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AI-DRIVEN REGULATORY COMPLIANCE FOR FINANCIAL INSTITUTIONS: EXAMINING HOW AI CAN ASSIST IN MONITORING AND COMPLYING WITH EVER-CHANGING FINANCIAL REGULATIONS

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ABSTRACT—This paper presents a new approach to compliance procedures and aims to aid regulators in the process of regulating financial institutions. We propose a model which enables regulators to act as advisors to financial institutions about the expected, acceptable level of behavior. The institution then acts to optimize its business conduct with respect to maximizing profits and meeting the advised level of conduct [1] This is an improvement from the current situation, where advisers to the financial industry provide stepwise regulations (if they do 'A', then they must do 'B' or face penalty) which can be complex, ambiguous, and non-optimal in terms of aligning the interests of the financial industry and the general public. Our model culminates in a system of analytics and a virtual environment which serves as a test bed for market regulations. In recent times, the financial industry has been perceived as an environment dominated by greed, collusion, and corruption [1]. Consequently, financial institutions have been under discussion with regards to compliance and regulations. It is generally assumed that regulators are responsible for the implementation of new regulations and compliance procedures. But in actual fact, compliance procedures and the subsequent penalties for non-compliance are a result of lawsuits filed against financial institutions for alleged fraud cases.Although it is an important development in reg tech, AI learning and monitoring is something that is held as controversial for regulated entities. AI automation has huge potential to improve cost efficiency and at the same time increase the effectiveness of regulation. However, the downside for regulated entities is that it becomes easier to detect wrongful actions and breaches, increasing the probability that they will be caught. This can be seen as an increase in the rate of enforcement and has the potential to create the very regulatory burden that the AI system was trying to alleviate [8]. Decision rules inferred from data can be used to automate and monitor the behavior of the regulated entity. This ranges from passive surveillance, in which the monitoring system alerts a human when the regulated entity has done something that warrants further investigation, to full automation, in which the monitoring system is taking the same actions as it is monitoring on the regulated entity.

Keywords— Compliance, artificial intelligence, algorithms, Finance, globalization, intelligent, technology, regulations, computer systems, information, AI techniques

I. INTRODUCTION

The regulation within the financial industry itself is becoming an integral part of its DNA. Compliance with the Risk-Weighted Rules can cause serious consequences for financial institutions, depending on the severity of the breach. However, the landscape in which finance operates has become much more complicated than in the past. Globalization, interconnectedness, and rapid technological change have increased the impact and frequency of the risks on which regulations are focused. Part of this growing complexity is technology-related [3]. The financial industry is undergoing a rapid transformation driven by increases in computing power, the growing use of high-speed internet connections, and other advances that have made it possible to develop and deliver new products and services and enter new markets. At some point, as industry executives have noted, the pace of technological change has overwhelmed the ability of the industry and its regulators to keep up. In the more mundane world of compliance, however, technology has often been seen as presenting more of a problem than a solution. Regulatory issues have generally lagged behind the industry's overall focus on technological advances. More importantly, technology is frequently identified as a source of the compliance failures whose consequences have been quite costly.

The main question becomes whether there is a form of technology that can enable firms to keep pace with the regulatory environment in such a way that keeping up with regulatory changes becomes more automated. The answer is yes. This paper will explain a form of automated intelligent technology known as artificial intelligence. It will show that AI is a tool that can enable firms to increase the automation of regulatory tracking and monitoring, and thus enable the firms to more cost-effectively track the compliance of their operations against a complex and changing regulatory environment [2]. The purpose of the paper will be to explore how AI can be used in regulatory compliance without a loss in effectiveness and the actual improvement of the effectiveness of compliance programs. This will be even more relevant given that technology has been associated with the growing globalization of the financial industry and will be of equal significance in enabling firms to maintain the same tempo of regulatory reforms. As technology grows in significance in the financial industry, the usefulness of

AI in the compliance regulatory field will be much more important. AI not only means better and cheaper regulatory compliance, but this is also a key piece of the puzzle for how the financial sector will develop [2].

