

Impact of Artificial Intelligence on Trading in Financial Markets

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Abstract

Artificial intelligence (AI) is the machine simulation of human intelligence processes by computer systems. It is nothing but the theory and development of computer systems which are designed to perform tasks which requires human intelligence, such as visual perception, decision-making, speech recognition and translation of languages. AI is everywhere and growing continuously since its inception. As Artificial Intelligence sneaks into almost everything, stealing jobs and creating an existential threat, according to experts that include Bill Gates, Elon Musk and Stephen Hawking^[1], it may be leading to a market environment more complex than humans can understand. But if AI succeeds, the human trading profession could well be one of its important sufferers. The extent to which AI investment strategies are autonomous or incorporate human oversight varies on a case-by case basis. It is evident that humans remains as a big part of the trading equation, but AI plays an increasingly significant role these days. According to a recent study by U.K. research firm Coalition, electronic trades account for almost 45 per cent^[2] of revenues in cash equities trading. And since hedge funds are more reluctant when it comes to automation, many of them use AI-powered analysis to get investment ideas and build portfolios.

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1. Objective of the Study

We are interested in exploring the extent to which AI investment strategies are autonomous or incorporate human oversight and its related questions on the role and application of artificial intelligence in financial trading. This article deals with a number of perspectives on what we see unfolding today? How did we get here? What is currently relevant? And what might the future hold?

2. Keystones of a disruptive AI wave

Neural networking is a highly effective and trainable algorithmic approach which emulates certain aspects of the functioning of human brain. It is used extensively in financial forecasting which allows quick investment decision making. AI systems often are the kind of systems deployed in domains where uncertainty is common. Daniel Kahneman^[3], Nobel Prize-winning psychologist, demonstrated through his work that humans exhibit two types of decision-making reasoning: 'thinking slow', which employs deliberative effort and the one more natural (to us), 'thinking fast', where we typically lean on mental rules of thumb that yield explainable but sometimes logically dubious judgments.

So while we excel at thinking fast, Machine Learning (ML) based computer systems increasingly excel at Daniel's more thorough reasoning process of thinking slow, by virtue of their ability to do billions of calculations in seconds, machines can perform this in a small fraction of the time as against a human.

There is a natural partnership opportunity in having humans work with ML-based AI assistants, as each complementing the other's ability. Indeed, such a pairing, often termed 'cognitive collaboration' or 'cognitive augmentation', which is emerging in several areas, most notably in freestyle chess. The computer's domination over humanity may start on the chessboard. Since IBM's Deep Blue beat chess master Garry Kasparov in 1996^[4], it was pointed that computers have gotten faster and faster. The simplest example of this is a chess computer versus a calculator. Both chess and arithmetic calculators requires some level of intelligence, but in chess there is a lot of uncertainty with regards to the opponents next move, whereas the routine calculations performed by a calculator contains no uncertainty.

Just like chess, financial-market orthodoxy is also based on several related principles, which includes the idea of full information, the supposition of rational participants and the lack of path-

dependency. Rational humans are supposed to be calculating the odds, i.e. maximizing return and minimizing risk. This creates path-independent market evolution, because the underlying assumption is that markets are instantaneously efficient and reflect all information in current asset prices.

If this scenario actually holds true, artificial intelligence would stand a good chance at ameliorating its human counterparts in making and capitalizing on market decisions. Unfortunately, rationality is not always the best assumption for humans as well as for markets. One needs to observe the current economic situation like how irrational human traits like confidence, fear and greed play out in market dynamics. In the actual world, the uncertainty injected by the human participants makes the markets much harder to predict.

The idea of automated trading is not new and has been around for a long time now. It is also known as algorithmic trading, the use of automation to trade takes the human biasness out of the equation which is what often leads to losses. Human emotions like fear, greed and insecurity ensure that most of us will never have a successful career in trading because we cannot control our senses while dealing with a stock market that is so irrational.

Human irrationality is entirely different from true AI, which trained using machine learning with large historical data. But that kind of AI is a mystery even to the people who build it because such systems learn by experience, not through programming, making the logical steps they follow a black box that programmers cannot see inside.

Application of AI is also growing at the retail level but its adoption is low because most traders still use methods that were proposed in the mid twentieth century, which includes traditional technical analysis, as they are easy to learn and apply^[5]. Note that artificial intelligence and machine learning are not only used to develop trading strategies but also in other areas as well, for example in developing liquidity searching algorithm and suggesting portfolios to clients. Therefore, with AI applications gaining ground, the number of humans involved in trading and investment decisions decreases and this ultimately affects markets and price action.

