

Managerial Competence Energizes Total Factor Productivity of Enterprises

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Abstract

In the environment of enterprise total factor productivity declining year by year, it is particularly important to find the factors that stimulate production efficiency. Enterprise managers are the important makers of production strategy, but how their own ability affects enterprise total factor productivity has not been clearly defined. In this paper, A sample of Shanghai and Shenzhen A-share listed companies from 2007 to 2022 is selected to test the impact of managers' ability on the total factor productivity of enterprises, explore the moderating effect of digital transformation degree index and supply chain efficiency, and divide enterprises into high-tech and high-pollution groups for in-depth analysis. The results show that manager competence has a significant promoting effect on the total factor productivity of enterprises. Both digital transformation and supply chain efficiency will strengthen the promoting effect of manager competence on the total factor productivity of enterprises. In high-tech and high-polluting enterprises, the promoting effect of manager competence is stronger. This paper expands the research on manager competence, explores one of the driving forces of firm TFP, and provides inspiration for enterprises to make strategic choices.

Keywords

Managerial Competence; Total Factor Productivity; Dea-Tobit Two-Stage Model; Digital Transformation.

1. Introduction

In today's global economic environment, the total factor productivity (TFP) of enterprises is declining year by year, which poses a major challenge to the competitiveness and sustainable development of enterprises. As a key indicator to measure the efficiency of resource allocation and production efficiency of enterprises, TFP reflects the comprehensive performance of technological progress, management level and resource utilization efficiency. In this context, it becomes particularly important to identify and optimize the factors that affect production efficiency.

Enterprise managers are the core figures of enterprise strategy and operation, and their decision-making and management ability directly affect the production efficiency and market competitiveness of enterprises. With the progress of science and technology and the constant changes of the market environment, managers need to have higher decision-making ability and adaptability to cope with the complex and changeable market environment. However, the current research on how managers' ability affects the total factor productivity of enterprises is still insufficient, and its specific mechanism needs to be further explored.

Digital transformation and supply chain efficiency are two key factors in business operations. With the advent of the Industry 4.0 era, digital technology is being applied more and more widely, which not only changes the way enterprises operate, but also improves their

information processing capabilities and decision-making efficiency. Digital transformation enables enterprises to integrate resources more efficiently and improve productivity. In addition, efficient supply chain management can ensure the efficient flow and utilization of resources, reduce inventory costs, and improve enterprise response speed and customer satisfaction.

This paper adopts the DEA-Tobit two-stage model to conduct an empirical analysis on the samples of Shanghai and Shenzhen A-share listed companies from 2007 to 2022, to test the impact of managers' ability on the total factor productivity of enterprises, explore the moderating effect of digital transformation degree index and supply chain efficiency, and divide enterprises into high-tech and high-pollution groups for in-depth analysis.

The innovations of this paper are as follows: First, based on the perspective of managers' ability, it expands the antecedent analysis of enterprise TFP, deepens the research on the impact of senior management team on enterprise production efficiency, and provides empirical evidence for enterprise strategy formulation. Second, it reveals the influence of different internal and external differences on the promotion effect of managers' competence, takes digital transformation and supply chain efficiency into consideration, and analyzes the contingent factors of managers' competence effect. Thirdly, the paper discusses the strength of the role of manager competence in different types of enterprises to deepen the connotation of strategy formulation.

2. Theory and Hypothesis

2.1. Managerial Competence and Total Factor Productivity

This paper holds that when managers' management ability is deeply integrated with the production process, managers' ability will affect the enterprise innovation strategy and the resource integration process of production and operation, and finally improve the enterprise total factor productivity.

From the perspective of strategy formulation, the strength of managers' ability determines whether managers can quickly identify the external uncertain environment, seize effective opportunities, and timely formulate innovation strategies in line with the economic environment, so as to introduce new products with higher profits and improve the total factor productivity of enterprises. The innovation management ability of managers has a significant impact on the business performance of science and technology enterprises. High-level managers can promote technological innovation and research and development activities, improve the technical level and innovation ability of enterprises, and thus improve the total factor productivity (Sun Huilin, 2016). Management ability has a significant impact on the dual innovation strategy of start-ups. Managers can promote the development of enterprises in technology and innovation and improve the total factor productivity by balancing exploration of new opportunities and utilization of existing resources (Fang Xin and Dong Jing, 2022).

