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The Impact of TMT Experience Heterogeneity on Enterprise Innovation Quality: Empirical Analysis on Chinese Listed Companies

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Abstract: High-quality innovation can solve the "bottleneck" problem of key enterprise technologies and drive the high-quality development of enterprises. Therefore, how to improve innovation quality has become a growing concern in the academic industry. In previous studies, the impact of TMT experience heterogeneity on enterprise innovation quality has not been well explored. Based on the panel data of Chinese A-share listed companies, this paper explored how TMT experience heterogeneity affects enterprise innovation quality. The following constitutes our findings: (1) TMT functional experience heterogeneity positively affects partner diversity to promote innovation quality, while industrial experience heterogeneity shows the opposite result. (2) Enterprise partner diversity partially mediates the relationship between TMT experience heterogeneity and innovation quality. (3) TMT technological participation positively regulates the relationship between TMT experience heterogeneity and enterprise partner diversity. This paper gave theoretical support for enterprises to play the role of TMT experience heterogeneity in enhancing innovation quality, and we extended the research on TMT heterogeneity based on empirical analysis. This study also provided new micro evidence for enterprises to use diverse partners to improve innovation quality.

Keywords: TMT experience heterogeneity; innovation quality; partner diversity; TMT technological participation

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1. Introduction

Innovation is not only the key factor for an enterprise to maintain its core competitiveness [1,2], but it is also the source of power for its economic development [3,4]. At present, the impact of the COVID-19 epidemic and the ebb of globalization lead to turbulence in the international market. Chinese enterprises are under increasing competitive pressure. To realize sustainable development, they need to rely on high-quality innovation to overcome the fundamental technological challenges and solve the "bottleneck" problem of key enterprise technologies. Meanwhile, the State Intellectual Property Office of China has repeatedly stressed that although the total number of patent applications of Chinese enterprises has been ranked first in the world, the quality of patents is generally low. China's economy has entered a high-quality development stage, which puts forward higher requirements for an innovation-driven strategy that enables quantity to match quality. This also requires enterprises to shift from the traditional pursuit of innovation ability and innovation quantity to the pursuit of innovation quality. Therefore, it is necessary to explore ways to improve innovation quality.

As the collective leader of the enterprise, the Top Management Team (TMT) has the highest strategic decision-making power, so the TMT has a great impact on enterprise innovation [5,6]. In recent years, due to the increasing difficulty of innovation decision making, TMT heterogeneity has attracted more and more attention [7,8]. TMT heterogeneity refers to the differences in demographic background characteristics and important cognitive concepts and values among senior management members. Based on the upper echelon theory, TMT heterogeneity affects the organization's performance and strategic choices [9,10]. In particular, more and more strategically minded researchers focus on how TMT heterogeneity affects innovation [11,12]. Among them, most scholars found that TMT heterogeneity can promote enterprise innovation. For example, Camelo-Ordaz (2005) [13] argued that TMT education heterogeneity is positively related to innovation performance. Taking the listed companies in the US healthcare industry as an example, Bass A E (2019) [14] found that TMT gender heterogeneity can promote enterprise innovation. On the contrary, some scholars have found that TMT heterogeneity inhibits innovation [15,16]. For example, Liu (2012) [17] believed that TMT age heterogeneity had a negative correlation with enterprise innovation performance.

In summary, two research gaps are shown in the existing literature on the influence of TMT heterogeneity on innovation. Firstly, prior studies have examined the effects of TMT heterogeneity on innovation outcomes [18] and innovation capability [7,19], but they have not yet deeply discussed its effect on innovation quality. The underlying mechanism between them has not been figured out. Secondly, there have been few studies on the effects of TMT experience heterogeneity on innovation quality compared to heterogeneity in terms of gender, age, education, and cognitive and functional background [18,19]. The influence of TMT experience heterogeneity on enterprise innovation quality has not attracted enough attention.

According to the knowledge classification method proposed by Michael Polanyi, experience is a rare tacit knowledge that is the essence of enterprise core competence. Experience, which is hard to learn, imitate, and transfer between enterprises, comes from the long-term work experience of TMT members and is a key source of enterprise core competitiveness. Yang et al. (2020) [7] argue that it is important to concentrate on TMT experience heterogeneity when investigating strategic issues, which is supported by Gu et al. (2020) [20]. Therefore, it is very important to explore the impact of TMT experience heterogeneity on enterprise innovation quality. In addition, TMT experience heterogeneity is an implicit feature, which needs the help of corporate behavior to manifest its role in innovation quality. At present, the speed of technological iteration is accelerating, and the difficulty of innovation is increasing. It is difficult for enterprises to achieve high-quality technological innovation by themselves. Therefore, looking for partners has become an important link in the process of enterprise innovation. Enterprises need to actively seek cooperation with the outside world and give full play to the resource advantages of each cooperative subject to achieve high-quality innovation. Meanwhile, in the process of seeking partners, TMTs have different familiarity with the market, partners, and customers due to their different technical participation, which will affect the direction of enterprise innovation, development, and partner selection. Therefore, to some extent, TMT technical participation will affect the relationship between TMT experience heterogeneity and enterprise partner diversity.

Therefore, the main questions to be solved in this study are listed as follows:

1. How does TMT experience heterogeneity including functional experience heterogeneity and industrial experience heterogeneity affect enterprise innovation quality?
2. What role does enterprise partner diversity play in the relationship between TMT experience heterogeneity and innovation quality?
3. How does TMT technological participation affect the relationship between TMT experience heterogeneity and innovation quality?

We contribute to TMT research in several ways. Firstly, we further enrich the research on TMT heterogeneity based on empirical analysis and provide a theoretical basis for enterprises to optimize the configuration of the TMT to improve innovation quality. Experience, as a kind of tacit knowledge, is an important source of competitive advantage for enterprises. This serves as our jumping-off point for a thorough analysis of the mechanisms behind the decision-making process and decision-making quality of various forms of TMT experience heterogeneity, and we expose their various contributions to the innovation quality. Secondly, we uncover the "black box" that TMT experience heterogeneity affects innovation quality from an internal perspective. We discover the role of partner diversity as an intermediary, which offers theoretical support for enterprises to rationally optimize and organize TMT members, encourages the formation of diversified partnerships, and is of great practical significance because it helps enterprises to enhance innovation quality. Thirdly, we reveal the practical significance of TMT's participation in technology R&D in the context of different experience heterogeneities, which points out the practical path for enterprises to achieve high-quality innovation under the current complex economic environment. We also provide important guidance for TMTs with different experience heterogeneities to participate in innovation R&D, thus further helping enterprises avoid risks when making strategic decisions and ensuring the stable, sustainable, and high-quality development of enterprises.

The rest of this paper is organized as follows: Section 2 reviews the existing research. Section 3 introduces the theory and hypotheses about the effects of TMT experience heterogeneity on innovation quality. Section 4 clarifies the methodology and describes the data collection and processing. Section 5 presents our empirical results. Section 6 is heterogeneity analysis of talent, followed by Section 7 which highlights the discussion and conclusions.

