Research on the Impact of Artificial Intelligence Innovation on Manufacturing Enterprise Idiosyncratic Risk

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Abstract: Under the background of the digital economy, the world is more closely connected, which also means the magnification of uncertainty and the elevation of the risk level of enterprise characteristics. How to make the enterprise have core competitiveness and reduce the enterprise's characteristic risk as much as possible, both the theoreticians and practitioners need to pay attention to and solve the problem. AI innovation is an important way for manufacturing enterprises to gain competitive advantage in the era of the digital economy. The existing data show that more scholars believe that technological innovation plays an important role in effectively reducing the risk of enterprise characteristics, and have a thorough discussion on it, it is found that not only the individual level of the enterprise factors will have an impact on the idiosyncratic risk, the internal resources of the enterprise will also have an impact on the idiosyncratic risk. As an important resource for enterprises to gain competitive advantage, redundant resources in this framework have attracted much attention from scholars. However, some studies have not revealed the mechanism and lack reliable empirical conclusions. Therefore, from the perspective of redundant resources to explore the impact of the digital economy era to reduce enterprise risk factors and their mechanisms have significant theoretical and practical value.

Keywords: AI Innovation, Idiosyncratic Risk, Redundant Resources

1. Introduction

The world is changing radically, and both individuals and businesses face great uncertainty. In today's world, the impact of risk can go well beyond the next quarter's financial statements and have long-term reputational or regulatory consequences. Companies must also consider whether the events that generate risk have broad implications for their industries, economies and societies as a whole, and what this means for them. COVID-19 has had a direct impact on most businesses, but it has also changed the global economic and social landscape. For companies, the level of risk is rising -- as are the expectations of employees, customers, shareholders, the government and society at large. The rise of risk level, for the enterprise may mean that at any time the risk of being hit or even bankruptcy failure, these are likely to affect the characteristics of the enterprise risk. Because enterprise-specific risk is not always visible to the naked eye, it can be potential, it may be accompanied by a high performance at the same time, it may also be in the enterprise when technological innovation is derived [1]. Therefore, the enterprise characteristic risk has a pivotal influence on the enterprise, each enterprise has to think about the characteristic risk question which faces itself, and what kind of way can let own characteristic risk reduce, this is something every business needs to think about carefully.

Innovation is the driving force for the development of enterprises, every enterprise needs constant innovation, or it will be eliminated by the market. Technological innovation is one of the main innovation ways of manufacturing enterprises, which can promote the quality and efficiency of enterprises and is the key to enhancing their competitiveness [2]. AI (Artificial Intelligence) innovation is the use of machines or software that mimic human behavior and Intelligence to improve programs, products, or processes to implement enterprise ideas, these include image processing, natural language processing, neural networks and machine learning [3]. As one of the most advanced technological

innovations in the digital economy, AI innovation plays an important role in enterprises. The country's manufacturing enterprises have gradually carried out AI innovation and achieved remarkable results. When manufacturing enterprises upgrade their industries, such as adopting AI innovation, improving product production efficiency, catering to customer preferences, and bringing core competitive advantages to enterprises, can reduce the risks of enterprises to a great extent. For example, Haier group's intelligent manufacturing, using digital technology, the factory to achieve digital product simulation research and development, supply chain data sharing, intelligent scheduling of production processes, high-precision, zero-defect end-to-end intelligent manufacturing meets the increasing demand of users for high-end products and services. Intelligent technologies such as robot intelligent makeup spraying, intelligent automation shell line, micro-channel intelligent gluing, inner tank intelligent laser welding, visual identification detection, intelligent packaging, especially in the epidemic era, greatly reduce the loss caused by the insufficient number of personnel, effectively reduce the risk Haier faced. However, different scholars hold different attitudes on the relationship between AI Innovation and enterprise risk, and think that AI innovation will reduce and increase risks. On the one hand, based on the resource-based view, AI innovation can be used as a differentiation strategy to help enterprises improve work efficiency and customer loyalty. In this way, AI innovations enhance the relationship between a company and its stakeholders, reducing stock volatility caused by company-specific events, and thus reducing corporate risk [4-6]. On the other hand, when AI is highly innovative, its cost is also high, the process is highly uncertain, and even requires more resources, which may result in higher enterprise risk.

