

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

1/2/2013 to 5/26/2023

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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 $y = a + bx$.

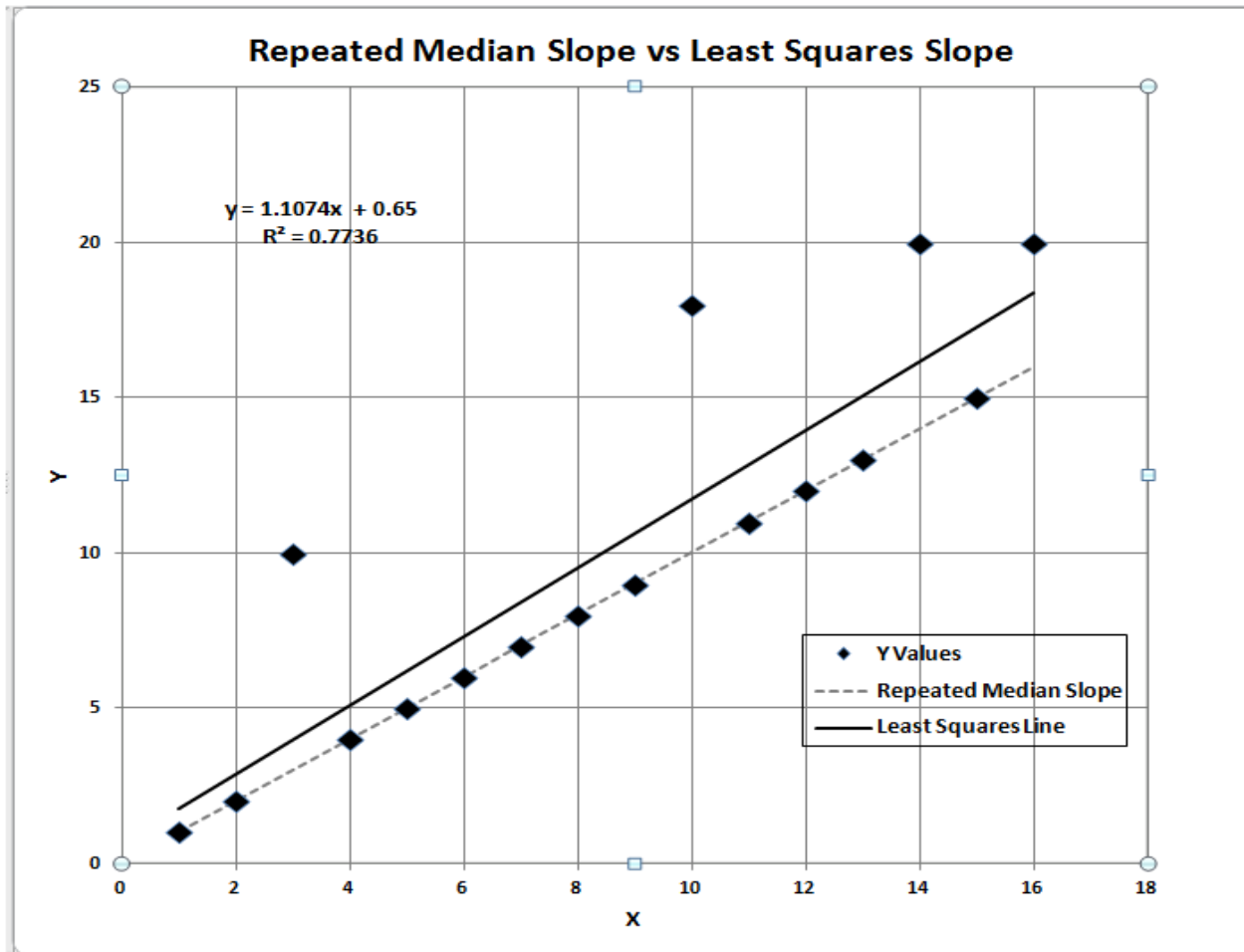


Figure 1 Repeated Median Slope vs Least Squares Slope.

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 538 weeks from January 2, 2013, to May 26, 2023.

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 2, 2013, to November 25, 2022. We will breakup and create 30-day calendar *in-sample* sections along with their corresponding one calendar week *out-of-sample* sections from the 538 weeks of CL (see Walk forward Testing below) creating 538 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 1/2/2013 to 5/26/2023. 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 538 weeks of CL (see Walk Forward Testing below) creating 538 out-of-sample weeks. Note the first in-sample week will be from 1/3/2013 to 2/1/2013 and the first out-of-sample week will be from 02/03/2013 to 02/08/13.

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 1/2/2013 to 5/26/2023 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 538 in-sample 30-day periods followed by 538 out-of-sample 7-day periods from 1/2/2013 to 5/26/2023.

We will use the following strategy input optimization ranges.

N from 2 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 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= $7*\sqrt{N}$. 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 4508 different input combinations or cases of the strategy input parameters. for each of the 538 in-sample/out-of-sample files for the approximately 10+ years of 5 min bar CL prices from 1/2/2013 to 5/26/2023.

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 512 in-sample and out-of-sample sections From 2/8/2013 to 11/25/2022. We will leave the 26 sections, 6 months of CL data from 12/02/22 to 5/26/2023 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**>4 . 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 <80, **r2**<80. 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 50 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 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 **b50mLb |p≤4lr≤3r2≤80** where **b50mLb** means the bottom or minimum 50 **mLb** rows left *after* the **pf-lr-r2** in-sample row elimination. Suppose for this filter, within the 50 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 **b50mLb |p≤4lr≤3r2≤80-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 **b50mLb |p≤4lr≤3r2≤80-mLTr filter** is then applied to each of the 512 in-sample sections which give 512 sets of strategy inputs that are used to produce the corresponding 512 out-of-sample performance results. The average out-of-sample performance is calculated from these 512 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 512 out-of-sample files of **(\$53.7)** with a bootstrap standard deviation of **\$69.1**. (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/512) and the average net weekly for the filter from **Figure 2, Row 3** would be the **filter toNP/ (# of OOS)** periods traded or **190321/481=395.68**. The probability of obtaining our filters average weekly net profit of **395.68** is **3.70×10^{-7}** which is **4.95** 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 **\$395.68** is **$[1 - (1 - 3.70 \times 10^{-7})^{172980}] \approx 172980 \times 3.70 \times 10^{-7} = 0.064$** 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 any random filter would beat our results or that our filter's 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 512 weeks ending 2/8/2013 – 11/25/22 and the equity curve on the 26 weeks following until 5/26/2023 (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 12/02/22 to 5/26/23. This is what would have happened if you used the strategy inputs found by the filter **b50mLb |p≤4lr≤3r2≤80** 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 3/28/23 to 3/31/23 with the RMedV Indicator or those dates.

Table 1 below presents a table of the 512 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 \$190321 net profits after costs in 512 weeks and \$18,379 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 82 weeks for this filter. This means that 82 weeks was the longest time that the equity for this strategy failed to make a new equity high in the 512 out-of-sample weeks. Note that this was at the beginning of the price data from 5/10/13 to 12/12/14 and the drawdown was -\$11,800. For this strategy, the **%P** (% of weekly oos periods that are positive) was **59%**, and the **%Wtr** (The % of all oos trades that are positive) was **45%**. This low **%Wtr** was made up for by **oW/oL** (average oos winning trades/average oos losing trades) equal to 1.6.

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 2 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 **b50mLb |p≤4|lr≤3r2≤80** filter on the 512 weeks of out-of-sample data. Notice how the equity curve follows the 2nd order polynomial trend line with an R² of 0.97. This R² dropped to 0.95 for the net equity curve.

Using this filter, the strategy generated a profit of \$208,700 net equity after commissions and slippage of \$13/trade trading one CL contract for the total 538 weeks. For slippage I used \$10 roundtrip and for commissions round trip, I used \$3. From **Table 1**, the largest losing week was -\$7180 on the week ending 2/16/2022. The largest drawdown was -\$11800 from the week ending on 4/3/13 to 5/29/13. This drawdown lasted 8 weeks and took 77 weeks of up and down equity to make a new high in equity. The start was disappointing. The **future** period that was not included in the WFME64 run from 12/02/22 to 5/26/23 was a volatile down market yet the RMedV strategy/WFME filter did well making a net profit of \$18,379 during that half-year time frame.

Lastly, as can be seen in **Figure 2**, the most of top 15 filters all did very well in the 52 **future** weeks from 12/02/22 to 5/26/23 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 31 of the 512 weeks to a high of 38 trades/week with an average of 9.1 trades/week in the weeks it did trade.

This is the 2nd paper where we used the RMedV strategy to trade CL 5min bars. The first paper,

1. 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>

was from 1/2/2008 to 6/10/2019. In that paper the filter was **t20t|p≤4|lr≤3-mDev** which is quite different than the filter found in this paper. This means that due to 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 also be investigated. Lastly why 10years of 5min data? Why not 5 years or 3 years? This is just a bias from the author.

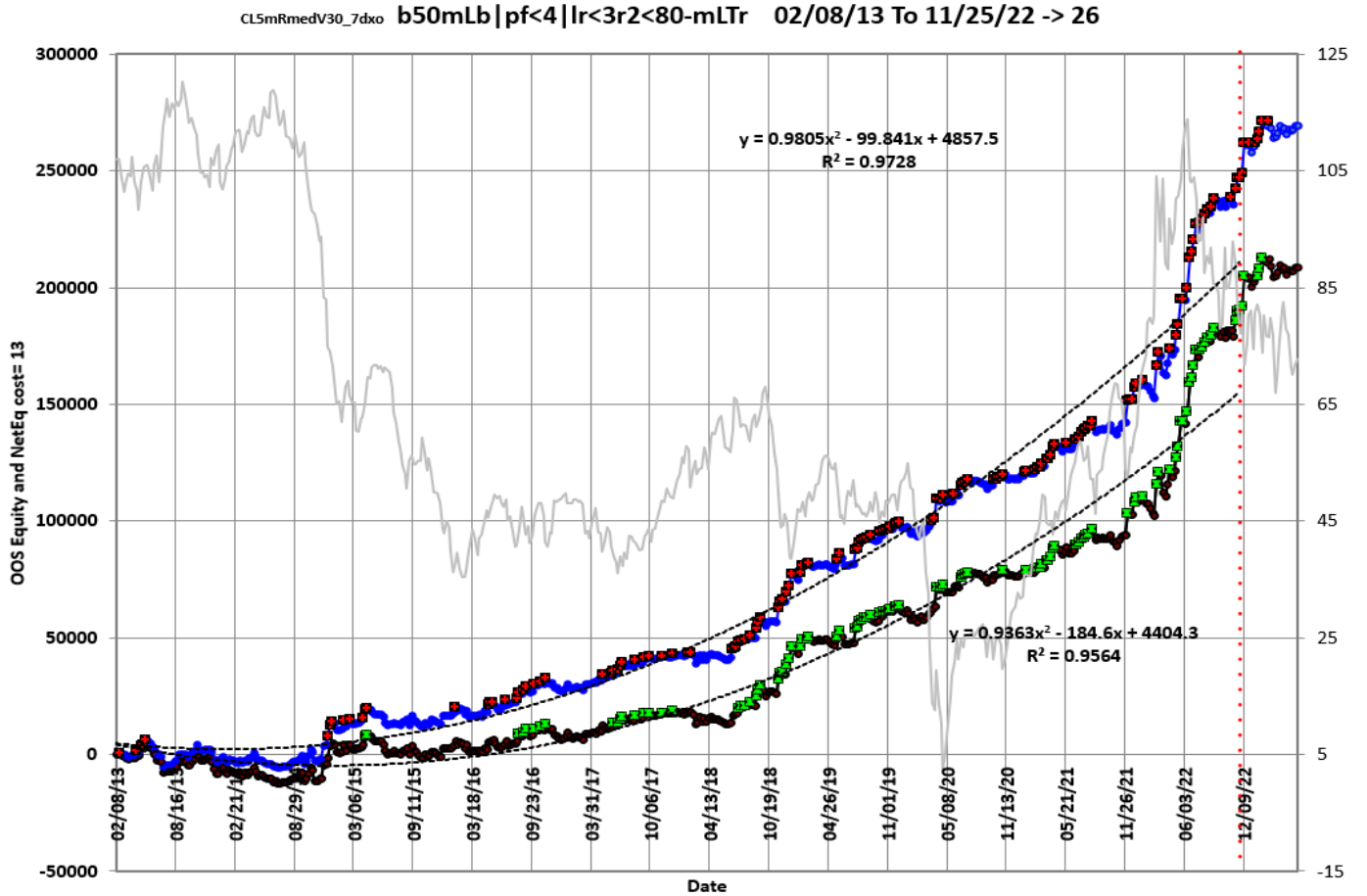
For all you who have read this paper and put up with the complex math wishing you good luck in your trading.

