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The Influence of Top Management Team Structure on Enterprise Innovation Performance in the Context of Mixed Ownership Reform of Chinese State-Owned Enterprises

LIU Zhen

Doctor of Management

Supervisors:
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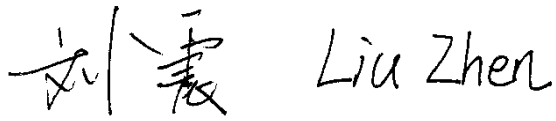
Signed:  Date: 2024.12.30

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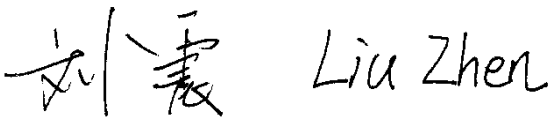
作者签名：  日期：2024.12.30

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Abstract

The aim of this thesis is to examine the influence of the top management team (TMT) structure of state-owned enterprises (SOE) on enterprise innovation performance in the context of mixed-ownership reform of Chinese SOEs.

This study collects unbalanced panel data of 1,321 observations of 387 mixed-ownership enterprises listed on the Shanghai and Shenzhen A-share markets from 2018 to 2022, and primarily uses Stata 18.0 as the statistical tool for descriptive statistics, correlation analysis, and multivariate regression analysis, which leads to the following conclusions:

Firstly, there is a positive relationship between the proportion of non-state directors on the board and enterprise innovation performance; there is also a positive relationship between the proportion of independent directors on the board and enterprise innovation performance; furthermore, there is a positive relationship between the proportion of expert directors on the board and enterprise innovation performance.

We have also found that the TMT structure influences enterprise innovation performance in an indirect manner through the mediation of the TMT's attention; CEO duality accentuates the relationship between enterprise innovation performance and the proportion of independent directors and that of expert directors; however, it does not accentuate the relationship between the proportion of non-state directors and enterprise innovation performance; and, finally, organizational slack accentuates the positive relationship between TMT structure and enterprise innovation performance.

Keywords: state-owned enterprises, mixed ownership reform, top management team, attention allocation, innovation performance

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Resumo

O objetivo principal desta tese é examinar a influência da estrutura da equipa de gestão de topo (*top management team*, TMT) das empresas públicas chinesas (*state-owned enterprises*, SOEs) no desempenho em inovação das empresas o contexto da reforma de propriedade mista das SOEs.

Este estudo utiliza dados de painel não equilibrado, com 1.321 observações de 387 empresas de propriedade mista listadas nos mercados de ações A de Xangai e Shenzhen no período de 2018 a 2022, e utiliza principalmente o Stata 18.0 como ferramenta estatística para a realização de estatísticas descritivas, análise de correlação e análise de regressão multivariada, o que conduz às seguintes conclusões:

Em primeiro lugar, há uma relação positiva entre a proporção de diretores de origem do sector privado no conselho de administração e o desempenho em inovação da empresa; há também uma relação positiva entre a proporção de diretores independentes no conselho de administração e o desempenho em inovação da empresa; além disso, há uma relação positiva entre a proporção de diretores tecnicamente qualificados no conselho e o desempenho em inovação da empresa.

Também descobrimos que a estrutura do conselho de administração influência o desempenho em inovação da empresa de modo indireto através do efeito mediador da "atenção" da TMT; a dualidade do CEO modera positivamente a relação entre o desempenho em inovação da empresa e a proporção de diretores independentes e de diretores tecnicamente qualificados; no entanto, não modera a relação entre a proporção de diretores provenientes do sector privado e o desempenho em inovação da empresa; por fim, a folga organizacional melhora a relação de forma positiva entre a estrutura do conselho de administração e o desempenho em inovação da empresa.

Palavras-chave: empresas públicas, reforma da propriedade mista, equipa de gestão de topo, atribuição de atenção, desempenho em inovação

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摘要

本论文结合中国国有企业混合所有制改革的背景，旨在探讨国有企业高管结构对企业创新绩效的影响。

本研究收集了 2018 年至 2022 年沪深 A 股市场中混合所有制 387 家企业的 1321 条观测值的非平衡面板数据，并主要运用了 Stata 18.0 统计软件进行描述性统计、相关性分析与多元回归分析等，主要得到以下研究结论：

首先，非国有董事在董事会占比与企业的创新绩效之间存在正相关性；其次，独立董事在董事会占比与企业的创新绩效之间存在正相关性；另外，专家型董事在董事会占比与企业的创新绩效之间存在正相关性。

本研究还发现，高管团队结构对企业创新绩效的影响并非直接产生，而是通过高管团队注意力的中介作用得以实现。两职合一对独立董事比例、专家型董事比例与企业创新绩效起正向调节作用；而对非国有董事比例与企业创新绩效之间关系没有正向调节作用。组织冗余增强了高管团队结构与企业创新绩效之间的正向关系。

关键词：国有企业，混合所有制改革，高管团队，注意力配置，创新绩效

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List of Abbreviations

CFA	Confirmatory factor analysis
EFA	Exploratory factor analysis
SOE	State-owned enterprise
TMT	Top management team

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Chapter 1: Introduction

1.1 Research background

Chinese state-owned enterprises (SOE) generally refer to enterprises invested by the Chinese government, distinct from privately-owned enterprises without government investment (L. Han, 2019). Since the reform and opening up, SOEs have achieved significant progress in terms of economic scale and number of enterprises, among others. However, phenomena such as extensive production, low-level competition, and blind construction still abound, and the original development model is no longer sustainable. That requires SOEs to promote high-quality development through mixed ownership reform, enhancing their "five capabilities". Specifically, they should improve overall "competitiveness" through capital complementarity, enhance "innovation capability" by stimulating entrepreneurial spirit, increase "control" and "influence" over key industries through the layout of state capital, and actively integrate high-quality SOEs into the global industrial system to enhance "risk-resistance" (He & Yang, 2021).

Innovation, continuous improvement, and transformation are the three cornerstones for enterprises to gain competitive advantage (J. Wu et al., 2016). Top management teams (TMTs) serve as the decision-makers and implementers of the innovation strategy within enterprises. Whether SOEs can leverage the innovative spirit of the TMT is crucial to enhancing their "innovation capabilities" and "competitiveness".

Modern corporate legal system includes two aspects: equity structure and corporate governance structure. Equity structure is mainly manifested through shareholders' meetings, while corporate governance structure is composed of boards of directors and management. With the gradual advancement of mixed ownership reform, SOEs gradually improve their structural adjustments at the shareholder level by introducing non-public capital.

Yet at the level of corporate governance structure, many SOEs do not recruit senior management positions through the board of directors, but rather, the senior management positions of central SOEs are directly appointed by the State-owned Assets Supervision and Administration Commission (SASAC), a practice that deviates from the norms of typical publicly listed companies in modern times (J. Liu et al., 2020). Under this model of TMT appointment, SOEs have become "transit stations" in the promotion mechanism for government

officials or the ideal "destinations" for retiring government officials (Qi & Zhang, 2019). In this mode, the TMT is likely to focus on short-term performance of SOEs, while paying limited attention to and being unmotivated to drive innovation activities with higher risks and longer implementation cycles.

Since the initiation of reform and opening up in 1978, China has experienced significant changes over the past 40 years. SOEs have undergone major reforms in ownership systems and internal operational mechanisms. The mixed ownership reform in SOEs has deep historical roots in the transition of China's economic system. The evolutionary process of mixed ownership reform in SOEs aligns closely with the timeline of economic system transitions, SOE reforms, and the development of private enterprises.

1.1.1 The evolution of reform

The evolution of mixed ownership reform in SOEs in China can be broadly divided into four stages: mixed "form", mixed "capital", mixed "property rights", and mixed "mechanism" (He & Yang, 2021). The first stage (1978-1992) features the "decentralization of power and transfer of profit"; the second stage (1992-2002) is characterized with "capital integration"; the third stage (2003-2012) features "state-owned asset supervision"; and the fourth stage (2013 to the present) is the period of "comprehensive deepening of reform".

1.1.1.1 The first stage: Decentralization of power and transfer of profit

Before China's reform and opening up in 1978, China's economic system, following the economic model of Lenin's Soviet Union, was featured by a comprehensive state-owned conglomerate where all economic resources were controlled by the government (J. Wu, 2018). Under the conditions of a planned economy, all Chinese enterprises were funded by the government, leading to the integration of public finance and enterprise finance. On one hand, all economic activities of enterprises were highly dependent on planned arrangements, and on the other hand, enterprises did not have their independent economic interests, severely impeding the initiative and vitality of enterprise development.

In order to stimulate the self-initiative of enterprises, following the reform ideology of "self-management, self-financing, self-development, and self-restraint", the Chinese government began to decentralize and delegate powers to the management of SOEs. In the mid to late 1980s, most SOEs implemented a contracting system.

While the contracting system to some extent activated the vitality of SOEs, it had significant limitations. The contracting system failed to clarify the property rights of SOEs,

making them prone to mutual infringement between contractors and subcontractors. In pursuit of short-term benefits, subcontractors' actions inevitably led to short-termism, and they might even expand their interests at the expense of the owners'.

1.1.1.2 The second stage: Property right reform

In the mid-1990s, China's SOEs encountered difficulties. In 1988, the loss-making rate of industrial SOEs was 10.7%. As of 1995, the number of loss-making industrial SOEs accounted for 33.3% of the total number of industrial enterprises. In 1998, this number increased to 47.4%, and the total profit of all SOEs turned negative, reaching a loss of SOEs 7.8 billion RMB (Ministry of Finance [MOF], 1999).

With the development of the private economy, increased supply led the market to gradually transition from a seller's market to a buyer's market. The contracting system reform in SOEs failed to achieve the expected results, and the demand for establishing a modern corporate system became increasingly urgent. Establishing corporate governance structures was the core content of corporatization. In December 1993, China promulgated the *Company Law of the People's Republic of China*, which aligned with international practices, and decided to gradually restructure large SOEs into joint-stock limited enterprises in accordance with this law.

Corporate governance is an institutional arrangement for the principal-agent relationship between ownership and management rights of an enterprise. It establishes a system of checks and balance through the design of owners (shareholders), the board of directors, and the management. A principal-agent relationship is formed between the owners (shareholders) and the board of directors, where shareholders authorize management rights to the board of directors, who are responsible for the enterprise's corporate assets. A principal-agent relationship is also formed between the board of directors and the management, where the management is appointed by the board of directors to handle the enterprise's daily operations. Through a comprehensive system of authorization and incentives, on one hand, it can motivate members of the board and management to maintain operational enthusiasm; on the other hand, members of the board and management are still subject to multiple constraints such as market competition, capital competition, and professional management market competition.

By the end of 1997, the State Economic and Trade Commission and the State Commission for Restructuring the Economic System conducted an inspection of the pilot SOEs and found that almost none of them reached the standard of modern corporate system (J. Wu, 2018). The main issue is that the board of directors is predominantly composed of "insiders", leading to a significant overlap with the management. Following property rights reform, SOEs commonly

faced a situation where "insider control" coexisted with routine intervention from the superior holding group.

1.1.1.3 The third stage: State-owned assets supervision

After entering the 21st century, Chinese SOEs faced a significant problem in establishing a modern corporate system, namely the long-term ownership absence. In March 2003, SASAC was established. In 2008, the *Law on State-owned Asset in Enterprises* was promulgated and implemented, stipulating that SASAC "legally exercises the rights and responsibilities of the investor in state-funded enterprises, including enjoying returns on assets, participating in major decision-making, and selecting and appointing managers". Thus, SASAC comprehensively manages SOEs in terms of personnel, affairs, and assets.

Although the establishment of SASAC strengthened the direct supervision and scrutiny of senior executives in SOEs by the government, significant problems persist. First, SASAC belongs to a governmental functional department and acts as a regulator of market rules. Simultaneously, SASAC participates in the market as the shareholder of SOEs. Thus, SASAC plays the dual roles of "referee" and "player", which inevitably brings adverse effects to the market. In addition, the establishment of SASAC still cannot address serious governance problems caused by insider control. The government's prioritized allocation of resources to SOEs through various administrative means not only leads to inefficiencies in resource allocation but also leads to rent-seeking behaviors and corruption.

1.1.1.4 The fourth stage: Comprehensive deepening of reform

In 2015, the State Council issued the *Guiding Opinions on Deepening the Reform of State-owned Enterprises*, which called for further classified advancement of the reform of SOEs. The State Council highlighted the need to promote the improvement of the modern corporate system, the management system of state-owned assets, and the government's management of enterprise executives. It especially emphasized that "mixed ownership reform" links the reform of SOEs themselves with other enterprises and investors (S. Huang, 2018).

The scale of mixed ownership reform in Chinese SOEs continues to expand. From 2013 to 2021, central SOEs implemented over 4,000 mixed ownership reform initiatives, absorbing more than 1.5 trillion yuan in social capital. In terms of the number of mixed ownership reform initiatives, mixed ownership enterprises accounted for over 70% of central SOE legal entities, an increase of nearly 20 percentage points compared to 2012. Local SOEs had a mixed ownership ratio of 54%, introducing over 700 billion yuan in social capital. From 2012 to 2020,

the minority shareholder equity formed by the introduction of social capital through mixed ownership reform in central SOEs increased from 3.1 trillion yuan to 9.4 trillion yuan, and the proportion of social capital in the ownership of central SOEs increased from 27% to 38%. State-owned capital and social capital have achieved a broad degree of integration at the ownership level (He & Yang, 2021).

In November 2019, during the third meeting of the State Council's Leading Group for State-owned Enterprise Reform, it was emphasized that the next three years would be a critical historical stage, and that it was a must to effectively implement the top-level design of SOE reform, urgently study and formulate a three-year action plan for SOE reform, and clearly outline the goals, timeframe, and roadmap for the reform. In December 2019, the Central Economic Work Conference further stressed that it was necessary to formulate and implement a three-year action plan for SOE reform to enhance the comprehensive effectiveness of the reform of state-owned assets and enterprises (J. Liu et al., 2020).

The reform of Chinese SOEs has always been accompanied by the reform of the Chinese economic system. As China's economy gradually opens up and moves toward marketization, SOEs are also progressively adjusting their ownership structures —a process closely aligned with the overall timeline of China's economic development (M. Li, 2021).

1.1.2 Enhancing innovation capability: One of the main aims of SOE reform

Enterprise innovation is one of the important responses for enterprises to survive and develop in a competitive environment. An increasing number of Chinese SOEs have recognized the importance of innovation and have chosen the path of development through innovation (E. Xu, 2022). The rapid development of Chinese enterprises is accompanied with the dual pressures of resource scarcity and environmental pollution. The existing extensive development model is no longer able to meet the long-term development needs of enterprises. There is a growing call from various sectors of society for environmentally friendly technologies. Therefore, changing the development model and achieving green development has become an urgent demand of Chinese enterprises (J. Wu & Hua, 2021).

On June 30, 2020, the 14th meeting of the Central Committee for Comprehensive Deepening Reform reviewed and approved the *Three-Year Action Plan for State-Owned Enterprise Reform (2020-2022)*, further clarifying the key stage roadmap for SOE reform. This roadmap took the increase in the "five capabilities" of the state-owned economy as the goal and end point of reform. Z. Li (2020) pointed out the following problems in innovation among

central SOEs: 1) weak innovation capabilities in central SOEs, with innovation mainly concentrated in several enterprises; 2) a small proportion of invention patents owned by central SOEs; 3) serious lag in national standards, leading to compromised product quality; 4) insufficient high-level talents and severe talent attrition.

If a country does not pursue a certain reform or innovation, another country will likely do so, forcing its neighbors to follow; otherwise, they risk being conquered or falling into economic disadvantage (Diamond, 1997). China's SOE's are also facing similar challenges and urgently need reform, whether in response to external or internal pressures.

Many Chinese SOEs are gradually transitioning from traditional labor-intensive enterprises to knowledge- and technology-intensive enterprises. The process of overcoming technological bottlenecks in SOEs involves a multitude of unforeseeable factors, and the enterprises face intense external competition and internal reform pressures. Therefore, management practices need to actively respond to both internal and external changes.

From an external perspective, SOEs have shifted from operating in a closed market before the reform and opening up to actively participating in an open market. With the development of private enterprises, market competition has intensified, shifting from a seller's market to a buyer's market. The rapid growth momentum of private enterprises has continuously weakened the scale advantage and policy advantage of SOEs, making it imperative for them to establish competitive advantages.

Internally, SOEs need to focus on building their core competitiveness. With the overall economic development of society, the core competitiveness of SOEs is gradually changing. The cost advantage of SOEs, resulting from their scale advantage, is gradually being replaced by innovation advantage, which is becoming the most important core competitive advantage for enterprises.

In summary, from either an external or internal perspective, the reform is imperative for SOEs, and one of its main purposes is to enhance the innovation capability of these enterprises.

1.1.3 Impact of TMT structure on innovation performance in SOEs

Enterprise innovation affects enterprise performance in terms of sales revenue, market share, and production efficiency, while also helping enterprises to establish sustainable competitive advantages, thereby generating economic rents above the average level (M. Wu, 2019). SOEs in China are emerging as the main drivers of innovation, with extensive investment in innovation being a necessary condition to ensure innovation outputs. From the perspective of

ownership structure, as private capital is more motivated to supervise the innovative development of enterprises, partial privatization of SOEs has a positive impact on these enterprises' profitability, productivity, and investment (Gupta, 2005). Ferreira et al. (2014) developed a model to study the impact of public and private ownership structures on enterprises' incentives to invest in innovative projects. They found that compared to SOEs, privately owned enterprises, when faced with bad news, have a higher risk tolerance and a stronger intention to invest in innovative projects because the internal personnel, due to their informational advantage, can choose to exit in advance.

Innovation and innovation investment, as strategic initiatives for enterprises, are determined and implemented by the TMT. The characteristics of the TMT influence TMT members' cognition, which in turn affects the decision-making and the implementation of decisions within the enterprise. Moreover, the innovation-related decisions made by the TMT are not solely dependent on the individual traits of its members but are also influenced by factors related TMT's attention. In other words, the amount of attention that the TMT devotes to innovation directly impacts the innovation performance of the enterprise. Against the backdrop of reform in Chinese SOEs, there has been a significant change in the TMT structure, transitioning from its members being solely appointed by the government to being recommended and appointed by various types of shareholders. This shift has had a noticeable impact on the innovation performance of SOEs.

1.1.4 Impact of organizational slack on innovation performance

The concept of "organizational slack" was first proposed by Cyert and March (1963). It refers to the part of the organization's resources that exceed the actual operational demands. These resources exist within the organization but have not yet been utilized. They can buffer the environmental impacts encountered by the organization to certain extent (X. Deng & Guo, 2020; Nohria & Gulati, 1996). Enterprise innovation is a high-risk and investment-intensive business activity, with considerable uncertainty in its outcomes (Haveman & Nonnemaker, 2000). With a higher the level of organizational slack, the environment for the enterprise's innovation, research and development (R&D), and investment is more relaxed (Hagedoorn & Cloodt, 2003; Qian et al., 2023). From the perspective of TMT, organizational slack impacts managers' perception of risk in decision-making (Lian et al., 2019). When organizational slack is at a higher level, the enterprise has greater risk resistance, and thus, the enterprise's TMT is likely to implement innovation investment; conversely, when organizational slack is at a lower level,

the enterprise's TMT may reduce investment in innovation (Kraatz & Zajac, 2001; Symeou et al., 2019).

From the perspectives of property rights structure and equity structure, scholars such as A. Xiong et al. (2021), D. Wang (2021), and Lu and Li (2021) studied the impact of changes in property rights and equity structure on SOEs' innovation during the mixed ownership reform. However, they did not consider how the structure of TMT (including board members and management team members) affects the innovation performance of SOEs under the dual-agent framework of shareholders' meeting – board of directors – management team (Boubakri et al., 2013; Joseph, 2017). To fill this research gap, considering the focus and hotspots of current economic reform, this study attempts to explore the impact process following the logic of "mixed ownership reform – TMT structure – management process – enterprise outcomes". Firstly, as non-state-owned shareholders represent marketization, through the proportion of non-state TMT members, we can analyze the degree of marketization of SOEs after mixed ownership reform. Secondly, this study examines to what extend and how the TMT influences SOEs' innovation after mixed ownership reform, and then clarifies whether the TMT formed after mixed ownership reform improved the innovation capability of SOEs. Finally, from the perspective of optimizing the implementation path of mixed ownership reform in SOEs and strengthening the management mechanism of TMTs in these enterprises, targeted recommendations are proposed to improve the governance mechanism of non-state shareholders and foster innovation in SOEs, providing references for mixed ownership SOEs to improve their innovation management.

1.2 Research problem, questions, and objectives

1.2.1 Research problem and questions

According to the literature, enterprise innovation in China mainly comes from the private sector, while SOEs generally are found to make insufficient innovation efforts. From the beginning of reform and opening up until 2018, approximately 70% of technological innovation, 65% of invention patents, and over 80% of new products developed in China originated from small and medium-sized enterprises. Moreover, private technology enterprises accounted for 70% of the enterprises in the 53 national-level high-tech development zones and 80% or above of government-certified high-tech enterprises (L. Zhou et al., 2018).

The Chinese government is increasingly emphasizing the enhancement of innovation

capabilities through SOE reforms. In April 2017, during an inspection tour in Guangxi, Xi Jinping emphasized that SOEs should serve as pioneers in implementing development concepts, driving innovation-led development, and implementing major national strategies (Z. Li et al., 2020). In December 2023, the SASAC of the State Council held a meeting of leaders of central SOEs, emphasizing that "central SOEs should give full play to their roles as main drivers in scientific and technological innovation, actively taking the lead in achieving key breakthroughs in core technologies, constructing a robust innovation system, and reshaping the national scientific and technological innovation capabilities, thereby promoting high-level self-reliance and strength in science and technology".

However, SOEs still face various problems such as weak innovation capabilities, concentration of innovation capabilities in a few enterprises, small proportion of invention patents, serious lag in national standards, and unreliable product quality.

Management innovation is an essential means to enhance organizational operational efficiency, maintain competitive advantage, and even improve the efficiency of technological innovation (Daft, 1978; Z. Zhang, 2021). The problem of insufficient innovation has persisted alongside the overall development of Chinese SOEs, and the reasons are complex. Schumpeter has provided insightful explanation on innovation, suggesting that innovation arises as new enterprises continually carry out reform internally, introducing new goods, production methods, or business opportunities to disrupt existing industry structures, thus fostering a creative destruction process characterized by constantly disrupting old structures and creating new ones (Z. Chen, 2021). For a considerable period, Chinese SOEs had the government as their sole shareholder, with their TMT members appointed by government authorities. The singularity of their ownership structure and governance framework, and especially the homogeneity of their TMTs have significantly impacted innovation within these enterprises.

As the formulators and implementers of enterprise innovation strategies, TMTs play a crucial role in enhancing enterprises' innovation performance (Xuan & Lv, 2024). To drive deeper reforms in SOEs, the Chinese government has identified mixed ownership reform as an effective path. By introducing shareholders with diverse ownership backgrounds, adjustments have been made to the corporate governance structure of SOEs. The involvement of various stakeholders in enterprise management has influenced innovation within these enterprises.

However, the implementation of mixed-ownership reform in SOEs does not necessarily lead to an improvement in these enterprises' innovation performance. In fact, after mixed-ownership reform, the innovation performance of some SOEs was found to be significantly lower than the average level of the industry. In light of this problem, this study attempts to

explore the following core question: "To what extent and how does the TMT structure of mixed-ownership SOEs affect enterprise innovation performance?" This core question was further divided into four specific research questions (RQs) for examination:

RQ1. What is the relationship between the board structure in mixed-ownership SOEs and enterprise innovation performance?

RQ2. How does the board structure affect enterprise innovation performance through the TMT's attention?

RQ3. How does organizational slack influence the relationship between the board structure and enterprise innovation performance?

RQ4. How does CEO duality influence the relationship between the board structure and enterprise innovation performance?

1.2.2 Research objectives

The Upper Echelons Theory, from management perspectives, suggests that TMTs can influence organizational behavior and significantly impact the outcomes of organizational activities (Quigley & Hambrick, 2012). The theory of organizational behavior posits that the limited organizational attention and the competitive nature of the organization's multiple internal objectives have significant impact on the allocation of organizational attention (M. Zhang et al., 2018). In the context of mixed ownership reform in Chinese SOEs, under the dual-delegation corporate governance structure of shareholders' meeting – board of directors – management, the mechanism by which the TMT structure of SOEs influences innovation performance remains unclear. After mixed ownership reform, the composition of the TMT in SOEs becomes more complex, raising questions about whether it affects the allocation of attention within the TMT and further influences the innovation performance of SOEs.

Under the background of mixed ownership reform in Chinese SOEs, this study aims to further investigate different TMT structures and their impact on innovation performance, as well as the underlying influence mechanisms.

1.3 Key concepts and their connotations

This study primarily focuses on the influence mechanism between TMTs in Chinese SOEs and innovation performance in the context of mixed ownership reform. The key concepts, as well as their definitions and connotations in this study, are outlined as follows.

1.3.1 Mixed ownership reform of SOEs

Based on the research by J. Wu (2018), S. Huang (2018) and He and Yang (2021), and considering the 40-year reform in Chinese SOEs, in this study, "mixed ownership reform of SOEs" refers to the reform of Chinese SOEs from wholly state-funded entities to mixed-ownership enterprises from 2015 to the present.

