

The Influence of Top Management Team Heterogeneity on Enterprise Total Factor Productivity

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Abstract: *China's requirements for economic development have shifted from high-speed to high-quality development. As a micro-subject, enterprises are an important part of the economy and society. Improving their total factor productivity is of great significance to the high-quality development of the economy. Based on the data of A-share listed companies from 2010 to 2020, a regression analysis model is established to explore the relationship between the heterogeneity of top management team and the total factor productivity of enterprises. It is found that the age heterogeneity and professional background of executives have a significant positive impact on the total factor productivity of enterprises. According to the heterogeneity analysis, for enterprises in the eastern and central regions, the age heterogeneity of the top management team has a significant impact on the total factor productivity of the enterprise, while for enterprises in the central and western regions, the heterogeneity of the top management team's professional background has a positive impact on the total factor productivity of the enterprise. The research conclusions provide important suggestions for companies in different regions to achieve the goal of improving total factor productivity.*

Keywords: *top management team heterogeneity; enterprise total factor productivity; regional heterogeneity*

1. Introduction

As the embodiment of the quality of factors such as technology and talents and the efficiency of resource allocation, total factor productivity is the source of vitality to increase labor productivity and achieve high-quality development goals, and determines the trend of productivity and economic development. As a micro subject, the total factor productivity of enterprises plays an important role in economic development. How to improve the total factor productivity of enterprises, improve the efficiency of resource allocation, and promote the growth of enterprises has important theoretical and practical significance for the high-quality development of China's economy.

As the core team responsible for corporate decision-making, the top management team has an important impact on corporate strategy, decision-making and performance. The personal characteristics of the top management team and the background of its members will have an impact on all aspects of the company. The heterogeneous top management team has richer information and resources, and has more types of intellectual assets, which can provide better preconditions for corporate decision-making, thus affecting the total factor productivity of the enterprise. How the heterogeneity of top management team can affect the total factor productivity of enterprises is a problem worthy of further study. It is of great significance to explore this research problem to broaden the research scope of total factor productivity and top management team.

Based on the above research questions, this paper selects the empirical data of A-share listed companies from 2010 to 2020 to explore the relationship between the age heterogeneity, gender heterogeneity and occupational background heterogeneity of top management team and the total factor productivity of enterprises.

The research contributions of the article are mainly reflected in: First, it further enriches the relevant research on the internal influencing factors of total factor productivity from the micro level, and provides new ideas for future research. Secondly, it explores the relationship between the heterogeneity of top management team and the total factor productivity of enterprises, and expands the research on the consequences of the heterogeneity of top management team.

2. Literature review

The existing literature review is mainly carried out from the following two aspects:

The first is the related research on the total factor productivity of enterprises. It is mainly reflected in the measurement, decomposition and influencing factors of total factor productivity of enterprises, among which the research on influencing factors is more common. The influencing factors of enterprise total factor productivity include external factors and internal factors. External factors include the uncertainty of the external environment, foreign investment, financing constraints and so on. The stability of external economic policy [1], fiscal policy [2], macroeconomic [3] will have an impact on TFP. The uncertainty of the external environment will have an impact on capital mismatch, financing constraints and technological innovation, which will lead to the increase or decrease of TFP. Most studies have shown that external investment plays an important role in the growth of total factor productivity of invested enterprises [4]. The strength of financing constraints faced by enterprises will affect the decline or growth of TFP. The research of Krishnan et al. [5] shows that the TFP of enterprises will increase after the deregulation of financing channels. The research of Zhao Chunming et al. [6] shows that the financing constraints of enterprises negatively affect TFP. The internal factors that affect the total factor productivity of enterprises include R & D investment, resource allocation, innovation, human capital. Yang et al. [7] found that R & D investment can effectively promote total factor productivity. Factor allocation efficiency is also one of the important influencing factors of total factor productivity, which promotes total factor productivity. Brandt et al. [8] conducted a study on Chinese manufacturing enterprises and found that if resources can be fully flowed among enterprises, the total factor productivity of enterprises will increase after resources are re-allocated. As an important ability of enterprises, innovation can have an impact on the total factor productivity of enterprises. Innovation and technological progress are the core of the improvement of total factor productivity of enterprises [9]. In addition, human capital can also affect the total factor productivity of enterprises. The difference of human capital level between regions will lead to the difference of total factor productivity of enterprises in different regions [10].

