

# Reversion Study

## Taper to the norm?

September 19, 2013

### Executive Summary

We examined the reversion behaviour of stocks which had significant moves at the end of the trading day. Some of these moves are driven by fundamental factors but some are also caused by aggressive trading near the close.

This paper examines whether stocks that have significant moves at the close tend to revert back to their 'fair' price.

Summary of conclusions:

- Significant movers do have a tendency to revert - especially on rebalance days
- Stocks can take hours to days to fully revert
- Stock behaviour at the start of the next trading day is a leading indicator whether further reversion will occur

Quantitative Execution Services - Program & Electronic Trading Desk

(416) 359-5743 | [qes@bmo.com](mailto:qes@bmo.com)

**Rizwan Awan, CFA**  
(416) 359-5195  
[rizwan.awan@bmo.com](mailto:rizwan.awan@bmo.com)

**Benjamin Chiu**  
(416) 359-4151  
[benjamin.chiu@bmo.com](mailto:benjamin.chiu@bmo.com)

**Jeremy Dietrich, CFA**  
(416) 359-5692  
[jeremy.dietrich@bmo.com](mailto:jeremy.dietrich@bmo.com)

**Charles Connor, CFA**  
(416) 359-7670  
[charles.connor@bmo.com](mailto:charles.connor@bmo.com)

**Chris Sampson**  
(416) 359-7670  
[chris.sampson@bmo.com](mailto:chris.sampson@bmo.com)

**Andrew Ng**  
(416) 359-8692  
[andrew.ng@bmo.com](mailto:andrew.ng@bmo.com)

## Methodology and Constraints

We sampled trading days in a 4 year period (2009-2013) to search for aggressive trading around the close.

We searched for ‘significant movers’ based off the following criteria:

- Price move between 3% and 10% from 3:00pm and the MOC
- Stock price greater than \$3
- Notional value traded greater than \$3mm

These constraints removed the highly volatile or highly illiquid names from the analysis. We found 1870 individual events that fit the criteria.

### Price measurements

To avoid bad ticks the 3:00pm price is defined as the VWAP from 2:45pm – 3:00pm. The closing price was the official price of the stock in the MOC session.

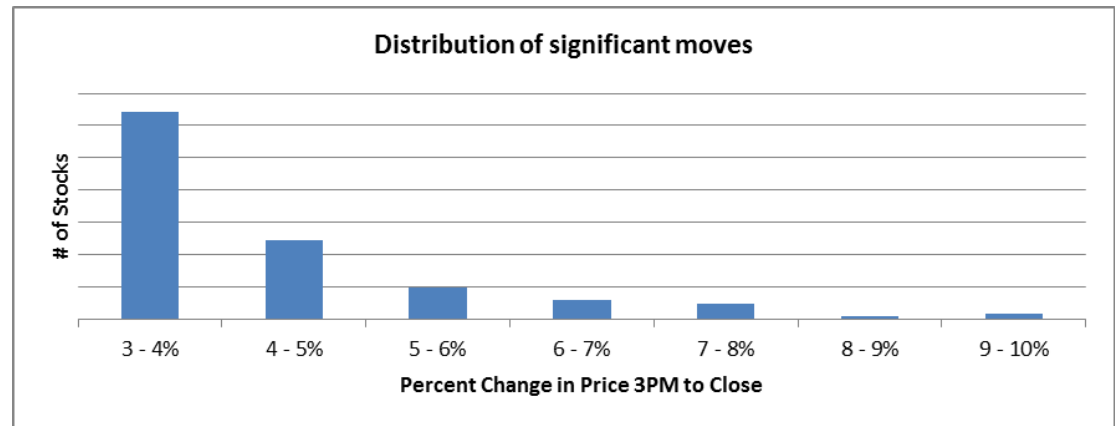
We continued to track and plot the price movements for the next 10 days by plotting intraday one hour VWAPs. Stock prices were sector adjusted to avoid any bias due to market moves.