1.3.2 Top management team (TMT) of SOEs

According to Krause (2022), the TMT of an enterprise refers to the group of executives responsible to the CEO. They convene regularly to design organizational strategies and oversee their implementation. Here, the definition of the TMT involves two core aspects: formulating enterprise strategies and organizing their implementation.

However, in the market environment of China, TMTs of enterprises face some particular circumstances. As the government typically holds the majority stake in SOEs, it wields ultimate decision-making power in personnel appointments and dismissals. SOE executives often hold dual identities as government officials and entrepreneurs, resembling "quasi-officials" rather than professional managers (Y. Xu, 2019). Moreover, due to the fact that the executives of Chinese SOEs operate in a closed, pyramid-shaped labor market, it is not feasible to directly replicate foreign corporate governance structures in their entirety (Y. Huang et al., 2021).

The definition of the TMT varies within the academic community in China. Some scholars hold that the relationship between the chairman and the CEO in Chinese listed enterprises differs somewhat from that in mature foreign markets: the chairman in Chinese enterprises is more akin to a CEO abroad, while the role of the CEO is closer to that of a COO (D. Wu & Xu, 2021). Zeng et al. (2020) defined the TMT as comprising the chairman (chairman of the board), vice chairman (vice chairman of the board), CEO, general manager, vice general manager, president, vice president, chief financial officer (CFO), and the board secretary. J. Liu et al. (2021), however, posit that the TMT includes members of the board of directors, members of the supervisory board, and members of the management team. Additionally, Sui and Zhao (2021) suggested that the TMT in Chinese enterprises consists of directors, vice general managers, chairmen, vice chairmen, vice presidents, and CFO.

Given the context in China, where the board of directors of SOEs is responsible for formulating and making decisions on enterprise strategy, and the management team is responsible for executing enterprise strategy, this study defines the TMT as primarily including the chairman, directors, and CEO.

1.3.3 TMT's attention

The Upper Echelons Theory suggests that the external environment in which enterprises operate is dynamic and complex. Managers cannot attend to all the information in the environment, and their traits determine how they select and implement strategies, thereby influencing enterprise performance (Fan et al., 2023). The decisions of the TMT of SOEs represent the decisions of the enterprises themselves, and the behavior of SOEs is determined by how they allocate and manage the attention of their top managers (J. Wu et al., 2016). On one hand, when TMTs of SOEs selectively focus on a specific issue (e.g., enterprise innovation), they will increase the intensity of attention, making them more likely to identify opportunities within it. On the other hand, once TMTs of SOEs have invested a certain amount of attention in innovation, they tend to invest more proactively in innovation due to the loss aversion psychology, aiming to avoid the sunk cost effect (Eggers & Kaplan, 2009).

The attention of TMT mentioned in this study mainly refers to selective attention and executive attention of the TMT of an SOE. Selective attention refers to the degree of attention that the TMT pays to innovation issues, while executive attention refers to the extent of the TMT's investment in enterprise innovation.

1.3.4 Innovation performance of SOEs

Innovation, as a key factor for enterprises to maintain core competitiveness, is crucial for the steady increase of enterprises' long-term value (Liang & Xu, 2023). However, scholars' opinions are divided regarding the definition of innovation performance (Gao, 2023). For instance, scholars such as Liang and Xu (2023), M. Song (2023), X. Xu and Xiao (2023), as well as X. Zhao (2023) argued that innovation performance, as an outcome variable, should be defined using indicators of innovation output, such as the number of patent applications, the number of patents granted, and the value of new product output. However, some scholars hold that innovation performance of enterprises should be measured through process variables using the ratio of innovation inputs to outputs, such as the ratio of R&D investment to operating income and the ratio of R&D revenue to total assets (Gao & Peng, 2021; S. Li & Li, 2022).

This study posits that the innovation performance of SOEs is influenced by both the decision-making and management processes of the enterprise and is reflected in the output results. Therefore, the innovation performance in this study is represented by the output of patent applications.

1.3.5 Organizational slack

Organizational slack refers to the existence of resources in an enterprise beyond what is necessary for operation. Due to the changes in the external environment and the limitation of decision making, factor resources will inevitably produce surplus in the process of production and management (Y. Liu et al., 2023). Organizational slack, as spare resources, exists in many forms in business activities and can provide enterprises with the ability to resist risks, affecting innovation and other strategic decisions within enterprises (Nohria & Gulati, 1996; Sharfman et al., 1988).

In this study, organizational slack refers to relatively idle resources in the organization, which can be freely used by decision makers and is an important resource guarantee for enterprises to carry out strategic innovation (J. Song et al., 2023).

1.4 Research design

1.4.1 Research methods

The research methods employed in this study align with mainstream research approaches, combining qualitative and quantitative methods, as well as normative and empirical research. It primarily adopts the following four research methods.

First, the literature method. This study primarily utilizes Chinese and international literature databases such as CNKI, Wanfang Data, and Web of Science. Comprehensive searches were conducted with keywords such as mixed ownership reform of state-owned enterprises, TMT, TMT's attention, CEO duality, and innovation performance. This study systematically reviewed and analyzed relevant literature to summarize the current research findings. It identified the gaps and limitations of existing research, highlighting the significance of this research.

Secondly, the theoretical research method. The primary theories utilized in this study include Principal-Agent Theory, Upper Echelons Theory, and Attention-Based View. Based on the literature review, this study endeavors to employ above theoretical framework to address the research questions.

Thirdly, the statistical analysis method. This study selected 387 mixed-ownership enterprises with state-owned capital as the actual controllers from the main board markets of the Shanghai Stock Exchange and the Shenzhen Stock Exchange (excluding ST enterprises and those that did not disclose R&D expenditure or patent data). Employing sources such as Sina Finance, WIND, Choice, and Wingo, data including annual reports and financial statements

from 2018 to 2022 were collected for analysis. Using Stata 18.0, the raw data was processed and cleaned, and descriptive statistics, correlation analysis, and multivariate regression analysis were conducted on the research variables.

Fourthly, the content analysis method. Content analysis is a research method that describes the content of text in a systematic, objective, and quantitative approach. By analyzing the information content and its changes in communication content, it can infer accurate meanings from words and phrases with representational significance. In this study, the "Management Discussion and Analysis" section in the annual report of listed enterprises was selected as the object of text analysis, with the aim of measuring the level of attention that TMTs of sample enterprises devote to innovation.

1.4.2 Technical roadmap

In accordance with the research objectives and content, the fundamental technical roadmap of this study are as follows. First, based on the practical background and the theoretical gaps, this study proposed specific research questions. Second, this study defined the core concepts (i.e., mixed-ownership reform of SOEs, TMTs of SOEs, TMT's attention, innovation performance of SOEs, and organizational slack), conducted theoretical reasoning based on the literature review, and proposed specific research hypotheses in the attempt to address the research questions. Third, this study analyzed the impact of TMTs on innovation performance of SOEs in the context of mixed ownership reform, delving into the influence mechanisms and contextual effects. Finally, drawing from the obtained results, this study carried out discussion and drew conclusions, while pinpointing research limitations and prospects for future research. The technical roadmap of this study is depicted in Figure 1.1.

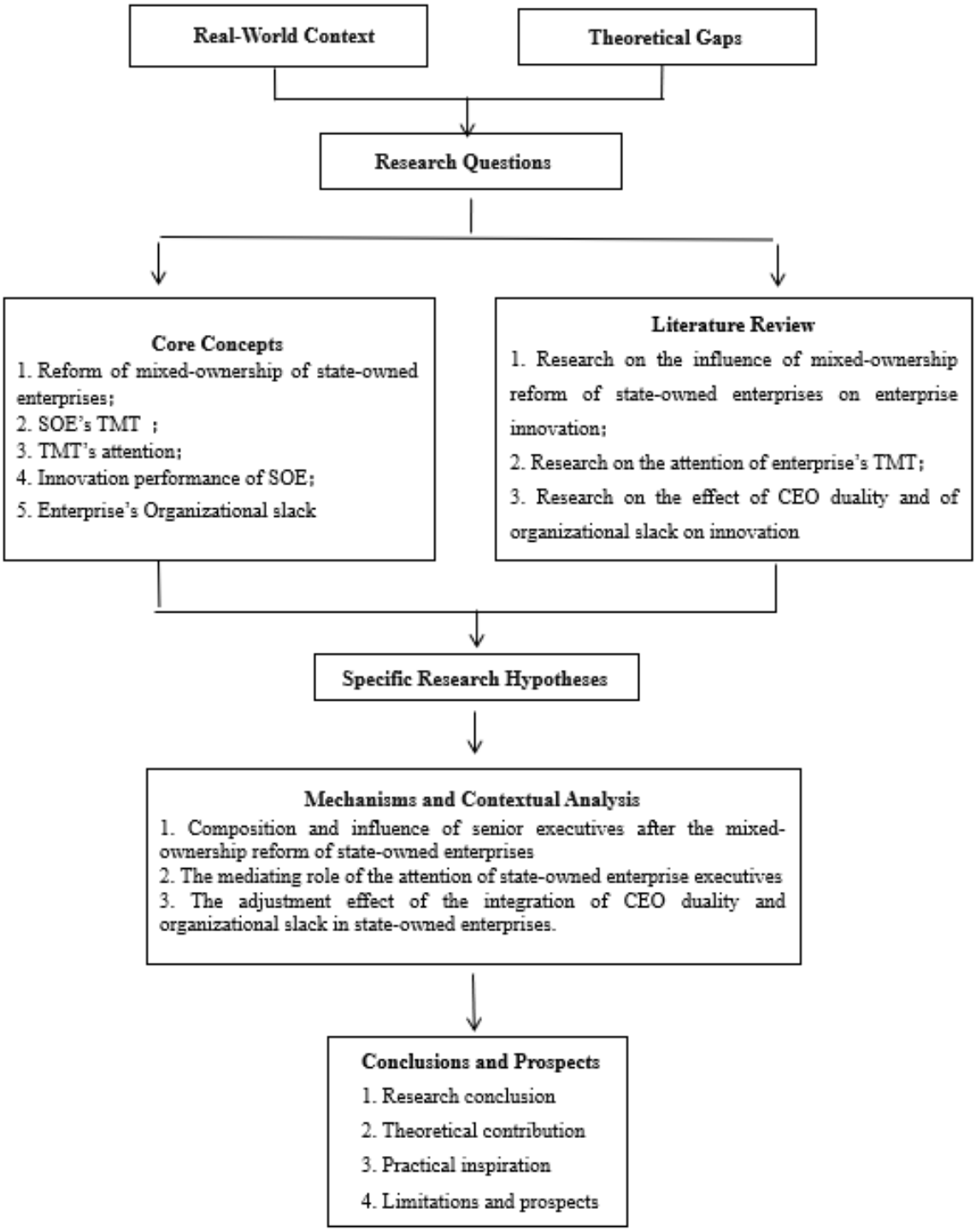

Figure 1.1 Research technical roadmap

1.4.3 Thesis structure

The structure of this thesis is outlined as follows:

Chapter One: Introduction. This chapter, consisting of four sections, introduces the research background, problem, and objectives, as well as the core concepts and research methods.

Chapter Two: Literature Review. This chapter collates, reviews, and analyzes the literature on the impact of mixed ownership reform of SOEs on enterprise innovation, the impact of the enterprise's TMT on enterprise innovation performance, and the impact of organizational slack on enterprise innovation performance, so as to identify relevant research gaps. In addition, existing theoretical studies were reviewed, and hypotheses were proposed. Drawing upon theories such as Upper Echelons Theory, Principal-Agent Theory, and Attention-Based View, through theoretical deduction and logical inference, it primarily analyzes four aspects: the relationship between the board structure and enterprise innovation performance, the mediating role of TMT's attention, the moderating role of organizational slack, and the moderating role of CEO duality. The relationships between the variables were established, and research hypotheses were proposed for testing, and the theoretical model of this study was constructed.

Chapter Three: Research Design. This chapter introduces the following contents in detail: sample selection, data collection, definitions of the indicators and variables in this study, the empirical research method, and the adopted model setting principles.

Chapter Four: Status-quo Analysis. This chapter mainly includes the overall statistics and description of the characteristics of the TMT structure, enterprise innovation performance, CEO duality, and organizational slack of mixed ownership enterprises listed on Shanghai and Shenzhen A-share markets.

Chapter Five: Data Analysis and Hypothesis Testing. This chapter primarily carries out descriptive statistics, correlation analysis, regression analysis, hypothesis testing, robustness testing, and analyses of endogeneity and heterogeneity.

Chapter Six: Results and Discussion. This chapter mainly summarizes the findings obtained in the previous research, and then discusses the results by comparing with the existing research findings in the literature. It carries out a comparative analysis and discussion of the relationship between the board structure and enterprise innovation performance, the mediating effect of TMT's attention, and the moderating effect of CEO duality and organizational slack.

Chapter Seven: Conclusions and Prospects. As the thesis's last chapter, it summarizes the findings and conclusions of this study, points out its theoretical contributions, innovations, and practical implications, and expounds the limitations of this research and the prospects for future studies.

Chapter 2: Literature Review

Numerous studies have addressed the factors affecting the innovation performance of Chinese state-owned enterprises (SOEs). From the perspective of equity structure, shareholders with different attributes have different claims on the innovation performance of the enterprise, and different claims have varied impacts on the enterprise's attention to innovation and innovation investment, further affecting the enterprise's innovation performance. From the perspective of enterprises, the governance structure, heterogeneity of the top management team (TMT), and resource endowment all have an impact on enterprises' innovation capabilities.

At present, scholars have explored this topic mainly from the theoretical perspectives of Property Rights Theory, Principal-Agent Theory, Upper Echelons Theory, TMT's attention allocation, and organizational slack, while taking into account the actual situation of SOEs' innovation performance. This chapter systematically reviews, synthesizes, and analyzes the relevant Chinese and international literature and the research findings in recent years, based on which the research gaps are identified, highlighting the innovation and significance of this study.

2.1 Impact of mixed ownership reform of SOEs on enterprise innovation

2.1.1 Impact of SOE's social functions on enterprise innovation

Since the Chinese government proposed the strategy of high-quality development in 2017, innovation has gradually become the primary driving force for enterprise development, and the improvement of innovation performance in SOEs has been a research focus. Boubakri et al. (2013) suggested that SOEs should take into account economic, social, and political objectives; besides pursuing profit maximization, they should also undertake multiple social functions of the government and assume strategic tasks, resulting in a very heavy policy burden.

In terms of social functions, SOEs assume multiple roles. SOEs serve as the stabilizers of China's labor market and play an important role in social employment; they also bear the important responsibility of China's brand innovation; SOEs also play an important role in environmental protection and are essential participants in the government's efforts to promote the construction of an ecological civilization; SOEs are also one of the main forces of social public welfare activities, contributing greatly to poverty alleviation, earthquake relief, and flood

relief; SOEs also undertake the task of regulating income distribution, narrowing the gap between the rich and the poor, and avoiding polarization. The assumption of these social functions has a great impact on the decision-making of SOEs, limiting the flexibility of enterprise innovation. In terms of national strategy, SOEs bear greater tasks. These tasks usually involve the strategic control of nationally important technologies in a number of core areas and industries. This puts more demands on the innovation of SOEs, requiring them to take into account national security, strategic interests, and other prerequisite objectives, and set up dual objectives, which makes the innovation decision-making of SOEs more complex.

At the same time, SOEs are also faced with many policy-related burdens. For example, the prices of certain products from SOEs (e.g., energy and transportation) are forced down; SOEs also face heavy burdens related to employees' pensions and various welfare benefits; the traditional development model has led to serious problems of overstaffing; and large-scale SOEs are too capital-intensive, which is not aligned with the conditions of China's resource endowment, resulting in limited competitiveness in the market economy. These policy burdens not only increase the operating costs of SOEs, but also limit the flexibility of their innovative activities.

Most international scholars believe that mixed ownership reform can improve the overall performance of enterprises. For example, Leutert (2016) selected many Chinese enterprises that were undergoing share reform as survey samples, and based on the empirical analysis of these enterprises, it was found that the mixed ownership reform of SOEs had a positive impact on enterprise R&D and innovation in China. Kubo and Phan (2019), using Vietnamese listed enterprises as a sample to conduct a case study, found that mixed ownership reforms were positively related to the overall performance of enterprises. C. Zhang et al. (2018) found through regression analysis that state ownership of dominance did not necessarily guarantee the long-term stability of enterprises and that mixed ownership reforms were the most effective way to promote stability and reduce business risks in SOEs. Walheera and He (2020) suggested that through mixed ownership reforms, the competitive relationship between SOEs and private enterprises was strengthened, and by learning from each other, they could promote technological innovation and progress. This momentum promotes rapid economic growth and lays a solid foundation for the long-term development of enterprises.

Mixed ownership reforms have broken down the traditional boundaries between SOEs and private enterprises, enabling both to compete directly and fairly in the same market environment. The original degree of market protection for SOEs has been greatly reduced, while private enterprises have been given the opportunity to compete in more industries and fields. The

optimization of the market environment can stimulate enterprises to engage in innovation and improve business efficiency, prompting them to explore new technologies, products, and service modes in order to occupy a larger market more rapidly. While SOEs compete with private enterprises, they also engage in broader and deeper cooperation and exchanges. The advantage of SOEs lies in that they usually have stronger resource integration ability, technology accumulation, and policy support, while the advantage of private enterprises lies in more flexible systems, stronger innovation capabilities, and rapid market response. Through mixed ownership reform, SOEs and private enterprises can share resources, technologies, and market information, enabling them to learn from each other's strengths and realize complementary advantages. SOEs can learn from private enterprises more market-oriented operation mechanisms, efficient management modes, and the ability to respond quickly to market changes; at the same time, private enterprises can leverage the resource platform and technology foundation of SOEs to enhance their core competitiveness.

Scholars such as J. Li et al. (2022) believe that compared to enterprises of other ownerships, SOEs have relatively lower efficiency in innovation and are faced with problems such as low innovation participation and investment levels, as well as insufficient innovation effectiveness and levels. First, in terms of innovation participation and investment levels, the institutional and mechanism barriers, such as serious principal-agent problems, soft budget constraints, and excessive government intervention, have led to significantly lower incentives for enterprises to innovate. Second, in terms of innovation effectiveness and levels, SOEs face challenges of unsound internal governance mechanisms and a lack of effective incentives and supervision mechanisms, resulting in managers' insufficient motivation and sense of responsibility in innovation decision-making and implementation, thus affecting the actual effectiveness of innovation.

In addition, SOEs fail to fully follow the market mechanism in resource allocation, resulting in ineffective utilization of innovation resources, thus hindering the improvement of the innovation level. At the same time, as SOEs are often in a relatively less competitive market environment, they do not have the sense of urgency to enhance their competitiveness through innovation, which further exacerbates the problem of insufficient innovation effectiveness and levels. According to Mao et al. (2023), Chinese private enterprises contributed to over 70% of the in technological innovation achievements in China. These achievements cover various fields, including but not limited to information technology, new energy, new materials, biomedicine, and other strategic emerging industries, highlighting the active participation and contribution of Chinese private enterprises in technological innovation. Moreover, the innovations of private

enterprises not only dominate in quantity, but are also improving in quality. Many private enterprises have continued to improve their technological innovation capacity through measures such as increasing R&D investment, establishing R&D organizations, and introducing high-level talents, and have launched a series of core technologies and products with independent intellectual property rights. X. Yang et al. (2022) believe that the proxy conflicts from the diverse goals of SOEs and the principal-agent conflicts due to the absence of owners have become obstacles hindering the effective implementation of innovation-driven development strategies in SOEs.

As the funder and regulator of SOEs, the government has strict control and requirements for SOEs. In order to ensure the preservation and appreciation of the value of state-owned assets and the stable development of the national economy as a whole, the government often intervenes and restricts the investment direction, business strategy, and profit distribution of SOEs. This government control limits the autonomy and decision-making flexibility of SOEs to a certain extent, which makes SOEs face many obstacles in the implementation of innovation-driven development strategies. For example, when formulating industrial policies, the government may tend to support projects that can bring economic benefits in a short term, while giving limited attention and support for projects that have long cycles and high risks but have potential innovation value. This policy orientation may lead SOEs to invest more resources in short-term projects while neglecting long-term technological innovation and industrial upgrading.

2.1.2 Impact of SOE's principal-agent mechanism on enterprise innovation

F. Zhang and Zhu (2021) conducted research on the relationship between the mixed ownership reform of SOEs and innovation performance, suggesting that the principal-agent relationships between the majority shareholders and the minority shareholders, and between the shareholders and the management are likely to cause conflicts of interest and moral hazard, which will affect innovation-related decision-making. Current studies generally fall into two categories: one focuses on the macro level of equity, where conflicts among shareholders caused by principal-agent relationships lead to insufficient innovation in SOEs; the other focuses on the micro level of enterprises, where phenomena such as the "absence of owners" resulting from principal-agent relationships, corporate governance, and inadequate supervision lead to insufficient innovation in SOEs (Ren et al., 2023).

At the macro level, SOEs in China are those invested in by the Chinese government.

Existing research indicates that major shareholders representing state-owned equity are often more sensitive about the potential decrease in their own interests and decline in enterprise value resulting from the failure of innovation activities. Consequently, their intention to invest in R&D projects is weaker, thereby adversely affecting the overall strategic decision-making for innovation in the entire enterprise (Y. Zhang & Zhou, 2020). Majority shareholders representing state-owned equity tend to show a more cautious attitude when dealing with innovative activities. Majority shareholders of SOEs, i.e., the government or government agencies, are often more concerned with the stable and sustainable development of the enterprise rather than short-term high returns involving high risks. Innovative activities, especially radical technological innovations, are often accompanied by high failure rates and uncertainty. From the perspective of risk aversion, state-owned major shareholders may be more inclined to reduce or avoid investment in such projects. At the same time, the interests of major shareholders of SOEs are closely related to the long-term value growth of these enterprises. Failure of innovation activities may lead to a decline in the value of the enterprise, which in turn affects the interests of the majority shareholders. In order to avoid such potential loss of value, major shareholders may be more alert to the risks associated with innovation activities and thus show reduced intention to invest in R&D projects.

Qiao et al. (2023) argued that the problem of unclear property rights weakens the internal control in SOEs, and the phenomenon of “absence of owners” exacerbates agency problems. Unclear property rights make it difficult to form a unified opinion in decision-making within the enterprise and to balance the interests of all parties. When an SOE needs to invest a large amount of funds in technological R&D, due to unclear property rights, the state, as the majority shareholder, may be reluctant to take the risk due to the uncertainty of the return on investment, while the management of the enterprise may believe that technological innovation is the key to the future development of the enterprise. This disagreement leads to a lengthy decision-making process and may even make the enterprise miss the best time for investment, which seriously weakens the internal control and decision-making efficiency of the enterprise. On the other hand, since the state, as an investor, cannot directly participate in the daily management and decision-making of the enterprise, it actually creates the phenomenon of “absence of owners”. The actual control of the enterprise often falls into the hands of the management or specific interest groups. The management may take advantage of this opportunity to pursue their personal achievements or interests, while ignoring the long-term development of the enterprise and the interests of shareholders. Specifically, the management may adopt aggressive investment strategies and ignore potential risks in order to improve performance in the short

term; or they may transfer enterprise interests to related parties or individuals through related-party transactions and asset transfers. These behaviors not only harm the overall interests of the enterprise, but also exacerbate the agency problem, directly leading to insufficient innovation in SOEs. However, the entry of private capital can effectively address these issues and promote enterprise innovation.

Ren et al. (2022) suggested that after the mixed ownership reform in SOEs, the integration and balance between state-owned and private capital can alleviate agency problems, foster enterprises' innovation investment, and thereby enhance their innovation performance. Y. Zhao et al. (2023) suggested that because of its clear property rights and flexible decision-making, private capital is more willing to take risks in order to obtain higher returns, showing a higher level of risk-tolerance. By changing the nature of ownership and introducing private capital through mixed ownership reform, SOEs can absorb the risk-taking spirit of private capital and change their attitudes toward risks. Through the mixed ownership reform, the introduction of non-state shareholders improves the enterprise's governance structure and makes the decision-making process more transparent and market-oriented, thus improving the enterprise's risk-bearing ability. That will result in changes in the enterprise's risk appetite attitude, leading to an increase in innovation investment, thus improving the enterprise's innovation performance.

At the micro level, SOEs prefer to achieve scale advantages through expansion instead of obtaining innovation advantages via investment in technology (G. Jia & Li, 2018). SOEs bear the important responsibility of national economic construction and social development. Besides realizing economic benefit growth, their goals also include social stability, employment security, and industrial upgrading, among others. In general, SOEs are more inclined to rapidly increase market share and influence by expanding their scales, so as to realize their economic and social goals. Expansion of scale can directly lead to an increase in production, expanded market share, and enhanced brand influence, which are important performance indicators for SOEs. At the same time, SOEs often have strong financial and resource advantages, enabling them to easily gain access to land, capital, talent, and other required resources in the process of expansion. However, technological innovation is characterized with long-term R&D investment, high-risk exploration, and uncertain returns. With limited resources, SOEs may be more inclined to invest resources in expansion projects that can quickly yield results, rather than technology innovation projects with higher risks and longer return cycles. As state- or government-controlled enterprises, SOEs tend to be subject to more regulations and constraints on their business decisions. In order to maintain sound operations and avoid potential risks, SOEs may prefer expansion strategies with relatively low risks and stable returns.

