How the Degree of Artificial Intelligence in Companies in the Digital Economy Affects Corporation Value -- Based on Data From Listed Manufacturing Companies

Yihan Wang*

*Corresponding author. Email: 1245590502@qq.com

Research Institute of Economics and Management, Southwestern University of Finance and Economics, Chengdu, 610000, China

Abstract: Artificial intelligence technology has the potential to significantly affect the growth and development of businesses as it is the primary technological force behind the digital economy era and the new round of scientific and technological revolution. This study uses machine learning to choose the text of the annual reports of China's listed manufacturing firms, builds an index of the level of enterprise AI adoption, and assesses how it affects the value of manufacturing enterprises. It has been discovered that the use of artificial intelligence technology can greatly increase an enterprise's worth; nevertheless, the result also reveals a clear heterogeneity among firms with various ownership qualities. This essay offers proposals for the creation and use of future artificial intelligence-related policies supported by empirical facts and how enterprises should integrate into the artificial intelligence era.

Keywords: artificial intelligence, long-term enterprise value, machine learning, text analysis

1. Introduction

Artificial intelligence technology is the core technology of today's digital economy and the new round of technological revolution, and at the same time, as a typical general purpose technology, it plays an important role in improving the quality, efficiency and power of economic growth. According to the "China Artificial Intelligence Development Report 2020", in 2020, China has been called the number one country in terms of patent applications for artificial intelligence technology, with patent applications accounting for 74.7% of the total, and the "2021 Artificial Intelligence Development White Paper" points out that the scale of China's artificial intelligence core industry has reached 325.1 billion yuan, which is the core driver of the quality and acceleration of the development of the digital economy. General Secretary Xi Jinping pointed out that "accelerating the development of a new generation of artificial intelligence is an important strategic grasp to win the initiative in global science and technology competition", to which the Chinese government attaches great importance to artificial intelligence technology, and from multiple angles and levels to open up space for the development of artificial intelligence technology.

IEDM 2024, February 23-25, Kuala Lumpur, Malaysia

DOI 10.4108/eai.23-2-2024.2345933

General Secretary Xi Jinping also pointed out that "the 'application of new technologies and their impact' will be studied in depth as a key task, and cooperative ideas and initiatives will be seriously explored." What is the performance of the use of artificial intelligence technology in manufacturing firms, which is the driving force behind China's industrial structure system? What effect does the use of artificial intelligence technologies have on businesses engaged in manufacturing? The answers to the questions above can assist offer recommendations for businesses on how to better employ frontier technologies and aid China in boosting its core competitiveness in the new wave of technological revolution. To examine the relationship between artificial intelligence technology application indicators and the value of manufacturing enterprises, this article constructs artificial intelligence technology application indicators.

The marginal contribution of this paper mainly lies in the use of machine learning and text analysis of corporate annual reports to construct an indicator of the degree of application of corporate artificial intelligence technologies, which more intuitively portrays the application of cutting-edge technologies by Chinese-listed manufacturing companies.

2. Literature Review

In the context of the new round of technological revolution and industrial change, artificial intelligence technology, as a core technology driver in the era of digital economy, can have a significant impact on the production and development of enterprises.

At present, domestic and international academic research on the application of intelligence technology focuses on its impact on labor force employment and on enterprises themselves. In terms of labor force employment, a part of scholars have a neutral attitude toward the use of artificial intelligence technology. Li Lei et al. (2021) point out that the application of artificial intelligence technology will stimulate the demand for labor in enterprises, but not all industries will benefit from it, and the employment of labor in traditional labor-intensive enterprises and low-skilled labor will be suppressed instead. Research found that the application of artificial intelligence technology will have some substitution effect on the labor demand of enterprises, and the impact on the demand for labor with different skills is significantly different.[1] Another part of scholars has a negative attitude toward the application of artificial intelligence technologies.Daron Acemoglu and Pascual Restrepo (2020) show that the application of artificial intelligence technologies has a significant negative impact on both employment and wage levels, stagnates labor demand, reduces the share of labor in national income, and increases social inequality equality, and reduce productivity growth.[2-3]

