

Who Let The Bots Out? Market Quality in a High Frequency World

Market Commentary

19 March 2012

Key Points

- Technological advances have dramatically altered our markets in just a few short years. But have these changes been good for trading? Has market quality degraded, or has the structure simply *changed*?
- Rather than criticizing or defending high frequency trading, we present an objective analysis of our current market structure. Among the factors considered:
 - Are markets more volatile than they used to be?
 - Has the probability of another flash crash increased?
 - What is the impact on bid-ask spreads and posted size?
 - Given that quote traffic has increased, does it represent real liquidity?

Has our Technological Evolution Made Flash Crashes More Likely?

No one can ignore the explosive growth in electronic trading over the years (see exhibit 1). Along with the technological evolution, we've seen new participants enter the market (high frequency traders), as well as exit (the NYSE specialist was officially replaced with a "Designated Market Maker"); new products (leveraged ETFs), and new trading tools (algorithms and smart order routers). We've also endured the worst 10yr span for equities ever and a "Flash Crash", in which the S&P dropped 7% in a 15 min span, only to recover most of the decline minutes later.

Some have put these facts together to argue that we can expect more flash crashes now that computers are running the show. Given that many of these changes were inevitable, and since we cannot turn back the technological hands of time, we do not propose to condemn *or* defend the players and products involved. Instead, we aim to quantitatively assess our current market's quality.

Measures of Market Quality

Are markets more volatile?

With the Flash Crash of May 2010, and the more recent whipsawing following the US downgrade in August 2011, many traders certainly *feel* that markets are much more volatile than a few years ago. The facts suggest otherwise.

- **Daily volatility:** We first measured daily volatility by calculating the average close-to-close price swing (exhibit 2). Looking at vol this way, we see that 2011 was actually only the *sixth* most volatile year since 1980. 2008 tops this list, which shouldn't surprise many, but 2002 and 2000, when electronic trading, and certainly high frequency trading were a very small part of the market (exhibit 1), also rank above 2011. Extending further back to the 1930s, 2011 doesn't even crack the top 15 most-volatile years.

Exhibit 1: Electronic trading % of all US equity trading

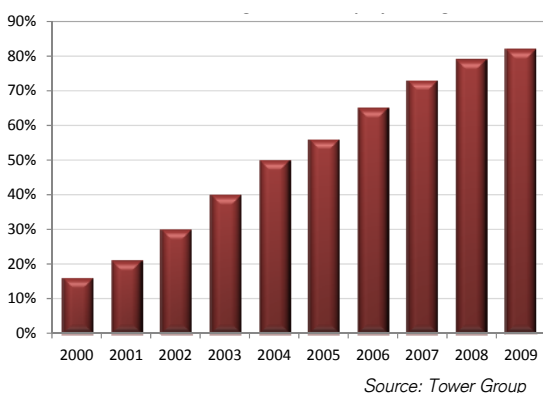


Exhibit 2: Average daily price moves – 2011 was only 16th most volatile year since 1932