II. RESEARCH PROBLEM

The main research problem in this study is an assessment of AI-driven Regulatory Compliance for Financial Institutions. The stranded approach in traditional compliance management is no longer effective. Financial institutions are spending more time and money on compliance. They are taking a scatter-shot approach to hiring new staff, implementing various technology solutions, and executing numerous tactical projects designed to reduce the frequency of compliance failures [4]. Yet with every strategic shift or tactical initiative, financial institutions face a choice between adding a new compliance silo to address a specific set of requirements or rationalizing and integrating their approach to create a more unified and holistic compliance function. This compliance silo approach is not efficient, often resulting in redundant compliance activities and a lack of standardization in the way regulations are interpreted and addressed across the organization. The silo approach also makes it difficult to assess and manage overall compliance risk exposure. In turn, that inability to assess risk effectively makes it hard to allocate resources to the highest areas of risk or to demonstrate to regulators the impact and effectiveness of the compliance program. The other pressing issue is that compliance functions tend to lack resources at the beginning [5]. The regulations and regulations that have recently been approved as well as the regulation which is constantly changing have resulted in the rise in the compliance requirements over the last five years, but the financial institutions have not reacted in a similar fashion by increasing the resources. The situation has been aggravated by the tough economic situation and growing expenses in the financial services sector. The compliance officers regard their two greatest obstacles as being the management of enormous regulatory volume and doing it while understaffed.

III. LITERATURE REVIEW

A. AI IN FINANCIAL INSTITUTIONS

AI in financial institutions has been revolutionizing the way financial institutions do business. AI techniques have the potential to improve the efficiency of financial institutions in the areas of classification, prediction, financial engineering, and decision making. As these are the main tasks based around compliance, it is logical that AI can be used to improve the way compliance is dealt with. They go on to state that this offers a promising alternative to the traditional methods of statistical analysis and expert systems that have been used in the past.

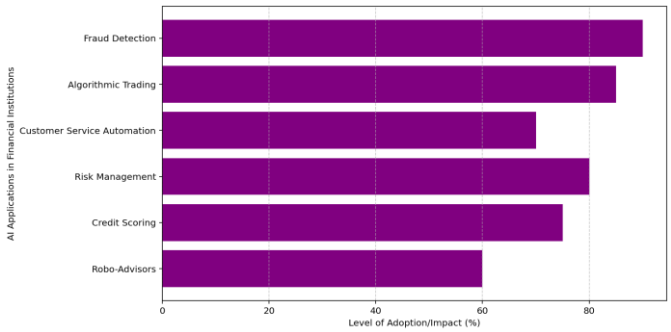

Fig. 1 AI in financial institutions

Compliance is one of the key areas that AI is useful in financial institutions. They make note that the complex and global nature of today's financial institutions and the regulations that they must adhere to pose significant challenges to financial institutions. They deem that these challenges for compliance can only be met effectively through intelligent systems such as AI with techniques of knowledge representation, decision support systems, data mining, ontologies, and intelligent agents. This is a key point because many of the most modern techniques in AI can be directly related to regulatory compliance. Monitoring financial regulations is a key to compliance and is discussed by [6] who talks about how AI is used in expert systems to assist in monitoring. He goes on to say that monitoring can be done in a passive manner where potential issues can be identified from current data or in an active manner where prediction is made as to what actions may cause a compliance breach and then data is checked to see if predictions are correct. [7] discuss a more specific method to monitoring "rule extraction and verification from a legal document" with an expert system. Their method extracted rules from legal documents and then used verification logic in an attempt to automate the checking of actions to the rules and thus determine validity of the rule, this method has great potential for automation in monitoring the validity of specific business actions to specific regulations.