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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 1/2/2013 to 5/26/2023.

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 12/2/23 to 5/26/23. This is what would have happened if you used b50mLb |p≤4|r<3r2<80 filter on the 6 months following the 2/9/13-11/25/22 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	CL5mRmedV30-7dxo	s02/08/13	e11/25/22	#512	AnyTnp	#26						ISnt2								
2	Filter-Metric	toGP	toNP	aoGP	aoTr	ao#T	#	std	skew	kur	t	oW oL	%Wtr							
3	b50mLb pf<4 r<3r2<80-mLTr	247170	190321	514	56.5	9.1	481	2052	1.726	11.19	5.49	1.6	45							
4	t50mWb mLb pf<4 r<3-mLTr	226270	175349	469	57.8	8.1	482	1888	1.234	10.75	5.46	1.5	46							
5	t10wr pf<2 r<5r2<50-t	237520	173235	465	48	9.7	511	1919	1.338	8.27	5.48	1.52	45							
6	t20wr pf<3 r<5r2<50-t	230880	171171	453	50.3	9	510	1924	1.427	10.37	5.31	1.51	45							
7	b50mLb pf<4 r<3-eq10	216100	170600	469	61.7	7.6	461	1928	0.994	9.31	5.22	1.5	46							
8	b50mLb pf<3 r<3-eq10	217300	169057	471	58.6	8	461	1937	1.014	9.16	5.22	1.56	45							
9	b50mLb pf<3 r<3r2<80-mLTr	225960	167395	468	50.2	9.3	483	2041	1.698	11.4	5.04	1.57	44							
10	t50mWT LT pf<2 r<3-tnp	210850	163868	422	58.3	7.2	500	2020	1.717	10.27	4.67	1.4	47							
11	t10t pf<4 r<5r2<60-tWb	239570	163442	471	40.9	11.5	509	2073	1.334	10.06	5.12	1.58	44							
12	b50mLb lr<3r2<80-mLTr	207170	163412	470	61.5	7.6	441	2043	1.946	12.32	4.83	1.59	45							
13	t20wr pf<2 r<5r2<50-t	230940	163392	451	44.4	10.1	512	1966	1.185	7.25	5.19	1.51	45							
14	t20PF pf<2 r2<50-tWb	218880	163188	433	51.1	8.5	506	2012	1.162	7.52	4.84	1.5	45							
15	b20mLb pf<4 r<3r2<80-mLTr	224750	162649	465	47	9.9	483	2064	1.323	10.57	4.96	1.58	44							
	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	a53.7	s69.1						c=\$13						s12/02/22	e05/26/23	#26			t538	f172980
2	%P	LLp	eqDD	wpr	lpr	v20	acc	KTau	eqR2	Blw	BE	tkr bl		toGPx	toNPx	aoTRx	aoNTx	#x	tOnpNet	Prob
3	59	-7180	-11800	10	7	1318	1.96	92	88	82	71	764		22240	18379	75	11.4	26	208700	3.70E-07
4	59	-8890	-10100	10	5	1008	0.96	95	94	47	72	1428		4170	478	15	10.9	26	175827	3.58E-06
5	60	-4480	-9130	8	5	1119	1.05	96	94	47	72	1466		16110	12912	65	9.5	26	186147	1.81E-05
6	59	-5410	-10570	8	5	885	0.95	93	96	83	76	751		12340	9571	58	8.2	26	180742	2.24E-05
7	59	-8950	-10090	9	7	1002	0.97	93	92	51	79	1113		20300	17245	86	9.8	24	187845	2.33E-06
8	59	-8950	-10680	8	7	1016	1.12	93	89	51	79	1077		18860	15766	79	9.9	24	184823	2.93E-06
9	59	-7180	-18320	9	7	1200	2.02	91	86	98	85	476		21880	18071	75	11.3	26	185466	1.12E-05
10	58	-6070	-14450	17	10	1377	1.17	88	81	75	99	450		3270	(357)	12	10.7	26	163511	3.64E-05
11	59	-4870	-13510	8	6	1095	1.61	91	92	60	82	869		9400	3160	20	18.5	26	166602	5.42E-05
12	58	-7180	-13830	9	5	1139	1.87	91	84	82	92	483		17500	14159	68	10.7	24	177571	2.25E-06
13	59	-4370	-16220	9	7	897	0.66	94	97	83	80	716		7610	4360	30	9.6	26	167752	6.09E-05
14	58	-5600	-13620	9	10	1177	0.77	89	89	61	92	688		3160	(831)	10	11.8	26	162357	4.98E-05
15	58	-8170	-11060	7	5	1110	1.31	93	91	80	88	601		27410	23484	91	11.6	26	186133	2.09E-05

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, **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: **b50mLb|p<4lr<3r2<80:**

Col B: *toGP* - Total out-of-sample(oos) gross profit for these 512 oos periods (= weeks).

Col C: *toNP* - Total out-of-sample(oos) Net profit (toGP-Number of Trade Weeks*cost) for the 512 oos periods.

Col D: *aoGP* - Average oos gross profit for the 481 # 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 512 oos period profits and losses

Col I: *skew* - The Skew statistic of the 512 oos period profits and losses

Col J: *kur* - he kurtosis statistic of the 512 oos period profits and losses

Col K: *t* - The student t statistic for the 512 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: *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* - the largest number of losing oos periods in a row.

COLS: *v20* - the equity velocity for the latest 20 periods

Col T: *acc* - The acceleration of a 2nd order polynomial fit to the oos equity curve.

Col U: *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 V: *eqR2* - The correlation coefficient(R²) of a straight-line fit to the equity curve.

Col W: *Blw* - The maximum number of oos periods the oos equity curve failed to make a new high.

Col X: *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 Y: *tkr/bl* = $t * ktau * eqR2 / Blw$ a measure of how good the filter fit is.

Col AA: *toGPx* Total gross profit for the 52 future excluded periods (for this run periods = weeks).

Col AB: *toNPx* Total Net profit {toGP-Number of Trade Weeks(#)*cost} for the 52 future excluded periods.

Col AC: *aoTrx* Average profit per trade for the 52 future excluded periods

Col AD: *aoNTx* Average number of trades per week for the 52 future excluded periods

Col AE: *#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 AF: *tOnpNet* - toNP+toNPx = Total Net Profits of oos+future periods

Col AG: *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. 3/28/23 to 3/31/23



**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	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
01/02/13	02/01/13	02/04/13	02/08/13	270	244	2	-20	-20	270	244	20	2	2.75
01/09/13	02/08/13	02/11/13	02/15/13	490	360	10	-570	-1020	760	604	14	0.75	0.5
01/16/13	02/15/13	02/18/13	02/22/13	(440)	(648)	16	-670	-1440	320	(44)	19	0.5	0.25
01/23/13	02/22/13	02/25/13	03/01/13	(100)	(360)	20	-350	-800	220	(404)	9	1	0.75
01/30/13	03/01/13	03/04/13	03/08/13	(830)	(921)	7	-560	-1730	(610)	(1325)	3	2.25	1.75
02/06/13	03/08/13	03/11/13	03/15/13	(690)	(703)	1	-690	-690	(1300)	(2028)	2	3.5	3.5
02/13/13	03/15/13	03/18/13	03/22/13	1150	1046	8	-700	-990	(150)	(982)	15	1.25	2
02/20/13	03/22/13	03/25/13	03/29/13	(310)	(349)	3	-630	-630	(460)	(1331)	11	1.5	3.5
02/27/13	03/29/13	04/01/13	04/05/13	260	208	4	-360	-660	(200)	(1123)	18	1.5	2.75
03/06/13	04/05/13	04/08/13	04/12/13	1840	1775	5	-190	-190	1640	652	11	1.5	3
03/13/13	04/12/13	04/15/13	04/19/13	(890)	(955)	5	-1390	-1390	750	(303)	21	1.25	3
03/20/13	04/19/13	04/22/13	04/26/13	2760	2695	5	-60	-60	3510	2392	19	1.5	3.5
03/27/13	04/26/13	04/29/13	05/03/13	910	897	1	0	0	4420	3289	22	2.75	3
04/03/13	05/03/13	05/06/13	05/10/13	1960	1921	3	-20	-20	6380	5210	19	1.5	3.5
04/10/13	05/10/13	05/13/13	05/17/13	(310)	(401)	7	-910	-1450	6070	4809	11	1.25	2.5
04/17/13	05/17/13	05/20/13	05/24/13	(1310)	(1531)	17	-860	-3600	4760	3278	8	0.25	1.75
04/24/13	05/24/13	05/27/13	05/31/13	(1470)	(1522)	4	-1290	-1960	3290	1756	16	1.75	3
05/01/13	05/31/13	06/03/13	06/07/13	(1080)	(1288)	16	-750	-1610	2210	468	22	0.25	0.25
05/08/13	06/07/13	06/10/13	06/14/13	(2320)	(2515)	15	-560	-3080	(110)	(2047)	2	2	1.25
05/15/13	06/14/13	06/17/13	06/21/13	310	219	7	-510	-510	200	(1828)	8	0.25	2.25
05/22/13	06/21/13	06/24/13	06/28/13	(910)	(1183)	21	-1310	-2260	(710)	(3011)	2	2.5	0.25
05/29/13	06/28/13	07/01/13	07/05/13	(4570)	(4726)	12	-1050	-4570	(5280)	(7737)	6	2.25	0.5
06/05/13	07/05/13	07/08/13	07/12/13	780	767	1	0	0	(4500)	(6970)	13	2.75	3
06/12/13	07/12/13	07/15/13	07/19/13	0	0	0	0	0	(4500)	(6970)	22	2.75	3.5
06/19/13	07/19/13	07/22/13	07/26/13	(20)	(33)	1	-20	-20	(4520)	(7003)	22	2.75	3.5
06/26/13	07/26/13	07/29/13	08/02/13	730	717	1	0	0	(3790)	(6286)	19	2.25	3.5
07/03/13	08/02/13	08/05/13	08/09/13	1220	1012	16	-540	-880	(2570)	(5274)	7	1.5	0.75
07/10/13	08/09/13	08/12/13	08/16/13	490	308	14	-470	-860	(2080)	(4966)	7	1.5	1.5
07/17/13	08/16/13	08/19/13	08/23/13	2480	2324	12	-1000	-1000	400	(2642)	3	0.75	3.5
07/24/13	08/23/13	08/26/13	08/30/13	0	0	0	0	0	400	(2642)	23	2.5	3.5
07/31/13	08/30/13	09/02/13	09/06/13	0	0	0	0	0	400	(2642)	23	2.5	3.5
08/07/13	09/06/13	09/09/13	09/13/13	0	0	0	0	0	400	(2642)	23	2.5	3.5
08/14/13	09/13/13	09/16/13	09/20/13	(1810)	(1927)	9	-1290	-3380	(1410)	(4569)	8	0.5	2.5
08/21/13	09/20/13	09/23/13	09/27/13	410	397	1	0	0	(1000)	(4172)	2	3.5	3.5
08/28/13	09/27/13	09/30/13	10/04/13	1570	1557	1	0	0	570	(2615)	11	3.25	3.25
09/04/13	10/04/13	10/07/13	10/11/13	1090	973	9	-780	-780	1660	(1642)	15	0.75	1.75
09/11/13	10/11/13	10/14/13	10/18/13	2780	2663	9	-390	-390	4440	1021	4	1.5	2
09/18/13	10/18/13	10/21/13	10/25/13	(1880)	(1997)	9	-880	-2960	2560	(976)	12	1	1.75

