0.5
01/20/11	02/18/11	02/21/11	02/25/11	500	400	5	-990	-1830	117160	96760	18	2.75	0.25

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	oltt	odd	EQ	NetEq	N	vup	vdn
01/27/11	02/25/11	02/28/11	03/04/11	-3970	-4090	6	-1750	-4370	113190	92670	21	2.25	0.5
02/03/11	03/04/11	03/07/11	03/11/11	-2740	-2920	9	-1890	-2970	110450	89750	20	1.5	0.75
02/10/11	03/11/11	03/14/11	03/18/11	370	310	3	-40	-60	110820	90060	12	2.25	3.25
02/17/11	03/18/11	03/21/11	03/25/11	1040	1020	1	0	0	111860	91080	12	2.25	2.75
02/24/11	03/25/11	03/28/11	04/01/11	170	150	1	0	0	112030	91230	11	2.75	2.5
03/03/11	04/01/11	04/04/11	04/08/11	1790	1690	5	-640	-900	113820	92920	7	1	3.5
03/10/11	04/08/11	04/11/11	04/15/11	-570	-730	8	-1890	-3090	113250	92190	4	1	3.25
03/17/11	04/15/11	04/18/11	04/22/11	750	710	2	-140	-140	114000	92900	24	1.5	2.75
03/24/11	04/22/11	04/25/11	04/29/11	1190	1050	7	-1250	-1250	115190	93950	18	0.5	2.75
03/31/11	04/29/11	05/02/11	05/06/11	-2450	-2710	13	-1860	-3660	112740	91240	18	0.25	3
04/07/11	05/06/11	05/09/11	05/13/11	3070	2810	13	-1830	-2710	115810	94050	4	3	3.25
04/14/11	05/13/11	05/16/11	05/20/11	1090	990	5	-1480	-1480	116900	95040	1	2	2
04/21/11	05/20/11	05/23/11	05/27/11	-1420	-1460	2	-950	-1420	115480	93580	1	2	2
04/28/11	05/27/11	05/30/11	06/03/11	850	750	5	-1280	-1280	116330	94330	17	2	0.75
05/05/11	06/03/11	06/06/11	06/10/11	-690	-850	8	-640	-1170	115640	93480	19	0.5	1.5
05/12/11	06/10/11	06/13/11	06/17/11	3900	3760	7	-800	-880	119540	97240	1	1.25	1.75
05/19/11	06/17/11	06/20/11	06/24/11	710	610	5	-370	-370	120250	97850	19	0.5	2.5
05/26/11	06/24/11	06/27/11	07/01/11	1650	1550	5	-360	-360	121900	99400	19	0.5	2.5
06/02/11	07/01/11	07/04/11	07/08/11	-330	-430	5	-410	-520	121570	98970	16	0.25	3
06/09/11	07/08/11	07/11/11	07/15/11	2520	2400	6	-670	-670	124090	101370	18	0.5	3
06/16/11	07/15/11	07/18/11	07/22/11	-2180	-2320	7	-1630	-3440	121910	99050	18	0.5	3
06/23/11	07/22/11	07/25/11	07/29/11	-1520	-1620	5	-1130	-1830	120390	97430	24	0.25	3
06/30/11	07/29/11	08/01/11	08/05/11	2060	2000	3	-10	-10	122450	99430	13	2.25	3.5
07/07/11	08/05/11	08/08/11	08/12/11	6270	5970	15	-1550	-2270	128720	105400	12	1.25	1
07/14/11	08/12/11	08/15/11	08/19/11	-90	-270	9	-960	-1230	128630	105130	9	2	1
07/21/11	08/19/11	08/22/11	08/26/11	-5190	-5470	14	-1690	-5190	123440	99660	10	2.25	0.75
07/28/11	08/26/11	08/29/11	09/02/11	-430	-470	2	-310	-430	123010	99190	5	2.75	3.25
08/04/11	09/02/11	09/05/11	09/09/11	860	800	3	0	0	123870	99990	16	1.75	3.5
08/11/11	09/09/11	09/12/11	09/16/11	280	200	4	-480	-1140	124150	100190	21	1.25	3.25
08/18/11	09/16/11	09/19/11	09/23/11	-3370	-3410	2	-3020	-3370	120780	96780	9	2.25	3.5
08/25/11	09/23/11	09/26/11	09/30/11	1410	1330	4	-1160	-1160	122190	98110	2	3	2.75
09/01/11	09/30/11	10/03/11	10/07/11	-2330	-2430	5	-2830	-2830	119860	95680	1	1.75	3
09/08/11	10/07/11	10/10/11	10/14/11	310	230	4	-890	-890	120170	95910	12	3.5	1
09/15/11	10/14/11	10/17/11	10/21/11	1600	1520	4	-1240	-1240	121770	97430	12	3.5	1.25
09/22/11	10/21/11	10/24/11	10/28/11	970	870	5	-630	-1100	122740	98300	17	2	1.25
09/29/11	10/28/11	10/31/11	11/04/11	-2540	-2620	4	-1440	-2540	120200	95680	12	3.5	1.25
10/06/11	11/04/11	11/07/11	11/11/11	810	670	7	-590	-1370	121010	96350	12	0.5	2.75
10/13/11	11/11/11	11/14/11	11/18/11	-340	-440	5	-1560	-1630	120670	95910	17	0.25	3.5
10/20/11	11/18/11	11/21/11	11/25/11	980	840	7	-320	-580	121650	96750	12	0.25	2.75
10/27/11	11/25/11	11/28/11	12/02/11	1230	1110	6	-660	-660	122880	97860	13	0.25	3.5
11/03/11	12/02/11	12/05/11	12/09/11	760	600	8	-660	-1000	123640	98460	8	0.5	2
11/10/11	12/09/11	12/12/11	12/16/11	540	340	10	-740	-1000	124180	98800	8	0.5	2
11/17/11	12/16/11	12/19/11	12/23/11	-1630	-1750	6	-820	-1850	122550	97050	7	1.75	1.75
11/24/11	12/23/11	12/26/11	12/30/11	-110	-150	2	-120	-120	122440	96900	18	1.25	3
12/01/11	12/30/11	01/02/12	01/06/12	290	270	1	0	0	122730	97170	22	1.5	2
12/08/11	01/06/12	01/09/12	01/13/12	-200	-300	5	-810	-990	122530	96870	21	1.25	1.75
12/15/11	01/13/12	01/16/12	01/20/12	-390	-430	2	-770	-770	122140	96440	24	1	2.75
12/22/11	01/20/12	01/23/12	01/27/12	1200	1160	2	0	0	123340	97600	15	1.5	3
12/29/11	01/27/12	01/30/12	02/03/12	810	730	4	-530	-530	124150	98330	20	1	2.25
01/05/12	02/03/12	02/06/12	02/10/12	820	760	3	0	0	124970	99090	14	1.25	3.25
01/12/12	02/10/12	02/13/12	02/17/12	840	760	4	-60	-60	125810	99850	18	0.75	2.75
01/19/12	02/17/12	02/20/12	02/24/12	3300	3220	4	-140	-140	129110	103070	5	1.5	3.5
01/26/12	02/24/12	02/27/12	03/02/12	2920	2680	12	-1100	-1100	132030	105750	2	1.5	2
02/02/12	03/02/12	03/05/12	03/09/12	-30	-170	7	-610	-1040	132000	105580	8	0.75	1.75
02/09/12	03/09/12	03/12/12	03/16/12	-1080	-1260	9	-1640	-3570	130920	104320	6	1	2.25
02/16/12	03/16/12	03/19/12	03/23/12	-1570	-1650	4	-1010	-1670	129350	102670	4	2	2.75
02/23/12	03/23/12	03/26/12	03/30/12	0	0	0	0	0	129350	102670	11	2	3.25
03/01/12	03/30/12	04/02/12	04/06/12	500	400	5	-800	-1340	129850	103070	19	0.25	3.25
03/08/12	04/06/12	04/09/12	04/13/12	350	250	5	-340	-530	130200	103320	23	0.25	3.25
03/15/12	04/13/12	04/16/12	04/20/12	610	530	4	-250	-250	130810	103850	22	0.25	2.5
03/22/12	04/20/12	04/23/12	04/27/12	390	330	3	-20	-20	131200	104180	2	1.25	3.25

