
Constructing VWAP Curves

TECHNICAL NOTE

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Overview

VWAP is perhaps the most broadly used benchmark, and correspondingly one of the most popular execution algorithms. But despite its conceptual simplicity, a variety of details around how the volume curves are constructed can influence the performance of the algorithm. Pragma has taken an empirical approach to determining the optimal method for constructing volume curves [1] [2] and this research note summarizes the results of our most recent update of those studies.

Broadly, our VWAP study explores:

- How to construct volume curves for use on ordinary days: single-stock; per sector, per market cap, or market-wide
- How long a historical window to use
- Which days deserve a special curve

Our general approach is to backtest several alternative methods, and evaluate each on the basis of the variability in VWAP shortfall that would have resulted from following that method over a test universe and period of time. For example, method A might yield a standard deviation of 25 basis points, and method B a standard deviation of 26 basis points. Curve construction methods generally have no effect on average VWAP shortfall, only on variability – to the extent a curve successfully predicts actual volume, the variability of shortfall will be minimized. This study used a trading universe of roughly 3000 stocks from Feb 2014 through Feb 2015.

Ordinary Curves

We compared the following methods of constructing volume curves for ordinary days:

- a fixed stylized volume curve over the large cap 500 stocks from 2012 (2012Vlm)
- rolling 22-day volume curve over the large cap 500 stocks (largeCap500)
- rolling 22-day volume curve over our trading universe of about 3000 stocks (allStks)
- rolling 22-day volume curve by sector over the large cap 500 stocks (lg500Sec)
- rolling 22-day volume curve by sector over the entire trading universe (sector)
- rolling 22-day volume curve by market cap into 4 groups: top 100, large cap from 101st to 500th in market cap, mid cap from 501st to 1000th, and small cap for the rest (mktcap)
- rolling 22-day volume curve of individual stocks (indivStk)



Figure 1 shows the variability in VWAP shortfall resulting in each method over the course of the study period.