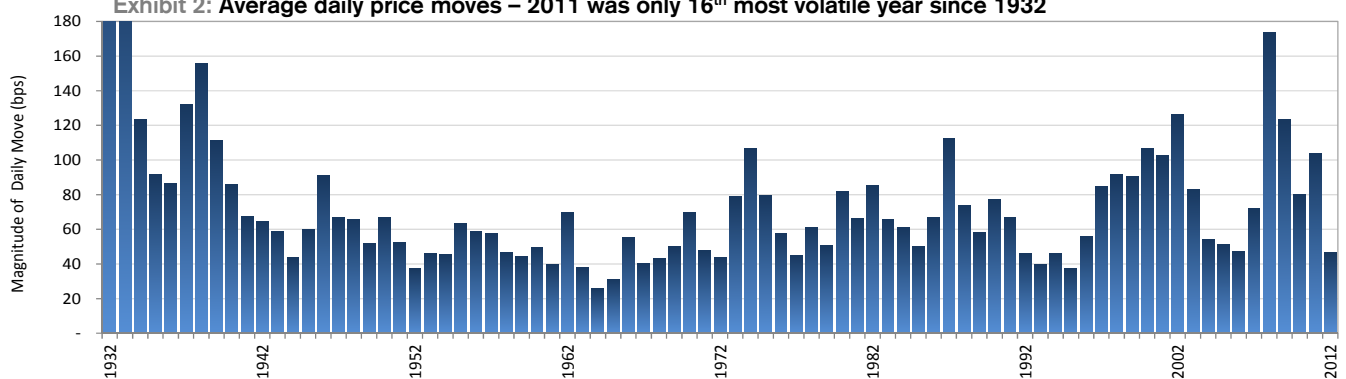


Exhibit 3: Intraday volatility (normalized to overall market vol) has been declining consistently over time

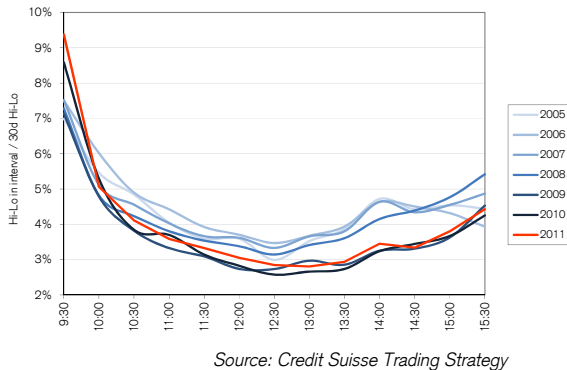
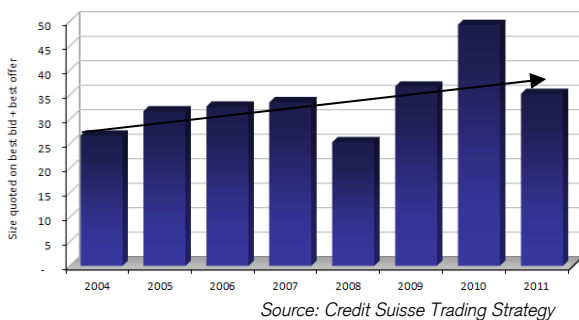


Exhibit 4: Average size posted at the NBBO for S&P 500 stocks priced >\$10

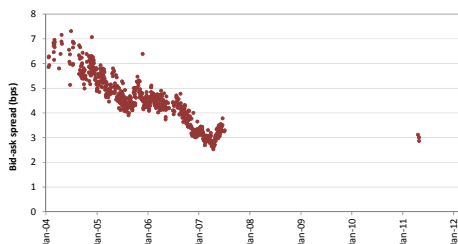


- **Intraday volatility:** Next, we calculated price changes *intraday*. We adjusted for the market's overall level of volatility by normalizing each interval to the hi-lo over the preceding 30 days. Now, we find that intraday vol has been *steadily decreasing* since 2005 (exhibit 3).
- **For every HFT buy there is a HFT sell:** One more point to keep in mind: a defining feature of high frequency strategies is that they go home flat at the end of the day. Everything they might have bought over the course of the day, they will also have sold. More commonly, the offsetting buys and sells occur over microseconds rather than hours. Given that, it is inconsistent that they could lean on a position in a single direction long enough to influence a stock's volatility. If anything, the matched buying and selling should dampen price oscillations. Long only investors do not all enter the market at the same time, so high frequency buying and selling can help to meet their liquidity needs whenever they may arise.

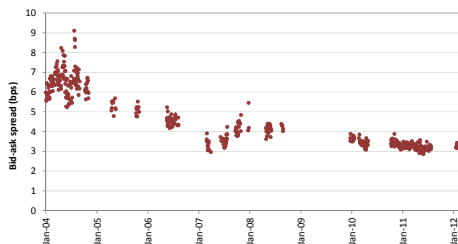
More size at the NBBO

Returning to the issue of whether the increase in posted quotes is meaningful to institutions looking to trade in size, we looked at how much size is actually advertised at the NBBO (exhibit 4). Not surprisingly, we again see a relationship with volatility, but this time inversely. Traders posted less size when vol skyrocketed in 2008 – but that is simply prudent risk management, not an indictment of high frequency traders! The general trend over the years is an *increase in posted size*. We found that to be true for both large caps and small caps. It even holds when we remove “cheap” stocks like C and BAC.

