

The Impact of Top Management Team Heterogeneity on The Performance of Technology Start-ups

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ABSTRACT

Based on upper echelon theory and the perspective of value creation in the business model for technology start-ups, this paper explains the mechanism of top management team (TMT) heterogeneity on the performance of technology start-ups. Using survey data from 183 technology start-ups in China, the model is empirically tested. The findings demonstrate that age and tenure heterogeneity among TMT members significantly and positively affects the performance of technology start-ups. While functional experience and educational level heterogeneity significantly and negatively affect their performance of technology start-ups. Moreover, the value creation of business models partially mediates the influences of age, tenure, functional experience and educational level heterogeneity among TMT members on the performance of technology start-ups.

Keywords: TMT heterogeneity, value creation, business model, technology start-ups, performance

INTRODUCTION

The low survival rate of start-ups has always been a concern of scholars and entrepreneurs. The growth and development of start-ups are determined by many factors. There are also many factors that influence the performance of start-ups, such as the entrepreneurial team, government policy, the market environment, technical resources, culture, organizational structure and so on. As the core of enterprise operations as well as the brain of enterprise decisions, the top management team (TMT) controls the overall direction of an enterprise. Hence, the structure of the TMT is of vital importance to the growth and development of start-ups. Following the upper echelon theory proposed by Hambrick and Mason in 1984, a series of studies on the influence of the TMT on enterprises has been conducted in academic circles. Existing studies on TMT heterogeneity are mainly focused on the influences of age, gender, nationality, tenure, professional experience and educational background on the development of enterprises.

However, different scholars have different opinions about these influences. Some scholars think that TMT heterogeneity can provide more comprehensive information for decision-making in enterprises, thus improving the quality of decisions and performance (Ensley, 2003; Carpenter, 2004; Carmen, 2006; Athanassiou et al., 2006; Cannella et al., 2008; Bjornali et al., 2016; Thiess et al., 2016), while some scholars hold the view that TMT heterogeneity can lead to conflicts and poor communications, which will result in the reduction of decision efficiency and quality (Wiersema et al., 1993; Keck, 1997; Richard, 2002; Boone, 2004; Wang et al., 2013).

Why does TMT heterogeneity have different effects on the performance of start-ups? To explain this "contradictory" phenomenon, scholars have attempted to research the functional path of TMT heterogeneity on the performance of start-ups taking different perspectives, such as strategic orientation, strategic integration, team integration, team conflict and so on (Zhong & Fan, 2016). However, scholars have ignored one factor that is critical to the growth of technology start-ups: the business model. Value creation, which is the core of a business model, has a direct relationship with the competitive position of enterprises in the market, and the establishment of value creation in the business model cannot be separated from the decisions of the TMT. The decisions of the TMT will directly affect the input of key resources as well as the identification and construction of key business activities

Contribution of this paper to the literature

- Age and tenure heterogeneity across TMT members significantly and positively affects the performance of technology start-ups, so it is better to maintain the age level and continue to introduce new members when constructing the TMT.
- To reduce differences arising from functional experience and educational level heterogeneity, technology start-ups should pay attention to work shifts and should let members communicate more to narrow the knowledge gap; in this way, members will learn to get along well with each other.

during the process of value creation. Business activities will directly affect the ability of technology start-ups to create products and services that provide good experiences and thereby directly affect the performance of enterprises.

Using survey data from 183 technology start-ups in China, this study verifies the functional path of TMT heterogeneity on the performance of technology start-ups using the statistical method of multivariate regression analysis. The main contributions of this study can be listed as follows: (1) It constructs a theoretical model of the relationships between TMT heterogeneity, the value creation of the business model and the performance of technology start-ups, and it provides a new way to explain the contradictions in findings regarding TMT heterogeneity and the performance of start-ups. (2) The greater the age and tenure heterogeneity among TMT members are, the higher the performance of technology start-ups is; further, the lower the functional experience and educational level heterogeneity are, the higher the performance of technology start-ups is. (3) This study not only enriches the theoretical basis of TMT heterogeneity but also provides suggestions for the construction of a TMT.