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	oltt	odd	EQ	NetEq	N	vup	vdn
03/29/12	04/27/12	04/30/12	05/04/12	440	340	5	-140	-190	131640	104520	24	0.25	3.25
04/05/12	05/04/12	05/07/12	05/11/12	-1290	-1470	9	-1130	-2110	130350	103050	15	0.25	1.5
04/12/12	05/11/12	05/14/12	05/18/12	-220	-260	2	-310	-310	130130	102790	6	2.25	3
04/19/12	05/18/12	05/21/12	05/25/12	0	0	0	0	0	130130	102790	4	2.25	3
04/26/12	05/25/12	05/28/12	06/01/12	70	30	2	-10	-10	130200	102820	6	2.5	3
05/03/12	06/01/12	06/04/12	06/08/12	380	360	1	0	0	130580	103180	6	2.5	3
05/10/12	06/08/12	06/11/12	06/15/12	610	310	15	-580	-1780	131190	103490	4	1.75	0.75
05/17/12	06/15/12	06/18/12	06/22/12	2110	1890	11	-810	-1010	133300	105380	4	2.25	0.5
05/24/12	06/22/12	06/25/12	06/29/12	340	280	3	-850	-1480	133640	105660	1	2.25	1.5
05/31/12	06/29/12	07/02/12	07/06/12	-1470	-1550	4	-940	-1890	132170	104110	24	0.5	2.5
06/07/12	07/06/12	07/09/12	07/13/12	1190	1090	5	-170	-170	133360	105200	23	0.75	2
06/14/12	07/13/12	07/16/12	07/20/12	480	360	6	-600	-600	133840	105560	23	0.75	2
06/21/12	07/20/12	07/23/12	07/27/12	560	460	5	-750	-750	134400	106020	16	0.5	3.5
06/28/12	07/27/12	07/30/12	08/03/12	-3270	-3550	14	-760	-3270	131130	102470	14	0.5	0.75
07/05/12	08/03/12	08/06/12	08/10/12	-650	-810	8	-860	-1890	130480	101660	19	0.75	1
07/12/12	08/10/12	08/13/12	08/17/12	-700	-740	2	-510	-700	129780	100920	7	1.75	3
07/19/12	08/17/12	08/20/12	08/24/12	-250	-270	1	-250	-250	129530	100650	24	2	3
07/26/12	08/24/12	08/27/12	08/31/12	460	420	2	0	0	129990	101070	23	1	2.75
08/02/12	08/31/12	09/03/12	09/07/12	1380	1340	2	0	0	131370	102410	16	1.25	3.5
08/09/12	09/07/12	09/10/12	09/14/12	-690	-770	4	-220	-690	130680	101640	6	1.25	2
08/16/12	09/14/12	09/17/12	09/21/12	760	660	5	-350	-350	131440	102300	9	1.75	1.25
08/23/12	09/21/12	09/24/12	09/28/12	-120	-200	4	-1180	-1180	131320	102100	9	2	1.25
08/30/12	09/28/12	10/01/12	10/05/12	910	890	1	0	0	132230	102990	23	2.5	2
09/06/12	10/05/12	10/08/12	10/12/12	1410	1250	8	-800	-800	133640	104240	4	1.75	1.75
09/13/12	10/12/12	10/15/12	10/19/12	-90	-270	9	-830	-830	133550	103970	8	1.5	1.25
09/20/12	10/19/12	10/22/12	10/26/12	640	540	5	-140	-140	134190	104510	7	1.25	1.75
09/27/12	10/26/12	10/29/12	11/02/12	-1240	-1340	5	-920	-1240	132950	103170	8	1.25	1.5
10/04/12	11/02/12	11/05/12	11/09/12	-870	-1050	9	-1140	-1630	132080	102120	4	1.75	1.75
10/11/12	11/09/12	11/12/12	11/16/12	-460	-480	1	-460	-460	131620	101640	22	1.75	2.25
10/18/12	11/16/12	11/19/12	11/23/12	280	180	5	-800	-1020	131900	101820	5	3	0.75
10/25/12	11/23/12	11/26/12	11/30/12	-190	-290	5	-490	-510	131710	101530	24	0.5	3
11/01/12	11/30/12	12/03/12	12/07/12	110	30	4	-110	-110	131820	101560	8	0.5	3.25
11/08/12	12/07/12	12/10/12	12/14/12	-40	-120	4	-640	-640	131780	101440	7	0.5	3.5
11/15/12	12/14/12	12/17/12	12/21/12	-130	-210	4	-240	-320	131650	101230	6	0.75	3.5
11/22/12	12/21/12	12/24/12	12/28/12	-280	-300	1	-280	-280	131370	100930	11	2	2
11/29/12	12/28/12	12/31/12	01/04/13	-480	-600	6	-440	-790	130890	100330	2	1	2.5
12/06/12	01/04/13	01/07/13	01/11/13	840	800	2	0	0	131730	101130	6	1	2.25
12/13/12	01/11/13	01/14/13	01/18/13	700	600	5	-470	-470	132430	101730	1	0.25	2.25
12/20/12	01/18/13	01/21/13	01/25/13	500	420	4	-70	-70	132930	102150	14	0.25	2.5
12/27/12	01/25/13	01/28/13	02/01/13	820	720	5	-170	-170	133750	102870	14	0.25	2.5
01/03/13	02/01/13	02/04/13	02/08/13	-1090	-1250	8	-780	-1120	132660	101620	15	0.25	1.5
01/10/13	02/08/13	02/11/13	02/15/13	430	370	3	-580	-580	133090	101990	12	1.75	1
01/17/13	02/15/13	02/18/13	02/22/13	1130	1110	1	0	0	134220	103100	17	1.5	1.25
01/24/13	02/22/13	02/25/13	03/01/13	240	160	4	-220	-220	134460	103260	14	1	1.5
01/31/13	03/01/13	03/04/13	03/08/13	-1940	-2080	7	-790	-1940	132520	101180	19	1	0.75
02/07/13	03/08/13	03/11/13	03/15/13	-690	-770	4	-520	-720	131830	100410	17	0.75	1.5
02/14/13	03/15/13	03/18/13	03/22/13	1600	1460	7	-700	-820	133430	101870	18	0.75	1.25
02/21/13	03/22/13	03/25/13	03/29/13	380	280	5	-130	-130	133810	102150	18	0.75	1.25
02/28/13	03/29/13	04/01/13	04/05/13	120	20	5	-1580	-1580	133930	102170	6	0.5	3
03/07/13	04/05/13	04/08/13	04/12/13	1750	1510	12	-390	-720	135680	103680	13	0.25	0.5
03/14/13	04/12/13	04/15/13	04/19/13	1130	1030	5	-400	-400	136810	104710	5	1	3
03/21/13	04/19/13	04/22/13	04/26/13	3730	3610	6	-350	-350	140540	108320	5	0.75	3
03/28/13	04/26/13	04/29/13	05/03/13	1660	1560	5	-770	-770	142200	109880	1	0.25	2.25
04/04/13	05/03/13	05/06/13	05/10/13	2710	2610	5	-190	-190	144910	112490	6	0.75	3.5
04/11/13	05/10/13	05/13/13	05/17/13	2240	2140	5	-40	-40	147150	114630	6	0.75	3.5
04/18/13	05/17/13	05/20/13	05/24/13	630	550	4	-450	-450	147780	115180	18	0.75	2
04/25/13	05/24/13	05/27/13	05/31/13	60	-20	4	-1010	-1010	147840	115160	13	0.75	2
05/02/13	05/31/13	06/03/13	06/07/13	-530	-650	6	-430	-530	147310	114510	5	1.5	1.75
05/09/13	06/07/13	06/10/13	06/14/13	-40	-100	3	-70	-70	147270	114410	7	2	1.25
05/16/13	06/14/13	06/17/13	06/21/13	-50	-70	1	-50	-50	147220	114340	17	1.75	2
05/23/13	06/21/13	06/24/13	06/28/13	1120	1020	5	-870	-990	148340	115360	7	1	3

