

Using The Repeated Median Velocity Strategy To Trade Crude Light CL 5min Bars III

3/14/2014 to 8/09/2024

Working Paper August 2024
Copyright © 2024 Dennis Meyers

Disclaimer

The strategies, methods and indicators presented here are given for educational purposes only and should not be construed as investment advice. Be aware that the profitable performance presented here is based upon hypothetical trading with the benefit of hindsight and can in no way be assumed nor can it be claimed that the strategy and methods presented here will be profitable in the future or that they will not result in losses.

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 determined 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:

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

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

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 $y = a + bx$.

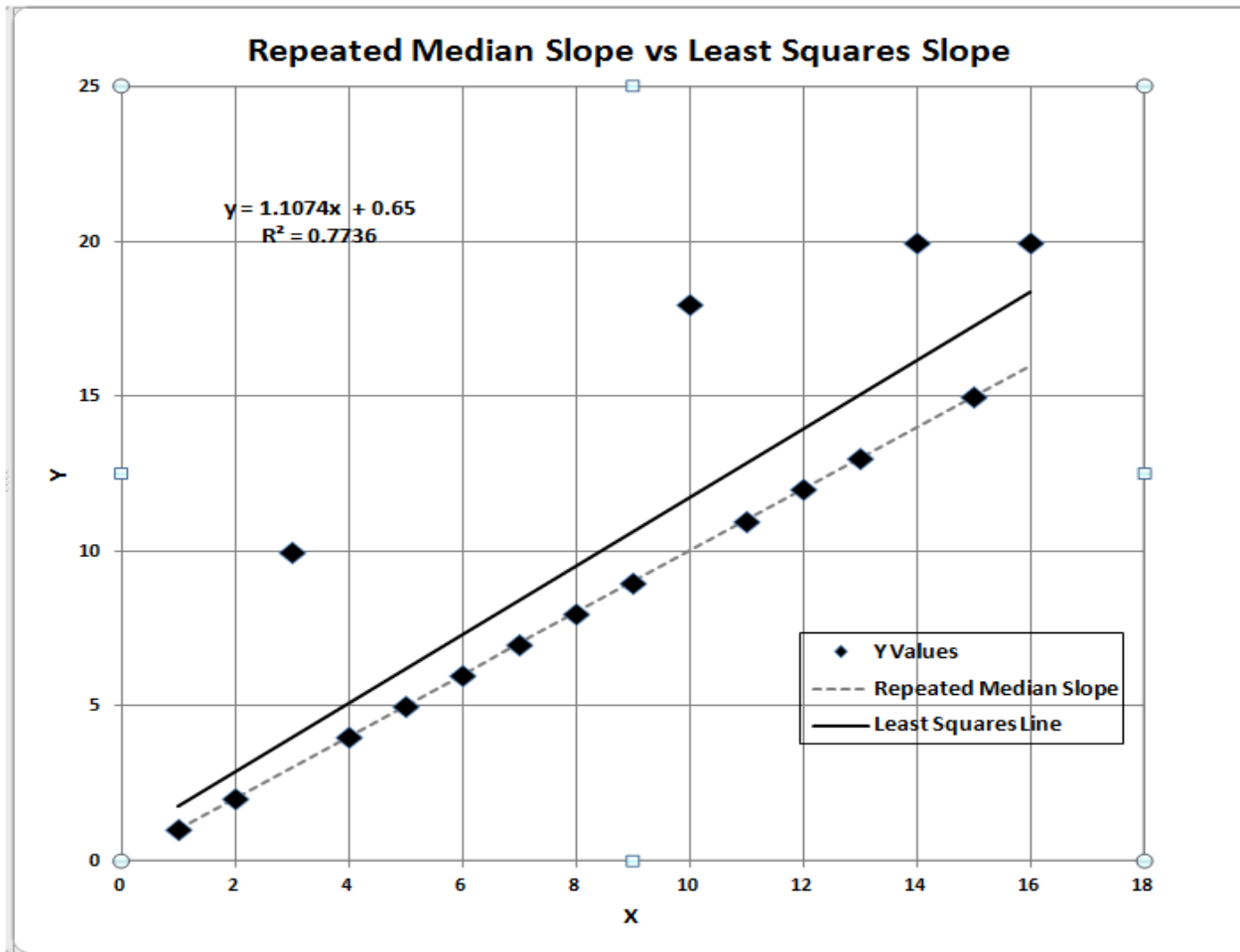


Figure 1 Repeated Median Slope vs Least Squares Slope.

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 or equal to the threshold amount *vup* and $RMedV[1] < vup$ then buy at the market.

Sell Rule:

IF RMedV is less or equal to the threshold amount *-vdn* and $RMedV[1] > -vdn$ then sell at the market.

Intraday Bars Exit Rule:

Close the position at 1430 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 544 weeks from March 14, 2014, to August 9, 2024.

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 March 14, 2014, to August 9, 2024. We will breakup and create 30-day calendar *in-sample* sections along with their corresponding one calendar week *out-of-sample* sections from the 544 weeks of CL (see Walk forward Testing below) creating 544 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 3/14/2014 to 8/9/2024. 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 544 weeks of CL (see Walk Forward Testing below) creating 544 out-of-sample weeks. Note the first in-sample week will be from 2/6/2014 to 3/7/2014 and the first out-of-sample week will be from 03/10/14 to 03/14/14.

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’re 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 2/6/2014 to 8/9/2024 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 544 in-sample 30-day periods followed by 544 out-of-sample 7-day periods from 2/26/2014 to 8/9/2024.

We will use the following strategy input optimization ranges.

N from 3 to 24 in steps of 1
vup from 0.25 to 3.5 steps of 0.25
vdown from 0.25 to 3.5 in steps of 0.25

Intraday Bars Exit Rule:

Close the position at 1430 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= $6.7 \cdot \sqrt{N}$. 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 vdown that worked for all N ranges. See *Appendix 1* for a detailed explanation.

This will produce 4508 different input combinations or cases of the strategy input parameters. for each of the 544 in-sample/out-of-sample files for the approximately 10+ years of 5 min bar CL prices from 2/26/2014 to 8/9/2024.

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 WFME64v8xb. 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 v8xb 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 518 in-sample and out-of-sample sections From 3/14/14 to 2/9/24. We will leave the 26 sections, 6 months of CL data from 2/16/24 to 8/9/2024 out of the WFME64 calculations so that we can see how the metric filters found by the WFME64 performed on these 26 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**>5 . We also wish to limit the number losing trades in a row (**lr**) in the *IS* period to 3 or less (**lr**≤3). In addition, we want the R2 equity trend line correction to be <50, **r2**<50. Using the **pf-lr-r2** 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 **mLb**. This metric, **mLb**, is the **Median of the Number of Bars in Losing Trades**. Each losing trade takes a certain number of time bars. If we order the number of bars each losing trade takes, then the median of all the losing trade bars is a robust statistic. We take the median of the losing trades bars to minimize the effect of large and small losing trade bars that may be outliers that distort this statistic. . Let us choose the **10** rows in the in-sample section that contain the **minimum mLb** values from the rows that are left from the **pf-lr-r2** screen. In other words, we sort **mLb** from low to high, eliminate the rows that have **lr**>3, **pf**>4 , **r2**>80 and then choose the 10 rows of whatever is left. This filter will now leave 10 cases or rows in the in-sample section that satisfy the above filter conditions. We call this filter **b10mLb** |**p**≤4|**r**≤3|**r2**≤50 where **b10mLb** means the bottom or minimum **10 mLb** rows left *after* the **pf-lr-r2** in-sample row elimination. Suppose for this filter, within the 10 in-sample rows that are left, we want the row that has the smallest value of the metric called **mLTr**. **mLTr** -**Median of The Losing Trades**. This is the median of the losing trade losses. We take the median of the losing trades to minimize the effect of large losing trades that may be outliers that are not repeatable. We abbreviate this final filter as **b10mLb** |**p**≤4|**r**≤3|**r2**≤50-**mLTr**. 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 **b10mLb** |**p**≤4|**r**≤3|**r2**≤50-**mLTr** filter is then applied to each of the 518 in-sample sections which give 518 sets of strategy inputs that are used to produce the corresponding 518 out-of-sample performance results. The average out-of-sample performance is calculated from these 518 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 518 out-of-sample files of **71.9** with a bootstrap standard deviation of **\$66.3**. (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/518) and the average net weekly for the filter from **Figure 2, Row 3** would be the **filter toNP/ (# of OOS)** periods traded or **189840/465=408.26**. The probability of obtaining our filters average weekly net profit of **408.26** is **1.96x10⁻⁷** which is **5.07** 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 **\$408.26** is **[1-(1- 1.08x10⁻⁷)²¹⁶²²⁵ ≈ 216225 x 1.08x10⁻⁷= 0.023** where **216225** 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 any random filter would beat our results or that our filter's result of \$189840 was due to pure chance.

Results

Figure 1 presents a graph of the equity curve generated by using the WFME64 filter on the 518 weeks ending 3/14/14 – 2/9/24 and the equity curve on the 26 weeks following until 8/9/24 (note the starting date 2/6/2014 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 2/16/24 to 8/9/24. This is what would have happened if you used the strategy inputs found by the filter **b10mLb |p≤5lr≤3r2≤50** 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 used and 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 8/1/24 to 8/9/24 with the RMedV Indicator or those dates.

Table 1 below presents a table of the 518 plus the 26 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 **b50mLb |p≤4lr≤3r2≤80** filter described above.

Discussion of Strategy Performance of the WFME64 run.

In **Figure 2, Row 3** is the filter chosen, **b50mLb |p≤4lr≤3r2≤80**. This Metric Filter produced \$189840 net profits after costs in 518 weeks and \$1802 net profits after costs in the withheld 26 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 49 weeks for this filter. This means that 49 weeks, almost a year from 10/14/16 to 9/29/17, was the longest time that the equity for this strategy failed to make a new equity high in the 518 out-of-sample weeks. Note that this was at the beginning of the price data and the drawdown was (\$5630). For this strategy, the **%P** (% of weekly oos periods that are positive) was **57%**, and the **%Wtr** (The % of all oos trades that are positive) was **46%**. This low **%Wtr** was made up for by **oW/oL** (average oos winning trades/average oos losing trades) equal to 1.55.

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 and trading conditions in the in-sample sample. In addition, notice how often **N** changes from 3 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 **b10mLb |p≤5lr≤3r2≤50 filter** on the 518 weeks of out-of-sample data. Notice how the equity curve follows the 2nd order polynomial trend line with an R² of 0.90. This R² dropped to 0.85 for the net equity curve.

Using this filter, the strategy generated a profit of \$191,642 net equity after commissions and slippage of \$13/trade trading one CL contract for the total 544 weeks. For slippage I used \$10 roundtrip and for commissions round trip, I used \$3. From **Table 1**, the largest losing week was -\$6640 on the week ending 3/25/2022. The largest drawdown was -\$11540 from the week ending on 6/25/21 to 10/29/21. This drawdown lasted 18 weeks and took 5 weeks to make a new high in equity. The start was disappointing. The *future* period that was not included in the WFME64 run from 2/6/24 to 8/9/24 was a volatile down market yet the RMedV strategy/WFME filter did only marginally making a net profit of \$1802 during that half-year time frame.

Lastly, as can be seen in **Figure 2**, that most of top 13 filters didn't do very well in the 52 *future* weeks from 2/16/24 to 8/9/24 where only 7 of 13 showed profits following the original analysis from 3/14/14-2/9/24.

In observing Table 1 we can see that this strategy and filter made trades from a low of no trades per week in 53 of the 518 weeks to a high of 38 trades/week with an average of 7.9 trades/week in the weeks it did trade.

This is the 3rd paper where we used the RMedV strategy to trade CL 5min bars.

The 2nd paper,

Using The Repeated Median Velocity Strategy To Trade Crude Light CL 5min Bars II
1/2/2013 to 5/26/2023 Working Paper June 2023

<https://meyersanalytics.com/publications2/CL5RMedV-2.pdf>

In this paper the filter was **b50mlb|p<4|lr<3|r2<80-mLTr**.

The 1st paper,

Trading the Crude Light CL 5min Bars With The Repeated Median Velocity Strategy
1/2/2008 to 6/10/2019, Working Paper June 2019,

<https://meyersanalytics.com/publications2/CL5RMedV.pdf>

In this paper the filter was $t_{20} | p \leq 4 | r \leq 3 - mDev$ which is quite different than the filter found in the previous 2 papers.

This means that due to changing macro conditions over time and due to different traders in the OIL space, let alone advances in computers and trading methodology that the metric filter is going to change over time. Thus, the current paper's methodology should be run every 6+ months to engage in CL trading changes.