2. Literature Review

2.1. Research on TMT Characteristics Based on the Upper Echelon Theory

Based on the cognitive basis and values of decision makers, Hambrick and Mason (1984) [9] explored the theoretical framework of enterprise strategic decision making and creatively put forward the upper echelon theory. Hambrick and Mason (1984) [9] argued that the behavior of senior managers is a response to their cognitive, value, and experience characteristics. By influencing team cognition, TMT characteristics enable them to make different judgments on alternative plans, future events, and corresponding results, thus affecting strategic decisions and ultimate outcomes. This theory aims to optimize the characteristics of TMTs to improve the team's operation level and subsequent enterprise performance [12,13]. The characteristics of TMTs proved to be an important factor affecting management and even corporate behavior [21].

Scholars have made many achievements in exploring the relationship between TMT characteristics and organizational performance. These scholars mainly focus on two aspects of TMT characteristics: the team's demographic characteristics and heterogeneity. In the face of the complex external strategic environment, executives will bring personal psychological factors (cognitive type, values, personality, etc.) and observable factors (age, gender, education, etc.) into the strategic decision-making process [19]. The advantage of using demographic characteristics for academic research is that it is simple and objective, easy to understand, easy to measure, and has a good predictive effect [22]. TMT heterogeneity refers to the differences in demographic background characteristics and important cognitive concepts and values among senior management members [23]. Theoretically, such differences can cover countless dimensions, including easily identifiable differences such as age, gender, race, educational background, functional experience, and industry experience (as well as differences such as personality and values that are difficult to measure specifically) [7,24]. In fact, considering the availability of data, most of the existing studies focus on the heterogeneity of easily identifiable and stable characteristics. Many organizations and strategically minded researchers apply the upper echelon theory to study the relationship between TMT heterogeneity and organizational performance [24,25]. With the increasingly complex decision-making environment and the increasing difficulty of decision making, heterogeneity has attracted more and more attention [18,26–28]. However, the research on TMT experience heterogeneity is still insufficient.

2.2. Research on TMT Heterogeneity and Innovation

Scholars have conducted extensive research on the impact of TMT heterogeneity on innovation. Researchers advocating a positive view believe that TMT heterogeneity is more likely to stimulate and amplify team members' creativity and innovation, which ultimately promotes the success of enterprise innovation [29]. Beckman (2006) [30] found that teams with a strong heterogeneity of work experience showed more exploratory and innovative behaviors because they have more external contacts and unique ideas. Henneke and Lüthje (2007) [31] pointed out that the composition of interdisciplinary entrepreneurial teams affects the quality of the enterprise's strategic planning process, thus indirectly promoting product innovation. Ni et al. (2016) [32] studied the impact of the balance of team heterogeneity on team creativity. They found that the balance of team knowledge heterogeneity can positively affect team creativity.

Researchers advocating a negative view believe that TMT heterogeneity is not necessarily more conducive to innovation than homogeneity. Amason et al. (2006) [33] found that in highly innovative enterprises, due to the increasing demand for face-to-face communication, the performance of homogeneous teams that could conduct open and collaborative communication was better than that of heterogeneous teams, a finding later supported by Elsbach and Kramer (2003) [34]. Chattopadhyay (1999) [35] argued that differences between team members significantly reduced mutual trust. This was not conducive to the information exchange and integration of the whole team and had a negative impact on innovation. Knight (1999) [36] found that the TMT education heterogeneity could increase the differences among members, trigger internal conflicts, and thus reduce the efficiency of enterprise decision making. The internal conflict caused by TMT heterogeneity also weakened the enterprise's innovation ability [37].

In summary, the existing research demonstrated the impact of TMT heterogeneity on innovation capability and innovation performance from different perspectives, but they have not yet reached a consensus or conclusion. In addition, there is a lack of research on the relationship between TMT experience heterogeneity and innovation quality. According to the patent statistics report of the World Intellectual Property Organization (WIPO) in recent years, the ratio of the effective amount to the applied amount of Chinese invention patents is low, the patent life is short, and a large number of invention patents become invalid before the protection period, which indicates that the patent quality is not high. Based on this, this paper will study the impact and mechanism of TMT experience heterogeneity on enterprise innovation quality to reveal the mechanism "black box" and theoretical boundary of this causal chain.

3. Theory and Hypotheses

3.1. TMT Experience Heterogeneity and Innovation Quality

As tacit knowledge, TMT experience is both difficult to transfer and difficult to be imitated, which is an important source of enterprise competitiveness. The experience heterogeneity caused by individual differences influences the creation of competitive advantages. According to the upper echelon theory, TMT experience heterogeneity influences the team's perception and interpretation of a given situation, which affects strategic decisions such as enterprise innovation [38]. Based on the existing research, TMT experience heterogeneity can be divided into functional experience heterogeneity and industrial experience heterogeneity [7,39,40].

Functional experience heterogeneity refers to the variations in the professional knowledge resources, experience skills, and modes of thought that TMT members possess depending on their job tasks and functions. The stronger the functional experience heterogeneity is, the greater the differences in the experience of general management, financial management, production management, marketing, and technology among members are [7]. Industrial experience heterogeneity reflects the differences in product processes, technology, and customer needs that TMT members have encountered within the industries in which they have worked [20]. The stronger the heterogeneity of industry experience is, the greater the knowledge differences among members regarding industry regulation, opportunities, threats, competitors, suppliers, and customers are. These two types of heterogeneity have different effects on innovation quality.

The knowledge of market service modes is fully integrated after combining members with different functional experiences. This can improve the quality of team decision making and create complementary benefits in company strategic decision making by reducing knowledge blind spots and developing varied thinking patterns [41,42].

Specifically, team members can first create diverse information-processing views based on their own functional experience thanks to the variability of TMT functional experience. On the one hand, it makes TMT members more sensitive to changes in the internal and external environment, which makes it easier to identify new routes for innovation [41] and lowers its uncertainty. On the other hand, it stimulates the TMT to respond to strategies in time, discourages the TMT from engaging in group thinking [9], and offers more innovative decision-making solutions to enhance innovation quality [43]. Secondly, TMT functional experience heterogeneity can promote innovation change [44]. The professional experience of TMT members is an important basis for TMT decision making. Meanwhile, differentiated functional backgrounds provide various professional knowledge, skills, and ideas for solving problems. The collision of cross-functional experiences can effectively enhance the team's capacity for decision making and problem solving [45], which makes TMT more inclined to implement innovation change and finally improve innovation quality. Therefore, we propose the first hypothesis: Hypothesis 1.

Hypothesis 1 (H1). *TMT functional experience heterogeneity is positively related to innovation quality.*

TMT industry experience represents the familiarity and sensitivity of team members to regulations, opportunities, threats, competitors, and industrial chains in the sector [10], which is a unique human capital that those outside the sector do not possess. However, TMT industry experience heterogeneity may diminish the enterprise‘s understanding of market change and knowledge base, which would lower the enterprise‘s ability to innovate [46]. First, the senior executives' inability to fully comprehend the current industry due to their experience working across multiple sectors makes it difficult for TMT to accurately identify market opportunities, perceive market changes, and comprehend the underlying changes taking place in the sector, all of which affect the quality of innovation decisions. Second, because high-quality innovation is characterized by specialization, refinement, and novelty [47], enterprises need to enhance vertical knowledge innovation and creativity, concentrate knowledge, human resources, and other resources to develop new technologies and vigorously develop specialized production. For this reason, many enterprises employ executives with extensive industry knowledge. They make sound decisions for high-quality innovation since they are knowledgeable about industry regulations and technological trends. On the contrary, frequently changing the industry in which they work makes senior executives lack professional knowledge and a unique perspective on the industry. Due to their lack of industry experience, they are not only unable to acquire and integrate resources in a more targeted way to meet the needs of high-quality innovation [48], but they also find it difficult to point out the direction for improving innovation quality. Together, these arguments suggest that TMT industry experience heterogeneity may hinder the improvement of enterprise innovation quality. Therefore, we propose the second hypothesis: Hypothesis 2.