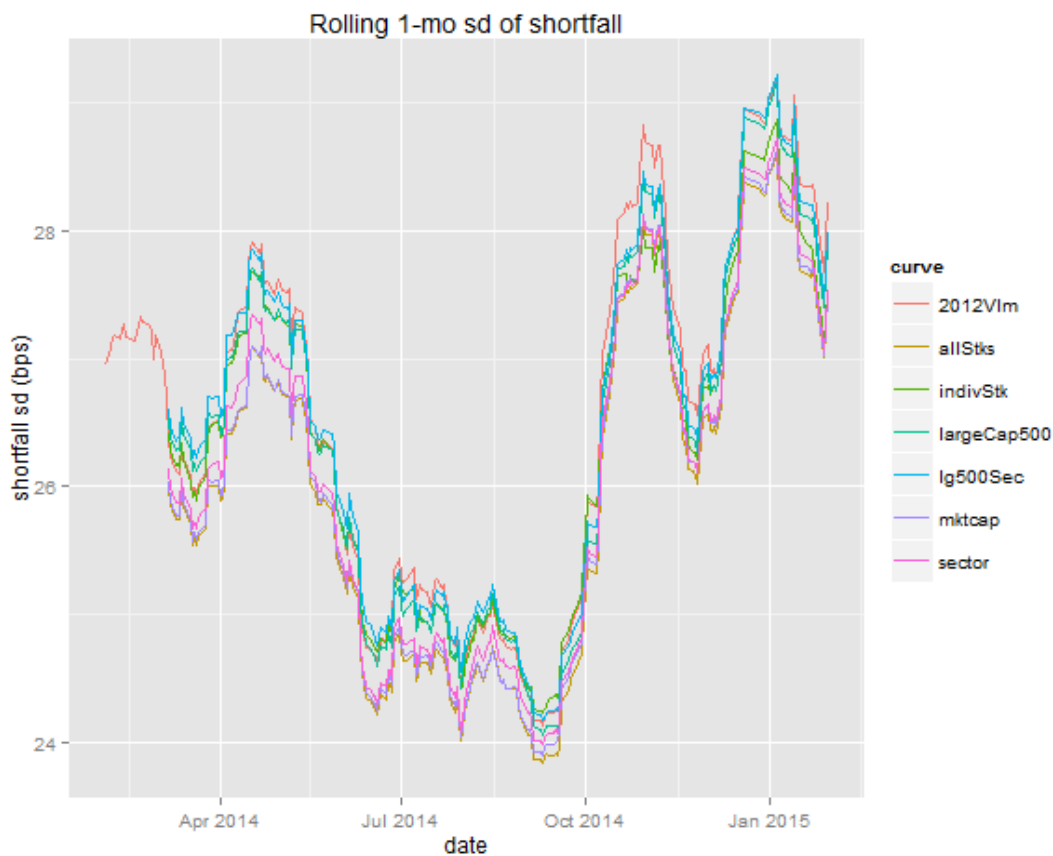


FIGURE 1

The performance of the methods differs by less than 1 bps in standard deviation of VWAP shortfall between the simplest fixed stylized volume curve (2012VIm) and the best performing curve (allStks). Figure 2 shows the differences among the methods more clearly, as the difference between each curve and the baseline (largeCap500) curve. Negative numbers indicate smaller standard deviation and better performance with respect to the baseline. The difference in performance is small relative to the magnitude of the shortfall standard deviation around 27 bps, which is in large part driven by market volatility and had been much higher in the past [1][2].

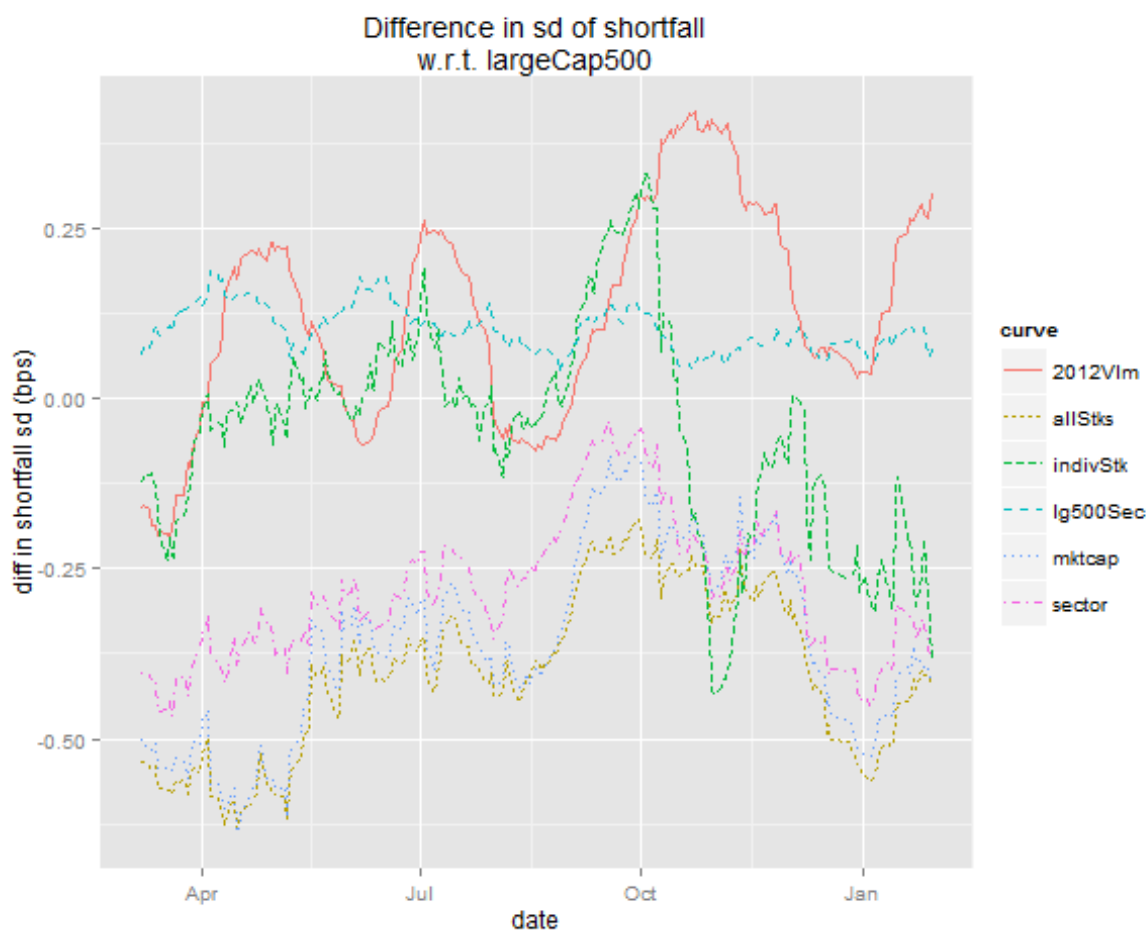


FIGURE 2

We observe that 3 methods, all based on the broader trading universe, outperform the baseline by about 1/3 of a basis point of standard deviation:

- rolling 22-day volume curve over the entire trading universe
- rolling 22-day volume curve by sector over the entire trading universe
- rolling 22-day volume curve by market cap

In addition, we confirmed a number of results from the previous studies [1][2]. We do not repeat the details here, but note that:

- The length of the rolling window matters little to performance.
- A REIT-specific curve continues to show the most performance improvement over the baseline.