2. Theoretical Foundations and Research Hypotheses

2.1. AI Innovation and Idiosyncratic Risk

In the era of digital economy, the continuous change of market demand promotes the enterprises to seek change. In order to obtain core competitiveness and seize the market opportunity, enterprises often choose to adjust their strategies, such as adopting AI innovation, new products, markets. On this basis, if the supply side can meet customer demand, the business income of the enterprise increases, the corresponding capital turnover speed also increases, to a large extent, which can improve the sales revenue of new products. Enterprises through AI innovation can bring great benefits for themselves. On the strategic level, based on the resource-based view, AI innovation can be used as a differentiation strategy to help enterprises improve work efficiency and customer loyalty. Enterprises carry out AI innovation, produce new products generated by AI innovation, and constantly inject capital into it to obtain greater profits, at the same time, it can also make up for the

excess capacity of ordinary products loss of income, achieve long-term, sustainable business development [7]. Moreover, when the new product gains sustained and stable income, the enterprise's investment in AI innovation can also be offset, reducing the possibility of capital disruption, while also enhancing customer loyalty, by making the company more relevant to its stakeholders, it reduces the likelihood of idiosyncratic risk arising from cash flows [8]. On the other hand, enterprise AI innovation is often accompanied by new business, new business models and new markets, which together constitute the overall strength of enterprise AI Innovation, on the contrary, it will also urge enterprises to increase the intensity of AI innovation. In a word, AI innovation can continuously affect the income of the enterprise, improve the competitive advantage of the enterprise in the market, and effectively prevent the income fluctuation caused by the system risk, investors will be more cautious, reducing the Information asymmetry of idiosyncratic risk [9-10]. Therefore, to a great extent, AI innovation makes the enterprise avoid risk, ease the problem of cash flow, makes the enterprise have a stable return on investment, thus greatly reducing the risk of enterprise characteristics. For those enterprises with limited conditions or not choosing AI innovation in strategy, generally speaking, they are not able to deal with the impact of risks in the turbulent market environment, which will inevitably lead to the cost of enterprises difficult to pass on, can not improve the production efficiency of enterprises, a capital chain is prone to break and so on, thus causing the enterprise's idiosyncratic risk. To sum up, AI innovation can effectively reduce trait risk. Based on this, this paper proposes the following hypothesis:

H1: there is a negative correlation between AI innovation and firm idiosyncratic risk.

2.2. The Regulatory Role of Precipitated Redundant Resources

Precipitating redundancy belongs to the redundant resources invested in the production and operation of enterprises. Compared with non-precipitating redundancy, it is difficult to be flexibly applied to other places, because the precipitate redundancy is mainly some finished and semi-finished products and machinery and equipment and other resources, and therefore some difficulties to call. And the process of innovation is not achieved overnight, the need to use resources and continuous resource allocation. Precipitate redundancy means the excess resources in the process of production and operation, which can be reconfigured at some special time, even if the enterprise is in the external resource environment is tight and the market environment is depressed, the precipitated redundancy can break away from the resource shackles, it provides a buffer against harsh environments, which gives companies time to adjust to changes in the environment, which helps them innovate and support AI innovation [11]. To be specific: (1) precipitate redundancy is slowly accumulated in the enterprise during the development process, for example,