Academics usually concur that the use of artificial intelligence technology boosts the innovative vigor and benefits of organizations in all respects. This is true of the influence on the businesses themselves. Zhu Zhujun et al. (2022) pointed out that the application of artificial intelligence technology improved the efficiency of resource allocation of innovation factors in enterprises.[4] Yang Renfa et al. (2022), on the other hand, concluded that artificial intelligence applications can significantly contribute to the high-quality development of manufacturing industries and can effectively enhance the economic, innovation, green and value-added benefits of manufacturing development.[5]

Artificial intelligence has good business prospects, and studies have shown that companies that are willing to deploy artificial intelligence in the operational phase and in core functions can reap real benefits and enhance performance advantages. However, current research on the factors influencing corporate value has focused on corporate social responsibility and internal business management. In terms of social responsibility, Li Zheng (2006) found that in the short term, the more corporate social responsibility, the lower the corporate value; however, in the long term, social responsibility does not reduce corporate value.[6] Further study by Zhu Yaqin et al. (2010) concluded that the social responsibility of enterprises to the government and the social responsibility of enterprises to employees are significantly and positively related to enterprise value; while the social responsibility of enterprises to investors is significantly and negatively related to enterprise value.[9]

In terms of intra-firm management, Wang Hua et al. (2006) pointed out that there is a stable relationship between operator equity incentives and firm value.[7] Zhan Lei et al. (2013) found that excessive investment behavior detracted from firm value, and firms with excessive investment had lower future operating performance and greater financial risk.[8] However, there are few studies on the combination of the application of artificial intelligence technology and enterprise value in the academic circles. Therefore, this paper will focus on this to explore whether the application of artificial intelligence technology will affect enterprise value.

3. Research Design

The following hypotheses are proposed in this research in order to further explore the relationship between the extent of artificial intelligence technology application and firm value in light of the previous review:

H1: The application of artificial intelligence technology has a positive impact on enterprise value.

H2: The influence of the application degree of artificial intelligence technology on enterprise value is different in enterprises with different equity natures.

At present, when measuring the degree of application of a technology, most academics use the Python crawler function to aggregate the annual reports of enterprises and finally sum up the keyword word frequencies to construct an index system to measure the degree of application of the technology. Therefore, this article uses this method to measure the level of use of AI technology in firms. However, this method only achieves a single count of keyword word frequencies and does not take into account that the frequency of keywords appearing in the annual reports of enterprises may be biased depending on the nature of the enterprises. Therefore, this paper will further utilize machine learning and text analysis on the basis of the original measurement method to reduce the impact of this bias on the results and improve the accuracy and objectivity of the study.

3.1 Index construction method

The majority of text analysis, according to Loughran and McDonald, only works at the document level and analyzes words as standalone tokens based on the presumption of "contextual insignificance," which has the drawbacks of missing context and redundancy bias.

Based on this, this research suggests a semi-supervised machine learning strategy, relying on Kai et al., to gauge the extent to which artificial intelligence techniques are used in businesses. This article will perform vector operations on words in natural language, select words according to their proximity, and calculate weighted word frequencies considering their frequency of occurrence in the current annual report and all annual reports, in order to obtain the most objective and comprehensive artificial intelligence technology keyword portrait of manufacturing enterprises. Specifically, this paper mainly introduces the training word embedding vector tool Word2Vec and TF-IDF algorithm to realize the metrics of the degree of application of artificial intelligence technology for each enterprise in each year.

3.2 Research design

3.2.1 Sample selection and data sources

In order to circumvent the impact of the 2020 epidemic, this paper selects all A-share listed non-ST manufacturing enterprises from 2017-2019 as the research sample and uses Word2Vec and TF-IDF algorithms to construct the enterprise artificial intelligence technology application degree index. This paper eliminates the samples with missing variable data in the regression analysis and shrinks the tails of all continuous variables to avoid the effect of outliers. The financial data used in this paper are from CSMAR database.