CONCEPTUAL FRAMEWORK

TMT Heterogeneity and the Performance of Technology Start-ups

Upper echelon theory was proposed by Hambrick and Mason (1984) under the hypothesis that human beings are characterized by bounded rationality. They argued that the collective decision-making of a management team could improve enterprise development but the decision-making of a single individual could not. Hence, the research on TMT is highly instructive for enterprises.

First, the age heterogeneity of the TMT can reflect differences in life experience, in understanding, and in attitudes. These differences can easily lead to poor communication in decision-making, resulting in divergences and a decline in the efficiency of decision-making, and they will act as an impediment to the performance of technology start-ups. Second, TMT members of different tenures will have different cognitions of the enterprise. Long-tenure members will be more willing to insist on the soundness of the original business philosophy and development strategy, while short-tenure members will be more inclined to innovation; this type of heterogeneity can help to ensure healthy development and create continuous innovation to adapt to the market. Third, different professional backgrounds among the TMT will produce greater differences and team conflicts between team members. (Hambrick et al., 1996); they will also cause a decline in the efficiency of decision-making (Cannella et al., 2008), and lead enterprises to miss many good opportunities. Finally, team members with similar educational levels will communicate more efficiently and effectively; therefore, conflicts will be lessened and will be solved quickly and effectively (Talke et al., 2012).

Based on the above analysis, this study proposes the following assumptions:

- H1a:** Age heterogeneity among TMT members negatively affects the performance of technology start-ups.
- H1b:** Tenure heterogeneity among TMT members positively affects the performance of technology start-ups.
- H1c:** Functional experience heterogeneity among TMT members negatively affects the performance of technology start-ups.
- H1d:** Educational level heterogeneity among TMT members negatively affects the performance of technology start-ups.

The Assumption of Value Creation in the Business Model as a Mediator

According to the upper echelon theory, TMT members will provide differing feedback on the decision making of the enterprise through different cognitive concepts and values, thus influencing enterprise performance; many scholars (Carpenter et al., 2004; Cannella, 2008; Xueli Wang et al., 2013) have verified this point. There are positive and negative effects of TMT heterogeneity on the performance of enterprises. To explain this phenomenon, some

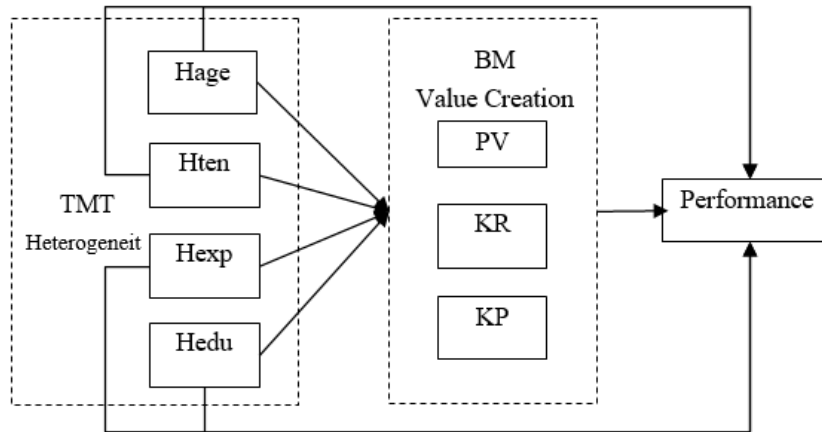


Figure 1. Path model of the impact of TMT heterogeneity on the performance of technology start-ups

scholars note that the majority of scholars studying heterogeneity only considered the “main effect”, while ignoring the mediation variable (van Knippenberg et al., 2004); therefore, it is necessary to consider the mediation mechanism between them. TMT heterogeneity is embodied in cognitive concepts and values, which will influence how strategies and decisions are developed; in addition, heterogeneity will also lead to different ways of creating value in the business model (Tsai & Lei, 2016). Technology start-ups tend to be in the early stage of development, and their business models are not mature. They need to make decisions to adapt to a rapidly changing market and depend on the TMT to make collective decisions. Therefore, the decision efficiency of TMT members is highly important. Age, tenure, functional experience and educational level heterogeneity among TMT members will all be reflected in how value is created in the business model, and thus they will ultimately influence the performance of technology start-ups. In addition, some types of heterogeneity will help performance, while others will play a negative role.