Hypothesis 2 (H2). *TMT industry experience heterogeneity is negatively related to innovation quality.*

3.2. The Mediating Effect of Enterprise Partner Diversity

Technological innovation is the process of recombining knowledge elements. The current ebb of globalization has intensified the market competition of Chinese enterprises. At the same time, the first wave of the industrial, scientific, and technological revolution swept in, offering new challenges to the quality and complexity of enterprise innovation. The enterprise's own knowledge elements are difficult to overcome the key core technologies to meet the above challenges [49,50]. Therefore, enterprises need to actively carry out R&D cooperation with various types of subjects to meet the requirements of high-quality innovation.

On the one hand, different types of partners have different advantages such as power and knowledge. Cooperation with the government can gain the support and trust of the government [51–53] and strive for a good external political environment. Cooperation with universities and scientific research centers enhances the degree of enterprise talent team construction [54], which in turn enhances the quality of enterprise innovation. It also allows universities to contribute their specialists, cutting-edge technology, and scientific information [55,56]. Consumer collaboration can help gain timely product feedback and offer fresh ideas for innovation. Diverse partners bring many high-quality external resources and access to knowledge for enterprises, broaden the knowledge base, optimize the original knowledge structure, and provide intellectual support for high-quality innovation [57,58]. Diverse collaborative research and development across departments, fields, and geographies can overcome geographic constraints, utilize several disciplines to solve innovative issues, and produce higher-quality innovation [59]. On the other hand, diversified partners provide enterprises with diversified thinking modes and R&D methods. This can effectively enhance enterprises' knowledge absorption capacity, promote the upgrading of original technologies and processes, and ultimately improve enterprise innovation quality. Therefore, partner diversity has a positive effect on innovation quality [60].

Based on the important role of partner diversity, exploring its antecedents is of great significance for improving innovation quality. TMT experience heterogeneity affects the team's resource acquisition and specialization, which affects the enterprise's partner selection and relationship maintenance. As for TMT functional experience heterogeneity, according to the resource-based theory, TMTs with a strong functional experience heterogeneity have a broader social network and contacts [61,62]. On the one hand, it supplies enterprises with the opportunity to establish cooperative relationships with partners who master different scarce technological resources. On the other hand, it provides enterprises with comprehensive and precise information to help them understand the real situation and benefits of potential partners so as to make the best decision [63,64]. In addition, TMT functional experience heterogeneity enables the team to have a diversified perspective on information processing, which is conducive to improving the team members' ability to perceive and control risks [65]. Moreover, it allows enterprises to coordinate cooperative relationships with different partners, maximize the advantages of cooperative innovation, and improve innovation quality. Therefore, we propose the third hypothesis: Hypothesis 3.

Hypothesis 3 (H3). *Partner diversity plays a mediating role between TMT functional experience heterogeneity and enterprise innovation quality. That is, TMT functional experience heterogeneity improves innovation quality by improving partner diversity.*

Members of teams with substantial TMT industrial experience heterogeneity have fairly distinct innovation knowledge bases because different industries have different technological R&D paradigms and innovation points. It is easy to have differences in opinion among members in the selection of partners, which leads to management conflicts and is not conducive to the selection of diversified partners. In addition, high-quality innovation needs to be supported by deep industry experience. Executives may not immerse themselves in a particular industry and become specialists in it due to the conversion of numerous industries. Years of work experience in the same industry has made senior executives enjoy a high reputation, which helps attract more types of partners. In the face of numerous choices, executives rely on long-term industry experience to identify which partners can support enterprise innovation. These are all unattainable due to industry experience heterogeneity. Therefore, teams with strong industrial experience heterogeneity find it challenging to identify the fundamental problems impacting innovation quality and develop diversified partnerships due to the absence of broad knowledge in the industry. Therefore, we propose the fourth hypothesis: Hypothesis 4.

Hypothesis 4 (H4). *Partner diversity plays a mediating role between TMT industrial experience heterogeneity and enterprise innovation quality. That is, TMT industrial experience heterogeneity reduces innovation quality by reducing partner diversity.*

3.3. The Moderating Effect of TMT Technological Participation

It is a common practice for senior executives to participate in technology R&D. By participating in technology R&D, senior executives can fully understand the problems and resources needed in the R&D process [66] and make their intellectual labor and creative activities play a leading role in the enterprise's technological innovation process. For a TMT with strong functional heterogeneity, senior executives who participate in R&D can better utilize their advantages in resource acquisition, select partners to better address R&D demands, and develop diversified cooperative relationships. At the same time, when TMTs participate in the process of technology R&D, they often have a risk aversion tendency to maintain their professional reputation [12]. As a result, the TMT is more ready to use its varied knowledge to mobilize resources in the social network, choose diversified partners, avoid R&D risks, and enhance the quality of innovation the higher its technological engagement [67]. Therefore, TMT technological participation enhances the promotion effect of TMT functional experience heterogeneity on partner diversity. Therefore, we propose the fifth hypothesis: Hypothesis 5.

Hypothesis 5 (H5). *TMT technological participation positively moderates the relationship between functional experience heterogeneity and partner diversity.*

When members of the TMT engage in technology R&D, they necessarily draw on their prior industry knowledge to inform their decision making because of the major disparities in innovation models and innovation elements, or in other words, across different industries. This can lead to divisions among TMT members over the choice of partners, causing conflicts, which is not conducive to the establishment and maintenance of diversified partnerships. Therefore, TMT technological participation enhances the inhibition effect of TMT industrial experience heterogeneity on partner diversity. Therefore, we propose the sixth hypothesis: Hypothesis 6.

Hypothesis 6 (H6). *TMT technological participation positively moderates the relationship between industrial experience heterogeneity and partner diversity.*

In summary, the conceptual model of this study is shown in Figure 1.

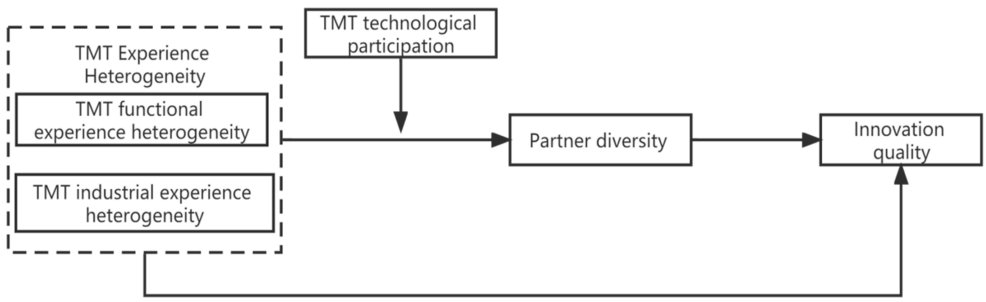

Figure 1. Conceptual model of the impact of TMT experience heterogeneity on innovation quality.