In addition, without proof, I eliminated overnight trading from 1430 to 900. This should be investigated, mainly because a number of big moves in CL occurred outside this time range as can be seen in the chart on page16.

Lastly why 10years of 5min data? Why not 5 years or 3 years? This is just a bias from the author. Maybe shorter time periods in years may produce better out-of-sample results.

For all you who have read this paper and put up with the complex math wishing you good luck in your trading.

References

1. Rousseau, P.J., Leroy, A.M., (1987) “Robust Regression and Outlier Detection”, New York, John Wiley & Sons.
2. Siegel, A.F. (1982), “Robust Regression using Repeated Medians.” *Biometrika*. 69, pp242-244.
3. Efron, B., Tibshirani, R.J., (1993), “An Introduction to the Bootstrap”, New York, Chapman & Hall/CRC.
4. Trading the Crude Light CL 5min Bars With The Repeated Median Velocity Strategy 1/2/2008 to 6/10/2019, Working Paper June 2019,
<https://meyersanalytics.com/publications2/CL5RMedV.pdf>
5. Using The Repeated Median Velocity Strategy To Trade Crude Light CL 5min Bars II 1/2/2013 to 5/26/2023 Working Paper June 2023
<https://meyersanalytics.com/publications2/CL5RMedV-2.pdf>

Figure 1 Graph of RMedV Strategy OOS Net Equity Applying the WFME64 Filter Each Week to In-Sample RMedV CL5min Bar Prices 1/2/2013 to 8/9/24.

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 \$13/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 2/16/24 to 8/9/24. This is what would have happened if you used b10mLb |p≤5|l<3r2<50-mLTr on the 3 months following the 3/14/14-2/9/24 analysis period on future CL prices which was not included in the WFME filter run.

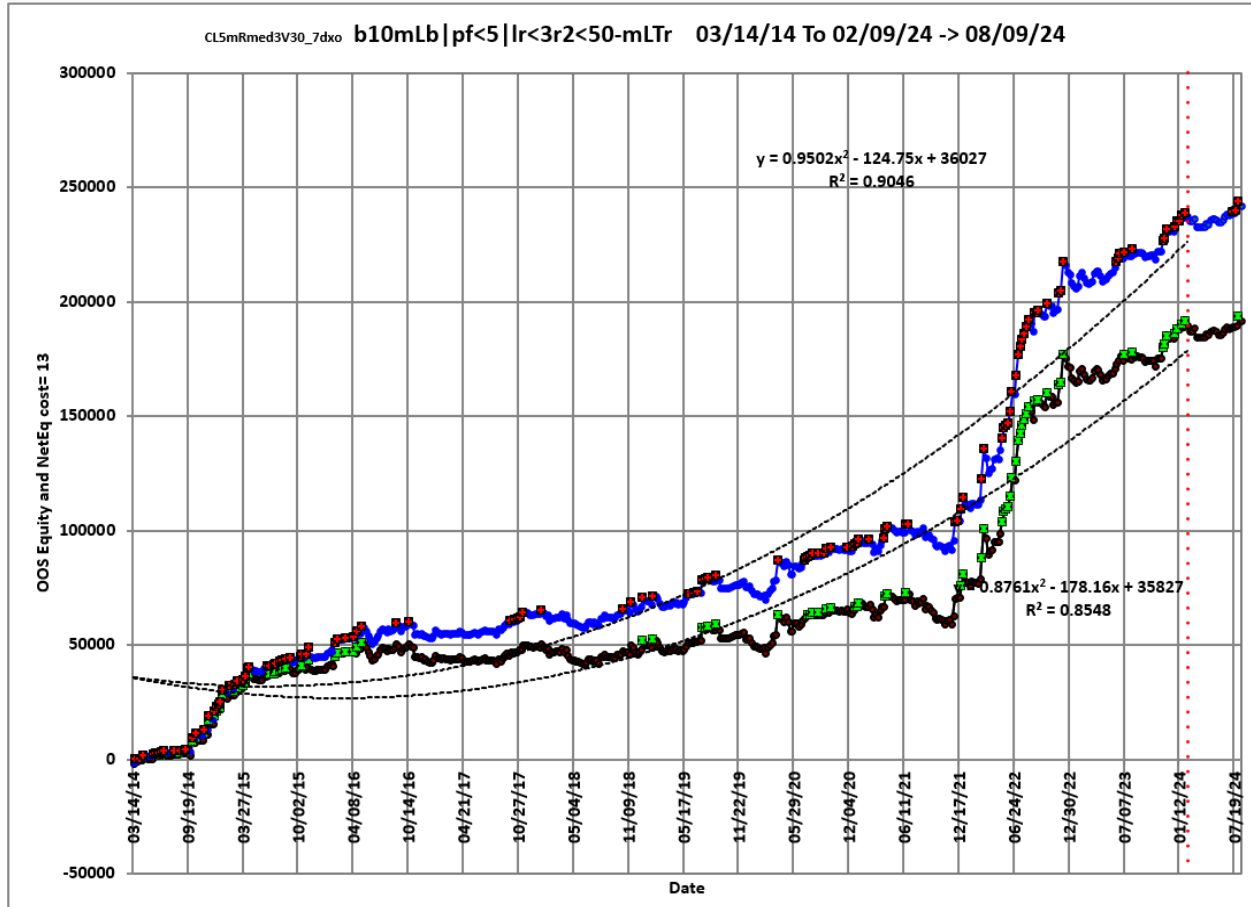


Figure 2 Partial output of the Walk Forward Metric Explorer (WFME64 v8X)
CL 5 min bars RMedV Velocity Strategy

	A	B	C	D	E	F	G	H	I	J	K	L	M								
1	CL5mRmed3V30-7dxo	s03/14/14	e02/09/24	#518	AnyTnp	#26					ISnt2										
2	Filter-Metric	toGP	toNP	aoGP	aoTr	ao#T	#	std	skew	kur	t	oW oL	%Wtr								
3	b10mLb pf<5 lr<3r2<50-mLTr	237550	189840	511	64.7	7.9	465	2094	1.752	10.2	5.26	1.55	46								
4	b10mLb lr<3r2<50-mLTr	231940	186531	520	66.4	7.8	446	2120	1.769	10.06	5.18	1.56	45								
5	b10mLb pf<4 lr<3r2<50-mLTr	233740	185419	504	62.9	8	464	2112	1.725	9.94	5.14	1.54	45								
6	b20mLb pf<4 lr<3r2<60-mLTr	227990	181619	488	63.9	7.6	467	2193	1.257	9.35	4.81	1.49	46								
7	t20mWb mLb pf<5 lr<3r2<80-PF	211250	180440	467	89.1	5.2	452	1981	2.502	16.6	5.02	1.47	48								
8	b10mLb pf<3 lr<3r2<50-mLTr	225730	176239	479	59.3	8.1	471	2102	1.724	10.03	4.95	1.53	45								
9	b20mLb pf<5 lr<3r2<60-mLTr	222160	175880	476	62.4	7.6	467	2191	1.276	9.42	4.69	1.5	46								
10	t20mWb mLb pf<4 lr<3r2<80-PF	207400	175745	459	85.2	5.4	452	1991	2.47	16.3	4.9	1.47	48								
11	t50tWb pf<2 lr<3r2<80-ktau	229500	174562	443	54.3	8.2	518	2147	1.281	8.96	4.7	1.34	48								
12	b10mLb pf<2 lr<3r2<50-mLTr	226330	173771	473	56	8.5	478	2173	1.723	9.69	4.76	1.54	45								
13	t50eqR2 pf<2 lr<5r2<60-t	241020	173433	466	46.4	10.1	517	2193	1.714	11.16	4.83	1.56	44								
14	t10mWb mLb pf<5 lr<3r2<80-llt	204750	171028	457	78.9	5.8	448	1885	1.904	13.35	5.13	1.51	47								
15	b20mLb pf<5 lr<3r2<80-PF	204620	170820	447	78.7	5.7	458	1966	1.426	11.24	4.86	1.48	47								
1	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1	a71.9	s66.3													s02/16/24	e08/09/24	#26			t544	f202500
2	%P	LLtr	LLp	eqDD	wpr	lpr	v20	acc	KTau	eqR2	Blw	BE	tkr bl	toGPx	toNPx	aoTRx	aoNTx	#x	tOnpNet	Prob	
3	57	-3540	-6640	-11540	8	9	986	1.9	94	81	49	79	1035	4480	1802	22	10.3	20	191642	1.956e-7	
4	57	-3540	-6640	-10970	8	9	985	2.01	93	81	49	81	978	4750	2787	31	8.4	18	189318	8.774e-8	
5	56	-3540	-6640	-10970	8	9	998	1.82	93	80	55	82	840	4480	1802	22	10.3	20	187221	3.852e-7	
6	56	-3540	-9140	-12750	8	7	786	2.1	91	85	60	94	660	2970	318	15	9.7	21	181937	8.711e-7	
7	56	-2900	-4730	-9620	10	5	802	1.82	96	86	36	86	1337	(5530)	(6531)	(72)	3.7	21	173909	3.975e-7	
8	56	-3540	-6640	-14860	8	9	998	2.02	92	77	55	89	716	4840	1980	22	10.5	21	178219	2.568e-6	
9	55	-3540	-9140	-13330	8	7	773	2.11	91	85	60	99	612	2970	318	15	9.7	21	176198	2.155e-6	
10	55	-2820	-4730	-10270	10	7	832	1.65	95	87	36	91	1237	(4790)	(5791)	(62)	3.8	20	169954	8.769e-7	
11	57	-4590	-7600	-18960	10	7	1169	2.57	86	86	100	99	351	990	(2039)	4	9	26	172523	3.192e-5	
12	56	-3540	-6640	-14860	7	6	979	2.26	89	77	106	96	323	5730	2857	26	10.5	21	176628	5.448e-6	
13	56	-2670	-5640	-11520	11	6	1118	2.6	93	81	50	93	780	(1190)	(3894)	(6)	8	26	169539	3.518e-5	
14	56	-3010	-6510	-9800	11	6	749	1.6	94	86	63	83	799	(1890)	(3047)	(21)	4.2	21	167981	1.481e-6	
15	57	-3540	-8050	-13360	7	8	915	1.46	96	88	37	92	1203	(5420)	(6850)	(49)	5.5	20	163970	2.801e-6	

The WFME64 v8X AVE File Output Cols are defined as follows.

❖ **Row 1**

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, AG=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 AA: Future PWFO File Start Date

Row 1 Col AB: Future PWFO File End Date

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

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

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

Col A: **The Strategy Input/Filter Names** Example Row 3: **b10mLb|p<5lr<3r2<50:**

Col B: **toGP** - Total out-of-sample(oos) gross profit for these 518 oos periods (= weeks).

Col C: **toNP** - Total out-of-sample(oos) Net profit (toGP-Number of Trade Weeks*cost) for the 518 oos periods.

