

The adoption of AI and Investment Efficiency

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Abstract. Artificial Intelligence (AI) plays an extremely important role because of its powerful data analysis and processing capabilities to lead society towards intelligence. This study investigates the effect of AI on investment efficiency. This literature analyzes the number of occurrences of AI in the financial reporting information of all A-share listed companies in China. The finding shows that the adoption of AI will accelerate investment efficiency. Taken together, this paper enriches the literature on the consequences of the determinants of investment efficiency and consequence of AI adoption in theory. In additional, this study provides implications that enterprises can improve the quality of decision-making and investment efficiency by applying AI.

Keywords: AI, investment efficiency, underinvestment, overinvestment.

1. Introduction

AI has an extremely important position. It can provide accurate decision support for various industries, optimize business processes and improve production efficiency through powerful data analysis and processing capabilities; It can also promote innovation, create new business models and products, greatly change the way people live and work, and lead the society to accelerate the intelligent era.

Furman and Seamans study the impact of AI on productivity and labor [1]. They argue that AI boosts productivity but hits labor in the short term. Pau research the influence of AI on conflict resolution strategies [2]. Existing literature rarely studies the impact of AI on investment efficiency, this paper fills the research gap. The results show that the adoption of AI can increase investment efficiency. This study results hold after a series of robustness check, including alterative measure of main variables.

First, this study contributes to the literature on AI adoption. Cao examine the critical role that modern AI technologies play in solving complex financial problems [3]. However, he doesn't specifically analyze what technical dilemmas AI solves. This paper illustrates the application of AI can improve the efficiency of investment.

Second, this study complements the literature on investment efficiency. Chen et al. suggest that government intervention harms investment efficiency [4]. This paper shows that financial reporting quality determinants of investment efficiency and AI can improve investment efficiency by capturing and integrating information.

This paper also provides practical implications. AI benefits costs double-edge sword. AI can improve the quality of investment decisions, optimize portfolio management, enhance risk management capabilities, improve the efficiency of trade execution, and promote the development of financial markets and so on.

Remainder of the paper. The paper can be organized as follows. Section 2 presents literature review, while section 3 develops hypotheses development. Section 4 demonstrates the research design and section 5 interpret empirical results. Finally, section 6 indicates conclusion.

2. Literature Review

2.1. Literature on AI

AI has become a prominent field due to the diversity and complexity of its research, permeating various aspects of society. AI is worth exploring actively. The research directions suggested in these papers, such as addressing ethical issues, improving technological capabilities, and enhancing authenticity, will likely shape the future development of AI. Future studies may further explore the intersection of these areas and apply the findings in more practical and diverse contexts.

Schank delves into the essence of artificial intelligence by dissecting multiple perspectives [5]. The research emerges from the context of the Institute for the Learning Sciences' work on educational software, which prompts the titular question. Schank examines four prevalent viewpoints: the magic bullet view, the inference engine view, the "gee whiz" view, and the learning view. Through examples, the paper showcases the evolution from theoretical concepts to practical applications and the significance of scaleup. It also critiques the expert system shell game, highlighting the misplacement of focus. The work contributes to the understanding of AI by emphasizing the importance of real-world problem-solving, knowledge representation, software engineering, and the shift from pure research to implementation. It guides future research towards areas like case-based reasoning and teaching, urging the field to address practical challenges for the development of genuine AI systems.

Vo et al. investigate the authenticity of AI-powered service apps [6]. With the proliferation of such apps, the concept of authenticity becomes crucial. Using regulatory engagement and parasocial interaction theories, the authors conduct two studies. Study 1 identifies four dimensions of authenticity: social presence, integrity, credibility, and symbolism. Study 2 confirms media richness, parent brand attitudes, and co-branding fit as influencing factors. Fuzzy-set Qualitative Comparative Analysis (FsQCA) reveals different combinations of factors leading to high authenticity perception. The research contributes to the understanding of authenticity in the AI context, extends relevant theories, and provides implications for practice, such as emphasizing the need for app designers to focus on authenticity-enhancing features.

Santos and Carvalho focus on the integration of AI technologies into participatory environmental management [7]. The rapid advancement of AI offers opportunities to address complex sustainability challenges. The authors use text mining tools to analyze 80 papers, identifying ten thematic clusters such as AI-enhanced urban health strategies, collaborative environmental health systems, and governance and climate resilience. Literature review and systematic review are commonly used methodologies, but the field is interdisciplinary, incorporating various techniques like IoT and digital twins.

2.2. Literature on Investment Efficiency

Investment efficiency is a crucial aspect of corporate finance that has garnered significant attention in academic research. In the digital age, the emergence of new technologies such as artificial intelligence and digital infrastructure development has brought new influences and challenges to corporate investment efficiency.