in-sample dates		out-of-sample dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
09/25/13	10/25/13	10/28/13	11/01/13	(970)	(1074)	8	-990	-1800	1590	(2050)	4	0.25	2.25
10/02/13	11/01/13	11/04/13	11/08/13	80	(76)	12	-540	-1000	1670	(2126)	4	0.75	2.25
10/09/13	11/08/13	11/11/13	11/15/13	480	337	11	-670	-1060	2150	(1789)	13	0.5	1.25
10/16/13	11/15/13	11/18/13	11/22/13	360	321	3	-440	-440	2510	(1468)	23	3.5	0.75
10/23/13	11/22/13	11/25/13	11/29/13	0	0	0	0	0	2510	(1468)	18	2.75	3.25
10/30/13	11/29/13	12/02/13	12/06/13	(1160)	(1264)	8	-1200	-1650	1350	(2732)	17	2	0.25
11/06/13	12/06/13	12/09/13	12/13/13	(3150)	(3410)	20	-580	-3150	(1800)	(6142)	8	0.25	1.25
11/13/13	12/13/13	12/16/13	12/20/13	(1730)	(1873)	11	-740	-1730	(3530)	(8015)	7	1.75	0.25
11/20/13	12/20/13	12/23/13	12/27/13	30	(22)	4	-140	-260	(3500)	(8037)	5	1.25	1.5
11/27/13	12/27/13	12/30/13	01/03/14	1900	1874	2	0	0	(1600)	(6163)	19	2.75	1.5
12/04/13	01/03/14	01/06/14	01/10/14	630	604	2	-50	-50	(970)	(5559)	5	2.5	2.25
12/11/13	01/10/14	01/13/14	01/17/14	(1350)	(1467)	9	-490	-1390	(2320)	(7026)	6	1.5	1.75
12/18/13	01/17/14	01/20/14	01/24/14	(760)	(825)	5	-310	-780	(3080)	(7851)	17	1.75	0.5
12/25/13	01/24/14	01/27/14	01/31/14	1330	1239	7	-310	-730	(1750)	(6612)	12	1.5	0.25
01/01/14	01/31/14	02/03/14	02/07/14	(380)	(484)	8	-1720	-1720	(2130)	(7096)	11	2	0.25
01/08/14	02/07/14	02/10/14	02/14/14	(220)	(285)	5	-560	-560	(2350)	(7381)	7	2.25	1
01/15/14	02/14/14	02/17/14	02/21/14	(790)	(855)	5	-550	-810	(3140)	(8236)	7	2	1
01/22/14	02/21/14	02/24/14	02/28/14	(300)	(404)	8	-560	-1120	(3440)	(8640)	4	1.25	2.75
01/29/14	02/28/14	03/03/14	03/07/14	1160	1030	10	-680	-780	(2280)	(7610)	6	0.75	2.25
02/05/14	03/07/14	03/10/14	03/14/14	(1280)	(1384)	8	-720	-1600	(3560)	(8994)	4	0.5	2.5
02/12/14	03/14/14	03/17/14	03/21/14	1440	1323	9	-570	-570	(2120)	(7671)	5	1	2.75
02/19/14	03/21/14	03/24/14	03/28/14	(760)	(890)	10	-660	-1060	(2880)	(8561)	9	0.5	1.75
02/26/14	03/28/14	03/31/14	04/04/14	1410	1306	8	-370	-580	(1470)	(7255)	3	2.25	1.75
03/05/14	04/04/14	04/07/14	04/11/14	290	199	7	-1020	-1090	(1180)	(7056)	15	1.75	0.25
03/12/14	04/11/14	04/14/14	04/18/14	1880	1750	10	-260	-260	700	(5306)	7	0.5	1.25
03/19/14	04/18/14	04/21/14	04/25/14	(1640)	(1796)	12	-460	-1870	(940)	(7102)	10	0.25	1.25
03/26/14	04/25/14	04/28/14	05/02/14	(1600)	(1743)	11	-670	-1620	(2540)	(8845)	4	1.5	1.75
04/02/14	05/02/14	05/05/14	05/09/14	180	128	4	-90	-90	(2360)	(8717)	18	2.5	1.25
04/09/14	05/09/14	05/12/14	05/16/14	0	0	0	0	0	(2360)	(8717)	18	2.75	1.25
04/16/14	05/16/14	05/19/14	05/23/14	(880)	(945)	5	-680	-900	(3240)	(9662)	4	2.5	0.25
04/23/14	05/23/14	05/26/14	05/30/14	(540)	(631)	7	-770	-1200	(3780)	(10293)	3	0.5	2
04/30/14	05/30/14	06/02/14	06/06/14	10	(3)	1	0	0	(3770)	(10296)	11	2.5	2.5
05/07/14	06/06/14	06/09/14	06/13/14	0	0	0	0	0	(3770)	(10296)	11	2.5	2.75
05/14/14	06/13/14	06/16/14	06/20/14	(1380)	(1445)	5	-790	-1470	(5150)	(11741)	16	1	1.75
05/21/14	06/20/14	06/23/14	06/27/14	450	411	3	-20	-20	(4700)	(11330)	21	1.25	1.75
05/28/14	06/27/14	06/30/14	07/04/14	(690)	(742)	4	-610	-780	(5390)	(12072)	15	2	2
06/04/14	07/04/14	07/07/14	07/11/14	(30)	(43)	1	-30	-30	(5420)	(12115)	22	1.25	2.25
06/11/14	07/11/14	07/14/14	07/18/14	570	531	3	-40	-40	(4850)	(11584)	22	1.25	2.5
06/18/14	07/18/14	07/21/14	07/25/14	(170)	(196)	2	-120	-170	(5020)	(11780)	17	2	2
06/25/14	07/25/14	07/28/14	08/01/14	190	177	1	0	0	(4830)	(11603)	24	2	2.25
07/02/14	08/01/14	08/04/14	08/08/14	260	247	1	0	0	(4570)	(11356)	14	3	2
07/09/14	08/08/14	08/11/14	08/15/14	860	808	4	-250	-480	(3710)	(10548)	16	1.5	1.75
07/16/14	08/15/14	08/18/14	08/22/14	650	611	3	-80	-80	(3060)	(9937)	10	1	3
07/23/14	08/22/14	08/25/14	08/29/14	370	318	4	-200	-280	(2690)	(9619)	10	1	3
07/30/14	08/29/14	09/01/14	09/05/14	330	317	1	0	0	(2360)	(9302)	8	2.5	2.75
08/06/14	09/05/14	09/08/14	09/12/14	690	664	2	-920	-920	(1670)	(8638)	7	2	2.75
08/13/14	09/12/14	09/15/14	09/19/14	1310	1102	16	-820	-2310	(360)	(7536)	3	0.75	2.5
08/20/14	09/19/14	09/22/14	09/26/14	(3560)	(3638)	6	-1480	-3600	(3920)	(11174)	7	2	2.75
08/27/14	09/26/14	09/29/14	10/03/14	1330	1044	22	-890	-1690	(2590)	(10130)	3	0.25	2.5
09/03/14	10/03/14	10/06/14	10/10/14	2270	2101	13	-450	-990	(320)	(8029)	4	2.25	1.75
09/10/14	10/10/14	10/13/14	10/17/14	2800	2722	6	-1050	-1320	2480	(5307)	2	3.5	3.5
09/17/14	10/17/14	10/20/14	10/24/14	(1120)	(1367)	19	-1180	-3680	1360	(6674)	5	1	2.5
09/24/14	10/24/14	10/27/14	10/31/14	(3920)	(4284)	28	-520	-4630	(2560)	(10958)	12	0.25	0.5
10/01/14	10/31/14	11/03/14	11/07/14	(340)	(353)	1	-340	-340	(2900)	(11311)	16	3	3.5
10/08/14	11/07/14	11/10/14	11/14/14	1060	969	7	-970	-970	(1840)	(10342)	5	1.5	3.5
10/15/14	11/14/14	11/17/14	11/21/14	0	0	0	0	0	(1840)	(10342)	20	2.5	3.25
10/22/14	11/21/14	11/24/14	11/28/14	5980	5941	3	0	0	4140	(4401)	7	3.25	3
10/29/14	11/28/14	12/01/14	12/05/14	440	336	8	-280	-640	4580	(4065)	14	0.25	2.25
11/05/14	12/05/14	12/08/14	12/12/14	3000	2909	7	-590	-590	7580	(1156)	11	2	0.5
11/12/14	12/12/14	12/15/14	12/19/14	5150	4916	18	-900	-1770	12730	3760	7	0.5	2.25
11/19/14	12/19/14	12/22/14	12/26/14	1140	1023	9	-1080	-1230	13870	4783	6	2.75	0.5

