

Measuring the Market Impact of Trading: CDF Suite Analysis

Executive Summary:

Determining the market impact of equity trading is challenging for institutional investors. Traditional methods of analyzing the market impact of trading are inadequate and add little to no tangible value to the investment decision process. Furthermore, SEC proposed changes to liquidity management rules for institutional investors, which include a requirement to evaluate the market impact of trading, significantly raise the bar on meeting this challenge.¹ Woodsdale Group has developed a series of market impact analysis tools, collectively referred to as our CDF Suite, that precisely quantify the market impact of equity trading and give actionable feedback to portfolio managers and traders, particularly when a firm's actual trading fill data is incorporated into the analysis. Importantly, the CDF Screen and CDF Factor algorithms do not require specialized, expensive data, and they measure the market impact of trading without penalizing managers who participate in market rallies and/or who sell on down days. In other words, the CDF Algorithms developed by Woodsdale Group are immune to the effects of overall market direction. In this paper, we present two examples of interesting events independently flagged by our CDF Screen and discuss the results of detailed analyses of these events using our CDF Factor framework.

Analysis:

Our CDF Suite uses algorithms that identify potential aggressive trading events and that quantify the market impact of these candidate events. The CDF Screen identifies points in time at which the target security deviates significantly from a correlated benchmark, marking events that warrant further examination. A detailed analysis of these events includes a calculation of the CDF Factor distribution. The positive and negative CDF Factors reflect how the bid and ask prices evolve over time. The observation that in a normal, liquid market the distributions of these factors are narrow and symmetric implies that under these conditions the stock is in some sense trading adiabatically, i.e. bid and ask prices are strongly correlated. When the market is disturbed by aggressive trading these correlations break down, and the CDF Factor distributions generally become wider and asymmetric.

Interestingly, several headline generating events involving the publicly traded shares of major U.S. listed companies have created opportunities for us to evaluate the real-world performance of our CDF Suite liquidity tools using examples that should be familiar to many readers. One such example is centered on the NYSE listed shares of Valeant Pharmaceutical (VRX). Our CDF

¹ <http://www.sec.gov/news/pressrelease/2015-201.html>

Screen flagged trading in VRX that occurred during the first week of November 2015. You may recall that on Thursday, November 5, 2015 Goldman Sachs was a forced seller of approximately 1.3 million VRX shares that had been pledged by the CEO as collateral for a loan.² The time ordered plots (Figure 1) show the VRX price and our CDF Screen analysis of VRX using the iShares NASDAQ Biotech ETF (IBB) as a market reference, where the CDF Screen was configured to identify aggressive selling candidates. In the plot shown below, the orange data points indicate events flagged for further analysis.