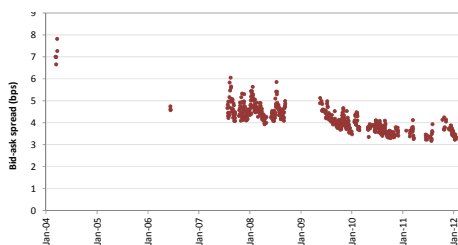
Avg bid-ask spreads when VIX Index < 15



VIX Index: 15 -20



VIX Index: 20-30

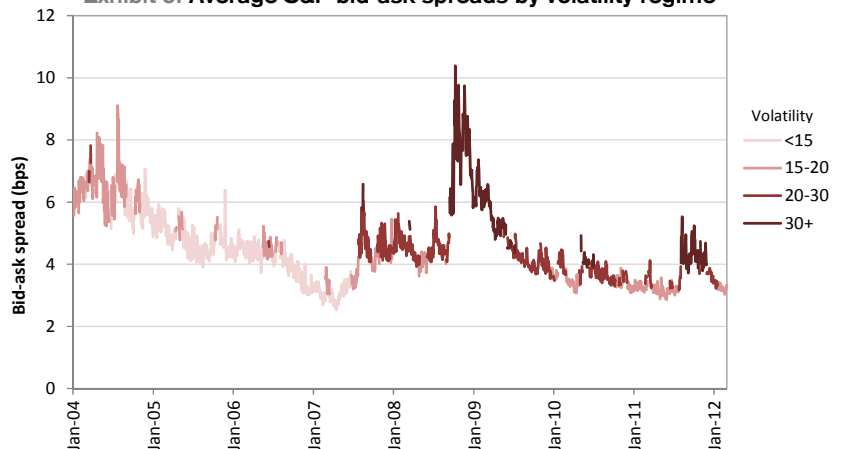


Source: Credit Suisse Trading Strategy

Tighter spreads

Another benefit of having so many more players competing in the market is more pressure on both the bid and ask, narrowing spreads. Because this data is directly related to volatility – the price of liquidity will increase when risk is higher – we tried to look at bid-ask spreads in comparable volatility regimes. Each differently colored section of exhibit 5 corresponds to a different volatility environment. To only consider spreads in related vol environments, we compare how spreads have evolved in each colored section separately. After controlling for volatility in this way, we can see that in all volatility bands, *spreads have gotten tighter over time*.

Exhibit 5: Average S&P bid-ask spreads by volatility regime



Source: Credit Suisse Trading Strategy

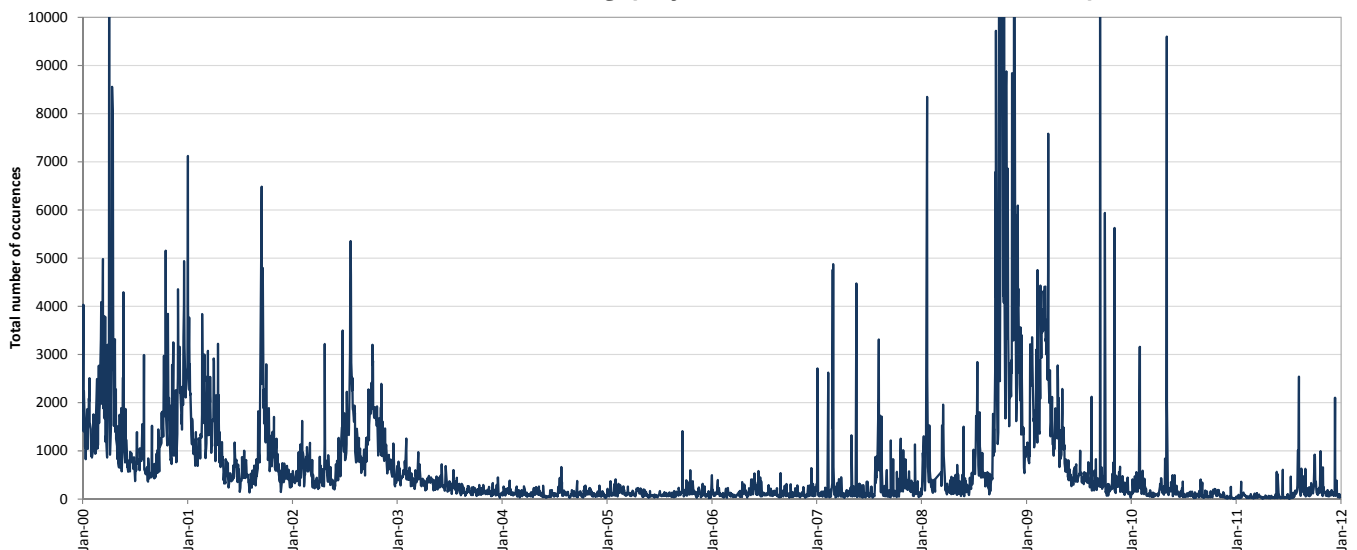
Increased risk of another flash crash?