From the perspective of resource integration, managers can effectively integrate various resources within the enterprise, including human, financial and technical resources, to ensure the efficient flow and utilization of resources among different departments, thus improving production efficiency. A high level of management ability can effectively reduce the cost-plus rate of an enterprise by strengthening internal control. The optimization of internal control helps to improve the operational efficiency and resource utilization efficiency of enterprises, thus improving the total factor productivity (Hua Junguo et al., 2022). The ability of managers plays a key role in the investment decision of enterprises. High-level managers can allocate resources more effectively, avoid excessive investment, improve the resource utilization efficiency of enterprises, and thus improve the total factor productivity (Pan Qianjin and Li Xiaonan, 2016). Managers optimize supply chain management, ensure efficient flow and

utilization of material resources, reduce inventory costs and production cycles, and improve production efficiency (Li Bingcheng and Zheng Shanshan, 2019). Modern managers pay attention to the management and utilization of information resources. By establishing data management systems and information platforms, enterprises can improve their insight and response speed to the market and internal operations, and improve resource utilization efficiency (Duan Wenqi and Xuan Xiao, 2018).

Based on this, this paper proposes the following research hypotheses:

H1: Manager competence has a significant positive impact on total factor productivity of enterprises.

2.2. The Regulatory Mechanism of Digital Transformation

After entering the era of Industry 4.0, the Internet has become a bridge connecting enterprises, customers and suppliers, and portable digital devices make information exchange more extensive and convenient. At the same time, the internal management of enterprises has also undergone major changes, and the links between departments have become increasingly close, which has greatly improved the production efficiency of enterprises. Therefore, enterprise digital transformation is an important way for enterprise managers to further exert their talents, as a regulatory effect to promote the increase of enterprise total factor productivity.

The reasons for digital transformation as a moderating variable are as follows. First, digital transformation can enhance an enterprise's information acquisition and processing capabilities, enabling managers to obtain market and operational data faster and more accurately, thus optimizing the decision-making process. Chen et al. (2020) pointed out that digital technology can improve an enterprise's information processing ability, reduce information asymmetry, improve the efficiency of management decision making, and thus enhance the total factor productivity of an enterprise. Secondly, digital transformation promotes enterprises' investment in technology research and development and innovation, enabling managers to make better use of new technologies and improve productivity. Demerjian et al. (2012) found that there is a positive correlation between managers' competence and technological innovation, and digital transformation can further enhance this relationship. Secondly, digital transformation enables enterprises to integrate and utilize internal resources more efficiently, and improve the accuracy and efficiency of resource allocation. Cui et al. (2019) shows that through digital tools, managers can better integrate resources, thereby improving the total factor productivity of enterprises. Finally, digital transformation improves the flexibility and responsiveness of enterprises, enabling managers to quickly respond to market changes and demand fluctuations. Chen et al. (2017) research shows that digital technology can enhance enterprises' adaptability and enable managers to manage enterprise resources and strategies more effectively in a dynamic environment.

Based on this, hypothesis 2 is proposed in this paper.

H2: Enterprise digital transformation has a moderating effect on the relationship between managers' competence and enterprise total factor productivity, and has a positive moderating effect.

2.3. The Regulating Mechanism of Supply Chain Efficiency

As a bridge connecting upstream and downstream enterprises, supply chain not only plays an important role in enterprise management, but also plays a non-negligible role in enterprise production. Whether the supply chain of an enterprise is efficient directly affects the external environment in which managers manage the enterprise. Once the external environment loses its effectiveness, it is difficult for the internal production of the enterprise to maintain its effectiveness, resulting in a variety of adverse situations such as overcapacity. Therefore,

supply chain efficiency can be used as a regulatory effect, affecting the ability of enterprise managers and total factor productivity. The reasons are as follows:

First, from the perspective of resource integration and optimal allocation, efficient supply chain management can ensure the efficient flow and utilization of resources between different departments and links, avoid resource waste, and improve the overall utilization efficiency of resources. Christopher (2016) pointed out that supply chain management can significantly improve the operational efficiency and productivity of enterprises by optimizing resource allocation. Second, from the perspective of reducing inventory costs and improving production efficiency, an efficient supply chain can reduce inventory costs, reduce capital occupation and improve production efficiency. Chopra and Meindl (2016) mentioned that the improvement of supply chain efficiency can reduce inventory levels and related costs, thus improving the overall production efficiency and productivity of enterprises. Thirdly, from the perspective of rapid response to market changes, enterprises with high supply chain efficiency can respond to market demands and changes more quickly, and managers can adjust production plans and resource allocation in a more timely manner. Lambert and Cooper (2000) emphasize that the improvement of supply chain efficiency can make enterprises more flexible in responding to market changes and improve market competitiveness and productivity. Fourthly, from the perspective of enhancing customer satisfaction, efficient supply chain management can ensure that products and services are delivered to customers more quickly and efficiently, enhance customer satisfaction and loyalty, and thus promote the long-term development and productivity of enterprises. Mentzer et al. (2001) pointed out that there is a significant positive correlation between efficient supply chain management and customer satisfaction, and the improvement of customer satisfaction can drive the improvement of enterprise productivity.

Based on this, hypothesis 3 is proposed in this paper.

H3: Supply chain efficiency positively moderates the impact of managers' competence on firm total factor productivity.

3. Research Design

3.1. Data Description

In this paper, Shanghai and Shenzhen A-share listed companies from 2007 to 2022 are taken as research samples, and all samples of ST, *ST, period delisting and financial industry enterprises are excluded. In order to control the statistical error caused by outliers, all continuous variables are treated with bilateral indent at 1% level, and observations with blank values are deleted. The sample data were obtained from the CSMAR database and the Wind database.

3.2. Variable Definition

Explained variable: Enterprise total factor productivity (TFP) is measured based on the production function of Cochrane and Griliches. Since traditional OLS estimation method is difficult to overcome the endogenous problem caused by two-way causality, this paper adopts semi-parametric estimation OP method to measure it. Drawing on the practice of Lu Xiaodong and Lian Yujun (2012), the natural logarithm of main business income is used to measure output level, the natural logarithm of the number of employees is used to measure labor input, the natural logarithm of fixed assets is used to measure capital input, and the natural logarithm of the total cash paid for the purchase and construction of fixed assets, intangible assets and other long-term assets is used to measure enterprise investment. To measure the total factor productivity (TFP_OP) of enterprises.

The OP method is based on the firm's current investment as the proxy variable of unobserved productivity impact, and in reality, the firm will also adjust the input-output based on the production efficiency of the previous period. Therefore, this paper adopts the GMM method and

takes the lag of the explained variable as the instrumental variable to eliminate the changes related to the input mix of production factors in the current period. Measure the total factor productivity (TFP_GMM) of enterprises and use it as a robustness test. OP method will make the samples with zero investment cannot be estimated, but in fact, not every enterprise has positive investment every year, so many enterprise samples are discarded in the estimation process. Therefore, LP method is adopted in this paper. The sum of operating costs, selling expenses, administrative expenses and financial expenses is deducted by depreciation and amortization, and cash paid to and for employees is deducted. Take the natural logarithm of the sum as the proxy variable of the intermediate input for measurement, and get the total factor productivity (TFP_LP) of the enterprise, which is also used as a robustness test.

Explanatory variables: Referring to the method proposed by Fang Xin and Dong Jing (2022), the DEA-Tobit two-stage model proposed by Demerjian et al. (2012) is adopted to measure managers' ability. The DEA method makes the samples free from industry restrictions, and the data is derived from the financial statements of enterprises, so that the total efficiency of enterprises can be estimated. Then the Tobit model is used to decompose the total efficiency of the enterprise into enterprise efficiency and manager ability, and the manager ability (MA) close to the true value is calculated.