The second is about the impact of top management team on the total factor productivity of enterprises. On the one hand, the existing research focuses on the impact of top management team on the total factor productivity of enterprises, mainly from the following aspects: overseas background of top management team, equity incentive, salary and so on. When making decisions, executives with overseas experience can better use their management skills and expertise acquired abroad to make better decisions and improve corporate governance [11]. During the period of employment, executives with overseas experience have a technology transfer effect and can positively affect the company's technological progress [12]. At the same time, the overseas background of the top management team can reduce financial mismatches and improve the total factor productivity of the company [13]. The incentive mechanism for executives is also an important factor affecting the total factor productivity of enterprises. Salary and equity incentives, as two important forms of executive incentives, can have an impact on total factor productivity. The equity incentive [14] and the salary incentive system [15] encourage executives to work harder and improve the level of corporate governance. The higher the shareholding ratio of executives [16] and the greater the internal salary gap, the higher the total factor productivity of enterprises. The restriction of executive compensation will have an adverse impact. The total wage control [17] and the salary restriction policy [18] will have a negative impact on the total factor productivity of enterprises.

On the other hand, many scholars pay attention to the impact of top management team heterogeneity on resource allocation and innovation. Many scholars have found that heterogeneous teams will have an impact on the acquisition, integration and allocation of resources. First of all, the top management team with heterogeneity can access more external resources. The top management team combines existing resources with external resources, which helps to make better use of existing resources [19]; secondly, different executive members provide a more diverse analytical perspective, [20] which helps to combine resources in new ways and find new resource combinations [21]. Thirdly, members with different backgrounds may realize the integration and complementarity of experience, knowledge, ability and resources, so that the team's decision-making ability is stronger and the allocation of innovative resources is continuously optimized [22]. Moreover, they can respond quickly to changes in the economic environment, and can also quickly discover opportunities and reconfigure related resources. Other scholars focus on the relationship between top management team heterogeneity and innovation. Donaldson [23] found that top management teams with strong heterogeneity have a diverse knowledge base and professional experience, and can make decisions more effectively and creatively in a dynamic environment, thereby improving innovation performance.

From the existing research, there is a certain relationship between the heterogeneity of the top management team and the total factor productivity of the enterprise. Unfortunately, there are few literatures directly on the relationship between the heterogeneity of the top management team and the total factor productivity of the enterprise. Therefore, based on the perspective of top management team heterogeneity, this paper discusses the influence of top management team age heterogeneity, gender heterogeneity and occupational background heterogeneity on enterprise total factor productivity from three dimensions of top management team age heterogeneity, gender heterogeneity and occupational background heterogeneity.

3. Research hypothesis

The top management team is the core leadership group that controls the business decision-making and resource allocation of the enterprise. The differentiation among the members of the top management team provides the team with more intellectual assets and a broader perspective, which can provide more comprehensive consideration, richer information and more diversified perspectives for the strategic decision-making of the enterprise. The heterogeneous top management team proposes resource allocation decisions that are more conducive to the growth of the company by integrating multiple resources and experience. Therefore, the heterogeneity of top management team will have an impact on the diversity of enterprise resource allocation [24]. The efficiency of factor allocation plays an important role in the total factor productivity of enterprises. Misallocation of resources will lead to a decrease in total factor productivity. If the factors of enterprises are reasonably allocated, the total factor productivity of enterprises will increase [25]. The heterogeneity of top management team can improve the allocation efficiency of enterprise innovation resources and improve the innovation ability of enterprises. As one of the key ways to improve the total factor productivity of enterprises, innovation has a positive effect on the total factor productivity [26]. To sum up, the heterogeneity of top management team may have a positive impact on the total factor productivity of enterprises. However, the heterogeneous top management team may also have a negative impact on the total factor productivity of enterprises. Due to the differences in thinking habits, background and experience, the members of the top management team have differences in cognition, resulting in more conflicts, which is not conducive to reaching a consensus decision-making, resulting in the reduction of enterprise decision-making efficiency, affecting enterprise growth and performance [27], and having a negative impact on the total factor productivity of enterprises.

