



2012 4th Quarter Stock Market Commentary

ALGOS GONE WILD

"Why join the navy if you can be a pirate?"
- Steve Jobs

The Sixties were a decade of counterculture and social revolution – antiwar protests, the rise of feminism, sexual emancipation, and experimentation with illegal drugs. No rock group captured the ethos of that period better than the Beatles, with songs like *Revolution* on the White Album inspired by the protest movement. The biggest-selling album of the decade was Sgt. Peppers Lonely Heart Club Band. One song on the album, credited to Lennon-McCartney, but primarily written by John Lennon, was *Lucy in the Sky with Diamonds*, considered the greatest example of psychedelic rock. The lyrics describe a phantasmagorical world filled with “tangerine trees” and “marmalade skies.” Lennon claimed that the song was inspired by a nursery school drawing by his son, Julian, but speculation quickly arose that the song was really a hidden tribute to an LSD-induced trip, especially since the first letters of the nouns in the song’s title spelled LSD. Lennon denied the hidden meaning, although Paul McCartney confirmed it in an interview thirty five years later. Other Beatles’ songs also contained hidden drug references. *Got to Get You Into My Life*, for example, was an allusion to marijuana.

My own musical tastes run more to the Eagles, where the hidden messages seem to have presaged many of the problems plaguing the financial system that have caused many individual investors to abandon the stock market. After all, the enigmatic *Hotel California*, an inn where “you can check in, but you can never leave,” may be referring to the illiquidity imposed on investors by hedge fund operators that restrict the ability of investors to withdraw their funds during periods of market volatility. *Desperado* may have been an allusion to Bernie Madoff. *The Long Run* just might be a tribute to the virtues of equity investing. But the most timely is *Life in the Fast Lane*, which warns about the pitfalls of high-frequency trading.

High-frequency trading (HFT) is simply the use of computers and computational algorithms to rapidly trade securities. An algorithm (referred to as an "algo" by HFT practitioners) is a set of rules to follow in performing a process or computation. For example, the instructions on the side of a fire extinguisher are an example of a process algorithm, while the steps used to perform long division form a computational algorithm. HFT came into existence post 1998, when the Securities and Exchange Commission authorized electronic exchanges. Initially, it took several seconds to execute trades. Now, execution times are measured in microseconds (millionths of a second). Unlike investors, who generally hold

positions for weeks, months or years, high-frequency traders typically hold positions for fractions of a second. Their goal is to make a profit of only a fraction of a penny on each share, but by trading thousands, or even millions, of shares, that small per share profit quickly amounts to a significant number of dollars. It has been estimated that in 2010 fully 70% of all stock trades in the U.S. were executed by high-frequency traders.

In order to get some idea of how HFT works, consider a hypothetical example. Imagine that some large institutional investor, such as Vanguard Group, State Street or Blackrock, decides to add a million shares of Microsoft to one of their funds. Suppose the stock is trading at \$28.50, and the buyer is willing to pay up to \$29 to accumulate its position. If they display an order of that size, the price of Microsoft will almost immediately rise to the \$29 price as sellers learn of the existence of such a large buyer. Instead, the buyer may break the order up into many smaller blocks, say 1,000 separate orders to buy 1,000 shares each. They offer to buy the first 1,000 shares at \$28.50, and the second at perhaps the same price. But they might try to buy the third 1,000 shares at \$28.51 and the fourth 1,000 at \$28.52, and so on.

Now here is where a high-frequency trading firm comes in. They have programmed their computer to detect the pattern of a large sequence of purchase orders at ever increasing prices, although they do not know how high the buyer is willing to ultimately pay. In an attempt at price discovery, their computer offers to sell 1,000 shares at \$31/share, but that offer is rejected. Almost instantaneously, the offer is cancelled and the computer offers 1,000 shares at \$30/share. Again it is rejected, and again the order is cancelled. This time 1,000 shares are offered at \$29, and the buyer accepts those shares. This all occurs in a fraction of a second, far faster than any human trader could process the information. Secure now in knowing that the buyer has a \$29 limit, the high-frequency trader scoops up every share available below \$29, and immediately re-sells them to the institutional buyer, pocketing the difference.