First of all, data envelopment analysis (DEA) is used to measure the production efficiency of enterprises in the industry. Operating income (*Sales*) is the numerator, and the denominator includes the sum of net fixed assets (*PPENT*), net research and development (*Net R&D*), goodwill (*Goodwill*), intangible assets (*INTAN*), operating costs (*COGS*), selling expenses and administrative expenses (*SGA*).

$$\begin{aligned} & \max \theta \\ & = \frac{Sales}{V1PPENT + V2Net\ R\&D + V3Goodwill + V4INTAN + V5COGS + V6SGA} \end{aligned} \quad (1)$$

Secondly, Tobit model is used to calculate the estimated value of the manager's ability. Based on the above model, in order to exclude the potential effect of enterprise characteristics on production efficiency, five factors are selected: enterprise size (*Size*), market share (*Market Share*), free cash flow (*Free Cash Flow*), listing years (*Age*), and whether there are overseas subsidiaries (*Foreign currency*). In Model 2 ε is the residual, which is the estimated value of the manager's ability.

$$\begin{aligned} Efficiency = & \beta_0 + \beta_1 Size + \beta_2 Market\ Share + \beta_3 Free\ Cash\ Flow + \beta_4 Age \\ & + \beta_5 Foreign\ currency + \varepsilon \end{aligned} \quad (2)$$

Regulating variables: Based on the practice of Wu Fei et al. (2021), the digital transformation index (DCG) is constructed by analyzing the word frequency of the feature words disclosed in the annual reports of enterprises. The supply chain efficiency (EFF) draws on the method of Zhang Shushan et al. (2023) to further reflect the supply chain efficiency based on the inventory of enterprises, and its calculation method is $\ln(365/\text{inventory turnover})$.

Control variables: In order to improve the accuracy of estimation, this paper focuses on the control of enterprise financial indicators and management indicators. The specific variables are shown in **Table 1**.

Table 1. Variable definitions

Variable names	Variable symbol	Variable definition
Total factor productivity of the firm	TFP_OP	The OP method measures total factor productivity of enterprises
Managerial ability	MA	DEA-Tobit two-stage model calculation
Digital Transformation Index	DCG	Word frequency statistics of digital transformation in corporate annual reports
Supply chain efficiency	EFF	$\ln(365/\text{inventory turnover})$
Business size	Size	Natural logarithm of main business income at the end of the year
Age of enterprise	FirmAge	$\ln(\text{year of this year} - \text{year the company was founded} + 1)$
Net profit margin on total assets of the business	ROA	Net profit/annual average balance of total assets
Tobin Q value	TobinQ	$(\text{Market value of outstanding shares} + \text{number of non-tradable shares} \times \text{net assets per share} + \text{book value of liabilities}) / \text{total assets}$
Cash flow ratio	Cashflow	Net cash flow from operating activities/total assets
Board size	Board	Take the natural logarithm of the number of boards
Whether the two positions are combined	Dual	If the chairman and the general manager are the same person, it is 1, otherwise it is 0
Average age of management	TMTAge	Average age of directors and supervisors
Top three management salaries	TMTPay1	The natural logarithm of total compensation for the top three executives
Management ownership	Mshare	Shares number of Directors, supervisors and executives/total share capital
Proportion of shares held by institutional investors	INST	Total institutional investor holdings/total share capital
Shareholding ratio of the largest shareholder	TOP1	Number of shares held by the largest shareholder/total number of shares

3.3. Model assumption

$$TFP_OP_{i,t} = \alpha_0 + \alpha_1 MA_{i,t} + \alpha_2 \sum Control_{i,t} + \sum Company + \sum Year + \sum Industry + \varepsilon_{i,t} \quad (3)$$

Among them, the explained variable is the total factor productivity ($TFP_OP_{i,t}$) measured by the OP method, the explanatory variable is the manager's ability ($MA_{i,t}$), $Control_{i,t}$ is a series of control variables, and $\varepsilon_{i,t}$ is a random disturbance term. Meanwhile, the paper also controls the fixed effects of the firm, year and industry.