The heterogeneity of top management teams in different dimensions may have different effects on the total factor productivity of enterprises. Executives with different ages, genders and professional backgrounds may have different performances in dealing with cognitive conflicts, integrating multiple perspectives and making decisions. For the age heterogeneity of the top management team, the younger executives in the top management team tend to be more innovative, creative and willing to take risks, while the older managers have rich management experience and a large social network. The overall situation is stronger when participating in decision-making [28]. Older and younger managers can combine their respective advantages to provide better decisions for enterprises. In this case, compared with more homogeneous teams, the higher the age heterogeneity, the greater the probability that the top management team will make higher quality decisions. Therefore, the top management team with age heterogeneity has a more diverse perspective and can better allocate resources. They can provide more feasible solutions for enterprise innovation, which is conducive to improving the total factor productivity of enterprises.

H1: The age heterogeneity of the top management team has a positive impact on the total factor productivity of the enterprise;

For the gender heterogeneity of the executive team, there are some differences in the degree of risk aversion and cognition between men and women in the executive team. Compared with men, women have a higher degree of risk aversion [29]. The increase of women in the team may lead enterprises to avoid some risk behaviors and reduce their R & D investment [30]. Due to the differences in work background and experience between male and female executives, their cognitive styles are different, and there are cognitive differences between the two [31]. Therefore, the gender heterogeneity of executives may cause greater conflicts within team members and cannot reach a consensus decision, which is not conducive to improving the total factor productivity of enterprises.

H2: gender heterogeneity of top management team has a negative impact on total factor productivity of enterprises;

For top management team members with different professional backgrounds, the knowledge reserves,

concepts and work orientation of these top management team members are more diverse [32]. In the face of the same problem, the top management team with heterogeneity of professional background can produce different opinions, think from multiple perspectives, and then improve the quality of decision-making [33], which has a positive impact on enterprise innovation [34] and enterprise performance [35], thereby improving the total factor productivity of enterprises. Therefore, the following assumptions are made:

H3: The heterogeneity of top management team's professional background has a positive impact on the total factor productivity of enterprises.

4. Research Design

4.1. Data sources

The data of A-share listed companies from 2010 to 2020 are selected as samples, and the data are all derived from the Cathay Pacific database. According to the practice, 7403 unbalanced panel data are obtained by eliminating ST, * ST and data missing enterprises. Considering the lag of the influence of executive heterogeneity on the total factor productivity of enterprises, the observation time of the total factor productivity of enterprises is lagged by one period, and Stata and Excel are used for data processing.

4.2. Variable measurement

4.2.1. Explained variables

The total factor productivity (TFP) of listed companies is estimated by the logarithmic Cobb-Douglas production function:

$$\ln Y_{i,t} = \beta_0 + \beta_1 \ln K_{i,t} + \beta_2 \ln L_{i,t} + \beta_3 \ln M_{i,t} + w_t + \eta_t \quad (1)$$

In the model (1), Y is operating income, K is capital investment, net fixed assets, L is labor input, calculated by the number of employees, and M is intermediate input. Based on the research methods of Lu Xiaodong and Lian Yujun [36], the total factor productivity (TFP_LP) of enterprises is calculated by LP semi-parametric method. At the same time, the robustness test is carried out by OP semi-parametric method.

4.2.2. Explanatory variables

Referring to the calculation method used by Deng Xinming et al. [37], the age heterogeneity (Age), gender heterogeneity (Sex) and occupational background heterogeneity (Func) of executives are measured by Herfindahl-Hirschman index. The calculation formula is:

$$H = 1 - \sum_{i=1}^n p_i^2$$

Among them: p_i refers to the proportion of type I members in the executive team members; n represents the category of age, gender and occupational background. The H value is between 0 and 1, and the greater the H value, the higher the degree of age heterogeneity (Age), gender heterogeneity (Sex) and occupational background heterogeneity (Func) of the top management team.

4.2.3. Control variable

Refer to Tang Jing and Feng Siyun [38] (2023)'s research on total factor productivity, using company size (Size), asset-liability ratio (Lev), return on total assets (ROA), Tobin Q (TobinQ), fixed asset ratio (Fix), the proportion of the largest shareholder (Share1), and whether it is a state-owned enterprise (State) as control variables (table 1).

