



INFORMATION SOCIETY

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## INFORMATION SOCIETY: THE VALUE OF INFORMATION AND WHERE TO GET IT IN PBO AND PBD SIGNALS

*Detailed Analysis Of Bullish And Bearish Signals Generated By MAP Quantitative Equity Research.*

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## SUMMARY

We wished to test if extremes in MAP PBO/PBD data can help identify market troughs and peaks. If it can, what happened to the S&P 500 one and two weeks after that date? We also wished to test marrying PBO/PBD stocks with high and low Compass Scores alongside bullish and bearish markets to see if they outperformed or underperformed the S&P 500.

With that in mind, this paper explores in detail the MAP PBO/PBD signal dataset of 51,383 individual equities over 3.5 years. Three studies were conducted which feed into each other. The first asks if there is a relationship between PBO/PBDs and market local troughs and peaks. The second asks what the market returns looked like one and two weeks after extreme PBO/PBD readings. The third asks about the value of a PBO and PBD in a bullish and bearish market coupled with extreme Compass Score stocks. (PBO= Potential Breakout, PBD= Potential Breakdown)

### **STUDY 1: Is there a relationship between the extreme net sum of PBOs and PBDs and the market local troughs and peaks?**

This study posed the questions:

- *Being that volume relationships are a component of PBO/PBD signals, do extreme daily instances contain measurable information suggestive of market local troughs and peaks?*
- *Is moving averaged data more relevant than discrete data?*

**HYPOTHESIS:** Extreme readings of PBO or PBD signals indicate market local troughs and peaks in the S&P 500 with statistical significance.

**RESULTS:** We define the net sum of PBOs and PBDs as: daily number of PBOs (positive number) + number of PBDs (negative number). Our research suggests that market local troughs (defined as the lowest closing price of the S&P 500 Index during defined lookback period) occurred more frequently when the net sum of PBOs and PBDs near extreme negative ends (heavily in favor of PBDs) while market local peaks occurred more frequently when the net sum of PBOs and PBDs near extreme positive ends (heavily in favor of PBOs). We found that discrete (non-moving averaged) net sums of PBOs and PBDs yielded higher probabilities of identifying these troughs and peaks as opposed to moving averaged sums. It was also observed that the probability of market local troughs occurring on the exact days of extreme negative net sum of PBOs and PBDs under certain thresholds tended to be no lower than 85.19%, and that the market local peaks on the days of extreme positive net sum of PBOs and PBDs tended to be no lower than 87.1%.

## STUDY 2: Extreme PBO (PBD) statistics and market returns

The second study posed the questions:

- *Studying a ratio of PBOs to PBDs, does the average market return after experiencing the extreme cases tend to revert, demonstrating price action suggestive of an overbought or oversold market?*
- *If so, can we measure how impactful these extreme cases tend to be with statistical significance?*

**HYPOTHESIS:** A PBO/PBD ratio can be used in extreme readings to identify potentially overbought or oversold conditions in the US equity market. Extreme cases of large PBDs will show higher market returns one and two weeks after the date of extreme readings. Extreme cases of large PBOs will show lower market returns one and two weeks after the date of extreme readings.

**RESULTS:** Studying 991 trading day observations, we found that on days when PBD statistics were at the top 5% level, market returns 1-2 weeks later demonstrated significant increases vs the average. When the PBO statistics were at the top 5% level, 1-2 week market returns were significantly lower on average. As statistics trended away from extreme cases, market returns reverted to their total mean level.

### STUDY 3: Extreme Compass Score stocks in extreme market conditions

The third study posed the questions:

- *Is it possible to measure the value of a high Compass Scored PBO in a bull and bear market as well as a low Compass Scored PBD in a bull and bear market?*
- *If so, are the observations statistically significant?*

**HYPOTHESIS:** A PBO signal coupled with a stock rated with a high Compass Score contains statistical significance in bull markets. A PBD coupled with a stock rated with a low Compass Score contains statistical significance in bear markets.

**RESULTS:** This study tested the performance of stocks with PBO or PBD signals with extreme Compass Scores under extreme market conditions. Both extreme Compass Scores and market conditions are defined by top or bottom 5% to 20% percentile. We ranked all trading days by 4-week market return, and took the top (bottom) 5%, 10%, 15%, and 20% as different thresholds for bullish (bearish) market conditions. In those cases, we then ranked all stocks by Compass Score, and took the stocks with PBOs (PBDs) and with top (bottom) 5%, 10%, 15%, and 20% Compass Scores, then calculated their 4-week excess return to the market, and performed t tests for statistical significance. When deciding the parameters of a bullish market, we isolated extreme days with the highest one month returns, and used the top 5-20% monthly return days as our bullish condition. For bearish markets, we isolated extreme days with the lowest one month returns, and used the bottom 5-20% monthly return days as our bearish condition. With these extreme days compiled, our next step was to take our PBO and PBD dataset and isolate the top 5-20% (bottom 5-20%) scoring stocks to measure the returns vs the market in these extreme bullish and bearish cases. Our analysis sheds light on the measurable value of high scoring PBOs and low scoring PBDs in extreme markets at a 95% significance level as follows:

1. High Compass Score PBO stocks in bullish markets outperform the market by 0.67% to 2.34% depending upon different thresholds.
2. High Compass Score PBO stocks in bearish markets outperform the market by about 1%.
3. Low Compass Score PBD stocks in bullish markets outperform the market by 2% to 3.17%.
4. Low Compass Score PBD stocks in bearish markets underperform the market by 1.75% to 5.42%.

Information is rampant in the world today. The current generation consumes media each year at a pace which dwarfs all prior generations combined. Consider that in 2015, it is estimated that humanity took over 1 trillion photos. Some claim that from now on each year humans will take more photos than in the entire history of photographing on sensitized substrates - meaning film and plates. Many of these photos are shared as texts or emails. Just think of your email box, (likely you have several) and the sheer quantity of electronic information in it. A great question to ponder is “what is the value of this information?” Clearly we are swimming in information that we oftentimes don’t even need. According to a study by the Radicati Group, there are 2.6 billion email users with an average of 1.7 accounts each. This amounts to over 200 billion emails sent every single day. And we thought old school junk-mail was bad!

So how do we assess the value of information and more importantly how do we interpret it? Misinterpretation or false information has caused some pretty colossal consequences throughout history.

- During the cold war, due to a legal loophole, East Germans were able to cross into West Germany through Hungary. To counter this, East Germany issued temporary visas through the “Anti-Fascist” wall. But these were for a later unspecified date. Gunter Schabowski, a low-level member of the politburo, was selected to give a press conference. He had a drinking problem and when an Italian journalist pressed for when the visas would be issued, he blurted out “immediately” which eventually caused crowds to storm the Berlin wall bringing down the East-West barriers.
- Supposedly at the end of World War II, when presented with the option of unconditional surrender, Japan’s Prime Minister Kantaro Suzuki replied with “mokusatsu” – meaning “no comment” while Japan mulled over its options. The comment was translated erroneously to “not worthy of comment; held in silent contempt” prompting obvious disastrous consequences.
- In 1776, George Washington was facing possible defeat and felt bold action was necessary. He decided to cross the Delaware River and attack Trenton which held a large garrison under command of a German, Johan Rall. A loyalist farmer watching Washington tried to warn Rall and wrote a note to give to Rall’s soldiers. The soldiers couldn’t read English and neither could Rall. He left the note in his pocket to be translated later which never happened. Following Washington’s surprise attack, the note was found on Rall’s body.
- Poor President Jimmy Carter was the victim of bad information transfer when he famously visited Poland in December of 1977. The President said he wanted to learn about the Polish people’s desires for the future. Instead, his translator bungled the job and said the president “desired the Poles carnally.” Carter then said he was glad to be in Poland which was translated as being happy to “grasp Poland’s private parts.” Other statements were similarly mangled causing extreme embarrassment for the President of the United States of America.