It is expected that soon observing the market and looking at charts will become an obsolete process. The future of trading is about processing information, developing and validating models in real-time. The hedge fund of the future will not rely on chart analysis. Some still do this because they are at the transition boundary where old ways meet with a new era. Many traders who are not familiar with AI are finding it hard to compete in the future and either

withdraw or embrace it the hard way, i.e. adopt it by starting to learn about AI, at a time when others are in the process of mastering it.

During the 1960's, an average share of stock was held 4 years. By 2000, average ownership dropped to 8 months, and in 2008 it dropped even further to 2 months. Today the average share is held a meagre 20 seconds and in the coming years, it is expected to drop to less than 10 seconds^[6]. At the centre of this rapid buying and selling of stock are actually a series of high-frequency trading machines run by the machine learning experts who is nothing but a sort of hackers.

3. Application of AI techniques in Hedge Funds

AI techniques rate of evolution is fast and one of the most promising uses of latest AI techniques is processing unstructured natural language data in the form of news articles, market movements, company accounts, and social media posts, in an effort to glean insights into the future performance of companies, currencies, commodities, or financial instruments.

According to the data provider, Prequin^{[7][8]}, more than 40% of new hedge funds were 'systematic', which means they were using computer models for the majority of their trades in 2014. The algorithm used in trading is designed in such a way as to react extremely quickly to market changes. In fact, the algorithms seek out and exploits even small windows of trading opportunity, measured in minute fractions of a second. This is the reason that many orders on the US stock market are now being placed by automated algorithms and this has enforced the Securities and Exchange Commission (USA) to look for ways to regulate them as it does the rest of Wall Street. The Securities and Exchange Board of India (SEBI) also plans to further tighten the regulations for algorithmic trading, in order to minimize instances of misuse of such systems, as these are being used to execute complex trading strategies at a very high speed.

One of the most successful example of algorithmic stock-picking in the history of Wall Street is hedge fund titan Robert Mercer, co-CEO of Renaissance Technologies, which is also one of the most profitable hedge funds in the world. However in recent years, funds have moved towards true machine learning, where artificially intelligent systems can also analyze large amounts of data quickly and improve upon themselves through such analysis. Watson, an IBM's supercomputer^[9], has been employed to help run an ETF (Exchange Traded Funds) and pick stocks to achieve better performance than the overall U.S. stock market index.

Rebellion Research^[10], New York based company, founded by the grandson of baseball Hall of Famer Hank Greenberg, are also among others, who relies upon a form of machine learning called Bayesian networks, by using a handful of machines to predict market trends and identify particular trades. Meanwhile, outfits such as Hong Kong-based, Aidyia^[10] and Sentient^[10] (San Francisco start up) are leaning on AI that functions across hundreds or even thousands of machines. This basically includes techniques like evolutionary computation, which is inspired by genetics, and deep learning, a technology used to recognize images, identify spoken words, and perform other tasks inside Internet companies like Google and Microsoft.

The stock market is a system which determines the trading price of companies through the buying and selling of stock. It's nothing but a human-based system, assigning human value to companies which are owned and operated by humans. It was supposed to work by humans, until the machines started taking over. Without having human at the centre of high frequency trades, we have lost the core constituent, our ability to accurately assess value. We're not going to let robots compete in the Olympics, driverless cars race in the Indianapolis 500, or automated machines play sports like football, basketball, or baseball. So why is it we allow AI to play a role in the most valuable world-wide stock exchange? With the entrance of the crude forms of AI in the quant manipulator's toolbox, we are now staggering dangerously close to a complete collapse of the stock market. This will leave many corporations and individuals financially destitute particularly at a time when client confidence in hedge funds is irresolute, many managers are seeing computers as the only way to secure the quickest, most thoroughly-researched bets. But it is interesting to mention that still there are other managers who are pushing in the opposite direction, i.e. recognizing that traditional human decision-making process has something to offer as well. A recent profile by Bloomberg^[11] introduces four significant money managers who have moved toward human decision-making and analysis in recent weeks. The report indicates that investment decisions at Winton, a \$30.6 billion^[11] hedge fund that has a 20-year history of using computer algorithms for trading purposes, must still ultimately be made by humans.

Michael Hintze^[11], a manager of another unnamed fund, indicated that computer models are useful only for identifying irregularities in the market, but these models are rarely able to suggest the best solutions to answer these irregularities or turn them into valuable investment opportunities. Other managers believe that human beings are more suitable when it comes

to detecting patterns and trends. Tristan Fletcher^[12], who wrote his doctoral thesis on machine learning in financial markets and works for a hedge fund, says investors may be reluctant to turn over their money completely to a machine.