According to G. Yuan and Li (2023), through the mixed ownership reform, SOEs have shifted from a singular equity structure to a diversified equity structure, thus enhancing the internal checks and balances of the enterprises and reducing the problem of insider control. At the same time, the market-oriented mechanism introduced by the mixed ownership reform has prompted SOEs to pay more attention to management efficiency and scientific decision-making, which helped to improve the governance level of SOEs, further enhancing the innovation motivation of SOEs. Under an adequate corporate governance mechanism, enterprises tend to pay more attention to their long-term development and the cultivation of core competitiveness, making them willing to invest more resources in innovation activities, thus further improving their innovation levels. According to J. Li (2022), SOEs suffer from serious principal-agent problems, resulting in insufficient investment in innovation and further affecting their innovation performance. Xing et al. (2023) suggested that due to the overly long principal-agent chain of SOEs, the supervision and incentive mechanisms of SOEs are inadequate. The management is more inclined to pursue short-term interests rather than the long-term development of the enterprise. SOEs are often affected by the external environment and short-term investment returns when making decisions on capital investment, and some SOEs invest their capital in the financial or real estate industry in pursuit of quick returns. Although this behavior may enhance the profit level of the enterprise in the short term, it will result in reduced innovation capital, thus hindering the enhancement of the innovation level of SOEs.

2.1.3 Impact of appraisal mechanisms on SOE's innovation

In pursuit of returns on state capital and improved performance, top management teams (TMTs) of SOEs may increase their shortsighted behavior and reduce innovation activities with long cycles and high risks (Fu et al., 2020). TMTs of SOEs often face strict performance appraisals and tenure targets. These appraisals are usually closely linked to short-term indicators such as the enterprise's financial performance, market share, and profit growth. In order to meet these appraisal targets and obtain better career development opportunities, TMTs may prefer projects that yield quick results and carry lower risks, such as expanding production scale and improving sales efficiency. In contrast, innovation activities often require longer R&D cycles and large capital investments, and carry a higher risk of failure. As a result, driven by short-sighted appraisal mechanisms, TMTs may reduce the investment in innovation activities to avoid negative impacts on their personal performance due to innovation failures. At the same time, innovation activities are inherently uncertain and risky, and even after sufficient market research

and risk assessment, the possibility of failure still exists. For risk-averse TMTs, they may be more inclined to choose the projects with lower risks and relatively stable returns in order to avoid personal liability or reputational loss due to innovation failures. This psychological tendency can further exacerbate TMTs' avoidance of innovation activities.

G. Chen et al. (2023) suggested that the main competitive advantage of SOEs lies in the institutional resources provided by the government, and TMTs of SOEs are more likely to consider policy factors when making decisions. TMTs of SOEs need to pay close attention to the policies issued by the government in order to ensure that the enterprise's decision-making is in line with the government's policy orientation, which will help the enterprise to obtain support and preferential treatment from the government. During the decision-making process, TMTs of SOEs will assess the potential risks associated with policy changes in order to prevent adverse effects of policy adjustments on the enterprise. However, industrial innovation and policy implementation in SOEs require experimentation and trial-and-error, which entails high uncertainty. The R&D and marketing of new technologies and products require investment of time and resources, and the results are often unpredictable. This uncertainty makes SOEs more cautious in their decision-making. Although the government has formulated a series of policies to support the innovation and development of SOEs, these policies may be difficult to fully implement in practice, and the disconnect between policy and practice leads to many obstacles for SOEs in the innovation process. In addition, the cost of trial and error is high for SOEs. On the one hand, SOEs need more time and resources to adjust their strategies or directions; on the other hand, as representatives of the government, SOEs' attempts of trial and error may be subject to more attention and evaluation, thus increasing the psychological pressure and actual costs. All these factors contribute to the enterprise's reduced motivation and slow actions.

In summary, at present, most scholars follow the "structure – procedure – performance" framework when studying the impact of mixed ownership reform of SOEs on enterprise innovation. Mixed ownership reform has changed the equity structure of the enterprise and the composition of the board members. It can optimize the enterprise's resource allocation through improved internal governance structure such as the board's right allocation, which ultimately affects the behavioral pattern and innovation performance of SOEs.

Currently, innovation performance is mainly assessed on two dimensions: innovation inputs and innovation outputs. Some studies have suggested that the intensity of R&D investment can be used to measure the intention of enterprises to carry out innovation activities, such that the higher the intensity of R&D investment, the stronger the intention (Ren et al., 2023; Xing et al., 2023; J. Zhou et al., 2021). Some other studies posit that enterprises possessing more patents

tend to have stronger market competitiveness and profitability, as patents can be transformed into new products, processes, or services, thus bringing economic benefits to the enterprise (J. Li et al., 2022; J. Lv, 2023). Therefore, the number of patents can, to a certain extent, predict the innovation potential and future economic benefits of an enterprise. Meanwhile, as patents are the direct product of an enterprise's innovation activities, they represent the novelty and originality of the enterprise in terms of technologies, products, or services. As the granting of patents is an official recognition of an enterprise's innovation achievements, the number of patents can intuitively reflect the level of an enterprise's innovation output. Thus, the number of patents granted can be used to measure an enterprise's innovation output.

2.2 Impact of TMTs on enterprise innovation performance

2.2.1 Impact of TMT heterogeneity on enterprise innovation performance

TMT heterogeneity refers to the differences of TMT members in demographic characteristics, values, cognitive concepts, experience, and other aspects (Finkelstein & Hambrick, 1996). The heterogeneity of demographic characteristics is the most intuitive and easily recognizable difference in the TMT of an enterprise, as the TMT members may belong to different age groups, have different gender identities, have received different levels of education, or come from different cultural and social backgrounds. Values are an individual's tendency to judge and determine the importance of things, which profoundly influences the way an individual behaves and the decision-making process. In the TMT of an enterprise, members may hold different values, such as views on success, risk, fairness, and responsibility. Heterogeneity of cognitive concepts refers to the differences in members' ways of thinking, information processing, and problem solving strategies. For example, some TMT members may be more inclined to intuitive and creative thinking, while others may be more logical and analytical. Experience heterogeneity refers to the diversity of knowledge, skills, and experiences that members have accumulated over the course of their careers. For example, some TMT members may have extensive experience in specific industries or fields, while others may have extensive exposure to other fields or international markets.

TMT heterogeneity's impact on enterprise innovation performance is a complex and multifaceted topic, involving multiple dimensions and levels. The views of Hambrick and Mason (1984) provide us with an important theoretical basis. They emphasize the decisive role of the characteristics and functional attributes of the TMT on an enterprise's actions and

performance results. In terms of TMT characteristics, they pointed out that 1) the demographic characteristics of TMT members, such as age, educational background, and professional experience, affect their perceptions, values, and behavioral styles, which further affect the team's decision-making process; 2) the psychological traits of TMT members, such as personality, risk appetite, and cognitive style, also have a significant impact on the team's decision-making; 3) social characteristics, such as social relationships, level of trust, and power structure among team members, affect the team's cohesion and decision-making efficiency. In terms of functional attributes, the TMT is the core of the strategic decision-making of the enterprise and is responsible for the allocation of the enterprise's resources, and at the same time, the behavior and decision-making of TMT affect the organizational culture of the enterprise. Therefore, TMT heterogeneity, as a core factor, significantly influence enterprises' innovation performance.

2.2.1.1 Positive impact of TMT heterogeneity on enterprise innovation performance

On the one hand, TMT heterogeneity can have a positive impact on the innovation performance of enterprises. Heterogeneity can bring different types of knowledge, professional directions, and decision-making styles to enterprises, thus providing a broader vision and richer experience for enterprise innovation. TMT heterogeneity is mainly reflected in members' differences in age, gender, professional background, educational background, and experience (X. Wang, 2019). J. Zhao et al. (2023) pointed out that TMT heterogeneity could bring a diversity of knowledge, experiences, and perspectives, which enables the team to assess risks and identify potential opportunities from multiple perspectives when making decisions related to radical innovation. A diverse cognitive model can reduce the cognitive bias brought about by a single perspective, significantly improving an enterprise's risk-taking ability for radical innovations, thus enhancing innovation performance. By enhancing cognitive diversity, promoting information exchange and integration, and improving decision-making quality, TMT heterogeneous can more effectively promote the generation and application of radical innovations, which is conducive to enhancing innovation performance.

TMT heterogeneity means that team members have different sources of knowledge, experience, and information. This diversity of information helps the team to identify more opportunities and threats in the decision-making process. Especially for projects that require radical innovations, diverse information inputs can stimulate new ideas and solutions, thus improving the enterprise's ability to identify and assess innovation risks. At the same time, heterogeneous teams are more prone to cognitive conflicts, i.e., differences in perspectives,

approaches, and solutions among team members. Although cognitive conflict may bring short-term team disharmony, it is an important force to stimulate creative thinking and drive innovative decisions. Through effective communication and negotiation, teams can transform these conflicts into a source of innovation, thus improving the enterprise's ability to bear the risks of radical innovation. Moreover, TMT heterogeneity also helps to diversify risks. Team members from different backgrounds may have varied risk assessments and levels of acceptance toward the same innovation project. Such differences enable the team to consider risks more comprehensively when making decisions and to reduce the overall risk level through diversified investment strategies.

Wesemann et al. (2018), focusing on the heterogeneity dimension in the psychology of TMTs, explored whether enterprises' innovation strategies are affected by heterogeneity in values and concluded that the relationship is positive. Tihanyi et al. (2000), through analysis of questionnaire responses, concluded that the greater the differences in the personalities of TMT members, the greater the enterprise's investment in R&D. Focusing on the development of American Airlines in the 1980s, Labich (1990) suggested that TMT heterogeneity brought resources and creativity to the enterprise, which is conducive to enterprise innovation. That is because team members with different backgrounds can bring diverse perspectives and ways of thinking, which helps to break traditional thinking patterns and generate new ideas.

TMT members of different ages tend to have different backgrounds, life experiences, and behavioral styles. This age diversification can broaden the team's horizons, improve the team's decision-making ability, and make enterprises more engaged in innovation activities. Hambrick (1989) found that TMTs with greater age heterogeneity are likely to be more active in carrying out innovation activities. When a TMT has greater age heterogeneity, it usually means that the team incorporates the experiences, ideas, and abilities of members from different age groups, and such a composition tends to stimulate a more favorable and diverse innovation atmosphere.

First, in TMTs with greater age heterogeneity can benefit from complementary experiences and knowledge. Older TMT members usually have extensive industry experience and rich historical perspectives, and they may have experienced various market changes and technological innovations, enabling them to provide valuable practical knowledge and risk avoidance strategies. Younger TMT members tend to have more cutting-edge technological knowledge, stronger learning ability, and keen insights into new things, and they are more likely to accept and promote innovative ideas, bringing new ideas and vitality to the team. Second, the TMT's age heterogeneity is conducive to the collision of ideas and the stimulation of creativity. TMT members of different ages often have varied thinking patterns and problem-

solving styles, and this diversity can trigger thought collisions in team discussions and promote the generation of ideas and problem analysis from multiple perspectives. Teams with high age heterogeneity are more likely to form an open and tolerant cultural atmosphere that encourages members to express different opinions, which can reduce stereotyped thinking and lay a foundation for innovation activities. Third, TMTs with greater age heterogeneity are prone to intergenerational exchange and motivation. Older TMT members can impart experience and wisdom to younger members, while younger members can introduce new technologies and ways of thinking to older members. This two-way learning and exchange promotes the effective transmission of knowledge and the continuous improvement of innovation ability, while fostering the formation of a fairer competition and incentive mechanism within the team. Members of different age groups can find their own value positioning and development space, making them more actively participate in innovation activities.

The length of a TMT member's tenure impacts an enterprise's strategic decisions. TMT members with a longer tenure tend to have a better understanding of the enterprise's status of development and can propose more actionable decisions and solutions, while those with a shorter tenure are more likely to propose innovative and disruptive decisions and institutions. Therefore, TMTs with higher tenure heterogeneity are more likely to make strategic decisions that are both feasible and innovative. Srivastava and Lee (2005) showed that enterprises with higher tenure heterogeneity in TMTs tend to be the first in their industry to launch new products.

First, TMTs with high tenure heterogeneity have diverse experiences and perspectives. As the members have served the organization for different lengths, this diversity brings different management experiences, industry insights, and market perceptions. Long-tenured members tend to have an in-depth understanding of the organization's history, culture, and operations, while short-tenured or new members may bring new ideas, technologies, and information about new market trends from the outside. This intermingling of experiences and perspectives helps enterprises to have a more comprehensive analysis in the decision-making process, making it easier for them to capture innovation opportunities, thus promoting new product development. Second, TMTs with high tenure heterogeneity are more likely to accept and drive changes. Newly joined TMT members are often less bound to the status quo and more willing to try new things, and their presence can stimulate innovative thinking within the team and drive enterprises to innovate products and services. Third, TMT members of different tenures can engage in effective knowledge transfer and learning. Long-tenured members can teach new members the enterprise's core values, successful experiences, and lessons learned from failures, while new members can share the latest knowledge and skills they have learned in other

organizations or fields. This two-way knowledge flow not only helps to improve the overall quality of the entire team, but also fosters the R&D of new products and innovations, enabling the enterprise to maintain its leading position in the market. Furthermore, tenure heterogeneity also helps reduce the risk of groupthink. In a TMT, if the members have too similar backgrounds or too long tenure, they may form fixed thinking patterns and find it difficult to accept new ideas. Conversely, teams with high tenure heterogeneity are more likely to have a diversity of voices and perspectives, which can help break out of this impasse and promote a more open and innovative decision-making process.

Educational background reflects an individual's cognitive foundation and values, and heterogeneity in educational background can enhance a TMT's ability to identify opportunities and solve problems. West III (2007) pointed out that high heterogeneity in educational background can bring broader perspectives and diversified ideas, which enable teams to identify in advance, analyze, and rationally solve problems, which is conducive to the innovation activities of enterprises.

First of all, high heterogeneity in educational background brings broader perspectives to TMT. Members with different educational backgrounds have distinctive knowledge systems and learning experiences, enabling them to provide different insights and solutions to the same problem from their respective professional perspectives. This diversity of knowledge provides the team with a more comprehensive perspective, helping the team to identify problems and opportunities that may be overlooked by members from a single background. In addition, differences in educational backgrounds are often accompanied by diversity in cultural backgrounds. Team members from different regions, countries, or cultural environments, tend to have varied understandings of markets, consumer behavior, and societal trends. This cross-cultural understanding enables the team to gain deeper insights into the dynamics of the global market, providing strong support for the enterprise's internationalization strategy and innovation activities.

Second, high heterogeneity in educational background provides a TMT with diverse thinking. Educational background heterogeneity promotes the collision of ideas and inspiration among team members. When members with different knowledge backgrounds get together to carry out discussions, their ways of thinking and problem-solving approaches will intermingle with each other, resulting in new ideas and creativity. This kind of innovative thinking is the key driving force behind enterprises' innovation activities. When faced with complex problems or challenges, teams with high heterogeneity in educational backgrounds can provide more diverse solutions. Each member will conceptualize a solution based on his or her own expertise

and experience, and this diversity helps the team evaluate the problem in multiple dimensions, enabling them to find a more comprehensive and effective solution strategy.

Third, high heterogeneity in educational background equips a TMT with the ability to identify opportunities in advance and conduct in-depth analysis. When the members have different professional backgrounds and knowledge strengths, the team tends to be able to identify potential problems or opportunities earlier. This problem identification ability enables enterprises to take the lead in market competition by adjusting their strategic directions or launching innovative projects in a timely manner. In such teams, members are able to apply different theoretical frameworks and methodologies when analyzing problems. This in-depth analytical ability helps enterprises to more accurately grasp the nature and root causes of problems, providing a scientific basis for formulating effective solutions. TMTs with high educational background heterogeneity can comprehensively consider various factors in the decision-making process, including technical feasibility, market potential, and cost-effectiveness. This comprehensive decision-making process helps to improve the quality of decision-making and ensure the successful implementation of innovation activities. Furthermore, high educational background heterogeneity is conducive to collaborative cooperation and resource integration. Team members with heterogeneous educational backgrounds can learn from each other and complement each other's strengths in the process of cooperation, thus realizing the effective integration of resources. This spirit of collaborative cooperation not only helps the team to solve specific problems, but also promotes the team's overall innovation capabilities and competitiveness.

In addition, the TMT's heterogeneity in professional background in SOEs and private enterprises is another aspect that deserves attention. In mixed ownership enterprises, the diversity of professional backgrounds among TMT members means that the team has a diverse perspectives and experiences, which collide and integrate with each other in the decision-making process, helping to break the limitations of single-mindedness. This prompts TMT members to engage in more communication and exchanges in order to understand each other's perspectives and stances, which enables the enterprise to take a more comprehensive perspective, thus increasing the enterprise's inclusiveness and making it more likely to generate new ideas. This makes the enterprise more inclusive and more likely to generate new ideas. In addition, the diversity of professional backgrounds among TMT members can also stimulate the adventurous and innovation spirit within the TMT, making the enterprise more willing to bear the risks associated with innovation, thus improving the enterprise's innovation capabilities and risk-bearing capacity (Meng & Li, 2022). This diversity helps enterprises

examine problems from multiple perspectives and levels, enabling them to formulate more comprehensive and effective innovation strategies (Acemoglu et al., 2018). Through exchange of cross-disciplinary experiences, the team can identify and seize opportunities for cross-disciplinary collaboration, thereby driving innovation in products and services. Boeing (2016) explored the impact of TMT members' personal traits and technological backgrounds on enterprise innovation performance. TMT members with an R&D background often have a better understanding of technological innovation, pay more attention to product development and design, and are have stronger intention to make R&D investments. These TMT members' expertise and sensitivity to technology enable them to effectively identify innovation opportunities, provide innovative ideas, and drive the innovation output of the enterprise. For example, TMT members with R&D background can drive the innovation output of the enterprise and increase the intensity of innovation subsidies and R&D investment (Y. Li et al., 2022). The technological expertise of the TMT helps the enterprise to integrate internal and external technological resources, forming a synergistic innovation effect. TMT members with expertise in a specific technology field can lead the enterprise to carry out in-depth exploration and innovation in that field, while forming a complementary relationship with members specialized in other technology fields to jointly promote the enterprise's technological innovation. Moreover, the presence of inventors in the decision-making level of the board of directors can drive enterprises to increase investment in innovation R&D, thereby improving their innovation performance (P. Wei & Ma, 2022).

2.2.1.2 Negative impact of TMT heterogeneity on enterprise innovation performance

TMT heterogeneity, however, can also have negative effects on enterprise innovation performance (Giannetti et al., 2015). The heterogeneity of TMT implies that there are differences among the members in terms of age, cultural background, professional experience, and values. These differences may lead to barriers in communication and difficulties in reaching consensus among team members, resulting in less efficient decision-making. Crocker and Major (1989) pointed out that with high age heterogeneity in a TMT, problems such as communication difficulties and reduced cohesion due to the generation gap are inevitable, and it may also lead to the TMT's dissatisfaction with their organization. Such communication barriers not only reduce the efficiency of collaboration within a team, but may also slow down the decision-making process, leading to a decrease in decision-making efficiency. In a rapidly changing market environment, slower decision-making may cause enterprises to miss opportunities, affecting their innovation performance.

Furthermore, excessive heterogeneity may lead to divisions and conflicts within the team, which is not conducive to the stability and cohesion of the team. When team members are seriously divided on key issues, they may form different factions, each sticking to their own views and positions. Such divisions not only reduce the team's decision-making efficiency, but may also undermine the stability and harmonious atmosphere of the team. Differences among members may lead to a lack of a common language and cultural foundation within the team, making it difficult to form strong team identification and sense of belonging. When members perceive that they are significantly different from other members of the team, they may focus more on personal goals rather than team goals, leading to reduced clarity of the team's overall goals and a decline in team cohesion. Reduced cohesion will further affect the team's collaborative efficiency and innovation capabilities, thus negatively affecting innovation performance.

Although many scholars have studied the relationship between TMT heterogeneity and enterprise performance, studies on the mechanism through which TMT heterogeneity impacts enterprise performance in the Chinese context remain limited (X. Wang et al., 2019). This may be due to the particularity and complexity of Chinese enterprises, highlighting the need for further in-depth exploration.

2.2.2 Impact of TMT's attention on enterprise innovation

Among the various factors influencing enterprise innovation, TMT's attention, as a key factor, has been extensively addressed in the literature. Cho and Hambrick (2006) combined the Upper Echelons Theory with the TMT attention-based view and proposed a strategic attention-based view, which provides a new perspective for understanding how TMT influences an enterprise's strategic change. Against the backdrop of the deregulation of the U.S. airline industry, they found a mediating role of attention between TMT characteristics and enterprise strategic change. According to the Upper Echelons Theory, the "cognition – interpretation – decision-making" path of the TMT determines the production activities and business directions of an enterprise, and the attention of the TMT determines the attention of the enterprise (Haas et al., 2015). At its core, this theory posits that the psychological characteristics of the TMT, such as personal cognition, values, and experiences, ultimately determine an enterprise's strategic choices and production activities through the interpretation and filtering of environmental information. Building on this, Cho and Hambrick (2006) further pointed out that the allocation of TMT's attention—specifically how they focus on, interpret, and respond to changes in the external

environment and the internal resource conditions—essentially shapes the enterprise's overall attention focus and strategic orientation. The allocation of TMT's attention is regarded as a key factor affecting an enterprise's innovation decision-making and implementation (Ocasio, 2011). This is because it is directly related to an enterprise's ability to identify, assess, and capitalize on innovation opportunities. With limited resources, how the TMT effectively allocates its attention determines which innovation projects can be supported and which technology or market trends can be captured in time and transformed into the enterprise's competitive advantages. This allocation of attention not only affects the enterprise's short-term decision-making, but also shapes an enterprise's long-term development direction and market positioning. Therefore, an in-depth understanding and the improvement of TMT's attention allocation mechanism of great significance in enhancing the innovation capability of the enterprise and promoting its sustainable development.

First of all, innovation is regarded as an important driving force for the survival and development of enterprises, enabling them to maintain competitive advantages. However, enterprises vary greatly in terms of innovation performance. This difference is largely due to the level of attention allocated to innovation by the TMT, which is not only reflected in the quantity and quality of innovation results, but also lies in the enterprise's ability to capture innovation opportunities and the development and implementation efficiency of innovation strategies. The attention-based view in the Upper Echelons Theory provides a powerful theoretical framework for explaining this phenomenon. This theory regards attention as a information processing mechanism at the cognitive level, emphasizing TMT's activities in information processing, such as attention, coding, interpretation, and time investment (Ocasio, 1997).

Second, TMT's attention is regarded as a scarce resource. In an environment with complex external information, the TMT needs to selectively allocate limited attention to specific information according to the needs and goals of the enterprise. Only the innovation issues that are paid attention to and valued by the TMT are likely to enter the scope of decision-making and implementation within the enterprise (Yu et al., 2022). In the area of innovation, this means that TMT needs to identify precisely which innovation issues are aligned with the enterprise's core competetiveness and which have potential market value, and focus the limited attention resources on them.

As TMT's attention is a key element in the process of enterprise innovation, its allocation strategy directly affects the innovation performance of the enterprise. When the TMT focuses its attention on a certain innovation issue, they will invest more time and resources to explore

its feasibility, formulate specific innovation strategies, and promote the implementation of the innovation project. This high level of attention and engagement not only can improve the success rate of the innovation project, but also stimulates the innovation enthusiasm and creativity of team members, forming a favorable innovation atmosphere. Conversely, if the TMT do not pay sufficient attention to innovation issues, these issues are likely to be neglected or omitted, resulting in missed innovation opportunities.

The influence mechanism of TMT's attention on enterprise innovation is a dynamic process from information screening to decision making, and then to action and implementation. Every step requires a high level of TMT engagement and the TMT's precise decision making, which jointly promote the continuous progress and successful realization of the enterprise's innovation activities. According to the literature, the influence mechanism of TMT's attention on enterprise innovation can be divided into four steps.

1) The TMT selectively pays attention to and screen the information related to enterprise innovation to ensure that sufficient attention is paid to the innovation opportunities that are aligned with the enterprise's strategic goals and market needs (Cao et al., 2024). When the TMT is faced with a huge amount of information, the first step is to ensure that the direction of innovation is aligned with the strategic goals of the enterprise and market demand through selective attention and screening. The TMT will screen out the innovation information that is related to the core competitiveness of the enterprise and has potential market value, considering factors such as the enterprise's long-term development plan, market trends, and technological frontiers.

2) The TMT will interpret the screened information and give it new meaning in order to better understand the nature and potential value of the innovation issues (Sapienza et al., 2005). The screened information is subjected to in-depth interpretation and recoding by the TMT, a process that involves in-depth analysis, comparison, and association of the information to reveal the essential characteristics of the innovation issue, its potential value, and the change it may bring about potentially. TMT members use their knowledge, experience, and intuition to give new meanings to the information so as to gain a more comprehensive understanding of this innovation issue.

3) The TMT will judge its impact on enterprise innovation based on relevant information and make decisions (Kaplan, 2011; Shepherd et al., 2017). Based on the interpreted information, the TMT further evaluates the possible positive and negative impacts of the information on the enterprise's innovation, including technical feasibility, market risk, and resource requirements. This step requires the TMT to have a high level of strategic vision and decision-making ability,

and to be able to make informed choices in the face of uncertainty and risks.