Lai et al. analyze the potential economic mechanisms in four aspects: information, governance, financing, and risk [8]. Digital technology innovation is found to enhance investment efficiency by promoting ESG disclosure, improving information quality, alleviating agency conflicts, reducing debt costs, and lowering risk and this conclusion is robust after a series of tests, including replacement variables, considering time lags, reverse causality tests, excluding special samples, and using instrumental variables and DID analysis.

Under the background of broadband China's policy, the development of digital infrastructure also has a certain impact on the investment efficiency of enterprises. Wang et al. study that the Broadband China policy significantly enhances corporate investment efficiency by mitigating the negative effects

of inefficient investment and overinvestment behaviors [9]. The effects are more pronounced in regions with more developed infrastructure.

AI development significantly enhances enterprise investment efficiency (EIE). Zhao et al. demonstrate that AI has a significant positive impact on EIE, even after a series of robustness tests such as variable substitution, addressing endogeneity, and sample limitations [10]. The mechanism analysis reveals that AI improves EIE by increasing the transparency of accounting information. Heterogeneity analysis further indicates that AI has a stronger impact on the investment efficiency of high-tech and technology-intensive enterprises, non-state-owned enterprises, and those located in highly urbanized areas.

3. Hypotheses Development

In the realm of investment, the efficiency of resource allocation is crucial for firms' growth and economic development. AI, with its powerful data processing capabilities, has gradually penetrated and significantly affected all aspects of investment decisions. Specifically, the application of AI can improve investment efficiency in the following ways.

On the one hand, information is important for investment efficiency. AI has remarkable capabilities in information capture. It can utilize natural language processing techniques to extract valuable investment - related information from various sources such as news, social media, and corporate announcements. These data sources are rich in information but unstructured, making it difficult for traditional methods to process effectively. AI can quickly identify information related to company performance, industry trends, and policy changes. For instance, when a company announces a new product launch, AI can not only capture this information in real - time but also analyze its potential impact on the company's future revenue, market share, and competitive landscape. This timely and accurate information capture enables investors to respond promptly and make more informed investment decisions, thereby improving investment efficiency.

In terms of information collection, AI's web crawler and data - gathering technologies enable it to amass a vast amount of data globally. It can collect comprehensive data, including traditional financial data, macro - economic data, industry - specific data, and competitor information. This comprehensive data collection is far more efficient than manual methods. For example, in cross - border investment analysis, AI can simultaneously gather data from different countries, including their macro - economic indicators, industry regulations, and the operating data of target companies in various markets. This ability to collect extensive and timely data helps investors build a more complete investment analysis framework, reducing the risk of decision - making errors due to information gaps, as emphasized by the importance of information comprehensiveness in investment decision - making in previous studies [11].

AI's data mining and machine - learning algorithms are powerful tools for information organization. It can analyze and integrate the collected data, revealing hidden patterns and trends. By processing historical data, AI can identify relationships between industries and macro - economic indicators or uncover the connection between corporate financial indicators and stock price fluctuations. AI can conduct quantitative risk assessments on enterprises, allowing investors to optimize their investment portfolios. This helps investors balance risks and returns more effectively, ultimately enhancing investment efficiency. This aligns with the idea in existing literature that better - organized information can lead to more efficient investment decisions [10-12].

On the other hand, corporate governance and monitoring management both play a key role in investment efficiency. Prior studies have emphasized the significance of corporate governance in investment decision - making. For instance, Salin et al. investigated the influence of corporate governance mechanisms such as board independence, board size, and managerial ownership on firm investment efficiency in the Malaysian context [13]. They found that board size can influence the level of investment, and board independence and managerial ownership can prevent inefficiencies in investment decision - making. Ward et al. focused on the role of institutional investors' motivated

monitoring in improving investment efficiency [14]. They demonstrated that institutional investors' monitoring can mitigate both over - investment and under - investment problems, highlighting the importance of monitoring in corporate governance. These studies lay the foundation for understanding the relationship between corporate governance and investment efficiency, and also suggest potential areas where AI could intervene to enhance this relationship.

AI has the potential to significantly improve corporate governance. Firstly, in terms of information processing and transparency, AI can analyze vast amounts of data in real - time from various sources, including financial reports, market news, and internal company data. It can identify and flag any irregularities or potential issues in financial data, similar to how independent directors are expected to monitor financial reporting quality. This real - time monitoring and data - driven analysis can help boards of directors and other stakeholders make more informed decisions, much like how institutional investors' monitoring based on portfolio importance affects investment decisions.