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	oltt	odd	EQ	NetEq	N	vup	vdn
05/30/13	06/28/13	07/01/13	07/05/13	100	60	2	-160	-160	148440	115420	6	3.25	1.25
06/06/13	07/05/13	07/08/13	07/12/13	1080	980	5	-370	-370	149520	116400	22	0.5	2.75
06/13/13	07/12/13	07/15/13	07/19/13	1640	1560	4	0	0	151160	117960	22	0.5	2.75
06/20/13	07/19/13	07/22/13	07/26/13	1100	1020	4	0	0	152260	118980	21	0.5	2.5
06/27/13	07/26/13	07/29/13	08/02/13	870	770	5	-430	-430	153130	119750	21	0.5	2.25
07/04/13	08/02/13	08/05/13	08/09/13	70	-10	4	-780	-780	153200	119740	12	1.25	1.5
07/11/13	08/09/13	08/12/13	08/16/13	990	870	6	-380	-610	154190	120610	12	1	2.75
07/18/13	08/16/13	08/19/13	08/23/13	-380	-460	4	-910	-910	153810	120150	22	1	2.25
07/25/13	08/23/13	08/26/13	08/30/13	-1100	-1220	6	-850	-1850	152710	118930	13	0.75	2.5
08/01/13	08/30/13	09/02/13	09/06/13	0	0	0	0	0	152710	118930	2	3.5	2
08/08/13	09/06/13	09/09/13	09/13/13	800	720	4	-40	-40	153510	119650	12	1	2.5
08/15/13	09/13/13	09/16/13	09/20/13	1670	1650	1	0	0	155180	121300	13	1.25	2.5
08/22/13	09/20/13	09/23/13	09/27/13	440	380	3	-20	-20	155620	121680	8	1.5	1.5
08/29/13	09/27/13	09/30/13	10/04/13	10	-70	4	-400	-400	155630	121610	6	1.75	1.5
09/05/13	10/04/13	10/07/13	10/11/13	-410	-490	4	-340	-410	155220	121120	3	3	1.5
09/12/13	10/11/13	10/14/13	10/18/13	-250	-350	5	-370	-370	154970	120770	8	1.25	1.5
09/19/13	10/18/13	10/21/13	10/25/13	900	860	2	0	0	155870	121630	3	3.25	1.5
09/26/13	10/25/13	10/28/13	11/01/13	0	0	0	0	0	155870	121630	14	1.5	1.75
10/03/13	11/01/13	11/04/13	11/08/13	200	140	3	-10	-10	156070	121770	2	2.5	1
10/10/13	11/08/13	11/11/13	11/15/13	1860	1740	6	-480	-480	157930	123510	2	2.25	1
10/17/13	11/15/13	11/18/13	11/22/13	890	850	2	0	0	158820	124360	2	2.25	1
10/24/13	11/22/13	11/25/13	11/29/13	850	750	5	-240	-240	159670	125110	9	1.5	0.25
10/31/13	11/29/13	12/02/13	12/06/13	-1720	-1940	11	-870	-1990	157950	123170	9	1.25	0.25
11/07/13	12/06/13	12/09/13	12/13/13	600	500	5	-590	-590	158550	123670	3	2.5	0.25
11/14/13	12/13/13	12/16/13	12/20/13	410	250	8	-550	-550	158960	123920	3	2	0.5
11/21/13	12/20/13	12/23/13	12/27/13	0	0	0	0	0	158960	123920	15	1.75	1.5
11/28/13	12/27/13	12/30/13	01/03/14	1570	1490	4	-80	-80	160530	125410	10	1.5	0.25
12/05/13	01/03/14	01/06/14	01/10/14	560	440	6	-480	-480	161090	125850	14	1.5	0.25
12/12/13	01/10/14	01/13/14	01/17/14	-200	-300	5	-350	-680	160890	125550	10	2	0.5
12/19/13	01/17/14	01/20/14	01/24/14	-1110	-1210	5	-480	-1110	159780	124340	12	1.5	0.75
12/26/13	01/24/14	01/27/14	01/31/14	400	320	4	-90	-90	160180	124660	16	0.75	1.5
01/02/14	01/31/14	02/03/14	02/07/14	-110	-250	7	-440	-1490	160070	124410	17	0.75	1.25
01/09/14	02/07/14	02/10/14	02/14/14	-560	-660	5	-760	-1070	159510	123750	7	0.25	2
01/16/14	02/14/14	02/17/14	02/21/14	820	760	3	-40	-40	160330	124510	21	0.75	1.25
01/23/14	02/21/14	02/24/14	02/28/14	-80	-180	5	-260	-620	160250	124330	21	0.75	1.25
01/30/14	02/28/14	03/03/14	03/07/14	880	760	6	-350	-380	161130	125090	22	1.5	0.25
02/06/14	03/07/14	03/10/14	03/14/14	270	210	3	-240	-410	161400	125300	23	0.75	1.25
02/13/14	03/14/14	03/17/14	03/21/14	-2800	-2960	8	-800	-2850	158600	122340	23	0.75	1.25
02/20/14	03/21/14	03/24/14	03/28/14	220	100	6	-630	-650	158820	122440	3	3.25	0.5
02/27/14	03/28/14	03/31/14	04/04/14	-530	-670	7	-790	-1290	158290	121770	5	3	0.5
03/06/14	04/04/14	04/07/14	04/11/14	-1090	-1270	9	-530	-1610	157200	120500	3	2	1
03/13/14	04/11/14	04/14/14	04/18/14	560	480	4	-150	-150	157760	120980	9	0.75	0.75
03/20/14	04/18/14	04/21/14	04/25/14	160	120	2	-40	-40	157920	121100	11	2.75	0.75
03/27/14	04/25/14	04/28/14	05/02/14	330	230	5	-360	-360	158250	121330	11	2.25	0.25
04/03/14	05/02/14	05/05/14	05/09/14	-210	-270	3	-140	-220	158040	121060	15	2	1
04/10/14	05/09/14	05/12/14	05/16/14	-440	-580	7	-660	-870	157600	120480	7	1.75	0.25
04/17/14	05/16/14	05/19/14	05/23/14	-710	-810	5	-470	-800	156890	119670	9	3	0.25
04/24/14	05/23/14	05/26/14	05/30/14	110	30	4	-270	-400	157000	119700	2	1.25	0.5
05/01/14	05/30/14	06/02/14	06/06/14	-330	-450	6	-380	-500	156670	119250	6	0.5	1.25
05/08/14	06/06/14	06/09/14	06/13/14	500	400	5	-390	-390	157170	119650	5	0.75	1.75
05/15/14	06/13/14	06/16/14	06/20/14	-920	-980	3	-850	-920	156250	118670	12	0.75	3.5
05/22/14	06/20/14	06/23/14	06/27/14	470	450	1	0	0	156720	119120	10	1	2
05/29/14	06/27/14	06/30/14	07/04/14	-750	-830	4	-860	-900	155970	118290	22	0.75	1.5
06/05/14	07/04/14	07/07/14	07/11/14	140	120	1	0	0	156110	118410	7	1.25	2
06/12/14	07/11/14	07/14/14	07/18/14	1330	1230	5	-150	-150	157440	119640	5	1.25	2.5
06/19/14	07/18/14	07/21/14	07/25/14	-270	-370	5	-700	-940	157170	119270	6	0.5	2
06/26/14	07/25/14	07/28/14	08/01/14	-1020	-1120	5	-630	-1300	156150	118150	7	0.75	2
07/03/14	08/01/14	08/04/14	08/08/14	510	450	3	-180	-180	156660	118600	5	1.5	1.75
07/10/14	08/08/14	08/11/14	08/15/14	640	600	2	0	0	157300	119200	5	1.5	2
07/17/14	08/15/14	08/18/14	08/22/14	-250	-270	1	-250	-250	157050	118930	3	2	2
07/24/14	08/22/14	08/25/14	08/29/14	-490	-530	2	-430	-490	156560	118400	18	2.5	0.75