B. OVERVIEW OF AI

AI has made a significant impact on business and is increasingly being applied within the financial sector at the present time. According to the previous research result, AI is an activity of performing human-like intelligence operations by using machines, especially computers. The learning processes take place while the subjects (the acquisition of facts and the rules for knowing the factual information) and reasoning (using the rules to come up with approximate or definite conclusions) are also taking place. The application of AI techniques empowers the creation of systems that can utilize data to improve the learning ability over time. The learning of information can be categorized into supervised or unsupervised learning. In supervised learning, there is a known set of input variables and a known response, or output, variable and the learning process involves the system making inferences from the input to the output. Supervised learning methods are very helpful when the system can identify patterns in data and build mathematical models that they can utilize to make predictions or to make decisions on unknown data. With the use of unsupervised learning, data has input variables but no output variables, the goal is to model the structure or underlying distribution in the data [7]. This is a useful tool for AI to build mathematical models that can draw inferences from the data and it can be extremely useful in finding patterns and information in large amounts of data. Steps beyond this is to mimic human reasoning. This is the conclusion of logical statements. Expert systems were built for this where the AI would ask a series of questions and based on the information given it would draw conclusions and make a decision [8]. The final stage in the progression of reasoning is to enable the AI to react to the environment and take action. This dichotomy with learning, reasoning and correction is much broader and deeper with the self-correction in action not necessarily being revision of logical reasoning but sometimes revising the formulation of the problem. All of this learning, reasoning and self-correction is very complex. But the more complex and broad the problem is, the greater the potential for AI techniques[8]. This great potential has led to an increasing number of studies that apply AI techniques to a wide range of financial problems.

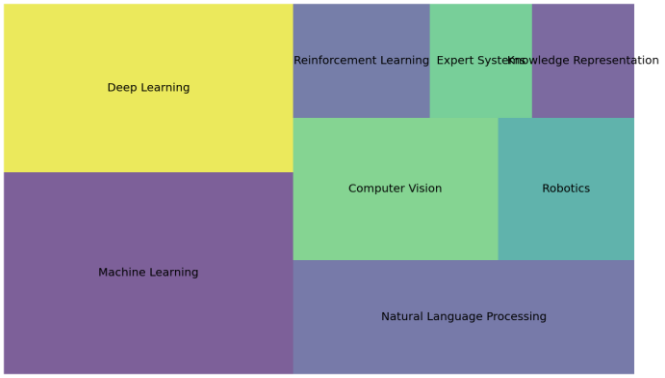

Fig. 2 Overview of AI

C. Monitoring Financial Regulations

While there is an intention to prevent regulatory breaches, regulatory events are a fact of life in these highly complex systems. New regulations won't prevent them from occurring; they generally are intended to improve the ratio of beneficial outcomes while preventing behavior that causes harm. As such, regulators will monitor regulated entities to assess if they are meeting their regulatory obligations and to take preventive or corrective action to address anticipated problems or events. Failure of regulated entities to notify the regulator of negative events that they have identified can be a breach of specific obligations and even if not, most regulations carry an implied obligation that the firm must operate in a manner that is in accordance with the objective of the regulation [9]. Monitoring can take on various forms, but the usual intention is for the regulator to understand the internal operations of the regulated entity and any interactions that it has with parties external to the entity. Such comprehensive information gathering often requires significant resources. Regulators have been known to be quite invasive in their information gathering and will often ask for reams of data and documentation from the regulated entity. In more serious cases, they will interview employees and request examination of the firm's internal practices by independent parties or the regulator themselves [9]. In order to understand regulation and engage in preventive or corrective action regarding events, AI learning must infer decision rules from the data on the regulation in order to determine right and wrong or cost and benefit in specific situations.

The realization of artificial intelligence in financial institutions has sparked increasingly rapid research. AI has been used predominantly to analyze large datasets and to automatically infer decision rules from that data. Its understanding has been used to learn the monitoring and compliance of financial regulation. Regulations are set in place to monitor the function of financial markets and firms in order to achieve specified economic objectives and to reduce failures that cause harm to consumers [11]. Failures in this context refer to omissions by private market participants to pursue actions that are socially optimal, undermine the efficiency of the market, and have implications for public policy. These regulations can vary from directives on how firms must conduct their strategic business to regulations on how they should treat their customers. This massive body of rules can be challenging to interpret and follow for regulated entities and often requires costly changes to business practices within the realm of compliance.