Table 1: Variables and measurement tables

Variable type	Variable name	Symbol	Measure index
dependent variable	total factor productivity	TFP LP	Calculation based on LP method
		TFP OP	Calculation based on OP method
independent variable	Age heterogeneity of top management team	Age	$H=1-\sum_{i=1}^n p_i^2$
	Gender heterogeneity of top management team	Sex	
	Heterogeneity of professional background of top management team	Func	
control variables	company scale	Size	The natural logarithm of total assets
	assets-liability ratio	Lev	Ratio of total liabilities to total assets
	return on total assets	ROA	Ratio of net profit to total assets
	TobinQ	TobinQ	Market value / (total assets-net intangible assets-net goodwill)
	fixed assets ratio	Fix	Fixed assets / total assets
	proportion of the largest shareholder	Share1	
	Whether it belongs to state-owned enterprises	State	state-owned enterprises =0, non-state-owned enterprises =1

4.2.4. Model construction

In order to verify the relationship between the age heterogeneity, gender heterogeneity and occupational background heterogeneity of executives and the total factor productivity of enterprises, the following four models are constructed in turn:

$$TFP=a_0+a_1Size+a_2Lev+a_3ROA+a_4TobinQ+a_5Fix+a_6State+a_7Share1+\varepsilon \tag{2}$$

$$TFP=a_0+a_1Age+a_2Size+a_3Lev+a_4ROA+a_5TobinQ+a_6Fix+a_7State+a_8Share1+\varepsilon \tag{3}$$

$$TFP=a_0+a_1Sex+a_2Size+a_3Lev+a_4ROA+a_5TobinQ+a_6Fix+a_7State+a_8Share1+\varepsilon \tag{4}$$

$$TFP=a_0+a_1Func+a_2Size+a_3Lev+a_4ROA+a_5TobinQ+a_6Fix+a_7State+a_8Share1+\varepsilon \tag{5}$$

The regression of control variables and explanatory variables is represented by model (2). On this basis, three independent variables of age heterogeneity (Age), gender heterogeneity (Sex) and occupational background heterogeneity (Func) of top management team are introduced to obtain model (3), model (4) and model (5), and hypothesis 1, 2 and 3 are tested respectively.

5. Empirical results

5.1. Descriptive statistics

Table 2: Variables Descriptive Statistics

Variable	N	Mean	S.D.	Min	p50	Max
Size	7403	22.2212	1.328	19.0327	22.0089	28.4159
Lev	7403	0.4035	0.1968	0.0091	0.3946	1.6853
ROA	7403	0.0091	0.0143	-0.0697	0.0073	0.2111
TobinQ	7403	2.443	1.7605	0.7037	1.9305	29.7819
Fix	7403	0.1951	0.1471	0.0002	0.1654	0.8758
State	7403	0.0258	0.1585	0	0	1
Share1	7403	0.3326	0.1455	0.0287	0.3101	0.8999
Age	7403	0.4698	0.1673	0	0.4938	0.7654
Sex	7403	0.2233	0.1863	0	0.2449	0.5
Func	7403	0.7939	0.1008	0	0.8194	0.9303
TFP LP	7403	8.4681	1.0754	5.1619	8.3429	13.1757

Table 2 is the descriptive statistics of all variables. It can be seen from Table 2 that the mean value of total factor productivity is 8.4681, the minimum value is 5.1619, the maximum value is 13.1757, and the standard deviation is 1.0754, indicating that the total factor productivity of different companies is quite different. The standard deviations of age heterogeneity, gender heterogeneity and occupational background heterogeneity of executives are 0.1673, 0.1863 and 0.1008, respectively. The standard deviation of the sample is small, indicating that the heterogeneity distribution of the executive team of the sample enterprise has certain consistency.

5.2. Multicollinearity test

VIF may have multicollinearity for core explanatory variables and control variables. The article uses the variance expansion factor to verify the multicollinearity between variables. The case where there is no multicollinearity is that the VIF value is less than 10, and the variables in the article do not have multicollinearity.

5.3. Regression analysis

Table 3 lists the regression results of top management team heterogeneity and enterprise total factor productivity. It can be seen from Model 2 that the age heterogeneity of executives has a positive impact on the total factor productivity of enterprises. It can be seen from Model 3 that gender heterogeneity has a negative but not significant impact on the total factor productivity of enterprises. It can be seen from Model 4 that the heterogeneity of executives' professional background experience has a significant positive impact on the total factor productivity of enterprises. In summary, H1 and H3 are established, and H2 is not established.