some employees with advanced equipment operation experience can quickly put into new innovation projects, adapt to some specific scenarios of AI innovation, provide support for enterprise AI innovation [12]; (2) the precipitated redundant resources represent the social relations of the enterprise with many external relations, such as having purchased equipment, redundant personnel reserve, customer reserve and political connections, etc., all of these can help enterprises respond to the turbulent external environment in a timely manner, understand the risks of innovation more comprehensively, understand the needs of customers more carefully, and make resources fully play their role, in order to make employees and managers more willing and more confident to carry out AI innovation; (3) for the existence of precipitating redundant resources of the enterprise, with relevant business, management and other experience, employees can seize the opportunity at a critical moment, promoting enterprises to carry out innovative activities. For example, the famous 3M post-it note product is a new use of resources that employees stumbled upon. It was born out of the company's precipitated redundant resources used as residual reagents for other projects, until today, still the star product of 3M. (4) in general, the departments with more precipitate redundancy are also the departments with stronger overall strength, which will have more decision-making power to carry out innovation activities and make enterprises more willing to adopt the strategy of AI Innovation [5]; (5) the precipitated redundant resources have been deeply integrated into the enterprise, usually some fixed assets, although the use of these resources is not flexible and convenient, but still can provide some logistical support for AI innovation, disperses some because of the cost to bring the shock, reduces the enterprise characteristic risk effectively. At the same time, the precipitated redundant resources can also provide some buffers to reduce the idiosyncratic risk effectively when the enterprise faces the turbulent external environment. Therefore, the precipitated redundant resources can make the enterprise carry on AI innovation to reduce its own idiosyncratic risk, and the existence of the precipitated redundant resources is also a way to reduce the enterprise's idiosyncratic risk. Based on this, this paper proposes the following hypothesis:

H2: precipitating redundancy positively moderates the relationship between AI innovation and trait risk.

2.3. Regulation of Non-Precipitating Redundancy

Non-precipitating redundancy is a resource that is flexible and easily deployed, such as cash resources. Because non-precipitating redundancy is easy to identify and more convenient to use, it can be used by enterprises in response to emergencies. First, the existence of non-precipitated redundant resources, when the enterprise is faced with a lot of uncertainty in innovation, because it can use resources to disperse part of the risk flexibly, can provide some confidence for the enterprise, prefer to innovate in AI. The redundant resources can be linked with the enterprise risk level, in the face of rapid changes in the market environment,

the existence of non-precipitating redundant resources can make enterprises respond in time, can reduce the risk of enterprise characteristics. Organizational redundancy is a reserve resource for enterprises to cope with market environment turbulence. When Enterprises encounter significant changes in the market environment, sufficient non-precipitating redundancy resources can mitigate the impact of environmental changes on AI innovation, so as to reduce the enterprise's idiosyncratic risk.

Second, AI innovation can not be achieved without the support of resources. Under normal circumstances, the first thing to be satisfied is the daily operational needs of the enterprise, and then consider whether to take the strategy of AI Innovation, that is, AI innovation is limited by greater resources, and it's hard to get outside financing in the early stages of AI innovation. Enterprises with non-precipitated redundant resources can better deal with the resource and capital constraints in the process of AI innovation, providing a strong support for their AI innovation [13]. When the manufacturing industry carries out the artificial intelligence innovation, the non-sediment redundant resources can become a kind of spare resource, which can be used to support the innovation.

Therefore, This paper propose the hypothesis of "The mechanism of non-precipitating redundant resources on employee innovation and performance risk". In Manufacturing Enterprises, non-precipitating redundant resources can provide necessary financial support for enterprises to carry out AI innovation. In order to realize AI innovation, it is necessary to reallocate the necessary resources, it would also give the managers concerned more autonomy to conduct innovative activities such as product research and development, technology upgrading and market expansion, thereby reducing the risk of the firm's idiosyncrasies [14]. At the same time, the existence of non-precipitated redundant resources can also ease the impact of external market changes on enterprises, natural and effective risk avoidance, that is, can reduce the risk of enterprise characteristics. In conclusion, the following hypotheses are proposed:

H3: non-precipitating redundant resources have a positive moderating effect on the relationship between AI innovation and trait risk.