The fact is, information is everywhere, but assessing its value and how to interpret it is crucial to planning a successful outcome of its use. If information and its misuse can happen on a geopolitical level, then of course it happens in markets all the time. We decided to pose the question of ourselves in assessing the intrinsic worth of the information we generate based on our analysis of the financial markets. In case you are unfamiliar with our process, which we will detail a bit below, as part of our filter to identify unusual institutional activity in US equities, our models assign a PBO (bullish) or PBD (bearish) signal as a data tag. With this in mind we wanted to know:

***Can we identify the intrinsic value of extreme PBO and PBD signals? And can we use this information to help us assess pivot points in the market?***

To address these questions, we undertook three studies based on MAP Equity Research historical data. In these we explored daily MAP PBO/PBD data beginning 1/2/2013 containing 51,383 individual equities. The objective of the studies was to reveal the reliability and usefulness of signals received during extreme bullish or bearish conditions.

This paper presents our three studies as follows:

- **The relationship between the net sum of PBOs and PBDs and market local troughs and peaks**
- **Extreme PBO/PBD statistics and market returns**
- **Extreme Compass Score stocks in extreme market conditions**

## INTRODUCTION TO OUR DAILY PROCESS

We begin our daily analysis of US equities by defining a universe of stocks that we deem to be tradable by institutions. Among other criteria, we filter stocks for liquidity, market capitalization, average volume, and whether options are available. This universe is defined daily and yields an average of 1400 US equities. The stocks that pass the filters collectively function as an index of institutionally tradable stocks that we refer to as the **MAP 1400**.

At this point, 110 individual historical data points are pulled for each equity. A truncated list of example data points are in the table below.

### STOCK DATA EXAMPLES:

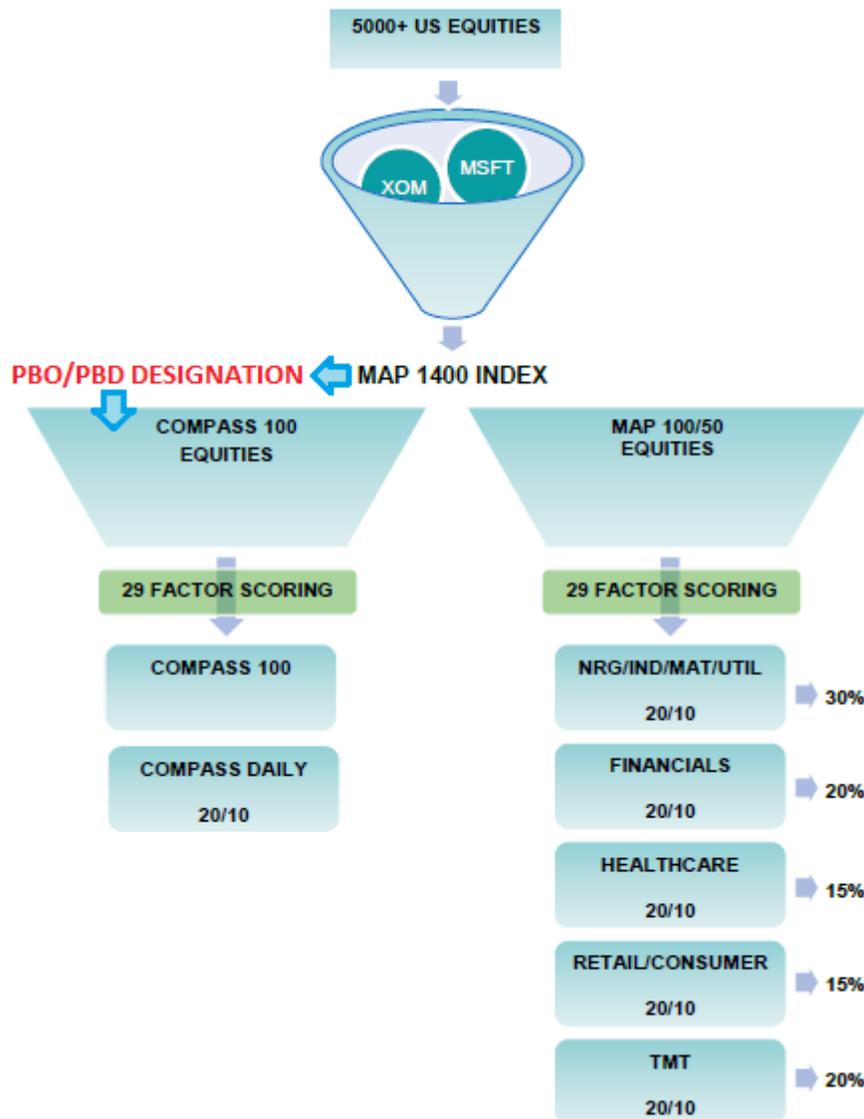
TECHNICAL	FUNDAMENTAL
Price highs and lows within a specified time period	Revenue and Earnings Growth - Single and Multi Year
52 week highs and lows	Analyst Revisions
Average Daily Volume within a specified time period	P/E ratio
Historical Volatility for a specified time period	Debt Levels
Several Moving Averages	Cash Flow
Relative Performance to Sector	Enterprise Value

We then employ a factor scoring method on the MAP 1400 utilizing 29 factors, each with various combinations of subsets of the 110 data points. Each factor component is part of an aggregate score. Aggregate scores approaching 100 are more bullish; approaching 0 are more bearish. The scores are further divided into technical and fundamental components. The technical score is our factor scoring methodology dealing with market mechanics: trading volumes, buying/selling pressure, price ranges, and volatility - to name a few factors. The fundamental score is our factor scoring methodology dealing with the fundamental health of a company: revenues, earnings, debt, and revisions to name a few. The composite Compass Score is roughly 58% market mechanics (technical) and 42% fundamentals.

## INTRODUCING THE PBO (POTENTIAL BREAKOUT) AND PBD (POTENTIAL BREAKDOWN)

An additional technical tag is applied searching for potentially unusual institutional activity. We identify this activity by studying violations of relationships between price, volume and volatility. When a stock violates the upper thresholds on our filter it receives a PBO or Potential Breakout (bullish signal) designation indicating the potential for unusual institutional accumulation. When a stock violates the lower thresholds on our filter it receives a PBD or Potential Breakdown (bearish signal) designation indicating the potential for unusual institutional distribution. Each day finds roughly 100 stocks resulting in PBO/PBDs. We refer to this daily pool as the **COMPASS 100**.

**The MAP Equity Filtering and PBO/PBD Process**



## STUDY ONE: RELATIONSHIP BETWEEN EXTREME NET SUM OF PBOs AND PBDs AND LOCAL MARKET TROUGHS AND PEAKS

Using one week, two week, and three week lookback periods, this study focuses on the potential relationship between the extreme net sum of PBOs and PBDs and market local troughs and peaks in two aspects:

1. The significance of discrete (non-moving averaged) net sum of PBOs and PBDs compared to moving averaged data
2. The thresholds on net sum of PBOs and PBDs that would statistically conclude as to the presence of market local troughs and peaks given non-parametric one sample Sign Test results

We used the MAP PBO/PBD signal dataset of 51,383 individual equity signals over 3.5 years. We define the net sum of PBOs and PBDs here forth represented as the OD value, equaling the number of PBOs (positive number) + the number of PBDs (negative number). For example: **given 100 PBOs and -230 PBDs: OD = -130**. In the first section, the OD values are taken via a simple moving average from 5 days to 30 days with a 5-day interval (5d MA, 10d MA, 15d MA... 30d MA). Also, market local troughs (peaks) are identified by the lowest (highest) closing prices of the S&P500 Index during each lookback period.

Our research suggests that market local troughs occur more frequently when the OD value is closer to extreme negative ends, while market local peaks display the pattern the other way around. Also, discrete (non-moving averaged) OD values tend to recognize higher probability of identifying market local troughs and peaks at extreme percentiles of all observations of OD values. This is opposed to moving averaged OD values; discrete OD values display a stronger relationship between extreme OD values and market local troughs and peaks than do moving averaged OD values. In other words, a single day's extreme reading of the OD value is better at identifying lookback troughs and peaks than an extreme moving average reading.

It can also be observed that the probability that market local troughs happen exactly on the days of extreme negative OD values below certain thresholds tends to be no lower than 85.19%, while the probability that market local peaks occur on the days of extreme positive OD values above certain thresholds tends to be no lower than 87.10%.