Returning to our original question of whether the likelihood of another flash crash has increased, we conducted our own study of how often “mini” flash crashes have occurred over time. We defined our mini crashes as a 1% price gap within a 1 minute interval for a stock in the S&P 500. Not surprisingly, these events increase as overall market volatility increases, such as in 2008 & 2009, and are much less common when markets are calm, as from 2004-2007 (exhibit 6).

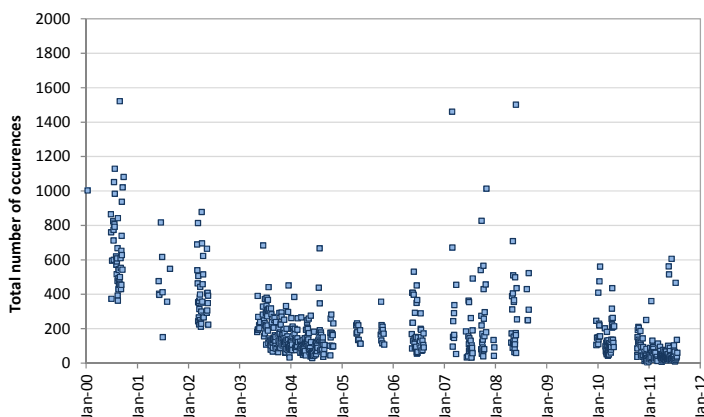
In an effort to control for this, we restricted the analysis to only compare days of comparable volatility as we did with our analysis of bid-ask spreads above. In the two lower charts of exhibit 6, every dot corresponds to an individual day when the VIX Index was within our defined range, and plots the number of “mini flash crashes” occurring on that day across all S&P 500 stocks.

While there is some noise, it seems fair to say that the number of occurrences is *not increasing* over the years. The pattern looks similar in all volatility bands analyzed (two representative ones are shown).

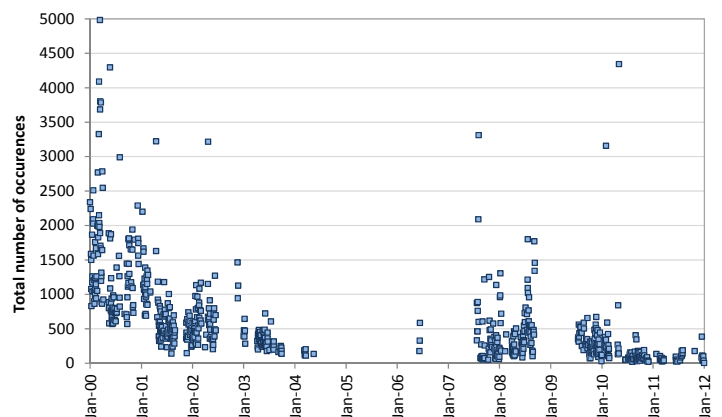
Exhibit 6: Number of times S&P stocks gap by 1% within 1 minute (10am – 3:30pm)