3.2.2 Model construction

In order to explore the impact of the application of artificial intelligence technology on enterprise value, this paper sets the following model:

$$LongValue_{i,t} = \alpha + \beta_1 AI + \beta_2 lev + \beta_3 turnover + \beta_4 procost + \beta_5 scale + \varepsilon$$

In this paper, the degree of artificial intelligence technology adoption is used as the core explanatory variable to explore its impact on firm value. Among them, enterprise value is measured by Tobin's Q, and the degree of artificial intelligence technology application is measured by the weighted word frequency of related words in the annual reports of enterprises. In addition, referring to the established literature, this paper incorporates a series of variables that may have an impact on the core explanatory variables, mainly including corporate financial indicators and firm size. The specific variables are defined in Table 1.

Table 1. Definition of variables

	Variable Identification	Variable Name	Variable Definition
Explained variables	LongValue	Enterprise Value	Enterprise Tobin's Q
Explanatory variables	AI	The degree of application of AI technology	Weighted word frequency of related words in enterprise annual report × 1000
Control variables	lev	Assets-liability Ratio	Total liabilities / Total assets
	turnover	Accounts Receivable Turnover Ratio	Operating income/Accounts receivable
	procost	Cost Profit Ratio	Total profit / Total cost
	scale	Enterprise Scale	Number of employees

4. Empirical Analysis

4.1 Benchmark regression analysis

The benchmark regression analysis of the impact of the degree of AI technology use on business value is shown in Table 2. The results of the regression of the level of artificial intelligence technology application on firm value alone are shown in column (1), the results of the regression after adding control variables are shown in column (2), and the results of the regression after adding control variables and adjusting for time-fixed effects are shown in column (3). Hypothesis H1 is supported by Table 2, which shows that the level of use of artificial intelligence technology significantly increases business value. However, only after adjusting for other factors can this effect be noticed. This may be due to the fact that there are several complicated aspects affecting business value, and their relevance cannot be determined by simply regressing them by the level of application of artificial intelligence technology.

Table 2. Application degree of artificial intelligence technology and enterprise value benchmark estimation results

	(1)	(2)	(3)
	Value	Value	Value
AI	0.376	1.575***	2.163***
	(0.57)	(2.72)	(4.03)
lev		-1.306***	-1.153***
		(-9.69)	(-7.53)
turnover		0.005**	0.005**
		(2.27)	(2.09)
procost		2.178***	1.571***
		(17.32)	(11.43)
scale		-0.378***	-0.384***
		(-16.45)	(-14.48)
Constant	2.498***	5.595***	6.075***
	(77.75)	(34.86)	(32.96)
Year FE			YES
N	4,587	4,583	4,583
Adj R^2	0.4005	0.3429	0.3468

To further analyze how the impact of the level of artificial intelligence technology application on firm value varies across various organization types, the paper further separates the sample into state-owned and non-state-owned businesses based on the nature of ownership. Table 3 illustrates the heterogeneity analysis for businesses with various ownership structures. Column (1) lists the regression results for state-owned businesses, column (2) lists the results for privately held businesses, and column (3) lists the regression results with the interaction term between the main explanatory factors and the equity structure added. Table 3 shows that applying artificial intelligence technology has a different effect on enterprise value in businesses with diverse equity natures, supporting H2.