### The significance of discrete (non-moving average) OD values

In this section, we studied discrete OD values (without moving averages) and OD values with moving averages. Moving averages of the OD values are taken from five days to thirty days at five-day intervals (5d MA, 10d MA, 15d MA... 30d MA). The OD values are then ranked from the lowest to the highest (extreme negative OD values ranked first). We divided this ranking into 10 percentiles and then calculated market peaks and troughs for each lookback period: 1 week, 2 weeks, and 3 weeks. We then tested to ascertain if discrete (non-moving average) OD values would yield higher percentages of market local troughs and peaks than OD values on a moving average.

### MARKET LOCAL TROUGHS

The following exhibits display the percentages of the market local troughs in all three lookback periods. We display from the lowest 10% to the lowest 50% of OD values, both discrete and each pair of moving-average data. The corresponding graphs exhibit the trend line of the percentage of market local troughs from the lowest 10% to the highest 10% of net sum of OD value. For example: discrete OD values between 0-10% (extreme PBDs) identify market local troughs with 70% probability. 5DMA OD values between 0-10% found troughs at 46.46% probability.

One Week Lookback					
Lowest %	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%
Moving Average					
0 Day	70.00%	46.00%	38.00%	15.00%	10.00%
5 Days	46.46%	35.35%	28.28%	23.23%	14.14%
10 Days	35.71%	28.57%	28.57%	33.67%	19.39%
15 Days	31.96%	26.80%	29.90%	23.71%	18.56%
20 Days	29.17%	29.17%	27.08%	18.75%	22.92%
25 Days	32.63%	23.16%	28.42%	18.95%	17.89%
30 Days	34.04%	17.02%	26.60%	18.09%	17.02%

Exhibit 1. percentage of market local troughs for one week lookback period

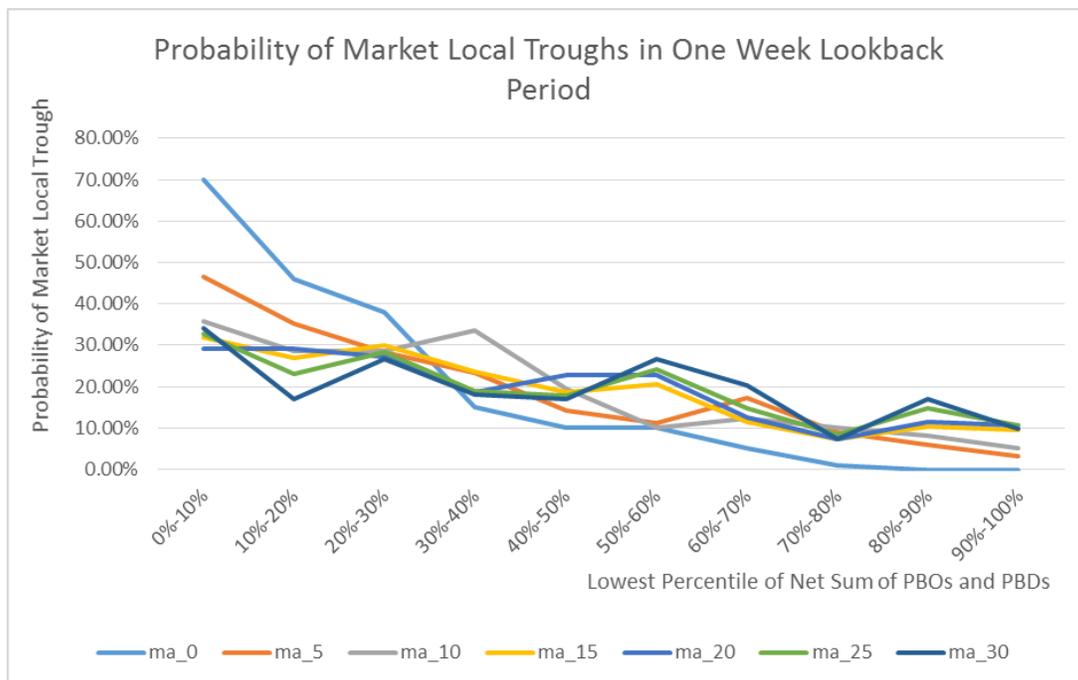


Exhibit 2. percentage of market local troughs for one week lookback period

Two Week Lookback					
Lowest %	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%
Moving Average					
0 Day	59.00%	28.00%	18.00%	6.00%	0.00%
5 Days	37.37%	22.22%	22.22%	7.07%	5.05%
10 Days	27.55%	20.41%	16.33%	18.37%	10.20%
15 Days	22.68%	20.62%	17.53%	15.46%	11.34%
20 Days	21.88%	22.92%	16.67%	9.38%	12.50%
25 Days	23.16%	17.89%	14.74%	8.42%	12.63%
30 Days	22.34%	12.77%	17.02%	9.57%	9.57%

Exhibit 3. percentage of market local troughs for two weeks lookback period

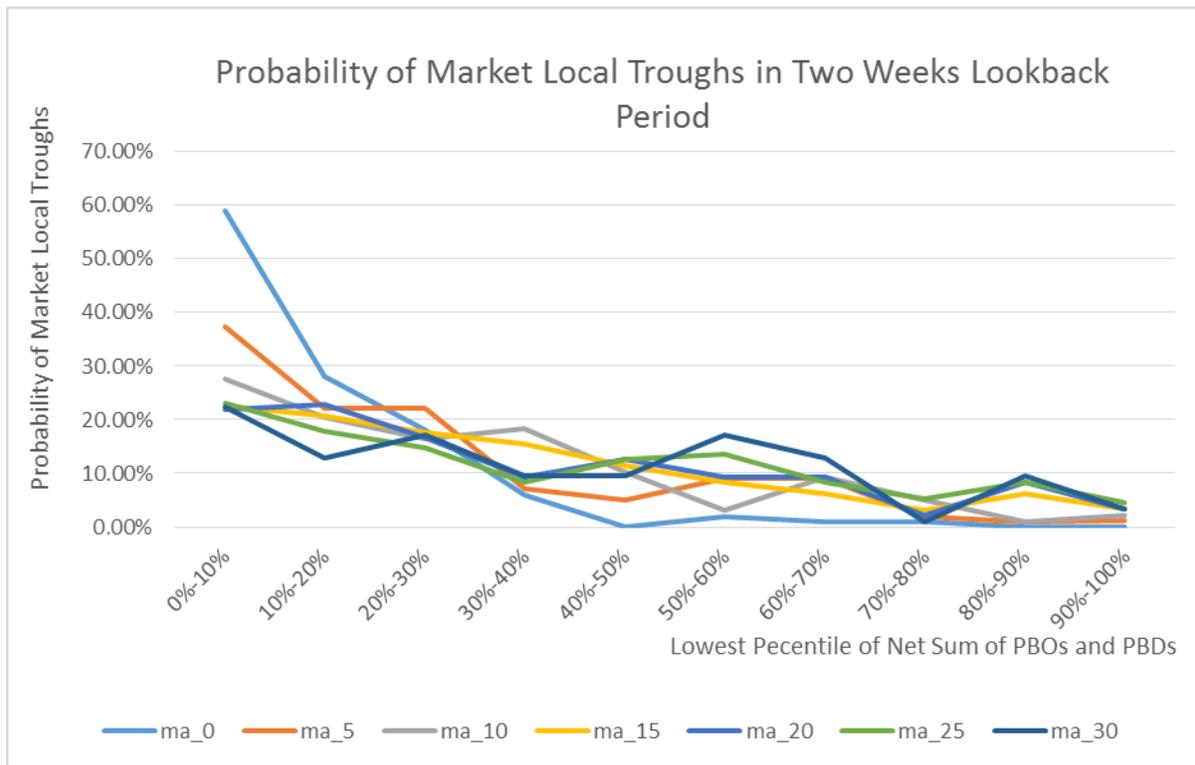
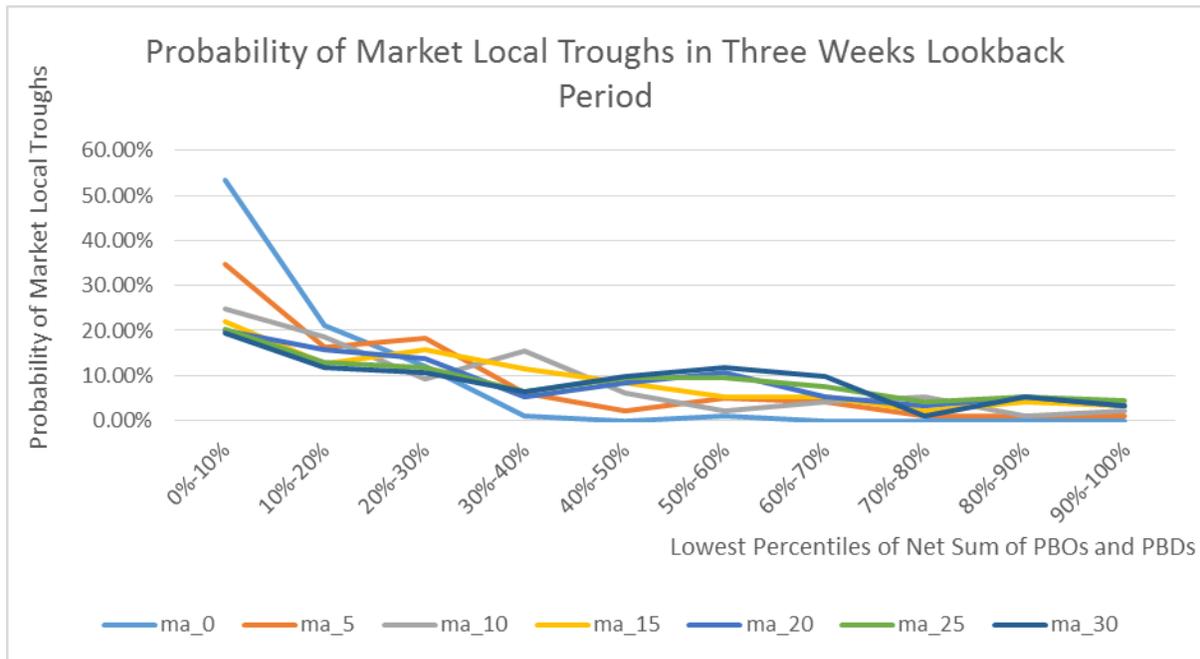