Figure 1: CDF Screen Output and Price Chart from VRX /IBB Run

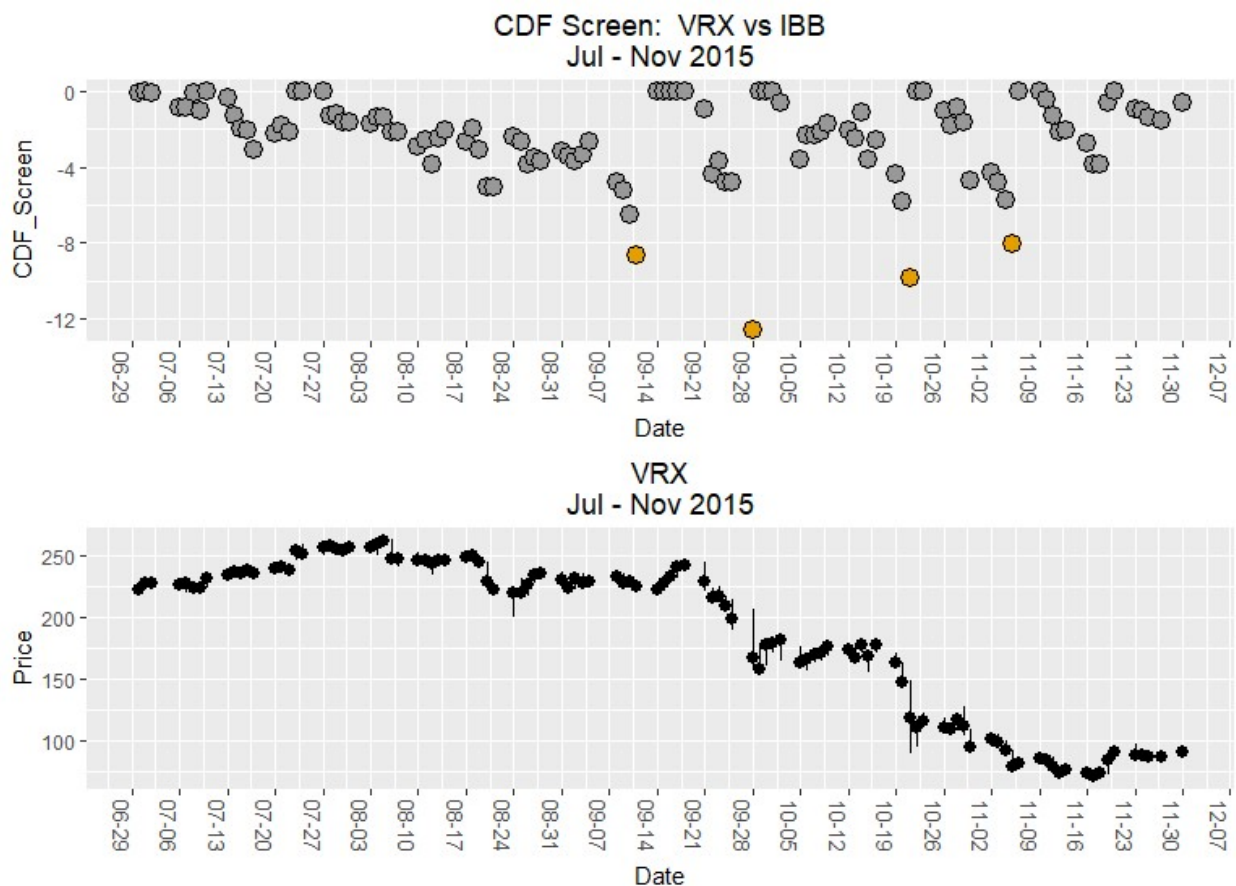
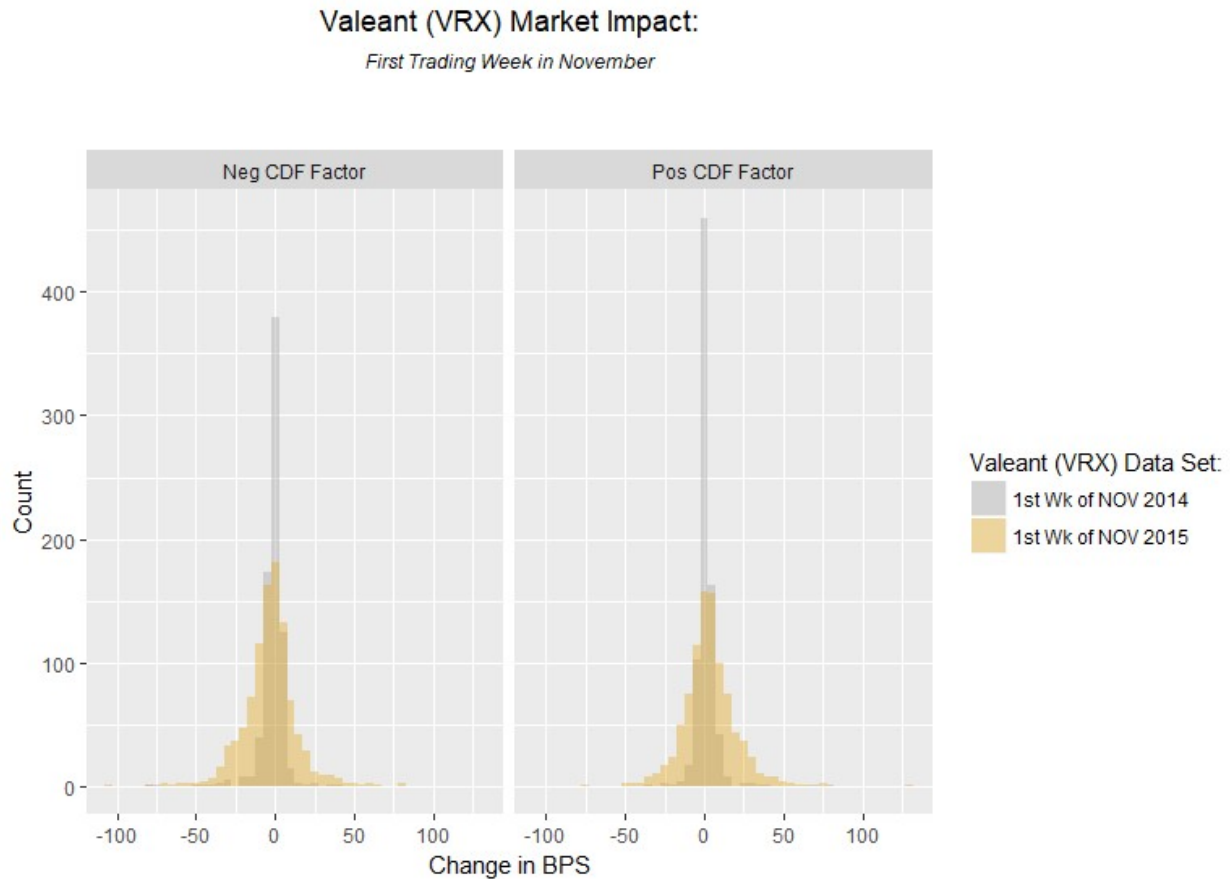