4. Research Design

4.1. Data Collecting

The initial study sample includes all Chinese A-share (RMB ordinary stock) companies listed on the Shanghai and Shenzhen Stock Exchanges from 2011 to 2020. The patent data of this study are from the database of the State Intellectual Property Office of China, and the information on listed companies and the original data of related variables are from the China Stock Market and Accounting Research (CSMAR) database. The following approaches were used to screen the data: (1) Excluding listed companies that issued both

A-shares and B-shares since they had multiple financial sources, a complicated financial structure, and potentially inconsistent data quality. (2) Eliminating any companies with unreasonable financial data or losses that have lasted longer than two years, namely the ST (Special Treatment, that is to say, exercise additional control over the stock trading of the listed companies with abnormal financial or other conditions), * ST (Early warning of delisting risk for stocks that have lost money for three consecutive years), and PT (Particular Transfer, that is to say, stop any trading, clear the price, and wait for delisting) samples of the companies. (3) The status of publicly traded financial corporations is not taken into consideration because they operate, manage, and innovate in ways that are distinct from real economy enterprises, making it difficult to calculate enterprise innovation and other key metrics. Among them, the classification of enterprises by industry refers to the Guidelines on the Classification of Listed Companies by Industry. (4) Eliminating enterprises with serious missing indicators and abnormal data. The data of this research on TMT heterogeneity are from the CSMAR China Listed Company Database.

The enterprise patent data used in this study to calculate the enterprise innovation quality, partner diversity, and other indicators are from the patent database of the State Intellectual Property Office of P.R. China (SIPO). In the database, the number of invention patents and practical patents applied by enterprises from 2011 to 2020 was searched with "applicant = enterprise name", and a total of 422,978 patents were retrieved (Figure 2). Then this research extracts the patent field information of each patent, such as title, application number, application date, IPC, applicant type, and inventor. On this basis, this research calculates the enterprise innovation quality, partner diversity, and the TMT technological participation of each enterprise by using Python and other tools. After the above processing, the remaining 2691 enterprises have 12,797 observations.

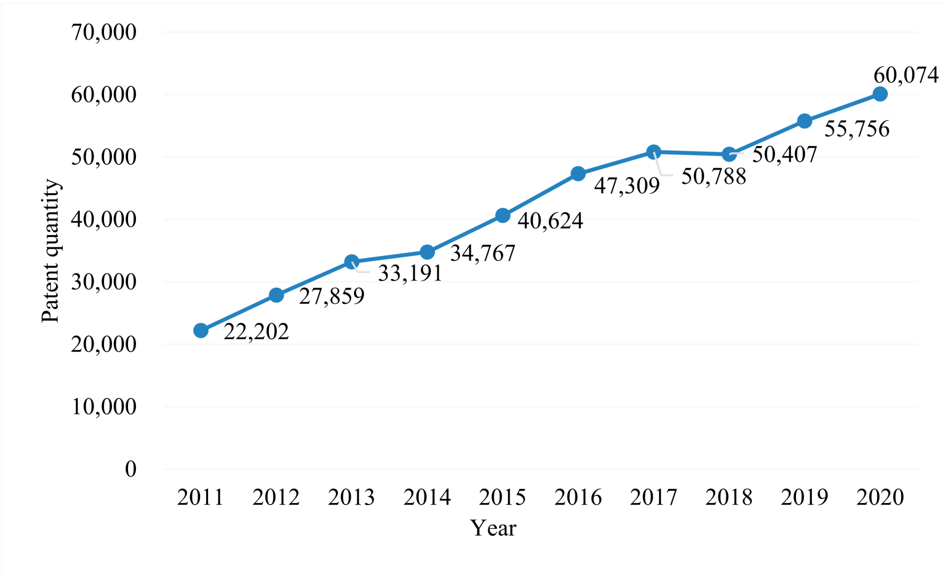

Figure 2. Distribution of annual patent applications of sample enterprises.

4.2. Variable Design and Specification

4.2.1. Independent Variable: TMT Experience Heterogeneity

Based on the research of Daellenbach et al. (1999) [39], Ston et al. (2005) [40], and Yang et al. (2020) [7], this study divides the experience heterogeneity of senior management teams into functional experience heterogeneity and industrial experience heterogeneity.

Functional Experience Heterogeneity (FEH). Firstly, this paper, which is enlightened by Tihanyi et al. (2000) [68] and Yang et al. (2020) [7] and is based on the situation of sample companies, divides the functional backgrounds of TMT members into six categories: (1) manufacturing, (2) research and development, (3) financial accounting, (4) marketing, (5) law, and (6) administrative management (including Party affairs, Communist

Youth Leagues, trade unions, etc.). Secondly, this paper uses Blau (1977)'s categorical index to calculate the TMT functional experience heterogeneity, and the formula is: $\text{HFE} = 1 - \sum_{\text{i}}^{n} p_{ijt}^{2}$. Among them, p_{ijt} is the percentage of members with a type i functional background in TMT of j enterprise in year t, and n is the number of functional background categories. The value of TMT functional experience heterogeneity ranges from 0 to 1. The closer the value is to one, the higher the functional experience heterogeneity of the team.

Industrial experience heterogeneity (IEH). Referring to Yang et al. (2018) [69], firstly, this research paper divides the TMT members' industries and determines the number of various industries. Secondly, the categorical index of Blau is used to calculate the value of each categorical variable separately, and the calculation formula is: $\text{IEH} = 1 - \sum_{\text{i}}^{n} p_{ijt}^{2}$. Among them, p_{ijt} is the percentage of members with a type i industrial background in TMT of j enterprise in year t, and n is the number of industry background categories. The value of TMT industrial background heterogeneity ranges from 0 to 1. The closer the value is to 1, the higher the industrial background heterogeneity of the team.

4.2.2. Dependent Variable: Enterprise Innovation Quality (Eiq)

A patent is an important carrier of enterprise innovation achievements. Traditionally, scholars take the number of patent applications and the number of patent citations as the measurement indicators of innovation quality. With the continuous deepening of research on patent text information mining, scholars are more inclined to use the breadth of enterprise patent knowledge to measure enterprise innovation quality [44,70–72].

This paper draws on the research of Liu et al. (2020) [73] and Wu Liu et al. (2022) [74], which uses the breadth of patent knowledge to represent innovation quality. First, according to the IPC classification system, which consists of five levels, namely part, large class, small class, large group, and group, the Herfindahl–Hirschman index (HHI index) at the large group level is used to measure the knowledge breadth of each patent. The calculation formula is as follows: $\text{HHI} = 1 - \sum \alpha_{\text{p}}{}^{2}$. Among them, α represents the proportion of each major group classification in the IPC classification number of patent documents, and p represents the patent number. A larger HHI means a larger difference in the IPC large group classification level, a wider range of technological fields, and higher patent quality.