Exhibit 4. percentage of market local troughs for two week lookback period

Three Week Lookback					
Lowest %	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%
Moving Average					
0 Day	53.54%	21.21%	12.12%	1.01%	0.00%
5 Days	34.69%	16.33%	18.37%	6.12%	2.04%
10 Days	24.74%	18.56%	9.28%	15.46%	6.19%
15 Days	21.88%	12.50%	15.63%	11.46%	8.33%
20 Days	20.00%	15.79%	13.68%	5.26%	8.42%
25 Days	20.21%	12.77%	11.70%	6.38%	9.57%
30 Days	19.35%	11.83%	10.75%	6.45%	9.68%

**Exhibit 5.** percentage of market local troughs for three weeks lookback period



**Exhibit 6.** percentage of market local troughs for three weeks lookback period

It can be observed that in most cases of each moving average (from 0 days to 30 days), the probability of market local troughs in all three lookback periods declines as the net sum of PBOs and PBDs increases, or moves in favor of PBOs. This observation is also supported by two sample proportional tests, where the p-values are mostly less than 0.05 with the alternative hypothesis that lower percentile of OD values (extreme negative ends) indicates higher probability of market local troughs.

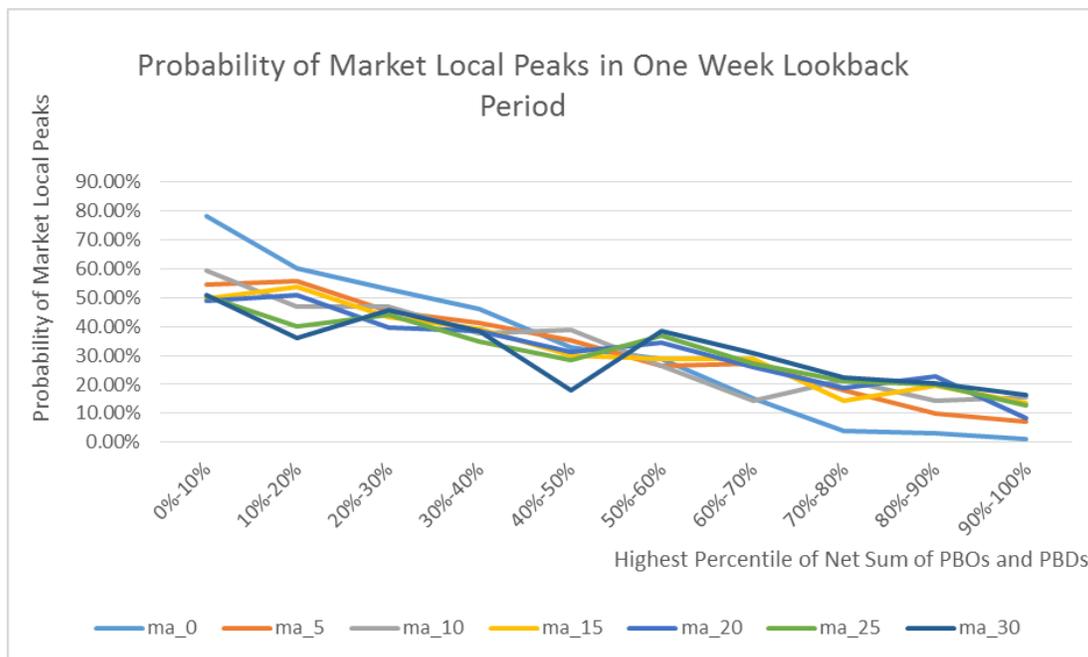
It can also be observed that the discrete (non-moving averaged) OD values yield a significantly higher probability of market local troughs in all three lookback periods than any moving averaged OD values do in the lowest 20% percentile. Since only extreme cases are concerned in the research, the observations suggest that discrete OD values imply a stronger relationship with market local troughs.

**MARKET LOCAL PEAKS**

The following exhibits display the percentages of the market local peaks in all three market return (lookback) periods, from the highest 10% to the highest 50% of discrete OD values and each pair of moving-average data. The corresponding graphs below, demonstrate the trend line of the percentage of market local peaks from the highest 10% to the lowest 10% of OD values. For example: discrete OD values between 0-10% (extreme PBOs) identify local peaks with 78% probability. 5 D MA OD values between 0-10% (extreme PBOs) peak at 54.55% probability.

One Week Lookback		0%-10%	10%-20%	20%-30%	30%-40%	40%-50%
Lowest %						
Moving Average						
0 Day		78.00%	60.00%	53.00%	46.00%	33.00%
5 Days		54.55%	55.56%	45.45%	41.41%	35.35%
10 Days		59.18%	46.94%	46.94%	37.76%	38.78%
15 Days		49.48%	53.61%	43.30%	39.18%	29.90%
20 Days		48.96%	51.04%	39.58%	38.54%	31.25%
25 Days		50.53%	40.00%	44.21%	34.74%	28.42%
30 Days		51.06%	36.17%	45.74%	38.30%	18.09%

**Exhibit 7.** percentage of market local peaks for one week lookback period



**Exhibit 8.** percentage of market local peaks for one week lookback period

Two Week Lookback					
Lowest %	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%
Moving Average					
0 Day	73.00%	50.00%	41.00%	39.00%	18.00%
5 Days	51.52%	47.47%	39.39%	33.33%	25.25%
10 Days	54.08%	39.80%	36.73%	32.65%	30.61%
15 Days	42.27%	48.45%	31.96%	35.05%	29.90%
20 Days	41.67%	45.83%	33.33%	26.04%	25.00%
25 Days	45.26%	33.68%	38.95%	28.42%	16.84%
30 Days	44.68%	32.98%	39.36%	24.47%	14.89%