Figure 2 shows our assessment of the market impact that aggressive selling had on VRX fill prices in early November 2015 on a one-minute time scale. We included November from the

² <http://ir.valeant.com/investor-relations/news-releases/news-release-details/2015/Valeant-Issues-Statement-On-Sales-Of-Company-Stock/default.aspx>

prior year to show the behavior of routine VRX trading using the same time scale. An in-depth study indicated that vigorous selling during this period possibly had a disruptive impact on trading in VRX shares; in fact, several standard statistical tests confirmed that the wider 2015 distributions are significantly different from the narrower 2014 distributions. A conservative interpretation of the data is that fill prices from one minute to the next in the first week in November 2015 deviated by as much as 3bps from what would be expected during routine trading. A more aggressive analysis that subtracts the reference trading distribution from the wider disturbed trading distribution demonstrated that fill prices were impacted by significantly more than 3bps from one minute to the next.

Figure 2: CDF Factor Detail: VRX 1st Week of November 2015

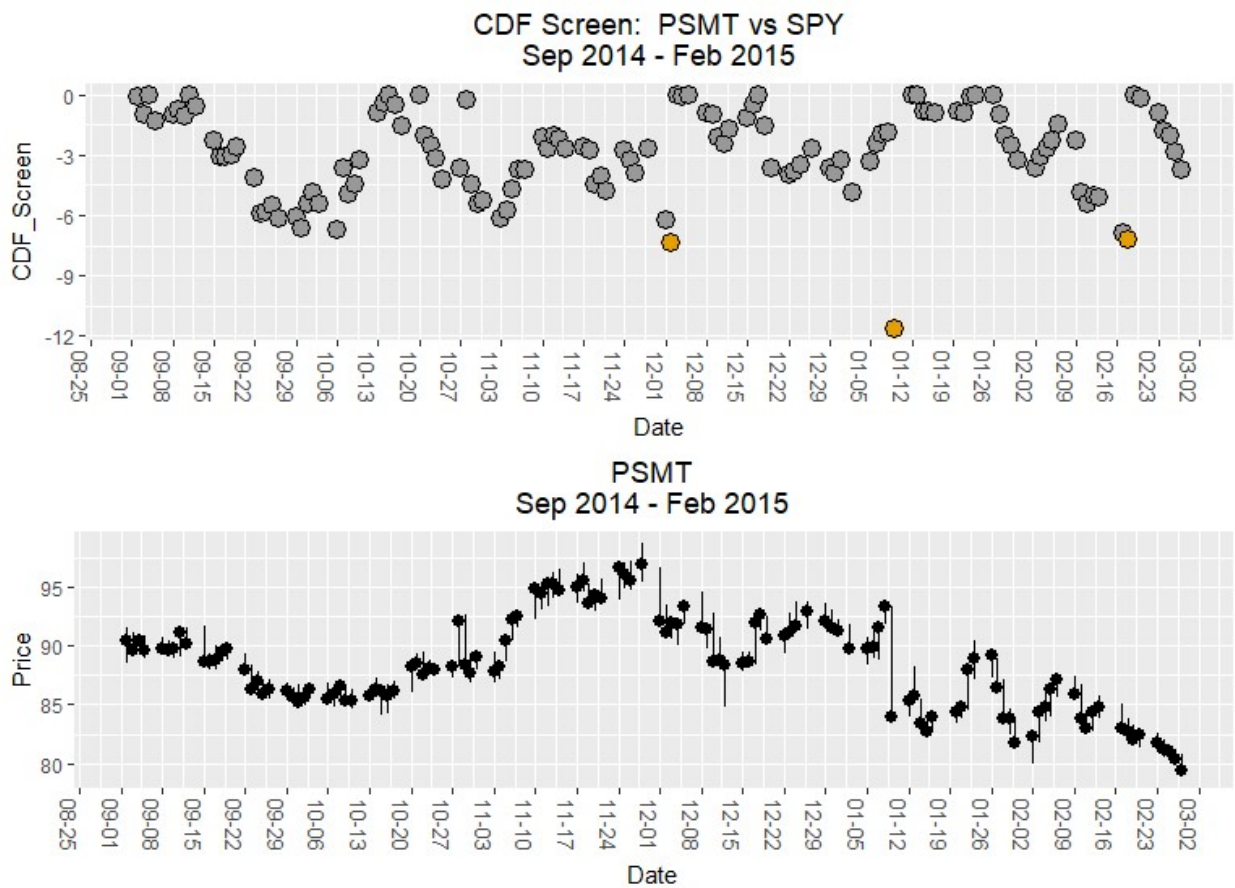


Another interesting scenario flagged by our CDF Screen was trading in PriceSmart Inc. (PSMT) shares that occurred in February 2015. A search of company news during this period did not turn up material news events that typically have been shown to move stock prices.

Nevertheless, a detailed examination of this period indicated that vigorous selling potentially occurred.