in-sample dates		out-of-sample dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
11/26/14	12/26/14	12/29/14	01/02/15	(20)	(111)	7	-640	-2100	13850	4672	3	3	0.75
12/03/14	01/02/15	01/05/15	01/09/15	(3180)	(3375)	15	-1140	-4000	10670	1297	6	0.75	2.75
12/10/14	01/09/15	01/12/15	01/16/15	20	(357)	29	-750	-3660	10690	940	4	2	2
12/17/14	01/16/15	01/19/15	01/23/15	650	520	10	-400	-520	11340	1460	2	3.25	0.25
12/24/14	01/23/15	01/26/15	01/30/15	3130	3039	7	-870	-1160	14470	4499	6	1.25	2
12/31/14	01/30/15	02/02/15	02/06/15	(2290)	(2550)	20	-1390	-4620	12180	1949	2	3.5	0.5
01/07/15	02/06/15	02/09/15	02/13/15	2140	1945	15	-590	-1530	14320	3894	6	2	2
01/14/15	02/13/15	02/16/15	02/20/15	540	319	17	-930	-1670	14860	4213	15	0.25	0.5
01/21/15	02/20/15	02/23/15	02/27/15	(1400)	(1621)	17	-630	-2590	13460	2592	14	0.5	1
01/28/15	02/27/15	03/02/15	03/06/15	(330)	(447)	9	-490	-1200	13130	2145	8	1.5	2.5
02/04/15	03/06/15	03/09/15	03/13/15	720	603	9	-550	-560	13850	2748	19	0.5	1.25
02/11/15	03/13/15	03/16/15	03/20/15	40	1	3	-500	-860	13890	2749	6	3.25	3.5
02/18/15	03/20/15	03/23/15	03/27/15	770	757	1	0	0	14660	3506	10	3.5	3.25
02/25/15	03/27/15	03/30/15	04/03/15	1040	1027	1	0	0	15700	4533	10	3.5	3.25
03/04/15	04/03/15	04/06/15	04/10/15	3470	3431	3	0	0	19170	7964	13	3	3
03/11/15	04/10/15	04/13/15	04/17/15	630	604	2	-440	-440	19800	8568	19	2.5	3.25
03/18/15	04/17/15	04/20/15	04/24/15	(460)	(499)	3	-440	-460	19340	8069	15	2.25	3
03/25/15	04/24/15	04/27/15	05/01/15	(930)	(995)	5	-850	-930	18410	7074	23	2.5	0.25
04/01/15	05/01/15	05/04/15	05/08/15	(820)	(859)	3	-830	-930	17590	6215	15	2.25	3
04/08/15	05/08/15	05/11/15	05/15/15	(370)	(435)	5	-990	-990	17220	5780	2	3.5	1.5
04/15/15	05/15/15	05/18/15	05/22/15	230	165	5	-820	-1190	17450	5945	6	3.25	0.25
04/22/15	05/22/15	05/25/15	05/29/15	(80)	(171)	7	-730	-1060	17370	5774	5	2.75	1.5
04/29/15	05/29/15	06/01/15	06/05/15	(1100)	(1321)	17	-550	-2870	16270	4453	10	1.5	0.25
05/06/15	06/05/15	06/08/15	06/12/15	(2280)	(2449)	13	-700	-2680	13990	2004	3	2.25	1.5
05/13/15	06/12/15	06/15/15	06/19/15	(1480)	(1649)	13	-780	-2280	12510	355	10	0.75	1.25
05/20/15	06/19/15	06/22/15	06/26/15	500	461	3	0	0	13010	816	8	2.5	3
05/27/15	06/26/15	06/29/15	07/03/15	0	0	0	0	0	13010	816	13	2.25	3.5
06/03/15	07/03/15	07/06/15	07/10/15	830	778	4	-90	-90	13840	1594	13	2.25	3.5
06/10/15	07/10/15	07/13/15	07/17/15	(560)	(599)	3	-1240	-1240	13280	995	2	2.75	3
06/17/15	07/17/15	07/20/15	07/24/15	0	0	0	0	0	13280	995	2	3.25	3
06/24/15	07/24/15	07/27/15	07/31/15	(390)	(481)	7	-1020	-2050	12890	514	2	2.75	0.5
07/01/15	07/31/15	08/03/15	08/07/15	1550	1511	3	-160	-160	14440	2025	3	3.5	1.75
07/08/15	08/07/15	08/10/15	08/14/15	(20)	(98)	6	-310	-540	14420	1927	4	2.5	1.75
07/15/15	08/14/15	08/17/15	08/21/15	900	861	3	-40	-40	15320	2788	6	3.25	2
07/22/15	08/21/15	08/24/15	08/28/15	(2370)	(2617)	19	-960	-3580	12950	171	4	2.75	0.25
07/29/15	08/28/15	08/31/15	09/04/15	3990	3769	17	-1140	-1920	16940	3940	6	2.5	1.75
08/05/15	09/04/15	09/07/15	09/11/15	(2240)	(2292)	4	-1360	-2490	14700	1648	8	3.5	2.25
08/12/15	09/11/15	09/14/15	09/18/15	(310)	(362)	4	-930	-960	14390	1286	2	2	3.25
08/19/15	09/18/15	09/21/15	09/25/15	(1330)	(1395)	5	-1310	-1330	13060	(109)	2	2	3.25
08/26/15	09/25/15	09/28/15	10/02/15	(970)	(1100)	10	-1060	-2180	12090	(1209)	4	0.5	2.75
09/02/15	10/02/15	10/05/15	10/09/15	140	23	9	-1030	-1690	12230	(1186)	5	1	3
09/09/15	10/09/15	10/12/15	10/16/15	1550	1433	9	-490	-1280	13780	247	18	1.25	1.25
09/16/15	10/16/15	10/19/15	10/23/15	(970)	(1048)	6	-370	-1170	12810	(801)	4	0.5	2.75
09/23/15	10/23/15	10/26/15	10/30/15	450	359	7	-420	-900	13260	(442)	16	1.25	1.25
09/30/15	10/30/15	11/02/15	11/06/15	1880	1828	4	-240	-240	15140	1386	9	1.5	2.5
10/07/15	11/06/15	11/09/15	11/13/15	(210)	(223)	1	-210	-210	14930	1163	19	1.75	3
10/14/15	11/13/15	11/16/15	11/20/15	(390)	(416)	2	-660	-660	14540	747	21	2.5	3.25
10/21/15	11/20/15	11/23/15	11/27/15	(800)	(826)	2	-420	-800	13740	(79)	20	1.75	3.25
10/28/15	11/27/15	11/30/15	12/04/15	(540)	(644)	8	-1110	-2030	13200	(723)	6	2.75	0.5
11/04/15	12/04/15	12/07/15	12/11/15	3600	3509	7	-120	-120	16800	2786	7	1.75	0.75
11/11/15	12/11/15	12/14/15	12/18/15	270	218	4	-120	-120	17070	3004	15	2.75	2
11/18/15	12/18/15	12/21/15	12/25/15	0	0	0	0	0	17070	3004	16	2.75	2.25
11/25/15	12/25/15	12/28/15	01/01/16	80	28	4	-100	-110	17150	3032	7	1	1.5
12/02/15	01/01/16	01/04/16	01/08/16	(140)	(153)	1	-140	-140	17010	2879	24	3	2.25
12/09/15	01/08/16	01/11/16	01/15/16	990	938	4	0	0	18000	3817	7	3.5	2.25
12/16/15	01/15/16	01/18/16	01/22/16	2150	2007	11	-430	-640	20150	5824	24	0.25	0.25
12/23/15	01/22/16	01/25/16	01/29/16	(1410)	(1488)	6	-870	-1820	18740	4336	20	3.25	1.5
12/30/15	01/29/16	02/01/16	02/05/16	1110	1006	8	-1230	-1400	19850	5342	2	3.5	2.25
01/06/16	02/05/16	02/08/16	02/12/16	(270)	(374)	8	-1000	-1400	19580	4968	4	2.75	2.5
01/13/16	02/12/16	02/15/16	02/19/16	(2090)	(2337)	19	-620	-2090	17490	2631	9	1	0.5
01/20/16	02/19/16	02/22/16	02/26/16	1730	1639	7	-960	-1390	19220	4270	13	1.75	1

in-sample dates		out-of-sample dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
01/27/16	02/26/16	02/29/16	03/04/16	(2800)	(2969)	13	-810	-2850	16420	1301	8	1.75	0.75
02/03/16	03/04/16	03/07/16	03/11/16	550	537	1	0	0	16970	1838	22	3.5	2.75
02/10/16	03/11/16	03/14/16	03/18/16	0	0	0	0	0	16970	1838	24	3	3.5
02/17/16	03/18/16	03/21/16	03/25/16	0	0	0	0	0	16970	1838	24	3	3.5
02/24/16	03/25/16	03/28/16	04/01/16	0	0	0	0	0	16970	1838	23	3	3
03/02/16	04/01/16	04/04/16	04/08/16	310	167	11	-900	-910	17280	2005	3	0.75	2.25
03/09/16	04/08/16	04/11/16	04/15/16	(650)	(871)	17	-570	-1920	16630	1134	3	1	2
03/16/16	04/15/16	04/18/16	04/22/16	2220	1921	23	-380	-2190	18850	3055	2	0.5	1.75
03/23/16	04/22/16	04/25/16	04/29/16	(580)	(645)	5	-950	-1470	18270	2410	5	2.25	1.5
03/30/16	04/29/16	05/02/16	05/06/16	3010	2906	8	-490	-620	21280	5316	5	2.5	1.25
04/06/16	05/06/16	05/09/16	05/13/16	840	788	4	-780	-780	22120	6104	2	3	2.75
04/13/16	05/13/16	05/16/16	05/20/16	300	248	4	-390	-390	22420	6352	13	1	2.75
04/20/16	05/20/16	05/23/16	05/27/16	(1310)	(1401)	7	-640	-1870	21110	4951	4	2	1.5
04/27/16	05/27/16	05/30/16	06/03/16	(1540)	(1618)	6	-700	-1540	19570	3333	3	2	3.25
05/04/16	06/03/16	06/06/16	06/10/16	110	(150)	20	-260	-900	19680	3183	17	0.25	0.25
05/11/16	06/10/16	06/13/16	06/17/16	610	441	13	-540	-1260	20290	3624	8	0.25	1.25
05/18/16	06/17/16	06/20/16	06/24/16	820	638	14	-580	-630	21110	4262	3	0.75	1.75
05/25/16	06/24/16	06/27/16	07/01/16	2140	1919	17	-490	-710	23250	6181	4	0.25	1.5
06/01/16	07/01/16	07/04/16	07/08/16	(1770)	(2017)	19	-1110	-2280	21480	4164	4	0.25	2
06/08/16	07/08/16	07/11/16	07/15/16	410	306	8	-580	-820	21890	4470	5	1.5	1.5
06/15/16	07/15/16	07/18/16	07/22/16	750	646	8	-600	-600	22640	5116	6	1.25	1.25
06/22/16	07/22/16	07/25/16	07/29/16	130	78	4	-290	-290	22770	5194	3	2	2
06/29/16	07/29/16	08/01/16	08/05/16	1080	833	19	-620	-1360	23850	6027	2	1.25	0.75
07/06/16	08/05/16	08/08/16	08/12/16	2730	2678	4	-430	-430	26580	8705	3	2	3.25
07/13/16	08/12/16	08/15/16	08/19/16	(430)	(690)	20	-500	-1890	26150	8015	4	1.25	1.25
07/20/16	08/19/16	08/22/16	08/26/16	1320	1138	14	-290	-880	27470	9153	13	0.25	0.75
07/27/16	08/26/16	08/29/16	09/02/16	1620	1529	7	-480	-480	29090	10682	4	1.25	2
08/03/16	09/02/16	09/05/16	09/09/16	(1080)	(1171)	7	-1020	-1830	28010	9511	4	1.25	2
08/10/16	09/09/16	09/12/16	09/16/16	(1150)	(1345)	15	-460	-1150	26860	8166	4	1.25	2
08/17/16	09/16/16	09/19/16	09/23/16	530	309	17	-630	-1060	27390	8475	3	0.25	1.75
08/24/16	09/23/16	09/26/16	09/30/16	2850	2629	17	-330	-890	30240	11104	3	0.25	1.75
08/31/16	09/30/16	10/03/16	10/07/16	(570)	(661)	7	-700	-1010	29670	10443	4	0.25	2
09/07/16	10/07/16	10/10/16	10/14/16	520	390	10	-590	-830	30190	10833	4	0.25	2
09/14/16	10/14/16	10/17/16	10/21/16	1010	919	7	-290	-290	31200	11752	10	0.25	1.5
09/21/16	10/21/16	10/24/16	10/28/16	(910)	(936)	2	-840	-910	30290	10816	4	2.75	3.25
09/28/16	10/28/16	10/31/16	11/04/16	2290	2173	9	-450	-640	32580	12989	6	1.25	0.5
10/05/16	11/04/16	11/07/16	11/11/16	(1430)	(1547)	9	-980	-2100	31150	11442	4	2.25	0.75
10/12/16	11/11/16	11/14/16	11/18/16	(820)	(950)	10	-550	-820	30330	10492	2	1.5	1.5
10/19/16	11/18/16	11/21/16	11/25/16	660	478	14	-440	-1120	30990	10970	5	1.25	0.75
10/26/16	11/25/16	11/28/16	12/02/16	(2330)	(2590)	20	-570	-2400	28660	8380	2	1.5	1.5
11/02/16	12/02/16	12/05/16	12/09/16	40	(51)	7	-620	-660	28700	8329	3	0.25	3.25
11/09/16	12/09/16	12/12/16	12/16/16	(1030)	(1134)	8	-1050	-2800	27670	7195	3	1.25	2.5
11/16/16	12/16/16	12/19/16	12/23/16	(310)	(453)	11	-500	-1760	27360	6742	2	0.25	2
11/23/16	12/23/16	12/26/16	12/30/16	330	304	2	-70	-70	27690	7046	10	0.75	1.75
11/30/16	12/30/16	01/02/17	01/06/17	910	871	3	-910	-910	28600	7917	24	1.75	1.5
12/07/16	01/06/17	01/09/17	01/13/17	1740	1545	15	-300	-1040	30340	9462	10	0.75	0.5
12/14/16	01/13/17	01/16/17	01/20/17	(1330)	(1408)	6	-560	-1330	29010	8054	23	0.25	1.5
12/21/16	01/20/17	01/23/17	01/27/17	(810)	(888)	6	-420	-950	28200	7166	17	0.5	1.25
12/28/16	01/27/17	01/30/17	02/03/17	750	607	11	-440	-530	28950	7773	7	1.5	0.25
01/04/17	02/03/17	02/06/17	02/10/17	370	331	3	-100	-100	29320	8104	21	2.25	1
01/11/17	02/10/17	02/13/17	02/17/17	(610)	(662)	4	-600	-730	28710	7442	19	2.75	0.75
01/18/17	02/17/17	02/20/17	02/24/17	(80)	(106)	2	-80	-80	28630	7336	19	2.75	0.75
01/25/17	02/24/17	02/27/17	03/03/17	(880)	(971)	7	-640	-1240	27750	6365	9	1.5	0.25
02/01/17	03/03/17	03/06/17	03/10/17	2840	2762	6	-420	-420	30590	9127	19	1.5	0.75
02/08/17	03/10/17	03/13/17	03/17/17	0	0	0	0	0	30590	9127	5	2.75	3.5
02/15/17	03/17/17	03/20/17	03/24/17	0	0	0	0	0	30590	9127	2	3.5	2.75
02/22/17	03/24/17	03/27/17	03/31/17	390	377	1	0	0	30980	9504	2	3.5	2.75
03/01/17	03/31/17	04/03/17	04/07/17	220	129	7	-500	-500	31200	9633	2	0.5	1.75
03/08/17	04/07/17	04/10/17	04/14/17	(210)	(275)	5	-360	-590	30990	9358	17	0.75	0.25
03/15/17	04/14/17	04/17/17	04/21/17	1580	1437	11	-470	-770	32570	10795	16	0.25	0.5
03/22/17	04/21/17	04/24/17	04/28/17	(420)	(446)	2	-520	-520	32150	10349	12	1.5	3