Based on the above analysis, this study proposes the following assumptions:

- H2a:** Value creation acts as a mediator of the impact of age heterogeneity on the performance of technology start-ups
- H2b:** Value creation acts as a mediator of the impact of tenure heterogeneity on the performance of technology start-ups
- H2c:** Value creation acts as a mediator of the impact of functional experience heterogeneity on the performance of technology start-ups
- H2d:** Value creation acts as a mediator of the impact of educational level heterogeneity on the performance of technology start-ups

A path model of the impact of TMT heterogeneity on the performance of technology start-ups is constructed in **Figure 1**.

STUDY DESIGN

Variable Measurement

In this study, we primarily measure four aspects of TMT heterogeneity: age, tenure, functional experience and educational level. The annual report and the Tai’an (CSMAR) database are two important channels for obtaining information on TMT members for this paper. For the measurement of heterogeneity, we adopt a common approach. Similar to Blau (1977), we use the Herfindahl-Hirschman Index to measure heterogeneity, $H = 1 - \sum_{i=1}^n P_i^2$, of which P_i represents the ratio of class i TMT members to the total number of members, for example, the ratio of members under the age of 20 to the total number of members. H is a number between 0 and 1, and the larger the value of H is, the greater the heterogeneity of the index is.

Table 1. Dimension measurement of TMT heterogeneity

Variable	Dimension	Measuring method	Reference
TMT Heterogeneity	Age Heterogeneity	1. Under 20 years old; 2. 21-30 years old; 3. 31-40-years old; 4. 41-50-years old; 5. Over 50 years old	Amason et al. (2006)
	Tenure Heterogeneity	1. Assignment time within 1 year; 2. 1- 2 years; 3. 2- 3 years; 4. 3- 5 years; 5. More than 5 years	Amason et al. (2006)
	Educational Level Heterogeneity	1. Junior college; 2. College; 3. Undergraduate; 4. Master's; 5. Doctorate	Bjornali et al. (2016)
	Functional Experience Heterogeneity	1. Production; 2. Marketing or Sales; 3. R & D, Technology or Information; 4. Finance, Securities or Accounting; 5. Management, Law, Government or Staff	Bjornali et al. (2016)

Table 2. Dimension measurement of value creation in the business model

Variable	Dimension	Measuring method	Reference
Value Creation of the Business Model	Provides Value	Whether the company provides competitive products and services	Jiang Wei (2012)
	Key Resources	Whether the enterprise masters the core technology and the brand	Johnson et al. (2008), Xiang Wei (2015)
	Key Processes	R & D investment, cash flow efficiency	Johnson et al. (2008) , Jiang Wei (2012)

Similar to Zott and Amit (2007), this paper also uses each business’s annual report to obtain data on the value creation of the business model; furthermore, the method of Wei River (2012) is also used as a reference to divide and measure value creation. Based on their research work, we are able to improve the research of technology start-ups. According to the distribution of the survey data, each variable is assigned a different value, with a gradient of 0, 0.25, 0.5 and 1.

To capture the profitability of technology start-ups, we use ROA to measure performance.

In addition to TMT heterogeneity and value creation, other factors also affect the performance of technology start-ups. This article uses team size, total assets and company attributes as control variables.