As for the annual innovation quality of enterprises, this study uses the natural logarithm of the median of the enterprise's annual patent knowledge breadth index plus one to measure the innovation quality of the enterprise in that year. It should be noted that according to the provisions of Chinese Patent Law on invention, utility model and design patents as well as invention and utility models have strong novelty, creativity, and practicability, but design patents are of low quality and do not have an IPC classification system. Therefore, this study only considers invention and utility model patents when measuring enterprise innovation quality.

4.2.3. Mediating Variable: Enterprise Partner Diversity (Epd)

According to the classification standards of patent applicants of the State Intellectual Property Office, the applicant types are divided into five categories: enterprises, scientific research institutions, colleges and universities, government organizations, and individuals. Based on Wang's research (2021) [75], the Blau index is used to calculate the Epd, and the formula is: $\text{Edp} = 1 - \sum_{\text{i}}^{\text{n}} \text{s}_{\text{i}}^{2}$. Among them, Si represents the proportion of partner type i in the annual technological innovation process of the target enterprise, and n represents the number of partner types in the annual technological innovation portfolio of the enterprise. The Epd index ranges from 0 to 1. The larger the Epd value is, the higher the cooperation diversity of the enterprise.

4.2.4. Moderating Variable: TMT Technological Participation (TMTTP)

TMTTP will not only affect the innovation quality of enterprises but will also change the relationship between TMT experience heterogeneity and Edp to a certain extent. Drawing on the research of Zeng (2012) [76], TMTTP is used as a moderating variable in this study. The formula of TMTTP is: $TMTTP = T_{tm-i}/T_{total-i}$. Among them, T_{tm-i} represents the number of patents with senior executives among the inventors of patents applied by the enterprise in year i, and $T_{total-i}$ represents the total number of the patent applications of the enterprise in that year. The TMTTP ranges from 0 to 1. The larger the value of TMTTP is, the stronger the TMT technological participation is.

4.2.5. Control Variables

In order to reduce the interference of factors other than independent variables and dependent variables in this study, several control variables are included in the analysis drawing on the research of Yang et al. (2018, 2019) [69], Fang et al. (2016) [77], Xiao et al. (2019) [78], and Zhang et al. (2022) [79].

(1) Proportion of technical employees: Human resources are the main force in technological innovation. It is crucial to have a certain number of technical personnel for high-quality innovation. (2) Employee proportion with a bachelor's degree or above: it affects the quality of enterprise human capital, and controlling this variable can avoid the interference caused by the difference of human capital among enterprises. (3) TMT average age: TMT average age reflects the risk tendency of the team members to make decisions. (4) Enterprise size: It may affect the extent of resources that firms commit for capabilities such as innovation. The resources will influence the speed and outcome of strategic decisions made by the TMT. (5) The TMT size: it affects the process and results of internal collaboration among team members [1]. (6) R&D investment: it is an important reflection of its innovation capability and innovation quality. (7) Enterprise capital structure: Capital structure is the result of enterprise financing. It determines the ownership of the property of the enterprise and also stipulates the rights and interests of different investment subjects and the risks borne by them.

Table 1 shows the definitions and descriptions of all variables.

Table 1. Variable definition and description.

Variable	Variable Name	Variable Code	Measurement/Source
Independent variable	Functional Experience Heterogeneity	FEH	Blau (1977) classification index
	Industrial experience heterogeneity	IEH	Blau (1977) classification index
Dependent variable	Enterprise innovation quality	Eiq	The natural logarithm of the median of the enterprise's annual patent knowledge breadth index plus 1
Moderating variable	TMT Technological participation	TMTTP	The ratio of the number of patents participated by senior executives to the total number of patents applied by enterprises every year
Mediating variable	Enterprise partner diversity	Epd	Blau (1977) classification index
Control variable	Proportion of technical employees	Pte	The ratio of the number of technical personnel disclosed by the enterprise to the total number of employees
	Employee proportion of bachelor's degree or above	Epbda	Proportion of employees with bachelor's degree or above disclosed by the enterprise in the total number of employees
	TMT average age	TMT age	The average age of TMT per year
	Enterprise size	Size	The number of employees in an enterprise
	TMT size	TMT size	Number of TMT members
	R&D investment	Rdi	Logarithm of R&D investment of enterprise in each year
	Enterprise capital structure	Ecs	Ratio of total liabilities to total assets

4.3. Research Model

We use the OLS model for empirical analysis. First, to examine the impact of TMT experience heterogeneity on innovation quality, the model is designed as follows:

$$\text{Eiq} = \beta_0 + \beta_1\text{EH} + \beta(\text{Control} + \text{Year} + \text{Industry}) + \varepsilon \quad (1)$$

In Model (1), Eiq is enterprise innovation quality. EH is experience heterogeneity including FEH and IEH. FEH and IEH are respectively substituted into the formula for calculation.

Second, to examine the mediating effect of enterprise partner diversity (Epd), we also use the OLS regression model. The model is designed as follows:

$$\text{Eiq} = \beta_0 + \beta_1\text{EH} + \beta_2\text{Epd} + \beta(\text{Control} + \text{Year} + \text{Industry}) + \varepsilon \quad (2)$$

Epd is added on the basis of Model (1). In Model (2), if the coefficient of β_2 is positive, it indicates that partner diversity plays an intermediary role in promoting enterprise innovation. Based on Hypotheses 3 and 4, we expect β_2 to be significantly positive. The definition of the remaining variables in Model (2) is the same as in Model (1).

Third, to test the moderating effect of TMT technological participation (TMTTP), we add the variable TMTTP and its interaction term with the Epd to Model (1). The model is designed as follows:

$$\text{Epd} = \beta_0 + \beta_1\text{EH} + \beta_2\text{TMTTP} + \beta_3\text{Epd} * \text{TMTTP} + \beta(\text{Control} + \text{Year} + \text{Industry}) + \varepsilon \quad (3)$$

FEH and IEH are respectively substituted into the formula for calculation, and the other variables are defined the same as the previous models. In Model (3), if the coefficient of β_3 is positive, it indicates that TMT technological participation positively moderates the relationship between TMT experience heterogeneity and partner diversity. Based on hypotheses 5 and 6, we expect β_3 to be significantly positive.

5. Results

5.1. Descriptive Statistics and Basic Analysis Results

Table 2 shows the descriptive statistics of all the variables. The maximum value of the dependent variable innovation quality is 0.625, while the minimum is 0, which reveals that the innovation quality of different enterprises varies greatly. The mean and standard deviation of innovation quality are 0.139 and 0.182, which indicates that the overall level of innovation quality of Chinese listed companies is not high. The mean of TMT functional experience heterogeneity and industrial experience heterogeneity are 0.647 and 0.560, which shows that the TMT experience in most enterprises is heterogeneous. In addition, the average, standard deviation, maximum, and minimum values of the other variables in this study are all within reasonable limits.

Table 3 reports the correlation coefficients between the variables. It can be seen that there is a significant correlation among independent variables, regulatory variables, intermediary variables, and dependent variables. Among them, FEH is significantly positively correlated with the Eiq, indicating that with the enhancement of FEH, the innovation quality also gradually improves, which is consistent with Hypothesis 1. Meanwhile, IEH is significantly negatively correlated with the Eiq, indicating that with the enhancement of IEH, the innovation quality gradually decreases, which is consistent with Hypothesis 2.