Col D: *aoGP* - Average oos gross profit for the 518 # oos periods
Col E: *#* - The number of oos periods this filter produced a 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 F: *aoTr* - Average oos profit per trade
Col G: *ao#T* - Average number of oos trades per week
Col H: *std* - he standard deviation of the 518 oos period profits and losses
Col I: *skew* - The Skew statistic of the 518 oos period profits and losses
Col J: *kur* - he kurtosis statistic of the 518 oos period profits and losses
Col K: *t* - The student t statistic for the 518 oos periods. The higher the t statistic the higher the probability that this result was not due to pure chance.
Col L: *oW/oL* - Ratio of average oos winning trades divided by average oos losing trades.
Col M: *%Wtr* - he percentage if oos winning trades.
Col N: *%P* - percent of all oos periods that were profitable.
Col O: *LLTr* Largest Losing Trade.
Col P: *LLp* - The largest losing oos period
Col Q: *eqDD* - The oos equity drawdown
Col R: *wpr* - The largest number of winning oos periods (weeks) in a row.
Col S: *lpr* - the largest number of losing oos periods in a row.
COLT: *v20* - the equity velocity for the latest 20 periods
Col U: *acc* - The acceleration of a 2nd order polynomial fit to the oos equity curve.
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(R²) 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 26 future excluded periods (for this run periods = weeks).
Col AC: *toNPx* Total Net profit {toGP-Number of Trade Weeks(#)*cost} for the 26 future excluded periods.
Col AD: *aoTrx* Average profit per trade for the 26 future excluded periods
Col AE: *aoNTx* Average number of trades per week for the 26 future excluded periods
Col AF: *#x* the number of the 26 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.
7/30/24 to 8/2/24



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

CL 5 min bars 3/2/2014 - 8/9/24 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: `b10mlb|pf<5|lr<3|r2<50-mLTr`

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*13**

NetEq = running sum of the weekly out-of-sample net profits (NOnp\$13)

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	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
02/12/14	03/14/14	03/17/14	03/21/14	1720	1577	11	-390	-440	180	(67)	4	0.5	1.75
02/19/14	03/21/14	03/24/14	03/28/14	(750)	(763)	1	-750	-750	(570)	(830)	23	1.5	2
02/26/14	03/28/14	03/31/14	04/04/14	800	722	6	-380	-380	230	(108)	9	0.25	1.5
03/05/14	04/04/14	04/07/14	04/11/14	0	0	0	0	0	230	(108)	6	2.5	3
03/12/14	04/11/14	04/14/14	04/18/14	1370	1266	8	-1100	-1100	1600	1158	7	0.25	1.25
03/19/14	04/18/14	04/21/14	04/25/14	0	0	0	0	0	1600	1158	7	2.25	2.5
03/26/14	04/25/14	04/28/14	05/02/14	(530)	(621)	7	-440	-580	1070	537	24	0.5	0.5
04/02/14	05/02/14	05/05/14	05/09/14	130	(52)	14	-420	-1130	1200	485	3	0.5	1.5
04/09/14	05/09/14	05/12/14	05/16/14	(20)	(85)	5	-440	-440	1180	400	4	0.25	1.5
04/16/14	05/16/14	05/19/14	05/23/14	970	905	5	-260	-260	2150	1305	5	0.5	1.25
04/23/14	05/23/14	05/26/14	05/30/14	440	375	5	-570	-570	2590	1680	4	1.75	0.5
04/30/14	05/30/14	06/02/14	06/06/14	10	(3)	1	0	0	2600	1677	11	1.75	1.75
05/07/14	06/06/14	06/09/14	06/13/14	130	117	1	0	0	2730	1794	9	1.25	2.25
05/14/14	06/13/14	06/16/14	06/20/14	350	337	1	0	0	3080	2131	10	1.25	2
05/21/14	06/20/14	06/23/14	06/27/14	550	511	3	0	0	3630	2642	18	1	1.25
05/28/14	06/27/14	06/30/14	07/04/14	(820)	(872)	4	-740	-910	2810	1770	14	1.5	1.5
06/04/14	07/04/14	07/07/14	07/11/14	0	0	0	0	0	2810	1770	15	1.5	1.75
06/11/14	07/11/14	07/14/14	07/18/14	270	257	1	0	0	3080	2027	17	1.5	1.5
06/18/14	07/18/14	07/21/14	07/25/14	290	264	2	0	0	3370	2291	3	2.25	3
06/25/14	07/25/14	07/28/14	08/01/14	270	257	1	0	0	3640	2548	24	1.5	1.5
07/02/14	08/01/14	08/04/14	08/08/14	0	0	0	0	0	3640	2548	14	2.25	1.5
07/09/14	08/08/14	08/11/14	08/15/14	0	0	0	0	0	3640	2548	13	2.25	1.5
07/16/14	08/15/14	08/18/14	08/22/14	110	97	1	0	0	3750	2645	14	2.25	1.5
07/23/14	08/22/14	08/25/14	08/29/14	0	0	0	0	0	3750	2645	5	2.75	2.5
07/30/14	08/29/14	09/01/14	09/05/14	60	34	2	-270	-270	3810	2679	7	1.75	2
08/06/14	09/05/14	09/08/14	09/12/14	310	284	2	-930	-930	4120	2963	7	1.75	2
08/13/14	09/12/14	09/15/14	09/19/14	(90)	(142)	4	-410	-510	4030	2821	7	1.75	2
08/20/14	09/19/14	09/22/14	09/26/14	(760)	(994)	18	-640	-2020	3270	1827	6	1.25	0.5
08/27/14	09/26/14	09/29/14	10/03/14	5840	5658	14	-520	-720	9110	7485	4	1.5	1.25
09/03/14	10/03/14	10/06/14	10/10/14	(10)	(23)	1	-10	-10	9100	7462	4	3	3.25
09/10/14	10/10/14	10/13/14	10/17/14	1880	1841	3	0	0	10980	9303	4	3	3.25
09/17/14	10/17/14	10/20/14	10/24/14	(650)	(676)	2	-540	-650	10330	8627	4	2.5	3.25
09/24/14	10/24/14	10/27/14	10/31/14	(20)	(46)	2	-210	-210	10310	8581	4	3	3
10/01/14	10/31/14	11/03/14	11/07/14	(20)	(46)	2	-210	-210	10290	8535	4	3	3.5
10/08/14	11/07/14	11/10/14	11/14/14	2510	2458	4	-300	-300	12800	10993	15	0.5	1.75
10/15/14	11/14/14	11/17/14	11/21/14	0	0	0	0	0	12800	10993	8	3	2.25
10/22/14	11/21/14	11/24/14	11/28/14	6030	5991	3	0	0	18830	16984	8	2.75	2.25

In-Sample Dates	Out-Of-Sample Dates	ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn		
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
10/29/14	11/28/14	12/01/14	12/05/14	(1340)	(1470)	10	-510	-1430	17490	15514	20	0.5	1
11/05/14	12/05/14	12/08/14	12/12/14	110	97	1	0	0	17600	15611	10	2	3.25
11/12/14	12/12/14	12/15/14	12/19/14	3460	3408	4	0	0	21060	19019	9	2	3.5
11/19/14	12/19/14	12/22/14	12/26/14	1990	1938	4	-880	-880	23050	20957	7	0.5	1.75
11/26/14	12/26/14	12/29/14	01/02/15	960	804	12	-480	-950	24010	21761	7	0.5	1.75
12/03/14	01/02/15	01/05/15	01/09/15	870	779	7	-520	-850	24880	22540	3	2.75	0.25
12/10/14	01/09/15	01/12/15	01/16/15	5200	5161	3	0	0	30080	27701	16	1.75	2.75
12/17/14	01/16/15	01/19/15	01/23/15	0	0	0	0	0	30080	27701	15	2	2.75
12/24/14	01/23/15	01/26/15	01/30/15	(820)	(924)	8	-1960	-2900	29260	26777	4	2.25	1.25
12/31/14	01/30/15	02/02/15	02/06/15	2810	2576	18	-1130	-1730	32070	29353	7	1.75	0.25
01/07/15	02/06/15	02/09/15	02/13/15	(890)	(903)	1	-890	-890	31180	28450	3	3.5	3.5
01/14/15	02/13/15	02/16/15	02/20/15	(430)	(456)	2	-390	-430	30750	27994	3	3.5	3.5
01/21/15	02/20/15	02/23/15	02/27/15	1800	1709	7	-1100	-1350	32550	29703	5	2.25	1.75
01/28/15	02/27/15	03/02/15	03/06/15	1550	1472	6	-450	-710	34100	31175	5	1	3
02/04/15	03/06/15	03/09/15	03/13/15	0	0	0	0	0	34100	31175	11	2.5	3.25
02/11/15	03/13/15	03/16/15	03/20/15	(70)	(83)	1	-70	-70	34030	31092	11	2.5	3.25
02/18/15	03/20/15	03/23/15	03/27/15	770	757	1	0	0	34800	31849	10	2.5	2.25
02/25/15	03/27/15	03/30/15	04/03/15	1040	1027	1	0	0	35840	32876	10	2.5	2.25
03/04/15	04/03/15	04/06/15	04/10/15	3870	3831	3	0	0	39710	36707	3	3.5	2.75
03/11/15	04/10/15	04/13/15	04/17/15	220	181	3	-1430	-1430	39930	36888	3	3.5	2.5
03/18/15	04/17/15	04/20/15	04/24/15	(360)	(425)	5	-410	-500	39570	36463	12	2	1
03/25/15	04/24/15	04/27/15	05/01/15	(1040)	(1092)	4	-820	-1040	38530	35371	5	3.25	1.75
04/01/15	05/01/15	05/04/15	05/08/15	130	78	4	-940	-940	38660	35449	17	3	1.5
04/08/15	05/08/15	05/11/15	05/15/15	(370)	(435)	5	-990	-990	38290	35014	3	3	1.25
04/15/15	05/15/15	05/18/15	05/22/15	10	(68)	6	-800	-1260	38300	34946	10	1.5	0.25
04/22/15	05/22/15	05/25/15	05/29/15	(160)	(199)	3	-520	-520	38140	34747	11	2.5	0.75
04/29/15	05/29/15	06/01/15	06/05/15	1610	1441	13	-550	-950	39750	36188	10	0.5	1
05/06/15	06/05/15	06/08/15	06/12/15	180	102	6	-150	-300	39930	36290	18	1	0.25
05/13/15	06/12/15	06/15/15	06/19/15	600	561	3	-70	-100	40530	36851	4	2.25	1.75
05/20/15	06/19/15	06/22/15	06/26/15	340	314	2	0	0	40870	37165	8	1.75	3.25
05/27/15	06/26/15	06/29/15	07/03/15	0	0	0	0	0	40870	37165	10	2	2.5
06/03/15	07/03/15	07/06/15	07/10/15	130	26	8	-790	-880	41000	37191	9	1.25	2
06/10/15	07/10/15	07/13/15	07/17/15	850	837	1	0	0	41850	38028	3	2.75	2.5
06/17/15	07/17/15	07/20/15	07/24/15	0	0	0	0	0	41850	38028	3	2.75	2.5
06/24/15	07/24/15	07/27/15	07/31/15	940	797	11	-730	-730	42790	38825	6	1.25	0.75
07/01/15	07/31/15	08/03/15	08/07/15	430	300	10	-320	-730	43220	39125	16	0.5	0.5
07/08/15	08/07/15	08/10/15	08/14/15	(220)	(285)	5	-360	-500	43000	38840	6	1.75	1.25
07/15/15	08/14/15	08/17/15	08/21/15	850	824	2	0	0	43850	39664	16	1.5	1
07/22/15	08/21/15	08/24/15	08/28/15	(270)	(530)	20	-960	-1240	43580	39134	6	1.5	0.25
07/29/15	08/28/15	08/31/15	09/04/15	610	428	14	-1600	-2470	44190	39562	3	3	2.75
08/05/15	09/04/15	09/07/15	09/11/15	(1810)	(1836)	2	-1510	-1810	42380	37726	6	3	2.5
08/12/15	09/11/15	09/14/15	09/18/15	290	277	1	0	0	42670	38003	6	2.75	3.25
08/19/15	09/18/15	09/21/15	09/25/15	1200	1187	1	0	0	43870	39190	6	3	3.25
08/26/15	09/25/15	09/28/15	10/02/15	270	218	4	-1210	-1210	44140	39408	4	3.25	2
09/02/15	10/02/15	10/05/15	10/09/15	550	511	3	-380	-380	44690	39919	4	2.75	2.75
09/09/15	10/09/15	10/12/15	10/16/15	940	758	14	-660	-1630	45630	40677	19	0.25	0.25
09/16/15	10/16/15	10/19/15	10/23/15	(1080)	(1158)	6	-460	-1190	44550	39519	7	0.25	1.75
09/23/15	10/23/15	10/26/15	10/30/15	1220	1090	10	-360	-1040	45770	40609	19	0.25	0.5
09/30/15	10/30/15	11/02/15	11/06/15	2750	2633	9	-100	-100	48520	43242	20	0.25	0.75
10/07/15	11/06/15	11/09/15	11/13/15	(3530)	(3712)	14	-850	-3530	44990	39530	18	0.25	0.75
10/14/15	11/13/15	11/16/15	11/20/15	(390)	(416)	2	-660	-660	44600	39114	21	1.75	2.25
10/21/15	11/20/15	11/23/15	11/27/15	0	0	0	0	0	44600	39114	6	3.25	2.25
10/28/15	11/27/15	11/30/15	12/04/15	190	86	8	-1020	-1570	44790	39200	5	2	0.25
11/04/15	12/04/15	12/07/15	12/11/15	10	(16)	2	-950	-950	44800	39184	6	2.75	2
11/11/15	12/11/15	12/14/15	12/18/15	230	217	1	0	0	45030	39401	15	2	1.5
11/18/15	12/18/15	12/21/15	12/25/15	0	0	0	0	0	45030	39401	15	2	1.5
11/25/15	12/25/15	12/28/15	01/01/16	(70)	(83)	1	-70	-70	44960	39318	3	2.5	1.75
12/02/15	01/01/16	01/04/16	01/08/16	1510	1458	4	-400	-400	46470	40776	5	2.5	1.5
12/09/15	01/08/16	01/11/16	01/15/16	540	488	4	-230	-370	47010	41264	5	2.5	2
12/16/15	01/15/16	01/18/16	01/22/16	1000	883	9	-510	-960	48010	42147	12	0.5	1