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	oltt	odd	EQ	NetEq	N	vup	vdn
07/31/14	08/29/14	09/01/14	09/05/14	1990	1710	14	-380	-380	158550	120110	3	1	1.25
08/07/14	09/05/14	09/08/14	09/12/14	510	390	6	-1080	-1230	159060	120500	17	0.25	1.75
08/14/14	09/12/14	09/15/14	09/19/14	970	850	6	-300	-540	160030	121350	3	0.75	2.5
08/21/14	09/19/14	09/22/14	09/26/14	1070	930	7	-260	-540	161100	122280	9	0.25	2
08/28/14	09/26/14	09/29/14	10/03/14	3280	3020	13	-640	-950	164380	125300	5	0.75	1.5
09/04/14	10/03/14	10/06/14	10/10/14	-20	-160	7	-1860	-1860	164360	125140	6	0.5	2
09/11/14	10/10/14	10/13/14	10/17/14	2310	1930	19	-530	-1750	166670	127070	4	1	1.75
09/18/14	10/17/14	10/20/14	10/24/14	-560	-840	14	-770	-1690	166110	126230	9	0.75	1
09/25/14	10/24/14	10/27/14	10/31/14	-1360	-1500	7	-730	-1590	164750	124730	5	2	1.5
10/02/14	10/31/14	11/03/14	11/07/14	130	90	2	-1120	-1120	164880	124820	1	2.75	1.75
10/09/14	11/07/14	11/10/14	11/14/14	1790	1690	5	-690	-690	166670	126510	24	1	1.5
10/16/14	11/14/14	11/17/14	11/21/14	230	210	1	0	0	166900	126720	19	1.5	2.25
10/23/14	11/21/14	11/24/14	11/28/14	2820	2720	5	-1200	-1200	169720	129440	24	1.25	1.5
10/30/14	11/28/14	12/01/14	12/05/14	-2240	-2480	12	-2860	-2860	167480	126960	23	0.5	0.75
11/06/14	12/05/14	12/08/14	12/12/14	2920	2820	5	-490	-490	170400	129780	18	1.75	0.25
11/13/14	12/12/14	12/15/14	12/19/14	3820	3440	19	-1030	-2110	174220	133220	5	2.25	0.5
11/20/14	12/19/14	12/22/14	12/26/14	890	830	3	-170	-170	175110	134050	9	1.5	1.25
11/27/14	12/26/14	12/29/14	01/02/15	-880	-1000	6	-790	-1510	174230	133050	7	2	1.75
12/04/14	01/02/15	01/05/15	01/09/15	-800	-900	5	-860	-1960	173430	132150	24	2.75	0.75
12/11/14	01/09/15	01/12/15	01/16/15	-1290	-1550	13	-1030	-3340	172140	130600	8	1.5	1
12/18/14	01/16/15	01/19/15	01/23/15	-980	-1040	3	-600	-990	171160	129560	5	2.75	2.75
12/25/14	01/23/15	01/26/15	01/30/15	1520	1500	1	0	0	172680	131060	5	2.75	3
01/01/15	01/30/15	02/02/15	02/06/15	-1100	-1200	5	-1490	-1710	171580	129860	14	2.5	2.5
01/08/15	02/06/15	02/09/15	02/13/15	0	0	0	0	0	171580	129860	5	3.25	3.5
01/15/15	02/13/15	02/16/15	02/20/15	910	850	3	-160	-160	172490	130710	8	2.5	2.5
01/22/15	02/20/15	02/23/15	02/27/15	-2370	-2450	4	-890	-2370	170120	128260	6	3.25	2.25
01/29/15	02/27/15	03/02/15	03/06/15	140	80	3	-1080	-1170	170260	128340	9	1.5	2.5
02/05/15	03/06/15	03/09/15	03/13/15	-1410	-1470	3	-880	-1530	168850	126870	21	0.5	2.5
02/12/15	03/13/15	03/16/15	03/20/15	1910	1830	4	-380	-380	170760	128700	4	1.5	3
02/19/15	03/20/15	03/23/15	03/27/15	2200	2080	6	-100	-100	172960	130780	3	2.5	1.25
02/26/15	03/27/15	03/30/15	04/03/15	740	700	2	-80	-80	173700	131480	12	2.25	3
03/05/15	04/03/15	04/06/15	04/10/15	2160	2100	3	0	0	175860	133580	8	2	2.25
03/12/15	04/10/15	04/13/15	04/17/15	150	110	2	-610	-610	176010	133690	14	1.75	2.25
03/19/15	04/17/15	04/20/15	04/24/15	-650	-710	3	-540	-650	175360	132980	13	0.75	2.75
03/26/15	04/24/15	04/27/15	05/01/15	280	260	1	0	0	175640	133240	8	1.25	2.25
04/02/15	05/01/15	05/04/15	05/08/15	-1600	-1720	6	-820	-2120	174040	131520	9	0.75	2.5
04/09/15	05/08/15	05/11/15	05/15/15	930	870	3	-130	-130	174970	132390	18	2.25	1
04/16/15	05/15/15	05/18/15	05/22/15	50	10	2	-380	-380	175020	132400	18	2.25	1
04/23/15	05/22/15	05/25/15	05/29/15	1100	1080	1	0	0	176120	133480	20	2	1
04/30/15	05/29/15	06/01/15	06/05/15	180	140	2	-210	-210	176300	133620	12	1.25	2.25
05/07/15	06/05/15	06/08/15	06/12/15	-130	-150	1	-130	-130	176170	133470	15	1.25	1.5
05/14/15	06/12/15	06/15/15	06/19/15	130	10	6	-90	-110	176300	133480	23	0.5	1
05/21/15	06/19/15	06/22/15	06/26/15	730	610	6	-270	-270	177030	134090	11	0.25	1.5
05/28/15	06/26/15	06/29/15	07/03/15	220	120	5	-1120	-1120	177250	134210	9	0.75	1.25
06/04/15	07/03/15	07/06/15	07/10/15	-140	-340	10	-520	-1370	177110	133870	2	1.5	1.5
06/11/15	07/10/15	07/13/15	07/17/15	-190	-270	4	-650	-750	176920	133600	6	1.5	1.75
06/18/15	07/17/15	07/20/15	07/24/15	820	740	4	-120	-120	177740	134340	13	2.75	0.75
06/25/15	07/24/15	07/27/15	07/31/15	860	760	5	-440	-640	178600	135100	17	2	0.75
07/02/15	07/31/15	08/03/15	08/07/15	490	370	6	-440	-650	179090	135470	6	1.5	0.75
07/09/15	08/07/15	08/10/15	08/14/15	-40	-120	4	-260	-260	179050	135350	22	2.5	0.25
07/16/15	08/14/15	08/17/15	08/21/15	1950	1850	5	0	0	181000	137200	13	3.5	0.5
07/23/15	08/21/15	08/24/15	08/28/15	210	-30	12	-630	-1430	181210	137170	12	1.5	0.5
07/30/15	08/28/15	08/31/15	09/04/15	3130	2950	9	-990	-1260	184340	140120	18	2.25	0.25
08/06/15	09/04/15	09/07/15	09/11/15	110	10	5	-570	-1020	184450	140130	18	3.25	0.5
08/13/15	09/11/15	09/14/15	09/18/15	-740	-860	6	-460	-1280	183710	139270	16	3.25	0.25
08/20/15	09/18/15	09/21/15	09/25/15	830	810	1	0	0	184540	140080	17	3	1.75
08/27/15	09/25/15	09/28/15	10/02/15	620	580	2	0	0	185160	140660	17	2	1.75
09/03/15	10/02/15	10/05/15	10/09/15	-1570	-1710	7	-1020	-1570	183590	138950	2	1.5	2.25
09/10/15	10/09/15	10/12/15	10/16/15	-580	-640	3	-1580	-1580	183010	138310	10	1.5	3.5
09/17/15	10/16/15	10/19/15	10/23/15	150	90	3	-20	-20	183160	138400	16	2	1
09/24/15	10/23/15	10/26/15	10/30/15	650	610	2	0	0	183810	139010	14	2.25	1.25