Table 4 reports the regression results of model (1). The dependent variable is Eiq, the independent variables are FEH and IEH. The control variables, year dummy variables, and industry variables are gradually added. Column (1) to (4) report the regression results with the independent variable as FEH, while column (5) to (8) reports the regression results with the independent variable as IEH. Eiq is significantly positively correlated with FEH (significant at the 1% level), indicating that FEH can improve innovation quality, which is consistent with Hypothesis 1. Eiq is significantly negatively correlated with IEH (significant at the 1% level), indicating that IEH can hinder the improvement of innovation quality, which is consistent with Hypothesis 2. The remaining variables are within the typical range and have no extreme values.

Table 2. Descriptive analysis.

Variable	Mean	p50	SD	Min	Max
FEH	0.647	0.667	0.086	0.180	0.819
IEH	0.560	0.571	0.146	0.067	0.888
Eiq	0.139	0.000	0.182	0.000	0.625
TMTTP	0.256	0.000	0.374	0.000	1.000
Epd	0.042	0.000	0.137	0.000	0.781
Pte	0.227	0.166	0.182	0.002	2.465
Epbda	0.271	0.211	0.215	0.000	2.226
TMT age	47.236	47.364	3.746	33.000	62.75
Size	7.654	7.575	1.113	4.143	12.438
TMT size	6.955	7.000	2.316	2.000	23.000
Rdi	5.105	7.363	4.397	0.000	14.221
Ecs	0.396	0.384	0.202	0.000	4.995

Table 3. Correlation analysis of each variable.

	Eiq	FEH	IEH	TMTTP	Epd	Pte	Epbda	TMT Age	Size	TMT Size	Rdi	Ecs
Eiq	1											
FEH	0.162 ***	1										
IEH	−0.060 ***	−0.029 ***	1									
TMTTP	0.123 ***	0.052 ***	−0.087 ***	1								
Epd	0.163 ***	0.022 **	−0.100 ***	0.098 ***	1							
Pte	−0.005	0.043 ***	0.019 **	−0.043 ***	−0.005	1						
Epbda	−0.032 ***	0.026 ***	0.076 ***	−0.125 ***	0.016 *	0.681 ***	1					
TMT age	−0.009	−0.031 ***	0.050 ***	−0.125 ***	0.026 ***	−0.060 ***	−0.027 ***	1				
Size	−0.044 ***	−0.078 ***	0.085 ***	−0.068 ***	0.049 ***	−0.206 ***	−0.187 ***	0.217 ***	1			
TMT size	−0.005	0.070 ***	−0.087 ***	0.100 ***	0.059 ***	0.035 ***	0.054 ***	0.107 ***	0.295 ***	1		
Rdi	−0.118 ***	0.037 ***	0.130 ***	−0.398 ***	−0.112 ***	0.075 ***	0.142 ***	0.158 ***	0.110 ***	−0.091 ***	1	
Ecs	−0.066 ***	−0.072 ***	0.079 ***	−0.098 ***	0.033 ***	−0.089 ***	−0.049 ***	0.116 ***	0.415 ***	0.169 ***	0.101 ***	1

Note: t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4. Basic results analysis.

	(1) Eiq	(2) Eiq	(3) Eiq	(4) Eiq	(5) Eiq	(6) Eiq	(7) Eiq	(8) Eiq
FEH	0.354 ***	0.358 ***	0.323 ***	0.314 ***				
	(16.61)	(16.77)	(15.24)	(14.82)				
IEH					−0.075 ***	−0.048 ***	−0.054 ***	−0.051 ***
					(−6.15)	(−3.92)	(−4.44)	(−4.14)
Pte		0.010	−0.008	0.000		0.024 *	0.006	0.019
		(0.78)	(−0.61)	(0.00)		(1.83)	(0.47)	(1.37)

Table 4. *Cont.*

	(1) Eiq	(2) Eiq	(3) Eiq	(4) Eiq	(5) Eiq	(6) Eiq	(7) Eiq	(8) Eiq
Epbda		−0.040 ***	−0.056 ***	−0.042 ***		−0.034 ***	−0.044 ***	−0.036 ***
		(−3.51)	(−4.60)	(−3.59)		(−2.97)	(−3.88)	(−3.09)
TMT age		0.002 ***	0.001 ***	0.001 ***		0.001 **	0.001	0.0015
		(3.35)	(2.99)	(2.64)		(2.00)	(1.45)	(1.03)
Size		−0.003 *	−0.012 ***	−0.011 ***		−0.002	−0.010 ***	−0.009 ***
		(−1.65)	(−5.95)	(−5.48)		(−1.19)	(−5.00)	(−4.45)
TMT size		−0.001	−0.001	−0.001		−0.0001	0.0004	−0.0001
		(−1.45)	(−0.70)	(−1.14)		(−0.09)	(0.49)	(−0.09)
Rdi		−0.004 ***	0.012 ***	0.011 ***		−0.005 ***	0.010 ***	0.009 ***
		(−10.26)	(7.69)	(6.81)		(−10.64)	(6.49)	(5.74)
Ecs		−0.049 ***	−0.041 ***	−0.030 ***		−0.049 ***	−0.041 ***	−0.03·***
		(−5.03)	(−4.22)	(−3.00)		(−5.04)	(−4.29)	(−3.12)
_cons	−0.070 ***	−0.067 **	0.029	0.008	0.181 ***	0.185 ***	0.250 ***	0.233 ***
	(−5.01)	(−2.33)	(0.97)	(0.24)	(25.65)	(7.37)	(9.55)	(7.44)
N	10196	10196	10196	10196	10360	10360	10360	10360
Year	No	No	Yes	Yes	No	No	Yes	Yes
Industry	No	No	No	Yes	No	No	No	Yes
R2	0.026	0.045	0.077	0.093	0.004	0.021	0.052	0.070
adj. R2	0.026	0.044	0.075	0.090	0.004	0.020	0.050	0.067

Note: t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.2. Mediating Effect Test

Table 5 reports the regression results for Model (2). As mentioned in the previous theoretical analysis, enterprise partner diversity (Epd) is an important mechanism by which TMT experience heterogeneity affects innovation quality. This paper examines the mediating effect of Epd based on a three-step method. The first step involves testing the relationship between TMT experience heterogeneity and innovation quality. The results of column (1) of Table 5 show that FEH has a significantly positive correlation with innovation quality, and the results of column (4) show that IEH has a significantly negative correlation with innovation quality. They are consistent with the main effect's test results, indicating that FEH can improve innovation quality, but IEH can hinder the improvement of innovation quality. The second step involves testing the regression of the intermediary variable and the independent variable. It can be seen from columns (2) and (5) in Table 5 that there is a significantly positive correlation between FEH and Epd but a negative correlation between IEH and Epd, indicating that FEH increases enterprise partner diversity, whereas IEH reduces it. The third step involves testing the dependent variable's relationship with the independent and mediating variables. The results of column (3) show a significantly positive correlation between FEH and innovation quality and a significantly positive correlation between Epd and innovation quality. The results of column (6) show a significantly negative correlation between IEH and innovation quality and a significantly positive correlation between Epd and innovation quality [80–82]. The influence of the coefficients of the independent factors on the dependent variable decreases when an intermediary variable is added. Epd partially mediates between TMT experience heterogeneity and innovation quality, according to the test of the mediation effect. The above results support Hypotheses 3 and 4.