Secondly, AI can play a role in enhancing the monitoring capabilities within a company. Just as institutional investors' monitoring is crucial for investment efficiency, AI - powered monitoring systems can continuously oversee managerial actions. AI algorithms can analyze patterns of managerial decision - making, resource allocation, and investment activities. By setting predefined benchmarks and risk thresholds, AI can detect deviations from optimal investment strategies in a timely manner. For example, if a manager is about to make an investment decision that might lead to over - investment, similar to the over - investment issues studied in relation to free cash flow and managerial behavior [15], the AI system can issue alerts. This is comparable to how board members or institutional investors would monitor managerial decisions to prevent over - investment or under - investment. Based on the above the analyses, this paper proposes the following hypothesis:

Hypothesis: AI improves investment efficiency by capturing, gathering and collating information and helping improve corporate governance and monitoring management.

4. Research Design

4.1. Sample and Data Sources

This study takes all Chinese A-share as initial sample from the period of 2010 to 2020, and this paper also excludes financial firms because the financial firms are subject to different accounting standards and we also exclude some special treaty firms. Finally, this study obtains 25905 observations. The data is collected form CSMAR databases.

4.2. Empirical Model

This paper is to testify whether the adoption of AI can increase investment efficiency in Chinese list firm. To effectively investigate the causal effects, this study implements OLS design.

$$Investment_{i,t+1} = \alpha_0 + \beta_1 AI_{i,t} + \gamma X_{i,t} + \delta + \varphi + \varepsilon_{i,t} \quad (1)$$

Investment proxies for investment efficiency, which contains overinvestment, and underinvestment. AI proxies for the adoption of AI using textual analysis. This paper calculates the proportion of AI-related words in the annual reports.

$X_{i,t}$ denotes a matrix of control variables including control size, leverage, return on assets (ROA).

Additionally, $\delta_{r,t}$ denotes firm fixed effects while $\varphi_{j,t}$ denotes year fixed effects, and $\varepsilon_{i,t}$ denotes the standard error of the regression model.

5. Empirical Results

5.1. Summary statistics

Table 1 report result of descriptive Statistics. The mean value of *investment* is 0.04 while its standard deviation is 0.049. *Investment* has a 25 quantile of 0.011, whereas its median is 0.025. In the meantime, the 75th quantile of *investment* is 0.049. The average of *AI* is 0.639, and its standard deviation is 1.005. The 25th quantile and 50th quantile both of *AI* are 0. Meanwhile, *AI*'s 75th quantile is 1.099. In addition, the mean value of *Size* is 22.384 and *ROA*'s mean is 0.038. At the same time, the average *Lev* is 0.447, while the mean *Cfo* is 0.047.

Table 1. Descriptive Statistics.

Variable	N	Mean	SD	p25	p50	p75
InefficInvest	25905	0.04	0.049	0.011	0.025	0.049
AI	25905	0.639	1.005	0	0	1.099
Size	25905	22.384	1.282	21.48	22.21	23.11
ROA	25905	0.038	0.074	0.013	0.039	0.072
Lev	25905	0.447	0.202	0.29	0.443	0.595
Cfo	25905	0.047	0.069	0.008	0.045	0.086

Table 2 report result of the impact of AI on investment efficiency. The first column does not include the control variables. For this column, the coefficient of AI is -0.001, and the t-value is -1.86. It can be seen that it is significant at the 10% level. While the second column adds the control variables, for this column, the coefficient of AI is -0.001, and the t-value is -2.26. It's in 5% significance level.

Table 2. The impact of AI on investment efficiency.

	(1)	(2)
	InefficInves	InefficInvest
AI	-0.001*	-0.001**
	(-1.86)	(-2.26)
Size		0.003**
		(2.33)
ROA		0.088***
		(12.16)
Lev		0.013***
		(2.83)
Cfo		-0.032***
		(-5.23)
_cons	0.041***	-0.028
	(89.95)	(-1.10)
Firm FE	YES	YES
Year FE	YES	YES
N	25691	25905
r2_a	0.185	0.198

6. Conclusion

In this study, we provide evidence on the impact of AI application on firm investment behavior in a sample of Chinese domestic listed A-share firms excluding financial firms and special treaty firms from 2010 to 2020. It finds that the adoption of AI can increase investment efficiency.

However, our study has certain limitations. This paper only takes China as a sample. Also, this study only measures whether a company is using AI by the proportion of words and sentences in each

company's financial report, but does not actually confirm whether the company is actually applying AI.

Future research could address cross-country data to review the association between AI adoption and investment efficiency. And we can explore more concise ways to measure AI applications.

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