4) Finally, enterprises will turn their attention into practical actions and promote the implementation of innovation projects through resource allocation, organization, and coordination (G. Song et al., 2022). This includes allocating the necessary resources, such as funds, talent, and technology, to innovation projects, as well as establishing cross-sectoral collaboration mechanisms to facilitate information flow and knowledge sharing.

In addition, the three types of attention proposed by Ocasio (1997), namely, selective attention, executive attention, and vigilance, also provide a useful perspective for understanding the allocation of TMT's attention.

Selective attention enables the TMT to focus on important innovation issues. This ability not only improves the efficiency of decision-making, but also ensures that the team is able to capitalize on key opportunities for innovation, thereby gaining a head start in a competitive marketplace. For example, when an enterprise is facing technological innovation or market change, the TMT can quickly identify the opportunities in these changes through selective attention, and focus resources on in-depth research and exploration, laying a solid foundation for the enterprise's future development (Tihanyi et al., 2000).

Executive attention, in contrast, focuses on transforming attention into concrete innovation actions. Once the team identifies important innovation issues through selective attention, executive attention comes into play, driving the team to translate these issues into concrete innovation actions and plans. This includes developing detailed implementation plans, allocating resources, and coordinating collaboration across departments (Tihanyi et al., 2000). The strength of executive attention lies in its ability to tightly integrate the team's focus with concrete actions, ensuring that innovation issues do not remain at the level of discussion but are effectively implemented to produce tangible results. For example, in promoting digital transformation within an enterprise, the TMT can leverage executive attention to ensure the smooth execution of transformation plans, including technology selection, personnel training, and process optimization, thus guaranteeing the successful implementation of the transformation.

Vigilance helps the TMT to timely identify and respond to potential innovation risks and challenges (Mei et al., 2018). This type of attention emphasizes a keen awareness of potential risks and challenges and the ability to take preventive measures or adjust strategies in a timely manner. In the innovation process, vigilance plays the role of "watcher", enabling the TMT to review the surrounding environment when pursuing innovation opportunities, so as to identify the risk factors that could threaten the success of the project. For example, when new

technologies or market trends emerge, a vigilant TMT can quickly recognize the opportunities or challenges that these changes may bring, and adjust their innovation strategies in a timely manner to avoid blindly following the trend or missing the opportunity. At the same time, vigilance also drives the team to establish an effective risk management system to ensure that they can quickly respond to emergencies during the innovation process, thus safeguarding the enterprise's innovative achievements and core competitiveness.

Talke et al. (2010) further empirically confirmed the positive effect of TMT's attention to innovation on enterprise innovation performance. They found that by allocating attention to innovation investment sectors, TMT can drive the enterprise to make innovation investment, thus improving the innovation performance of the enterprise. This focus not only facilitates the generation of innovative ideas, but also accelerates the process of incubating and implementing innovation projects. By carefully selecting and managing the innovation investment projects, TMT can ensure that these projects are aligned with the overall strategy of the enterprise, thereby maximizing the economic benefits of innovation investments. TMT's attention allocation has a significant impact on enterprise innovation. An in-depth study of the theoretical framework of the attention-based view enables us to more clearly explore the internal logic and dynamic mechanism of the enterprise innovation process, so as to reveal how enterprises can effectively enhance their innovation performance and build a sustained competitive advantage by optimizing TMT's attention allocation.

In summary, current research on the impact of TMT on innovation performance mainly draws on TMT heterogeneity and TMT's attention-based view. It is believed that TMT heterogeneity may bring new resources to the enterprise, thus affecting the innovation performance of the enterprise. Attention-based view holds that TMT's attention itself is a kind of resource, which influences the internal resource allocation within the enterprise, thus affecting the enterprise's innovation performance.

2.3 Impact of organizational slack on enterprise innovation performance

Organizational slack is a state of the enterprise's internal resources, and its impact on enterprise innovation has received extensive attention from the academic community (George, 2005). Organizational slack represents additional resources accumulated by an enterprise beyond what is required for its daily operations, which include but are not limited to excess capital, underutilized production capacity, and idle talent. The existence of these resources provides a potential material base for innovation activities, allowing more room for trial-and-error and

offering resource support when the enterprise is faced with innovation challenges. With intensified market competition and increased external environment uncertainty, enterprises have an increasingly urgent demand for resource utilization and innovation. Organizational slack, as a potential resource "buffer", plays an important role in the process of enterprise innovation (J. Chen et al., 2020). It can provide enterprises with the necessary resource support to help them resist external risks and seize market opportunities in the innovation process.

2.3.1 Connotation and classification of organizational slack

In the 1960s, Cyert and March (1963) defined organizational slack as resources that are retained within an organization beyond the actual demands and controlled by individuals or small groups. This definition emphasizes the two main characteristics of organizational slack, "beyond demand" and "internal control", laying a theoretical foundation for subsequent research. Subsequently, the concept of organizational slack was further developed on the basis of the Resource-Based View (RBV). Bourgeois and Singh (1983) further regarded organizational slack as a real or potential resource "buffer" for enterprises, enabling enterprises to successfully cope with internal adjustments and external changes. It can not only provide the necessary resource support for enterprises to cope with internal strategic adjustments and organizational changes, but also help them to effectively withstand the challenges brought about by drastic changes in the external environment, such as fluctuations in market demand and technological innovations. This "buffer" effect reflects the important role of organizational slack in enhancing the resilience and adaptability of enterprises. With the exploration of organizational slack advanced, scholars further classified it according to different classification criteria. For example, Nohria and Gulati (1996) divided organizational slack into absorbed slack and unabsorbed slack. Absorbed slack refers to resources that have already been absorbed by the organization and used for daily operations, such as excess inventory and idle but depreciated production lines. Although these resources do not directly contribute to productivity at present, they used to be an indispensable part of the enterprise's operations. Unabsorbed slack, on the other hand, refers to the potential resources that have not yet been fully utilized by the organization, such as undeveloped technology patents and unused R&D funds. These resources have higher flexibility and future value, and are an important source of innovation and development for the enterprise. This classification method not only contributes to a better understanding of the different forms of organizational slack, but also provides a more refined analytical perspective for studying how it affects enterprise innovation and strategic adjustment.

2.3.2 Impact of organizational slack on enterprise innovation

The impact of organizational slack on enterprise innovation performance is complex and multidimensional, involving both positive effects and latent negative effects. The positive impact of organizational slack on enterprise innovation performance is mainly reflected in that it provides enterprises with the resource base for exploratory innovation, offering important support for the innovation activities of enterprises (Voss et al., 2008). In particular, scholars such as X. Zhou and Han (2022) and X. Wang et al. (2023) found that organizational slack played a positive role in technology mergers and acquisitions and could provide necessary financial support for accelerating the innovation process of enterprises. According to Mauch (1991), organizational slack can provide enterprises with more trial and error opportunities, encouraging enterprises to carry out exploratory innovation. In addition, organizational slack can also improve the innovation efficiency of enterprises by facilitating knowledge sharing and technology transfer within enterprises (Ehls et al., 2020).

Organizational slack, however, may also have a negative impact on enterprise innovation performance. Higgins and Rodriguez (2006) argued that excessive organizational slack might lead to waste and inefficient use of resources, thus hindering the innovation motivation of enterprises. This is because when enterprises have large amounts of redundant resources, managers may lack a sense of urgency and utilize resources in a less sophisticated and efficient manner, hampering innovative activities. Ghosh et al. (2017) suggested that organizational slack might lead managers to overly rely on existing resources and capabilities and neglect the exploration of new technologies and new markets. The reliance on existing resources can limit the innovation horizons of enterprises and make it difficult for them to capture new market opportunities and technological trends. Y. Liu et al. (2023) further emphasized the negative impact of organizational slack on managers' intention to learn. According to these authors, excessive organizational slack makes managers reluctant to learn new knowledge to update their existing capabilities, thus inhibiting enterprise innovation.

The impact of organizational slack on the innovation performance of enterprises is twofold. It serves as an important resource support but may become an obstacle to innovation. Therefore, when enterprises make use of organizational slack, they need to weigh its advantages and disadvantages and formulate a reasonable resource management strategy to ensure that redundant resources can be effectively utilized while avoiding their negative impacts. By optimizing resource allocation, strengthening internal knowledge management, and encouraging a culture of innovation, enterprises can maximize the positive effects of

organizational slack while mitigating its potential negative impacts, thereby achieving sustained innovation and growth.

2.3.3 Mechanism of the relationship between organizational slack and enterprise innovation

The influence mechanism of organizational slack on enterprise innovation performance is complex and diverse (Arena et al., 2018). Meyer and Leitner (2018) pointed out that organizational slack could enhance an enterprise's exploratory innovation capability as it provides the enterprise with resources for carrying out high-risk attempts. Specifically, organizational slack, as a kind of excess resource, provides a material basis and psychological security for enterprises to venture into unexplored sectors and carry out high-risk but potentially rewarding R&D projects. This resource buffer not only reduces the financial pressure faced by enterprises due to failure in the innovation process, but also encourages the management and R&D personnel to try out new ideas and etechnologies, thus facilitating the birth of radical innovations. Moreover, organizational slack can improve the innovation efficiency of enterprises by facilitating knowledge sharing and technology transfer within enterprises (Ehls et al., 2020).

Research has shown that the characteristics of the internal and external environments of enterprises may affect the relationship between organizational slack and innovation performance (Liao & Long, 2018). Especially in the context of the government's growing environmental concerns, organizing slack has become an important driver for enterprises to transition to green and sustainable development. For instance, research has shown that the government's environmental concerns and organizational slack can strengthen the positive relationship between digital transformation and green innovation in enterprises (J. Song et al., 2023). The combination of government policy guidance and organizational slack can significantly enhance the investment and effectiveness of enterprises in digital transformation and green innovation, which suggests that the external institutional environment has a profound impact on the internal resource allocation and innovation path selection of organizations. Moreover, the social capital of the TMT is considered as an important moderator, which facilitates the effective use of organizational slack by providing additional knowledge and experiences (Lian et al., 2019). TMT's extensive social contacts and network resources can bring diverse sources of information and practical experiences to the organization, helping the organization to identify the best way to allocate redundant resources. Social capital not only

facilitates the introduction and integration of external knowledge, but also enhances the team's insights into market trends, making the process of transforming organizational slack into an innovation driver more efficient and precise.

The relationship between organizational slack and enterprise innovation performance is complex and varied, and is affected by many factors (Vanacker et al., 2017). Excessive organizational slack may also give rise to problems such as wasted resources and lax management, especially in enterprises that lack an effective monitoring mechanism or a strong innovation culture. Organizational slack may promote exploratory innovation by providing resources and flexibility, but can also lead to resource waste and inefficiency, hindering the innovation motivation of enterprises (Troilo et al., 2014). When redundant resources are not properly managed and utilized, they can lead to innovation inertia, hindering an enterprise's rapid response to market changes and reducing the efficiency and effectiveness of innovation activities.

Therefore, how to balance the positive effects and potential risks of organizational slack and build an effective governance structure and incentive mechanism has become a key challenge for enterprises to sustain innovative development.

2.4 Synthesis of literature review and research gaps

2.4.1 Synthesis of literature review

Through a literature review focusing on the impact of mixed ownership reform of SOEs on enterprise innovation, the impact of TMT on enterprise innovation performance, and the impact of the enterprise's organizational slack on enterprise innovation performance, this study systematically reviewed the research findings in the related fields, attempting to construct a comprehensive analytical framework.

2.4.1.1 Impact of mixed ownership reform of SOEs on enterprise innovation

In the studies on the impact of mixed ownership reforms in SOEs on enterprise innovation, it has been pointed out that SOEs show limited innovation efficiency compared to enterprises with other ownership structures. Through empirical analysis, J. Li et al. (2022) revealed the disadvantages of SOEs in the allocation of innovation resources and flexibility of innovation decision-making due to constraints in institutional mechanisms, which affects their innovation efficiency. Some studies elaborated on the innovation pressures and challenges faced by SOEs from the perspective of the competitive market environment, further corroborating the above

views (Mao et al., 2023). These studies provide in-depth insights into the problem of limited innovation efficiency in SOEs, laying a solid theoretical foundation for subsequent research. A large number of empirical studies have supported the positive impact of mixed ownership reforms on the innovation performance of SOEs. The mixed ownership reform of SOEs alleviates the agency problems by improving enterprises' governance structure and supervision mechanism, thus promoting their innovation performance. Some studies have found that mixed ownership reforms can significantly improve innovation performance indicators such as the number of patent applications and new product development cycles in SOEs. These studies usually use regression analysis, analysis of covariance, and other methods to process the data, and control for variables such as enterprise size, financial status, and industry attributes to ensure the reliability of the results. Through case studies, Ren et al. (2023) analyzed in detail how mixed ownership reform effectively alleviated the agency problem by optimizing the enterprise's governance structure and strengthening the supervision mechanism, thereby stimulating the innovation vitality of enterprises. Other studies have focused on the positive effects of the introduction of private capital, suggesting that the flexibility and market orientation of private capital can change the risk appetite of enterprises, prompting enterprises to be more inclined to invest in innovation, thus enhancing their innovation performance (Y. Zhao et al., 2023). These studies not only revealed the facilitating effect of mixed ownership reform on the innovation performance of SOEs, but also provide valuable implications for the direction of SOEs' future reform.

2.4.1.2 Impact of TMT on enterprise innovation performance

This chapter reviewed the literature on the impact of TMT heterogeneity. According to the Upper Echelons Theory, proposed by Hambrick and Mason (1984), the characteristics and functional attributes of the TMT play a decisive role in the actions and performance results of enterprises. Based on this theory, studies have conducted analysis of the dual impact of TMT heterogeneity on enterprise innovation performance. On the one hand, TMT heterogeneity can bring diverse types of knowledge and decision-making styles to the enterprise, facilitating the generation of innovative ideas and creativity. In addition, TMT heterogeneity can bring different types of knowledge and professional perspectives to the enterprise, thus expanding the enterprise's innovation vision. TMT members from different backgrounds can identify problems and propose solutions from different perspectives, and this diversity helps to stimulate creativity and new ideas. For example, J. Zhao et al. (2023) pointed out that TMT heterogeneity could improve the enterprise's risk-taking ability for radical innovations, which

is conducive to enhancing innovation performance. Furthermore, TMT heterogeneity on specific dimensions, such as age, tenure, and educational background, also positively affects enterprises' innovation performance. For example, a TMT with greater age heterogeneity tends to have broader perspectives and more diverse experiences, which can stimulate innovative thinking and idea generation. Heterogeneity in tenure helps teams to balance feasibility and innovativeness in decision-making, driving new product development. Heterogeneity in educational background brings broader perspectives and diversified thinking, which enables teams to identify problems in advance and conduct analysis to address the problem, thus contributing to the enterprise's innovation activities. On the other hand, TMT heterogeneity may also lead to difficulties in communication and coordination within the team, affecting the efficiency and implementation of innovation decisions. Excessive heterogeneity may lead to divisions and conflicts within the team, which is not conducive to team stability and cohesion. Such divisions and conflicts may disrupt the harmonious atmosphere of the team and reduce the efficiency of teamwork and innovation capabilities. Through empirical analysis, X. Wang (2019) verified the existence of this dual effect, providing an important reference for TMT's construction and optimization.

We also reviewed the impact of TMT's attention on enterprise innovation performance. Cho and Hambrick (2006) proposed a strategic attention-based view, providing a new perspective on understanding how TMT influences the enterprise's strategic change. They emphasized that the allocation of TMT's attention is a mediator between TMT characteristics and the enterprise's strategic change. This theoretical framework states that the psychological characteristics of TMTs, such as their cognition, values, and experience, ultimately determine the enterprise's strategic choices and production activities through the interpretation and filtering of information. This suggests that TMT's attention is not only a reflection of individual cognitions, but also a determinant of the enterprise's strategic orientation. Based on Ocasio's (1997) attention-based view, studies have examined how the TMT influences the enterprise's innovation decisions and implementation through selective attention and screening of innovation-related information. It has been found that by allocating their attention to innovation investment, TMTs can promote enterprises' innovation investment, thereby enhancing their innovation performance. This focus of attention not only facilitates the generation of innovative ideas, but also accelerates the incubation and implementation of innovation projects, ensuring that innovation investments are aligned with the overall strategy, thus maximizing economic benefits. G. Song et al. (2022) empirically examined the positive effect of innovation attention on enterprise innovation performance by constructing a measurement model of TMT's innovation attention. This finding

not only revealed the significant role of TMT's attention in the process of enterprise innovation, but also provides theoretical guidance to enterprise managers on how to effectively allocate attention resources.

2.4.1.3 Impact of organizational slack on enterprise innovation performance

We also reviewed the impact of organizational slack on enterprise innovation performance. Existing studies generally suggest that organizational slack can serve as a resource "buffer" to provide necessary support and guarantee for exploratory innovation in enterprises. However, the impact of organizational slack on enterprise innovation performance is complex and multidimensional. X. Zhou and Han (2022) analyzed the complex impact of organizational slack on enterprise innovation performance from various perspectives, providing useful insights on how enterprise managers can rationally manage and utilize organizational slack. On the one hand, organizational slack provides enterprises with a resource base for exploratory innovation. By facilitating technology mergers and acquisitions, providing trial-and-error opportunities, and fostering internal knowledge sharing, it can enhance innovation efficiency. This positive effect has been empirically supported by various studies (e.g., March, 1991; X. Wang et al., 2023; X. Zhou and Han, 2022). On the other hand, excessive organizational slack may also lead to waste and inefficient use of resources, as well as overly dependency on existing resources, thus hindering the enterprise's innovation motivation. Some studies have revealed the potential negative impacts of organizational slack, showing that the mechanisms by which organizational slack affects enterprise innovation performance are complex and diverse (Ghosh et al., 2017; Higgins & Rodriguez, 2006; Y. Liu et al., 2023). Meyer and Leitner (2018) showed that organizational slack enhanced the enterprise's exploratory innovation capabilities by providing resources and psychological security. In addition, the characteristics of the enterprise's internal and external environments, such as the government's environmental concerns and the TMT's social capital, have been found to moderate the relationship between organizational slack and innovation performance. These external factors play a role by influencing resource allocation and innovation path selection, further enriching our understanding of the influence mechanism of organizational slack.

In summary, through the literature review, we synthesized the influence mechanisms of factors such as mixed ownership reform, TMT structure, TMT's attention, and organizational slack on the innovation performance of SOEs. These research results not only deepened our understanding of the innovation efficiency problem in SOEs, but also provide a rich theoretical resource and empirical basis for subsequent research. However, it is worth noting that when

exploring the influence mechanism of these factors, it is necessary to consider the actual situation in Chinese context, and combine empirical research and case study analysis in order to reveal more comprehensively their complex impacts on enterprise innovation performance.

2.4.2 Research gaps

Through the literature review, the study identified the following research gaps.

2.4.2.1 Influence of TMT structure on enterprise innovation performance after mixed ownership reform

Although current studies have examined the impact of TMT heterogeneity on the innovation performance of enterprises, there is need for further research on how the TMT structure of private capital and state-owned capital jointly affects the innovation performance of enterprises in specific contexts, such as after the mixed ownership reform. J. Li et al. (2022) studied the effects of mixed ownership reform on the innovation of SOEs, as well as the influence mechanisms. However, they failed to conduct an in-depth analysis of the realization path. Xiang and Yu (2020) suggested that the impact of mixed ownership reform on enterprise innovation should be studied from a multidimensional perspective, beyond the theory of property rights, further emphasizing the need for in-depth exploration of the influence mechanism of TMT structures in the context of mixed ownership reforms.

X. Luo et al. (2023) suggested that in the face of mixed empirical results regarding the relationship between strong/weak corporate governance mechanisms and enterprise innovation, it is necessary to rely on more refined theories or adopt more precise and refined measures for corporate governance mechanisms and enterprise innovation variables. In the context of mixed ownership reform, it is necessary to explore how TMT members with different ownership backgrounds influence enterprises' innovation decision-making and implementation through cooperation and conflict (Balsmeier et al., 2017). On this basis, further exploring the cooperation mechanisms and conflict resolution strategies among TMT members in mixed-ownership enterprises, and how these factors jointly influence the enterprise's innovation strategies and decision-making processes, would be a powerful complement to existing research. In addition, as independent directors constitute an important component of the corporate governance structure, their influence on enterprises' innovation activities in the context of mixed-ownership reform is also worth in-depth investigation. More specifically, how the expertise, experience, and networks of independent directors influence the enterprise's innovation decisions and how independent directors can contribute to the enterprise's

innovation activities by providing independent perspectives and advice are relevant topics in current research (Hambrick et al., 2015). In addition, how the participation of independent directors affects the enterprise's risk-taking intention and innovation investment decisions is also a key for understanding the impact of TMT structure on enterprise innovation performance in the context of mixed-ownership reform. By analyzing the roles and functions of independent directors in mixed-ownership enterprises, we can understand more comprehensively the complex impacts of TMT structure on the enterprise's innovation activities, providing strong theoretical support and practical guidance for the in-depth implementation of mixed-ownership reform and the improvement of enterprise innovation performance (Kang et al., 2018).

2.4.2.2 Influence of TMT's attention on enterprise innovation

Although the impact of TMT's attention on enterprise innovation has received extensive attention from the academic community and a series of research results have been obtained, there are certain limitations, and it is necessary to explore this relationship in SOEs, especially in the context of mixed ownership reform.

Existing studies are often limited in terms of sample selection, which, to some extent, limits the generalizability of their findings. For instance, Z. Wang and Liu (2021) only employed the software and technology services industry as the sample. While this industry is highly innovative, their findings may not be applicable to other industries. X. Xie and Han (2022) selected four case enterprises for their study, but they also recognized that the typicality of these cases reduced the generalizability of the findings to a certain extent. The sample of S. Lv et al. (2019) were primarily innovative enterprises in Shaanxi Province, and the geographical limitations reduced the applicability of the study's findings. To overcome these limitations, this study decided to employ a large sample size by selecting mixed-ownership enterprises listed on Shanghai and Shenzhen stock exchanges as the research subjects, aiming to obtain findings with more generalizability.

Moreover, in the literature, attention has been paid to the concept of attention allocation (Joseph & Wilson, 2018; Kim et al., 2016), but current studies have not yet delved deep into its definition, connotation, and mechanism. C. Wu (2020) pointed out that in current research, the understanding of attention remains at a superficial level, and there lacks an in-depth exploration on how attention is allocated and the effects of that allocation. Based on that, this study attempts to delve deeper into the essential characteristics of TMT's attention to explore how TMTs identify and select innovation-related information and make effective attention allocation based on this information. In addition, this study also focuses on how the innovation-related

information is transformed into specific innovation issues and how the TMT puts these issues into practice, thereby revealing the key role of attention allocation in the process of enterprise innovation.

2.4.2.3 Impact of organizational slack on enterprise innovation performance

In organization theory and enterprise management practice, organizational slack, as a special form of internal resources of enterprises, has received extensive attention from scholars for its impact on enterprise innovation performance. Although studies have preliminarily explored the relationship between organizational slack and enterprise innovation performance, more research is still needed to explore the underlying mechanism through which organizational slack ontributes to enterprise innovation performance.

From the existing literature, it is notable that the impact of organizational slack on enterprise innovation performance is complex, encompassing both positive and negative effects. On the one hand, moderate organizational slack may provide the necessary resource buffer and trial-and-error space for enterprise innovation and promote innovation activities; on the other hand, excessive slack may lead to waste and inefficiency use of resources, and even hinder innovation motivation. Some scholars have argued for including a broader sample to expand the research scope so as to more comprehensively reveal the relationship between organizational slack and enterprise innovation performance (Y. Liu et al., 2023; X. Wang et al., 2023). J. Chen et al. (2020) stated in their literature review that the role of organizational slack on innovation was still controversial. Most of the current research on the role of organizational slack on innovation is based on organizational and agency theories, and there lacks an intergration with other theories, leading to an overly monolithic understanding of the influence mechanism of organizational slack (Moses, 1992). In addition, most of the existing studies on the impact of organizational slack on innovation focus on the dimension of R&D investment, ignoring the potential role of organizational slack in multiple aspects such as innovation strategy formulation, innovation project implementation, and innovation resource allocation. This study attempts to further explore the moderating role of organizational slack, more specifically, how organizational slack affects the innovation strategy and implementation of innovation projects, and how to optimize the allocation of innovation resources by managing organizational slack. Z. Li et al. (2022) suggested that, at the level of enterprise strategic management, it is important to further investigate the phenomenon of CEO duality (i.e., the chairman and the CEO are held by the same person) in individual enterprises. CEO duality may have far-reaching impacts on enterprises' internal power structure, decision-making efficiency,

and innovation activities, while organizational slack may play an important role therein. Therefore, future research should combine organizational slack with enterprise governance characteristics such as CEO duality to explore in depth how they jointly affect enterprise innovation performance.

Based upon these research gaps, future studies are suggested to comprehensively explore how the mixed ownership reform of SOEs, the TMT structure, the allocation of TMT's attention, organizational slack, independent directors, and other factors jointly affect the innovation performance of enterprises. This not only contributes to theoretical innovation, but also provides stronge theoretical and practical support for innovation management and policy formulation in SOEs.