Table 5. Intermediary effect test.

	(1) Eiq	(2) Epd	(3) Eiq	(4) Eiq	(5) Epd	(6) Eiq
FEH	0.306 ***	0.0563 ***	0.296 ***			
	(14.46)	(3.52)	(14.07)			
IEH				−0.0507 ***	−0.0963 ***	−0.0325 ***
				(−4.17)	(−10.22)	(−2.69)
TMTTP	0.0377 ***	0.0249 ***	0.0334 ***	0.0456 ***	0.0273 ***	0.0396 ***
	(6.97)	(6.27)	(6.21)	(8.39)	(6.74)	(7.34)
Pte	−0.00165	−0.0205 *	0.00237	0.0166	−0.0190 *	0.0211
	(−0.12)	(−1.93)	(0.17)	(1.21)	(−1.78)	(1.56)
Epbda	−0.0336 ***	0.0341 ***	−0.0386 ***	−0.0255 **	0.0345 ***	−0.0321 ***
	(−2.87)	(3.81)	(−3.32)	(−2.20)	(3.84)	(−2.79)
TMT age	0.00146 ***	0.00114 ***	0.00130 ***	0.000714	0.00105 ***	0.000526
	(2.97)	(3.03)	(2.64)	(1.46)	(2.78)	(1.08)
Size	−0.0102 ***	0.00318 **	−0.0106 ***	−0.00756 ***	0.00335 **	−0.00812 ***
	(−4.95)	(2.02)	(−5.16)	(−3.70)	(2.13)	(−4.01)
TMT size	−0.00137 *	0.00101	−0.00149 *	−0.000671	0.000548	−0.000740
	(−1.68)	(1.63)	(−1.84)	(−0.83)	(0.88)	(−0.93)
Rdi	0.0105 ***	0.00123	0.0103 ***	0.00828 ***	0.00149	0.00798 ***
	(6.49)	(1.00)	(6.41)	(5.31)	(1.24)	(5.18)
Ecs	−0.0268 ***	0.0182 **	−0.0291 ***	−0.0268 ***	0.0187 **	−0.0300 ***
	(−2.71)	(2.41)	(−2.96)	(−2.74)	(2.47)	(−3.10)
Epd			0.134 ***			0.177 ***
			(11.35)			(15.08)
_cons	−0.0257	−0.0162	−0.0233	0.184 ***	0.0769 ***	0.168 ***
	(−0.75)	(−0.62)	(−0.69)	(5.81)	(3.15)	(5.36)
N	10,196	11,313	10,196	10,360	11,298	10,360
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.097	0.040	0.109	0.076	0.051	0.096
adj. R2	0.094	0.037	0.105	0.073	0.048	0.093

Note: t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.3. Moderating Effect Test

Table 6 reports the regression results for model (3). It presents the moderating effect of the technological participation of the top management team (TMTTP) on the relationship between TMT experience heterogeneity and Epd. Column (2) and (3) added FEH, IEH and their interaction terms to test Hypotheses 5 and 6, respectively. In column (2), the regression coefficients of the interaction items between FEH×TMTTP and Epd are positive at the level of 1%, indicating that TMTTP enhances the positive correlation between FEH and Epd, which supports Hypothesis 5. In column (3), the regression coefficients of the interaction items between IEH×TMTTP and Epd are positive at the level of 1%, indicating that TMTTP strengthens the negative correlation between IEH and Epd, which supports Hypothesis 6.

Table 6. Moderation effect test.

	(1) Epd	(2) Epd	(3) Epd
FEH	0.057 ***	0.046 ***	
	(3.17)	(2.85)	
IEH	−0.105 ***		−0.107 ***
	(−10.02)		(−11.16)
TMTTP	0.028 ***		
	(6.37)		
Pte	−0.024 **	−0.020 *	−0.019 *
	(−2.05)	(−1.92)	(−1.78)
Epbda	0.038 ***	0.034 ***	0.034 ***
	(3.83)	(3.79)	(3.76)
TMT age	0.001 ***	0.001 ***	0.001 ***
	(2.96)	(3.06)	(2.75)
Size	0.00367 **	0.003 **	0.003 **
	(2.09)	(2.01)	(2.05)
TMT size	0.000	0.001 *	0.001
	(0.65)	(1.65)	(0.92)
Rdi	0.002	0.001	0.002
	(1.25)	(1.00)	(1.32)
Ecs	0.021 **	0.018 **	0.019 **
	(2.45)	(2.42)	(2.44)
FEH * TMTTP		0.038 ***	
		(6.27)	
IEH * TMTTP			0.044 ***
			(6.16)
_cons	0.039	−0.010	0.088 ***
	(1.35)	(−0.37)	(3.63)
N	10,015	11,313	11,298
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
R2	0.053	0.040	0.051
adj. R2	0.049	0.037	0.047

Note: t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.4. Robustness Test

Table 7 shows the robustness of the evaluation methods and indicators. That is, when changing certain parameters, the evaluation methods and indicators still maintain a relatively consistent and stable interpretation of the evaluation results. This research uses the method of replacing the dependent variable for the robustness test. According to the existing research, this paper chooses the ratio of the invention patents number to all patents numbers to measure innovation quality from the perspective of innovation output [83,84]. In columns (1) and (2), the regression coefficients between FEH and Eiq are positive at the level of 1%, while the regression coefficients are negative at the level of 1%. Therefore, the results of the multiple regression analysis remain unchanged after altering the measurement method of innovation quality, indicating that FEH promotes innovation quality while IEH inhibits it.

Table 7. Robustness Test.

	(1) Eiq	(2) Eiq
FEH	0.396 ***	
	(10.74)	
IEH		−0.142 ***
		(−6.56)
Pte	0.151 ***	0.180 ***
	(6.18)	(7.32)
Epbda	0.201 ***	0.184 ***
	(9.77)	(8.93)
TMT age	0.00410 ***	0.00275 ***
	(4.73)	(3.16)
Size	−0.00980 ***	−0.00709 **
	(−2.71)	(−1.97)
TMT size	0.00293 **	0.00444 ***
	(2.04)	(3.11)
Rdi	0.0255 ***	0.0237 ***
	(8.93)	(8.58)
Ecs	−0.0530 ***	−0.0702 ***
	(−3.04)	(−4.03)
_cons	0.151 ***	0.180 ***
	(6.18)	(7.32)
N	11,313	11,298
Year	Yes	Yes
Industry	Yes	Yes
R2	0.198	0.198
adj. R2	0.195	0.196

Note: t statistics in parentheses; ** $p < 0.05$, *** $p < 0.01$.

6. Heterogeneity Analysis of Talent

Talent is an important driving force for the development of enterprise innovation. High-quality talent has become a solid foundation for enterprises to realize the high-quality development of innovation. This paper discusses the impact of TMT experience heterogeneity on enterprise innovation quality. However, the role of technological talents in innovation quality still needs to be further discussed. As the main carrier of technological knowledge, technological talents can promote information and knowledge spillover and improve the enterprise innovation quality, which is an important driving force for the high-quality development of the enterprise economy. Enterprise technological talents may help an organization keep up with or surpass international advanced levels in advanced experimental technology and method innovation. In view of the important role of technical personnel, we explored how the main effect was impacted by the technological talent distribution's heterogeneity.