Model Construction

In this paper, the research object is technology start-ups, and the research purpose is to analyze the relationship between TMT heterogeneity, value creation in the business model and the performance of technology start-ups. Furthermore, we primarily use multiple linear regression as the research method. The specific research model is shown as follows:

(1) The impact of TMT heterogeneity on the performance of technology start-ups:

$$\text{Model 1: } ROA_{t+1} = a_0 + a_1SIZE + a_2ASSET + a_3FORM$$

$$\text{Model 2: } ROA_{t+1} = a_0 + a_1SIZE + a_2ASSET + a_3FORM + a_4Hage + a_5Hten + a_6Hexp + a_7Hedu$$

(2) The impact of TMT heterogeneity on the performance of value creation in the business model:

$$\text{Model 3: } CV_t = a_0 + a_1SIZE + a_2ASSET + a_3FORM$$

$$\text{Model 4: } CV_t = a_0 + a_1SIZE + a_2ASSET + a_3FORM + a_4Hage + a_5Hten + a_6Hexp + a_7Hedu$$

(3) The impact of value creation in the business model on the performance of technology start-ups:

$$\text{Model 5: } ROA_{t+1} = a_0 + a_1SIZE + a_2ASSET + a_3FORM + a_4CV$$

$$\text{Model 6: } ROA_{t+1} = a_0 + a_1SIZE + a_2ASSET + a_3FORM + a_4PV + a_5KP + a_6KP$$

Sample and Data

For this study, we select 335 listed companies from Chinese Gem before the end of 2014. In accordance with the screening criteria of a greater than 2% proportion of R & D, 275 companies are selected; further deletions results in 183 observations. In this study, the independent variables, mediating variables and control variables were selected from 2014, while the dependent variables were the data from 2015.

Table 3 shows the distribution of each item in the model. We find that the dimension of TMT heterogeneity and value creation are both between 0 and 1, while the performance of technology start-ups is between 1.14 and 20.1. Therefore, there is a clear difference between them. The control variables show a greater fluctuation in their

Table 3. Descriptive Statistics

Variables	N	Min	Max	Mean	SD	Skewness	Kurtosis
TMTsize	183	3.00	15.00	6.92	2.14	0.88	1.34
InAsset	183	19.59	22.17	20.85	0.55	0.33	-0.28
Organizational form	183	1.00	5.00	2.95	0.50	-0.91	8.30
Hage	183	0.00	0.72	0.47	0.15	-0.78	0.55
Hten	183	0.00	0.78	0.47	0.20	-0.99	0.52
Hexp	183	0.20	0.78	0.59	0.13	-0.92	0.25
Hedu	183	0.00	0.75	0.50	0.17	-1.37	1.90
PV	183	0.25	1.00	0.56	0.16	0.05	-0.15
KR	183	0.25	0.88	0.57	0.13	0.34	-0.18
KP	183	0.25	0.88	0.54	0.14	0.06	-0.31
ROA	183	1.14	20.10	6.74	3.28	1.17	2.46

N: 183

Table 4. Pearson’s correlations for continuous variables

	Hage	Hten	Hexp	Hedu	PV	KR	KP	CV	ROA
Hage	1								
Hten	0.284***	1							
Hexp	-0.125*	-0.023	1						
Hedu	0.102	0.077	0.101	1					
PV	0.323***	0.254***	-0.182**	-0.161**	1				
KR	0.273***	0.219***	-0.170**	-0.130*	0.678***	1			
KP	0.287***	0.254***	-0.154**	-0.079	0.628***	0.540***	1		
CV	0.342**	0.282***	-0.196***	-0.144*	0.903***	0.846***	0.837***	1	
ROA	0.361**	0.300**	-0.250***	-0.187**	0.689***	0.600***	0.611***	0.737***	1

N=183: ***p<.01, **p<.05, * p<.1

distribution, which indicates different impacts of TMT heterogeneity on the performance of technology start-ups. Furthermore, the kurtosis of the organizational form reaches 8.3, showing an abnormal distribution. In addition, as seen in 4.5, private enterprises account for a larger proportion of the sample and the skewness and kurtosis of the other indexes were within the normal range, with the maximum skewness coefficient being 3 and kurtosis coefficient being 8.

RESULTS

Before the regression analysis, this article conducts a correlation analysis between the variables, and the results are shown in **Table 4**.