Table 3: Regression analysis of top management team heterogeneity and enterprise total factor productivity

Variable	Model 1	Model 2	Model 3	Model 4
Age		0.1125*** (3.3072)		
Sex			-0.0348 (-0.5957)	
Func				0.2169* (1.7936)
Size	0.4641*** (21.0197)	0.4623*** (20.9775)	0.4642*** (21.0318)	0.4617*** (20.9566)
Lev	0.3167*** (3.3030)	0.3121*** (3.2664)	0.3177*** (3.3095)	0.3192*** (3.3219)
ROA	1.2698** (2.5117)	1.2455** (2.4756)	1.2709** (2.5175)	1.2596** (2.5094)
TobinQ	0.0260*** (5.7731)	0.0262*** (5.8257)	0.0260*** (5.7830)	0.0264*** (5.8892)
Fix	-0.5516*** (-4.7714)	-0.5462*** (-4.7177)	-0.5516*** (-4.7697)	-0.5483*** (-4.7783)
State	0.0716 (1.1489)	0.0654 (1.0565)	0.0725 (1.1632)	0.0716 (1.1890)
Share1	-0.6502*** (-4.6607)	-0.6432*** (-4.6164)	-0.6520*** (-4.6814)	-0.6452*** (-4.6496)
Constant	-1.7248*** (-3.4219)	-1.7406*** (-3.4587)	-1.7188*** (-3.4127)	-1.8479*** (-3.5858)
Observations	7,403	7,403	7,403	7,403
R-squared	0.3205	0.3221	0.3206	0.3217
Numberofid_new	1,346	1,346	1,346	1,346

Note: *** means significant at the 1 % level, ** means significant at the 5 % level, * means significant at the 10 % level (the same below).

5.4. Heterogeneity analysis

Factors such as regional economic development and cultural differences may also affect the relationship between the heterogeneity of top management teams and the total factor productivity of enterprises. Therefore, this paper divides the samples of listed companies into four regions according to the region, namely the eastern, central, western and northeastern regions, and explores whether there are differences in the impact of the heterogeneity of top management teams in different regions on the total factor productivity of enterprises.

5.4.1. Age heterogeneity of top management team

According to Table 4, the age heterogeneity of senior executives in the eastern and central regions

has a significant positive impact on the total factor productivity of enterprises, indicating that in the western and northeastern regions, the age heterogeneity of senior executives has a smaller promoting effect on total factor productivity.

Table 4: Heterogeneity analysis of age heterogeneity of top management team and total factor productivity of enterprises

Variables	Eastern	Central	Western	Northeast
Age	0.1225*** (2.9624)	0.2039** (2.5576)	-0.0965 (-0.9458)	0.0935 (0.5831)
Size	0.4348*** (16.7952)	0.5589*** (10.3628)	0.5342*** (6.5656)	0.4321*** (3.5579)
Lev	0.2736*** (2.6650)	0.1688 (0.8946)	0.2788 (0.8560)	1.6438* (1.6884)
ROA	0.7677 (1.4559)	1.3977 (1.2150)	4.7313** (2.1996)	-2.3853 (-0.7355)
TobinQ	0.0229*** (4.6877)	0.0175** (2.3292)	0.0449** (2.5286)	0.0682 (1.2023)
Fix	-0.4774*** (-3.1778)	-0.2594 (-0.9510)	-0.8043*** (-3.3752)	-0.4184 (-0.5120)
State	0.1919*** (2.7639)	-0.0416 (-0.2977)	-0.0608 (-0.8798)	0.7949* (1.8249)
Share1	-0.7642*** (-4.9229)	-0.4135 (-1.3524)	-0.6406* (-1.6852)	0.8022 (0.5693)
State	-1.0435* (-1.7809)	-4.0292*** (-3.3130)	-3.3860* (-1.8590)	-2.3666 (-0.8277)
Constant	5,115	1,113	878	297
Observations	0.3276	0.3946	0.3029	0.3199
R-squared	0.1225***	0.2039**	-0.0965	0.0935
Number of id_new	945	196	155	50

5.4.2. Gender heterogeneity of top management team

Table 5: Heterogeneity analysis of gender heterogeneity of top management team and total factor productivity of enterprises