in-sample dates		out-of-sample dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
03/29/17	04/28/17	05/01/17	05/05/17	2320	2242	6	-150	-150	34470	12591	13	0.75	0.5
04/05/17	05/05/17	05/08/17	05/12/17	(560)	(755)	15	-360	-1200	33910	11836	19	0.25	0.25
04/12/17	05/12/17	05/15/17	05/19/17	(460)	(577)	9	-780	-1590	33450	11259	6	1.5	0.25
04/19/17	05/19/17	05/22/17	05/26/17	680	576	8	-500	-830	34130	11835	19	0.75	0.25
04/26/17	05/26/17	05/29/17	06/02/17	490	334	12	-510	-870	34620	12169	4	1.5	1
05/03/17	06/02/17	06/05/17	06/09/17	1450	1320	10	-290	-720	36070	13489	15	0.5	0.75
05/10/17	06/09/17	06/12/17	06/16/17	(860)	(912)	4	-610	-1140	35210	12577	14	0.5	1
05/17/17	06/16/17	06/19/17	06/23/17	970	931	3	0	0	36180	13508	10	1.25	1.25
05/24/17	06/23/17	06/26/17	06/30/17	1570	1466	8	-200	-200	37750	14974	7	0.5	1.25
05/31/17	06/30/17	07/03/17	07/07/17	1490	1334	12	-580	-930	39240	16308	2	1.25	0.25
06/07/17	07/07/17	07/10/17	07/14/17	(950)	(1262)	24	-540	-950	38290	15046	2	1.25	0.5
06/14/17	07/14/17	07/17/17	07/21/17	110	97	1	0	0	38400	15143	24	1	2.25
06/21/17	07/21/17	07/24/17	07/28/17	560	508	4	0	0	38960	15651	24	1	2.25
06/28/17	07/28/17	07/31/17	08/04/17	(630)	(643)	1	-630	-630	38330	15008	21	1.75	2.5
07/05/17	08/04/17	08/07/17	08/11/17	90	(27)	9	-570	-1500	38420	14981	3	1.5	2.5
07/12/17	08/11/17	08/14/17	08/18/17	1960	1882	6	-940	-940	40380	16863	6	0.75	2
07/19/17	08/18/17	08/21/17	08/25/17	(410)	(592)	14	-290	-1090	39970	16271	13	0.5	0.5
07/26/17	08/25/17	08/28/17	09/01/17	(840)	(944)	8	-430	-1250	39130	15327	2	1.25	2.25
08/02/17	09/01/17	09/04/17	09/08/17	760	734	2	0	0	39890	16061	9	2.75	2.25
08/09/17	09/08/17	09/11/17	09/15/17	1480	1389	7	-340	-340	41370	17450	5	0.25	2.25
08/16/17	09/15/17	09/18/17	09/22/17	(100)	(165)	5	-320	-320	41270	17285	4	1.25	2.5
08/23/17	09/22/17	09/25/17	09/29/17	530	465	5	-430	-540	41800	17750	23	0.75	0.25
08/30/17	09/29/17	10/02/17	10/06/17	(480)	(571)	7	-580	-880	41320	17179	7	1	2
09/06/17	10/06/17	10/09/17	10/13/17	(270)	(283)	1	-270	-270	41050	16896	16	1.5	1.75
09/13/17	10/13/17	10/16/17	10/20/17	0	0	0	0	0	41050	16896	22	2	1.5
09/20/17	10/20/17	10/23/17	10/27/17	520	507	1	0	0	41570	17403	22	2	1.5
09/27/17	10/27/17	10/30/17	11/03/17	(30)	(43)	1	-30	-30	41540	17360	22	2	1.5
10/04/17	11/03/17	11/06/17	11/10/17	630	565	5	-300	-730	42170	17925	19	0.5	1.5
10/11/17	11/10/17	11/13/17	11/17/17	(20)	(33)	1	-20	-20	42150	17892	22	2.75	1.75
10/18/17	11/17/17	11/20/17	11/24/17	0	0	0	0	0	42150	17892	19	2.75	2.5
10/25/17	11/24/17	11/27/17	12/01/17	(170)	(183)	1	-170	-170	41980	17709	19	2.75	2.5
11/01/17	12/01/17	12/04/17	12/08/17	0	0	0	0	0	41980	17709	18	3	2.75
11/08/17	12/08/17	12/11/17	12/15/17	1060	995	5	-230	-230	43040	18704	5	1	2.25
11/15/17	12/15/17	12/18/17	12/22/17	(500)	(565)	5	-680	-1100	42540	18139	5	1	2.25
11/22/17	12/22/17	12/25/17	12/29/17	390	364	2	-180	-180	42930	18503	9	1.5	1
11/29/17	12/29/17	01/01/18	01/05/18	(350)	(363)	1	-350	-350	42580	18140	5	1.75	1.75
12/06/17	01/05/18	01/08/18	01/12/18	270	231	3	-580	-580	42850	18371	10	1.25	1
12/13/17	01/12/18	01/15/18	01/19/18	(630)	(786)	12	-610	-1280	42220	17585	5	0.25	1.25
12/20/17	01/19/18	01/22/18	01/26/18	660	452	16	-400	-1320	42880	18037	6	0.5	1.25
12/27/17	01/26/18	01/29/18	02/02/18	750	659	7	-280	-340	43630	18696	15	0.5	1.5
01/03/18	02/02/18	02/05/18	02/09/18	190	(304)	38	-520	-1180	43820	18392	4	0.25	1.5
01/10/18	02/09/18	02/12/18	02/16/18	(780)	(1131)	27	-760	-1580	43040	17261	7	1	0.5
01/17/18	02/16/18	02/19/18	02/23/18	(3590)	(3954)	28	-710	-3630	39450	13307	5	1	0.25
01/24/18	02/23/18	02/26/18	03/02/18	800	553	19	-640	-1580	40250	13860	9	0.75	0.75
01/31/18	03/02/18	03/05/18	03/09/18	2660	2530	10	-450	-640	42910	16390	5	1.75	1
02/07/18	03/09/18	03/12/18	03/16/18	(1900)	(1939)	3	-1510	-1960	41010	14451	13	2.75	3.5
02/14/18	03/16/18	03/19/18	03/23/18	1650	1559	7	-730	-740	42660	16010	2	0.25	2
02/21/18	03/23/18	03/26/18	03/30/18	(1670)	(1865)	15	-590	-1840	40990	14145	3	0.5	2.5
02/28/18	03/30/18	04/02/18	04/06/18	1650	1533	9	-530	-1090	42640	15678	10	0.75	1.5
03/07/18	04/06/18	04/09/18	04/13/18	730	600	10	-670	-1060	43370	16278	13	0.5	0.75
03/14/18	04/13/18	04/16/18	04/20/18	(490)	(698)	16	-380	-1240	42880	15580	13	0.5	0.75
03/21/18	04/20/18	04/23/18	04/27/18	(150)	(215)	5	-1160	-1510	42730	15365	4	1.75	3.5
03/28/18	04/27/18	04/30/18	05/04/18	(40)	(53)	1	-40	-40	42690	15312	6	3.5	3.5
04/04/18	05/04/18	05/07/18	05/11/18	(440)	(466)	2	-620	-620	42250	14846	6	3	3
04/11/18	05/11/18	05/14/18	05/18/18	(380)	(406)	2	-470	-470	41870	14440	7	2.75	2.75
04/18/18	05/18/18	05/21/18	05/25/18	(460)	(473)	1	-460	-460	41410	13967	8	2.25	3
04/25/18	05/25/18	05/28/18	06/01/18	(610)	(636)	2	-710	-710	40800	13331	16	1.5	3.5
05/02/18	06/01/18	06/04/18	06/08/18	0	0	0	0	0	40800	13331	24	2.25	3.25
05/09/18	06/08/18	06/11/18	06/15/18	810	589	17	-640	-1190	41610	13920	2	0.25	1.5
05/16/18	06/15/18	06/18/18	06/22/18	3360	3126	18	-280	-680	44970	17046	2	0.25	1.5
05/23/18	06/22/18	06/25/18	06/29/18	490	438	4	-80	-140	45460	17484	24	2	2.25