Exhibit 9. percentage of market local peaks for two weeks lookback period

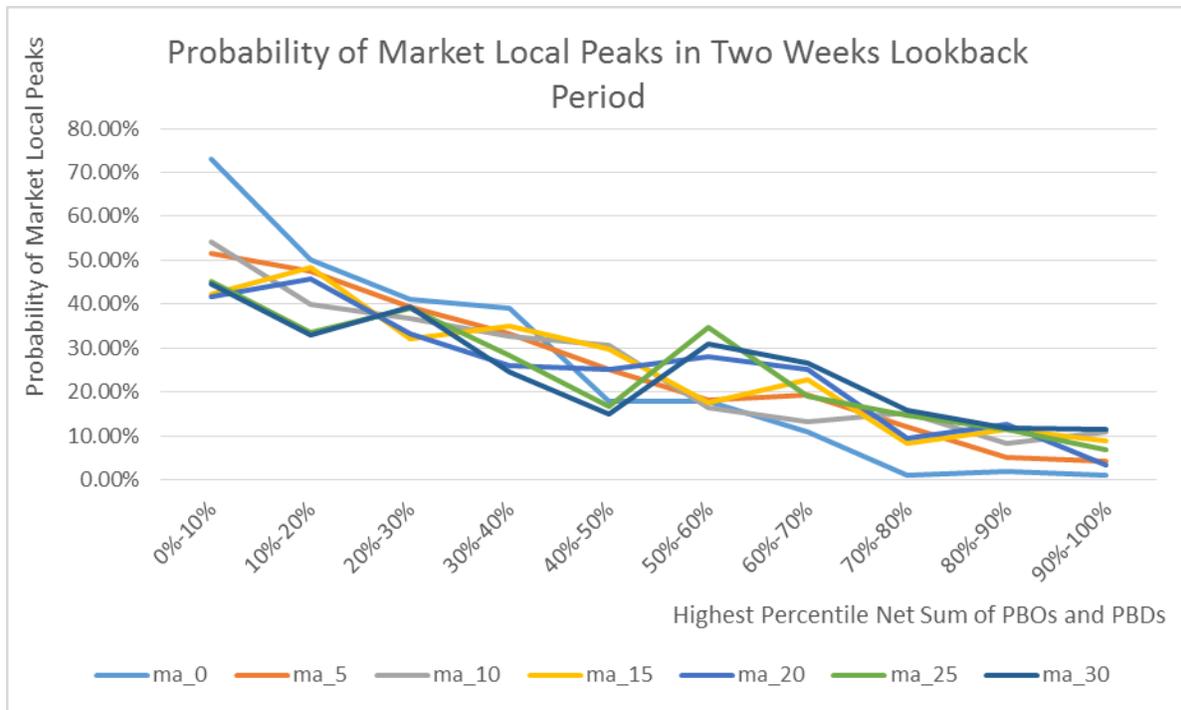


Exhibit 10. percentage of market local peaks for two weeks lookback period

Three Week Lookback					
Lowest %	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%
Moving Average					
0 Day	70.71%	48.48%	36.36%	29.29%	14.14%
5 Days	51.02%	41.84%	37.76%	27.55%	20.41%
10 Days	48.45%	37.11%	37.11%	30.93%	26.80%
15 Days	38.54%	42.71%	32.29%	29.17%	26.04%
20 Days	36.84%	41.05%	34.74%	18.95%	24.21%
25 Days	39.36%	35.11%	34.04%	26.60%	12.77%
30 Days	39.78%	33.33%	34.41%	23.66%	11.83%

Exhibit 11. percentage of market local peaks for three weeks lookback period

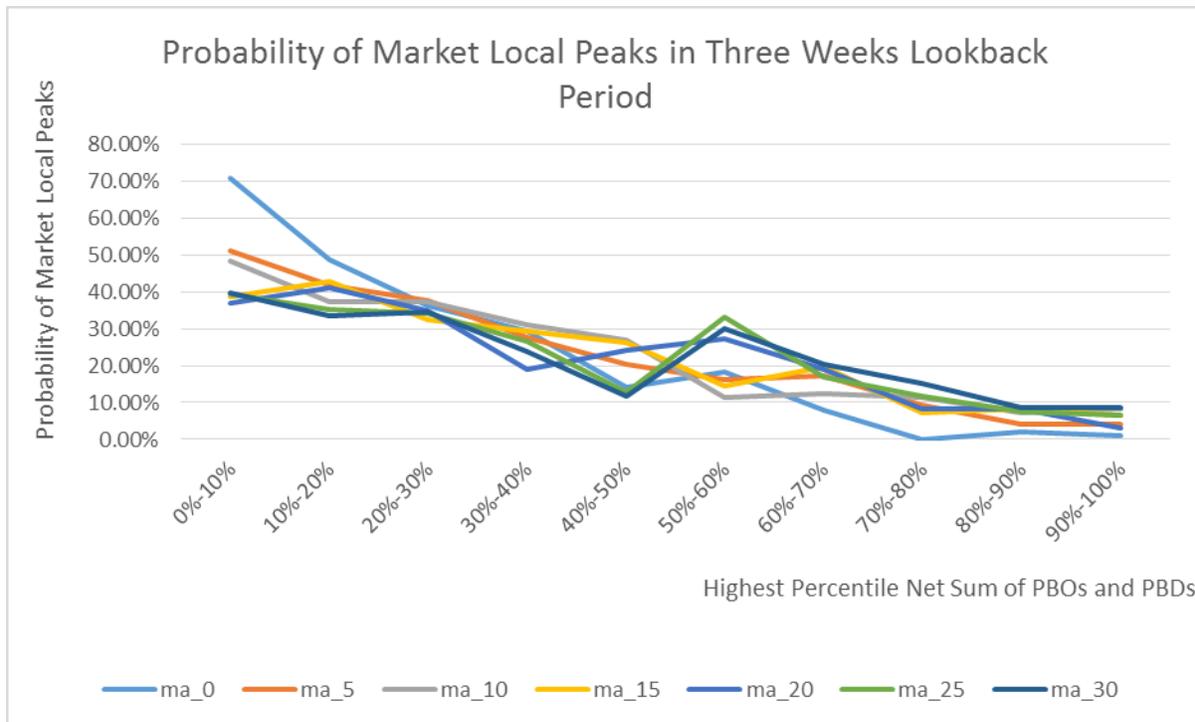


Exhibit 12. percentage of market local peaks for three weeks lookback period

Contrary to market troughs, in each moving average case (from 0 days to 30 days), the probability of market local peaks in all three lookback periods declines as OD values decrease (moves in favor of PBDs) in most cases. Again, the observation is supported by two sample proportional tests, where the p-values are mostly less than 0.05 with the alternative hypothesis that higher percentile of OD values indicates a higher probability of market local peaks.

It can also be observed that discrete OD values yield significantly higher probabilities of market local peaks in all three lookback periods than any moving averaged OD values do in the highest 20% percentile. Since only extreme cases are concerned in the research, the observations suggest that discrete OD values imply a stronger relationship with market local peaks.

### Thresholds on OD values to identify the local market troughs and peaks

As suggested by the first section, discrete OD values tend to be more highly correlated to market local troughs and peaks. Thus, in this section, only non-moving averaged OD values are used to find the thresholds that would not reject the null hypotheses that: i) the day with an OD value equal to or less than the thresholds would be expected as the market local trough, and that ii) the day with OD value equal to or greater than the thresholds would be expected as the market local peak, in a given market return lookback period.

Here, we calculate the differences between the market prices of any trading day with OD values under certain thresholds and market local troughs (peaks) in a given lookback period. These are tested with one-sided one sample non-parametric Sign tests. This is due to the natural property of the sample differences that they concentrate at 0 and are either left skewed (in market local trough cases) or right skewed (in market local peak cases).

The following two exhibits indicate the percentile thresholds of OD values and their corresponding net sum values, and sample sizes under thresholds. Also displayed are the lowest, median, and highest percentage change of market prices to the market local troughs and peaks in a given lookback period. Additionally included are the probabilities of market local troughs and peaks in the samples, with p-values of the Sign tests.