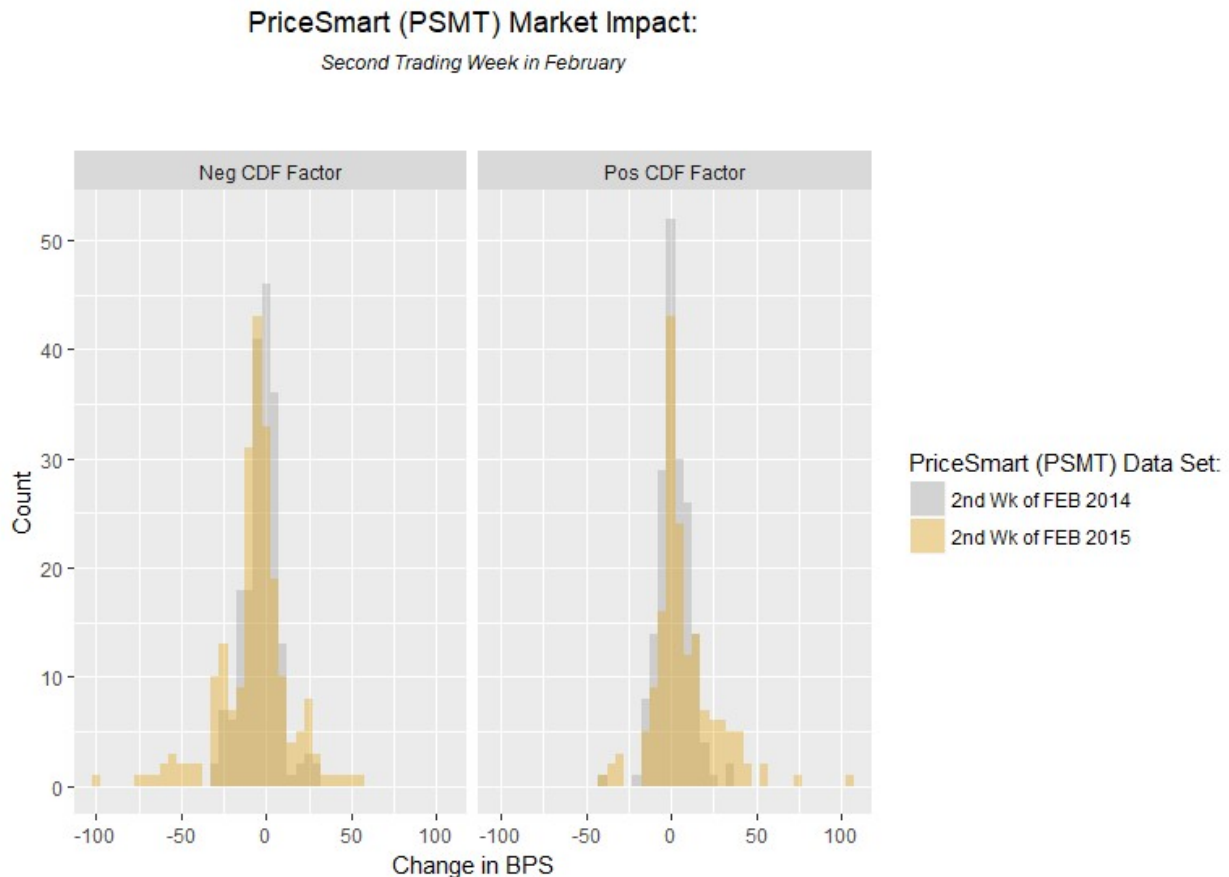
The time ordered plots (Figure 3) show the PSMT price and our CDF Screen analysis using the SPDR S&P 500 ETF (SPY) as a market reference, where the CDF Screen was configured to identify aggressive selling candidates. Among other events, the sustained selling period that occurred in mid-February 2015 was flagged by our CDF Screen, shown by the orange data points below.

Figure 3: CDF Screen Output and Price Chart from PSMT/SPY Run



Further analysis of trading that occurred in mid-February 2015 using our CDF Factors implied that vigorous selling impacted PSMT fill prices. Using data from February of the previous year as a reference distribution we found that PSMT fill prices deviated by at least 6bps from one minute to the next. A more aggressive approach that subtracts the reference distribution from the disturbed trading distribution indicated larger deviations. Additionally, standard two-sided tests confirmed that these distributions are not identical at the 95% confidence level.

Figure 4: CDF Factor Detail: PSMT 2nd Week of February 2015



Closing Remarks:

Woodsdale Group has developed a robust methodology that enables us to quantitatively measure the market impact of trading in U.S. listed equities using inexpensive, readily available price data. This two-step process initially flags aggressive trading candidates. A subsequent detailed analysis generates visually compelling charts and statistically rigorous numeric output that makes it easy for compliance teams, traders and portfolio managers to assess the market

impact of trading, particularly if the firm's actual trading fill data is inserted into the CDF Factor histograms. Please visit woodsdales.com for more information.

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Data/Software Acknowledgement:

Data sources include tradingphysics.com, Money.Net and Yahoo Finance. Software used include R x64 3.2.2 with the following packages: ggplot2, xts, zoo and fBasics.