Variables	Eastern	Central	Western	Northeast
sex	-0.0092 (-0.1428)	0.1248 (1.0048)	-0.2567 (-1.4416)	-0.1252 (-0.4212)
size	0.4355*** (16.7941)	0.5647*** (10.3761)	0.5294*** (6.5596)	0.4298*** (3.2053)
lev	0.2836*** (2.7578)	0.1451 (0.7564)	0.2809 (0.8540)	1.6154* (1.7167)
ROA	0.7861 (1.4850)	1.4704 (1.2500)	4.7387** (2.1969)	-2.2536 (-0.6884)
TobinQ	0.0226*** (4.6262)	0.0176** (2.3029)	0.0456** (2.5762)	0.0656 (1.1564)
Fix	-0.4808*** (-3.2044)	-0.2717 (-0.9851)	-0.7805*** (-3.2080)	-0.4166 (-0.5093)
State	0.1953*** (2.6562)	-0.0291 (-0.2113)	-0.0672 (-1.0467)	0.7594* (1.8669)
Share1	-0.7756*** (-4.9902)	-0.4249 (-1.3656)	-0.6291* (-1.6609)	0.7589 (0.5026)
State	-0.9989* (-1.7074)	-4.0712*** (-3.2910)	-3.2806* (-1.8070)	-2.2057 (-0.6794)
Constant	5,115	1,113	878	297
Observations	0.3257	0.3900	0.3054	0.3203
R-squared	-0.0092	0.1248	-0.2567	-0.1252
Number of id_new	945	196	155	50

It can be seen from Table 5 that for listed companies in the eastern, central, western and northeastern regions, the gender heterogeneity of the executive team has no significant impact on the total factor productivity of enterprises. For enterprises with different geographical locations, the gender heterogeneity of the executive team has no significant impact on the total factor productivity of enterprises.

5.4.3. Heterogeneity of professional background of top management team

From Table 6, it can be seen that for companies in the central and western regions, the heterogeneity of the professional background of the top management team has a significant positive impact on the total factor productivity of enterprises, while for enterprises in the eastern and northeastern regions, the heterogeneity of the professional background of the top management team has no significant impact on total factor productivity.

Table 6: Heterogeneity analysis of occupational background heterogeneity of top management team and total factor productivity of enterprises

Variables	Eastern	Central	Western	Northeast
Func	0.0778 (0.5205)	0.4108** (2.2613)	0.8744* (1.9120)	0.0188 (0.0841)
Size	0.4349*** (16.7825)	0.5590*** (10.4630)	0.5165*** (6.4863)	0.4377*** (3.5807)
Lev	0.2836*** (2.7516)	0.1655 (0.8467)	0.2315 (0.7640)	1.6254 (1.6755)
ROA	0.7828 (1.4804)	1.5363 (1.3111)	4.5631** (2.2440)	-2.3186 (-0.7148)
TobinQ	0.0228*** (4.6750)	0.0189** (2.4864)	0.0452** (2.6005)	0.0667 (1.1712)
Fix	-0.4821*** (-3.2191)	-0.2467 (-0.9041)	-0.7193*** (-3.0834)	-0.4098 (-0.4995)
State	0.1959*** (2.6791)	-0.0096 (-0.0711)	-0.0719 (-1.3086)	0.7768 (1.6627)
Share1	-0.7724*** (-4.9782)	-0.4406 (-1.4477)	-0.5828 (-1.5751)	0.8518 (0.5916)
State	-1.0492* (-1.7528)	-4.2629*** (-3.4641)	-3.7518** (-2.1178)	-2.4653 (-0.8257)
Constant	5,115	1,113	878	297
Observations	0.3259	0.3928	0.3156	0.3192
R-squared	0.0778	0.4108**	0.8744*	0.0188
Number of id_new	945	196	155	50