Market Local Trough									
Lookback Period	Lowest % of Net Sum	Threshold	Data Points	Lowest Diff	Highest Diff	Median	% of Market local trough	P-value for Sign test	
One Week	2.60%	-215	27	0	0.52%	0	85.19%	0.0625	
Two Week	2.40%	-217	25	0	0.12%	0	88.00%	0.0625	
Three Week	2.40%	-217	25	0	0.12%	0	88.00%	0.0625	

**Exhibit 13.** thresholds of market local troughs for all three lookback periods

Market Local Peak	Lookback Period	Highest % of Net Sum	Threshold	Data Points	Lowest Diff	Highest Diff	Median	% of Market local peak	P-value for Sign test
	One Week	5%	125	51	-0.34%	0	0	92.16%	0.0625
	Two Week	3%	148	31	-0.34%	0	0	90.32%	0.125
	Three Week	3%	148	31	-0.44%	0	0	87.10%	0.0625

**Exhibit 14.** thresholds of market local peaks for all three lookback periods

As shown in the exhibits, the percentages that the market local troughs happen exactly on the days of OD values under the thresholds tends to be as high as 88%, and the local market peaks tend to be as high as 92.16%.

All in all, when OD values are equal to or less than -217, the corresponding trading days are expected to be market local troughs in all three lookback periods, while when OD values are no less than 148, the corresponding trading days are expected to be market local peaks in all three lookback periods.

## STUDY TWO: EXTREME PBO (PBD) STATISTICS AND MARKET RETURNS

### SUMMARY

Among 991 trading day observations, we found that days when the PBD statistic is at the top 5% level, market returns 1-2 weeks later demonstrate a significant increase. When the PBO statistic is at the top 5% level, 1-2 week market returns are significantly lower than the usual level. As statistics trend away from extreme cases, market returns revert to the total mean level.

### DATA AND METHODOLOGY

To measure the relative strength of PBO signals against PBD signals, we define the variable “Ratio” as the ratio between number of PBO signals and absolute sum of PBO and PBD signals with the following formula: **PBO/ABS(PBO-PBD)**. By definition, the value of “Ratio” is between 0 and 1. A larger value of “Ratio” is related to more PBOs, while a smaller value of “Ratio” is related to more PBDs.

Isolating the top 5% PBD days leaves us with 50 observations. To test whether these days preclude significantly higher market returns a week or more later, we sought to perform a paired Wilcoxon signed-rank test between weekly returns related to these 50 observations and the entire data pool. Random resampling with replacement was used to achieve this goal.

With similar methods we examined the observations of subsequent rankings. We also sliced the dataset to examine the data in between these levels.

### STATISTICAL RESULTS

#### 1. Top 5% PBD Ratio Days

Among the 991 observations, the top 5% PBD ratio days are those with “Ratio” smaller than or equal to 0.067. ***The mean of one-week market returns for top 5% PBD days was 0.754%, against the general market weekly return of 0.229%. The two-week return was 2.025%, while the general market two-week return was 0.463%.***

To test whether the mean of the selected sample was statistically significantly higher than the general market, we have the Wilcoxon signed-rank test result between the top 5% PBD observations and the market pool as follows:

	One Week	Two Weeks
W statistics	568740	529950
p value	1.064e-09	0.002253

**Exhibit 15.** paired Wilcoxon Signed-Rank Test Result for weekly and two-week returns, top 5% PBD

In both cases, the W and p-value suggest the selected days preclude a statistically significantly higher one week/two week return than the general market.

## 2. Top 5% PBO Ratio Days

Among 991 observations, the top 5% PBO ratio days are those with “Ratio” larger than or equal to 0.963. **The mean of one-week market returns for top 5% PBO days was -0.014%, against the general market weekly return of 0.229%. The two-week return was 0.056%, while the general market two-week return was 0.463%.**

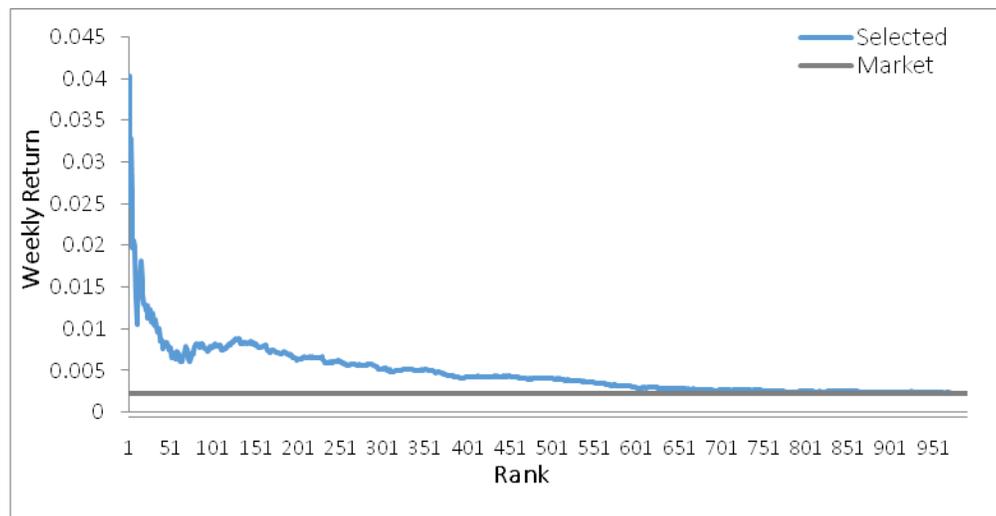
To test whether the mean of the selected sample is statistically significantly lower than the general market, we conducted the Wilcoxon signed-rank test between top 5% PBO observations and the market pool with the following results:

	One Week	Two Weeks
W statistics	441470	409990
p-value	9.975e-05	1.988e-10

**Exhibit 16.** paired Wilcoxon Signed-Rank Test Result for weekly and two-week returns, top 5% PBO

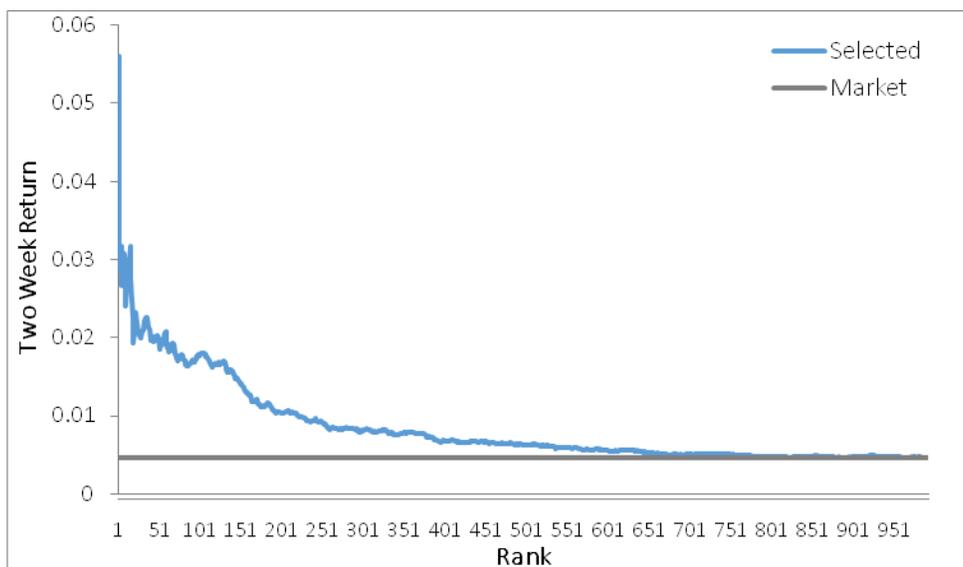
In both cases, the W and p-value suggest the selected days foresee a statistically significant, lower weekly/two week return than the general market.

## 3. Slicing the PBD Ratio Levels



**Exhibit 17.** average weekly return foreseen by top  $n$  (on X axis) PBD days

In Exhibit 17 the blue line represents PBD selected days, and the gray line represents the average market return. The graph demonstrates the average weekly return foreseen by the top 1 - 991 PBD ratio days. From the figure, it can be seen that higher PBD ratio days, on average, indeed indicate higher weekly returns. Two-week returns demonstrate the same pattern, as presented in Exhibit 18.