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	oltt	odd	EQ	NetEq	N	vup	vdn
10/01/15	10/30/15	11/02/15	11/06/15	510	450	3	-400	-400	184320	139460	16	1.75	1
10/08/15	11/06/15	11/09/15	11/13/15	280	200	4	-310	-310	184600	139660	13	1.75	0.75
10/15/15	11/13/15	11/16/15	11/20/15	-760	-840	4	-590	-1060	183840	138820	5	2.75	1.5
10/22/15	11/20/15	11/23/15	11/27/15	-530	-590	3	-270	-530	183310	138230	12	2	0.75
10/29/15	11/27/15	11/30/15	12/04/15	200	120	4	-310	-310	183510	138350	4	2.75	1.5
11/05/15	12/04/15	12/07/15	12/11/15	370	250	6	-470	-620	183880	138600	2	2.5	1.25
11/12/15	12/11/15	12/14/15	12/18/15	130	50	4	-600	-600	184010	138650	2	2.75	1.25
11/19/15	12/18/15	12/21/15	12/25/15	-810	-850	2	-580	-810	183200	137800	15	2.5	0.5
11/26/15	12/25/15	12/28/15	01/01/16	-120	-200	4	-340	-450	183080	137600	14	2.5	0.25
12/03/15	01/01/16	01/04/16	01/08/16	540	440	5	-210	-210	183620	138040	18	2	0.5
12/10/15	01/08/16	01/11/16	01/15/16	270	170	5	-540	-650	183890	138210	19	2.5	0.5
12/17/15	01/15/16	01/18/16	01/22/16	-670	-750	4	-720	-1180	183220	137460	21	2.25	0.5
12/24/15	01/22/16	01/25/16	01/29/16	380	160	11	-1080	-1280	183600	137620	18	0.25	1.25
12/31/15	01/29/16	02/01/16	02/05/16	-1310	-1570	13	-670	-1930	182290	136050	20	0.25	0.75
01/07/16	02/05/16	02/08/16	02/12/16	650	590	3	-600	-600	182940	136640	16	1.75	1.25
01/14/16	02/12/16	02/15/16	02/19/16	-80	-120	2	-440	-440	182860	136520	6	1.75	2.25
01/21/16	02/19/16	02/22/16	02/26/16	800	760	2	0	0	183660	137280	14	1.75	1.75
01/28/16	02/26/16	02/29/16	03/04/16	100	80	1	0	0	183760	137360	6	3	2.25
02/04/16	03/04/16	03/07/16	03/11/16	0	0	0	0	0	183760	137360	14	1.5	1.75
02/11/16	03/11/16	03/14/16	03/18/16	1000	900	5	-370	-370	184760	138260	11	0.75	2.25
02/18/16	03/18/16	03/21/16	03/25/16	500	440	3	-300	-300	185260	138700	10	0.75	2.25
02/25/16	03/25/16	03/28/16	04/01/16	-700	-780	4	-630	-980	184560	137920	5	0.75	3.5
03/03/16	04/01/16	04/04/16	04/08/16	110	30	4	-180	-180	184670	137950	3	1.5	1.75
03/10/16	04/08/16	04/11/16	04/15/16	-530	-670	7	-620	-1670	184140	137280	6	0.5	2
03/17/16	04/15/16	04/18/16	04/22/16	1790	1730	3	-70	-70	185930	139010	3	1.75	2.25
03/24/16	04/22/16	04/25/16	04/29/16	40	-80	6	-970	-1280	185970	138930	3	1.75	1.5
03/31/16	04/29/16	05/02/16	05/06/16	100	40	3	-110	-110	186070	138970	3	1.5	3.5
04/07/16	05/06/16	05/09/16	05/13/16	260	200	3	-140	-140	186330	139170	3	1.5	2.75
04/14/16	05/13/16	05/16/16	05/20/16	950	870	4	-200	-200	187280	140040	1	1	1
04/21/16	05/20/16	05/23/16	05/27/16	0	0	0	0	0	187280	140040	3	2	1.75
04/28/16	05/27/16	05/30/16	06/03/16	350	310	2	-20	-20	187630	140350	23	0.75	1.75
05/05/16	06/03/16	06/06/16	06/10/16	0	0	0	0	0	187630	140350	23	1	1.25
05/12/16	06/10/16	06/13/16	06/17/16	-1420	-1520	5	-810	-1870	186210	138830	14	0.5	1.5
05/19/16	06/17/16	06/20/16	06/24/16	-590	-650	3	-570	-680	185620	138180	4	1.75	1.75
05/26/16	06/24/16	06/27/16	07/01/16	-980	-1000	1	-980	-980	184640	137180	19	1.75	1
06/02/16	07/01/16	07/04/16	07/08/16	300	140	8	-830	-1530	184940	137320	6	0.75	1.5
06/09/16	07/08/16	07/11/16	07/15/16	-200	-440	12	-500	-1190	184740	136880	10	0.75	0.5
06/16/16	07/15/16	07/18/16	07/22/16	-160	-220	3	-80	-160	184580	136660	24	0.25	2
06/23/16	07/22/16	07/25/16	07/29/16	-160	-240	4	-180	-320	184420	136420	10	0.75	1
06/30/16	07/29/16	08/01/16	08/05/16	1470	1390	4	0	0	185890	137810	15	0.75	1
07/07/16	08/05/16	08/08/16	08/12/16	1750	1650	5	-120	-120	187640	139460	21	1	0.5
07/14/16	08/12/16	08/15/16	08/19/16	0	0	0	0	0	187640	139460	24	1.75	0.5
07/21/16	08/19/16	08/22/16	08/26/16	-810	-970	8	-490	-1450	186830	138490	4	1.25	1.25
07/28/16	08/26/16	08/29/16	09/02/16	-80	-160	4	-170	-180	186750	138330	8	0.5	2
08/04/16	09/02/16	09/05/16	09/09/16	480	380	5	-790	-790	187230	138710	23	0.5	0.75
08/11/16	09/09/16	09/12/16	09/16/16	-760	-840	4	-360	-760	186470	137870	24	0.25	1.75
08/18/16	09/16/16	09/19/16	09/23/16	420	380	2	0	0	186890	138250	23	2.5	1
08/25/16	09/23/16	09/26/16	09/30/16	-410	-510	5	-1130	-1370	186480	137740	11	1.75	1.25
09/01/16	09/30/16	10/03/16	10/07/16	0	0	0	0	0	186480	137740	5	2.25	2.25
09/08/16	10/07/16	10/10/16	10/14/16	-980	-1020	2	-880	-980	185500	136720	4	2.5	1.75
09/15/16	10/14/16	10/17/16	10/21/16	450	410	2	0	0	185950	137130	1	0.5	1
09/22/16	10/21/16	10/24/16	10/28/16	-930	-1090	8	-790	-1000	185020	136040	2	0.75	1.25
09/29/16	10/28/16	10/31/16	11/04/16	-10	-30	1	-10	-10	185010	136010	5	1.75	3
10/06/16	11/04/16	11/07/16	11/11/16	200	120	4	-410	-410	185210	136130	3	1.5	1.5
10/13/16	11/11/16	11/14/16	11/18/16	-1040	-1140	5	-1060	-1620	184170	134990	2	2.75	0.5
10/20/16	11/18/16	11/21/16	11/25/16	850	750	5	-200	-200	185020	135740	3	1.5	1
10/27/16	11/25/16	11/28/16	12/02/16	150	-170	16	-570	-1380	185170	135570	3	1.5	0.75
11/03/16	12/02/16	12/05/16	12/09/16	150	130	1	0	0	185320	135700	24	1.75	1.5
11/10/16	12/09/16	12/12/16	12/16/16	220	180	2	0	0	185540	135880	8	2.25	1.5
11/17/16	12/16/16	12/19/16	12/23/16	830	750	4	-60	-60	186370	136630	14	2	0.5
11/24/16	12/23/16	12/26/16	12/30/16	-30	-70	2	-80	-80	186340	136560	13	1.75	0.5