2.5 Theoretical basis and research hypotheses

At present, relevant studies primarily take the theoretical perspectives of Property Rights Theory, Principal-Agent theory, Upper Echelons Theory, TMT's attention, and organizational slack, while taking into account the actual situation of SOEs' innovation performance. Based on the research gaps identified in the literature review, this section will construct a theoretical model and propose research hypotheses using the Upper Echelons Theory as the main framework, in combination with the Principal-Agent Theory and the Attention-Based View.

2.5.1 Board structure and enterprise innovation performance

The modern property rights theory, represented by Ronald H. Coase, a professor at the University of Chicago, is a private property rights theory established by the New Institutional Economics school. The central idea of the modern property rights theory is to clearly define, change, and reasonably allocate property rights to have property rights clearly defined so as to reduce or eliminate transaction costs in market operations, thereby improving resource allocation and enhancing economic efficiency (Xiang & Yu, 2020). The transaction cost theory, derived from the property rights theory, posits that markets and enterprises are two alternative means of resource allocation. Markets allocate resources through the price mechanism driving the flow of factors, while enterprises allocate resources through internal authoritative relationships (C. Yuan et al., 2021). Resource allocation through internal authoritative relationships within enterprises relies on the control of the TMT (Z. Hu et al., 2024).

The theory of property rights posits that when transaction costs are zero, resource allocation efficiency is not affected by the definition of property rights (Acemoglu et al., 2010; Fan et al.,

2017; Fan & Lang, 2000). However, in practice, transaction costs always exist, and different ways of defining property rights lead to varying resource allocation methods and transaction costs. Therefore, a clear definition of property rights is particularly important. Clear property rights boundaries can clarify the rights boundaries of different entities, thereby improving the efficiency of resource allocation (R. Yuan et al., 2021). Developing countries generally lack a fully competitive external market environment, which affects the allocation of innovation resources between and within enterprises, thus hindering the innovation efficiency of enterprises. As a response strategy to the external market environment, enterprises can internalize key innovation resources by adjusting their equity structure, thereby reducing transaction costs (Jia et al., 2018). The theory of property rights is one of the important guiding theories for the mixed ownership reform of SOEs in China.

Building on the theory of property rights, the principal-agent theory has been progressively developed and improved. In the book *The Modern Corporation and Private Property* (Adolf & Gardiner, 1991), it is stated that due to various drawbacks of direct management by enterprise owners, it is advisable for owners to hire managers with specialized skills to operate and manage the enterprise. This approach, through the principal-agent relationship, aims to achieve optimal resource allocation. However, the separation of ownership and management results in the owners holding residual ownership rights of the enterprise, while the appointed managers cannot enjoy the full value they create. This results in a clear conflict of interest between the owners and the managers, giving rise to the principal-agent problem.

The principal-agent theory posits that modern enterprises face agency problems due to the separation of ownership and control. The objectives of the principal (shareholders) and the agent (management) are not entirely aligned, and agents may not act in the best interests of shareholders due to their self-interest (J. Lv, 2023). The principal-agent theory categorizes agency problems into two main types: the first type is the agency problem between shareholders and the management, and the second type of agency problem is between controlling shareholders and minority shareholders.

In Chinese SOEs, phenomena such as multiple management levels, long chains of command, and numerous decision-making stages are quite pronounced (X. Wang, Wang et al., 2023). The absence of owners easily leads to the formation of internal controllers, while the low level of marketization and the lack of separation between the government and enterprises result in short-sighted behavior and the maximization of personal interests among SOE TMT members (C. Zhang et al., 2023). The government, as the principal, entrusts innovation resources to enterprises, which act as agents to carry out related innovation activities. Due to

the inconsistency of goals between the government and enterprises, along with information asymmetry, enterprises may reduce the effective utilization of innovation resources, thus hindering enterprise innovation (W. Wei et al., 2021).

Y. Liu (2021) provided extensive explanations for the lack of innovation in enterprises based on the principal-agent theory. In terms of management style, enterprise management tends to choose more comfortable operating methods, abandoning or reducing innovation investment in favor of other less risky investments. Regarding the issue of responsibility, since the management may bear full responsibility for innovation failures, they might exhibit reduced intention to innovate. Concerning the tenure system, the short tenure system in SOEs means that by the time innovation investments start to yield results, the management will face the possibility of a term change, leading to a decrease in their intention to innovate. As for the use of enterprise funds, innovation investments require significant funding and have long payback periods, which is detrimental to the opportunistic behavior of the enterprise management (Eisenhardt, 1989; Jensen & Meckling, 1976).

After the mixed ownership reform of Chinese SOEs, from the perspective of property rights, the introduction of non-state capital has further clarified the property rights relationship of the enterprise. This allows for the identification of the ultimate property owners of the enterprise, effectively mitigating the problem of owner absence. From the perspective of the principal-agent relationship, the inclusion of management personnel from non-state capital leads to changes in the TMT structure, further impacting the way resources are allocated within the enterprise, which in turn affects the enterprise's performance.

In the context of mixed ownership reform of SOEs, with the increasing proportion of non-state shareholders, the cost of government intervention in enterprises is also gradually rising (D. Xu et al., 2023). Directors appointed by non-state shareholders have strong incentives to supervise the controlling shareholders and the management, thereby reducing agency costs and improving the innovation efficiency of SOEs. Meanwhile, as directors and senior managers appointed by non-state shareholders participate in the enterprise's operations, their influence grows and they gain access to internal information about the enterprise's operations and management, alleviating information asymmetry issues (Xiang & Yu, 2020). Moreover, these directors and senior managers can reduce SOEs' focus on short-term performance, prompting them to prioritize the enterprise's long-term development, which can enhance the enterprise's engagement in technological innovation and increase R&D investment, thereby enhancing the enterprise's innovation performance. In China's wholly-state-owned SOEs, it is not required to include independent directors in the board of directors, and the board members are basically

appointed by state-owned shareholders. With SOEs transformed into mixed ownership enterprises, the board structure is reformed, allowing for the introduction of independent directors. Independent directors, by effectively performing their supervisory roles, can further lower agency costs and strengthen the intentionntenti of enterprises to invest in R&D (Y. Deng et al., 2023; Francis et al., 2015; Jiraporn et al., 2018), thereby boosting innovation performance. Expert directors, with their systematic professional knowledge and focus on the latest technological trends, can help enterprises identify valuable technological opportunities (Gong & Peng, 2021). In China's wholly-state-owned SOEs, directors are mainly appointed internally by state-owned shareholders. The mixed ownership reform facilitates the introduction of expert directors from outside the enterprise. As expert directors have undergone academic training in independent and critical thinking, they are both industry experts and key participants in the enterprise's innovation strategies (Barker III & Mueller, 2002; Hambrick, 2007), they can more effectively play a supervisory role and alleviate managers' short-sighted tendencies (Shao & Yuan, 2024), which helps to improve innovation-related decision-making and enhance enterprise innovation performance.

Based on this, we propose the following research hypotheses:

H1a: The proportion of non-state directors positively affects enterprise innovation performance.

H1b: The proportion of independent directors positively affects enterprise innovation performance.

H1c: The proportion of expert directors positively affects enterprise innovation performance.

2.5.2 Mediating role of TMT's attention

According to Hambrick and other scholars, the core of the Upper Echelons Theory posits that top managers tend to interpret the situations and choices they face in a highly personalized manner and act based on these interpretations. This means that the behaviors of top managers are greatly influenced by their own experiences, personalities, values, and other characteristics. These behaviors are crucial as they determine the formation of strategies or influence the actions of others, making the organization a reflection of its top managers (Hitt, 2010).

Hambrick and Mason (1984), in *Upper Echelons: The Organization as a Reflection of Its Top Managers*, proposed three arguments: 1) Top managers act based on their personal biases, experiences, and values; 2) the characteristics of the TMT better predict organizational

outcomes than the individual characteristics of the CEO; 3) demographic variables can serve as proxies for managers' cognition and values.

Hambrick (1989) made the first revision to the upper echelons theory model, providing a more systematic description of the operations of TMTs by dividing this process into three elements: composition, structure, and process. TMT composition mainly refers to the demographic characteristics of TMT members, such as gender, age, education level, and tenure; TMT structure refers to the authority structure of TMT members; while the TMT process refers to the operational processes that include communication, collaboration, information sharing, and conflict management among members (X. Guo, 2023).

Finkelstein and Hambrick (1996) refined the Upper Echelons Theory and created a research framework of "Strategic situation – TMT Characteristics – Strategic Choices – Organizational Performance".

Exploring enterprise behavior from an attention-based view (ABV) originated from Simon's views (Simon, 1947), which emphasized the bounded rationality of decision-makers or the limited attention capacity of humans. The attention-based view posits that organizational behavior results from how enterprises guide and allocate the attention of their decision-makers (Barnett, 2008; Ocasio et al., 2018). This theory explains how attention at individual, social cognition, and organizational levels interact to shape enterprise behavior, providing a new integrative perspective for understanding enterprise cognition, organizational structure, and strategy formulation (X. Xie & Han, 2022). The core of the attention-based view of TMTs is to explain how TMTs allocate and regulate their attention (Berchicci & Tarakci, 2022; Joseph & Wilson, 2018; Ocasio et al., 2018). It encompasses three basic principles: 1) The principle of attention focus. This states that decision-makers' attention focus impacts related decisions as they selectively focus on certain issues and answers. 2) The principle of situated attention. This principle indicates that decision-makers' attention focus and the corresponding decisions depend on the specific environment in which they operate. 3) The principle of structural distribution of attention. This principle asserts that an enterprise's rules, resources, and social relationships influence how decision-makers allocate their attention, thereby affecting the prioritization of issues and solutions (Tang et al., 2023).

Attention allocation is defined as the process by which decision-makers devote their time and energy to focusing on, encoding, interpreting, and concentrating on organizational issues and answers (Lo et al., 2022; Sullivan, 2010; Yadav et al., 2007). Here, "issues" refer to the issues that require decisions based on the organization's perception of the environment, such as opportunities and threats; "answers" refer to the set of alternative actions that managers can

take, such as proposals, routines, projects, plans, and processes (Ni & Wei, 2023).

After the mixed ownership reform of SOEs, the heterogeneity of the management team, which arises from their varied sources, professional experiences, and cultural backgrounds, significantly impacts strategic decision-making. The board of directors, being the core group responsible for strategy formulation, benefits from the team's heterogeneity, as it provides diversified strategic perspectives, which can help overcome individual limitations and enhance the enterprise's innovation performance (G. Zhang & Deng, 2020). Furthermore, the heterogeneity of the TMT also affects TMT's attention allocation, thereby influencing their focus and execution regarding innovation performance, making them place greater emphasis on the enterprise's innovation capabilities, R&D environment, and R&D investment (Lechner et al., 2020; Rhee & Leonardi, 2018). The attention of TMT mentioned in this study primarily refers to the selective and executive attention of the TMT.

Based on this, the following research hypotheses are proposed:

H2a: The attention of TMT mediates the relationship between the proportion of non-state directors and enterprise innovation performance;

H2b: The attention of TMT mediates the relationship between the proportion of independent directors and enterprise innovation performance;

H2c: The attention of TMT mediates the relationship between the proportion of expert directors and enterprise innovation performance.

2.5.3 Moderating role of organizational slack

Organizational slack, as the core concept of organizational theory, originated from the discussion of the role of organizational resources by scholars in this field. This concept reflects scholars' attempts to shift the perspective of organizational theory from the "state view" of resources to the impact of "unexploited" resources on organizations (Dong, 2021). Organizational slack is defined as the resources that are stored in the organization beyond the actual needs, and they are idle and unused resources in the organization (Cyert & March, 1963).

In general, the academic community has generally reached a consensus regarding the connotation of organizational slack (Hitt, 2010). Most subsequent studies were conducted in light of the characteristics of management autonomy, recognition degree, and use difference (Dong, 2021). From the perspective of viewing slack resources as a "stabilizer", J. Zhou et al. (2021) studied how slack resources reduce the risks associated with innovation investment, boost innovation confidence, and mitigate the challenge of external environment changes. From

the perspective of managers' free exercise of resource operation rights, some scholars believe that a higher level of organizational slack increases managers' free exercise of resource operation rights, making it easier for managers to turn their attention to exploratory activities (Z. Li et al., 2022). W. Han and Liu (2024) showed that a high level of organizational slack reduced the intention of enterprises to develop new resources and weakened the enterprise's updating of knowledge and capabilities.

With respect to the research focus of this study, on the one hand, as organizational slack can provide SOEs with the resource base for innovation and mitigate the management's constraint on resources in SOEs, it serves as one of the necessary conditions for TMTs to devote their attention to innovation (Voss et al., 2008). With a higher level of organizational slack, the management will place more attention to enterprise innovation and be more willing to invest resources, which is conducive to enterprise innovation (Troilo et al., 2014). On the other, organizational slack can improve the ability of the management of SOEs to bear the risks related to innovation failure, thus mitigating the pressure of performance assessment, improving the management's resistance to decision-making risks, which is conducive to innovation activities (Hughes et al., 2015; Malen & Vaaler, 2017).

Hence, the following research hypothesis is proposed:

H3: Organizational slack accentuates the relationship between board structure and enterprise innovation performance.

2.5.4 Moderating role of CEO duality

In recent years, enterprises' governance structure and innovation performance have been the focus of academic circles. Howver, no consensus has been reached regarding the impact of integration or separation of the positions of chairman and CEO on the innovation performance of enterprises. The Principal-Agent Theory and and modern Stewardship Theory form the theoretical basis for understanding the influence of CEO duality on innovation performance.

According to the Principal-Agent Theory, there are agency problems between shareholders and the management when ownership and management are separated. The independence of the board of directors is very important, especially because the chairman needs to maintain the independence of the management and be able to supervise the behavior of the managers (Firth et al., 2014). Hao (2017) suggested that the governance structure based upon CEO duality results in self-supervision, thus reducing the effectiveness of supervision while increasing the possibility of the CEO encroaching on enterprise interests, which may have a negative impact

on the innovation performance of enterprises. However, Sun and Ren (2019) claimed that within the CEO duality structure, the chairman of the board who also serves as the CEO has greater discretion and is inclined to high-risk strategies, which is conducive to enterprise innovation investment.

According to the s Stewardship Theory, the needs for the realization of their personal value, their own dignity, and inner work satisfaction will prompt enterprise TMTs' to work hard and do a good job of "steward", which can help to realize their personal value while increasing enterprise value (K. Li et al., 2023). Based on the Stewardship Theory, L. Liu (2018) hold that the implementation of the governance structure with CEO duality in enterprises can strengthen the role of CEO in promoting enterprise innovation. The TMT's attention to innovation does not necessarily translate directly into innovation activities. CEO duality enables the TMT to have greater autonomy when making decisions related to innovation and organizational changes, which is conducive to the decision-making and implementation of innovation activities (Y. Li et al., 2021).

As CEO duality reduces the possibility of conflicts caused by the role division of chairman and CEO, it has a positive impact on enterprises' decision-making and execution of innovation attention, thereby improveing the innovation performance of enterprises (Boyd et al., 2011; Krause et al., 2015; J. Li & Tang, 2010). On the one hand, at the decision-making level of the board of directors, with CEO duality, the chairman can urge the board of directors to pay more attention to issues such as innovation investment. On the other hand, at the execution level of the management, with CEO duality, the CEO can more effectively implement the relevant decisions of the board of directors, thus improving the innovation performance of the enterprise.

The following research hypothesis is thus proposed:

H4: CEO duality accentuates the relationship between board structure and enterprise innovation performance.

2.5.5 Model construction

Based on the above theoretical analysis, this study posits that in the context of the mixed ownership reform of China's SOEs, the introduction of non-state-owned capital shareholders has caused a great change in the structure of the board, thus impacting the innovation of enterprises. This research endeavors to open the "black box" of innovation in SOEs by clarifying the influence mechanism of enterprise innovation.

With the implementation of the mixed ownership reform of SOEs, the members of the board

of directors have changed from being appointed solely by state-owned capital to being appointed jointly by state-owned capital and non-state-owned capital. In terms of enterprise innovation, the change of the structure of the board of directors leads to the shift of TMT's attention, which further impacts the innovation performance of the enterprises. Meanwhile, organizational slack, board size, CEO duality, and other factors may have a moderating effect on enterprise innovation performance. The specific research model is shown in Figure 2.1 below.

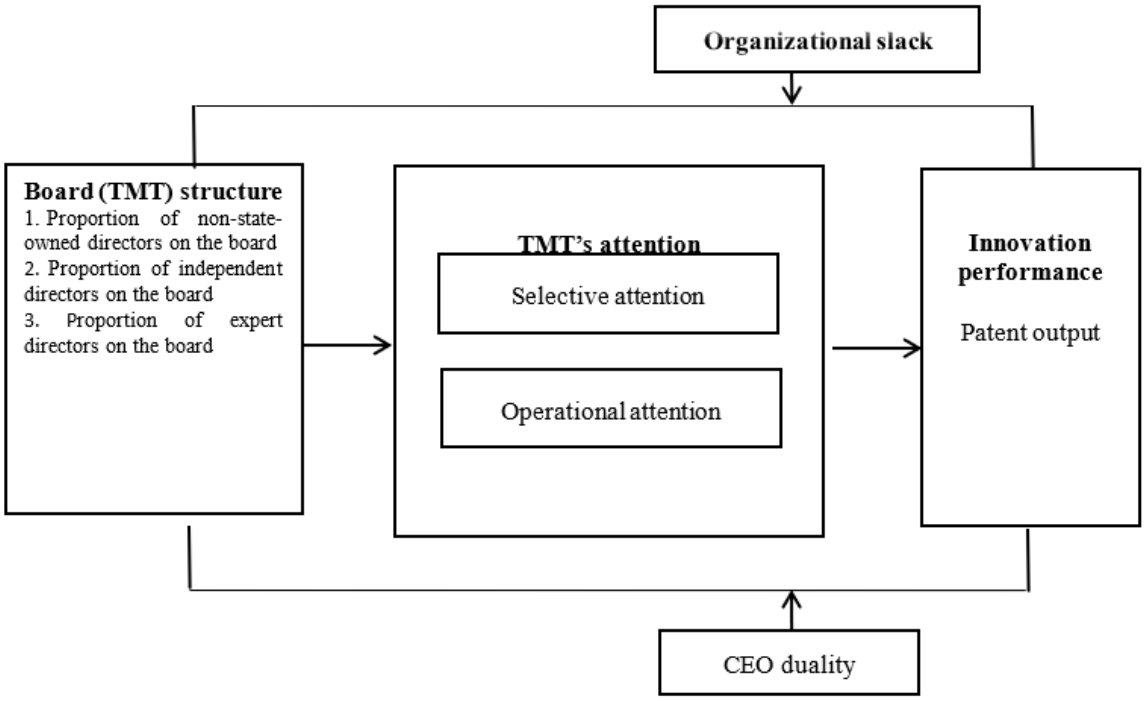

Figure 2.1 Research model

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Chapter 3: Research Design

3.1 Sample and Data

3.1.1 Sample Selection

This study selected the enterprises listed on Shanghai and Shenzhen A-share stock markets from 2018 to 2022 as the research objects. Their actual controllers are local government agencies or China State Council and have undergone mixed ownership reform. We chose 2018 as the starting year of the sample observation because in 2015, the Chinese government proposed to further promote the mixed ownership reform of state-owned enterprises (SOEs), and the data on R&D investment and patents were disclosed more comprehensively after 2018. Meanwhile, considering the lag in the manifestation of innovation performance and the completeness of data collection, the sample selection period of this study was determined to be from 2018 to 2022. This study eliminated ineligible observations from the original sample based on the following exclusion criteria: (1) enterprises with abnormal or missing number of patent applications per year; (2) enterprises in the ST or *ST category and suspended enterprises; (3) enterprises with missing data of other variables. Finally, 387 enterprises were selected as the research objects, and unbalanced panel data with a total of 1,321 observations are obtained.

3.1.2 Data sources

This study obtained research data from several sources: 1) the basic data of the top management team (TMT) of the sample enterprises were retrieved from the CHOICE database and WIND database; 2) the basic data of TMT's attention of SOEs were from the annual reports of the enterprises disclosed by Sina Finance and were analyzed through text analysis; 3) the data of the innovation performance of SOEs came from the WINGO database; and 4) the basic information of the enterprises, the financial indicators, and data about the directors' and top managers' demographic characteristics were all from the WIND and CHOICE databases.

3.2 Definition of variables

3.2.1 Dependent variables

Innovation performance (Inn P)

Refering to the practice of X. Li et al. (2020), this study utilized the number of patent applications to measure innovation performance (the specific operation is adding 1 to the number of patent applications to take the natural logarithm). Patent is the reflection of an enterprise's technological innovation, with the characteristics of homogeneity, comprehensiveness, objectivity, accessibility, and technological relevance, can more accurately reflect the level of enterprise's innovation output.

3.2.2 Independent variables

Board structure

Referring to the practice of D. Liu et al. (2023) and H. Xie et al. (2024), this study utilized the proportion of independent directors (Dl), the proportion of expert directors (Zj), and the proportion of non-state directors (Fg) to measure the board structure.

Specifically, this study screened expert directors by referring to the practice of some previous studies (Audretsch & Stephan, 1996; Fuller & Rothaermel, 2012; Gore et al., 2011; Higgins et al., 2011; Y. Hu & Ji, 2017; X. Luo et al., 2009; L. Wang & Yao, 2019; White et al., 2014; Withers et al., 2012). The inclusion criteria include: (i) education background, with doctoral degree or above; (ii) senior professional titles, such as professorial engineers, senior engineers, and senior economists; (iii) patents or awards, owning invention patents or having received awards for inventions at the provincial level or above; and (iv) explicitly mentioned in their CVs that they are experts of a certain industry. The director who fulfills any of the above conditions is determined to be an expert director. For the screening of non-state directors, this study referred to the research by Q. Wu and Du (2022), where directors appointed by non-state shareholders were recognized as non-state directors. We conducted manual screening accordingly.

3.2.3 Mediators

TMT's attention

This study employed text analysis to code text content to measure TMT's attention. TMT's attention is further categorized into Selective Attention (Selection) and Executive attention

(Action). The specific calculation process includes the following steps:

The first step is to identify the text to be analyzed. The texts written, verbalized, and recorded by the TMT reveal the TMT's attention to and execution of the relevant issues, and are a concentrated reflection of the TMT's attention. While letters to shareholders, minutes of shareholders' meetings and board meetings, and public speeches by top managers are often used as research materials, for listed enterprises, it is more widely practiced to use the annual reports of these enterprises to measure the attention of the TMT. The annual report reflects not only the enterprise's annual operation status but the TMT's thinking about future strategic development, which can show the enterprise's attention to innovation strategies. The use of annual reports can ensure the relevance, comparability, and comprehensiveness of innovation attention measurement. This study used Scrapy crawler framework to acquire the PDF files of the annual reports of enterprises limited on Shanghai and Shenzhen A-share markets (excluding GEM and KIC) from 2018 to 2022 from the webpage of Sina Finance.

Since the annual reports are lengthy and contain "noisy" contents such as financial statements, this study referred to existing studies (Feng et al., 2022; X. Wang & Hu, et al., 2023; M. Wu, 2019) and adopted the method of truncating the text by using the section of the annual report entitled "Discussion and Analysis of Operating Situation" as the text for analysis.

The second step was to determine the unit of text analysis. Referring to the research methods in the studies (X. Wang & Wang, 2024; M. Wu, 2019; X. Xiong, 2021), among the options of words, sentences, and paragraphs, this research chose "words" as the basic unit of text analysis.

The third step was to determine the category of analysis. In this study, the research category of TMT's attention was defined as "enterprise innovation".

The fourth step was word frequency analysis. In this study, the Python programming language was used to perform the word frequency analysis on the text. The first substep was to carry out the stop word processing. Stop words include common punctuation marks and dummy words, among others, which contribute less to the analysis of the text theme, but occupy a certain proportion in the word division results. Removing these stop words can significantly reduce noise and improve the accuracy of keyword extraction. Subsequently, this study introduced the Jieba lexical library to carry out lexical processing on the preprocessed text. It deactivated word is a highly efficient lexical tool widely used in the field of Chinese text processing and can maximize the retention of the original intent of the sentence to ensure that the results of the lexical processing are both accurate and suitable for the analysis needs. After completing the word segmentation, we then used the Counter class in the Python standard

library to perform word frequency statistics on the word segmentation results, and used the sorted() function to perform descending sorting on the statistical word frequency.

The fifth step was to determine the keywords. In order to strengthen the authority and validity of the keyword list and to differentiate between the TMT's selective and executive attention to innovation, this study applied the expert scoring method. After further eliminating dummy words, connectives, and other words that are obviously irrelevant to the innovation environment, this study screened the words in the top 30% of the word frequency ranking, totaling 62 words. The preliminary screening results were given to 50 directors and top managers of SOEs whose research direction is enterprise innovation to categorize and select the above innovation keywords (the options are "selective attention to innovation", "executive attention to innovation", "both", and "neither"; no discussion was allowed, and they were asked to complete this process independently). The results showed that only a small percentage of individuals chose "neither", suggesting that the 62 words well representated attention to innovation. In the end, after removing the words which more than half of the experts found impossible to distinguish between selective and executive attention (by choosing "both"), a total of 54 words were screened out for distinguishing between selective and executive attention of TMTs. A comparison of the selected words with previous studies revealed that most of the words were overlapped, including "science and technology", "high-tech", and "talent"; in addition, these words are up-to-date, such as "integrated circuit", "new energy", and "digital" .