Speed is of the essence in this transaction, because every high-frequency trader is trying to exploit the same pattern. Competitive advantage is measured in thousandths, or even millionths, of a second. Whichever HFT firm determines the size and nature of the institutional buy order most quickly will be able to buy all the shares available up to the \$29 limit. High-frequency traders now locate their computers right next to the exchanges' computers, so-called "co-location," because even the amount of time required to send data at the speed of light for an extra few miles can be crucial. As comedienne Samantha Bee stated on the Jon Stewart show while dressed as a "cash cow." "If I know about a stock's activity a day before, it's called insider trading; but if I know about a stock's activity one second before, that's high frequency trading."

HFT has become an enormous profit center for the various exchanges. According to a study by broker Raymond James in 2011, 32% of the revenue of the Chicago Mercantile Exchange was derived from high frequency trading. At the New York Stock Exchange, the comparable figure was 21.4%. The NASDAQ received 17% from HFT, and the Chicago Board of Options took in 22.4%. Proponents of HFT point out that it narrows bid-ask spreads, improves price discovery and (most importantly for those of us that like to invest in smaller capitalization companies) increases liquidity.

Admittedly, tighter spreads and increased liquidity are worthwhile goals, but many high-frequency traders have apparently decided that simply having the ability to trade more rapidly than the average investor is not enough of an edge. In addition, they have devised ethically dubious tactics to slow down their HFT competitors. One technique for doing this is called "quote stuffing," a process in which they create and transmit millions of orders which they have no intention of completing. The sole purpose is to overwhelm the computer capabilities of the various exchanges and other trading firms, causing them to work more slowly, which is known as increasing latency.

Consider what happened on April 26, 2010. At 9:29:10 A.M., a deluge of orders from a variety of exchanges appeared. Orders are transmitted on 12 high speed data lines, each of which carries quotes for

a certain range of ticker symbols alphabetically. For instance, quotes for all stocks whose ticker symbols begin with A or B are transmitted on line 1, those for C and D are transmitted on line 2, and so on. At the time in question there were between 250 and 500 quote updates per second for every stock symbol. The number of quotes for each symbol were chosen in a way that filled each line to capacity. This was obviously not a random event, but rather a sophisticated algorithm involving a precise count of quotes from multiple exchanges. This appeared to be one of the earliest uses of a "full feed quote stuffing algorithm," most likely undergoing a test. The orders were quickly cancelled, a not unusual occurrence, as it has been estimated that more than 90% of the orders placed by HFT firms are never executed.

Roughly a week later, it appears that this same algorithm, or one almost identical to it, played a role in the devastating Flash Crash of May 6, 2010, where the Dow Jones Industrial Average plunged a gut-wrenching 1,000 points in a matter of minutes, only to recover most of the losses within minutes. It was the biggest intra-day point decline in history. That day started out as a rough one for the equity markets. The Greek Parliament had approved austerity measures to avert default, which triggered riots in Athens that were broadcast live around the world. The Dow was down roughly 300 points by early afternoon.

At 2:42:44 P.M. quote traffic for all stocks traded on the New York Stock Exchange, the NYSE Arca (its electronic trading equivalent) and the NASDAQ surged to saturation levels within a space of 75 milliseconds. Quotations were delayed in some stocks by as much as 24 seconds (those whose tickers begin with the letters A through M, except I and J), in the others (letters N through Z) by 5 seconds.

Within 400 milliseconds of the quote stuffing orders, two large sell orders appeared. One was an order to sell \$125 million of CME (Chicago Mercantile Exchange) eMini futures contracts, and the other to sell \$100 million worth of ETF contracts on the most liquid ETFs. Both sales were sudden and executed at prevailing bid prices. The orders appeared to hit the bids, soaking up all available liquidity. The combination of heavy selling and delayed quotations caused fear and panic, resulting in other market participants immediately withdrawing from the market. With no buyers, prices collapsed.

This resulted in even greater absurdities. Market makers, those professional traders charged with maintaining orderly markets, are required at all times to have some bid and some offer on those stocks in which they make a market. Typically, when not actively trading, they leave an extremely low-ball bid way below the current stock price and another offer to sell way above the current price, never expecting to have to trade at those prices. These are known as "stub quotes." On the date of the flash crash, as other buyers disappeared, the only bids that remained were stub quotes. As one example of the lunacy that ensued, Accenture, a consulting company with a current market capitalization of \$47 billion, dropped from roughly \$40/share in one trade to \$0.01 (that's one penny!) in the next. The entire quote stuffing event that prompted this panic lasted 50 milliseconds (one twentieth of one second).