We used the median regression method. In the first step, the median proportion of enterprise technological talents was 0.166. The proportion of enterprise technical talents less than 0.166 was organized into the group of low technical talents, and the others were organized into the group of high technical talents. In the second step, regression analysis was carried out on the two groups, respectively. According to columns (1) and (2) of Table 8, it can be found that the FEH and IEH regression coefficients of enterprises with low and high technological talents proportions were significant at the 0.01 level and 0.1 level, respectively. The results show that regardless of the technological talents level, the relationship between the enterprises' FEH, IEH, and innovation quality is affected by the proportion of technological talents. Technical personnel play an important role in the high-quality development of enterprises, which is conducive to the effective implementation of the R&D strategy formulated by the TMT, constantly improve the quality of the innovation of the enterprise's products or technologies, and thus make the enterprise handle the leading position in the industry. Therefore, enterprises should pay attention to the structure of technological talents, improve management systems to attract technological talents effectively, and guarantee the high-quality development of enterprises. In the third step, the independent variables were tested separately using the inter-group coefficient difference test. It was found that the coefficients of both groups in FEH and IEH indicators were not significant, so the coefficients of the two groups could not be directly compared.

Table 8. Heterogeneity test of the proportion of technical talents.

	(1) **Enterprises with Low Proportion of Technical Talents**	**(2)** **Enterprises with High Proportion of Technical Talents**
FEH	0.283 ***	0.305 ***
	(9.22)	(9.21)
IEH	−0.0357 *	−0.0314 *
	(−1.94)	(−1.70)
TMTTP	0.0310 ***	0.0432 ***
	(3.80)	(5.31)
Epd	0.153 ***	0.108 ***
	(9.24)	(6.17)
Epbda	−0.0340	−0.0276 **
	(−1.60)	(−2.09)
TMT age	0.000156	0.00231 ***
	(0.21)	(3.09)
Size	−0.00811 ***	−0.00916 ***
	(−2.60)	(−2.90)
TMT size	−0.000565	−0.00202 *
	(−0.43)	(−1.76)
Rdi	0.0104 ***	0.00531 **
	(4.53)	(2.10)
Ecs	−0.0767 ***	0.0116
	(−5.38)	(0.73)
_cons	0.0710	−0.118 **
	(1.41)	(−2.21)
N	4425	4652
Year	Yes	Yes
Industry	Yes	Yes
Ch2	0.24	0.03
R2	0.140	0.096
adj. R2	0.133	0.088

Note: t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7. Conclusions and Discussion

Innovation is the strategic support for promoting high-quality development and building a modern economic system. The government of China has repeatedly emphasized that quality comes first. From a macro perspective, enhancing innovation quality is an inevitable requirement for China to promote the construction of quality power and lead high-quality development. From a micro perspective, it is the top priority for enterprises to maintain vitality and achieve sustainable development. Therefore, it is of great practical significance to explore the driving factors of innovation quality. This research takes the data of Chinese A-share market-listed companies from 2011 to 2020 as research samples. Based on the perspective of experience in tacit knowledge, this research investigates how TMT experience heterogeneity affects enterprise innovation quality, which provides enlightenment for the high-quality development path of China's enterprise innovation. Our findings comprise the following: (1) TMT functional experience heterogeneity positively affects partner diversity to promote innovation quality, while industrial experience heterogeneity shows the opposite result. Hypotheses 1 and 2 are supported. (2) Enterprise partner diversity partially mediates the relationship between TMT experience heterogeneity and innovation quality. Hypotheses 3 and 4 are supported. (3) TMT technological participation positively regulates the relationship between TMT experience heterogeneity and enterprise partner diversity. Hypotheses 5 and 6 are supported.

The increasingly complex global market environment has put forward higher requirements for the stability and sustainability of the high-quality development of enterprise innovation. Accordingly, enterprises should coordinate the advantages of TMT functional and industry experience, build a reasonable and effective executive team, strengthen their awareness of market opportunities and threats, and support the continual improvement of enterprise innovation quality. In addtion, enterprises should utilize TMT functional and industry experience to carry out diverse cooperation with other enterprises, scientific research institutions, universities, government agencies, and organizations. In this way, they can realize the training, introduction, exchange, and sharing of technological talents so as to promote the long-term growth of enterprise innovation quality.

Specifically, firstly, optimize the TMT structure. Building an efficient TMT is not only a need that faces the complex market environment at home and abroad, but it is also an inevitable requirement for enterprises to maintain stability and development. This paper finds that functional experience heterogeneity can promote the improvement of innovation quality, while heterogeneous industry experience can inhibit the improvement of innovation quality. Therefore, enterprises should implement the job rotation system to enrich the working experience of senior executives in different functional positions, which can enhance the team's diversified thinking and innovation awareness and promote the improvement of innovation quality. At the same time, enterprises should hire experts or professional managers who have worked in the industry for many years and reduce the employment of personnel who change frequently in the industry so as to reduce the inhibitory effect of industry experience heterogeneity on innovation quality.

Secondly, establish diversified innovation cooperation relationships and promote technology exchange and sharing. High-quality innovation usually faces a longer R&D cycle and greater risks while putting forward higher requirements on the technology and resources of enterprises. Creating diverse innovation partnerships can, on the one hand, realize resource complementarity and promote knowledge creation and absorption. On the other hand, it can spread risk over a larger group of participants by creating technology co-ownership enabling companies to respond to the challenges posed by high-quality innovation. Therefore, in the process of improving the quality of enterprise innovation, TMT can make full use of the functional and industry experience to actively carry out stable and diversified cooperation with other enterprises, scientific research institutions, colleges and universities, organs, and organizations.

Thirdly, TMT should actively participate in the technology R&D process. TMT not only has a keen perception of the market, partners, and customers but also has the ability to integrate internal and external resources. When TMT members participate in technology R&D, they often have stricter requirements for innovation in order to maintain their professional reputation. An in-depth understanding of the innovation process and problems is conducive to improving the quality of innovation decision making. The enterprise should actively encourage the technical participation of TMT, which can increase the consistency between the innovation achievements and the market demand trend and strengthen the supervision of the enterprise's innovation process to improve the quality of innovation achievements.

8. Limitations and Future Directions

In addition, there are some limitations in this study. (1) Due to a lack of sufficient data, this research only focused on Chinese listed organizations, ignoring the position of unlisted companies, which is only representative for a limited period. However, this research model can be used in different enterprises in other countries. (2) Based on the classification basis of functions and industries in Tihanyi (2000), Yang (2020), and Yang (2018), this study divides experience heterogeneity into functional experience heterogeneity and industry experience heterogeneity, which is insufficient. The classification basis will be refined in future studies to improve the focus of the research results. (3) In this paper, the matching procedure for sample data acquisition based on several databases may involve some manual errors.

Therefore, in future research, based on more comprehensive data, scholars can expand beyond the objects of local Chinese enterprises and consider studying TMTs of multinational enterprises or enterprises in different countries so as to reduce the impact caused by regional cultural differences. In addition, scholars also need to establish a cross-level model from the individual and organizational levels to further analyze the impact of TMT experience heterogeneity on innovation quality.

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