**Algorithmic trading risks include market manipulation, systemic risk, and unfair advantages.**

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Algorithmic trading (or 'algo' trading) refers to the use of computer algorithms (basically a set of rules or instructions to make a computer perform a given task) for trading large blocks of stocks or other financial assets while minimizing the market impact of such trades. **Algorithmic** **trading** involves placing trades based on defined criteria and carving up these trades into smaller lots so that the price of the stock or asset isn't impacted significantly.

The benefits of algorithmic trading are obvious: it ensures the 'best execution' of trades because it minimizes the human element, and it can be used to trade multiple markets and assets far more efficiently than a flesh-and-bones trader could hope to do.

High-frequency trading (**HFT**) takes algorithmic trading to a different level altogether—think of it as 'algo' trading on steroids. As the term implies, high-frequency trading involves placing thousands of orders at blindingly fast speeds.

The goal is to make tiny profits on each trade, often by capitalizing on price discrepancies for the same stock or asset in different markets. HFT is diametrically opposite from traditional long-term, buy-and-hold investing, since the arbitrage and market-making activities that are HFT's bread-and-butter generally occur within a small time window before the price discrepancies or mismatches disappear.

Algorithmic trading and HFT have become an integral part of the financial markets due to the convergence of several factors. These include the growing role of technology in present-day markets, the increasing complexity of financial instruments and products, and the ceaseless drive towards greater efficiency in trade execution and lower transaction costs.

While algorithmic trading and HFT arguably have improved market liquidity and asset pricing consistency, their growing use also has given rise to certain **risks** that can't be ignored.

One of the biggest risks of algorithmic HFT is the one it poses to the financial system. A July 2011 report by the International Organization of Securities Commissions (IOSCO) Technical Committee noted that because of the strong inter-linkages between financial markets, such as those in the U.S., algorithms operating across markets can transmit shocks rapidly from one market to the next, thus amplifying systemic risk. The report pointed to the Flash Crash of May 2010 as a prime example of this risk.

The Flash Crash refers to the 5% to 6% plunge and rebound in major U.S. equity indices within the span of a few minutes on the afternoon of May 6, 2010. The Dow Jones plunged almost 1,000 points on an intraday basis, which at that time was its largest point drop on record.

As the IOSCO report notes, numerous stocks and exchange-traded funds (ETFs​) went haywire that day, tumbling by between 5% and 15% before recovering most of their losses. Over 20,000 trades in 300 securities were done at prices as much as 60% away from their values mere moments earlier, with some trades executed at absurd prices, from as low as a penny or as high as $100,000.

The speed at which most algorithmic high-frequency trading takes place means one errant or faulty algorithm can rack up millions in losses in a short period.

This unusually erratic trading action rattled investors, especially because it occurred just over a year after the markets had rebounded from their biggest declines in more than six decades.

What caused this bizarre behavior? In a joint report released in September 2010, the SEC and the Commodity Futures Trading Commission pinned the blame on a single $4.1-billion program trade by a trader at a Kansas-based mutual fund company. But in April 2015, U.S. authorities charged a London-based day trader, Navinder Singh Sarao, with **market** **manipulation** that contributed to the crash. Sarao was extradited to the U.S. and pleaded guilty to the charges.

Sarao allegedly used a tactic called 'spoofing,' which involves placing large volumes of fake orders in an asset or derivative (Sarao used the E-mini S&P 500 contract on the day of the Flash Crash) that get canceled before they are filled. When such large-scale bogus orders show up in the order book, they give other traders the impression that there's greater buying or selling interest than there is in reality, which could influence their own trading decisions.

For example, a spoofer may offer to sell a large number of shares in stock ABC at a price that's a little away from the current price. When other sellers jump in on the action and the price goes lower, the spoofer quickly cancels their sell orders in ABC and buys the stock instead. Then the spoofer puts in a large number of buy orders to drive up the price of ABC. And after this occurs, the spoofer sells their holdings of ABC, pocketing a tidy profit, and cancels the spurious buy orders. Rinse and repeat.

Many market watchers have been skeptical of the claim that one trader could have single-handedly caused a crash that wiped out close to a trillion dollars of market value for U.S. stocks within minutes. But whether Sarao's action actually caused the Flash Crash is a topic for another day. Meanwhile, there are some valid reasons why algorithmic HFT magnifies **systemic** risks.

First, since there's a great deal of algorithmic HFT activity in present-day markets, attempting to dynamically outfox the competition is a built-in trait of many algorithms. Algorithms can react instantaneously to market conditions. As a result, during tumultuous markets, algorithms may greatly widen their bid-ask spreads (to avoid being forced to take trading positions) or will temporarily stop trading altogether, which diminishes liquidity and exacerbates volatility.

Given the increasing degree of integration between markets and asset classes in the global economy, a meltdown in a major market or asset class often ripples across to other markets and asset classes in a chain reaction.