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	oltt	odd	EQ	NetEq	N	vup	vdn
12/01/16	12/30/16	01/02/17	01/06/17	730	650	4	-480	-1010	187070	137210	13	1.75	0.5
12/08/16	01/06/17	01/09/17	01/13/17	-1260	-1380	6	-760	-1390	185810	135830	11	0.75	1
12/15/16	01/13/17	01/16/17	01/20/17	-740	-760	1	-740	-740	185070	135070	6	1	2.25
12/22/16	01/20/17	01/23/17	01/27/17	-860	-920	3	-540	-900	184210	134150	7	1	1.5
12/29/16	01/27/17	01/30/17	02/03/17	410	310	5	-170	-170	184620	134460	5	2.75	0.5
01/05/17	02/03/17	02/06/17	02/10/17	-70	-170	5	-300	-310	184550	134290	1	2	0.25
01/12/17	02/10/17	02/13/17	02/17/17	-470	-570	5	-600	-860	184080	133720	3	3.5	0.25
01/19/17	02/17/17	02/20/17	02/24/17	590	510	4	-10	-10	184670	134230	6	1.75	0.25
01/26/17	02/24/17	02/27/17	03/03/17	10	-130	7	-460	-570	184680	134100	6	1.75	0.25
02/02/17	03/03/17	03/06/17	03/10/17	1110	1050	3	-960	-960	185790	135150	1	1.5	0.75
02/09/17	03/10/17	03/13/17	03/17/17	-1150	-1250	5	-700	-1150	184640	133900	6	2	0.25
02/16/17	03/17/17	03/20/17	03/24/17	390	350	2	0	0	185030	134250	19	0.75	1
02/23/17	03/24/17	03/27/17	03/31/17	10	-50	3	-270	-270	185040	134200	3	1	2.25
03/02/17	03/31/17	04/03/17	04/07/17	40	-20	3	-440	-440	185080	134180	16	0.5	2.75
03/09/17	04/07/17	04/10/17	04/14/17	-190	-270	4	-390	-390	184890	133910	21	0.5	0.5
03/16/17	04/14/17	04/17/17	04/21/17	1120	1060	3	-80	-80	186010	134970	24	0.5	1
03/23/17	04/21/17	04/24/17	04/28/17	220	120	5	-670	-670	186230	135090	14	0.25	1.75
03/30/17	04/28/17	05/01/17	05/05/17	-100	-160	3	-230	-230	186130	134930	22	0.5	1.25
04/06/17	05/05/17	05/08/17	05/12/17	210	90	6	-190	-190	186340	135020	4	1	0.75
04/13/17	05/12/17	05/15/17	05/19/17	-550	-590	2	-310	-550	185790	134430	6	0.75	1.5
04/20/17	05/19/17	05/22/17	05/26/17	1570	1530	2	0	0	187360	135960	8	1	1.5
04/27/17	05/26/17	05/29/17	06/02/17	-930	-1030	5	-890	-1090	186430	134930	15	0.5	3.5
05/04/17	06/02/17	06/05/17	06/09/17	370	350	1	0	0	186800	135280	15	1.75	1.5
05/11/17	06/09/17	06/12/17	06/16/17	310	290	1	0	0	187110	135570	5	1	2.25
05/18/17	06/16/17	06/19/17	06/23/17	-70	-110	2	-50	-70	187040	135460	5	1	2.25
05/25/17	06/23/17	06/26/17	06/30/17	600	480	6	-350	-470	187640	135940	12	0.5	1
06/01/17	06/30/17	07/03/17	07/07/17	260	80	9	-420	-850	187900	136020	7	1	0.25
06/08/17	07/07/17	07/10/17	07/14/17	-980	-1140	8	-440	-1140	186920	134880	10	0.75	0.75
06/15/17	07/14/17	07/17/17	07/21/17	600	540	3	0	0	187520	135420	15	1.75	0.5
06/22/17	07/21/17	07/24/17	07/28/17	0	0	0	0	0	187520	135420	19	1.5	0.75
06/29/17	07/28/17	07/31/17	08/04/17	-1070	-1150	4	-770	-1400	186450	134270	23	1.25	0.5
07/06/17	08/04/17	08/07/17	08/11/17	0	0	0	0	0	186450	134270	23	0.75	2.5
07/13/17	08/11/17	08/14/17	08/18/17	1150	1090	3	-70	-100	187600	135360	5	0.75	2.5
07/20/17	08/18/17	08/21/17	08/25/17	680	560	6	-150	-150	188280	135920	19	0.25	1.25
07/27/17	08/25/17	08/28/17	09/01/17	-490	-590	5	-600	-690	187790	135330	18	0.5	1.75
08/03/17	09/01/17	09/04/17	09/08/17	30	-70	5	-280	-430	187820	135260	17	0.25	1
08/10/17	09/08/17	09/11/17	09/15/17	760	620	7	-230	-270	188580	135880	20	0.5	0.25
08/17/17	09/15/17	09/18/17	09/22/17	480	320	8	-130	-130	189060	136200	20	0.25	0.5
08/24/17	09/22/17	09/25/17	09/29/17	1550	1430	6	-70	-80	190610	137630	17	0.25	0.5
08/31/17	09/29/17	10/02/17	10/06/17	-270	-330	3	-210	-340	190340	137300	7	0.75	2
09/07/17	10/06/17	10/09/17	10/13/17	-700	-820	6	-420	-1090	189640	136480	5	1	1.5
09/14/17	10/13/17	10/16/17	10/20/17	460	360	5	-150	-200	190100	136840	7	0.5	2
09/21/17	10/20/17	10/23/17	10/27/17	1430	1330	5	-160	-160	191530	138170	2	0.25	1.5
09/28/17	10/27/17	10/30/17	11/03/17	770	710	3	0	0	192300	138880	6	0.75	3
10/05/17	11/03/17	11/06/17	11/10/17	160	-20	9	-520	-980	192460	138860	10	0.25	1.25
10/12/17	11/10/17	11/13/17	11/17/17	-120	-220	5	-370	-550	192340	138640	1	0.25	2.25
10/19/17	11/17/17	11/20/17	11/24/17	60	40	1	0	0	192400	138680	2	0.75	3.5
10/26/17	11/24/17	11/27/17	12/01/17	40	-60	5	-420	-480	192440	138620	4	0.25	3.5
11/02/17	12/01/17	12/04/17	12/08/17	-680	-780	5	-480	-680	191760	137840	4	0.5	3.5
11/09/17	12/08/17	12/11/17	12/15/17	-210	-310	5	-700	-810	191550	137530	8	1.5	0.25
11/16/17	12/15/17	12/18/17	12/22/17	-510	-650	7	-650	-880	191040	136880	24	0.25	1
11/23/17	12/22/17	12/25/17	12/29/17	270	230	2	-30	-30	191310	137110	14	1	0.5
11/30/17	12/29/17	01/01/18	01/05/18	-560	-620	3	-420	-560	190750	136490	13	1	0.5
12/07/17	01/05/18	01/08/18	01/12/18	530	230	15	-300	-760	191280	136720	3	0.5	0.75
12/14/17	01/12/18	01/15/18	01/19/18	150	-30	9	-200	-390	191430	136690	13	0.25	0.5
12/21/17	01/19/18	01/22/18	01/26/18	910	670	12	-490	-680	192340	137360	13	0.25	0.75
12/28/17	01/26/18	01/29/18	02/02/18	630	550	4	-180	-180	192970	137910	19	0.5	1.75
01/04/18	02/02/18	02/05/18	02/09/18	700	400	15	-480	-1090	193670	138310	11	0.25	0.75
01/11/18	02/09/18	02/12/18	02/16/18	2230	2170	3	0	0	195900	140480	21	1	1.5
01/18/18	02/16/18	02/19/18	02/23/18	-270	-310	2	-530	-530	195630	140170	5	1.75	2
01/25/18	02/23/18	02/26/18	03/02/18	470	430	2	0	0	196100	140600	2	2.25	1.5