4. Analysis of Empirical Results

4.1. Descriptive Statistics

The descriptive statistics of this paper are shown in **Table 2**. The mean and standard deviation of total factor productivity of enterprises are 6.68 and 0.81 respectively, and the values are between 4.81 and 9.12, indicating that there is a large difference between the total factor productivity of different listed companies. The mean and standard deviation of managers' abilities are 0.69 and 0.07 respectively, and the values are between 0.57 and 1.06, indicating that there are differences in managers' abilities among different enterprises. The mean values

of the two moderating variables are 1.31 and 4.5, the standard deviations are 1.39 and 1.29, and the values range between 0 and 6.3, and -7.42 and 11.83, showing significant heterogeneity among different firms.

Table 2. Descriptive statistics

Variable	N	Mean	SD	Min	Max
TFP_OP	25342	6.680	0.810	4.810	9.120
MA	25342	0.690	0.0700	0.570	1.060
DCG	25342	1.310	1.390	0	6.300
EFF	25207	4.500	1.290	-7.420	11.83
Size	25342	22.25	1.150	19.81	26.27
FirmAge	25342	2.920	0.310	1.950	3.530
ROA	25342	0.0400	0.0600	-0.240	0.220
TobinQ	25342	1.980	1.110	0.840	8.740
Cashflow	25342	0.0500	0.0600	-0.160	0.250
Board	25342	2.150	0.170	1.790	2.710
Dual	25342	0.250	0.430	0	1
TMTAge	25342	49.34	2.930	41.53	56.71
TMTPay1	25342	14.52	0.690	12.58	16.56
Mshare	25342	10.42	16.59	0	65.26
INST	25342	45.45	23.20	0.410	95.98
TOP1	25342	33.03	13.82	8.380	73.97

4.2. Baseline Regression

The baseline regression results are shown in Table 3. In model (1), the fixed effect of the firm is controlled. At this time, the linear estimation coefficient of the explained variable and the explanatory variable is 1.484, and the significance level is 1%. This data indicates that the manager ability has a significant positive impact on the total factor productivity of the firm. When the control variables are added to model (2), the estimated coefficient becomes 1.142, and the significance level is still 1%. Models (3) and (4) control the fixed effects of year and industry, and the estimated coefficients become 6.648 and 2.528, the significance level remains unchanged, the model estimates are more perfect, and hypothesis H1 is proved. Among the control variables, firm size, firm age, net profit rate on total assets, Tobin's Q, cash flow ratio, board size, remuneration of the top three managers, shareholding ratio of institutional investors and shareholding ratio of the largest shareholder are positively correlated with the total factor productivity of the firm, while whether the two jobs are integrated, average age of management and shareholding ratio of management are negatively correlated with the total factor productivity of the firm. It indicates that financial health and executive compensation incentive mechanism play an important role in improving enterprise productivity, higher average age of management may have a negative impact on enterprise productivity, and decentralization of management power may improve enterprise TFP.

Table 3. Baseline regression test

TFP_OP	(1)	(2)	(3)	(4)
MA	1.484***	1.142***	6.648***	2.528***
	(0.060)	(0.048)	(0.101)	(0.126)
Size		0.341***		0.293***
		(0.006)		(0.007)
FirmAge		0.383***		0.409***
		(0.018)		(0.043)
ROA		1.846***		1.769***
		(0.049)		(0.048)
TobinQ		0.003		0.013***
		(0.003)		(0.003)
Cashflow		0.407***		0.415***
		(0.040)		(0.040)
Board		0.007		0.004
		(0.022)		(0.022)
Dual		-0.001		-0.001
		(0.007)		(0.007)
TMTAge		-0.004***		-0.004***
		(0.001)		(0.001)
TMTPay1		0.078***		0.073***
		(0.006)		(0.006)
Mshare		-0.000		-0.000
		(0.000)		(0.000)
INST		0.000**		0.000**
		(0.000)		(0.000)
TOP1		0.001*		0.001
		(0.000)		(0.000)
_cons	5.658***	-3.912***	0.678***	-4.111***
	(0.042)	(0.119)	(0.111)	(0.178)
N	24908	24908	24908	24908
R ²	0.774	0.881	0.864	0.887
Adjusted R ²	0.741	0.863	0.844	0.870
Firm	Yes	Yes	Yes	Yes
Year	NO	NO	Yes	Yes
Industry	NO	NO	Yes	Yes