### Rebalance vs non-rebalance days

We independently examined rebalance days vs all non-rebalance days to gauge different reversion characteristics. Rebalance days were S&P/TSX or MSCI quarterly rebalance days.

## Results

Based on our ‘significant move’ criteria, the average move from 3pm to close was about 4.5%. The distribution of all the moves are in the below chart. As expected a majority of the results are in the lowest bucket (3-4%).

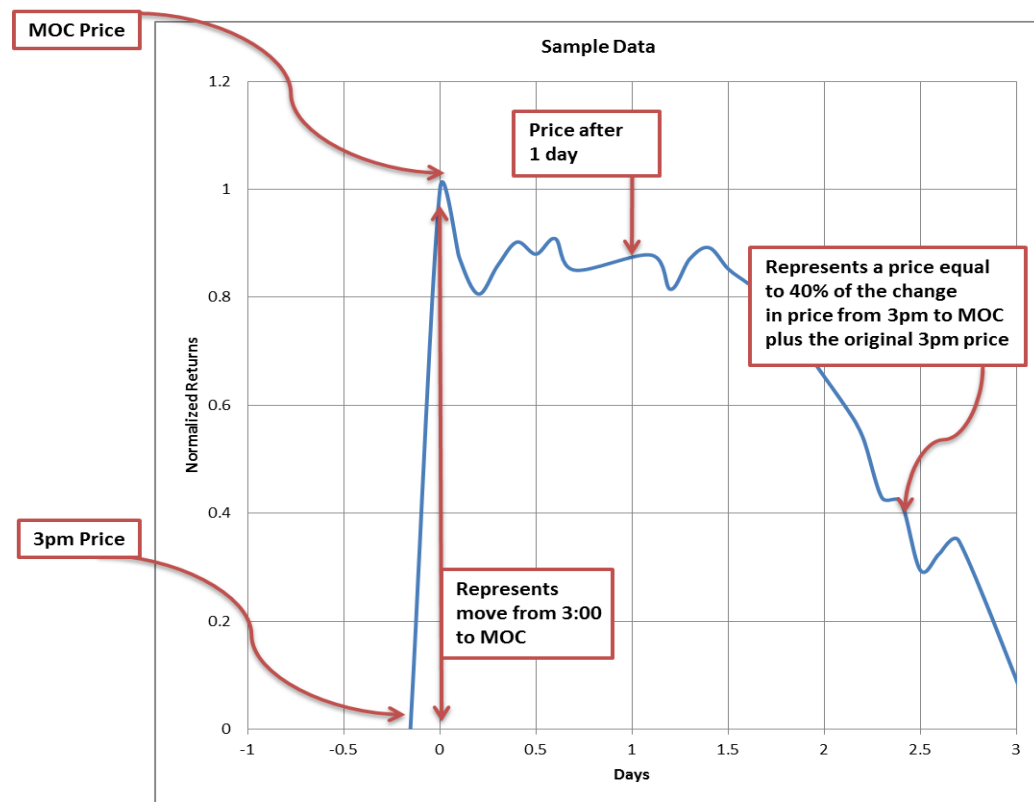


## Reversion through Time

We separated the results between the index rebalance days (229) and non-rebalance days (1641) as well as by gap ups and gap downs.

The chart below describes how to read the price through time charts in figure 1 and figure 2.

- We normalized the measurement date 3:00 pm price as 0 and the closing price as 1 (Normalized Returns axis)
- The initial move from Days -0.8 to 0 represents the significant price move from 3:00 PM and the closing price (Days axis).
- Reversion is measured in subsequent days on the same normalized scale. For example a value of 0.4 Normalized Return represents a 60% reversion from the MOC price to the 3:00 price.



*Reversion Characteristics*

Figures 1 and 2 demonstrate the price performance through time of significant movers.