3. Research Design

3.1. Data Sources

This paper uses the Listed Manufacturing Enterprises from 2015 to 2019 as the research sample, because the manufacturing enterprises in the relevant technology, knowledge requirements are relatively high, demand is also relatively large, technological innovation and upgrading is the dominant strategy of this kind of enterprises. In addition, the research related to this topic rarely involves the field of manufacturing. First, This paper selected a typical sample and did the following work: (1) eliminate St Company data;

(2) eliminate incomplete and outliers, get 559 manufacturing industry annual observations, 2,479 in total. In addition, this research uses AI patent data from the National Intellectual Property Public Service Network (CNIPA) Patentt Searcharch and analysis system, the data of current ratio, quick ratio, management cost, sales cost and revenue come from Guotaian database, and the index of Carhart four-factor model comes from Shenwan Index. Finally, the data were processed by Excel and imported into STATA.14 for empirical analysis.

3.2. Variable Measurements

Table 1 summarizes the way variables are measured.

Table 1. *The way variables are calculated.*

Variable name	Method of calculation
AI innovation	Number of AI patents [15]
Idiosyncratic risk	Standard deviation of Carhart four-factor model residuals
Precipitating redundancy	(overhead + sales)/revenue
Non-precipitating redundancy	Current ratio
Market Book Ratio	Stock market value/total assets
Company size	The logarithm of total assets
Company age	The logarithm of the number of days after a stock is listed
Cash	Net cash flow per share of operations
Industry growth	To return sales to the business, divide the regression coefficient by the average of the industry's sales for the year

3.3. Descriptive Statistics

The sample data of this study is 2015-2019 data of listed companies in manufacturing industry, the sample size is 559, statistical values of various indicators. The results of the descriptive analysis can be seen in table 2.

Table 2. *Descriptive statistics.*

Variable	Samples	Mean	Standard deviation	Median	Min	Max
AI innovation	2478	2.730	6.535	1	0	70
Idiosyncratic risk	2478	0.083	0.072	0.081	0.001	0.377
Non-precipitating redundancy	2478	1.793	0.978	1.518	0.169	14.430
Precipitating redundancy	2478	0.165	0.380	0.134	0.009	18.350
Market Book Ratio	2478	0.622	0.240	0.613	0.043	1.341
Company size	2478	22.590	1.150	22.491	17.880	26.470
Company age	2478	8.537	0.438	8.417	7.554	9.343
Cash	2478	0.453	0.807	0.306	-5.020	7.696
Industry growth	2478	0.062	1.769	0.063	-27.200	18.300

(* $p < 0.1$, * * $p < 0.05$, * * * $p < 0.01$)

3.4. Regression Analysis

In order to test the effect of AI innovation on firm Trait Risk, the regression analysis was carried out for Model 1, and the results shown in table 3 Model 1 and Model 2 were obtained. The regression coefficient of AI innovation was -0.51, at the level of 5%, there is a significant negative correlation between AI innovation and firm trait risk. Hypothesis 1 is verified. The reason may be that AI innovation, as a differentiation strategy of enterprises, enterprises carry out AI innovation, produce new products generated by AI innovation, and continuously inject funds into them to obtain greater profits, at the same time, it can also make up for the excess capacity of ordinary products, and achieve long-term, sustainable business development. Moreover, when the new product gains sustained and stable income, the enterprise's investment in AI innovation can also be offset, reducing the possibility of capital disruption, while also enhancing customer loyalty, by making the company more relevant to its stakeholders, it reduces the likelihood of idiosyncratic risk arising from cash flows.

