

Risks and Control Strategies of Robo-advisors in the Digital Financial Environment

Yunyan Lin¹, Yang Lyu^{2*}, Ziwen Wang³, Jiaqi Zhao⁴

¹School of Business, Macau University of Science and Technology, Macau, China

²School of Economics and Management, USTB, University of Science and Technology Beijing, China

³School of Statistics and Data Science, Ningbo University of Technology, Ningbo, China

*⁴School of Economics and Finance, Hohai University, Changzhou, China
U202242661@xs.ustb.edu.cn*

Abstract. The development of digital finance and the emergence of artificial intelligence have driven the rapid rise of the robo-advisory industry. By leveraging the cutting-edge technology of digital algorithms, it provides professional and personalized investment advice for individuals and enterprises. However, it also faces risks such as algorithmic black boxes and data security issues. Most of the existing research results focus on robo-advisors themselves, and the risk control strategies are relatively insufficient, which urgently requires further research. This paper systematically summarizes the relevant research results at home and abroad, explores the risks of intelligent investment advisors in different fields under the digital finance environment, and proposes targeted comprehensive control strategies, providing references for the improvement and development of the digital finance risk governance system. The results of this study indicate that robo-advisors face risks at four levels: technology, data, legal regulation, and market. It also proposes a comprehensive control strategy system specifically including the application of regulatory technology, the construction of a regulatory framework, strengthening full-process control, improving guarantee mechanisms, implementing differentiated regulation, and conducting risk control research. This study holds that establishing scientific and effective control strategies can reduce the risks of intelligent investment advisory platforms, safeguard the legitimate rights and interests of investors, and promote the stable and efficient operation of the financial market.

Keywords: Risk Control, Digital Finance, Robo-advisors

1. Introduction

With the continuous development of the financial industry and the acceleration of digitalization, the global financial system is moving towards digital transformation. The advent of artificial intelligence has revolutionized the financial industry. Robo-advisory is a key innovation in this field. With the help of cutting-edge technology in digital algorithms, it provides professional and personalized investment advice with efficient algorithms, enabling individuals and enterprises to

optimize their financial strategies according to their own needs and conditions, attracting the help of many financial institutions and enabling them to develop rapidly. However, with the rapid development of the robo-advisory industry, the attention to risk issues is also increasing, for example, the risk of algorithmic black boxes at the technical level, the infringement of data privacy and security, the difficulty of legal supervision, and the lack of diversity of investment strategies if the market is unified.

Some scholars have researched the safety, interpretability, and accuracy of robo-advisors. For example, Belanche et al. proposed and analyzed a new behavioral model of robo-advisors to reduce the risk of artificial intelligence, revealing that robo-advisors need to learn to cope with different challenges and improve the security and ease of use of robo-advisors [1]. And what Xia et al. did is explore the current situation of robo-advisors and propose an interpretable model that integrates automatic data cleaning and quantitative weighting to improve its accuracy and avoid model problems [2]. However, most of the existing research results focus on the robo-advisor itself, and the research on risk management and control strategies is insufficient. Therefore, in the face of different research directions and risk control strategies at different levels, this paper is committed to exploring the risks and prevention and control paths of robo-advisors in different fields in the current digital financial environment, and providing them with targeted risk governance solutions to promote the improvement and development of China's digital financial risk governance system.

2. Analysis of the current situation of intelligent investment advisory development in the context of digital finance

In recent years, driven by the emergence of fintech, the financial industry has undergone a significant transformation. Financial services have begun to leverage and cover digital technologies to provide and optimize systems and means for their services. Digital credit, digital currency, and blockchain finance provide a more diversified, convenient, and flexible platform for the promotion of financial services and products. This has made banks, non-bank financial institutions, the stock market, etc., increasingly dependent on various innovative technologies and business models [3]. As a typical representative of digital financial services in the field of investment advisory, the intelligent investment advisory business, which refers to the service where robot advisors provide financial advice to investors through computer algorithms, began to rise after the 2008 US financial crisis. For instance, Wealthfront, whose predecessor was the investment consulting firm Kaching, established in 2008, was officially renamed Wealthfront in 2011. It is one of the pioneers in the field of intelligent investment advice, with its core mission being to make complex financial planning and investment management services accessible and affordable to all. Wealthfront, through the power of software, offers services such as high-yield savings, diversified investments, and low-cost loans to help investors accumulate long-term wealth. As of 2023, the company manages over 31 billion US dollars in assets for more than 400,000 clients in the United States [4].

Previous studies have shown that, relying on the advancement of digital technology, intelligent investment advisors have been favored by investors in various markets for their advantages, such as cost reduction and efficiency improvement. Moreover, their extremely strong computing power and sufficient objectivity can, to a certain extent, make more efficient financial decisions than independent human decision-making [5]. Therefore, with the support of the digital financial ecosystem, the application of intelligent investment advisors has become increasingly widespread and inclusive in the financial services industry. Moreover, in some financial analysis scenarios, investors are more likely to adopt the suggestions of intelligent advisors. However, as it has developed, the issues of robo-advisors in investment advice or risk control have received attention,

especially those related to technology, responsibility, and regulation, which have become increasingly prominent. This has led to the risk control and management strategies of robo-advisors attracting the attention and analysis of many researchers.