In-Sample Dates	Out-Of-Sample Dates	ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn		
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
12/23/15	01/22/16	01/25/16	01/29/16	(1170)	(1248)	6	-1190	-1690	46840	40899	21	1.5	0.75
12/30/15	01/29/16	02/01/16	02/05/16	3710	3632	6	-500	-500	50550	44531	4	3	1.5
01/06/16	02/05/16	02/08/16	02/12/16	1930	1852	6	-470	-470	52480	46383	4	3	1.5
01/13/16	02/12/16	02/15/16	02/19/16	0	0	0	0	0	52480	46383	22	2.75	2
01/20/16	02/19/16	02/22/16	02/26/16	(70)	(83)	1	-70	-70	52410	46300	22	2.75	2
01/27/16	02/26/16	02/29/16	03/04/16	0	0	0	0	0	52410	46300	24	3	2.25
02/03/16	03/04/16	03/07/16	03/11/16	550	537	1	0	0	52960	46837	24	3	1.75
02/10/16	03/11/16	03/14/16	03/18/16	0	0	0	0	0	52960	46837	24	2	2.5
02/17/16	03/18/16	03/21/16	03/25/16	0	0	0	0	0	52960	46837	24	2	2.5
02/24/16	03/25/16	03/28/16	04/01/16	0	0	0	0	0	52960	46837	23	2	2
03/02/16	04/01/16	04/04/16	04/08/16	280	111	13	-1040	-1610	53240	46948	3	0.25	1.5
03/09/16	04/08/16	04/11/16	04/15/16	(230)	(347)	9	-480	-980	53010	46601	5	1.5	0.5
03/16/16	04/15/16	04/18/16	04/22/16	2670	2397	21	-350	-1760	55680	48998	3	0.5	1.5
03/23/16	04/22/16	04/25/16	04/29/16	(650)	(728)	6	-760	-1840	55030	48270	6	1.5	0.25
03/30/16	04/29/16	05/02/16	05/06/16	2700	2596	8	-950	-1150	57730	50866	3	2	1
04/06/16	05/06/16	05/09/16	05/13/16	(310)	(375)	5	-1350	-1350	57420	50491	8	2.5	1.25
04/13/16	05/13/16	05/16/16	05/20/16	(1370)	(1487)	9	-730	-1400	56050	49004	16	1	0.25
04/20/16	05/20/16	05/23/16	05/27/16	(1750)	(1854)	8	-550	-1870	54300	47150	11	0.75	1.25
04/27/16	05/27/16	05/30/16	06/03/16	(1720)	(1824)	8	-700	-1720	52580	45326	3	1.25	1.5
05/04/16	06/03/16	06/06/16	06/10/16	(1980)	(2123)	11	-880	-1980	50600	43203	6	0.5	0.75
05/11/16	06/10/16	06/13/16	06/17/16	760	526	18	-390	-820	51360	43729	9	0.25	0.5
05/18/16	06/17/16	06/20/16	06/24/16	1690	1586	8	-470	-470	53050	45315	8	0.25	1.25
05/25/16	06/24/16	06/27/16	07/01/16	880	750	10	-770	-1050	53930	46065	5	0.75	1.25
06/01/16	07/01/16	07/04/16	07/08/16	2000	1974	2	0	0	55930	48039	22	0.75	2
06/08/16	07/08/16	07/11/16	07/15/16	990	847	11	-420	-660	56920	48886	8	1	0.75
06/15/16	07/15/16	07/18/16	07/22/16	(440)	(531)	7	-490	-550	56480	48355	3	1	1.75
06/22/16	07/22/16	07/25/16	07/29/16	(880)	(1010)	10	-680	-980	55600	47345	3	1	1.25
06/29/16	07/29/16	08/01/16	08/05/16	1310	1232	6	-900	-900	56910	48577	3	1	2.25
07/06/16	08/05/16	08/08/16	08/12/16	(590)	(759)	13	-370	-1050	56320	47818	12	0.25	0.5
07/13/16	08/12/16	08/15/16	08/19/16	380	211	13	-540	-1010	56700	48029	11	0.25	0.75
07/20/16	08/19/16	08/22/16	08/26/16	840	749	7	-520	-520	57540	48778	9	0.25	1.75
07/27/16	08/26/16	08/29/16	09/02/16	1830	1752	6	-130	-130	59370	50530	4	1	1.25
08/03/16	09/02/16	09/05/16	09/09/16	(940)	(1057)	9	-1020	-1860	58430	49473	4	1	1.25
08/10/16	09/09/16	09/12/16	09/16/16	(2320)	(2502)	14	-1070	-3320	56110	46971	6	0.5	1
08/17/16	09/16/16	09/19/16	09/23/16	1800	1670	10	-360	-550	57910	48641	4	0.75	1.25
08/24/16	09/23/16	09/26/16	09/30/16	450	268	14	-520	-1980	58360	48909	4	1	1.25
08/31/16	09/30/16	10/03/16	10/07/16	430	378	4	-350	-350	58790	49287	6	1	1.25
09/07/16	10/07/16	10/10/16	10/14/16	1190	1060	10	-200	-240	59980	50347	6	1	0.5
09/14/16	10/14/16	10/17/16	10/21/16	(580)	(671)	7	-770	-920	59400	49676	3	1.75	0.5
09/21/16	10/21/16	10/24/16	10/28/16	(500)	(643)	11	-900	-1480	58900	49033	9	0.75	0.25
09/28/16	10/28/16	10/31/16	11/04/16	(4100)	(4295)	15	-1290	-4110	54800	44738	6	0.25	1.25
10/05/16	11/04/16	11/07/16	11/11/16	310	115	15	-300	-890	55110	44853	5	1	0.5
10/12/16	11/11/16	11/14/16	11/18/16	(330)	(421)	7	-1090	-1500	54780	44432	3	1	2
10/19/16	11/18/16	11/21/16	11/25/16	440	427	1	0	0	55220	44859	24	1.5	1.5
10/26/16	11/25/16	11/28/16	12/02/16	(1300)	(1326)	2	-1410	-1410	53920	43533	4	3	1.75
11/02/16	12/02/16	12/05/16	12/09/16	250	172	6	-500	-500	54170	43705	4	0.75	2
11/09/16	12/09/16	12/12/16	12/16/16	(830)	(934)	8	-1240	-2410	53340	42771	3	0.75	2
11/16/16	12/16/16	12/19/16	12/23/16	(30)	(121)	7	-990	-1480	53310	42650	3	0.25	2
11/23/16	12/23/16	12/26/16	12/30/16	(430)	(469)	3	-210	-430	52880	42181	9	1	0.5
11/30/16	12/30/16	01/02/17	01/06/17	1370	1344	2	-480	-480	54250	43525	17	1.75	1
12/07/16	01/06/17	01/09/17	01/13/17	2180	2102	6	-400	-400	56430	45627	5	1.25	0.75
12/14/16	01/13/17	01/16/17	01/20/17	(1070)	(1096)	2	-830	-1070	55360	44531	14	1.25	2
12/21/16	01/20/17	01/23/17	01/27/17	(80)	(119)	3	-170	-220	55280	44412	16	0.5	1.25
12/28/16	01/27/17	01/30/17	02/03/17	(660)	(725)	5	-750	-1020	54620	43687	3	2.5	1.25
01/04/17	02/03/17	02/06/17	02/10/17	650	572	6	-210	-510	55270	44259	3	1	1
01/11/17	02/10/17	02/13/17	02/17/17	(310)	(336)	2	-520	-520	54960	43923	21	1.75	0.75
01/18/17	02/17/17	02/20/17	02/24/17	(80)	(106)	2	-100	-100	54880	43817	18	2	0.75
01/25/17	02/24/17	02/27/17	03/03/17	(340)	(431)	7	-620	-650	54540	43386	6	1.25	0.25
02/01/17	03/03/17	03/06/17	03/10/17	430	404	2	-830	-830	54970	43790	7	1.5	1.75
02/08/17	03/10/17	03/13/17	03/17/17	(50)	(63)	1	-50	-50	54920	43727	5	1.75	2.5

In-Sample Dates	Out-Of-Sample Dates	ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn		
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
02/15/17	03/17/17	03/20/17	03/24/17	0	0	0	0	0	54920	43727	3	3	2.5
02/22/17	03/24/17	03/27/17	03/31/17	390	377	1	0	0	55310	44104	3	3	2.5
03/01/17	03/31/17	04/03/17	04/07/17	770	692	6	-330	-330	56080	44796	3	0.5	1.5
03/08/17	04/07/17	04/10/17	04/14/17	(500)	(565)	5	-470	-650	55580	44231	24	0.25	0.5
03/15/17	04/14/17	04/17/17	04/21/17	(950)	(1158)	16	-420	-1110	54630	43073	10	0.25	0.75
03/22/17	04/21/17	04/24/17	04/28/17	(280)	(293)	1	-280	-280	54350	42780	9	1.25	2.25
03/29/17	04/28/17	05/01/17	05/05/17	50	37	1	0	0	54400	42817	8	2.5	2
04/05/17	05/05/17	05/08/17	05/12/17	230	217	1	0	0	54630	43034	5	1.25	1.75
04/12/17	05/12/17	05/15/17	05/19/17	320	242	6	-320	-660	54950	43276	13	0.25	0.75
04/19/17	05/19/17	05/22/17	05/26/17	800	683	9	-390	-1070	55750	43959	9	0.25	1
04/26/17	05/26/17	05/29/17	06/02/17	(600)	(665)	5	-640	-850	55150	43294	16	0.5	1.5
05/03/17	06/02/17	06/05/17	06/09/17	(320)	(463)	11	-380	-1360	54830	42831	4	1	0.75
05/10/17	06/09/17	06/12/17	06/16/17	650	559	7	-720	-940	55480	43390	11	0.75	0.25
05/17/17	06/16/17	06/19/17	06/23/17	490	360	10	-390	-990	55970	43750	11	0.75	0.25
05/24/17	06/23/17	06/26/17	06/30/17	680	485	15	-200	-830	56650	44235	11	0.25	0.25
05/31/17	06/30/17	07/03/17	07/07/17	(620)	(932)	24	-530	-1430	56030	43303	10	0.25	0.25
06/07/17	07/07/17	07/10/17	07/14/17	0	0	0	0	0	56030	43303	24	1.5	1.5
06/14/17	07/14/17	07/17/17	07/21/17	0	0	0	0	0	56030	43303	21	1.5	1.75
06/21/17	07/21/17	07/24/17	07/28/17	0	0	0	0	0	56030	43303	24	1.5	1.5
06/28/17	07/28/17	07/31/17	08/04/17	(620)	(633)	1	-620	-620	55410	42670	24	1.25	1.5
07/05/17	08/04/17	08/07/17	08/11/17	(720)	(928)	16	-620	-1330	54690	41742	12	0.25	0.5
07/12/17	08/11/17	08/14/17	08/18/17	2230	2087	11	-440	-440	56920	43829	7	0.5	0.5
07/19/17	08/18/17	08/21/17	08/25/17	(510)	(692)	14	-400	-710	56410	43137	7	0.5	0.5
07/26/17	08/25/17	08/28/17	09/01/17	1430	1326	8	-500	-500	57840	44463	9	0.75	0.5
08/02/17	09/01/17	09/04/17	09/08/17	800	774	2	0	0	58640	45237	11	1.75	1.5
08/09/17	09/08/17	09/11/17	09/15/17	1110	1019	7	-320	-330	59750	46256	3	1	1
08/16/17	09/15/17	09/18/17	09/22/17	(560)	(651)	7	-780	-850	59190	45605	4	0.5	1.5
08/23/17	09/22/17	09/25/17	09/29/17	1350	1233	9	-700	-740	60540	46838	4	0.25	1.25
08/30/17	09/29/17	10/02/17	10/06/17	(190)	(242)	4	-580	-580	60350	46596	7	1	1.25
09/06/17	10/06/17	10/09/17	10/13/17	530	504	2	0	0	60880	47100	5	1.25	2.25
09/13/17	10/13/17	10/16/17	10/20/17	0	(26)	2	-230	-230	60880	47074	5	1.25	2.5
09/20/17	10/20/17	10/23/17	10/27/17	710	671	3	-330	-330	61590	47745	8	0.75	1.75
09/27/17	10/27/17	10/30/17	11/03/17	480	441	3	-260	-260	62070	48186	17	0.75	1
10/04/17	11/03/17	11/06/17	11/10/17	1990	1795	15	-370	-790	64060	49981	8	0.25	0.5
10/11/17	11/10/17	11/13/17	11/17/17	(20)	(33)	1	-20	-20	64040	49948	22	2	1.25
10/18/17	11/17/17	11/20/17	11/24/17	0	0	0	0	0	64040	49948	23	2.25	0.75
10/25/17	11/24/17	11/27/17	12/01/17	(640)	(679)	3	-400	-640	63400	49269	23	2.25	0.75
11/01/17	12/01/17	12/04/17	12/08/17	0	0	0	0	0	63400	49269	17	2.25	2.25
11/08/17	12/08/17	12/11/17	12/15/17	30	(113)	11	-490	-1600	63430	49156	7	1	0.25
11/15/17	12/15/17	12/18/17	12/22/17	240	201	3	-140	-140	63670	49357	3	1	1.25
11/22/17	12/22/17	12/25/17	12/29/17	60	21	3	-370	-550	63730	49378	7	1	0.75
11/29/17	12/29/17	01/01/18	01/05/18	(180)	(232)	4	-390	-740	63550	49146	12	0.5	1
12/06/17	01/05/18	01/08/18	01/12/18	1520	1442	6	-270	-270	65070	50588	6	0.75	0.75
12/13/17	01/12/18	01/15/18	01/19/18	(960)	(1051)	7	-500	-1030	64110	49537	6	0.75	0.75
12/20/17	01/19/18	01/22/18	01/26/18	(1240)	(1305)	5	-900	-2020	62870	48232	3	2	1.5
12/27/17	01/26/18	01/29/18	02/02/18	380	250	10	-260	-470	63250	48482	21	0.25	0.5
01/03/18	02/02/18	02/05/18	02/09/18	(2510)	(2562)	4	-1540	-2510	60740	45920	24	1	2
01/10/18	02/09/18	02/12/18	02/16/18	960	947	1	0	0	61700	46867	12	2.5	2
01/17/18	02/16/18	02/19/18	02/23/18	0	(13)	1	0	0	61700	46854	12	2.5	2
01/24/18	02/23/18	02/26/18	03/02/18	660	647	1	0	0	62360	47501	12	2.5	2
01/31/18	03/02/18	03/05/18	03/09/18	(10)	(36)	2	-310	-310	62350	47465	13	2.25	2.5
02/07/18	03/09/18	03/12/18	03/16/18	(390)	(416)	2	-450	-450	61960	47049	13	2.25	2.5
02/14/18	03/16/18	03/19/18	03/23/18	1650	1559	7	-730	-740	63610	48608	3	0.25	1.75
02/21/18	03/23/18	03/26/18	03/30/18	(1670)	(1865)	15	-590	-1840	61940	46743	3	0.25	1.75
02/28/18	03/30/18	04/02/18	04/06/18	1430	1261	13	-540	-790	63370	48004	7	0.25	1.25
03/07/18	04/06/18	04/09/18	04/13/18	(2090)	(2324)	18	-620	-2090	61280	45680	7	0.75	0.25
03/14/18	04/13/18	04/16/18	04/20/18	(1440)	(1700)	20	-540	-2100	59840	43980	7	0.75	0.25
03/21/18	04/20/18	04/23/18	04/27/18	(280)	(371)	7	-580	-1290	59560	43609	5	1	2
03/28/18	04/27/18	04/30/18	05/04/18	(40)	(53)	1	-40	-40	59520	43556	6	2.5	2.5
04/04/18	05/04/18	05/07/18	05/11/18	(440)	(466)	2	-620	-620	59080	43090	5	2.75	3.25