Table 3. *Results of regression analysis.*

	Model 1 Idiosyncratic risk	Model 2 Idiosyncratic risk
AI innovation		-0.051**
Market Book Ratio	-0.226***	-0.230***
Company size	0.090***	-0.110***
Company age	-0. 179***	0.183***
Cash	-0.003	-0.004
Industry growth	-0.078***	-0.076***
R^2	0.085	0.087
Adjust R^2	0.083	0.085
F value	45.780***	39.250***

(* $p < 0.1$, * * $p < 0.05$, * * * $p < 0.01$)

3.5. Regulation Analysis

On the basis of the above, Model 3, Model 4, Model 5, and Model 6 of Table 4 make adjustment analysis to the two classification of redundant resources step by step. In Model 6, the interaction terms of AI innovation and non-precipitating redundancy and AI innovation and precipitating redundancy are added. From Model 6, the regression coefficient of

interaction term between AI innovation and non-precipitating redundancy was -0.085, which was significant at 1% level, and the R2 value was 0.100, which was 0.007 higher than that of Model 5, therefore, non-precipitating redundancy has a significant positive moderating effect on the relationship between AI innovation and Trait Risk, and is significant at 1% level. Hypothesis 2 is validated.

In Model 6, the interaction between AI innovation and precipitating redundancy was also added. From Model 6, the regression coefficient of interaction between AI innovation and precipitating redundancy was -0.242, which was significant at 1% level, the R^2 value of Model 5 was 0.100, which was 0.007 higher than that of Model 5, indicating that precipitating redundancy has a significant positive moderating effect on AI innovation and trait risk. Thus, hypothesis 3 is validated.

Table 4. Results of moderating effect analysis.

	Model 3	Model 4	Model 5	Model 6
	Idiosyncratic risk	Idiosyncratic risk	Idiosyncratic risk	Idiosyncratic risk
AI innovation		-0.051**	-0.044**	-0.070***
Market Book Ratio	-0.226***	-0.230***	-0.244***	-0.254***
Company size	0.090***	-0.110***	-0.083***	-0.077***
Company age	-0. 179***	0.183***	0.185***	0.190***
Cash	-0.003	-0.004	-0.005	-0.006
Industry growth	-0.078***	-0.076***	-0.073***	-0.073***
Non-precipitating redundancy			-0.077**	-0.095***
Precipitating redundancy			-0.041***	-0.137***
AI innovation*Non-precipitating redundancy				-0.085***
AI innovation*precipitating redundancy				-0.242***
R^2	0.085	0.087	0.093	0.100
Adjust R^2	0.083	0.085	0.091	0.096
F value	45.780***	39.250***	31.810***	27.330***

4. Conclusion

This paper analyzes the mechanism of AI innovation on corporate idiosyncratic risk, and examines the moderating effect of two types of organizational redundancy. First, AI innovation can reduce the risk of enterprise idiosyncrasies. For manufacturing enterprises, AI innovation can realize product digital simulation research and development, supply chain data sharing, intelligent scheduling of production process, high-precision and zero-defect end-to-end intelligent manufacturing by using digital technology, to meet the growing demand for high-end products and services. Secondly, precipitating redundancy has a positive moderating effect on the relationship between AI innovation and firm trait risk. The precipitated redundant resources represent the company has a lot of social relations with the outside world, which helps the company to react more quickly when facing the turbulent external environment, better understanding of the risks involved in the innovation process and the diverse needs of customers, improving the efficiency of resource use, and making employees and managers more willing and confident to conduct AI innovation. Finally, non-precipitating redundancy has a positive moderating effect on the relationship between AI innovation and firm trait risk. Non-precipitating redundant resources can reduce the impact of uncertain factors on enterprises, enhance their confidence in strategic transformation such as AI Innovation, gain their core competitive advantage, and thus reduce their idiosyncratic risks. Therefore, enterprises should actively innovate, especially in the era of digital economy, actively carry out artificial intelligence innovation, rather than just rely on the development of external technology and then introduce, positive innovation to obtain competitive advantage in order to long-term development. In addition, enterprises should also pay attention to special risk prevention and risk management. Companies can use the digital revolution to improve risk management.

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