3. Risks currently faced by robo-advisors

3.1. Technical aspects

As a cutting-edge technology, robo-advisors rely heavily on digital algorithms, which may lead to systematic misjudgments due to model biases at the technical level. There have been many cases of such misjudgments in actual operations, among which the black box risk is particularly prominent [5]. The black box risk refers to the information asymmetry in the algorithmic decision-making process, where the robo-advisor operates like a closed machine, making it difficult for investors and regulatory authorities to understand its operational logic and decision-making basis. For instance, in the 2012 Knight Capital algorithmic trading incident, the algorithm's deviation or error led to a systematic misjudgment, causing significant losses to investors and making it hard for them to hold anyone accountable [6].

3.2. Data aspects

As the foundation of robo-advisors, there are also issues with data. For example, excessive collection and use of information seriously threaten user privacy and financial security. Since robo-advisors focus on personalization, they need to collect a large amount of investors' personal and financial data, including ID numbers, bank account information, investment preferences, etc. If these data are not managed properly, information leakage is highly likely. Some platforms, in pursuit of commercial interests, sell the collected user data to third-party marketing companies, and even some unscrupulous individuals obtain this data through illegal means for fraudulent activities [7]. Meanwhile, data quality is also crucial. As algorithm models rely on a large amount of historical and real-time market data, false, incorrect, incomplete, or outdated data can directly affect the accuracy and reliability of the models. For highly time-sensitive financial derivatives trading, this could lead to severe consequences. Moreover, the market is prone to data update delays, resulting in outdated data. Some platforms, in pursuit of data volume, neglect quality and choose to use data from unknown or unverified sources, which can lead to biased investment advice and economic losses [8].

3.3. Legal and regulatory aspects

The relevant laws and regulations for robo-advisors are still not well-established, with obvious deficiencies in suitability management, information rights protection, and investor rights protection mechanisms. There is an urgent need to establish corresponding legal regulations to protect investors' rights. The legal risks of robo-advisors also lie in unclear subjects and responsibilities, as well as undefined market access, algorithmic regulations, and fiduciary duties. These issues also require legal improvement and updates [9].

In addition, robo-advisors also face risks such as regulatory arbitrage. Currently, the legal positioning and regulatory standards for robo-advisors are not uniform globally, with differences in laws and regulations among different countries and regions. This poses challenges for cross-border robo-advisors. For example, different countries have varying degrees of legal constraints on robo-advisors. Some countries consider robo-advisors as having the same risks as traditional advisors and

apply similar regulations, requiring strict information disclosure and qualification reviews, while others have lax regulations and impose almost no constraints on robo-advisors. For instance, in the EU, as studied by Tereszkievicz, robo-advisors are classified as investment advisory services and regulated under MiFID II, only requiring companies providing investment advisory services to inform clients of the nature and independence of investment advice [10]. Against this backdrop, some multinational robo-advisor companies choose to take advantage of these differences, focusing their business in regions with lenient regulations to avoid strict regulatory requirements and engage in regulatory arbitrage.

3.4. Market aspects

There is a risk of market homogenization due to uniform decision-making at the market level, which can have a significant impact on the diversity and stability of financial markets. The risks at the market level mainly manifest as a lack of diversity in investment strategies and risks triggered by market fluctuations. Since most robo-advisors base their decisions on similar algorithm models and market data, many platforms adopt uniform decision-making logics, which leads to convergence of investment strategies and market homogenization. For instance, as Daniel pointed out, there is a fixed pattern in terms of gender and age, with robo-advisors tending to favor middle-aged male users over female ones [11]. In such circumstances, if popular stocks rise, over 80% of robo-advisor platforms will recommend related stocks in that industry to their users, causing a large amount of capital to flood in and making the stock prices of that industry deviate significantly from their actual value, thus forming a bubble. When the bubble bursts, market liquidity drops sharply, increasing systemic risks. When the market fluctuates greatly, convergent strategies may trigger a large number of buying and selling activities, intensifying market volatility and threatening the stability of the financial market.

4. Effective control strategies

4.1. Face challenges

The existing regulatory framework lacks specialized regulatory rules for robo-advisors, with low adaptability. Algorithm flaws and opacity make it difficult to determine responsibility and trace risks, and technological iterations may further exacerbate the difficulty of control. However, the digital twin technology involved in Anshari's research has not yet been fully regulated for the risk of multi-source data integration [12]. Meanwhile, Jing pointed out that the complexity of intelligent data processing technology may exacerbate the concealment of risk transmission, increase the difficulty of risk tracing, and further enhance control challenges [13]. In addition to the tension between financial security and technological innovation, regulatory agencies also need to reconcile the contradiction between data security and technological development. Li's research shows that the balance between the public opinion pressure of online media supervision and institutional compliance costs has become a new regulatory contradiction [14].