In-Sample Dates	Out-Of-Sample Dates	ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn		
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
04/11/18	05/11/18	05/14/18	05/18/18	(190)	(216)	2	-280	-280	58890	42874	8	1.75	1.75
04/18/18	05/18/18	05/21/18	05/25/18	(500)	(513)	1	-500	-500	58390	42361	6	1.75	2.25
04/25/18	05/25/18	05/28/18	06/01/18	(610)	(636)	2	-710	-710	57780	41725	16	1	2.5
05/02/18	06/01/18	06/04/18	06/08/18	(140)	(179)	3	-440	-580	57640	41546	3	2.5	3.25
05/09/18	06/08/18	06/11/18	06/15/18	1120	1055	5	-510	-510	58760	42601	11	0.75	1
05/16/18	06/15/18	06/18/18	06/22/18	1270	1127	11	-470	-690	60030	43728	8	0.25	1.25
05/23/18	06/22/18	06/25/18	06/29/18	200	161	3	-280	-280	60230	43889	24	1.5	1.75
05/30/18	06/29/18	07/02/18	07/06/18	(980)	(1136)	12	-1690	-2820	59250	42753	11	0.5	0.75
06/06/18	07/06/18	07/09/18	07/13/18	820	703	9	-570	-1010	60070	43456	15	0.75	0.75
06/13/18	07/13/18	07/16/18	07/20/18	(160)	(173)	1	-160	-160	59910	43283	20	1.5	3
06/20/18	07/20/18	07/23/18	07/27/18	(1360)	(1412)	4	-1350	-1360	58550	41871	15	0.75	3
06/27/18	07/27/18	07/30/18	08/03/18	3030	2926	8	-90	-90	61580	44797	4	1.25	0.5
07/04/18	08/03/18	08/06/18	08/10/18	0	0	0	0	0	61580	44797	24	2	3
07/11/18	08/10/18	08/13/18	08/17/18	1620	1412	16	-410	-1250	63200	46209	4	1.25	0.5
07/18/18	08/17/18	08/20/18	08/24/18	(1090)	(1155)	5	-640	-1090	62110	45054	16	0.75	1.25
07/25/18	08/24/18	08/27/18	08/31/18	0	0	0	0	0	62110	45054	24	1.75	1
08/01/18	08/31/18	09/03/18	09/07/18	(80)	(210)	10	-480	-910	62030	44844	9	1	0.5
08/08/18	09/07/18	09/10/18	09/14/18	(520)	(559)	3	-780	-1210	61510	44285	20	1.25	3.25
08/15/18	09/14/18	09/17/18	09/21/18	450	281	13	-470	-820	61960	44566	13	0.5	0.25
08/22/18	09/21/18	09/24/18	09/28/18	1320	1164	12	-180	-530	63280	45730	13	0.5	0.25
08/29/18	09/28/18	10/01/18	10/05/18	660	452	16	-1070	-1540	63940	46182	5	1.5	0.75
09/05/18	10/05/18	10/08/18	10/12/18	0	0	0	0	0	63940	46182	22	2	3
09/12/18	10/12/18	10/15/18	10/19/18	1460	1343	9	-440	-630	65400	47525	3	1.75	0.25
09/19/18	10/19/18	10/22/18	10/26/18	(360)	(607)	19	-610	-1530	65040	46918	3	1.75	0.25
09/26/18	10/26/18	10/29/18	11/02/18	100	74	2	-540	-540	65140	46992	8	2.75	1.75
10/03/18	11/02/18	11/05/18	11/09/18	(910)	(1066)	12	-450	-1290	64230	45926	17	0.25	0.75
10/10/18	11/09/18	11/12/18	11/16/18	4210	4106	8	-730	-1290	68440	50032	14	1.25	0.25
10/17/18	11/16/18	11/19/18	11/23/18	(810)	(875)	5	-1160	-1550	67630	49157	24	1.5	0.75
10/24/18	11/23/18	11/26/18	11/30/18	(2060)	(2086)	2	-1310	-2060	65570	47071	4	2.5	2.5
10/31/18	11/30/18	12/03/18	12/07/18	(850)	(915)	5	-780	-850	64720	46156	24	1.25	0.75
11/07/18	12/07/18	12/10/18	12/14/18	770	640	10	-800	-1900	65490	46796	12	1.5	0.25
11/14/18	12/14/18	12/17/18	12/21/18	1190	1047	11	-1100	-1800	66680	47843	7	1.5	0.5
11/21/18	12/21/18	12/24/18	12/28/18	4060	3995	5	-700	-700	70740	51838	18	0.75	0.5
11/28/18	12/28/18	12/31/18	01/04/19	(1650)	(1702)	4	-1210	-1870	69090	50136	21	1.75	1.75
12/05/18	01/04/19	01/07/19	01/11/19	0	0	0	0	0	69090	50136	14	3.25	2.75
12/12/18	01/11/19	01/14/19	01/18/19	100	87	1	0	0	69190	50223	21	2	1.25
12/19/18	01/18/19	01/21/19	01/25/19	(1190)	(1281)	7	-550	-1430	68000	48942	3	2	0.5
12/26/18	01/25/19	01/28/19	02/01/19	3260	3156	8	-170	-310	71260	52098	14	0.25	1
01/02/19	02/01/19	02/04/19	02/08/19	0	0	0	0	0	71260	52098	24	2.5	2.25
01/09/19	02/08/19	02/11/19	02/15/19	(1110)	(1201)	7	-660	-1110	70150	50897	10	1	0.75
01/16/19	02/15/19	02/18/19	02/22/19	(1850)	(1954)	8	-1380	-2180	68300	48943	7	1.25	0.25
01/23/19	02/22/19	02/25/19	03/01/19	(1560)	(1703)	11	-650	-1900	66740	47240	4	0.25	1.75
01/30/19	03/01/19	03/04/19	03/08/19	80	(102)	14	-650	-1250	66820	47138	4	0.25	1.5
02/06/19	03/08/19	03/11/19	03/15/19	500	383	9	-330	-690	67320	47521	4	0.5	1.5
02/13/19	03/15/19	03/18/19	03/22/19	480	389	7	-590	-1050	67800	47910	5	0.5	1.5
02/20/19	03/22/19	03/25/19	03/29/19	(380)	(484)	8	-700	-1250	67420	47426	22	0.75	0.25
02/27/19	03/29/19	04/01/19	04/05/19	1140	1036	8	-520	-960	68560	48462	5	0.5	1.5
03/06/19	04/05/19	04/08/19	04/12/19	(150)	(293)	11	-440	-1160	68410	48169	5	0.5	1.5
03/13/19	04/12/19	04/15/19	04/19/19	340	301	3	-90	-90	68750	48470	16	0.5	1.25
03/20/19	04/19/19	04/22/19	04/26/19	(850)	(889)	3	-930	-980	67900	47581	17	1	1.5
03/27/19	04/26/19	04/29/19	05/03/19	260	182	6	-580	-630	68160	47763	3	1.75	2.25
04/03/19	05/03/19	05/06/19	05/10/19	(310)	(505)	15	-330	-560	67850	47258	11	0.5	0.75
04/10/19	05/10/19	05/13/19	05/17/19	730	574	12	-500	-870	68580	47832	11	0.75	0.25
04/17/19	05/17/19	05/20/19	05/24/19	2010	1880	10	-620	-1070	70590	49712	11	0.5	1
04/24/19	05/24/19	05/27/19	05/31/19	1600	1457	11	-940	-1120	72190	51169	8	0.25	1.25
05/01/19	05/31/19	06/03/19	06/07/19	0	0	0	0	0	72190	51169	23	2.25	3
05/08/19	06/07/19	06/10/19	06/14/19	0	0	0	0	0	72190	51169	23	2.25	3
05/15/19	06/14/19	06/17/19	06/21/19	540	514	2	-420	-420	72730	51683	3	2.75	3
05/22/19	06/21/19	06/24/19	06/28/19	0	0	0	0	0	72730	51683	17	1.5	3
05/29/19	06/28/19	07/01/19	07/05/19	210	197	1	0	0	72940	51880	16	1.5	3