in-sample dates		out-of-sample dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
05/30/18	06/29/18	07/02/18	07/06/18	550	394	12	-1000	-1540	46010	17878	4	0.75	2.5
06/06/18	07/06/18	07/09/18	07/13/18	2010	1867	11	-930	-1750	48020	19745	18	0.25	0.75
06/13/18	07/13/18	07/16/18	07/20/18	970	905	5	-560	-560	48990	20650	15	1	2
06/20/18	07/20/18	07/23/18	07/27/18	(50)	(76)	2	-190	-190	48940	20574	11	2.25	3.5
06/27/18	07/27/18	07/30/18	08/03/18	460	434	2	-330	-330	49400	21008	13	1.5	3.5
07/04/18	08/03/18	08/06/18	08/10/18	0	0	0	0	0	49400	21008	12	2.25	3.5
07/11/18	08/10/18	08/13/18	08/17/18	1620	1412	16	-410	-1250	51020	22420	4	1.75	0.75
07/18/18	08/17/18	08/20/18	08/24/18	(800)	(917)	9	-910	-1390	50220	21503	9	1.75	0.5
07/25/18	08/24/18	08/27/18	08/31/18	(330)	(343)	1	-330	-330	49890	21160	3	3	2.25
08/01/18	08/31/18	09/03/18	09/07/18	4080	3898	14	-220	-220	53970	25058	4	2	0.25
08/08/18	09/07/18	09/10/18	09/14/18	2700	2479	17	-720	-1280	56670	27537	4	2	0.25
08/15/18	09/14/18	09/17/18	09/21/18	2200	2018	14	-490	-490	58870	29555	7	1	0.5
08/22/18	09/21/18	09/24/18	09/28/18	(1660)	(1842)	14	-1120	-1960	57210	27713	7	1.5	0.5
08/29/18	09/28/18	10/01/18	10/05/18	(2010)	(2361)	27	-800	-2690	55200	25352	4	1.75	1
09/05/18	10/05/18	10/08/18	10/12/18	1410	1280	10	-490	-1210	56610	26632	10	1.5	0.5
09/12/18	10/12/18	10/15/18	10/19/18	840	697	11	-440	-830	57450	27329	3	2.25	0.5
09/19/18	10/19/18	10/22/18	10/26/18	(20)	(280)	20	-610	-1240	57430	27049	3	2.25	0.5
09/26/18	10/26/18	10/29/18	11/02/18	30	(48)	6	-580	-1280	57460	27001	6	2.25	2.5
10/03/18	11/02/18	11/05/18	11/09/18	(730)	(769)	3	-410	-730	56730	26232	10	2.75	2.5
10/10/18	11/09/18	11/12/18	11/16/18	5870	5805	5	0	0	62600	32037	14	2	0.5
10/17/18	11/16/18	11/19/18	11/23/18	2680	2524	12	-910	-910	65280	34561	7	2.25	0.25
10/24/18	11/23/18	11/26/18	11/30/18	900	770	10	-650	-870	66180	35331	10	2.5	0.25
10/31/18	11/30/18	12/03/18	12/07/18	(770)	(874)	8	-1120	-1710	65410	34457	11	2.25	0.75
11/07/18	12/07/18	12/10/18	12/14/18	4050	3985	5	0	0	69460	38442	13	2.5	0.5
11/14/18	12/14/18	12/17/18	12/21/18	2900	2809	7	-650	-830	72360	41251	13	2.25	0.5
11/21/18	12/21/18	12/24/18	12/28/18	4790	4738	4	-320	-320	77150	45989	13	2.25	0.5
11/28/18	12/28/18	12/31/18	01/04/19	(120)	(133)	1	-120	-120	77030	45856	17	3.25	3.5
12/05/18	01/04/19	01/07/19	01/11/19	(810)	(836)	2	-1000	-1000	76220	45020	18	2	2.75
12/12/18	01/11/19	01/14/19	01/18/19	(1450)	(1671)	17	-940	-2210	74770	43349	15	0.5	0.25
12/19/18	01/18/19	01/21/19	01/25/19	3060	2969	7	0	0	77830	46318	24	0.25	0.75
12/26/18	01/25/19	01/28/19	02/01/19	3200	3096	8	-240	-410	81030	49414	14	0.25	1.25
01/02/19	02/01/19	02/04/19	02/08/19	0	0	0	0	0	81030	49414	24	3.5	3.25
01/09/19	02/08/19	02/11/19	02/15/19	230	100	10	-600	-1090	81260	49514	11	1	1.5
01/16/19	02/15/19	02/18/19	02/22/19	690	612	6	-530	-640	81950	50126	8	0.25	2.25
01/23/19	02/22/19	02/25/19	03/01/19	(1090)	(1220)	10	-630	-1430	80860	48906	5	1.25	2
01/30/19	03/01/19	03/04/19	03/08/19	(230)	(334)	8	-580	-1510	80630	48572	15	0.25	1.75
02/06/19	03/08/19	03/11/19	03/15/19	420	277	11	-300	-870	81050	48849	4	0.5	2
02/13/19	03/15/19	03/18/19	03/22/19	680	589	7	-590	-1050	81730	49438	5	0.5	2.25
02/20/19	03/22/19	03/25/19	03/29/19	(530)	(621)	7	-640	-870	81200	48817	23	0.25	1.25
02/27/19	03/29/19	04/01/19	04/05/19	0	0	0	0	0	81200	48817	18	2	3.5
03/06/19	04/05/19	04/08/19	04/12/19	550	524	2	-240	-240	81750	49341	8	1.5	2.75
03/13/19	04/12/19	04/15/19	04/19/19	0	0	0	0	0	81750	49341	17	1.5	2.25
03/20/19	04/19/19	04/22/19	04/26/19	(890)	(929)	3	-970	-1020	80860	48412	16	1.5	2.25
03/27/19	04/26/19	04/29/19	05/03/19	(830)	(947)	9	-800	-1520	80030	47465	15	1	1.5
04/03/19	05/03/19	05/06/19	05/10/19	(350)	(519)	13	-340	-760	79680	46946	16	0.75	0.25
04/10/19	05/10/19	05/13/19	05/17/19	2210	2041	13	-320	-620	81890	48987	16	0.75	0.25
04/17/19	05/17/19	05/20/19	05/24/19	1620	1451	13	-730	-1100	83510	50438	9	0.5	1.25
04/24/19	05/24/19	05/27/19	05/31/19	2520	2273	19	-690	-1050	86030	52711	9	0.5	1.25
05/01/19	05/31/19	06/03/19	06/07/19	(1790)	(1946)	12	-1620	-2840	84240	50765	13	0.5	1.5
05/08/19	06/07/19	06/10/19	06/14/19	(3240)	(3344)	8	-1060	-3360	81000	47421	12	0.5	1.75
05/15/19	06/14/19	06/17/19	06/21/19	0	0	0	0	0	81000	47421	18	3.5	2.25
05/22/19	06/21/19	06/24/19	06/28/19	0	0	0	0	0	81000	47421	18	3.5	2.25
05/29/19	06/28/19	07/01/19	07/05/19	520	468	4	-980	-980	81520	47889	14	2.75	2
06/05/19	07/05/19	07/08/19	07/12/19	0	0	0	0	0	81520	47889	14	2.75	2.25
06/12/19	07/12/19	07/15/19	07/19/19	5940	5849	7	-170	-300	87460	53738	3	2.75	1.25
06/19/19	07/19/19	07/22/19	07/26/19	870	701	13	-320	-600	88330	54439	4	2	0.75
06/26/19	07/26/19	07/29/19	08/02/19	2740	2584	12	-480	-1080	91070	57023	5	2.25	0.5
07/03/19	08/02/19	08/05/19	08/09/19	680	654	2	0	0	91750	57677	15	2	2.75
07/10/19	08/09/19	08/12/19	08/16/19	860	821	3	-130	-130	92610	58498	21	2	3.5
07/17/19	08/16/19	08/19/19	08/23/19	370	357	1	0	0	92980	58855	21	2	3.5
07/24/19	08/23/19	08/26/19	08/30/19	(240)	(279)	3	-610	-670	92740	58576	19	2	3.5