Special Days

On special days, trading volume deviates greatly from the normal pattern. Because there are so few special days, evaluating whether treating them differently can be challenging, and to increase the amount of data we look back several years. We look at:

- Month end (EOM)
- Half days (half)
- Option expiration days (OptExp)
- FOMC announcement days (Fed)
- Russell rebalance days (Rus)
- A control group of several days in June each year that have no known relation to the stock market (Bday)

For each special day, we compare the variability of the theoretical VWAP shortfall that results from using a baseline volume curve (a single pattern for all stocks, but excluding any special days) and a special curve computed from the market volume on past special days of the same type over the entire trading universe. Figure 3 shows the results.

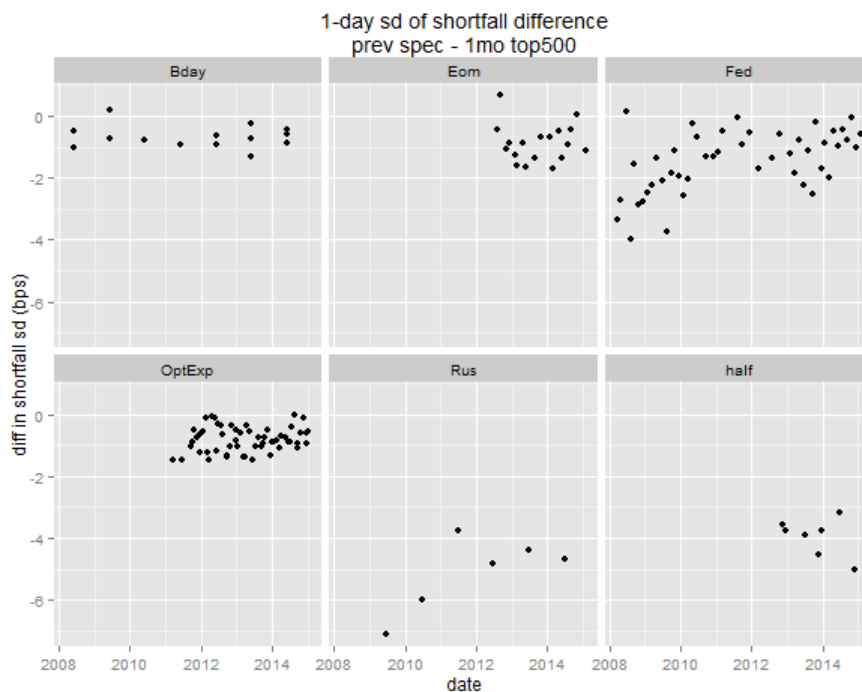


FIGURE 3



Only Russell days and half-days show a large benefit from special curves. The control group, EOM, Fed, and Option expiration days show a smaller benefit. Part of this benefit may be due to the fact that the baseline curve is computed from 500 stocks but the special-day curves are built from the entire trading universe, which as we saw above is slightly better than the baseline.

Conclusion

We confirmed the findings of our previous studies on VWAP volume curves and our previous observations of the relative quality of various choices of volume curves.

We continue to use as a default the baseline curve of a rolling 22-day volume average over the large cap 500 stocks for trading on normal days, as this baseline method is well defined using reliable data while the performance improvement achieved by any of the alternative approaches is relatively modest. In comparison, the special curves offer more performance improvement, so we continue to use them for special days. We find this approach to provide a reasonable trade-off between robustness and performance.

We also continue to generate sector, REIT, and individual stock curves. These alternative curves are available, by configuration, to clients who prefer them.

References

[1] Pragma Securities LLC, "Static VWAP: A comparative Analysis," Pragma Securities LLC, New York, 2009.

[2] Pragma Securities LLC, "Constructing VWAP Curves," Pragma Securities LLC, New York, 2012.