The finally selected keywords include 55 words in two categories. Among them, there are 13 words for selective attention, namely, emerging industry, information industry, science and technology, modern, new energy, advanced, high-tech, emerging, venture capital, leading position, science, innovation, digitalization; 42 words are for executive attention, namely, high-tech, network technology, high-tech, laboratory, professor, technology transfer, science and technology, key technology, innovation capability, new process, scientific research results, technology consulting, robot, introduction, science and technology development zone, researcher, electronic technology, high precision, high technology, patent application, development cost, integrated circuit, technology, equipment, research, intellectual property rights, intelligent, utility model, information network, invention patent, scientific and technological shares, technological reform, scientific research projects, technological innovation, engineering technology, human resources team, study, technicians, development, product development, product quality, and nd technological transformation.

3.2.4 Moderators

CEO duality (Dual)

The variable CEO duality is a dummy variable. Specifically, CEO duality takes the value of 1 if the enterprise's CEO is also serving as the chairman of the board, and 0 if the enterprise's CEO is not the chairman of the board.

Organizational slack (Liquid)

Referring to J. Wu et al. (2016), organizational slack, which reflects current resources that are not being used for liabilities, was measured by the current ratio (i.e., the ratio of current assets to current liabilities).

3.2.5 Control variables

With reference to previous studies, this study controlled a series of factors that may affect innovation performance. The control variables selected in this study include:

1) Liability (Lev), measured by total liabilities at the end of the year / total assets at the end of the year (J. L. Xu et al., 2023); 1

2) Growth of operating income, measured by operating income of the current year / operating income of the previous year-1 (J. Xu et al., 2023);

3) Top five shareholders' shareholding ratio (Top5), measured by the number of shares held by the top five shareholders / the total number of shares (X. Liu & Zhang, 2019);

4) Number of years listed (ListAge), measured by ln(Current Year - Listed Year + 1) (J. Xu et al., 2023).

Specific variable indicators are shown in Table 3.1.

Table 3.1 Variable definitions

Variable Types	Variable Names	Variable Description	Variable Definition
Dependent variable	Inn P	Innovation performance	Ln(1 + Number of patent applications)
Independent variables	Dl	Proportion of independent directors	Number of independent directors / Total number of board members
	Zj	Proportion of expert directors	Ln(number of expert directors / Total number of board members)
	Fg	Proportion of non-state directors	Number of non-state directors / Total number of board members
Control variables	Lev	Liability	Total liabilities at year-end / Total assets at year-end
	Growth	Growth of operating income	(Current year's operating income / Prior year's operating income) - 1

Variable Types	Variable Names	Variable Description	Variable Definition
	Top5	Top five shareholders' shareholding ratio	Number of shares held by top five shareholders / Total number of shares
	ListAge	Number of years listed	Ln(Current year - Year of listing + 1)
Moderators	Dual	CEO duality	The chairman of the board and the CEO are the same person as 1, otherwise 0
	Liquid	Organization slack	Current assets / Current liabilities
Mediators	Selection	Selective attention	Selective attention keywords / Total word frequency in annual report
	Action	Executive attention	Executive attention keywords / Total word frequency in annual reports

3.3 Empirical method and modeling

3.3.1 Empirical method

In the empirical analysis phase of this study, we used Stata 18.0 was to ensure the accuracy and efficiency of data analysis.

First of all, this study conducted a comprehensive descriptive statistics of the research variables. This step aimed at visualizing and describing the overall distribution and characteristics of the data by calculating statistical quantities such as the mean, standard deviation (SD), maximum value, and minimum value of the variables to provide a basic reference for the subsequent analysis.

Secondly, this study conducted correlation analysis. By calculating the correlation coefficients between the variables, this study explored the degree and direction of the linear relationship between them, which provided an important precondition for the subsequent multiple regression analysis. In the multiple regression analysis, this research incorporated the research variables into a unified regression model and examined the causal relationship and mechanism of action between the core variables by controlling the effects of other variables. This step not only helps to test the theoretical hypotheses, but also provides strong empirical support for practical applications.

Finally, in order to more accurately estimate the relationship between the research variables, this study adopted a two-way fixed-effects model for estimation. This model is able to control for both time and individual fixed effects, effectively avoiding potential endogeneity problems and bias, thus improving the accuracy and reliability of the estimation results.

3.3.1.1 Two-way fixed effects model

This study chose the two-way fixed effects model for empirical analysis, which has significant advantages in panel data analysis in economics, social sciences, management, and commercial fields. First, the two-way fixed effects model is able to capture the information in the data more comprehensively by controlling for both individual fixed effects and time fixed effects, thus improving the explanatory power of the model. In this study, individual fixed effects were controlled for the traits of each individual that are invariant over the observation period using enterprise industry; time fixed effects captured all individual years. Second, heteroskedasticity and serial correlation are common problems in panel data analysis. By introducing both individual and time fixed effects, the two-way fixed effects model helps to reduce the impact of these problems on the model estimation, thereby improving the accuracy and robustness of the estimation. In addition, by controlling for both individual- and time-level fixed effects, the two-way fixed effects model is able to reduce the bias due to missing variables (especially those that do not vary over time or with individuals), thus enhancing the estimation accuracy of the model.

In similar studies, some scholars mainly utilize research methods such as two-way fixed effects method, hierarchical regression (X. R Wang & Wang, 2024), GEE model (Walrave et al., 2024), and confirmatory factor analysis (CFA) (Zhao et al., 2024). Among the many research methods, the two-way fixed effects method has become a more dominant one due to its excellent performance in reducing the impact of heteroskedasticity and serial correlation problems on model estimation, which can effectively improve the accuracy and robustness of estimation. Controlling for enterprise year and industry code is particularly prevalent in the choice of fixed effects. G. Li and Bai (2024) employed the two-way fixed effects method, controlling for enterprise-year and industry code effects, to successfully explore the effects of the application of artificial intelligence in technological research and development (R&D) in manufacturing enterprises on the enterprise's innovation performance. J. Wang et al. (2024) used the two-way fixed effects method to conduct a regression analysis while controlling for enterprise year and industry code and suggested that the participation of the TMT in green innovation directly contributed to the enterprise's environmental, social, and governance (ESG) performance. Z. Hu et al. (2024) also controled for enterprise's industry and year and conducted a regression analysis through a two-way fixed effects model to reveal the intrinsic link between strategic deviance and enterprise innovation.

Long et al. (2023) investigated the impact of the nation's ESG performance on green

innovation by applying a quantile regression approach with fixed effects. Choi and Lee (2018) suggested that the two-way fixed effects model is a superior approach when dealing with panel data sets, used this model to revisit the financial performance. Zheng and Feng (2024) employed a two-way fixed effects model with a specific focus on the enterprise value perspective. The results indicated that the performance in ESG factors could enhance the overall value of an enterprise, and they further conducted multiple robustness tests to validate this finding. Furthermore, F. Li et al. (2023) used a two-way fixed effects model on a sample of 269 Chinese listed digital enterprises from 2012 to 2019, and their findings revealed the relationship between digital technology innovation and internationalization performance. Kendo and Tchakounte (2022) applied a panel quantile approach with non-additive fixed effects, revealing that an increase in asset size would lead to increased profitability. Y. Wei et al. (2020) employed a two-way fixed-effects model with control of the industry-fixed and year-fixed effects, and the results revealed the impact of employee welfare on innovation performance.

3.3.1.2 Stepwise regression

This study attemtps to explore the mediating role of TMT's attention between board structure and innovation performance. Before presenting the modeling design, it is necessary to first describe the mechanism of the mediating effect. This study intends to examine the specific paths and mechanisms through which the independent variables have an impact on the dependent variable. In this study, the stepwise regression method described by Wen et al. (2004) was used to first test the predictive effect of the independent variables on the mediators through two successive regression analysis steps, followed by assessing the direct effect of the mediators on the dependent variable while controlling for the effect of the independent variables. The core of this process lies in the identification and quantification of the variables that act as a bridge between the independent and dependent variables, i.e., the mediator, which explains how and why the independent variable is able to influence the dependent variable. Through rigorous statistical testing, the stepwise approach can accurately assess the magnitude and significance of the mediating effect, thereby more precisely depicting the causal chain behind complex phenomena. The use of stepwise regression to test the mediating effect has been widely employed in the studies on factors influencing enterprise performance. For example, G. Li and Bai (2024) used stepwise regression to investigate the mediating effect of dynamic capabilities on the impact of the application of artificial intelligence in the field of technological research and development in manufacturing enterprises on enterprise's innovation performance.

3.3.2 Model design

3.3.2.1 Test of direct effects

In order to test hypotheses H1a, H1b, and H1c, this study established empirical models 3.1, 3.2, and 3.3 of the mechanism of influence of board structure on innovation performance, as follows:

$$\mathbf{Inn\ P_{it}} = \alpha_0 + \alpha_1 \mathbf{Fg_{it}} + \alpha_4 \sum \mathbf{Control} + \mu_i + \delta_t + \varepsilon_{it} \quad (3.1)$$

$$\mathbf{Inn\ P_{it}} = \alpha_0' + \alpha_2 \mathbf{Dl_{it}} + \alpha_4' \sum \mathbf{Control} + + \mu_i' + \delta_t' + \varepsilon_{it}' \quad (3.2)$$

$$\mathbf{Inn\ P_{it}} = \alpha_0'' + \alpha_3 \mathbf{Zj_{it}} + \alpha_4'' \sum \mathbf{Control} + + \mu_i'' + \delta_t'' + \varepsilon_{it}'' \quad (3.3)$$

In these models, Inn P_{it} is the innovation performance of industry i in the period t. Fg_{it} stands for the proportion of non-state directors in industry i in hypothesis H1a in the period t. Dl_{it} trepresents the proportion of independent directors in industry i in hypothesis H1b in the period t. Zj_{it} stands for the proportion of expert directors in industry i in hypothesis H1c in period t. ∑Control is the control variable; μ_i and δ_t represent respectively industry and time fixed effect (same for μi', μ i"; δt', δ t"). ε_{it}, ε_{it}', and ε_{it}" stand for randomized perturbation terms, while α_0, α_0', and α_0" represent cosntant terms. This study mainly focuses on the coefficient values of α_1, α_2, and α_3, which respectively measure the influence of non-state directors, independent directors, and expert directors on enterprise innovation performance.

3.3.2.2 Test of mediating effects

In order to further examine the possible mechanisms of action of board structure on innovation performance and to test hypotheses H2a, H2b, and H2c, this study established the regression models 3.4.1, 3.4.2, 3.4.3, and 3.5, as well as the models 3.6.1, 3.6.2, 3.6.3, and 3.7 based on models 3.1, 3.2, and 3.3. These models are as follows:

$$\mathbf{M_{it}} = \beta_0 + \beta_1 \mathbf{Fg_{it}} + \beta_4 \sum \mathbf{Control} + \mu_i + \delta_t + \varepsilon_{it} \quad (3.4.1)$$

$$\mathbf{M_{it}} = \beta_0' + \beta_2 \mathbf{Dl_{it}} + \beta_4' \sum \mathbf{Control} + \mu_i' + \delta_t' + \varepsilon_{it}' \quad (3.4.2)$$

$$\mathbf{M_{it}} = \beta_0'' + \beta_3 \mathbf{Zj_{it}} + \beta_4' \sum \mathbf{Control} + \mu_i'' + \delta_t'' + \varepsilon_{it}'' \quad (3.4.3)$$

$$\mathbf{Inn\ P_{it}} = \gamma_0 + \gamma_1 \mathbf{M_{it}} + \gamma_2 \sum \mathbf{Control} + \mu_i + \delta_t + \varepsilon_{it} \quad (3.5)$$

$$\mathbf{N_{it}} = \theta_0 + \theta_1 \mathbf{Fg_{it}} + \theta_4 \sum \mathbf{Control} + \mu_i + \delta_t + \varepsilon_{it} \quad (3.6.1)$$

$$\mathbf{N_{it}} = \theta_0' + \theta_2 \mathbf{Dl_{it}} + \theta_4' \sum \mathbf{Control} + \mu_i' + \delta_t' + \varepsilon_{it}' \quad (3.6.2)$$

$$\mathbf{N_{it}} = \theta_0'' + \theta_3 \mathbf{Zj_{it}} + \theta_4' \sum \mathbf{Control} + \mu_i'' + \delta_t'' + \varepsilon_{it}'' \quad (3.6.3)$$

$$\mathbf{Inn\ P_{it} = \varphi_0 + \varphi_1 N_{it} + \varphi_2 \sum Control + \mu_i + \delta_t + \varepsilon_{it}} \quad (3.7)$$

Inn P_{it} is the innovation performance of industry i in period t. Fg_{it} represents the proportion of non-state directors in industry i in period t. Dl_{it} represents the proportion of independent directors in industry i in period t. Zj_{it} represents the proportion of expert directors in industry i in period t. M_{it} stands for Selection, while N_{it} represents Action. Selection and Action together form the mediator: TMT's attention to innovation in SOEs. ∑Contro is the control variable. μ_i and δ_t represent respectively industry and time fixed effect (same for μi', μi'', δt', δt''). ε_{it}, ε_{it}', and ε_{it}'' are randomized perturbation terms. β_0, β_0', β_0'', θ_0, θ_0', and θ_0'' represent constant terms. This study focuses on the coefficient values of β_1, β_2, β_3, θ_1, θ_2, θ_3, γ_1, and φ_1, which measure the effects of non-state directors, independent directors, and expert directors on selective attention, the effects of non-state directors, independent directors, and expert directors on executive attention, the effects of selective attention on the innovation performance of SOEs, and the effects of executive attention on the innovation performance of SOEs, respectively.

3.3.2.3 Test of moderating effects

In order to test hypotheses H3 and H4, that is, the moderating effects of CEO duality and organizational slack on the relationship between board structure and enterprise innovation performance, the regression models 3.8.1, 3.8.2, 3.8.3, 3.9.1, 3.9.2, and 3.9.3 were developed in this study:

$$\mathbf{Inn\ P_{it} = \omega_0 + \omega_1 Fg_{it} \times Dual_{it} + \omega_4 \sum Control + \mu_i + \delta_t + \varepsilon_{it}} \quad (3.8.1)$$

$$\mathbf{Inn\ P_{it} = \omega_0' + \omega_2 Dl_{it} \times Dual_{it} + \omega_4' \sum Control + \mu_i' + \delta_t' + \varepsilon_{it}'} \quad (3.8.2)$$

$$\mathbf{Inn\ P_{it} = \omega_0' + \omega_3 Zj_{it} \times Dual_{it} + \omega_4'' \sum Control + \mu_i'' + \delta_t'' + \varepsilon_{it}''} \quad (3.8.3)$$

$$\mathbf{Inn\ P_{it} = \rho_0 + \rho_1 Fg_{it} \times Liquid_{it} + \rho_4 \sum Control + \mu_i + \delta_t + \varepsilon_{it}} \quad (3.9.1)$$

$$\mathbf{Inn\ P_{it} = \rho_0' + \rho_2 Dl_{it} \times Liquid_{it} + \rho_4' \sum Control + \mu_i' + \delta_t' + \varepsilon_{it}'} \quad (3.9.2)$$

$$\mathbf{Inn\ P_{it} = \rho_0'' + \rho_3 Zj_{it} \times Liquid_{it} + \rho_4'' \sum Control + \mu_i'' + \delta_t'' + \varepsilon_{it}''} \quad (3.9.3)$$

Inn P_{it} is the innovation performance of industry i in period t. Fg_{it} represents the proportion of non-state directors in industry i in period t. Dl_{it} represents the proportion of independent directors in industry i in period t. Zj_{it} represents the proportion of expert directors in industry i in period t. Fg_{it}×$Dual_{it}$, Dl_{it}×$Dual_{it}$, and Zjit×$Dual_{it}$ stand for the interaction terms of the proportion of non-state directors, the proportion of independent directors, and the proportion of expert directors with CEO Duality, respectively. Fg_{it} ×$Liquid_{it}$, Dl_{it}×$Liquid_{it}$, and Zj_{it}×$Liquid_{it}$

represent respectively the interaction terms of the proportion of non-state directors, the proportion of independent directors, and the proportion of expert directors with organizational slack. $\sum$Control is the control variable. μ_i and δ_t represent respectively industry and time fixed effect (same for μi', μi'', δt', δt''). ε_{it}, ε_{it}', and ε_{it}'' are randomized perturbation terms. ω_0, ω_0', ω_0'', ρ_0, ρ_0', and ρ_0'' are constant terms. This study mainly focuses on the coefficient values of ω_1, ω_2, ω_3, ρ_1, ρ_2, and ρ_3. They measure the moderating effects of organizational slack and CEO duality on the relationship between board structure and enterprise innovation performance.

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Chapter 4: Analysis of the Status-Quo of Top Management Team Structure and Innovation Performance of Chinese Mixed Ownership Enterprises

The status-quo analysis, as a foundational component of the empirical research, supports the overall research design through a three-tiered logical progression. 1) It systematically reviews the characteristics of top management team (TMT) structures, innovation performance indicators, and the distribution patterns of control variables, thereby establishing the operational definitions and measurements for the variables, laying a foundation for the regression model. 2) Descriptive statistics are employed to preliminarily examine the direction and strength of the relationships among the variables, while data cleaning and collinearity tests are conducted to ensure the robustness of the measurement model. 3) The analysis reveals the institutional particularities of TMTs in state-owned enterprises (SOEs) and the patterns of their association with innovation activities, offering empirical grounding for the theoretical framework. The status-quo analysis essentially constructs a logical transition from observed phenomena to causal inference, laying a theoretical foundation for subsequent influence mechanism testing through empirical research.

The object of this study is the mixed ownership enterprises listed on the Shanghai and Shenzhen A-share markets from 2018 to 2022. In general, the number of mixed ownership enterprises in China is growing rapidly. The number of mixed ownership enterprises in the Shanghai and Shenzhen A-share markets (excluding the GEM and KIC, which are mainly targeted at enterprises with short establishment time, smaller capital size, and better growth, and have a weak correlation with the mixed ownership reform of SOEs, and thus were not included in this study) gradually increased from 706 in 2016 to 867 in 2022, indicating that China’s mixed ownership reform in SOEs is expanding year by year. Among these SOEs, the number of reformed local SOEs witnessed a faster growth.

With the gradual improvement of information disclosure of listed enterprises, after 2018, the innovation investment and patents were gradually and comprehensively disclosed. Therefore, the period from 2018 to 2022 was chosen as the research period for this study. From the overall disclosed data of listed enterprises, we observed improved innovation performance in each enterprise. From the perspective of innovation input, listed enterprises as a whole were

increasing their R&D expenditure, with the R&D expenditure of mixed ownership enterprises more pronounced; from the perspective of innovation output, the number of authorised patents increased year by year, with a significant positive association with R&D expenditure.

From those mixed ownership enterprises, after excluding ST enterprises and those that did not disclose data on R&D expenses and patents, we selected a total of 387 enterprises for this study.

4.1 Characteristics of TMT structures in Chinese mixed ownership enterprises

4.1.1 Professional background

A. The proportion of directors appointed by state-owned capital is lower than state-owned capital's shareholding ratio

Overall from 2018 to 2022, in the sample of the selected 387 enterprises, the proportion of state-owned capital (state capital contribution/registered capital of the enterprise) increased year by year from 45.51% in 2018 to 55.31% in 2022, with a 5-year average of 51.31%; from the viewpoint of the personnel structure of the board of directors, from 2018 to 2022, the proportion of board members appointed by state-owned capital rose from 45.76% in 2018 to 46.16% in 2022, with a 5-year average proportion of only 46.02%. The proportion of directors appointed by state-owned capital was lower than the proportion of equity held by state-owned capital in these enterprises.

The share of state-owned capital in these enterprises increased year by year from 2018 to 2022, with the five-year average exceeding 50%. However, the proportion of directors appointed by state-owned capital did not significantly increase with the increase in the proportion of state-owned shares. This may be due to the rationality of the decision-making to enhance the mixed ownership enterprises. As the shareholders of all parties need to maintain the diversity of the board of directors and the voice of non-state-owned shareholders, the proportion of directors from state-owned capital in the board of directors did not increase year-on-year.

B. Executives appointed by state-owned capital account for more than half

This study collated and analyzed the numbers and sources of executives of the selected sample enterprises from 2018 to 2022 through CHOICE and WIND databases. The number of executives from 2018 to 2022 were 4427, 4325, 4389, 4377, and 4372, respectively, with an

annual average of 4378. In particular, the number of executives assigned by state-owned capital in those years were 2,318, 2,278, 2,365, 2,387 and 2,372, respectively, with an annual average of 2,344, accounting for 53.54% of the executives. Comparing individual years from 2018 to 2022, the year 2018 had the smallest proportion of executives assigned by state-owned capital, accounting for only 52.36%, while the year 2021 had the highest proportion of executives assigned by state-owned capital , accounting for 54.54%. During these five years, the proportion of executives assigned by state-owned capital was maintained above 50%. The details are shown in Figure 4.1.

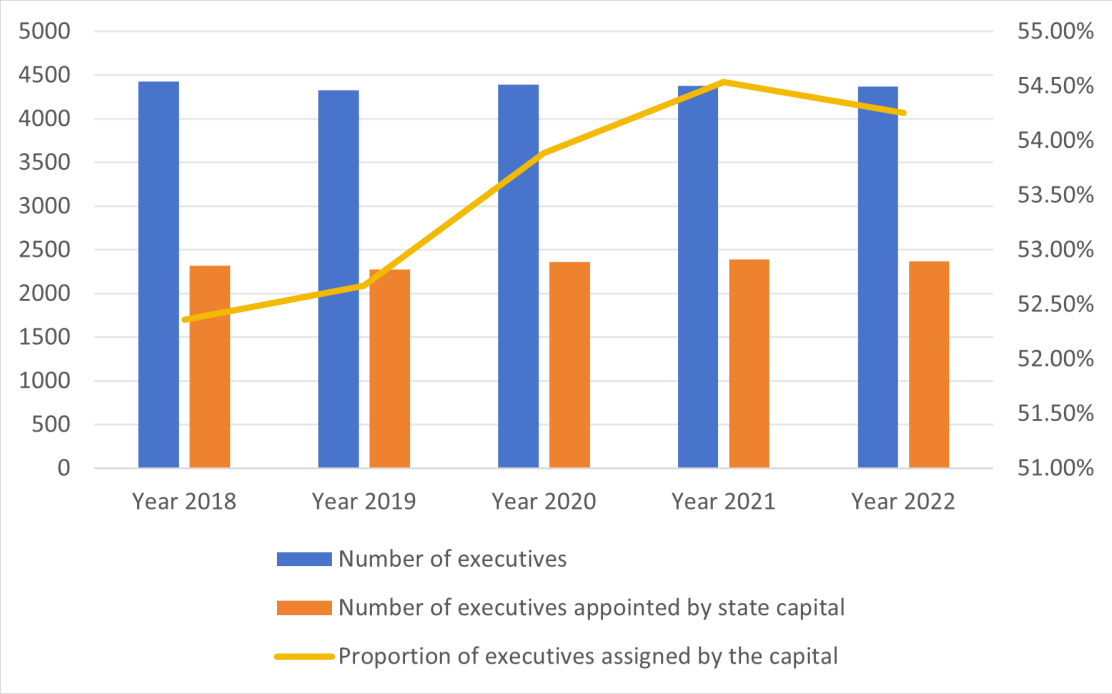

Figure 4.1 Number of executives assigned by state-owned capital

As can be seen from the above figure, the overall proportion of executives appointed by the state-owned capital is relatively high in mixed ownership SOEs. In particular, the executives at the managerial level are mostly recommended and appointed by state-owned capital. Probably due to the historical background, the daily operation of mixed ownership SOEs still mainly relies on the original state-owned system, and thus, the executives at the managerial level are still dominated by those who are familiar with the state-owned system, mainly appointed by the state-owned shareholders.

C. The proportion of independent directors is slightly higher

Chinese listed enterprises have clear institutional requirements for the number of independent directors. According to the *Administrative Measures for Independent Directors of Listed Companies*, the proportion of independent directors in the board of directors of listed enterprises shall not be less than one-third. During the period from 2018 to 2022, the annual average total

number of board directors of all listed enterprises in Shanghai and Shenzhen A-share markets (excluding KIC and GEM) was 27,605, of which the number of independent directors was 10,162, accounting for 36.81%; the annual average toal number of board directors of the 387 mixed ownership enterprises in the sample was 2,521, of which the average annual number of independent directors was 957, accounting for 37.97% of the total number of board directors, which is higher than the proportion of independent directors in all A-share listed enterprises in Shanghai and Shenzhen by 1.16%.

Overall, all listed enterprises fulfil the requirements of the *Administrative Measures for Independent Directors of Listed Companies*, with a slightly higher proportion of independent directors in mixed ownership enterprises. This may be due to the fact that given the independence of independent directors in mixed ownership enterprises, the shareholders of all parties hope that a higher proportion of independent directors can give full play to their supervisory and advisory functions, thereby fostering the board's scientific decision-making.