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	oltt	odd	EQ	NetEq	N	vup	vdn
02/01/18	03/02/18	03/05/18	03/09/18	1090	1050	2	0	0	197190	141650	2	2.25	1.75
02/08/18	03/09/18	03/12/18	03/16/18	-240	-280	2	-480	-480	196950	141370	6	2	2
02/15/18	03/16/18	03/19/18	03/23/18	1120	1000	6	-200	-200	198070	142370	4	0.5	1.5
02/22/18	03/23/18	03/26/18	03/30/18	40	-160	10	-530	-830	198110	142210	4	0.5	1.5
03/01/18	03/30/18	04/02/18	04/06/18	-230	-330	5	-550	-550	197880	141880	6	0.75	3
03/08/18	04/06/18	04/09/18	04/13/18	440	340	5	-270	-270	198320	142220	19	0.5	1.75
03/15/18	04/13/18	04/16/18	04/20/18	1150	1090	3	0	0	199470	143310	24	0.5	1.25
03/22/18	04/20/18	04/23/18	04/27/18	-430	-490	3	-1260	-1450	199040	142820	20	0.75	1.75
03/29/18	04/27/18	04/30/18	05/04/18	1450	1330	6	-260	-360	200490	144150	16	0.5	1.25
04/05/18	05/04/18	05/07/18	05/11/18	-200	-300	5	-710	-880	200290	143850	14	1	1.5
04/12/18	05/11/18	05/14/18	05/18/18	290	230	3	-470	-470	200580	144080	16	0.5	1.25
04/19/18	05/18/18	05/21/18	05/25/18	-590	-710	6	-640	-1250	199990	143370	12	0.5	1.5
04/26/18	05/25/18	05/28/18	06/01/18	20	-100	6	-760	-970	200010	143270	2	0.75	3
05/03/18	06/01/18	06/04/18	06/08/18	-540	-600	3	-480	-590	199470	142670	19	1	0.75
05/10/18	06/08/18	06/11/18	06/15/18	520	480	2	-100	-100	199990	143150	2	1.5	1.25
05/17/18	06/15/18	06/18/18	06/22/18	320	180	7	-430	-800	200310	143330	2	1.5	1.25
05/24/18	06/22/18	06/25/18	06/29/18	-520	-820	15	-510	-1630	199790	142510	3	0.5	1.75
05/31/18	06/29/18	07/02/18	07/06/18	10	-30	2	-160	-160	199800	142480	5	3.5	1.25
06/07/18	07/06/18	07/09/18	07/13/18	1430	1290	7	-30	-30	201230	143770	3	0.5	2.5
06/14/18	07/13/18	07/16/18	07/20/18	80	-60	7	-390	-880	201310	143710	3	0.5	2.5
06/21/18	07/20/18	07/23/18	07/27/18	360	260	5	-330	-380	201670	143970	13	0.5	2.25
06/28/18	07/27/18	07/30/18	08/03/18	-580	-600	1	-580	-580	201090	143370	10	2.25	2.25
07/05/18	08/03/18	08/06/18	08/10/18	-790	-850	3	-840	-840	200300	142520	24	0.25	3
07/12/18	08/10/18	08/13/18	08/17/18	-2760	-2860	5	-1450	-2760	197540	139660	3	2	3.5
07/19/18	08/17/18	08/20/18	08/24/18	-730	-890	8	-590	-1260	196810	138770	9	1	0.25
07/26/18	08/24/18	08/27/18	08/31/18	-1380	-1480	5	-790	-1470	195430	137290	9	1.75	0.25
08/02/18	08/31/18	09/03/18	09/07/18	730	630	5	-770	-780	196160	137920	7	0.75	1.5
08/09/18	09/07/18	09/10/18	09/14/18	310	250	3	-640	-640	196470	138170	22	0.5	3
08/16/18	09/14/18	09/17/18	09/21/18	460	380	4	-290	-290	196930	138550	5	2.25	1
08/23/18	09/21/18	09/24/18	09/28/18	-1190	-1330	7	-340	-1190	195740	137220	2	1.75	0.75
08/30/18	09/28/18	10/01/18	10/05/18	90	-50	7	-1730	-2510	195830	137170	5	0.25	3
09/06/18	10/05/18	10/08/18	10/12/18	-1450	-1550	5	-800	-1600	194380	135620	8	0.75	2
09/13/18	10/12/18	10/15/18	10/19/18	-760	-800	2	-670	-760	193620	134820	5	1.75	1.75
09/20/18	10/19/18	10/22/18	10/26/18	-1150	-1190	2	-1410	-1410	192470	133630	16	1.5	3.5
09/27/18	10/26/18	10/29/18	11/02/18	420	300	6	-770	-910	192890	133930	21	1.75	0.75
10/04/18	11/02/18	11/05/18	11/09/18	480	360	6	-410	-440	193370	134290	19	2	0.25
10/11/18	11/09/18	11/12/18	11/16/18	4580	4480	5	0	0	197950	138770	14	2.5	0.75
10/18/18	11/16/18	11/19/18	11/23/18	-390	-610	11	-1150	-1700	197560	138160	7	1.5	0.5
10/25/18	11/23/18	11/26/18	11/30/18	150	-110	13	-820	-970	197710	138050	7	1.5	1
11/01/18	11/30/18	12/03/18	12/07/18	1280	1100	9	-600	-850	198990	139150	20	0.75	0.25
11/08/18	12/07/18	12/10/18	12/14/18	2870	2710	8	-380	-550	201860	141860	20	0.75	0.25
11/15/18	12/14/18	12/17/18	12/21/18	2920	2820	5	0	0	204780	144680	13	3.25	0.5
11/22/18	12/21/18	12/24/18	12/28/18	3290	3090	10	-740	-740	208070	147770	5	1.5	0.75
11/29/18	12/28/18	12/31/18	01/04/19	-1960	-2200	12	-670	-2240	206110	145570	5	1.5	0.75
12/06/18	01/04/19	01/07/19	01/11/19	-250	-370	6	-710	-1030	205860	145200	12	1.5	1
12/13/18	01/11/19	01/14/19	01/18/19	40	20	1	0	0	205900	145220	12	1.25	2.5
12/20/18	01/18/19	01/21/19	01/25/19	-10	-30	1	-10	-10	205890	145190	1	1.5	2.25
12/27/18	01/25/19	01/28/19	02/01/19	1080	980	5	-230	-420	206970	146170	12	0.5	1.25
01/03/19	02/01/19	02/04/19	02/08/19	400	340	3	-70	-70	207370	146510	3	2	2.5
01/10/19	02/08/19	02/11/19	02/15/19	970	850	6	-480	-480	208340	147360	10	0.75	1.25
01/17/19	02/15/19	02/18/19	02/22/19	250	190	3	-270	-270	208590	147550	11	0.5	1.5
01/24/19	02/22/19	02/25/19	03/01/19	550	450	5	-190	-390	209140	148000	11	0.75	2.25
01/31/19	03/01/19	03/04/19	03/08/19	-370	-430	3	-360	-370	208770	147570	18	1.25	1
02/07/19	03/08/19	03/11/19	03/15/19	160	80	4	-50	-50	208930	147650	13	0.5	1.25
02/14/19	03/15/19	03/18/19	03/22/19	-180	-280	5	-250	-460	208750	147370	15	0.25	1.25
02/21/19	03/22/19	03/25/19	03/29/19	-610	-670	3	-590	-680	208140	146700	17	1	1.25
02/28/19	03/29/19	04/01/19	04/05/19	780	620	8	-560	-770	208920	147320	10	0.25	1.25
03/07/19	04/05/19	04/08/19	04/12/19	110	-30	7	-360	-360	209030	147290	11	0.25	1.25
03/14/19	04/12/19	04/15/19	04/19/19	-40	-100	3	-300	-300	208990	147190	2	0.75	2
03/21/19	04/19/19	04/22/19	04/26/19	-490	-590	5	-180	-520	208500	146600	13	0.25	2.25
03/28/19	04/26/19	04/29/19	05/03/19	-570	-790	11	-550	-1060	207930	145810	2	0.5	1.25