D. Ethical Implications of AI in Trading

The intriguing issue of 'rogue traders' is one that is more relevant to rule based AI than to machine learning. An infamous example is that of Brian Hunter, a trader for Amaranth Advisors who single handedly caused the fund to lose $9 billion through speculation in natural gas futures. In his testimony to the US Federal Energy Regulatory Commission, Hunter attributed his large losses to a 'bias trade[11,`2]'. This was in reference to a trade that will only work if certain assumptions on market conditions are correct, so as a result the trade is biased by the trader's belief. The trade in question was based on a complex calendar spread option and it is actually an ideal candidate for an AI based event strategy[12]. Step simulation can be used to test a similar set of conditions and if the rule was deemed to be effective, a live implementation would only require slight deviations from simulated results. It is not inconceivable that in the future, a move would be made to prevent such trades from incurring further losses by use of market manipulation. This was the case of Hunter's final attempt to recover losses on the failed option with real-time trading the underlying futures. He admittedly increased the position size and changed the trade when simulation results were unfavorable.

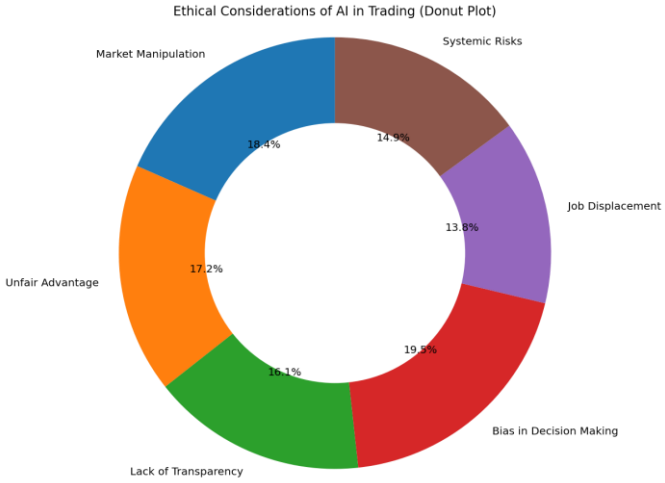

Fig. 3 Roles of AI in Algorithmic Trading

Conversely, it is also possible for traders to spend a large amount of time on implementation, only to find that the rules no longer apply due to changing market conditions. This essentially causes a strategy to become redundant. With markets as dynamic as the one for foreign exchange, this is a big problem[1]. Capturing data attributing to the influence of a given rule on market conditions can also be an onerous task that may require extensive back testing by its very own nature. This sort of rule data is critical in the event of strategy failure, in which case it can act as a road map for future attempts. High quality rule data is an asset which can be passed on or even sold to other parties. Any automatic rules identified using pattern recognition techniques are also at risk in markets of changing behavior.[13] In a scenario where traders using artificial intelligence are competing against one another, there is also the possibility of a particular strategy becoming less effective as its rules are effectively reverse engineered by other AI algorithms.

E. Impact of AI Algorithms on Stock Trading

The use of AI in algorithmic stock trading has raised significant interest from researchers across multiple academic disciplines. Many AI methods have been applied to trading, however, specific implications and effects of such methods have not been properly addressed. AI, much like stock trading, has a high level of uncertainty and non-linearity. Traditional methods of AI learning, such as the neural network, have been used to model stock prices and do trading. These methods have been chosen for their ability to model complex, non-linear systems such as stock markets, however their ability to do this is debatable[14,15]. Neural networks are well known for their ability to model complex systems, however in the case of the stock market this feature may be a hindrance. A neural network models data by changing weights in order to minimize error, given the high level of noise in stock prices it is common for the network to model the noise in data, rather than the underlying signal. This has been termed "overfitting". The network becomes so tuned to the specific data that it is unable to generalize to new data. In the stock market this is very undesirable, an algorithm may perform remarkably well while test trading, however when it is used in a live market situation it will make huge losses [16].