4.1.2 Characteristics of knowledge background

Professional title refers to the title representing the professional and technical level, ability, and achievement of professional and technical personnel. It is used to reflect the technical level and work ability of professional and technical personnel. According to the relevant requirements of the *Notice on Further Improving the Evaluation of Professional Titles* (Ministry of Human Resource and Social Security [MOHRSS], 2022), it is recognized that the senior title is the highest level among the professional titles, and it is divided into two categories, namely, the full senior level and the deputy senior level. In accordance with the classification of the 29 types of professional titles, this study summarized the definitions of relevant titles, as shown in Table 4.1. In this study, the senior title was selected as the criterion for the determination of experts.

Table 4.1 Professional title definitions

No.	Range	Professional and Technical Title				
		Senior Title		Intermediate Title	Junior Title	
1	Higher Education Teachers	Professor	Associate Professor	Lecturer	Teaching Assistant	
2	Social Science Researchers	Research Fellow	Associate Research Fellow	Assistant Research Fellow	Research Intern	
3	Natural Science Researchers	Research Fellow	Associate Research Fellow	Assistant Research Fellow	Research Intern	
4	Health Technicians	Chief Physician	Associate Chief Physician	Attending Physician	Physician	Medical Practitioner
		Chief Pharmacist	Associate Chief Pharmacist	Senior Pharmacist	Pharmacist	Pharmaceutical Technician
		Chief Nurse	Associate Chief Nurse	Senior Nurse	Registered Nurse	Nurse
		Chief Technician	Associate Chief Technician	Senior Technician	Technician	Technical Assistant
5	Engineering Technicians	Associate Chief Technician	Senior Engineer	Engineer	Assistant Engineer	Technician
6	Agricultural Technicians	Senior Agronomist	Agronomist	Assistant Agronomist	Agricultural Technician	Agricultural Technician
		Senior Animal Husbandry Specialist	Animal Husbandry Specialist	Assistant Animal Husbandry Specialist	Animal Husbandry Technician	Animal Husbandry Technician
		Senior Veterinarian	Veterinarian	Assistant Veterinarian	Veterinary Technician	Veterinary Technician
7	Journalism Professionals	Senior Reporter	Chief Reporter	Reporter	Assistant Reporter	
		Senior Editor	Chief Editor	Editor	Assistant Editor	
8	Publishing Professionals		-	Technical Editor	Assistant Technical Editor	Technical Designer
			-	First-Class Proofreader	Proofreader Level 2	Proofreader Level 3
9	Library and Information Professionals	Research Librarian	Associate Research Librarian	Librarian	Assistant Librarian	Administrator
10	Cultural Relics and Museum Professionals	Research Librarian	Associate Research Librarian	Librarian	Assistant Librarian	Administrator

No.	Range	Professional and Technical Title				
		Senior Title		Intermediate Title	Junior Title	
11	Archive Professionals	Research Librarian	Associate Research Librarian	Librarian	Assistant Librarian	Administrator
12	Arts and Crafts Professionals	Senior Craft Artist at the Researcher Level	Senior Craft Artist	Craft Artist	Assistant Craft Artist	Craft Art Specialist
13	Vocational School Teachers	Senior Lecturer		Lecturer	Assistant Lecturer	Instructor
		Senior Internship Supervisor		First-Class Internship Supervisor	Second-Class Internship Supervisor	Third-Class Internship Supervisor
14	Sports Coaches	National Coach	Senior Coach	Coach	Assistant Coach	
15	Translation Professionals	Translation Reviewer	Associate Translation Reviewer	Translator	Assistant Translator	
16	Broadcasting and Television Announcers	Broadcast Director	Chief Announcer	First-Class Announcer	Second-Class Announcer	Third-Class Announcer
17	Customs Professionals	Senior Customs Supervisor		Customs Supervisor	Assistant Customs Supervisor	Customs Officer
18	Accounting Professionals	Chief Senior Accountant	Senior Accountant	Accountant	Assistant Accountant	Accounting Clerk
19	Statistics Professionals	Senior Statistician		Statistician	Assistant Statistician	Statistical Clerk
20	Economics Professionals	Senior Economist		Economist	Assistant Economist	Economic Clerk
21	Laboratory Technicians	Senior Experimental Scientist		Experimental Scientist	Assistant Experimental Scientist	Laboratory Technician
22	Secondary Vocational School Teachers	Senior Lecturer		Lecturer	Assistant Lecturer	Instructor
23	Secondary School Teachers	Senior High School Teacher (Senior Level)	Senior High School Teacher	First-Class High School Teacher	Second-Class High School Teacher	Third-Class High School Teacher

No.	Range	Professional and Technical Title				
		Senior Title		Intermediate Title	Junior Title	
24	Primary School (and Kindergarten) Teachers	Senior Primary School Teacher (Associate Senior Level)		Senior Primary School (Kindergarten) Teacher	First-Class Primary School (Kindergarten) Teacher	Second-Class Primary School (Kindergarten) Teacher
25	Arts Professionals	First-Class Screenwriter	Second-Class Screenwriter	Third-Class Screenwriter	Fourth-Class Screenwriter	
		First-Class Composer	Second-Class Composer	Third-Class Composer	Fourth-Class Composer	
		First-Class Director	Second-Class Director	Third-Class Director	Fourth-Class Director	
		First-Class Actor	Second-Class Actor	Third-Class Actor	Fourth-Class Actor	
		First-Class Performer	Second-Class Performer	Third-Class Performer	Fourth-Class Performer	
		First-Class Conductor	Second-Class Conductor	Third-Class Conductor	Fourth-Class Conductor	
		First-Class Fine Artist	Second-Class Fine Artist	Third-Class Fine Artist	Fine Art Specialist	
		First-Class Stage Designer	Second-Class Designer	Third-Class Stage Designer	Stage Design Specialist	
		Chief Stage Technician		Stage Technician	Stage Technical Specialist	
		Chief Film Projection Technician		Film Projection Technician	Film Projection Technical Specialist	
26	Notaries	First-Class Notary	Second-Class Notary	Third-Class Notary	Fourth-Class Notary	Notary Assistant
27	Lawyers	First-Class Lawyer	Second-Class Lawyer	Third-Class Lawyer	Fourth-Class Lawyer	Lawyer Assistant
28	Marine Engineers	Senior Captain		Chief Mate (First Officer)	Second Mate	Third Mate
		Senior Chief Engineer		Chief Engineer (First Assistant Engineer)	Second Assistant Engineer	Third Assistant Engineer
		Senior Electrical Engineer		First-Class Electrical Engineer	Second-Class Electrical Engineer	

No.	Range	Professional and Technical Title			
		Senior Title	Intermediate Title	Junior Title	
29	Civil Aviation Flight Technicians	Senior Radio Operator	First-Class Radio Operator	Second-Class Radio Operator	Restricted Radio Operator
		Senior Pilot	First-Class Pilot	Second-Class Pilot	Third-Class Pilot
		First-Class Flight Navigator	Second-Class Flight Navigator	Third-Class Flight Navigator	Fourth-Class Flight Navigator
		First-Class Navigator	Second-Class Navigator	Third-Class Navigator	Fourth-Class Navigator
		First-Class Flight Communications Officer	Second-Class Flight Communications Officer	Third-Class Flight Communications Officer	Fourth-Class Flight Communications Officer
		First-Class Flight Mechanic	Second-Class Flight Mechanic	Third-Class Flight Mechanic	Fourth-Class Flight Mechanic

Source: MOHRSS (2022)

A. Executives assigned by state-owned capital have higher proportion of experts

In the sample enterprises selected during the period from 2018 to 2022, the number of executives averaged 4,378 per year, of which the number of experts in the 5-year period was 1409, 1,278, 1,302, 1,261 and 1,212, respectively, averaging 1,292 per year, accounting for 29.51% of the overall number of executives. In the sample enterprises selected during the period from 2018 to 2022, the annual average number of executives assigned by state-owned capital was 2,344, of which the number of experts was 995, 892, 913, 881, and 836, respectively, with an annual average of 903, accounting for 38.57% of the total number of executives assigned by state-owned capital, which is higher than the overall proportion of experts in the number of executives by 9 percentage points, as shown in Figure 4.2.

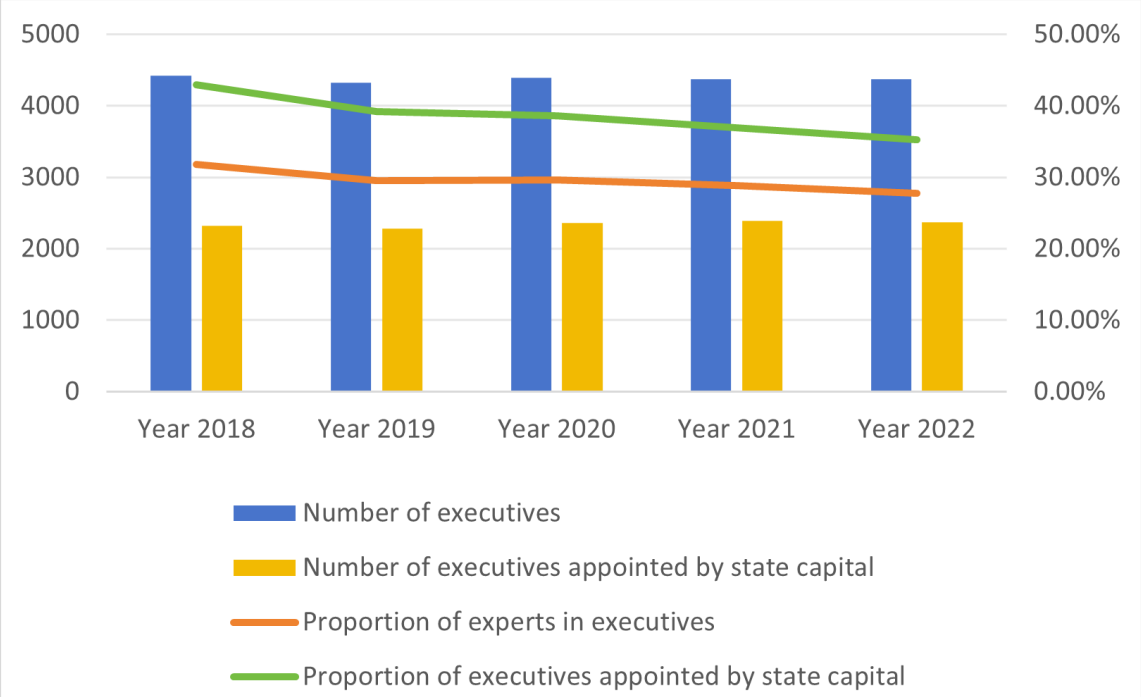

Figure 4.2 Proportion of executives in mixed ownership enterprises

The relatively high proportion of experts among the executives assigned by state-owned capital may be due to the fact that in the state-owned system, the relevant personnel attach more importance to professional skill qualifications. From the perspective of professional title system, the professional skills of the personnel of the state-owned system is evaluated according to the hierarchy of “junior - intermediate – senior”, corresponding to different title levels, with clear differences in treatment and benefits, which also motivates the personnel of the state-owned system to pay more attention to professional skill qualifications. That may also result in a high proportion of expert-type personnel among the executives assigned by the state-owned capital. At the same time, as the state-owned capital wants to have more voice over the mixed ownership enterprises and hopes to enhance its voice by increasing the professional authority of the

executives, it has the intention to assign expert executives to mixed ownership enterprises.

B. TMT members appointed by state-owned capital have higher academic qualifications

From the perspective of academic qualifications, during the period from 2018 to 2022, the annual average number of directors and top managers with a bachelor's degree or above in the selected sample enterprises was 1,349, of which the annual average number of those assigned by state-owned capital was 797, accounting for 59.08%. The 5-year annual average number of directors and top managers with a doctoral degree or above in the sample enterprises was 79, of which the the annual average number of those assigned by the state-owned capital was 46, accounting for 58.23%, as shown in Figure 4.3.

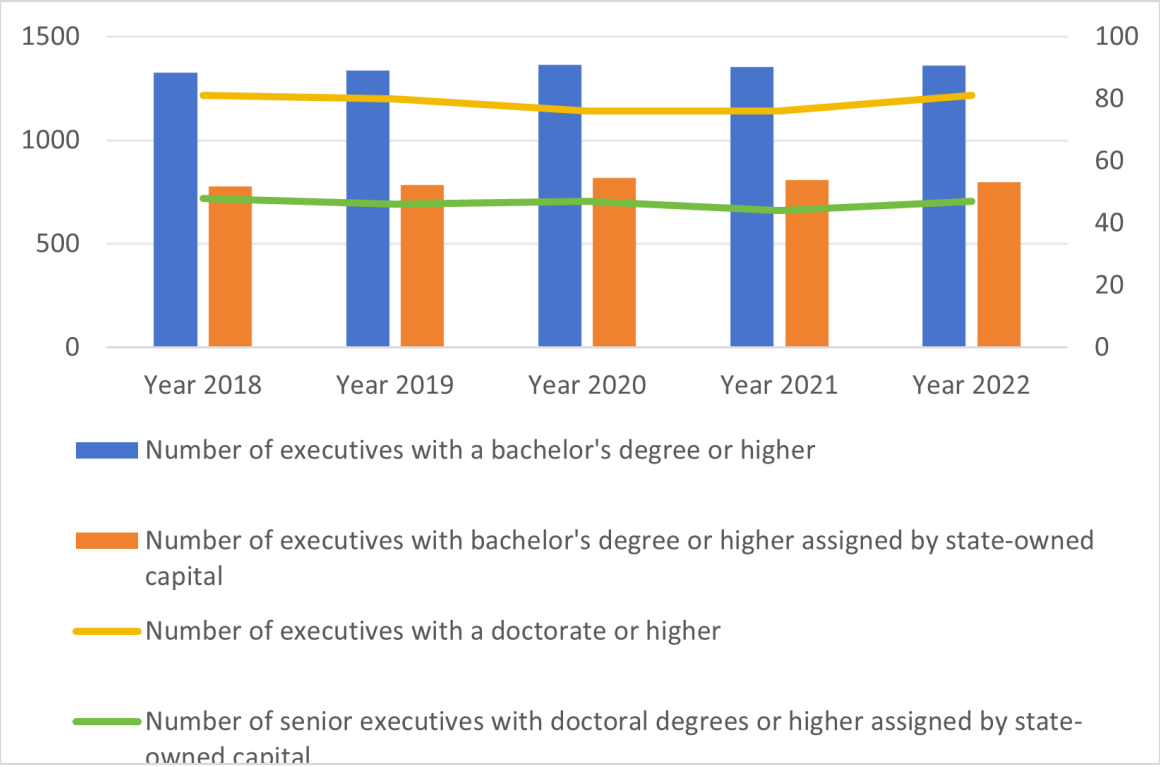

Figure 4.3 Academic qualifications of executives

Overall, the academic qualifications of directors and top managers appointed by state-owned capital are higher than those assigned by non-state-owned capital, which may be mainly due to a few reasons. On the one hand, due to the higher entry requirements of SOEs, there is a higher concentration of highly educated personnel; on the other hand, as academic qualifications are an important component of the evaluation system of SOEs for their employees, employees of these enterprises tend to have a greater intention to pursue further education in order to improve their academic qualification levels. For these reasons, on the whole, directors and top managers appointed by state-owned capital tend to have higher academic qualifications.

C. Mixed ownership enterprises have a higher proportion of expert independent directors

During the period from 2018 to 2022, the 5-year average number of independent directors of all listed enterprises was 10,162, of which the average number of expert independent directors was 6,153, accounting for 60.56% of all independent directors on average. In the selected sample enterprises, during the period from 2018 to 2022, the 5-year average number of independent directors was 957, of which the average number of expert independent directors was 653, accounting for 68.37% of all independent directors in these enterprises, which is 7.81% higher than that of all listed enterprises. The details are shown in Figure 4.4.

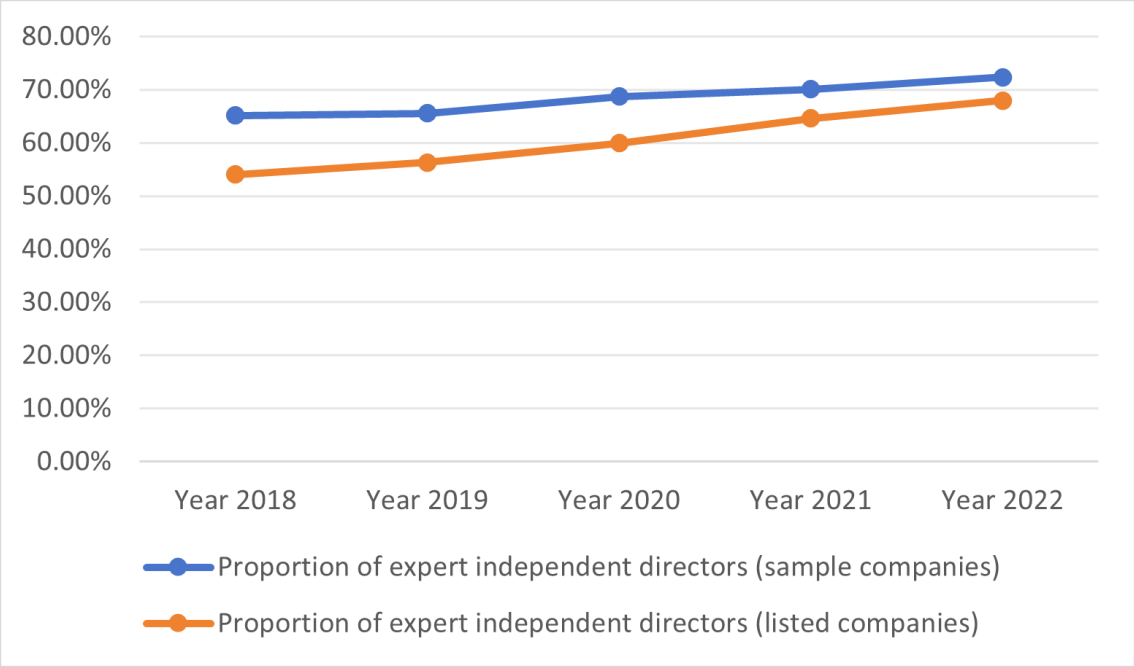

Figure 4.4 Proportion of expert independent directors

As mixed ownership enterprises involve multiple shareholders, including state-owned shareholders, private shareholders, and foreign shareholders, the diversified shareholding structure requires the board of directors to have a higher degree of professionalism and independence. Expert independent directors usually have rich professional knowledge and experience and thus can play an important role in corporate governance, helping the board of directors to make more scientific and reasonable decisions. At the same time, expert independent directors can more accurately assess the enterprise's operating conditions and decision-making, enablinig them to effectively fulfill their supervisory duties. In addition, the inclusion of expert independent directors can enhance the enterprise's information transparency and market reputation, thus improving the enterprise's image in the perspectives of investors and partners. For those reasons, overall, the proportion of expert independent directors is

relatively high in mixed ownership enterprises.

4.1.3 Demographic characteristics of TMTs in Chinese mixed ownership enterprises

Directors and top managers in Chinese mixed ownership enterprises generally have older ages. The ages of directors and top managers in the sample of selected enterprises between 2018 and 2022 showed two main characteristics. First, overall, the average age of directors and top managers was decreasing year by year, from 58.73 years old in 2018 to 55.21 years old in 2022. In particular, the average age of directors and top managers assigned by the state-owned capital also showed a year-on-year decrease, from 59.26 years old in 2018 to 57.5 years old in 2022. Secondly, the directors and top managers assigned by the state-owned capital are generally older. During the period from 2018 to 2022, the 5-year annual average age of directors and top managers assigned by non-state-owned capital in the sample was 56 years old, and the average age of those assigned by the state-owned capital was 57.5 years old, which is 1.5 years older. The details are shown in Figure 4.5.

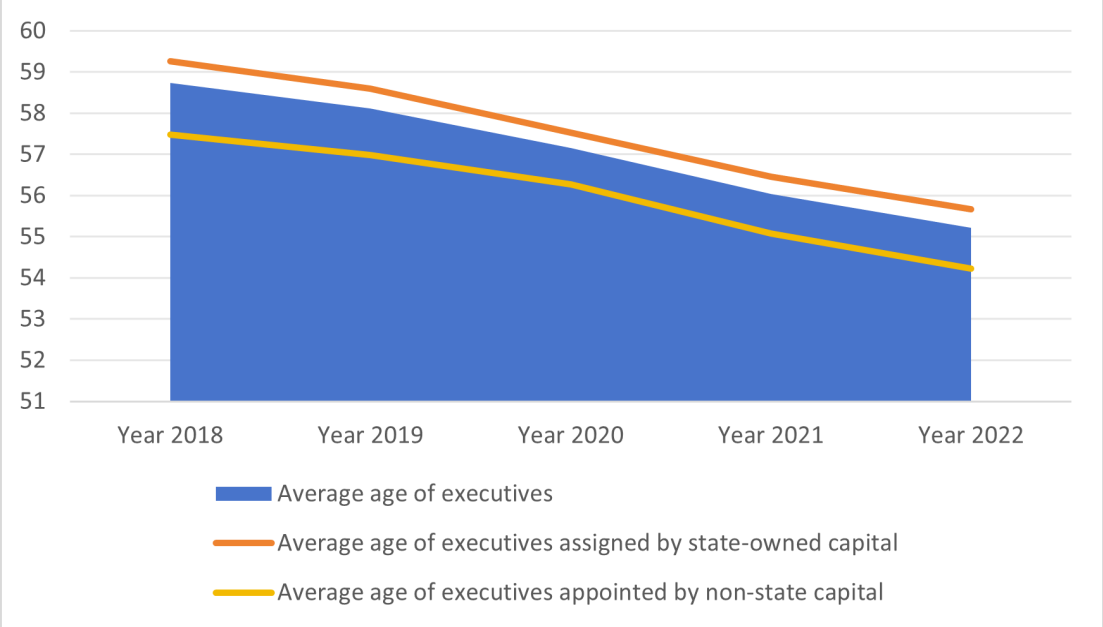

Figure 4.5 Age of executives

The reason for the older age of directors and top managers appointed by state-owned capital may be because there are strict selection processes and time frames for the promotion of senior management in the state-owned capital system, while the process of personnel promotion in the non-state-owned capital system is relatively simple, making the directors and top managers appointed by non-state-owned capital generally younger. On the other hand, to foster a better development, enterprises are gradually promoting the energetic and prospecting core employees to the decision-making level and key positions, which results in the gradual decrease of the

average age of directors and top managers.

4.2 Status-quo of innovation performance of mixed ownership enterprises in China

4.2.1 R&D investment

A. Mixed ownership enterprises have a large increase in R&D expenditure

Using the CHOICE and WIND databases as the data source, we observed that the R&D expenditure of China's mixed ownership enterprises grew significantly between 2018 and 2022. According to the disclosed R&D expenditure in the annual reports of these enterprises, the total R&D expenditure of listed enterprises grew significantly, from 549.609 billion yuan in 2018 to 112.842 billion yuan in 2022. In particular, the R&D expenditure of the selected sample enterprises grew from 122.343 billion yuan in 2018 to 310.447 billion yuan in 2022. The R&D expenditure of mixed ownership enterprises accounted for 22.26% of that of all listed enterprises in 2018, and this proportion increased to 27.51% in 2022, indicating a greater R&D investment intensity in mixed ownership enterprises. The details are shown in Figure 4.6.

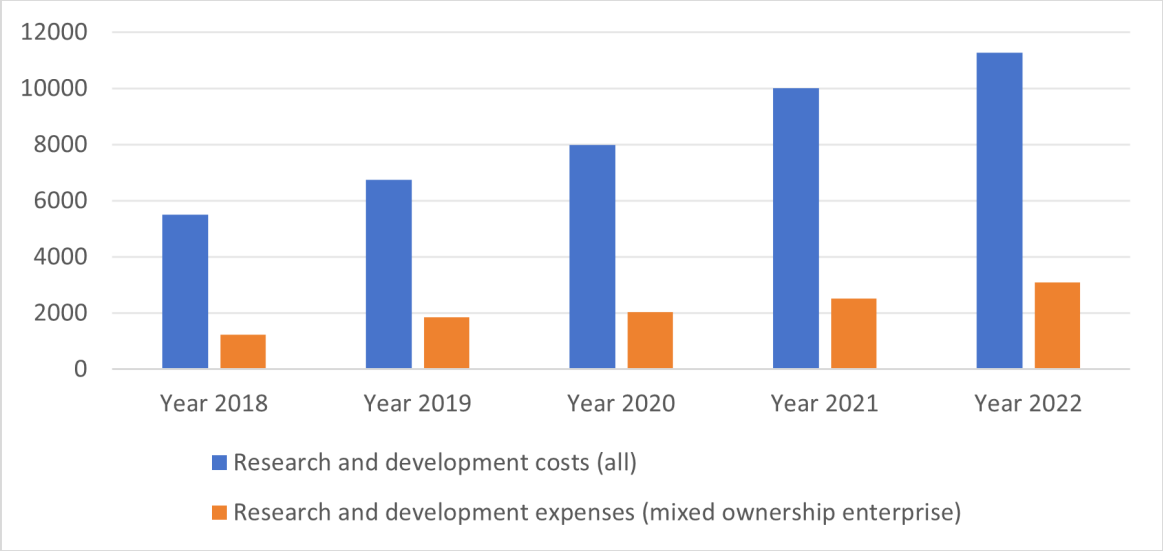

Figure 4.6 R&D expenditure

In terms of the growth rate of R&D expenditure, the growth rates of listed enterprises fluctuated considerably from 2018 to 2022. The average compound annual growth rate (CAGR) of R&D expenditure of listed enterprises in China as a whole was 22.93% during the period from 2018 to 2022, while the growth rate of R&D expenditure of the sample enterprises, although also fluctuating, had an average CAGR of 23.91%, which was higher than the overall average of all listed enterprises. This indicates that the growth rate of R&D expenditure of

mixed ownership enterprises is higher than that of listed enterprises as a whole, as shown in Figure 4.7.