There are many who are not convinced that an AI revolution in finance is imminent, however, David Harding^[13], the billionaire founder and CEO of another British trading company, Winton Capital Management, is generally skeptical of propaganda over machine learning and AI. David also said that a similar boom in interest in neural networks resulted in many start-ups during the early 1990s but none of those companies exist today. Andreas Park^[14], a finance professor at the University of Toronto's Rotman School of business says, 'Many of these artificial intelligence algorithms are trained with typical data and the trouble with typical data is that it doesn't perform well when you get into atypical situations'.

Stephen Roberts^[13], a professor of machine learning at Oxford University, said that deep learning could be good for extracting hidden trends, information, and relationships, but adds that it is still too brittle with regard to handling of high uncertainty and noise, which are prevalent in finance. Stephen also noted that deep learning can be a relatively slow process, and cannot offer the kinds of guaranteed behaviour that other statistical approaches can offer.

The real trouble is, as with the flash crash, once artificial intelligence programs are competing with humans and against other different AI trading programs, no one can be certain about what will happen if the markets receive an unexpected shock^[14]. Trading might seem like an obvious place to apply deep learning, but in reality it isn't clear how comparable would be the challenge of finding elusive patterns in real-time trading data, for example, spotting faces in digital photographs^[13]. The ability to process millions of numbers faster than a human fund manager can definitely provide an advantage, but it makes such models inherently prone to following the consensus, such as the collapse of the seemingly hugely profitable Hong Kong solar group Hanergy^[15], or the debate over the business model of Valeant^[15], show the limits to superficial, data-based valuation methods. A rogue algorithm at one of the country's major banks, or a cascading failure in which multiple big banks are derailed by faulty programs, could lead to a catastrophic crash^[16].

4. How much automation is useful for Retail Traders?

Algorithmic trading (also known as automated trading, black-box trading, or algo-trading) uses a computer program that follows a defined algorithm to place a trade. In theory, algo trading can generate profits at a speed and frequency that is impossible for a human trader^[17]. Just as in the world of stocks and futures, algo traders need to be a quant or mathematician and this is the reason why it is out of scope of the normal man. Since retail traders are individuals mostly acting on their own, the industry soon found value in building communities to enable traders to develop their code and skills, while at the same time staying loyal to the trading platform^[18]. Many financial technology companies that develop algo-friendly trading platforms have been competing to provide custom services that suit trader's best interest, from the range of add-ons to a solid programming language, indicators, templates, back testing, and many more. The landscape is evolving, however, the ability for retail traders to develop their own software for retail trading platforms is very important now a days, as is the ability to trade using algorithms whilst ensuring that the entire trading system meets their practical requirements^[18]. Trading strategies can be complex and obscure and this is the reason it is very essential to provide rich APIs using well known languages to would allow traders and developers an absolute freedom to employ any strategy of their desire^[18].

5. Conclusion

The idea of financial singularity would be beneficial for the industry. So, a market that operates purely on logic could reach perfect efficiency, means all assets are priced correctly with no need for human intervention. Schiller a Yale^[16], an economics professor is skeptical that a financial singularity lies ahead. He argues that it this kind of market would occur in a world where markets run according to rationality alone. But human beings are irrational, so a successful AI would have to account for our unpredictable natures also. Economic theory suggests that AI would substantially raise the value of human judgment. People who display good judgment will become more valuable, and vice versa. In fact even if people are talking about AI, we require human capital to train these machines in understanding data. The hedge funds industry has to reskill people on newer technologies and have to hire from outside to cover the skill gaps in embracing AI. The success of AI in Trading is yet to be seen in financial trading market but in our opinion balanced approach must be adopted to ensure all market participants have equal opportunities to succeed. Overall, it is too early to comment whether machine prediction decrease or increase the amount of work available for traders in decision-making as AI is used

to process and analyze vast amount of data much quicker than humans, but sometimes the challenge lies in deciding the weightage of each piece of information for the investment decision. Until computer traders develop genuine artificial intelligence they will still remain unable to gain an edge over the best human investors in spotting a catastrophic disruptive threat to the industry, or a revolutionary emerging technology^[15]. AI and machine learning impose upon a user a range of legal issues relating to privacy and data protection, consumer protection, anti-discrimination and liability issues, and cross-border issue. There are certain legal issues which are being evaluated in the context of the use of AI and machine learning with big data that includes applicability of data ownership rights as well as data privacy protections and cross-border flows of data. Recently the European Union (EU) enacted a General Data Protection Regulation (GDPR)^[19], which is due to come into force in 2018. This is especially relevant with respect to the use of artificial intelligence and machine learning, prescribed under Article 11, which provides a right to 'an explanation of the decision reached after algorithmic assessment', and allied articles providing for similar disclosures. Whether the financial singularity will happen and whether its impact would be positive or negative is yet to be determined. But we all should be paying attention because, as we witnessed in 2008 with the financial crisis, what happens in the market ultimately affects us all.

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