In-Sample Dates		Out-Of-Sample Dates		ogp	osnp\$20	ont	ollt	odd	EQ	NetEq	N	vup	vdn
04/04/19	05/03/19	05/06/19	05/10/19	1080	980	5	-50	-50	209010	146790	9	0.25	3
04/11/19	05/10/19	05/13/19	05/17/19	-1220	-1320	5	-820	-1220	207790	145470	9	0.25	3
04/18/19	05/17/19	05/20/19	05/24/19	10	-10	1	0	0	207800	145460	9	1.25	3.5
04/25/19	05/24/19	05/27/19	05/31/19	1370	1350	1	0	0	209170	146810	9	1.25	3.5
05/02/19	05/31/19	06/03/19	06/07/19	1080	940	7	-970	-970	210250	147750	13	0.75	1.75

Appendix: The Normalization Multiplier

Repeated Median Velocity Normalization Multiplier

One of the inputs to the calculation of RMedV is N , the number of lookback bars. When we plot the RMedV we notice that the amplitude, and the maximum and minimum values of the RMedV vary quite significantly with different N inputs.

Below is a table, generated by the #iRMedVtMULTSTD indicator of the standard deviation(SD) of the 108333 calculated RMedV values for different N . We used 5 min bars of the CL from 3/8/2014 to 2/12/2016 to generate this table.

@CL 5 min bars Date Range 1140803 to 1160212
Total Number of Bars=108333 Sqrt(n) Norm=0
Trading Times Constraint Start Time=800 EndTime=1430
RMedVx Multiplier to Scale RMedVx N Range to One Std

4 Std=0.0734077 1/std=13.6226
6 Std=0.056242 1/std=17.7803
8 Std=0.0470003 1/std=21.2765
10 Std=0.0414414 1/std=24.1304
12 Std=0.0375377 1/std=26.6399
14 Std=0.0346289 1/std=28.8776
16 Std=0.0322738 1/std=30.9849
18 Std=0.0302399 1/std=33.0689
20 Std=0.0285976 1/std=34.968
22 Std=0.0272164 1/std=36.7426
24 Std=0.0259991 1/std=38.4629
26 Std=0.0249334 1/std=40.1069
28 Std=0.0239323 1/std=41.7845
30 Std=0.0230171 1/std=43.446
1/Std Mult Average=30.8494

As one can see the RMedV Standard Deviation for $N=4$ is over 3 times the SD for $N=30$. This makes it difficult to find a range for v_{up} and v_{dn} that satisfy all N . We would like to find a multiplier of the RMedV that normalizes all the RMedV standard deviations for any given N to the same SDs.

Fortunately, the SDs for the different N s for The RMedV are proportional to \sqrt{N} . So, if we multiply the RMedV by the \sqrt{N} , the RMedV for different N should have the same SDs and ranges. Below are the results for multiplying the RMedV by \sqrt{N} and computing it's standard deviation.

@CL 5 min bars Date Range 1140803 to 1160212
Total Number of Bars=108333 Sqrt(n) Norm=1
Trading Times Constraint Start Time=800 EndTime=1430
RMedVx Multiplier to Scale RMedVx N Range to One Std

4 Std=0.146815 1/std=6.81128
6 Std=0.137764 1/std=7.25878
8 Std=0.132937 1/std=7.52237
10 Std=0.131049 1/std=7.63072
12 Std=0.130034 1/std=7.69028
14 Std=0.12957 1/std=7.71786
16 Std=0.129095 1/std=7.74622
18 Std=0.128297 1/std=7.79441
20 Std=0.127892 1/std=7.81907
22 Std=0.127656 1/std=7.83354
24 Std=0.127369 1/std=7.8512
26 Std=0.127136 1/std=7.86561
28 Std=0.126638 1/std=7.89652
30 Std=0.12607 1/std=7.93212
1/Std Mult Average=7.66928

As we can see the SDs are now very close. If we multiply all RMedVs by $7.669 \cdot \sqrt{N}$ then the SDs of the velocities for all will be normalized to 1. For this case 7.669 would be the multiplier *xmult*, in the strategy and indicator. This allows us to do an optimization search for ranges of vup and vdn from 0.2 to 3.4 standard deviations for all N.

Please note that different futures and different time bars give different multipliers.