For example, the U.S. housing market crash caused a global recession and debt crisis because substantial holdings of U.S. sub-prime paper were held not just by U.S. banks, but also by European and other financial institutions. Another example of such ripple effects is the detrimental impact of China's stock market crash, as well as the collapse in crude oil prices, on global equities from August 2015 to January 2016.

Algorithmic HFT is a notable contributor to exaggerated market volatility, which can stoke investor uncertainty in the near term and affect consumer confidence over the long term. When a market suddenly collapses, investors are left wondering about the reasons for such a dramatic move. During the news vacuum that often exists at such times, large traders (including HFT firms) will cut their trading positions to scale back risk, putting more downward pressure on the markets.

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As the markets move lower, more stop-losses are activated, and this negative feedback loop creates a downward spiral. If a bear market develops because of such activity, consumer confidence is shaken by the erosion of stock market wealth and the recessionary signals emanating from a major market meltdown.

The dazzling speed at which most algorithmic HFT trading takes place means that one errant or faulty algorithm can rack up millions in losses in a very short period. An infamous example of the damage that an errant algorithm can cause is that of Knight Capital, a market maker that lost $440 million in a 45-minute period on Aug. 1, 2012.

A new trading algorithm at Knight made millions of faulty trades in about 150 stocks, buying them at the higher 'ask' price and instantly selling them at the lower 'bid' price. Note that market makers buy stocks from investors at the bid price and sell to them at the offer price, the spread being their trading profit.

Unfortunately, the hyper-efficiency of algorithmic HFT—wherein algorithms constantly monitor markets for just this sort of pricing discrepancy—meant that rival traders swooped in and took advantage of Knight's dilemma while Knight employees frantically tried to isolate the source of the problem. By the time they did, Knight had been pushed close to bankruptcy, which led to its eventual acquisition by Getco LLC.

Volatility swings worsened by algorithmic HFT can saddle investors with huge losses. Many investors routinely place stop-loss orders on their stock holdings at levels that are 5% away from current trading prices. If the markets gap is down for no apparent reason (or even for a very good reason), these stop-losses would be triggered.

To add insult to injury, if stocks subsequently rebound in short order, investors would have needlessly incurred trading losses and lost their holdings. While some trades were reversed or canceled during unusual bouts of market volatility like the Flash Crash and the Knight fiasco, most trades were not.

For example, most of the nearly two billion shares that traded during the Flash Crash were at prices within 10% of their 2:40 p.m. close (the time when the Flash Crash started on May 6, 2010), and these trades stood. Only about 20,000 trades, involving a total of 5.5 million shares that were executed at prices more than 60% away from their 2:40 p.m. price, were subsequently canceled. So an investor with a $500,000 equity portfolio of U.S. blue-chips who had 5% stop-losses on their positions during the Flash Crash would most likely be out $25,000.

On Aug. 1, 2012, the NYSE canceled trades in six stocks that occurred when the Knight algorithm was running amok because they were executed at prices 30% above or below that day's opening price. The NYSE's 'Clearly Erroneous Execution' rule states the numerical guidelines for reviewing such trades.

Investors trade in financial markets because they have full faith and confidence in their integrity. However, repeated episodes of unusual market volatility like the Flash Crash could shake this confidence and lead some conservative investors to abandon the markets altogether.

In May 2012, Facebook's IPO had numerous technology issues and delayed confirmations, while on Aug. 22, 2013, Nasdaq stopped trading for three hours due to a problem with its software. In April 2014, close to 20,000 erroneous trades had to be canceled following a computer malfunction at IntercontinentalExchange Group's two U.S. options exchanges. Another major blow-up like the Flash Crash could greatly shake investors' confidence in the integrity of markets.

With the Flash Crash and Knight Trading 'Knightmare' highlighting the risks of algorithmic HFT, exchanges, and regulators have been implementing protective measures. In 2014, the Nasdaq OMX Group introduced a 'kill switch' for its member firms that would cut off trading once a pre-set **risk** exposure level is breached. While many HFT firms already have 'kill' switches that can stop all trading activity under certain circumstances, the Nasdaq switch provides an additional level of safety to counter rogue algorithms.

Circuit-breakers were introduced after 'Black Monday' in October 1987, and are used to quell market panic when there's a huge sell-off. The SEC approved revised rules in 2012 that enable circuit breakers to kick in if the S&P 500 index tumbles 7% (from the previous day's closing level) before 3:25 p.m. EST, which would halt market-wide trading for 15 minutes. A 13% plunge before 3:25 p.m. would trigger another 15-minute halt in the entire market, while a 20% dive would shut the stock market for the rest of the day.

In Jan. 2021, the Commodity Futures Trading Commission implemented regulations for firms using algorithmic trading in derivatives. These regulations would require such firms to have pre-trade risk controls. A controversial provision that would have required firms to make the source code of their programs available to the government was withdrawn.

Algorithmic HFT has a number of risks, the biggest of which is its potential to amplify systemic risk. Its propensity to intensify **market** volatility can ripple across to other markets and stoke investor uncertainty. Repeated bouts of unusual market volatility could wind up eroding many investors' confidence in market integrity.

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