**Exhibit 18.** average two-week return foreseen by top  $n$  (on X axis) PBD days

Additionally, we sliced the days by PBD ratio rankings to see the predictive indication of different levels of signals. In Exhibits 19 and 20, each pillar indicates the average market return related to 30 PBD ratio ranks (top 1-30, 31-60, etc).

***We cannot draw a conclusion for all rankings, yet it's safe to say that the first 150 rankings (indicating "Ratio" smaller than or equal to 0.261) present weekly returns higher or equal to market average levels in both cases, indicating a strong predictive power of extreme PBD cases.***

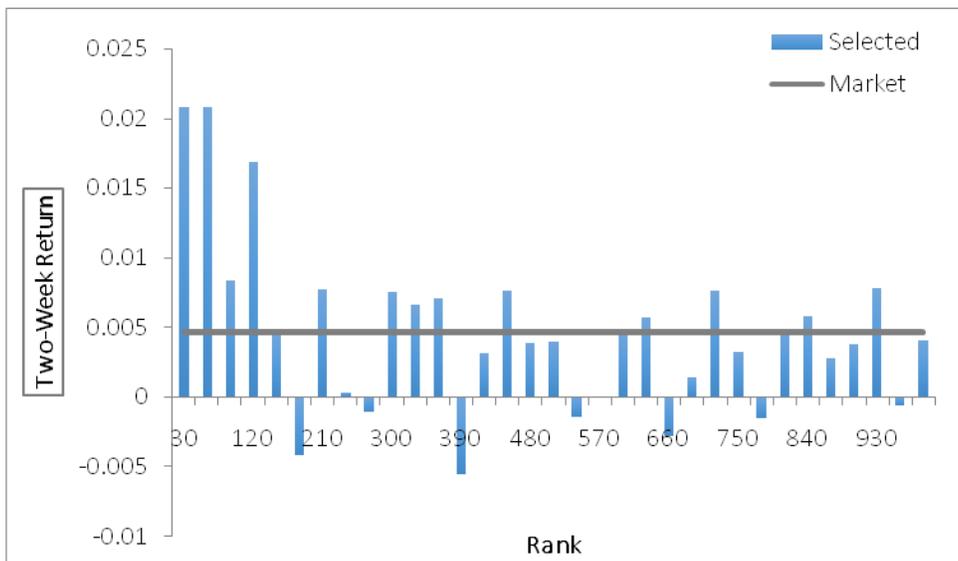
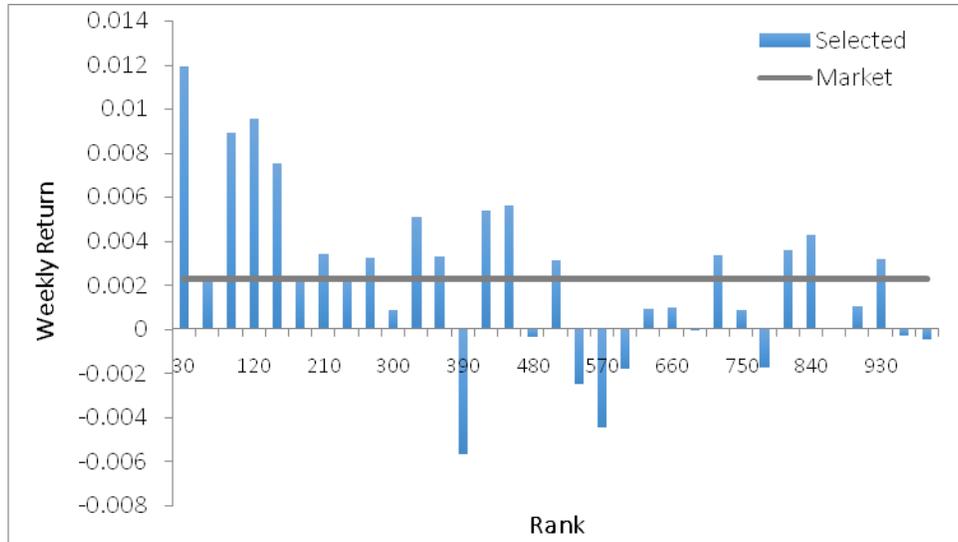


Exhibit 19, 20. (above) weekly and two-week sliced PBD ratio levels, with 30 rankings for each pillar

## STUDY THREE: EXTREME COMPASS SCORE STOCKS IN EXTREME MARKET CONDITIONS

### SUMMARY

This report tested the performance of stocks with PBO or PBD signals and with extreme Compass Scores under extreme market conditions. Both extreme Compass Scores and market conditions are defined by top or bottom 5% to 20% percentile. We ranked all trading days by 4-week market return, and took the top (bottom) 5%, 10%, 15%, 20% as different thresholds for bullish (bearish) market conditions. In those cases, we then ranked all stocks by Compass Score, and took the stocks with PBOs (PBDs) and with top (bottom) 5%, 10%, 15%, and 20% Compass Scores, calculating 4-week excess return to the market, and running t tests for statistical significance.

Using the MAP PBO/PBD signal dataset of 51,383 individual equities over 3.5 years, our study showed the following results at 95% significance level:

1. High Compass Score PBO stocks in bullish markets outperform the S&P 500 by 0.67% to 2.34% depending on different thresholds.
2. High Compass Score PBO stocks in bearish markets outperform the S&P 500 by about 1%.
3. Low Compass Score PBD stocks in bullish markets outperform the S&P 500 by 2% to 3.17%.
4. Low Compass Score PBD stocks in bearish markets underperform the S&P 500 by 1.75% to 5.42%.

### High Compass Score PBO stocks in bullish market

In this section, the performance of stocks with PBOs and Compass Scores in the top 5%, 10%, 15%, and 20% are compared to that of the S&P 500 that yields top 5%, 10%, 15%, and 20% returns over 4 weeks.

Given different market return and stock Compass Score thresholds; we obtained excess returns and conducted t tests on the stocks' outperformance over the market at 95% significance level. The following tables display the averaged excess returns and p-values of t tests at different thresholds. For example, the excess return of stocks with a top 5% Compass Score (greater than 81.48) versus top 5% market days (greater than 6.35% monthly market return) on average was 0.0116, with p-value of 0.1524.

Stock Market	5% (81.48)	10% (79.63)	15% (77.78)	20% (75.93)
5%(6.35%)	0.0116	<b>0.0234</b>	<b>0.0155</b>	<b>0.0171</b>
10%(4.5%)	<b>0.0148</b>	<b>0.0192</b>	<b>0.0091</b>	0.0043
15%(4.1%)	0.0093	<b>0.0139</b>	0.0042	0.0026
20%(3.37%)	<b>0.0136</b>	<b>0.0177</b>	<b>0.0094</b>	<b>0.0067</b>

Exhibit 21. excess return of high Compass Score stocks against bullish market

Stock Market	5% (81.48)	10% (79.63)	15% (77.78)	20% (75.93)
5%(6.35%)	0.1524	<b>0.0026</b>	<b>0.0114</b>	<b>0.0066</b>
10%(4.5%)	<b>0.0485</b>	<b>0.0041</b>	<b>0.0387</b>	0.1498
15%(4.1%)	0.1269	<b>0.0113</b>	0.1767	0.2326
20%(3.37%)	<b>0.0188</b>	<b>0.0002</b>	<b>0.0049</b>	<b>0.0111</b>

Exhibit 22. p-value from t test of high Compass Score stocks against bullish market

All of the averaged excess returns with statistical significance are in bold. **The greatest outperformance over the market happened when the monthly market return was at least 6.35%, with corresponding 2.34% average outperformance from the stocks with PBOs and with Compass Score higher than 79.63.** In particular, when observing stocks with Compass Scores at the top 10% (greater than 79.63), the outperformance of stocks with statistical significance persists in all of the top 10% market return days.

### High Compass Score PBO stocks in bearish market

In this section, the performance of stocks with PBOs and Compass Scores in the top 5%, 10%, 15%, and 20% are compared to that of the S&P 500 that yields bottom 5%, 10%, 15%, and 20% returns.