Table 3. Heterogeneity of equity nature regression results

	(1)	(2)	(3)
	Value	Value	Value
AI	2.174**	1.839***	1.514***
	(2.06)	(3.02)	(2.55)
lev	-1.195***	-1.052***	-1.097***
	(-5.47)	(-5.78)	(-7.19)
turnover	0.002	0.009**	0.007***
	(0.66)	(2.57)	(2.75)
procost	1.645***	1.506***	1.548***
	(5.12)	(9.84)	(11.30)
scale	-0.315***	-0.372***	-0.362***
	(-7.02)	(-11.83)	(-13.59)
ownership			-0.365***
			(-6.01)
ownership×AI			2.872***
			(2.61)
Constant	5.149***	6.058***	5.962***
	(14.09)	(28.19)	(32.21)
Year FE	YES	YES	YES
N	1,029	3,554	4,583
Adj R^2	0.4136	0.3533	0.3589

5. Conclusion

The development of Chinese businesses is increasingly dependent on artificial intelligence technology as a key component of the new wave of scientific and technical revolution and industrial transformation. This study creates an indicator of the level of artificial intelligence technology application in listed manufacturing businesses based on the annual report text data of China's listed manufacturing enterprises from 2017 to 2019. Due to the deep integration of artificial intelligence technology and the real economy, this paper examines the impact of the degree of application of artificial intelligence technology on enterprise value and the heterogeneity among enterprises with various ownership properties.

First, the study discovered that using artificial intelligence technology can greatly increase an enterprise's worth. Second, companies with various ownership structures clearly differ in how much artificial intelligence technology is applied to their company value.

The following policy consequences and insights stem from the aforementioned conclusions: A deep integration of cutting-edge artificial intelligence technology with actual organizations is promoted by the application of artificial intelligence technology, which has several important advantages. The government should adopt the overall trend of the digital economy, technological revolution, and industrial change, seize the critical window of opportunity presented by the scientific breakthrough in artificial intelligence, and offer excellent support for the continued growth of businesses. In order to strengthen the effectiveness of listed industrial

businesses in achieving technological advancements, the government should increase its support for artificial intelligence technology research and development. Second, governments may think about appropriately shifting resources to non-state enterprises to reap more marginal advantages due to the increased administrative efficiency within these businesses.

References

[1] Li Lei, Wang Xiaoxia, Bao Qun. The Employment Effect of Robots : Mechanisms and Chinese Experience [J].Managing the World, 2021,37 (09) : 104-119.DOI : 10.19744 / j.cnki.11-1235 / f.2021.0140.

[2] Daron Acemoglu, Pascual Restrepo. Robots and Jobs: Evidence from US Labor Markets[J]. Journal of Political Economy,2020,128(6).

[3] Acemoglu Daron, Restrepo Pascual. The wrong kind of AI? Artificial intelligence and the future of labor demand[J]. Cambridge Journal of Regions, Economy and Society,2020,13(1).

[4] Zhu Zhujun, Yuan Yiming, Jiao Jiajia. Industrial Automation and Manufacturing Innovation Behavior [J].China Industrial Economy, 2022 (07) : 84-102.DOI : 10.19581 / j.cnki.ciejournal.2022.07.019.

[5] Yang Renfa, Lu Yao. Research on the impact of artificial intelligence on the high-quality development of manufacturing industry [J/OL].East China Economic Management : 1-19 [2023-04-01].http://kns.cnki.net/kcms/detail/34.1014.F.20221228.2006.001.html

[6] Li Zheng. Research on the correlation between corporate social responsibility and corporate value-Empirical evidence from listed companies in Shanghai [J]. China Industrial Economy, 2006 (02) : 77-83.DOI : 10.19581 / j.cnki.ciejournal.2006.02.010.

[7] Wang Hua, Huang Zhijun. Managers ' equity incentive, board composition and firm value-empirical analysis based on endogenous perspective [J].Management World, 2006 (09) : 101-116 + 172.DOI : 10.19744 / j.cnki.11-1235 / f.2006.09.015.

[8] Zhan Lei, Wang Yaoyao. Management Incentives, Over-investment and Firm Value [J].Nankai Management Review, 2013,16 (03) : 36-46.

[9] Zhu Yaqin, Yao Haixin. Empirical Research on the Relationship between Corporate Social Responsibility and Corporate Value [J].Research on Financial Issues, 2010 (02) : 102-106.