In-Sample Dates	Out-Of-Sample Dates	ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn		
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
06/05/19	07/05/19	07/08/19	07/12/19	0	0	0	0	0	72940	51880	10	2.25	2.25
06/12/19	07/12/19	07/15/19	07/19/19	5360	5269	7	-170	-300	78300	57149	3	2	1
06/19/19	07/19/19	07/22/19	07/26/19	0	0	0	0	0	78300	57149	14	1.75	3
06/26/19	07/26/19	07/29/19	08/02/19	430	404	2	-150	-150	78730	57553	14	1.5	3.25
07/03/19	08/02/19	08/05/19	08/09/19	260	234	2	-190	-190	78990	57787	16	2.5	2
07/10/19	08/09/19	08/12/19	08/16/19	(20)	(59)	3	-810	-810	78970	57728	15	1.5	2
07/17/19	08/16/19	08/19/19	08/23/19	(940)	(1005)	5	-1090	-1720	78030	56723	4	2	2.75
07/24/19	08/23/19	08/26/19	08/30/19	(60)	(73)	1	-60	-60	77970	56650	18	1.75	2.25
07/31/19	08/30/19	09/02/19	09/06/19	2490	2386	8	-330	-440	80460	59036	15	0.5	0.75
08/07/19	09/06/19	09/09/19	09/13/19	(2000)	(2182)	14	-920	-2430	78460	56854	17	0.25	0.5
08/14/19	09/13/19	09/16/19	09/20/19	(3410)	(3644)	18	-1030	-4290	75050	53210	5	1.25	1.25
08/21/19	09/20/19	09/23/19	09/27/19	0	0	0	0	0	75050	53210	7	2.75	3.25
08/28/19	09/27/19	09/30/19	10/04/19	0	0	0	0	0	75050	53210	7	2	2.75
09/04/19	10/04/19	10/07/19	10/11/19	0	0	0	0	0	75050	53210	7	2	2.75
09/11/19	10/11/19	10/14/19	10/18/19	0	0	0	0	0	75050	53210	7	2	2.75
09/18/19	10/18/19	10/21/19	10/25/19	440	414	2	-500	-500	75490	53624	6	1.75	2.5
09/25/19	10/25/19	10/28/19	11/01/19	290	277	1	0	0	75780	53901	6	1.75	2.75
10/02/19	11/01/19	11/04/19	11/08/19	480	454	2	0	0	76260	54355	24	1.5	1.5
10/09/19	11/08/19	11/11/19	11/15/19	340	288	4	-80	-80	76600	54643	7	1	1.25
10/16/19	11/15/19	11/18/19	11/22/19	(140)	(231)	7	-860	-1170	76460	54412	7	1	1.5
10/23/19	11/22/19	11/25/19	11/29/19	920	855	5	-490	-940	77380	55267	19	1	0.25
10/30/19	11/29/19	12/02/19	12/06/19	450	164	22	-300	-1340	77830	55431	6	0.5	0.75
11/06/19	12/06/19	12/09/19	12/13/19	(2620)	(2724)	8	-820	-2620	75210	52707	18	1	0.25
11/13/19	12/13/19	12/16/19	12/20/19	390	364	2	0	0	75600	53071	8	1.25	1
11/20/19	12/20/19	12/23/19	12/27/19	210	171	3	-40	-40	75810	53242	13	0.5	1.25
11/27/19	12/27/19	12/30/19	01/03/20	(1820)	(1989)	13	-620	-2130	73990	51253	10	0.5	0.5
12/04/19	01/03/20	01/06/20	01/10/20	(1810)	(1862)	4	-2150	-2150	72180	49391	7	1.25	2.75
12/11/19	01/10/20	01/13/20	01/17/20	110	58	4	-320	-420	72290	49449	5	1.25	1
12/18/19	01/17/20	01/20/20	01/24/20	(170)	(300)	10	-550	-660	72120	49149	11	0.5	1
12/25/19	01/24/20	01/27/20	01/31/20	(580)	(723)	11	-610	-1300	71540	48426	10	0.5	1.25
01/01/20	01/31/20	02/03/20	02/07/20	0	0	0	0	0	71540	48426	5	2.25	2.75
01/08/20	02/07/20	02/10/20	02/14/20	450	359	7	-200	-210	71990	48785	14	0.75	0.25
01/15/20	02/14/20	02/17/20	02/21/20	(1950)	(2106)	12	-780	-2130	70040	46679	14	0.75	0.25
01/23/20	02/22/20	02/25/20	02/29/20	2280	2111	13	-820	-1150	72320	48790	14	0.75	0.25
01/29/20	02/28/20	03/02/20	03/06/20	1420	1368	4	-1140	-1140	73740	50158	4	2.5	2.5
02/05/20	03/06/20	03/09/20	03/13/20	1170	1066	8	-1250	-1580	74910	51224	8	2	2.25
02/12/20	03/13/20	03/16/20	03/20/20	3100	3009	7	-2080	-2300	78010	54233	14	1.75	2.25
02/19/20	03/20/20	03/23/20	03/27/20	550	485	5	-510	-510	78560	54718	3	2	2.75
02/26/20	03/27/20	03/30/20	04/03/20	8140	8010	10	-120	-280	86700	62728	3	1.75	3
03/04/20	04/03/20	04/06/20	04/10/20	(720)	(876)	12	-1180	-1980	85980	61852	3	1.75	3
03/11/20	04/10/20	04/13/20	04/17/20	0	0	0	0	0	85980	61852	6	3.5	3
03/18/20	04/17/20	04/20/20	04/24/20	(1210)	(1444)	18	-1380	-3230	84770	60408	4	3.25	3.25
03/25/20	04/24/20	04/27/20	05/01/20	1760	1630	10	-430	-740	86530	62038	3	1.75	3.5
04/01/20	05/01/20	05/04/20	05/08/20	(1720)	(1824)	8	-3010	-3240	84810	60214	3	1.5	3.5
04/08/20	05/08/20	05/11/20	05/15/20	(3780)	(3897)	9	-1530	-4360	81030	56317	3	3.25	0.25
04/15/20	05/15/20	05/18/20	05/22/20	0	0	0	0	0	81030	56317	23	3.5	2
04/22/20	05/22/20	05/25/20	05/29/20	3590	3460	10	-410	-410	84620	59777	19	0.25	0.5
04/29/20	05/29/20	06/01/20	06/05/20	0	0	0	0	0	84620	59777	21	1.75	2.25
05/06/20	06/05/20	06/08/20	06/12/20	(1210)	(1457)	19	-920	-3080	83410	58320	3	1	2
05/13/20	06/12/20	06/15/20	06/19/20	780	676	8	-1060	-1530	84190	58996	10	1	2.25
05/20/20	06/19/20	06/22/20	06/26/20	1910	1754	12	-600	-900	86100	60750	5	1.25	1
05/27/20	06/26/20	06/29/20	07/03/20	920	829	7	-130	-130	87020	61579	6	1.25	1.25
06/03/20	07/03/20	07/06/20	07/10/20	1060	1034	2	0	0	88080	62613	3	2	2
06/10/20	07/10/20	07/13/20	07/17/20	410	358	4	-380	-380	88490	62971	10	1	1
06/17/20	07/17/20	07/20/20	07/24/20	210	145	5	-520	-600	88700	63116	3	0.25	2.75
06/24/20	07/24/20	07/27/20	07/31/20	980	928	4	-180	-180	89680	64044	6	1.25	1.25
07/01/20	07/31/20	08/03/20	08/07/20	(640)	(809)	13	-730	-2580	89040	63235	3	0.5	1.25
07/08/20	08/07/20	08/10/20	08/14/20	0	0	0	0	0	89040	63235	7	1.5	3
07/15/20	08/14/20	08/17/20	08/21/20	940	914	2	0	0	89980	64149	6	1.5	2.5
07/22/20	08/21/20	08/24/20	08/28/20	(850)	(967)	9	-450	-870	89130	63182	4	0.5	1.5

In-Sample Dates		Out-Of-Sample Dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
07/29/20	08/28/20	08/31/20	09/04/20	290	277	1	0	0	89420	63459	7	2	2.25
08/05/20	09/04/20	09/07/20	09/11/20	690	534	12	-630	-1310	90110	63993	7	1	0.75
08/12/20	09/11/20	09/14/20	09/18/20	1640	1393	19	-380	-540	91750	65386	4	0.5	1
08/19/20	09/18/20	09/21/20	09/25/20	(1090)	(1220)	10	-580	-2040	90660	64166	14	0.5	1
08/26/20	09/25/20	09/28/20	10/02/20	1790	1608	14	-510	-1310	92450	65774	12	0.75	0.25
09/02/20	10/02/20	10/05/20	10/09/20	(490)	(594)	8	-500	-1090	91960	65180	11	1	0.75
09/09/20	10/09/20	10/12/20	10/16/20	0	0	0	0	0	91960	65180	7	1.75	3
09/16/20	10/16/20	10/19/20	10/23/20	0	0	0	0	0	91960	65180	7	1.75	3
09/23/20	10/23/20	10/26/20	10/30/20	(380)	(419)	3	-810	-810	91580	64761	23	0.75	1
09/30/20	10/30/20	11/02/20	11/06/20	430	404	2	-200	-200	92010	65165	21	1.75	1.25
10/07/20	11/06/20	11/09/20	11/13/20	(220)	(246)	2	-610	-610	91790	64919	3	2.25	3
10/14/20	11/13/20	11/16/20	11/20/20	0	0	0	0	0	91790	64919	5	1.75	2
10/21/20	11/20/20	11/23/20	11/27/20	690	612	6	-490	-640	92480	65531	3	1	1.25
10/28/20	11/27/20	11/30/20	12/04/20	(1270)	(1452)	14	-740	-1270	91210	64079	3	1	1.25
11/04/20	12/04/20	12/07/20	12/11/20	40	(142)	14	-730	-1070	91250	63937	17	0.25	0.25
11/11/20	12/11/20	12/14/20	12/18/20	1670	1566	8	-470	-570	92920	65503	3	0.5	1.75
11/18/20	12/18/20	12/21/20	12/25/20	1260	1195	5	-340	-340	94180	66698	3	0.75	1.75
11/25/20	12/25/20	12/28/20	01/01/21	150	33	9	-320	-760	94330	66731	9	0.5	0.75
12/02/20	01/01/21	01/04/21	01/08/21	1670	1566	8	-910	-1050	96000	68297	4	0.5	1.75
12/09/20	01/08/21	01/11/21	01/15/21	(60)	(73)	1	-60	-60	95940	68224	4	1.5	2.75
12/16/20	01/15/21	01/18/21	01/22/21	(1000)	(1117)	9	-420	-1460	94940	67107	4	1	1.25
12/23/20	01/22/21	01/25/21	01/29/21	(120)	(159)	3	-1020	-1020	94820	66948	5	1.25	2.25
12/30/20	01/29/21	02/01/21	02/05/21	70	(73)	11	-330	-610	94890	66875	7	0.25	1
01/06/21	02/05/21	02/08/21	02/12/21	1150	1098	4	-340	-340	96040	67973	6	1	2.25
01/13/21	02/12/21	02/15/21	02/19/21	(1860)	(1990)	10	-900	-2610	94180	65983	6	0.75	1.5
01/20/21	02/19/21	02/22/21	02/26/21	(3540)	(4008)	36	-790	-5390	90640	61975	4	1	0.75
01/27/21	02/26/21	03/01/21	03/05/21	1430	1404	2	0	0	92070	63379	8	2	3.5
02/03/21	03/05/21	03/08/21	03/12/21	(840)	(1035)	15	-550	-2370	91230	62344	3	1	1.75
02/10/21	03/12/21	03/15/21	03/19/21	2700	2674	2	0	0	93930	65018	22	2	2.25
02/17/21	03/19/21	03/22/21	03/26/21	2010	1776	18	-1290	-1730	95940	66794	4	1	1.75
02/24/21	03/26/21	03/29/21	04/02/21	420	199	17	-960	-2850	96360	66993	4	1	1.75
03/03/21	04/02/21	04/05/21	04/09/21	4250	4107	11	-540	-710	100610	71100	4	1.5	1.75
03/10/21	04/09/21	04/12/21	04/16/21	1020	981	3	-940	-940	101630	72081	5	1.25	2
03/17/21	04/16/21	04/19/21	04/23/21	(520)	(650)	10	-530	-990	101110	71431	5	1.25	1.75
03/24/21	04/23/21	04/26/21	04/30/21	0	0	0	0	0	101110	71431	7	2	2.75
03/31/21	04/30/21	05/03/21	05/07/21	(1050)	(1076)	2	-570	-1050	100060	70355	7	2	2
04/07/21	05/07/21	05/10/21	05/14/21	(870)	(896)	2	-520	-870	99190	69459	24	2	1.25
04/14/21	05/14/21	05/17/21	05/21/21	390	234	12	-1360	-2220	99580	69693	8	0.25	1.25
04/21/21	05/21/21	05/24/21	05/28/21	0	0	0	0	0	99580	69693	11	2	3.25
04/28/21	05/28/21	05/31/21	06/04/21	(80)	(93)	1	-80	-80	99500	69600	12	1.75	2.5
05/05/21	06/04/21	06/07/21	06/11/21	0	0	0	0	0	99500	69600	11	2	3.25
05/12/21	06/11/21	06/14/21	06/18/21	3120	2886	18	-650	-1040	102620	72486	3	1.5	0.25
05/19/21	06/18/21	06/21/21	06/25/21	70	(112)	14	-480	-1330	102690	72374	14	0.25	0.5
05/26/21	06/25/21	06/28/21	07/02/21	(2160)	(2394)	18	-570	-2400	100530	69980	19	0.25	0.25
06/02/21	07/02/21	07/05/21	07/09/21	(620)	(711)	7	-760	-1370	99910	69269	18	1.5	0.25
06/09/21	07/09/21	07/12/21	07/16/21	(1820)	(1872)	4	-1260	-1980	98090	67397	4	2.25	3.25
06/16/21	07/16/21	07/19/21	07/23/21	1860	1834	2	0	0	99950	69231	8	2.25	3
06/23/21	07/23/21	07/26/21	07/30/21	(970)	(1009)	3	-500	-970	98980	68222	5	1.75	1.5
06/30/21	07/30/21	08/02/21	08/06/21	510	354	12	-510	-1450	99490	68576	5	1.75	1.75
07/07/21	08/06/21	08/09/21	08/13/21	1630	1539	7	-700	-700	101120	70115	4	0.5	2.75
07/14/21	08/13/21	08/16/21	08/20/21	(4020)	(4306)	22	-930	-5150	97100	65809	4	0.5	1.75
07/21/21	08/20/21	08/23/21	08/27/21	1370	1253	9	-360	-650	98470	67062	5	1	2
07/28/21	08/27/21	08/30/21	09/03/21	(120)	(159)	3	-700	-700	98350	66903	5	1.5	2
08/04/21	09/03/21	09/06/21	09/10/21	(1530)	(1712)	14	-510	-1610	96820	65191	3	1	2
08/11/21	09/10/21	09/13/21	09/17/21	(800)	(930)	10	-530	-1180	96020	64261	15	0.25	1
08/18/21	09/17/21	09/20/21	09/24/21	(2330)	(2499)	13	-930	-3370	93690	61762	3	1.75	0.25
08/25/21	09/24/21	09/27/21	10/01/21	(430)	(456)	2	-280	-430	93260	61306	7	3.5	2.75
09/01/21	10/01/21	10/04/21	10/08/21	430	417	1	0	0	93690	61723	15	3.5	2
09/08/21	10/08/21	10/11/21	10/15/21	(280)	(293)	1	-280	-280	93410	61430	14	2.75	2
09/15/21	10/15/21	10/18/21	10/22/21	(870)	(883)	1	-870	-870	92540	60547	16	3.5	2