in-sample dates		out-of-sample dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
07/31/19	08/30/19	09/02/19	09/06/19	1000	896	8	-480	-1200	93740	59472	20	0.25	0.5
08/07/19	09/06/19	09/09/19	09/13/19	(1850)	(2032)	14	-950	-1870	91890	57440	19	0.5	0.5
08/14/19	09/13/19	09/16/19	09/20/19	(330)	(408)	6	-850	-2590	91560	57032	6	2.75	3.5
08/21/19	09/20/19	09/23/19	09/27/19	640	510	10	-620	-1230	92200	57542	16	0.5	1.25
08/28/19	09/27/19	09/30/19	10/04/19	3520	3416	8	-70	-70	95720	60958	6	1.5	1.75
09/04/19	10/04/19	10/07/19	10/11/19	(1520)	(1611)	7	-870	-1940	94200	59347	6	1.5	2
09/11/19	10/11/19	10/14/19	10/18/19	1760	1656	8	-220	-220	95960	61003	6	0.75	1.75
09/18/19	10/18/19	10/21/19	10/25/19	440	414	2	-500	-500	96400	61417	6	2.5	2.75
09/25/19	10/25/19	10/28/19	11/01/19	250	198	4	-310	-510	96650	61615	20	1.75	2
10/02/19	11/01/19	11/04/19	11/08/19	850	824	2	0	0	97500	62439	22	2	2
10/09/19	11/08/19	11/11/19	11/15/19	(710)	(866)	12	-600	-1730	96790	61573	18	0.5	0.5
10/16/19	11/15/19	11/18/19	11/22/19	1930	1800	10	-300	-480	98720	63373	6	1.25	1.5
10/23/19	11/22/19	11/25/19	11/29/19	310	193	9	-700	-1960	99030	63566	2	1.5	1.25
10/30/19	11/29/19	12/02/19	12/06/19	520	208	24	-300	-1180	99550	63774	6	0.5	1
11/06/19	12/06/19	12/09/19	12/13/19	(2150)	(2332)	14	-950	-2940	97400	61442	10	0.25	0.75
11/13/19	12/13/19	12/16/19	12/20/19	(280)	(319)	3	-170	-280	97120	61123	10	0.75	2
11/20/19	12/20/19	12/23/19	12/27/19	830	726	8	-40	-40	97950	61849	10	0.25	0.5
11/27/19	12/27/19	12/30/19	01/03/20	(1040)	(1313)	21	-760	-1990	96910	60536	10	0.25	0.5
12/04/19	01/03/20	01/06/20	01/10/20	(2460)	(2668)	16	-730	-2460	94450	57868	4	0.5	2.5
12/11/19	01/10/20	01/13/20	01/17/20	1100	1022	6	-270	-270	95550	58890	9	1.5	0.5
12/18/19	01/17/20	01/20/20	01/24/20	(880)	(958)	6	-520	-1030	94670	57932	23	0.75	0.25
12/25/19	01/24/20	01/27/20	01/31/20	(750)	(945)	15	-370	-1010	93920	56987	6	1.75	0.5
01/01/20	01/31/20	02/03/20	02/07/20	2170	2001	13	-460	-1400	96090	58988	6	1.75	0.5
01/08/20	02/07/20	02/10/20	02/14/20	730	652	6	-270	-270	96820	59640	8	2.25	0.75
01/15/20	02/14/20	02/17/20	02/21/20	(1840)	(1931)	7	-730	-1840	94980	57709	7	2	0.5
01/23/20	02/22/20	02/25/20	02/29/20	1520	1364	12	-880	-1650	96500	59073	7	2	0.5
01/29/20	02/28/20	03/02/20	03/06/20	1420	1368	4	-1140	-1140	97920	60441	4	3.5	3.5
02/05/20	03/06/20	03/09/20	03/13/20	900	770	10	-1290	-2610	98820	61211	6	3.5	3.25
02/12/20	03/13/20	03/16/20	03/20/20	1440	1375	5	-2110	-2360	100260	62586	16	2	3.25
02/19/20	03/20/20	03/23/20	03/27/20	940	875	5	-510	-510	101200	63461	4	3	3.25
02/26/20	03/27/20	03/30/20	04/03/20	8190	8060	10	-100	-230	109390	71521	2	2	3.5
03/04/20	04/03/20	04/06/20	04/10/20	(720)	(876)	12	-1180	-1980	108670	70645	2	2	3.5
03/11/20	04/10/20	04/13/20	04/17/20	940	901	3	-410	-410	109610	71546	10	3.5	1.75
03/18/20	04/17/20	04/20/20	04/24/20	1530	1296	18	-1200	-3950	111140	72842	7	3.5	3.5
03/25/20	04/24/20	04/27/20	05/01/20	(2690)	(3015)	25	-1020	-4050	108450	69827	2	2	2.5
04/01/20	05/01/20	05/04/20	05/08/20	80	(37)	9	-570	-2270	108530	69790	2	3.5	1.25
04/08/20	05/08/20	05/11/20	05/15/20	350	142	16	-790	-1380	108880	69932	20	0.25	0.25
04/15/20	05/15/20	05/18/20	05/22/20	0	0	0	0	0	108880	69932	24	3.5	3.25
04/22/20	05/22/20	05/25/20	05/29/20	2640	2510	10	-440	-440	111520	72442	22	0.25	0.5
04/29/20	05/29/20	06/01/20	06/05/20	0	0	0	0	0	111520	72442	23	2.75	3
05/06/20	06/05/20	06/08/20	06/12/20	(420)	(446)	2	-710	-710	111100	71996	23	2.75	3
05/13/20	06/12/20	06/15/20	06/19/20	4070	3927	11	-500	-800	115170	75923	6	1.5	1.5
05/20/20	06/19/20	06/22/20	06/26/20	1170	1014	12	-590	-2270	116340	76937	5	0.75	2.75
05/27/20	06/26/20	06/29/20	07/03/20	580	476	8	-330	-740	116920	77413	15	0.25	1.25
06/03/20	07/03/20	07/06/20	07/10/20	620	568	4	-120	-180	117540	77981	4	2.25	3
06/10/20	07/10/20	07/13/20	07/17/20	(360)	(386)	2	-940	-940	117180	77595	2	2.25	2.25
06/17/20	07/17/20	07/20/20	07/24/20	210	145	5	-520	-600	117390	77740	2	0.25	3.25
06/24/20	07/24/20	07/27/20	07/31/20	150	111	3	-480	-480	117540	77851	3	2.25	2.75
07/01/20	07/31/20	08/03/20	08/07/20	(30)	(69)	3	-620	-620	117510	77782	18	1.5	2.5
07/08/20	08/07/20	08/10/20	08/14/20	(270)	(283)	1	-270	-270	117240	77499	17	1.5	2.5
07/15/20	08/14/20	08/17/20	08/21/20	(540)	(605)	5	-460	-600	116700	76894	2	2.25	2.25
07/22/20	08/21/20	08/24/20	08/28/20	(780)	(1027)	19	-430	-1920	115920	75867	6	0.5	1.25
07/29/20	08/28/20	08/31/20	09/04/20	290	277	1	0	0	116210	76144	6	3	3.25
08/05/20	09/04/20	09/07/20	09/11/20	(2110)	(2331)	17	-450	-2200	114100	73813	7	0.5	1.5
08/12/20	09/11/20	09/14/20	09/18/20	1480	1207	21	-380	-850	115580	75020	4	0.5	1.5
08/19/20	09/18/20	09/21/20	09/25/20	(100)	(113)	1	-100	-100	115480	74907	24	1.5	2.5
08/26/20	09/25/20	09/28/20	10/02/20	2230	1918	24	-470	-1320	117710	76825	4	0.5	1.5
09/02/20	10/02/20	10/05/20	10/09/20	240	97	11	-690	-810	117950	76922	15	0.25	1
09/09/20	10/09/20	10/12/20	10/16/20	930	878	4	-20	-20	118880	77800	24	1.25	1.5
09/16/20	10/16/20	10/19/20	10/23/20	150	137	1	0	0	119030	77937	20	2.5	2
09/23/20	10/23/20	10/26/20	10/30/20	900	835	5	-350	-350	119930	78772	13	0.5	1.75

in-sample dates		out-of-sample dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
09/30/20	10/30/20	11/02/20	11/06/20	0	0	0	0	0	119930	78772	18	3	2
10/07/20	11/06/20	11/09/20	11/13/20	(1670)	(1761)	7	-790	-1670	118260	77011	13	1.25	1.5
10/14/20	11/13/20	11/16/20	11/20/20	0	0	0	0	0	118260	77011	2	2.5	3.5
10/21/20	11/20/20	11/23/20	11/27/20	140	(3)	11	-460	-1190	118400	77008	3	1.25	1.5
10/28/20	11/27/20	11/30/20	12/04/20	(160)	(355)	15	-560	-1380	118240	76653	3	2	0.5
11/04/20	12/04/20	12/07/20	12/11/20	120	(49)	13	-740	-900	118360	76604	17	0.25	0.5
11/11/20	12/11/20	12/14/20	12/18/20	(70)	(239)	13	-290	-1380	118290	76365	17	0.25	0.5
11/18/20	12/18/20	12/21/20	12/25/20	1370	1292	6	-210	-320	119660	77657	2	0.75	2
11/25/20	12/25/20	12/28/20	01/01/21	0	(65)	5	-760	-1030	119660	77592	2	0.25	2
12/02/20	01/01/21	01/04/21	01/08/21	1050	894	12	-450	-590	120710	78486	4	1	1.75
12/09/20	01/08/21	01/11/21	01/15/21	620	412	16	-250	-610	121330	78898	10	0.5	0.75
12/16/20	01/15/21	01/18/21	01/22/21	(600)	(678)	6	-420	-1130	120730	78220	4	1.25	2.25
12/23/20	01/22/21	01/25/21	01/29/21	0	(39)	3	-1020	-1020	120730	78181	6	1.5	3.25
12/30/20	01/29/21	02/01/21	02/05/21	100	(30)	10	-410	-610	120830	78151	7	0.75	1.75
01/06/21	02/05/21	02/08/21	02/12/21	1270	1244	2	0	0	122100	79395	6	1.5	3.25
01/13/21	02/12/21	02/15/21	02/19/21	640	510	10	-720	-880	122740	79905	5	1.5	2
01/20/21	02/19/21	02/22/21	02/26/21	410	241	13	-440	-1200	123150	80146	13	0.25	1
01/27/21	02/26/21	03/01/21	03/05/21	1360	1139	17	-1030	-1170	124510	81285	3	0.75	2.5
02/03/21	03/05/21	03/08/21	03/12/21	(980)	(1188)	16	-560	-2510	123530	80097	2	1	2
02/10/21	03/12/21	03/15/21	03/19/21	2880	2841	3	0	0	126410	82938	19	2	3.25
02/17/21	03/19/21	03/22/21	03/26/21	330	239	7	-1050	-1250	126740	83177	12	2	3
02/24/21	03/26/21	03/29/21	04/02/21	1310	1284	2	0	0	128050	84461	24	2.75	3
03/03/21	04/02/21	04/05/21	04/09/21	3710	3554	12	-590	-1370	131760	88015	5	2.25	1
03/10/21	04/09/21	04/12/21	04/16/21	1150	1085	5	-740	-910	132910	89100	3	1.75	2.5
03/17/21	04/16/21	04/19/21	04/23/21	(900)	(1056)	12	-480	-990	132010	88044	7	1	2.25
03/24/21	04/23/21	04/26/21	04/30/21	70	18	4	-290	-320	132080	88062	10	1.5	2
03/31/21	04/30/21	05/03/21	05/07/21	(2010)	(2218)	16	-550	-2850	130070	85844	16	0.25	1
04/07/21	05/07/21	05/10/21	05/14/21	1300	1118	14	-680	-1620	131370	86962	8	0.25	1.5
04/14/21	05/14/21	05/17/21	05/21/21	2060	2008	4	0	0	133430	88970	7	3	3.25
04/21/21	05/21/21	05/24/21	05/28/21	(2200)	(2473)	21	-790	-2800	131230	86497	9	1	0.25
04/28/21	05/28/21	05/31/21	06/04/21	(50)	(193)	11	-410	-640	131180	86304	6	1.5	0.75
05/05/21	06/04/21	06/07/21	06/11/21	1090	973	9	-640	-640	132270	87277	6	1.75	0.75
05/12/21	06/11/21	06/14/21	06/18/21	2450	2281	13	-390	-1570	134720	89558	3	2.25	1.75
05/19/21	06/18/21	06/21/21	06/25/21	280	202	6	-1000	-1220	135000	89760	13	1.25	1.5
05/26/21	06/25/21	06/28/21	07/02/21	1170	988	14	-360	-630	136170	90748	9	1.5	0.25
06/02/21	07/02/21	07/05/21	07/09/21	1920	1842	6	-50	-80	138090	92590	22	1.75	2
06/09/21	07/09/21	07/12/21	07/16/21	790	530	20	-640	-2240	138880	93120	4	1	2
06/16/21	07/16/21	07/19/21	07/23/21	800	618	14	-820	-990	139680	93738	6	1.5	1.5
06/23/21	07/23/21	07/26/21	07/30/21	950	885	5	-190	-310	140630	94623	17	0.25	3.5
06/30/21	07/30/21	08/02/21	08/06/21	80	(50)	10	-700	-1740	140710	94573	24	0.25	2
07/07/21	08/06/21	08/09/21	08/13/21	1810	1758	4	-800	-800	142520	96331	10	1.25	3.5
07/14/21	08/13/21	08/16/21	08/20/21	(4080)	(4301)	17	-1270	-5350	138440	92030	2	1	2.75
07/21/21	08/20/21	08/23/21	08/27/21	1010	906	8	-420	-560	139450	92936	6	1	2.25
07/28/21	08/27/21	08/30/21	09/03/21	(160)	(264)	8	-840	-2270	139290	92672	6	0.5	2.25
08/04/21	09/03/21	09/06/21	09/10/21	540	397	11	-410	-730	139830	93069	10	1	1
08/11/21	09/10/21	09/13/21	09/17/21	(510)	(640)	10	-490	-900	139320	92429	12	1.25	0.75
08/18/21	09/17/21	09/20/21	09/24/21	310	206	8	-500	-1010	139630	92635	19	0.25	1
08/25/21	09/24/21	09/27/21	10/01/21	430	326	8	-750	-1140	140060	92961	15	1.25	1.75
09/01/21	10/01/21	10/04/21	10/08/21	1150	1033	9	-960	-960	141210	93994	13	2	0.25
09/08/21	10/08/21	10/11/21	10/15/21	(2260)	(2390)	10	-710	-2260	138950	91604	13	2	0.5
09/15/21	10/15/21	10/18/21	10/22/21	(290)	(316)	2	-910	-910	138660	91288	15	3	2.75
09/22/21	10/22/21	10/25/21	10/29/21	(1460)	(1629)	13	-1200	-2760	137200	89659	12	1	2.5
09/29/21	10/29/21	11/01/21	11/05/21	2510	2302	16	-760	-1220	139710	91961	11	1.5	0.5
10/06/21	11/05/21	11/08/21	11/12/21	1980	1772	16	-990	-1830	141690	93733	9	1.75	0.25
10/13/21	11/12/21	11/15/21	11/19/21	600	353	19	-580	-1940	142290	94086	13	1.5	0.25
10/20/21	11/19/21	11/22/21	11/26/21	200	5	15	-900	-3190	142490	94091	10	1.25	0.75
10/27/21	11/26/21	11/29/21	12/03/21	9250	9016	18	-820	-2160	151740	103107	10	1	1
11/03/21	12/03/21	12/06/21	12/10/21	60	(174)	18	-700	-2490	151800	102933	9	0.5	1.5
11/10/21	12/10/21	12/13/21	12/17/21	230	126	8	-960	-1470	152030	103059	10	0.25	2.25
11/17/21	12/17/21	12/20/21	12/24/21	4970	4905	5	0	0	157000	107964	13	0.5	1
11/24/21	12/24/21	12/27/21	12/31/21	1960	1804	12	-350	-840	158960	109768	10	0.5	1.5