4.2. Control strategy

4.2.1. Application of regulatory technology

To effectively address the regulatory challenges posed by algorithmic black boxes, data complexity, and rapid technological iteration, regulatory agencies should actively explore and apply regulatory

and compliance technologies, such as digital twins. Anshari pointed out that, as an aspect of the development of artificial intelligence, digital twins can integrate all kinds of digital data and near-real-time data, generate advanced analysis results, provide users with feedback, suggestions, and alternative solutions, and apply them to the financial field to optimize financial services and management [12]. At the same time, regulators need to pay attention to the application risk of digital twin technology in investment advisers, and require operators to separately record the data source range and aggregation rules when integrating multi-source user data to build virtual images [12].

4.2.2. Building a multi-level supervision and full-cycle technology risk management and control system

The regulatory authority should take the operators as the regulatory object, implement the indirect licensing system, and clarify the access conditions and management personnel qualifications; And urge institutions to improve the service continuity mechanism, retain user information completely, accurately and safely, establish and strictly implement the conflict of interest prevention and management system, and clarify the responsibilities of robo-advisor service providers to their customers. In terms of technology risk management and control, regulators should establish a system of prior review and filing of algorithms, covering the appropriateness of algorithm compliance review and customer due diligence, and carry out tests from the dimensions of interpretability and security. In addition, an algorithm dynamic update reporting mechanism should be established to deal with the risk of rapid technology iteration. On this basis, regulators also need to establish a full life cycle dynamic regulatory system, requiring operators to timely remedy loopholes and manage data according to risk levels, clarify the accountability of algorithms, and adopt the principle of presumption of fault.

4.2.3. Improve the protection mechanism for investors' rights and interests

Regulators should unify the regulatory standards of robo-advisors and traditional consultants, strengthen information disclosure, and clarify the responsibilities of directors and executives. At the same time, the active and iterative disclosure mode should be introduced, and the disclosure quality should be supervised by a third-party institution to protect investor information throughout the life cycle, and the sensitive data should be managed and encrypted at different levels to reduce the risk of disclosure. At the same time, online media supervision can be used as a supplementary mechanism. As Li's research points out, online media supervision can form effective constraints on enterprise behavior through its powerful public opinion guidance and supervision function. This pressure can further urge investment advisory institutions to regulate information disclosure and service behavior [14].

4.2.4. Implement differentiated supervision

Regulators should implement differentiated regulation based on the differences between robo-advisors and traditional consultants, and implement differentiated protection in combination with the classification of investors, so as to promote market efficiency and ensure fairness. Horn defined the core asset allocation characteristics of robo-advisors. For the hybrid model, it defined the responsibility boundary between the algorithm and labor. When the core of decision-making was an algorithm, it applied stricter technical supervision requirements. For the index fund portfolio

strategy of the robo-advisors, the risk preference evaluation model is optimized in combination with the actual trading behavior of users [15].

4.2.5. Carry out risk control research

There are many modeling studies on robo-advisor risk control algorithms in foreign countries for reference [16]. Humoud Alsabab et al. proposed a framework based on reinforcement learning to help retail investors learn and adjust their risk preferences in different market environments, so as to improve the effectiveness and accuracy of portfolio selection [17]. Jung discussed the application of robo-advisors in retail and private banking and pointed out that these tools can effectively support users' decision-making, such as risk measurement, portfolio selection, and rebalancing [18].

5. Conclusion

In the context of the vigorous development of digital finance, robo-advisors, as a major advancement in financial technology, have achieved rapid development with the advantages of efficiency and personalization, but at the same time, there are also risks and challenges in technology, data, legal supervision, and the market.

This paper clarifies the core risks such as black box risk caused by information asymmetry, user privacy leakage and data quality defects, regulatory arbitrage caused by imperfect laws and regulations, and market homogenization caused by the convergence of investment strategies, and proposes a comprehensive control strategy system covering the application of regulatory technology, the establishment of a multi-level regulatory framework, the whole process of controlling technical risks, improving the investor rights protection mechanism, the implementation of differentiated supervision and development of risk control research.

However, the risk governance of robo-advisors is a long-term and complex system project, which still faces practical challenges such as the superposition of institutional and technical risks and the problem of multiple regulatory balances. Looking forward to the future, with the continuous iteration of digital technology and the continuous evolution of the financial market, the risks in the field of robo-advisory may further evolve, and the corresponding control strategies need to be optimized. This study believes that the construction of a scientific and effective management and control strategy can not only reduce risks for robo-advisory platforms and protect the legitimate rights and interests of investors, but also improve our country's digital financial risk governance system and promote the stable and efficient operation of the financial market. Therefore, follow-up research can further focus on exploring the potential risks brought by the application of emerging technologies to robo-advisors, as well as evaluating the adaptability and practical effects of control strategies in different market scenarios, so as to continue to empower the healthy development of the robo-advisory industry.

Authors Contribution

All the authors contributed equally, and their names were listed in alphabetical order.

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