This is due to the noise in the modeled data changing, the algorithm will be unable to react because it believes the data is taking a different path, when in fact the noise has pushed it off the track of the underlying signal.

IV. SIGNIFICANCE AND BENEFITS

The use of algorithmic trading has provided impressive economic benefits to the United States. The automation of the trading process has increased efficiency in the US markets, which is highly desirable in this time of slow economic growth. These higher productivity levels are likely to help the US trade deficit and will help the US financial sector to maintain growth and innovation. Conspicuously, the rise in the swiftness and accuracy of US equity markets aided by algorithmic trading causes investors to incur big savings on trading cost[17]. The Tabb Group report estimates that investors would have saved about $11.5 billion in 2006[1]. The rise in the quality of the US market credited international investors with more to invest in US equities. For instance, between 2005 and 2007 the US equity trading accounts of European based traders have fallen from 28% to only 16%; the majority of trading is now done in the United States which is more liquid and cheaper[18]. Overall, the increase in trade volume and cost savings has led to an estimated $2 trillion increase in funds allocated to US equity markets. All of these measures of success - trade volume, quality, and investment in the US equity markets - are expected to bring a significant positive impact on the long-term economic growth in the United States.

In terms of creating new job opportunities, a global simulation approach to AI impact on employment predicts that a 1% increase in new AI raises the growth rate of employment by 0.88% and the growth rate of the wage by 0.93%[19]. This simulation suggests that the productivity increases due to AI will significantly increase the demand for labor, but the effect on employment and job wage will depend on the price changes of AI relative to human wages.Firms engaging in algorithmic trading are not only competing on strategy. They are, much like the rest of the business world, competing for resources. This could be talent, such as a quant with a PhD in math specializing in a particular area of statistical arbitrage, or computing resources to test and run their strategies. As such, there is a race to get the latest and greatest methods of pricing and volatility discovery, signal generation, alpha creation and risk management into the market.

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V. ENHANCEMENT & FUTURE

Machine learning techniques, for example, have proven themselves to be superior to static model strategies due to their ability to more closely model complex systems and changing environments. In the future, it is likely that machine learning will be expected as a basic requirement for any trading algorithm, just as online trading is today. This will be both a pro and con. On one hand, with machine learning being a statistically based process, it is nearly impossible to prove that the strategy behind an algorithm is not discriminatory in some way[19]. This could leave the door open to another wave of litigation if public opinion turns and there are mass complaints against "unfair" trading practices. On the other hand, with trading becoming a thoroughly machine-based process, the probability of trading errors caused by humans will decrease and the need for a human to directly supervise an algorithm will also decrease. This could lead to significant reductions in employment within the financial sector.Algorithmic trading specifically may or may not come under closer regulatory scrutiny. Algorithmic and high-frequency trading were big news in 2010, as the U.S. Securities and Exchange Commission and other regulatory agencies began to investigate any possible connection between the "flash crash" and the automated trading strategies that quickly offloaded positions as stock prices declined [20].

VI. CONCLUSION

The aim of the research is to give a deeper understanding of algorithmic trading and its relation with AI, and how AI can affect the trading itself. This research is more intended to provide formal information with complete sources for a better understanding, especially for AI developers and people who work in the trading market and want to improve their trading analysis methods.A high number of algorithmic trading firms are more likely to depend on AI, as their profit is highly time dependent. AI is not just being used for investment decisions and trading strategies, many firms are looking for different ways they can use AI to gain a competitive edge, whether that be through alpha generation, risk management and compliance, operational efficiency, and even client interaction. Classification of an algorithm making a certain decision in order to maximize some expected value as different from one making that same decision out of utility to a human is not one that the current legal system is equipped to handle. A situation where algorithm developers are held liable for actions of their algorithms offers no incentive to use algorithms in place of humans, while no differentiation from the status quo offers no reason to expect a difference in the results. Regulations do not only affect whether a given algorithm can be implemented, but also its competitiveness with the rest of the market. If constraints add costs to specific types of trading, firms will move resources away from developing strategies that are no longer cost effective.

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