in-sample dates		out-of-sample dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
12/01/21	12/31/21	01/03/22	01/07/22	(1160)	(1290)	10	-630	-2520	157800	108478	4	0.75	3.25
12/08/21	01/07/22	01/10/22	01/14/22	840	658	14	-560	-1540	158640	109136	8	0.5	1.5
12/15/21	01/14/22	01/17/22	01/21/22	1740	1480	20	-360	-950	160380	110616	8	0.25	1.25
12/22/21	01/21/22	01/24/22	01/28/22	(2410)	(2839)	33	-740	-2950	157970	107777	6	1.25	1.25
12/29/21	01/28/22	01/31/22	02/04/22	(180)	(206)	2	-220	-220	157790	107571	20	3.25	3.25
01/05/22	02/04/22	02/07/22	02/11/22	(1720)	(1759)	3	-1080	-1720	156070	105812	24	3.5	2.75
01/12/22	02/11/22	02/14/22	02/18/22	(2260)	(2312)	4	-1120	-2260	153810	103500	20	3.25	3.25
01/19/22	02/18/22	02/21/22	02/25/22	(990)	(1185)	15	-1850	-3950	152820	102315	13	0.25	3.5
01/26/22	02/25/22	02/28/22	03/04/22	13650	13455	15	-2170	-2800	166470	115770	7	3.5	3.25
02/02/22	03/04/22	03/07/22	03/11/22	5630	5292	26	-3540	-3540	172100	121062	8	3	3.25
02/09/22	03/11/22	03/14/22	03/18/22	(1130)	(1429)	23	-2620	-5550	170970	119633	13	1.25	1.25
02/16/22	03/18/22	03/21/22	03/25/22	(7180)	(7349)	13	-2030	-8450	163790	112284	12	3.5	2.75
02/23/22	03/25/22	03/28/22	04/01/22	(1210)	(1431)	17	-1980	-3060	162580	110853	13	2.75	1.5
03/02/22	04/01/22	04/04/22	04/08/22	5060	4891	13	-1270	-1650	167640	115744	7	3.25	3.25
03/09/22	04/08/22	04/11/22	04/15/22	6210	6132	6	-1000	-1450	173850	121876	19	0.25	1.25
03/16/22	04/15/22	04/18/22	04/22/22	(2500)	(2643)	11	-960	-2600	171350	119233	24	0.25	1.25
03/23/22	04/22/22	04/25/22	04/29/22	2360	2217	11	-1590	-2080	173710	121450	18	2.75	0.75
03/30/22	04/29/22	05/02/22	05/06/22	5900	5770	10	-1660	-3050	179610	127220	23	1	0.25
04/06/22	05/06/22	05/09/22	05/13/22	4840	4684	12	-1010	-1010	184450	131904	23	1	0.25
04/13/22	05/13/22	05/16/22	05/20/22	10650	10559	7	-840	-1400	195100	142463	17	3.25	1
04/20/22	05/20/22	05/23/22	05/27/22	160	30	10	-940	-1770	195260	142493	19	3	0.25
04/27/22	05/27/22	05/30/22	06/03/22	(450)	(645)	15	-1600	-4190	194810	141848	17	0.75	0.25
05/04/22	06/03/22	06/06/22	06/10/22	5200	4992	16	-740	-2070	200010	146840	11	1.5	0.75
05/11/22	06/10/22	06/13/22	06/17/22	12780	12429	27	-1160	-2020	212790	159269	6	2.5	0.75
05/18/22	06/17/22	06/20/22	06/24/22	2550	2290	20	-720	-2050	215340	161559	8	2.75	0.25
05/25/22	06/24/22	06/27/22	07/01/22	5250	5081	13	-700	-830	220590	166640	10	3.25	1.5
06/01/22	07/01/22	07/04/22	07/08/22	6780	6585	15	-1080	-2190	227370	173225	10	3.25	1.5
06/08/22	07/08/22	07/11/22	07/15/22	(2500)	(2786)	22	-1880	-4690	224870	170439	12	1.5	0.5
06/15/22	07/15/22	07/18/22	07/22/22	2880	2815	5	-840	-1500	227750	173254	17	1	3.25
06/22/22	07/22/22	07/25/22	07/29/22	1480	1337	11	-1520	-2520	229230	174591	18	1	2
06/29/22	07/29/22	08/01/22	08/05/22	2080	1924	12	-2200	-2370	231310	176515	19	0.25	2.5
07/06/22	08/05/22	08/08/22	08/12/22	2150	2020	10	-1380	-1430	233460	178535	19	0.25	2.5
07/13/22	08/12/22	08/15/22	08/19/22	(1420)	(1576)	12	-1410	-3140	232040	176959	16	0.5	2.5
07/20/22	08/19/22	08/22/22	08/26/22	2580	2424	12	-1490	-4570	234620	179383	19	0.25	2.5
07/27/22	08/26/22	08/29/22	09/02/22	3570	3466	8	-970	-970	238190	182849	22	1.25	1.25
08/03/22	09/02/22	09/05/22	09/09/22	(350)	(441)	7	-1100	-2990	237840	182408	14	2.25	3.25
08/10/22	09/09/22	09/12/22	09/16/22	(960)	(1129)	13	-970	-2530	236880	181279	14	2.25	1.5
08/17/22	09/16/22	09/19/22	09/23/22	(1960)	(2129)	13	-1620	-2080	234920	179150	22	1	0.75
08/24/22	09/23/22	09/26/22	09/30/22	2520	2429	7	-1330	-1840	237440	181579	22	3.5	0.25
08/31/22	09/30/22	10/03/22	10/07/22	(2840)	(2944)	8	-1550	-4500	234600	178635	21	3.5	0.5
09/07/22	10/07/22	10/10/22	10/14/22	3420	3316	8	-1300	-1300	238020	181951	12	2.5	2
09/14/22	10/14/22	10/17/22	10/21/22	30	(126)	12	-1100	-2630	238050	181825	15	0.25	2.75
09/21/22	10/21/22	10/24/22	10/28/22	370	214	12	-1320	-2410	238420	182039	6	3.5	0.25
09/28/22	10/28/22	10/31/22	11/04/22	(2770)	(2874)	8	-1760	-2770	235650	179165	8	3.5	2
10/05/22	11/04/22	11/07/22	11/11/22	6600	6509	7	-60	-60	242250	185674	6	3.25	1
10/12/22	11/11/22	11/14/22	11/18/22	4530	4374	12	-1280	-1840	246780	190048	6	3	2.5
10/19/22	11/18/22	11/21/22	11/25/22	390	273	9	-1200	-2590	247170	190321	6	3.25	2.75
10/26/22	11/25/22	11/28/22	12/02/22	1660	1504	12	-1370	-2020	248830	191825	10	2.75	0.25
11/02/22	12/02/22	12/05/22	12/09/22	13210	13106	8	-300	-300	262040	204931	10	3	0.25
11/09/22	12/09/22	12/12/22	12/16/22	(580)	(788)	16	-1270	-2200	261460	204143	8	3	0.75
11/16/22	12/16/22	12/19/22	12/23/22	650	507	11	-480	-620	262110	204650	9	3	0.25
11/23/22	12/23/22	12/26/22	12/30/22	(3980)	(4201)	17	-1080	-4370	258130	200449	8	2.25	0.75
11/30/22	12/30/22	01/02/23	01/06/23	2550	2368	14	-1710	-3050	260680	202817	6	2.5	0.25
12/07/22	01/06/23	01/09/23	01/13/23	1470	1249	17	-750	-1540	262150	204066	5	3	0.25
12/14/22	01/13/23	01/16/23	01/20/23	1240	1058	14	-1330	-2040	263390	205124	5	3	0.5
12/21/22	01/20/23	01/23/23	01/27/23	3270	3075	15	-650	-1340	266660	208199	5	3	0.5
12/28/22	01/27/23	01/30/23	02/03/23	4810	4693	9	-1010	-1250	271470	212892	19	2.25	0.5
01/04/23	02/03/23	02/06/23	02/10/23	(910)	(1066)	12	-790	-2830	270560	211826	8	2.5	0.75
01/11/23	02/10/23	02/13/23	02/17/23	(890)	(1059)	13	-730	-1330	269670	210767	15	1.5	0.25
01/18/23	02/17/23	02/20/23	02/24/23	1900	1744	12	-420	-780	271570	212511	15	1.5	0.25
01/25/23	02/24/23	02/27/23	03/03/23	(2930)	(3112)	14	-990	-5590	268640	209399	15	1.25	0.25

in-sample dates		out-of-sample dates		ogp	NOnp\$13	ont	ollt	odd	EQ	NetEq	N	vup	vdn
02/01/23	03/03/23	03/06/23	03/10/23	(4480)	(4636)	12	-2190	-5800	264160	204763	7	1.5	3.5
02/08/23	03/10/23	03/13/23	03/17/23	810	628	14	-1440	-1960	264970	205391	10	1	3
02/15/23	03/17/23	03/20/23	03/24/23	1700	1609	7	-1240	-1240	266670	207000	10	1	3
02/22/23	03/24/23	03/27/23	03/31/23	2710	2632	6	-560	-560	269380	209632	10	1	3
03/01/23	03/31/23	04/03/23	04/07/23	(1840)	(1918)	6	-1490	-2160	267540	207714	13	0.5	2.25
03/08/23	04/07/23	04/10/23	04/14/23	1040	910	10	-730	-1490	268580	208624	12	0.75	1.5
03/15/23	04/14/23	04/17/23	04/21/23	(2800)	(2930)	10	-760	-3290	265780	205694	4	2.5	3.25
03/22/23	04/21/23	04/24/23	04/28/23	2110	2019	7	-1370	-1370	267890	207713	7	1.25	3
03/29/23	04/28/23	05/01/23	05/05/23	(250)	(432)	14	-1300	-1950	267640	207281	8	3	0.5
04/05/23	05/05/23	05/08/23	05/12/23	100	(56)	12	-790	-1610	267740	207225	6	1.5	3
04/12/23	05/12/23	05/15/23	05/19/23	1770	1640	10	-640	-640	269510	208865	5	3.5	0.75
04/19/23	05/19/23	05/22/23	05/26/23	(100)	(165)	5	-570	-880	269410	208700	13	2.75	0.25

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 5/26/2023 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.