The key takeaway from these charts is that the stocks that have significant moves on rebalance days have a higher tendency to revert than on non-rebalance days. On rebalance days roughly half the reversion takes place on day 1 alone. We also saw that the stocks that move up have a higher tendency to revert than stocks that move down.

*Reversion occurs more often on rebalance days than non-rebalance days*

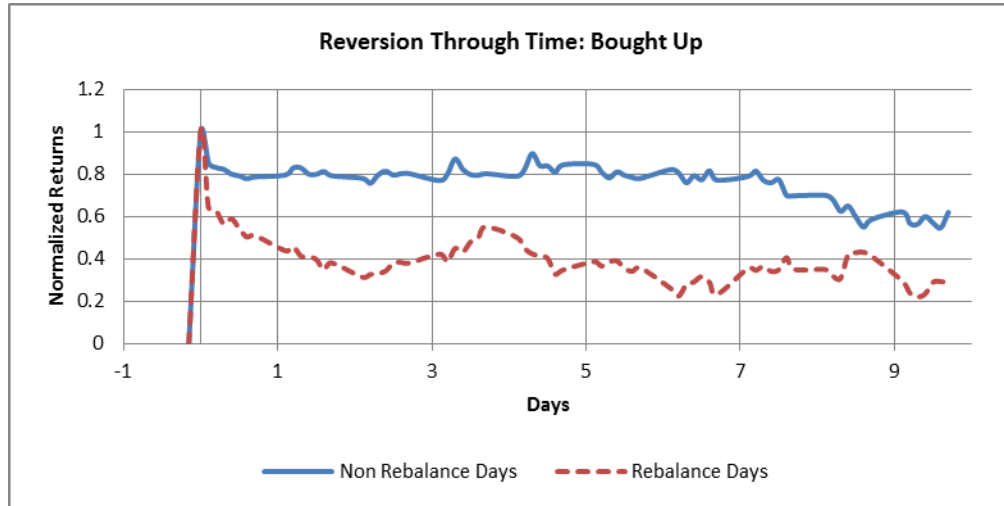


Figure 1: Time profile for stocks bought up into the close

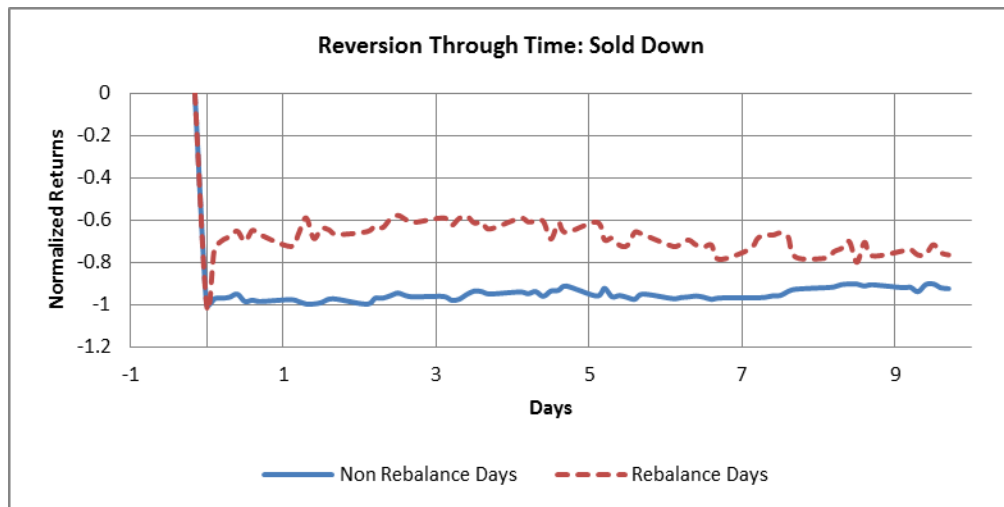


Figure 2: Time profile for stocks sold down into the close

Figures 3-4 show the distribution of reversion over 1 hour, 1 day, 10 day snapshots by stocks that show no reversion, partial reversion or have full reversion. We classified movers as partial reversion when the normalized return was between 0 and 1.