In-Sample Dates	Out-Of-Sample Dates	ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn		
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
09/22/21	10/22/21	10/25/21	10/29/21	(1390)	(1559)	13	-1330	-2600	91150	58988	10	0.75	1.75
09/29/21	10/29/21	11/01/21	11/05/21	1900	1718	14	-1400	-1400	93050	60706	8	1.5	0.25
10/06/21	11/05/21	11/08/21	11/12/21	500	266	18	-820	-1380	93550	60972	4	1.75	0.5
10/13/21	11/12/21	11/15/21	11/19/21	(1880)	(1906)	2	-1580	-1880	91670	59066	4	3.5	3.25
10/20/21	11/19/21	11/22/21	11/26/21	4080	3885	15	-830	-2010	95750	62951	4	2	0.25
10/27/21	11/26/21	11/29/21	12/03/21	7600	7353	19	-930	-1450	103350	70304	8	0.25	1.25
11/03/21	12/03/21	12/06/21	12/10/21	850	694	12	-800	-1780	104200	70998	8	0.25	1.5
11/10/21	12/10/21	12/13/21	12/17/21	0	0	0	0	0	104200	70998	19	2.75	3
11/17/21	12/17/21	12/20/21	12/24/21	4890	4812	6	-300	-300	109090	75810	4	0.5	2.25
11/24/21	12/24/21	12/27/21	12/31/21	4900	4770	10	-220	-370	113990	80580	4	0.5	2.25
12/01/21	12/31/21	01/03/22	01/07/22	(2840)	(3113)	21	-1000	-3810	111150	77467	5	1.25	1
12/08/21	01/07/22	01/10/22	01/14/22	50	(93)	11	-1010	-1010	111200	77374	9	1.5	0.75
12/15/21	01/14/22	01/17/22	01/21/22	(1200)	(1499)	23	-480	-1330	110000	75875	8	0.75	0.25
12/22/21	01/21/22	01/24/22	01/28/22	2100	2022	6	-870	-870	112100	77897	18	1.5	0.75
12/29/21	01/28/22	01/31/22	02/04/22	(360)	(386)	2	-320	-360	111740	77511	24	2.75	2
01/05/22	02/04/22	02/07/22	02/11/22	(130)	(143)	1	-130	-130	111610	77368	22	3.25	2.75
01/12/22	02/11/22	02/14/22	02/18/22	(360)	(386)	2	-900	-900	111250	76982	24	3	2.75
01/19/22	02/18/22	02/21/22	02/25/22	2260	2195	5	-1700	-2700	113510	79177	22	3.25	2.75
01/26/22	02/25/22	02/28/22	03/04/22	8970	8567	31	-1410	-2850	122480	87744	5	2.25	1.5
02/02/22	03/04/22	03/07/22	03/11/22	13240	12941	23	-3540	-4240	135720	100685	7	3.25	2.25
02/09/22	03/11/22	03/14/22	03/18/22	(3880)	(4036)	12	-1980	-6740	131840	96649	10	2.75	3
02/16/22	03/18/22	03/21/22	03/25/22	(6640)	(6848)	16	-2130	-8200	125200	89801	10	3.5	1.5
02/23/22	03/25/22	03/28/22	04/01/22	1340	1106	18	-1730	-2760	126540	90907	9	2.5	2
03/02/22	04/01/22	04/04/22	04/08/22	860	587	21	-1420	-2440	127400	91494	7	2	2.25
03/09/22	04/08/22	04/11/22	04/15/22	3610	3493	9	-1170	-1450	131010	94987	20	0.5	0.75
03/16/22	04/15/22	04/18/22	04/22/22	650	455	15	-1280	-3570	131660	95442	7	2	2.25
03/23/22	04/22/22	04/25/22	04/29/22	(350)	(467)	9	-1990	-3840	131310	94975	17	2.75	0.5
03/30/22	04/29/22	05/02/22	05/06/22	3960	3817	11	-1270	-1450	135270	98792	18	1.75	0.5
04/06/22	05/06/22	05/09/22	05/13/22	5020	4903	9	-1040	-1300	140290	103695	14	2.5	1.25
04/13/22	05/13/22	05/16/22	05/20/22	4390	4286	8	-1140	-1720	144680	107981	17	2.5	0.5
04/20/22	05/20/22	05/23/22	05/27/22	1080	1067	1	0	0	145760	109048	19	3	2.75
04/27/22	05/27/22	05/30/22	06/03/22	1170	1131	3	-380	-380	146930	110179	17	2.75	3.5
05/04/22	06/03/22	06/06/22	06/10/22	4740	4519	17	-640	-1570	151670	114698	11	1	0.5
05/11/22	06/10/22	06/13/22	06/17/22	8660	8335	25	-1220	-1940	160330	123033	7	1.75	1.25
05/18/22	06/17/22	06/20/22	06/24/22	(710)	(762)	4	-2010	-2270	159620	122271	17	3.5	3.5
05/25/22	06/24/22	06/27/22	07/01/22	7730	7574	12	-830	-1160	167350	129845	5	3.5	2.75
06/01/22	07/01/22	07/04/22	07/08/22	9320	9190	10	-1430	-1740	176670	139035	5	3.5	3.5
06/08/22	07/08/22	07/11/22	07/15/22	3340	3184	12	-1320	-2150	180010	142219	17	0.5	2
06/15/22	07/15/22	07/18/22	07/22/22	3330	3252	6	-840	-1470	183340	145471	17	0.5	2.25
06/22/22	07/22/22	07/25/22	07/29/22	2700	2583	9	-2270	-3130	186040	148054	15	2.5	0.75
06/29/22	07/29/22	08/01/22	08/05/22	2720	2564	12	-2200	-2370	188760	150618	19	0.25	1.75
07/06/22	08/05/22	08/08/22	08/12/22	3300	3196	8	-1940	-2920	192060	153814	6	1.5	3.25
07/13/22	08/12/22	08/15/22	08/19/22	(1520)	(1624)	8	-1430	-4470	190540	152190	15	3	0.75
07/20/22	08/19/22	08/22/22	08/26/22	(3340)	(3587)	19	-1940	10170	187200	148603	6	1.5	3
07/27/22	08/26/22	08/29/22	09/02/22	7850	7759	7	-590	-590	195050	156362	22	1.5	0.5
08/03/22	09/02/22	09/05/22	09/09/22	30	(61)	7	-1100	-2990	195080	156301	13	2	2.5
08/10/22	09/09/22	09/12/22	09/16/22	960	817	11	-560	-790	196040	157118	15	1.5	1
08/17/22	09/16/22	09/19/22	09/23/22	(1360)	(1490)	10	-1920	-4260	194680	155628	15	1.5	1
08/24/22	09/23/22	09/26/22	09/30/22	(910)	(1040)	10	-2320	-4620	193770	154588	10	2.75	0.75
08/31/22	09/30/22	10/03/22	10/07/22	(200)	(291)	7	-1430	-2290	193570	154297	11	2.25	1.75
09/07/22	10/07/22	10/10/22	10/14/22	5540	5475	5	-20	-20	199110	159772	7	3.5	1.25
09/14/22	10/14/22	10/17/22	10/21/22	(1080)	(1236)	12	-2310	-3690	198030	158536	5	3.25	0.25
09/21/22	10/21/22	10/24/22	10/28/22	50	(106)	12	-1320	-2410	198080	158430	6	2.5	0.25
09/28/22	10/28/22	10/31/22	11/04/22	(3080)	(3171)	7	-1860	-3080	195000	155259	5	3.5	1.25
10/05/22	11/04/22	11/07/22	11/11/22	1120	912	16	-690	-2600	196120	156171	3	3	0.75
10/12/22	11/11/22	11/14/22	11/18/22	350	116	18	-1680	-2420	196470	156287	3	2.75	1.5
10/19/22	11/18/22	11/21/22	11/25/22	7220	7116	8	-930	-1250	203690	163403	11	1.25	1.5
10/26/22	11/25/22	11/28/22	12/02/22	1130	974	12	-2530	-2800	204820	164377	7	2.25	0.25
11/02/22	12/02/22	12/05/22	12/09/22	12220	12077	11	-770	-770	217040	176454	7	2.25	0.25