Given different market and stock thresholds, we obtained excess returns and conducted t tests on the stocks' outperformance over the market at 95% significance level. The following tables display the averaged excess returns and p-values of t tests at different thresholds. For example, the excess return of stocks with a top 5% Compass Score (greater than 81.48) against bottom 5% market days (less than -5.95% monthly market return) on average was 0.0086, with p-value of 0.2566.

Stock Market	5% (81.48)	10% (79.63)	15% (77.78)	20% (75.93)
5%(-5.95%)	0.0086	0.0018	0.0084	<b>0.0119</b>
10%(-3.36%)	0.0094	0.0041	0.0060	0.0052
15%(-2.29%)	0.0075	<b>0.0100</b>	<b>0.0135</b>	<b>0.0126</b>
20%(-1.64%)	<b>0.0128</b>	<b>0.0124</b>	<b>0.0137</b>	<b>0.0121</b>

**Exhibit 23.** excess return of high Compass Score stocks against bearish market

Stock Market	5% (81.48)	10% (79.63)	15% (77.78)	20% (75.93)
5%(-5.95%)	0.2566	0.4232	0.1267	<b>0.0252</b>
10%(-3.36%)	0.1368	0.2313	0.0908	0.0984
15%(-2.29%)	0.0695	<b>2.343e-3</b>	<b>3.313e-6</b>	<b>6.374e-7</b>
20%(-1.64%)	<b>2.634e-3</b>	<b>4.695e-5</b>	<b>8.984e-8</b>	<b>3.883e-8</b>

**Exhibit 24.** p-value from t test of high Compass Score stocks against bearish market

All of the averaged excess returns with statistical significance are in bold. In this case, the spread of outperformance over the bearish markets with statistical significance was very small, less than 0.35%. **The greatest outperformance over the market happened when the monthly market return was less than -1.64%, with corresponding 1.37% outperformance from the stocks with PBOs and with Compass Score higher than 77.78.** Also, when the market decreased by less than -1.64%, all of the stocks with the top 20% Compass Scores outperformed the market with statistical significance.

### Low Compass Score PBD stocks in bullish market

In this section, the performance of stocks with PBDs and with Compass Scores in the bottom 5%, 10%, 15%, and 20% are compared to that of the S&P 500 that yields a top 5%, 10%, 15%, and 20% return.

Given different market and stock thresholds, we obtained excess returns and conducted t tests on the stocks' outperformance over the market at 95% significance level. The following tables display the averaged excess returns and p-values of t tests at different thresholds. For example, the excess return of the portfolio with the lowest 5% Compass Score (less than 27.78) against the top 5% market days (greater than 6.35% monthly market return) on average is 0.0034, with a p-value of 0.3898.

Stock Market	5% (27.78)	10% (31.03)	15% (33.33)	20% (35.19)
5%(6.35%)	0.0034	<b>0.0271</b>	<b>0.0246</b>	<b>0.0257</b>
10%(4.5%)	0.0050	<b>0.0265</b>	<b>0.0213</b>	<b>0.0200</b>
15%(4.1%)	0.0099	<b>0.0277</b>	<b>0.0227</b>	<b>0.0210</b>
20%(3.37%)	0.0134	<b>0.0307</b>	<b>0.0237</b>	<b>0.0234</b>

Exhibit 25. excess return of low Compass Score stocks against bullish market

Stock Market	5% (27.78)	10% (31.03)	15% (33.33)	20% (35.19)
5%(6.35%)	0.3898	<b>0.0003</b>	<b>2.32e-05</b>	<b>8.94e-08</b>
10%(4.5%)	0.3196	<b>0.0001</b>	<b>3.43e-05</b>	<b>1.97e-06</b>
15%(4.1%)	0.1355	<b>3.31e-06</b>	<b>2.70e-07</b>	<b>6.35e-09</b>
20%(3.37%)	0.0687	<b>9.63e-08</b>	<b>2.73e-08</b>	<b>3.75e-11</b>

Exhibit 26. p-value from t test of low Compass Score stocks against bullish market

All of the averaged excess returns with statistical significance are in bold. It can be observed that when the stocks with PBDs have Compass Scores in the lowest 10% (less than 31.03), 15% (less than 33.33), and 20% (less than 35.19), they all show significant outperformance over the bullish market. **The greatest outperformance over the market happens when the monthly market return is at least 3.37%, with corresponding 3.07% outperformance from the stocks with PBDs and with Compass Scores higher than 31.03.**

### Low Compass Score PBD stocks in bearish market

In this section, the performance of stocks with PBDs and with Compass Scores in the bottom 5%, 10%, 15%, and 20% are compared to that of the S&P 500 that yields a bottom 5%, 10%, 15%, and 20% return.

Given different market and stock thresholds, we obtained excess returns and conducted t tests on the stocks' underperformance against the market at 95% significance level. The following tables display the averaged excess returns and p-values of t tests at different thresholds. For example, the excess return of the stocks with the lowest 10% Compass Score (less than 31.03) against the bottom 5% market days (less than -5.95% monthly market return) on average is -2.53%, with a p-value of 0.0008.

Stock Market	5% (27.78)	10% (31.03)	15% (33.33)	20% (35.19)
5%(-5.95%)	-0.0542	-0.0253	-0.0227	-0.0175
10%(-3.36%)	-0.0526	-0.0329	-0.0299	-0.0275
15%(-2.29%)	-0.0501	-0.0315	-0.0271	-0.0250
20%(-1.64%)	-0.0475	-0.0327	-0.0286	-0.0262

Exhibit 27. excess return of low Compass Score stocks against bearish market

Stock Market	5% (27.78)	10% (31.03)	15% (33.33)	20% (35.19)
5%(-5.95%)	1.09e-05	0.0008	0.0002	0.0016
10%(-3.36%)	2.85e-06	1.88e-06	1.49e-07	4.46e-08
15%(-2.29%)	2.52e-06	2.37e-06	4.29e-07	1.34e-07
20%(-1.64%)	1.43e-06	3.14e-07	2.25e-08	4.13e-09

Exhibit 28. p-value from t test of low Compass Score stocks against bearish market

In this case, all of the stocks with PBDs and with the lowest 20% Compass Scores underperform the bearish markets with statistical significance. **The greatest underperformance vs the market happens when the monthly market return is less than -5.95%, with corresponding -5.42% underperformance from the stocks with PBDs and with Compass scores lower than 27.78.**

## CONCLUSION

In conclusion, we tested for the efficacy of our PBO/PBD signal data.

From a “30,000-foot view”, we wanted to know if extreme PBO/PBD readings helped identify market troughs and peaks. If they did, we wanted to know what market returns looked like one and two weeks after. We also wanted to know the value of extreme PBO or PBD readings, by looking at extreme high and low Compass score stocks with bullish and bearish markets. We can summarize our findings by saying:

- Extreme PBD readings identify market local troughs with statistical significance
- Extreme PBO readings identify market local peaks with statistical significance
- Discrete OD value readings identify lookback peaks/troughs better than moving averages of OD values
- When we employ thresholds, the probability of identifying lookback peaks/troughs increased significantly
- As the ratio of PBOs/PBDs approaches 0, forward weekly market returns are higher than the average.
- As the ratio of PBOs/PBDs approaches 1, forward weekly market returns are lower than the average.
- PBOs with high Compass Scores, regardless of market extremes, tend to outperform the market with the following characteristics:
  - PBOs with high Compass Scores outperform a bull market with statistical significance.
  - PBOs with high Compass Scores outperform a bear market with statistical significance.
- PBDs with low Compass Scores, have statistical significance in extreme markets, however:
  - PBDs with low Compass Scores outperform a bull market with statistical significance.
  - PBDs with low Compass Scores underperform a bear market with statistical significance.

Information is everywhere. Parsing out the useful information from the junk is one task. Then identifying what information is worthy of further analysis is another. Interpreting that information and applying it in a significant way is another task altogether. At MAP we seek to find hidden relationships and patterns in the equity markets. With this study of our PBO and PBD designations, we can illustrate that they do exist and that there are statistically significant ways to identify them, quantify them, and potentially profit from them.

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