The primary conclusion from these charts is that reversion takes time to occur. There is a distinct difference between the proportions of stocks that have reverted after the first hour compared to after the first day.

*Reversion can take hours to days to be realized*

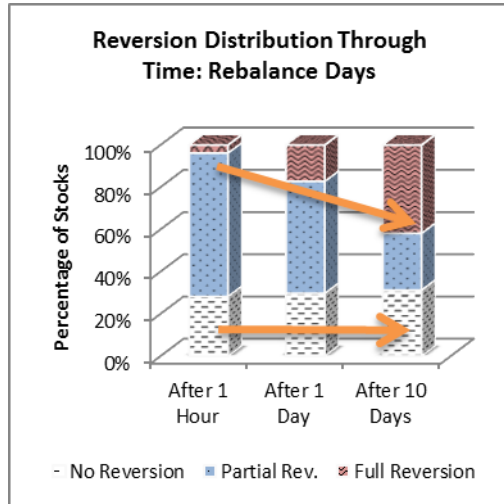


Figure 3: Distribution of how many stocks have reverted at different times for the rebalance day sample

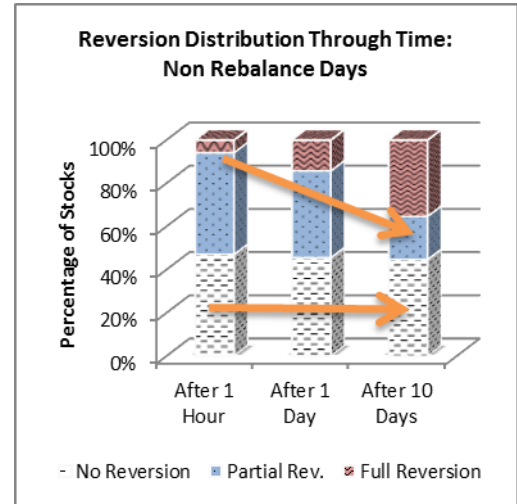


Figure 4: Distribution of how many stocks have reverted at different times for the non-rebalance day

Figures 5 and 6 show the percentage of stocks in the sample that reverted at any given point during the 10 day period. We note that the vast majority of *both* rebalance and non-rebalance stocks reverted at some point during the 10 day period.

Some of this behaviour will occur due to the natural volatility in the stock. However it is notable that only a small portion of stocks (<10%) exhibited no reversion during the 10 day period.

*Fewer than 10% of names do not revert at some point over the next 10 days.*

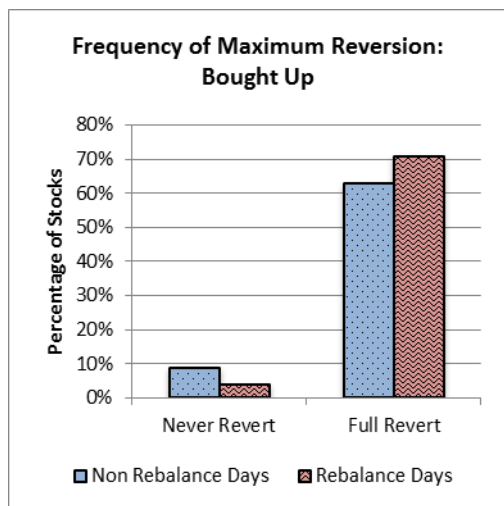


Figure 5: Frequency of maximum reversion in 10 day window for stocks bought up into the close