The flash crash is only one example of many that appear to have been caused by trading algorithms run amok. Here are a few more. On August 1st of last year Knight Capital started to use a new software program to execute its trades. The program failed to work properly, sending thousands of buy and sell orders out in less than an hour, costing Knight \$440 million. Shares in the company plunged, and within a week, shareholders were forced to accept a bailout that heavily diluted their ownership.

BATS Global, the newest U.S.-based exchange, uses complex software (that is, another algorithm) to match buyers and sellers of stock. The firm is privately held, with most of the stock held by brokerage firms who use its trading platform. BATS had scheduled its own IPO (initial public offering) for Friday, March 23, 2012, and not surprisingly, was using its own software to handle the offering. The IPO price was \$16/share, but within seconds "a software bug" caused the issue to plunge. The technical problem was fixed by mid-afternoon, but by then all of the money managers who had committed to buy the stock were in open revolt. The offering was cancelled and several directors urged that executives responsible for the fiasco lose their bonuses.

There is also some evidence that HFT was a factor in the disastrous IPO of Facebook. Market data analysis firm Nanex has published several papers about NASDAQ trading on that day. First, the IPO was delayed by half an hour due to unspecified technical difficulties at the exchange. Then there were enormous inflows of orders, most of which were cancelled, which caused NASDAQ's trading system to crash. This resulted in a brief blackout of all trading at the exchange, which produced panic. Eric Hunsader, the firm's founder and CEO, was quoted as saying "High-frequency traders absolutely caused this."

In these example, as well as many others, firms gaming the system with complex algorithms disrupted the capital markets either by accident or design. In no case did any firm discard the problematic code. Instead, programmers simply patched it. After all, no firm wants to suspend operations for months while better software is written and de-bugged. It is not likely that panics like the May 6, 2010 Flash Crash will occur in the future - it is a certainty, unless limitations on HFT are imposed.

Regulators are well aware of this problem, although as is typical, the SEC has been slow to act. In fact, the agency has been an active enabler. Thirty years ago there were only a few kinds of orders that a trader could place, with names like market order, limit order, stop-loss order, and so on. Now there are a staggering 2,000 order types, with esoteric names like "dark reserve," "do not ship" and "hide not slide." These order types are requested by high-frequency traders, who use them to conceal their own activities, to allow their orders to step ahead of others that were placed earlier, or to route them to alternative exchanges, among other things. To date, the SEC has never refused a request for a new order type, although just last month they initiated a review of this topic.

Recently, the Federal Reserve of Chicago urged the SEC to examine HFT and propose a method for curbing abuses and potential problems. Other countries, such as Canada, Australia and Germany have banned this activity. This seems extreme. After all, no one thinks that we should go back to the earliest days of stock trading when shares changed hands through face-to-face negotiations under the Buttonwood Tree on Wall Street. Some critics have urged that all trading software come with a kill switch that would permit the software to be disabled if it malfunctioned. Another proposal would require that all orders must remain valid for some minimum time period, such as five seconds. The theory is that HFT firms would think twice about placing millions of fictitious buy orders entered if they thought they might actually have to pay for orders that would be executed. My own solution would be to impose a miniscule tax, perhaps two mils (two thousandths of a penny) on all orders. This would have little effect on legitimate trading. After all, the additional cost to purchase 1,000 shares would then rise by two cents, and even a million share order would only cost an extra \$20. But this would certainly inhibit the rapid placing and cancellation of orders for billions of shares, which has helped destroy confidence in the capital markets. Because HFT firms typically reap a miniscule profit on a very large number of trades, this would rein in such trading. It is not a coincidence that the rise in HFT is coincident with the withdrawal of the retail investor from the stock market. As it is now, retail orders, which serve a vital role in the efficient allocation of capital, instead are functioning as a tip sheet for gamers.

Hopefully, whatever changes are adopted will preserve the benefits that computerized trading has brought, making U.S. markets the most liquid and transparent in the world. But at the same time, it is important that investors can be spared the spine-tingling fear induced by algos gone wild.