Note:* Means $p < 0.1$, ** means $p < 0.05$, *** means $p < 0.01$

4.3. Robustness Test

The results of robustness test are shown in **Table 4**. By changing the measurement method of the firm's total factor productivity, LP and GMM are used to measure the total factor productivity respectively. After replacing the explained variable with the robustness test, H1 is still assumed to be valid, which proves that the positive effect of manager ability on the firm's total factor productivity is robust. However, after 2019, when the global epidemic broke out, a large number of enterprises could not maintain production, leading to the possible unreliable nature of the data. Therefore, after removing the observed values after 2019, it was found that hypothesis H1 was still valid after regression. Due to the lag in the decision-making of enterprise managers, this year's decision may not be implemented until next year. Therefore, this paper deals with the enterprise total factor productivity with a lag of one stage. After the

regression again, the result is still positive and significant, which proves the robustness of H1 hypothesis.

Table 4. Regression results of Robustness test

	TFP_LP	TFP_GMM	De-epidemic	One phase lag
MA	2.933***	2.408***	2.448***	1.613***
	(0.126)	(0.131)	(0.142)	(0.181)
Control	Yes	Yes	Yes	Yes
_cons	-6.117***	-3.405***	-3.711***	-3.069***
	(0.178)	(0.185)	(0.219)	(0.288)
N	24808	24840	17376	13177
R ²	0.917	0.868	0.900	0.901
Adjusted R ²	0.904	0.848	0.882	0.881
Firm	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes

4.4. Mechanism Analysis

Table 5. Regression results of regulatory mechanisms

	TFP_OP	TFP_OP	TFP_OP
MA	2.528***	2.553***	2.374***
	(0.126)	(0.126)	(0.122)
DCG		0.015***	
		(0.003)	
MA*DCG		0.067**	
		(0.031)	
EFF			-0.154***
			(0.003)
MA*EFF			0.150***
			(0.029)
Control	Yes	Yes	Yes
_cons	-4.111***	-4.008***	-3.471***
	(0.178)	(0.179)	(0.172)
N	24908	24908	24771
R ²	0.887	0.887	0.897
Adjusted R ²	0.870	0.870	0.881
Firm	Yes	Yes	Yes
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes

The regression results of the regulatory mechanism are shown in **Table 5**. The estimated coefficient of interaction between the digital transformation index and managers' ability is 0.067, which is significant at the 5% level, which proves that the digital transformation index plays a significant positive moderating role in managers' ability and total factor productivity of enterprises, indicating that digital transformation can enhance managers' decision-making and management efficiency. Manager competence has a more obvious role in enhancing TFP, assuming H2 is established. The estimated coefficient of interaction between supply chain efficiency and manager ability is 0.15, which is significant at 1% level, which proves that supply

chain efficiency plays a positive regulating role in explained variables and explanatory variables, and the result is significant, indicating that in enterprises with good supply chain efficiency, manager ability has a more obvious strengthening effect on enterprise total factor productivity. Hypothesis H3 is established.

4.5. Further Analysis

Table 6. regression results of Further analysis

TFP_OP	High Tech	Low Tech	High Pollution	Low Pollution
MA	4.462***	2.051***	5.871***	2.378***
	(0.295)	(0.157)	(0.457)	(0.131)
Control	Yes	Yes	Yes	Yes
_cons	-2.251***	-4.009***	-0.686**	-4.328***
	(0.189)	(0.311)	(0.286)	(0.202)
N	14587	10126	6053	18680
R ²	0.917	0.896	0.923	0.899
Adjusted R ²	0.903	0.880	0.911	0.883
Firm	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes

In order to further explore the impact of managers' ability on the total factor productivity of enterprises under different environments, this paper divides enterprises into two groups: high-tech enterprises and non-high-tech enterprises and high-polluting enterprises and non-high-polluting enterprises, and further regression analysis is conducted. The regression results are shown in **Table 6**. The influence coefficient of managers' competence on TFP in high-tech enterprises is 4.462, and managers' competence also has a significant positive impact on the TFP of low-tech enterprises, but the influence coefficient is 2.051. This indicates that in technology-intensive industries, the performance of manager competence can significantly improve the productivity of enterprises. This may be because high-tech enterprises usually have high R&D investment and high technology content, which requires high innovation and management efficiency, while high-tech enterprises rely on managers' decision-making and innovation ability to promote technological progress and efficiency improvement. Similarly, the influence of managers' ability on high-polluting enterprises is also very significant, with a coefficient of 5.871. Managers' ability has a significant positive impact on the total factor productivity of low-polluting enterprises, the coefficient is 2.378, but the impact degree is lower than that of high-polluting enterprises. It shows that in resource-intensive industries with high environmental burden, managers' ability plays an important role in improving production efficiency. The possible reason is that high-polluting enterprises usually face stricter environmental regulations and greater environmental responsibilities, and need efficient management to optimize production and reduce pollution. In highly polluting industries, effective management by managers and resource optimization are essential to enhance production efficiency and reduce environmental impact.

5. Conclusion and Implications

5.1. Conclusion

This paper focuses on the total factor productivity of enterprises. From the micro perspective of manager ability, this paper studies the sample of Shanghai and Shenzhen A-share listed enterprises from 2007 to 2022, adopts the DEA-Tobit two-stage model and the OP method to measure the manager ability and total factor productivity of enterprises, and explores the

possible relationship between them. At the same time, the adjustment factors such as digital transformation and supply chain efficiency are added for in-depth analysis, and the enterprises are divided into two groups of high-tech and high-pollution for further study, and the conclusion is drawn.

First of all, managers' ability has a significant promoting effect on the total factor productivity of enterprises, indicating that managers' ability plays a decisive and important role in the production process of enterprises. The lack of managers' ability will lead to the downturn of enterprises' total factor productivity. Secondly, from the perspective of internal management mode, digital transformation will strengthen the promotion effect of managers' ability on the total factor productivity of enterprises, indicating that managers' ability is sensitive to digital transformation. With the deepening of enterprises' digital transformation, managers will strengthen the full implementation of digital production mode and promote the improvement of enterprises' TFP. Thirdly, from the perspective of external supply chain, supply chain efficiency can improve the promoting effect of managers' ability on enterprises' TFP, indicating that efficient supply chain management can amplify the positive impact of managers' ability on enterprises' production efficiency. Finally, there are significant differences in the impact of managers' competence on total factor productivity in different types of firms. In high-tech enterprises and high-polluting enterprises, manager competence has the most significant effect on TFP, while in low-tech enterprises and low-polluting enterprises, it also has a positive effect, but the degree is relatively low. This indicates that in the high-intensity competitive environment that requires high-level management and technological innovation, manager competence plays a more critical role in improving the production efficiency of enterprises.

5.2. Implications

According to the research of this paper, the following enlightenments are drawn: First, enterprises should pay attention to improving the ability of managers. Through training and development plans, they should enhance the decision-making, innovation and resource integration ability of managers, which is crucial to improving the overall production efficiency of enterprises. At the same time, it is also necessary to design excellent recruitment system and salary incentive plan to attract excellent managers. Second, both internal and external environments should be taken into account. Internally, enterprises should actively promote digital transformation, utilize advanced information technology and data analysis tools, improve the operational efficiency and decision-making level of enterprises, and amplify the positive impact of managers' ability on productivity. Externally, enterprises should pay attention to the optimization of supply chain management, reduce inventory costs and waste of resources, and enhance the flexibility and response speed of the supply chain. Efficient supply chain management can enhance the positive effect of managers' ability on enterprise productivity. Third, through the study of different types of enterprises, it is concluded that the higher the level of pollution and the higher the demand for innovation, the higher the level of total factor productivity, that is, the higher the competition intensity of the enterprise, the more powerful the role of management ability, and the more it can stimulate the production potential of the enterprise. Therefore, managers should pursue a more intensive strategy formulation mode, and at the same time, give full play to their own capabilities. Excavate the production efficiency of the enterprise.