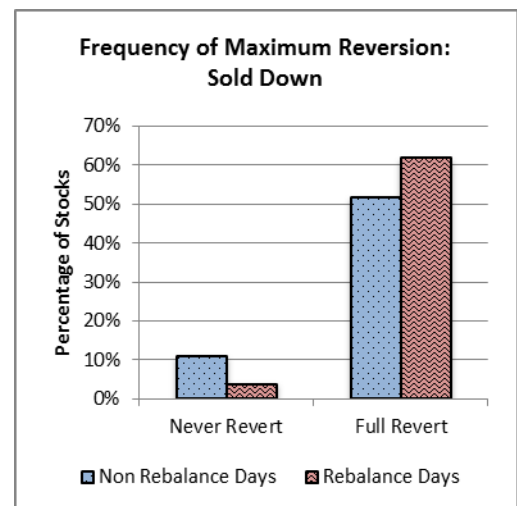


Figure 6: Frequency of maximum reversion in 10 day window for stocks sold down into the close

## Other considerations

We examined several other factors that could affect the reversion tendency but did not find any strong results besides isolating rebalance days. Comparing reversion tendency over different time periods did not show any distinguishing differences. Also the magnitude of the initial move did not have an impact on the likelihood of reversion. The most distinguishing factor was if the move occurred on a rebalance day vs a non-rebalance day.

### *Further examination of non-rebalance day behavior*

On non-rebalance days, aggressive moves into the close should generally be caused by fundamental changes or aggressive trading. As the results indicate, the moves on non-rebalance days appear to be more permanent than compared to rebalance days.

*Stock moves on non-rebalance days are more permanent regardless of whether the cause is fundamental or trading related*

While it's easy to understand why fundamental changes would cause permanent moves, we examined reversion characteristics around month end to isolate non-fundamental moves on non-rebalance days. We found the month end moves to be permanent leading us to believe that stock moves on non-rebalance days are more permanent in nature regardless of whether the cause is fundamental or trading related.

### *Introduction of LOC order type*

The strong reversion on rebalance days shows why Canadian markets could benefit from the introduction of a limit on close (LOC) order type which could be entered before the imbalance. Traders who are benchmarked to the close currently only have access to a market on close order. As the reversion behaviour clearly show there is value destruction in aggressively traded close benchmarked orders. See our MOC paper for our suggestions on implementing an LOC order type.

*Gap characteristics*

We also studied the different characteristics of how stocks gap on rebalance vs non-rebalance days. Figures 7 and 8 show the median price movements of our sample set for both rebalance and non-rebalance days. It is clear that there is a heavier emphasis on trading right around the close on rebalance days as indexers want to avoid benchmark risk whereas non-rebalance days bring about a more uniform move in the last hour.

*On rebalance days significant movements generally occur closer to the close than on non-rebalance days*