As seen, there are significant correlations between TMT heterogeneity, the value creation in the business model and the performance of technology start-ups, but that does not mean that there is a causal relationship between them, so we use a multiple regression analysis to verify the further relationship between variables. The regression model is tested for multiple collinearity, sequence correlation and heteroskedasticity. According to previous studies, multicollinearity has less effect when the VIF value is greater than 0 and less than 5, and when the DW value is approximately 2, the sequence correlation is weak, and the random interference term does not affect the model. In this study, all of the models pass this test, so the multiple linear regression can be carried out.

The Verified Relationship between TMT Heterogeneity and the Performance of Technology Start-ups

As we can see from Model 2 in **Table 4**, age heterogeneity among TMT members significantly positively affects the performance of technology start-ups ($\beta=0.279$, $p<0.01$), so hypothesis H1a is not verified. Tenure heterogeneity among TMT members significantly positively affects the performance of technology start-ups ($\beta=0.218$, $p<0.01$), functional experience heterogeneity significantly negatively affects the performance of technology start-ups ($\beta=-0.186$, $p<0.01$), and educational experience heterogeneity negatively affects the performance of technology start-ups ($\beta=-0.234$, $p<0.01$), so H1b, H1c, H1d, respectively, are all verified.

Table 5. Regression analysis results

Variables	MOD1	MOD2	MOD3	MOD4	MOD5	MOD6	MOD7
	ROA	ROA	CV	CV	ROA	ROA	ROA
TMTsize	0.137*	0.075	0.130*	0.061	0.042	0.039	0.058
InAsset	0.024	0.002	0.035	0.015	-0.001	0.001	-0.011
Organizational form	-0.008	-0.022	-0.032	-0.046	0.015	0.015	0.011
Hage		0.279***		0.269***			0.108*
Hten		0.218***		0.204**			0.089*
Hexp		-0.186***		-0.137**			-0.099**
Hedu		-0.234***		-0.190***			-0.113**
PV						0.393***	
KR						0.194***	
KP						0.253***	
CV					0.731***		0.635***
MAX VIF	1.117	1.320	1.117	1.320	1.132	2.270	1.325
F	1.306	9.124***	1.328	6.832***	53.186***	35.549***	30.495***
R ²	0.021	0.267	0.022	0.215	0.544	0.548	0.584
Change in R ²	0.005	0.238	0.005	0.183	0.534	0.532	0.565
DW	2.000	1.987	2.105	2.223	1.955	1.943	1.882

Table 6. Mediating variables' checking procedures

Procedure	Equation	Explanation
1	$Y=cX+e_1$	If coefficient c is not significant, there is no mediating effect. If coefficient c is significant, check equation in step 2.
2	$M=aX+e_2$	Check the significance of coefficient a, then go to step 3. If both coefficient b and coefficient c are significant, and coefficient a is significant in step 2, there exists a partial mediating effect.
3	$Y=bM+cX+e_3$	If coefficient b is significant, coefficient c is not significant or c=0 is significant, and coefficient a in step 2 is significant, there exists a complete mediating effect. If either coefficient b or coefficient a in step 2 is not significant, then take the SOBLE test. If both are not significant, then the mediating effect is not obvious.

The Hypothesis Test of Value Creation in the Business Model as a Mediator

This paper tests the value creation in business models as a mediator using the method by Baron and Kenny (1986); the process is shown in [Table 6](#).

As we can see in [Table 5](#), model 4 reports the impact of TMT heterogeneity on the performance of value creation in the business model. Age heterogeneity among TMT members significantly positively affects value creation within technology start-ups ($\beta=0.279$, $p<0.01$); tenure heterogeneity among TMT members significantly positively affects value creation within technology start-ups ($\beta=0.204$, $p<0.05$); functional experience heterogeneity significantly negatively affects value creation within technology start-ups ($\beta=-0.137$, $p<0.05$); and educational experience heterogeneity negatively affects value creation within technology start-ups ($\beta=-0.190$, $p<0.01$). Model 5 and model 6 both explain the positive effect of value creation in the business model on the performance of technology start-ups ($\beta=0.731$, $p<0.01$); furthermore, PV ($\beta=0.393$, $p<0.01$), KR ($\beta=0.194$, $p<0.01$) and KP ($\beta=0.253$, $p<0.01$) all have a positive effect on the performance of technology start-ups.