5.3. Shortcomings and Prospects

In this paper, managers' competence is measured only through the financial reports of enterprises, without in-depth analysis of the specific types of managers' competence, so as to study the effects of different types of competence on the total factor productivity of enterprises. Therefore, future research can adopt the methods of case study and questionnaire survey. At the same time, the research on the path between manager competence and enterprise TFP is

insufficient, and there is a lack of powerful intermediary mechanism and regulatory effect. The black box between the two still needs to be explored. In addition, other boundary conditions affecting the role of managers' ability still need to be explored to get closer to reality.

References

- [1] Lu Xiaodong, Lian Yujun. Estimation of Total Factor Productivity of Industrial Enterprises in China: 1999-2007[J]. *China Economic Quarterly*, 2012, 11(02): 541-558.
- [2] Zhang Shushan, Zhang Peiwen, Gu Chen. Enterprise Digital Transformation and Supply Chain Efficiency [J]. *Statistics & Decision*, 2023, 39(18): 169-173.
- [3] Fang xin, Dong jing. The Impact of Managerial Competence on Ambidextrous Innovation Strategy of Entrepreneurial Firms[J]. *Foreign Economics & Management*, 2022, 44(11): 77-92.
- [4] Hua Junguo, Jiang Zezhen, Lang Yifeng. Managerial Ability, Internal Control and Markups of Enterprises[J]. *On Economic Problems*, 2022, (09): 123-129.
- [5] Wu Fei, Hu Huizhi, Lin Huiyan, Ren Xiaoyi. Enterprise Digital Transformation and Capital Market Performance: Empirical Evidence from Stock Liquidity[J]. *Journal of Management World*, 2021, 37(07): 130-144+10.
- [6] Li Bingcheng, Zheng Shanshan. Can Managerial Ability Improve the Capital Market Efficiency? - Analysis from the Perspective of Stock Price Synchronicity[J]. *Journal of Audit & Economics*, 2019, 34(03): 80-90.
- [7] Duan Wenqi, Xuan Xiao. Is Managerial Ability the Signal to Market Value for Is Managerial Ability the Signal to Market Value for Value-relevance Test Results of Financial Indicators[J]. *Nankai Business Review*, 2018, 21(03): 54-65.
- [8] Sun Huilin. The Impact of Managerial Capabilities on the Operational Performance of Technology Enterprises [J]. *Seeker*, 2016, (11): 121-125.
- [9] Pan Qianjin, Li Xiaonan. Managerial competence, institutional investors, and corporate overinvestment [J]. *Modern Management Science*, 2016, (03): 106-108.
- [10] Chen M, Ruan L, Zhu Z, Sang F. Macro uncertainty, analyst performance, and managerial ability. *Eurasian Business Review*. 2020 Sep;10:333-53.
- [11] Demerjian P, Lev B, McVay S. Quantifying managerial ability: A new measure and validity tests. *Management science*. 2012 Jul;58(7):1229-48.
- [12] Cui H, Leung SC. The long-run performance of acquiring firms in mergers and acquisitions: Does managerial ability matter?. *Journal of Contemporary Accounting & Economics*. 2020 Apr 1;16(1):100185.
- [13] Chen TK, Liao HH, Chen WH. CEO ability heterogeneity, board's recruiting ability and credit risk. *Review of Quantitative Finance and Accounting*. 2017 Nov;49:1005-39.
- [14] Lambert DM, Cooper MC. Issues in supply chain management. *Industrial marketing management*. 2000 Jan 1;29(1):65-83.
- [15] Mentzer JT, DeWitt W, Keebler JS, Min S, Nix NW, Smith CD, Zacharia ZG. Defining supply chain management. *Journal of Business logistics*. 2001 Sep;22(2):1-25.
- [16] Chopra S, Meindl P. *Supply Chain Management: Strategy, Planning, and Operation*. 6th ed. Essex, NE: Pearson Education, 2016. 528 p.
- [17] Christopher, M. (2016). *Logistics & Supply Chain Management*. Pearson UK.