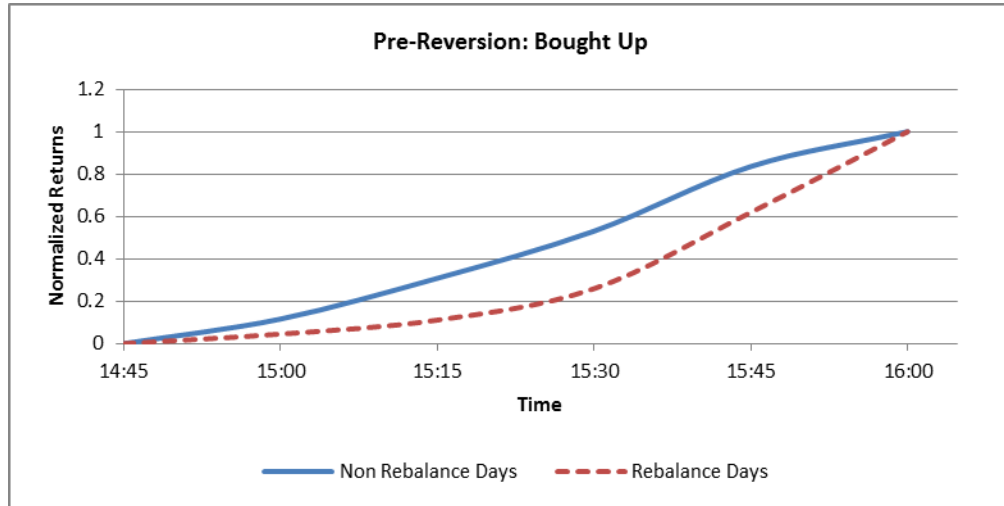


Figure 7: 3-4pm Time Profile for stocks bought into the close

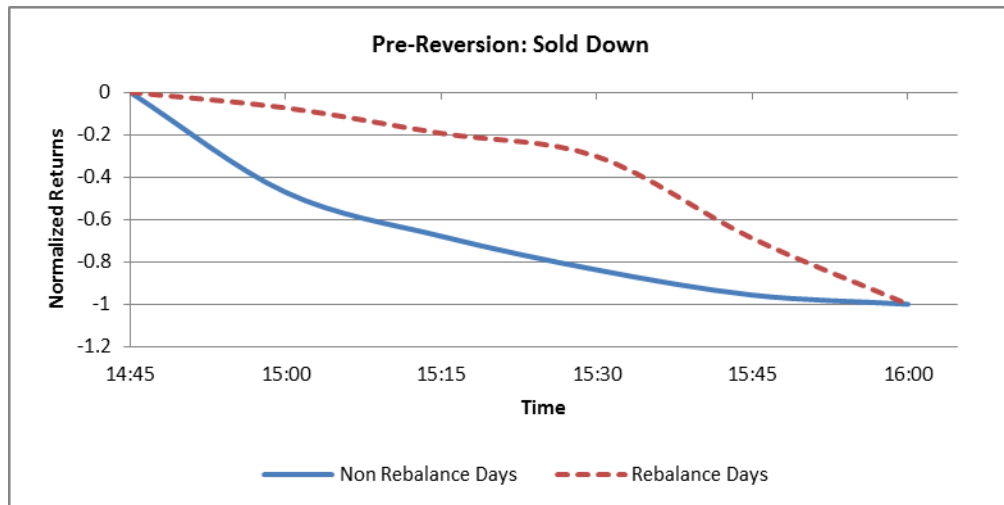


Figure 8: 3-4pm Time Profile for stocks sold down into the close

## Conclusion

We found that reversion does occur after significant moves and is strongest on rebalance days. To efficiently capture the reversion behaviour requires an understanding of why and when a significant move occurred. In addition, timing the entry and exit points is important since reversion does not occur immediately and can take hours or days to occur.

The study also leads us to believe that excessive impact occurs when trading aggressively into close. The impact could be reduced by trading over a longer time interval

As always, questions/comments are welcome!

### *QES Team*

BMO Capital Markets is a trade name used by the BMO Investment Banking Group, which includes the wholesale/institutional arms of BMO Nesbitt Burns Inc. and BMO Nesbitt Burns Ltée/Ltd. in Canada, BMO Capital Markets Corp. and Harris N.A. in the U.S., BMO Capital Markets Limited in the U.K. and Bank of Montreal globally. This material contained in this paper is for information purposes only and is not an offer or solicitation with respect to the purchase or sale of any security. The opinions, estimates, and projections contained herein are those of BMO Capital Markets as of the date of this paper and are subject to change without notice. BMO Capital Markets endeavours to ensure that the contents have been compiled or derived from sources that it believes are reliable and contain information and opinions that are accurate and complete. However, neither BMO Capital Markets nor any of its affiliates makes any representation or warranty, express or implied, in respect thereof, takes no responsibility for any errors and omissions contained herein, and accepts no liability whatsoever for any loss arising from any use of, or reliance on, this paper or its contents. Nothing in this paper constitutes legal, accounting or tax advice. This material is prepared for general circulation to clients and has been prepared without regard to the objectives of the persons who receive it. No matter contained in this document may be reproduced or copied by any means without the prior written consent of BMO Capital Markets.