As shown in model 7, if we conduct a regression analysis of the performance of technology start-ups with the various dimensions of TMT heterogeneity and value creation as independent variables, the regression coefficient of value creation is 0.635, significant at the 1% level. This means that value creation acts as a mediator in the impact of TMT heterogeneity on the performance of technology start-ups. In addition, age, tenure, functional experience and educational level heterogeneity all have a significantly positive effect on the performance of technology start-ups, and the main effect declines. Thus, value creation acts as a mediator of the impact of TMT heterogeneity (including age, tenure, functional experience and educational level) on the performance of technology start-ups. In other words, H2, H2a, H2b, H2c are all verified.

RESULTS

In this study, we explore the relationship between TMT heterogeneity, value creation and the performance of technology start-ups. In addition, multiple regression analysis is used to conduct an empirical study, finally, the hypotheses we make are verified and we obtain the empirical results. Now we will analyze the empirical results

Different Types of TMT Heterogeneity have Different Effects on the Performance of Technology Start-ups

The regression analysis results for the model show that the impact of TMT heterogeneity on the performance of technology start-ups is not completely positive or negative: it is influenced by the characteristics of TMT heterogeneity. The results indicate that age and tenure heterogeneity among TMT members significantly and positively affect the performance of technology start-ups, while functional experience and educational level heterogeneity significantly and negatively affect their performance. One possible reason why the results do not fully verify our expectations is that the samples in this study are technology start-ups and that age heterogeneity leads to a complementary atmosphere rather than to conflicts around decisions. This relationship could make decision-making more reasonable; in other words, members are not aggressive or rigid, and thus the results show that age positively affects the performance of technology start-ups.

Although the expectations are not completely verified, we still obtain valuable conclusions in this study: different types of TMT heterogeneity have different effects on the performance of technology start-ups, and we should refine our research. Age and tenure heterogeneity among TMT members are complementary; they significantly and positively affect the performance of technology start-ups, while functional experience and educational level heterogeneity are conflicting and significantly and negatively affect the performance of technology start-ups. Because the object of this research is technology start-ups in China, this conclusion may not necessarily apply to other types of enterprises; more study is required to explain the mechanism through which TMT heterogeneity influences the performance of technology start-ups.

The Value Creation of Business Models Explains the Differentiation mechanism of TMT heterogeneity on the performance of technology start-ups

Value creation acts as a mediator of the impact of different types of TMT heterogeneity on the performance of technology start-ups. The empirical results verify our hypotheses. This means that TMT heterogeneity affects the performance of technology start-ups through the impact of value creation within the business models. This amplifies the effects, without changing the functional path of TMT heterogeneity on the performance of technology start-ups. The study results help to explain the paradox of the impact of TMT heterogeneity on the performance of technology start-ups. Hence, greater TMT heterogeneity will not necessarily result in higher performance; different types of heterogeneity have different effects on enterprise performance, and the differences are transmitted by value creation within business models.

Discussion

TMT heterogeneity directly influences the value creation of business models, which then affect the performance of technology start-ups. Therefore, during the development process, technology start-ups should focus on the construction of the TMT. (1) Age and tenure heterogeneity across TMT members significantly and positively affects the performance of technology start-ups, so it is better to maintain the age level and continue to introduce new members when constructing the TMT. (2) To reduce differences arising from functional experience and educational level heterogeneity, technology start-ups should pay attention to work shifts and should let members communicate more to narrow the knowledge gap; in this way, members will learn to get along well with each other.

In brief, although some achievements have been made by this study, there are still some limitations. As the research object is in China, the conclusion may not necessarily apply to other types of enterprises. Here, we hope that further study is conducted to enrich the conclusions in related fields.

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