Number of gaps when VIX Index between 15-20

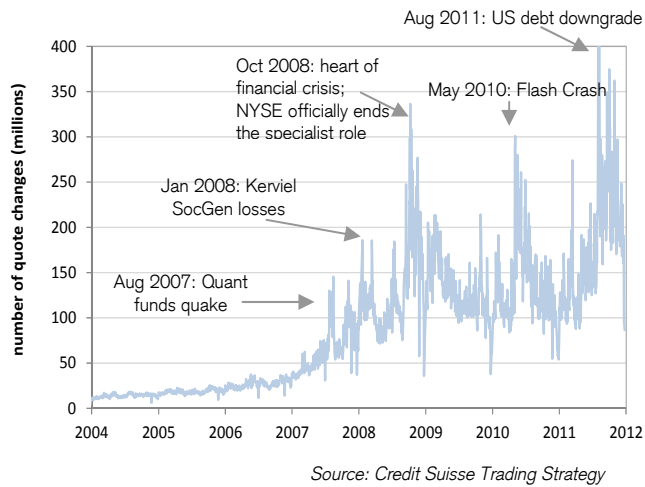


Number of gaps when VIX Index between 20-25



Source: Credit Suisse Trading Strategy

Exhibit 7: Total number of NBBO quote changes per day (all NMS stocks)



Increased messaging traffic

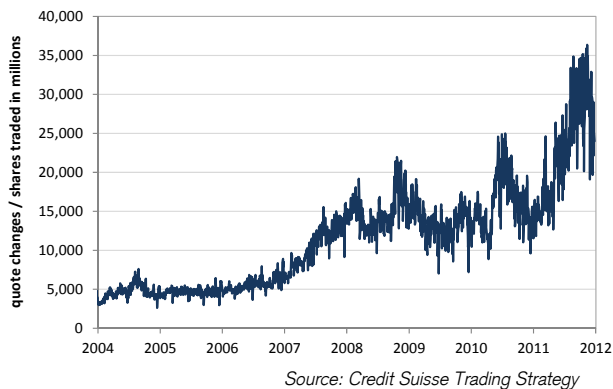
One negative byproduct of having faster connections is certainly an increase in messaging generated by all the computers. As exhibit 7 shows, the trajectory of the number of daily quote changes has gone one way over the years: up. Sure, the number of trades has also increased, but when we adjust for the number of shares traded (exhibit 8), it still follows the same pattern.

While the rise in electronic trading and HFT has increased quotes, critics complain that these quotes do not represent meaningful liquidity since quotes can change in fractions of a second, faster than the long-only investor can respond. In fact, Nasdaq and DirectEdge announced a rule on March 7, 2012 (effective on June 1) that penalizes firms that quote “excessively”.

It may be true that much of the quote traffic looks like noise, but it does still contribute buy and sell price indications to lit markets. It’s interesting to note that the most popular algorithm among long-only investors is one that promises to be stealthy and only trade in the dark (either in dark pools or with hidden liquidity on exchanges). That leaves high frequency responsible for posting the quotes in lit markets that allow price discovery.

Another point to realize before denouncing high frequency quotes as “phantom liquidity” is that institutions do have ways to access this liquidity. Brokerages have responded to the buy-side’s complaints by developing algos, like AES’s Blast, that hit these transient quotes, creating true, actionable, liquidity.

Exhibit 8: Daily NBBO quote changes per million shares traded



The bottom line

Our intent is not to defend or criticize high frequency trading. Rather, we hope to raise awareness of some of the factors involved and objectively present data that is not always considered in the debate.

Yes, the markets have changed as technology plays a larger role, but this natural evolution has affected – and created opportunities – for all participants. Not only have fast computers meant the rise of high frequency “bots”, but they’ve also provided long only institutions with algorithms and market access tools to hide their tracks and minimize market impact, and to capture dispersed liquidity.

Our examination of HFT is akin to the testing of a null hypothesis in science: you cannot definitively *prove* the hypothesis, you can only confirm it to be false. In our case, we cannot singularly attribute various aspects of our current markets – good or bad – to the emergence of high frequency traders. Instead, we can report our microstructure analysis and suggest that at a minimum, markets are *not worse* for their presence.

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