5.5. Robustness test

Table 7: Robustness test of explanatory variables

Variable	Model 1	Model 2	Model 3	Model 4
Age		0.1173*** (3.6517)		
Sex			-0.0099 (-0.1834)	
Func				0.2433** (2.1081)
Size	0.3852*** (18.8116)	0.3834*** (18.7760)	0.3852*** (18.8187)	0.3825*** (18.7612)
Lev	0.3193*** (3.6332)	0.3144*** (3.5957)	0.3195*** (3.6302)	0.3220*** (3.6611)
ROA	0.9535** (2.0320)	0.9281** (1.9893)	0.9538** (2.0335)	0.9421** (2.0237)
TobinQ	0.0177*** (4.3449)	0.0179*** (4.4059)	0.0177*** (4.3480)	0.0182*** (4.4870)
Fix	-0.3604*** (-3.3823)	-0.3548*** (-3.3262)	-0.3604*** (-3.3823)	-0.3568*** (-3.3752)
State	0.0811 (1.3726)	0.0746 (1.2711)	0.0814 (1.3769)	0.0811 (1.4302)
Share1	-0.6762*** (-5.0908)	-0.6690*** (-5.0557)	-0.6768*** (-5.1014)	-0.6707*** (-5.0925)
Constant	-1.6859*** (-3.6144)	-1.7023*** (-3.6639)	-1.6842*** (-3.6127)	-1.8240*** (-3.8251)
Observations	7,403	7,403	7,403	7,403
R-squared	0.2732	0.2753	0.2732	0.2750
Number of id_new	1346	1346	1346	1346

In order to enhance the reliability of the results, the calculation caliber of the explained variables is replaced, the OP method is used to measure TFP, and the model is regressed again. The test results are shown in Table 7. From the model 2 and model 4 in table 7, it can be seen that the age heterogeneity of the executive team and the heterogeneity of the executive professional background have a significant impact on the total factor productivity of the enterprise, and the coefficient symbol and significance level

are basically consistent with the previous article. According to the model 3, the gender heterogeneity of the executive team has no significant impact on the total factor productivity of the enterprise. The coefficient symbol and the significance level are consistent with the previous results, indicating that the research results are more feasible.

6. Conclusions and discussion

6.1. Research conclusion

This paper selects the data of A-share listed companies from 2010 to 2020 to analyze the impact of gender heterogeneity, age heterogeneity and occupational background heterogeneity of top management team on the total factor productivity of enterprises. At the same time, according to the region, enterprises are divided into enterprises in the central, eastern, western and northeastern regions, and heterogeneity analysis is carried out to explore whether the relationship between the heterogeneity of top management team and the total factor productivity of enterprises in different geographical locations is different. The empirical results show that the age heterogeneity and occupational background heterogeneity of executives have a significant positive impact on the total factor productivity of enterprises. Through heterogeneity analysis, it is concluded that the age heterogeneity of top management team in the eastern and central regions has a significant positive impact on the total factor productivity of enterprises, and the heterogeneity of top management team's professional background in the central and western regions has a significant positive impact on the total factor productivity of enterprises.

6.2. Suggestions

According to the research conclusions, the following suggestions are put forward: First, adjust the top management team members. Enterprises should pay attention to the allocation of top management team members, focus on adjusting the age heterogeneity and professional background heterogeneity of the top management team, improve the complementarity between team members, and promote the improvement of the total factor productivity of the enterprise. Second, enterprises in different regions need to adopt different executive structures. For enterprises in the eastern region, we should focus on improving the age heterogeneity of the top management team. For the central region, we should focus on improving the age heterogeneity and professional background heterogeneity of the top management team. For enterprises in the western region, we should adjust the professional background heterogeneity of the top management team to improve the total factor productivity of enterprises.

6.3. Theoretical contributions and future research prospects

Through reviewing the previous literature, this paper establishes a research model of top management team heterogeneity-enterprise total factor productivity, discusses the relationship between top management team heterogeneity and enterprise total factor productivity, and draws relevant conclusions. This study further enriches the research on the internal factors that affect the total factor productivity of enterprises, and expands the research on the consequences of the heterogeneity of the top management team.

Although this study has achieved some results, there are still some shortcomings. Due to the diversity of their members' background characteristics, heterogeneous top management teams are prone to constructive debates. They can perceive changes in the external environment of the enterprise, quickly identify opportunities and avoid risks, and promote organizational innovation and change. Therefore, the heterogeneous top management team can better reflect its advantages in a complex environment. The impact of the heterogeneity of the top management team on the company is often affected by the organizational environment. In different organizational environments, the impact of heterogeneity on the company may be different. In the future, scholars can study enterprises in different environments and explore the regulatory role of the organizational environment on the relationship between the heterogeneity of the top management team and the total factor productivity of the company. This paper only discusses the relationship between the heterogeneity of top management team and the total factor productivity of enterprises, and does not study the mechanism of action between the two. In the future, scholars can add mediating variables to the model to explore the complete mechanism of action between the heterogeneity of top management team and the total factor productivity of enterprises.

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