In-Sample Dates	Out-Of-Sample Dates	ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn		
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
11/09/22	12/09/22	12/12/22	12/16/22	(820)	(1054)	18	-1270	-2240	216220	175400	8	2	0.5
11/16/22	12/16/22	12/19/22	12/23/22	(3300)	(3417)	9	-1690	-3300	212920	171983	9	0.5	2
11/23/22	12/23/22	12/26/22	12/30/22	(770)	(874)	8	-1390	-1660	212150	171109	7	1.5	1.75
11/30/22	12/30/22	01/02/23	01/06/23	(3980)	(4123)	11	-1310	-5240	208170	166986	24	0.5	0.5
12/07/22	01/06/23	01/09/23	01/13/23	(1390)	(1481)	7	-1480	-2630	206780	165505	20	1.5	0.25
12/14/22	01/13/23	01/16/23	01/20/23	(710)	(801)	7	-1380	-2930	206070	164704	20	1.75	0.25
12/21/22	01/20/23	01/23/23	01/27/23	750	659	7	-1380	-2710	206820	165363	8	2.5	1.75
12/28/22	01/27/23	01/30/23	02/03/23	4420	4290	10	-1020	-1940	211240	169653	8	2.75	1.5
01/04/23	02/03/23	02/06/23	02/10/23	1530	1361	13	-780	-780	212770	171014	18	0.25	0.25
01/11/23	02/10/23	02/13/23	02/17/23	(2480)	(2675)	15	-560	-3160	210290	168339	11	1.25	0.75
01/18/23	02/17/23	02/20/23	02/24/23	(2040)	(2157)	9	-2250	-3820	208250	166182	6	0.25	2.5
01/25/23	02/24/23	02/27/23	03/03/23	(330)	(434)	8	-870	-2800	207920	165748	15	0.5	2.25
02/01/23	03/03/23	03/06/23	03/10/23	220	12	16	-900	-3040	208140	165760	7	1.25	1
02/08/23	03/10/23	03/13/23	03/17/23	950	781	13	-1350	-1860	209090	166541	11	0.5	2
02/15/23	03/17/23	03/20/23	03/24/23	3130	3065	5	-1240	-1240	212220	169606	11	0.25	2
02/22/23	03/24/23	03/27/23	03/31/23	1460	1330	10	-800	-2160	213680	170936	4	0.25	2.5
03/01/23	03/31/23	04/03/23	04/07/23	(420)	(498)	6	-920	-1080	213260	170438	11	1	1.5
03/08/23	04/07/23	04/10/23	04/14/23	(1880)	(2153)	21	-650	-2390	211380	168285	8	0.75	0.5
03/15/23	04/14/23	04/17/23	04/21/23	(2260)	(2390)	10	-760	-2750	209120	165895	4	1.75	2.25
03/22/23	04/21/23	04/24/23	04/28/23	1040	858	14	-1020	-3500	210160	166753	4	2.25	1.5
03/29/23	04/28/23	05/01/23	05/05/23	(450)	(723)	21	-1010	-2580	209710	166030	4	0.75	2.25
04/05/23	05/05/23	05/08/23	05/12/23	1670	1579	7	-1100	-1320	211380	167609	5	2.5	0.5
04/12/23	05/12/23	05/15/23	05/19/23	1120	1016	8	-1000	-1000	212500	168625	5	2.5	0.5
04/19/23	05/19/23	05/22/23	05/26/23	320	229	7	-670	-1230	212820	168854	6	2.25	0.25
04/26/23	05/26/23	05/29/23	06/02/23	2310	2180	10	-680	-1010	215130	171034	6	2.25	0.25
05/03/23	06/02/23	06/05/23	06/09/23	2130	2026	8	-930	-1320	217260	173060	14	1.5	0.5
05/10/23	06/09/23	06/12/23	06/16/23	1580	1450	10	-910	-910	218840	174510	8	0.75	1.25
05/17/23	06/16/23	06/19/23	06/23/23	1860	1704	12	-660	-1030	220700	176214	8	0.75	1.25
05/24/23	06/23/23	06/26/23	06/30/23	(1530)	(1595)	5	-1560	-2020	219170	174619	4	2.75	3
05/31/23	06/30/23	07/03/23	07/07/23	2010	1841	13	-860	-1900	221180	176460	11	0.25	0.75
06/07/23	07/07/23	07/10/23	07/14/23	(430)	(534)	8	-1070	-1070	220750	175926	4	1.5	2.25
06/14/23	07/14/23	07/17/23	07/21/23	(450)	(580)	10	-960	-2630	220300	175346	4	1.25	2.25
06/21/23	07/21/23	07/24/23	07/28/23	(470)	(652)	14	-660	-2720	219830	174694	3	1.5	1.75
06/28/23	07/28/23	07/31/23	08/04/23	2880	2815	5	-500	-500	222710	177509	10	1.25	2
07/05/23	08/04/23	08/07/23	08/11/23	(1490)	(1698)	16	-840	-1780	221220	175811	6	1.25	1.25
07/12/23	08/11/23	08/14/23	08/18/23	590	538	4	-330	-370	221810	176349	11	1.75	2.25
07/19/23	08/18/23	08/21/23	08/25/23	(180)	(310)	10	-1400	-1740	221630	176039	4	0.25	2.25
07/26/23	08/25/23	08/28/23	09/01/23	0	0	0	0	0	221630	176039	17	2.75	2.75
08/02/23	09/01/23	09/04/23	09/08/23	(640)	(653)	1	-640	-640	220990	175386	12	3.5	2.75
08/09/23	09/08/23	09/11/23	09/15/23	(1550)	(1693)	11	-660	-2190	219440	173693	12	1	0.75
08/16/23	09/15/23	09/18/23	09/22/23	810	706	8	-630	-1070	220250	174399	7	2	2.25
08/23/23	09/22/23	09/25/23	09/29/23	(150)	(215)	5	-920	-920	220100	174184	7	2	2
08/30/23	09/29/23	10/02/23	10/06/23	470	236	18	-870	-2680	220570	174420	15	0.5	0.5
09/06/23	10/06/23	10/09/23	10/13/23	80	(37)	9	-1320	-1320	220650	174383	9	2.25	0.75
09/13/23	10/13/23	10/16/23	10/20/23	(2340)	(2405)	5	-950	-2880	218310	171978	7	1.75	2
09/20/23	10/20/23	10/23/23	10/27/23	3690	3573	9	-600	-1520	222000	175551	6	1.75	2
09/27/23	10/27/23	10/30/23	11/03/23	0	0	0	0	0	222000	175551	16	3	3.5
10/04/23	11/03/23	11/06/23	11/10/23	0	0	0	0	0	222000	175551	21	2.5	2.5
10/11/23	11/10/23	11/13/23	11/17/23	4350	4285	5	-490	-490	226350	179836	3	3	1.75
10/18/23	11/17/23	11/20/23	11/24/23	1180	1167	1	0	0	227530	181003	12	2.75	2.25
10/25/23	11/24/23	11/27/23	12/01/23	4100	3970	10	-760	-1310	231630	184973	5	2.25	2
11/01/23	12/01/23	12/04/23	12/08/23	(880)	(919)	3	-1300	-2230	230750	184054	18	2.25	1.75
11/08/23	12/08/23	12/11/23	12/15/23	350	324	2	-280	-280	231100	184378	16	3	1.5
11/15/23	12/15/23	12/18/23	12/22/23	(170)	(183)	1	-170	-170	230930	184195	18	2.5	1.75
11/22/23	12/22/23	12/25/23	12/29/23	1680	1563	9	-610	-1120	232610	185758	20	0.5	0.25
11/29/23	12/29/23	01/01/24	01/05/24	2430	2274	12	-540	-890	235040	188032	13	1.25	0.25
12/06/23	01/05/24	01/08/24	01/12/24	200	(86)	22	-740	-1060	235240	187946	3	1.25	2
12/13/23	01/12/24	01/15/24	01/19/24	2150	1968	14	-490	-630	237390	189914	3	1.25	2
12/20/23	01/19/24	01/22/24	01/26/24	(540)	(566)	2	-420	-540	236850	189348	24	1.75	3.25
12/27/23	01/26/24	01/29/24	02/02/24	1830	1804	2	0	0	238680	191152	22	2	3

In-Sample Dates		Out-Of-Sample Dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
02/05/14	03/07/14	03/10/14	03/14/14	(1540)	(1644)	8	-810	-1690	(1540)	(1644)	4	0.5	1.75
01/03/24	02/02/24	02/05/24	02/09/24	(1130)	(1312)	14	-1060	-1680	237550	189840	6	1.75	0.25
01/10/24	02/09/24	02/12/24	02/16/24	(2390)	(2572)	14	-1410	-2670	235160	187268	6	1.75	0.25
01/17/24	02/16/24	02/19/24	02/23/24	0	0	0	0	0	235160	187268	8	2.5	2.25
01/24/24	02/23/24	02/26/24	03/01/24	1370	1292	6	-230	-260	236530	188560	5	2	1.5
01/31/24	03/01/24	03/04/24	03/08/24	(3980)	(4123)	11	-1500	-4020	232550	184437	3	1.5	2.25
02/07/24	03/08/24	03/11/24	03/15/24	0	0	0	0	0	232550	184437	6	3.25	2.5
02/14/24	03/15/24	03/18/24	03/22/24	0	0	0	0	0	232550	184437	6	3.25	2.5
02/21/24	03/22/24	03/25/24	03/29/24	0	0	0	0	0	232550	184437	6	2.5	2.5
02/28/24	03/29/24	04/01/24	04/05/24	130	117	1	0	0	232680	184554	6	2.5	2.5
03/06/24	04/05/24	04/08/24	04/12/24	1760	1565	15	-730	-1320	234440	186119	10	1	0.25
03/13/24	04/12/24	04/15/24	04/19/24	(600)	(756)	12	-930	-1860	233840	185363	8	0.75	1.25
03/20/24	04/19/24	04/22/24	04/26/24	1770	1627	11	-480	-670	235610	186990	11	1	0.25
03/27/24	04/26/24	04/29/24	05/03/24	900	705	15	-530	-1230	236510	187695	11	1	0.25
04/03/24	05/03/24	05/06/24	05/10/24	0	0	0	0	0	236510	187695	18	2	3.5
04/10/24	05/10/24	05/13/24	05/17/24	(480)	(584)	8	-570	-1190	236030	187111	21	1	0.25
04/17/24	05/17/24	05/20/24	05/24/24	(1390)	(1533)	11	-690	-2390	234640	185578	22	1	0.25
04/24/24	05/24/24	05/27/24	05/31/24	(30)	(121)	7	-1050	-1050	234610	185457	10	1.25	0.75
05/01/24	05/31/24	06/03/24	06/07/24	960	921	3	-160	-160	235570	186378	4	2.75	2.5
05/08/24	06/07/24	06/10/24	06/14/24	1720	1538	14	-640	-640	237290	187916	3	0.25	1.75
05/15/24	06/14/24	06/17/24	06/21/24	1250	1081	13	-650	-1000	238540	188997	3	0.25	1.75
05/22/24	06/21/24	06/24/24	06/28/24	(490)	(724)	18	-710	-1830	238050	188273	3	0.25	1.75
05/29/24	06/28/24	07/01/24	07/05/24	330	148	14	-670	-1380	238380	188421	4	1.5	0.75
06/05/24	07/05/24	07/08/24	07/12/24	560	521	3	-70	-70	238940	188942	9	1.5	2.5
06/12/24	07/12/24	07/15/24	07/19/24	0	0	0	0	0	238940	188942	4	2.25	2.75
06/19/24	07/19/24	07/22/24	07/26/24	660	621	3	-860	-860	239600	189563	4	2.25	2.75
06/26/24	07/26/24	07/29/24	08/02/24	4060	3930	10	-460	-850	243660	193493	6	1.5	0.5
07/03/24	08/02/24	08/05/24	08/09/24	(1630)	(1851)	17	-770	-2080	242030	191642	6	1.5	0.5

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 712815 calculated RMedV values for different N . We used 5 min bars of the CL from 1/1/2013 to 5/26/23 to generate this table.

CL5M010113-052623 5 min bars Date Range 1130101 to 1230526
Total Number of Bars=736241 sqrt(N)Norm=0
Trading Times Constraint Start Time=0 EndTime=0

RMedV Multiplier to Scale RMedV N Range to One Std

2 Std=0.0 1/Std=0.0
3 Std=0.065024 1/Std=15.378960
4 Std=0.055546 1/Std=18.003075
5 Std=0.047342 1/Std=21.122911
6 Std=0.042738 1/Std=23.398412
7 Std=0.038771 1/Std=25.792282
8 Std=0.036130 1/Std=27.677799
9 Std=0.033673 1/Std=29.697591
10 Std=0.031903 1/Std=31.344970
11 Std=0.030213 1/Std=33.097821
12 Std=0.028895 1/Std=34.607575
13 Std=0.027620 1/Std=36.205743
14 Std=0.026593 1/Std=37.603751
15 Std=0.025612 1/Std=39.044376
16 Std=0.024809 1/Std=40.307442
17 Std=0.024003 1/Std=41.661430
18 Std=0.023349 1/Std=42.828140
19 Std=0.022674 1/Std=44.102415
20 Std=0.022103 1/Std=45.242740

1/Std Mult Ave=32.617635

As one can see the RMedV Standard Deviation for $N=4$ is 2.5 times the SD for $N=20$. 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.

RMedV Multiplier to Scale RMedV N Range to One Std

2 Std=0.0 1/Std=0.0

3 Std=0.114441 1/Std=8.738099

4 Std=0.112604 1/Std=8.880718

5 Std=0.107389 1/Std=9.311984

6 Std=0.106082 1/Std=9.426695

7 Std=0.103985 1/Std=9.616792

8 Std=0.103547 1/Std=9.657454

9 Std=0.102365 1/Std=9.768961

10 Std=0.102245 1/Std=9.780442

11 Std=0.101559 1/Std=9.846492

12 Std=0.101442 1/Std=9.857818

13 Std=0.100930 1/Std=9.907816

14 Std=0.100853 1/Std=9.915431

15 Std=0.100549 1/Std=9.945427

16 Std=0.100603 1/Std=9.940072

17 Std=0.100329 1/Std=9.967254

18 Std=0.100422 1/Std=9.957990

19 Std=0.100210 1/Std=9.979009

20 Std=0.100223 1/Std=9.977714

1/Std Mult Ave=9.693120

As we can see the SDs are now very close. If we multiply all RMedVs by $9.69 \cdot \sqrt{N}$ then the SDs of the velocities for all will be normalized to 1. For this case 9.69 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 0.25 to 3.5 standard deviations for all N.

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