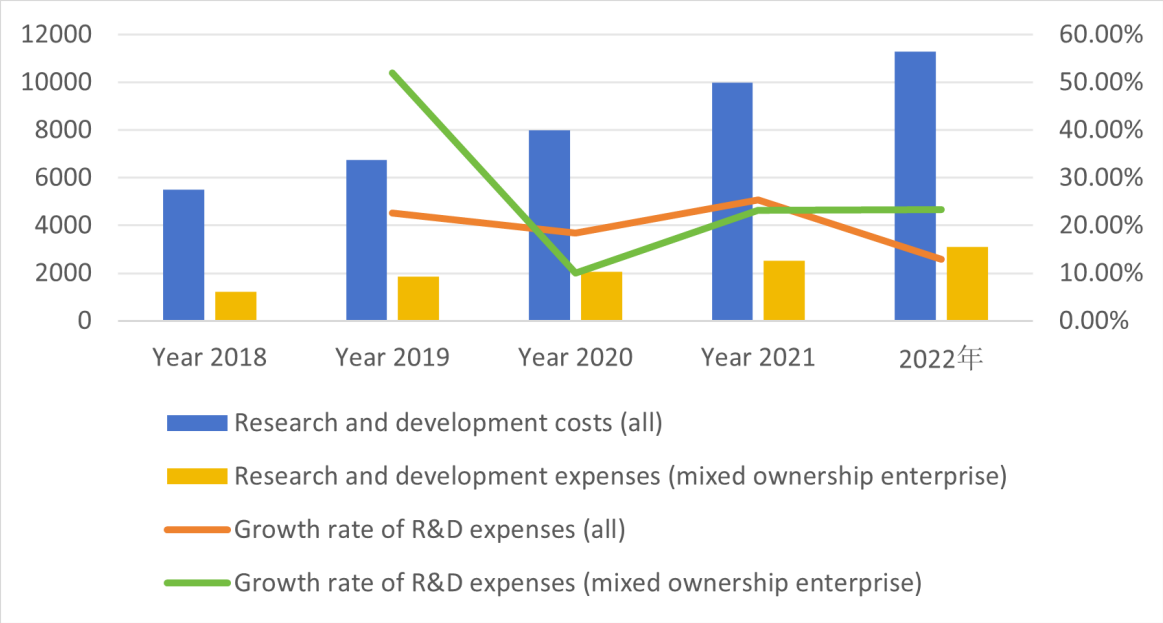

Figure 4.7 Growth rate of R&D expenditure of mixed ownership enterprises

The above illustration shows that the R&D expenditure of mixed ownership enterprises is generally higher than that of other enterprises, which may be due to the fact that executives with different professional backgrounds are involved in these enterprises' decision-making. They tend to pay more attention to the long-term development of the enterprise, focus their attention on the areas of technological innovations that can generate benefits in the future, and foster the innovation activities of the enterprise through R&D investment.

B. Central mixed ownership enterprises make more R&D investment than local mixed ownership enterprises

Although the overall R&D investment is stronger among mixed ownership enterprises, a further analysis based on their funding attributes showed that the R&D investment of mixed ownership enterprises funded by central state capital is higher than that of those funded by local state capital. The details are shown in Figure 4.8.

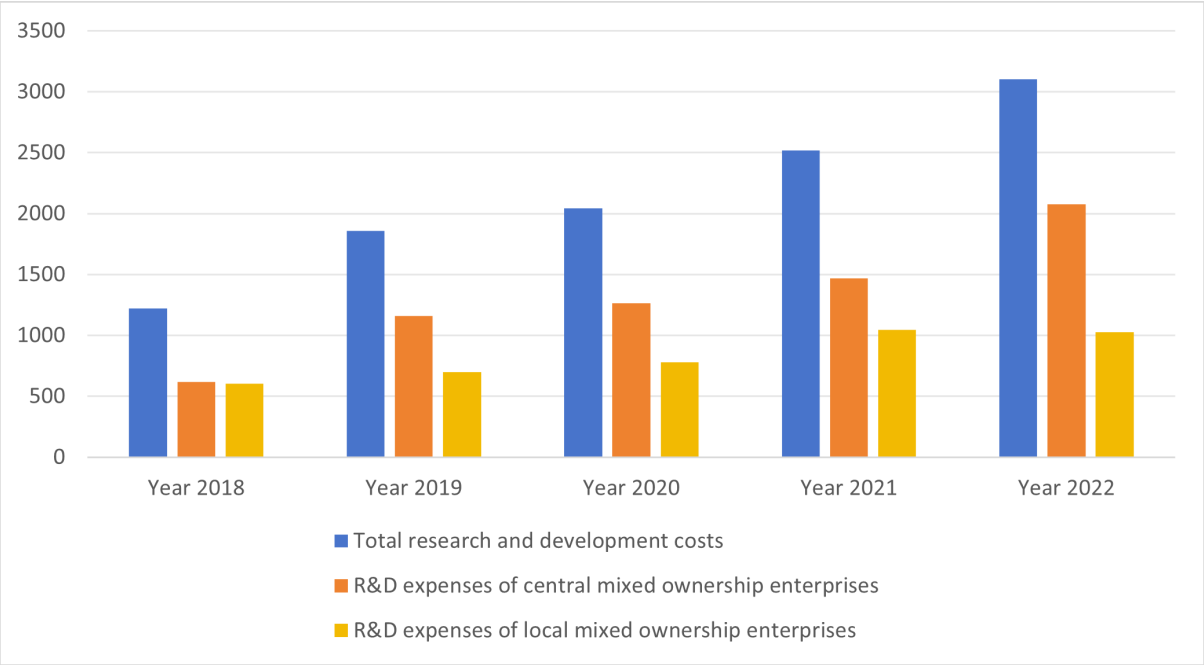

Figure 4.8 R&D expenditure of mixed ownership enterprises

In terms of the growth rate of R&D expenditure, between 2018 and 2022, the R&D expenditure of mixed ownership enterprises as a whole grew at a relatively high rate, with an average growth of 27.10%. In particular, the R&D expenditure of central mixed ownership enterprises grew faster, with an average growth rate of 29.54%, while the local mixed ownership enterprise witnessed a smaller R&D expenditure growth rate, at 14.32%. The details are shown in Figure 4.9.

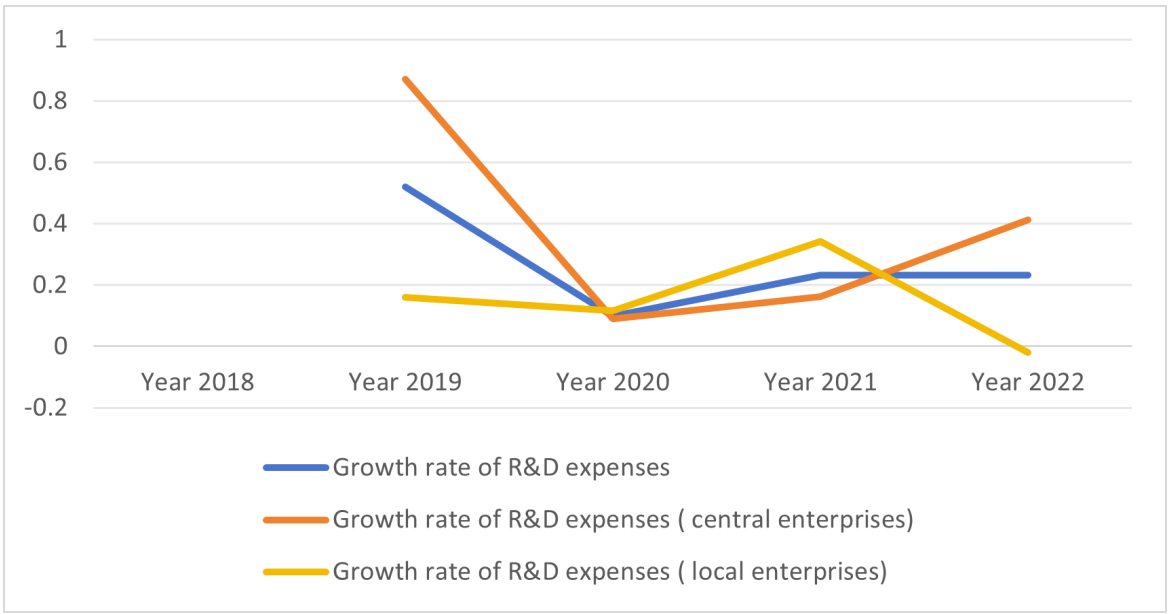

Figure 4.9 Growth rate of R&D expenditure

As can be seen from the above, although the overall level of R&D investment in mixed ownership enterprises is high, comparatively, the R&D investment is higher in mixed ownership

enterprises funded by central state capital, which may be due to the fact that centrally-funded mixed ownership enterprises pay more attention to innovation strategies. It is also possibly due to the fact that centrally-funded enterprises are in a more robust financial position and thus have the conditions for more R&D investment.

4.2.2 Innovation outputs

Using the WINGO database as a data source, we observed that the innovation output of China's mixed ownership enterprises grew more significantly between 2018 and 2022. In the 5-year period from 2018 to 2022, the number of patents granted by the sample enterprises grew from 83,253 to 139,728, with an overall growth rate of 67.84% and a CAGR of 10.91%, as shown in Figure 4.10.

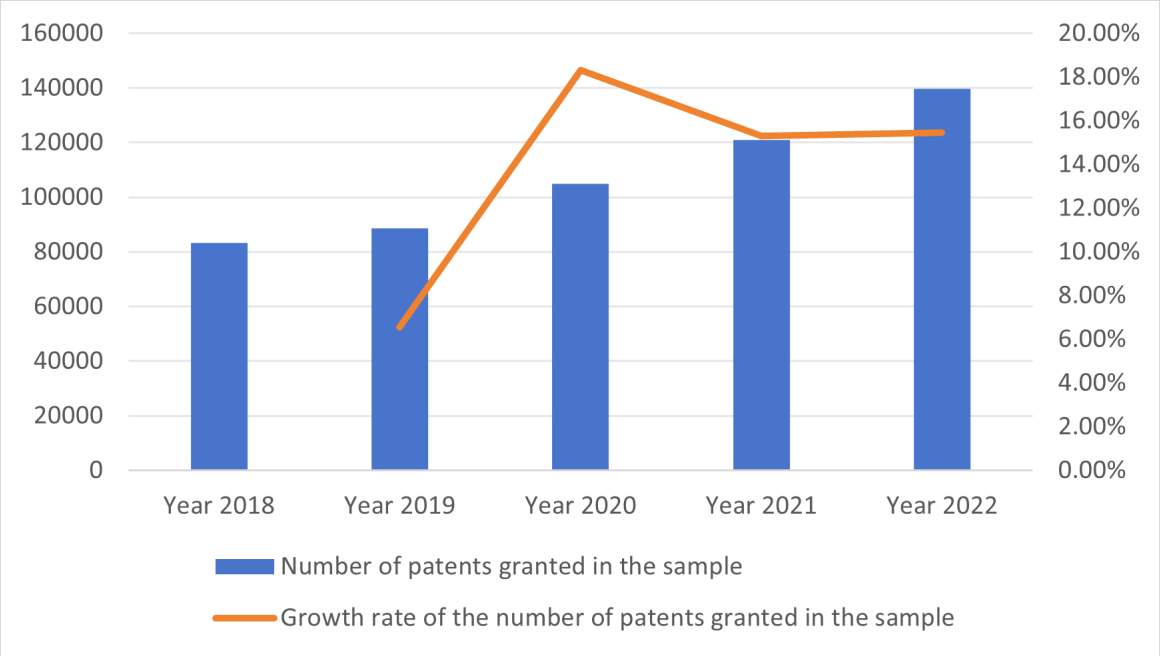

Figure 4.10 Innovation output of mixed ownership enterprises

Overall, the innovation output level of mixed ownership enterprises was in line with the level of R&D investment. However, the average CAGR of the number of patents granted was lower than the average CAGR of R&D investment. That is probably because, as innovation is always accompanied by risk, there is a factor of innovation failure.

4.3 Status-quo of CEO duality and organizational slack in mixed ownership enterprises in China

4.3.1 CEO duality

In China's mixed ownership enterprises, the practice of having the chairman also serve as the CEO is quite rare. In the sample enterprises, from 2018 to 2022, an average of 16 enterprises per year implemented the CEO duality, accounting for only 4.24% of the total sample size, as shown in Figure 4.11.

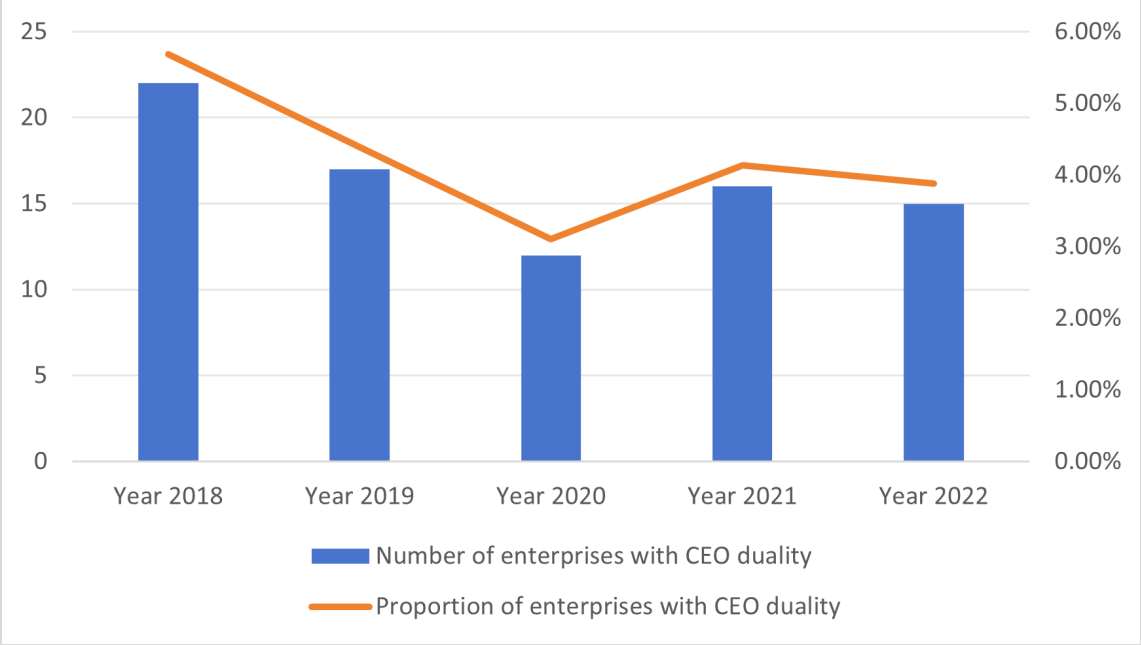

Figure 4.11 Enterprises with CEO duality

The governance structure with CEO duality reduces the possibility of conflicts caused by the division of the roles of chairman and CEO and has a positive impact on the enterprise's decision-making and execution of innovation attention. However, since mixed ownership enterprises are composed of multiple shareholders, where the interests of the state-owned shareholders and the non-state-owned shareholders are prominently different, the vast majority of enterprises are likely to have different candidates for the positions of chairman and CEO in order to reduce the principal-agent risk.

4.3.2 Organizational slack

Organizational slack refers to the actual or potential idle resources in an enterprise, which can alleviate the pressure faced by enterprises when implementing their innovation strategies. Drawing on the current studies (Y. Liu et al., 2023; J. Wu et al., 2016), this thesis used the

current ratio (current assets / current liabilities) to reflect organizational slack.

During the 5-year period from 2018 to 2022, the total current assets of the sample enterprises were 7,466,785 million yuan, 867,659.58 million yuan, 1,030,662 million yuan, 1,089,564 million yuan, and 1,135,970 million yuan, respectively, with an annual average of 9,685,970 million yuan. The total liabilities of the sample enterprises were 6,9275,998 million yuan, 7,913,911 million yuan, 9,006,867 million yuan, 9,862,093 million yuan, and 10,245,869 million yuan, respectively, with an annual average of 8,791,270 million yuan. The overall organizational slack during those five years were 1.07, 1.09, 1.11, 1.10, and 1.11, respectively, as shown in Figure 4.12.

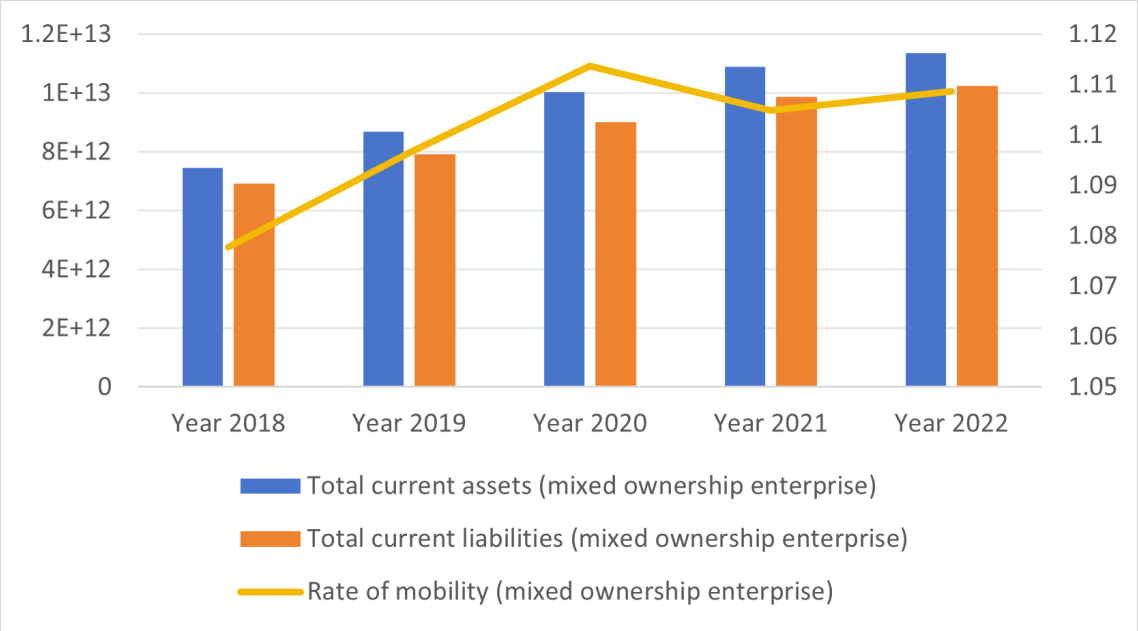

Figure 4.12 Organizational slack

Overall, the level of organizational slack in mixed ownership enterprises increased year on year, which can further explain the higher intention of mixed ownership enterprises to innovate.

Chapter 5: Data Analysis and Hypothesis Testing

5.1 Descriptive statistics

The descriptive statistics of this study for the main variables are shown in Table 5.1.

Table 5.1 Descriptive statistics of variables

	Inn P	Dl	Zj	Fg	Lev	Growth	Top5	ListAge
Sample size	1339	1339	1339	1339	1339	1333	1339	1339
Mean	2.773	0.386	0.891	0.539	0.505	0.127	56.84	2.764
SD	1.507	0.080	0.411	0.169	0.187	0.254	16.58	0.593
Min	0.693	0.143	0	0	0.06	-0.515	21.69	0
Max	7.543	0.833	3	1	0.902	2.032	89.21	3.401

According to the resualts in Table 5.1, it can be seen that the mean value of the number of patent applications in 2018-2022 was 2.773, and the standard deviation (SD) was 1.507, which indicates that there is a large gap in the innovation performance among different sample enterprises, in line with the previously mentioned observation that SOEs are still suffering from a variety of problems such as weak innovation capacity, high concentration of innovation capacity in specific enterprises, and a small proportion of invention patents. The mean value of the proportion of non-state directors was 0.539, indicating that non-state directors accounted for about half of the board of directors, and SD was 0.169, which shows that the differences in the proportion of non-state directors among different enterprises were relatively small. The mean value of the proportion of independent directors was 0.386, indicating that the average proportion of independent directors on the board of directors was relatively low, and SD was 0.080, which reflects that the differences in the proportion of independent directors among different enterprises were relatively small, but with certain fluctuations. The mean value of the proportion of expert directors was 0.891 (in Ln form), and SD was 0.411, indicating that there were great differences in the proportion of expert directors among different enterprises.

5.2 Regression analysis and hypothesis testing

Based on the sample selection presented in Chapter 3, we conducted a regression analysis using unbalanced panel data comprising a total of 1,321 observations from 387 enterprises over the period from 2018 to 2022.

5.2.1 Board structure and innovation performance

Based on the results of Hausman test, this thesis adopted a two-way fixed-effects model with control of time and industry fixed effects to test the effect of board structure on innovation performance, and the regression results are shown in Table 5.2. The regression coefficients of the core independent variables were significantly positive, which indicates that optimizing the board structure can promote the enterprise's innovation performance.

Table 5.2 Benchmark regression results on the influence of board structure on innovation performance

		Model 3.1	Model 3.2	Model 3.3
	Inn P	Inn P	Inn P	Inn P
Fg		0.414**		
		(1.92)		
Dl			1.071***	
			(2.58)	
Zj				0.130*
				(1.73)
Lev	0.650**	0.416	0.367	0.380
	(2.45)	(1.30)	(1.14)	(1.17)
Growth	-0.098	-0.108	-0.098	-0.136
	(-1.09)	(-1.20)	(-1.09)	(-1.47)
Top5	0.010***	0.010***	0.009***	0.009**
	(2.80)	(2.94)	(2.62)	(2.57)
ListAge	0.039	0.04	0.023	0.067
	(0.38)	(0.40)	(0.22)	(0.64)
Liquid		-0.051	-0.048	-0.057
		(-1.36)	(-1.29)	(-1.45)
_cons	0.388	0.391	0.299	0.763
	(0.68)	(0.64)	(0.49)	(1.25)
year	yes	yes	yes	yes
industry	yes	yes	yes	yes
N	1339	1339	1339	1339
r^2	0.349	0.352	0.351	0.349

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

The R^2 of Models 3.1, 3.2, and 3.3 were 0.352, 0.351, and 0.349 respectively, which indicates that the model fitting results are relatively satisfactory. The regression results of the control variables on innovation performance are shown in the first column. In particular, the liability ratio and top five shareholders' shareholding ratio were significantly positively associated with innovation performance, which indicates that the control variables selected in this study were relatively effective. Model 3.1 tests the effect of the proportion of non-state directors (Fg) on the innovation performance (Inn P) of SOEs. The coefficient of the proportion of non-state directors was 0.415 and was significant at the 5% level, which supports H1a, that is, a higher proportion of non-state directors positively promotes the enterprise's innovation performance. More specifically, for every one-point increase in the proportion of non-state directors, the effect on enterprise innovation performance increases by 0.041.

Model 3.2 tests the effect of the proportion of independent directors (Dl) on enterprise innovation performance (Inn P). The coefficient of the proportion of independent directors was 1.072 and was significant at the 1% level, which supports H1b. That means, a higher proportion of independent directors positively affects the innovative performance of the enterprise. More specifically, for every one-point increase in the proportion of independent directors, the effect on the innovative performance of SOEs increases by 1.072.

Model 3.3 tests the effect of the proportion of expert directors (Zj) on the innovation performance (Inn P) of SOEs. The coefficient of the proportion of expert directors was 0.130 and was significant at the 10% level, which supports H1c, that a higher proportion of expert directors positively affects the innovation performance of the enterprise. More specifically, the effect on enterprise innovation performance rises by 0.130 for every point increase in the proportion of expert directors.

Overall, the board structure has a facilitating effect on the innovation performance of SOEs. Hypotheses H1a, H1b, and H1c were supported.

5.2.2 Mediating effects of TMT's attention

5.2.2.1 Mediating effect tests

This study used a two-step approach to examine the mediating role of TMT's attention. The first step tested the relationship between TMT's attention and the independent variables. From Model 3.4.1, Model 3.4.2, and Model 3.4.3 in Table 5.3, it can be seen that board structure positively affected selective attention at 5% significance level. As shown in Model 3.6.1, Model 3.6.2, and Model 3.6.3 in Table 5.3, executive attention to innovation was significantly and positively related to board structure and passed the 5% significance test. The second step tested the effect of TMT's attention to innovation on the dependent variable, namely, SOEs' innovation performance. The results, as shown in Model 3.5 and Model 3.7 in Table 5.3, indicate that the effects of TMT's selective attention and executive attention to innovation on enterprise innovation performance were both positive and significant, and passed the 1% and 10% significance tests, respectively. Therefore, it can be concluded that TMT's attention mediated the relationship between board structure and enterprise innovation performance, and thus, hypotheses H2a, H2b, and H2c were supported. The finding further suggests that the planning and execution of enterprise innovation is largely in the hands of the TMT. The composition and characteristics of the TMT shape its cognitive framework, which in turn affects

the team's overall allocation of attention, thereby profoundly influencing the enterprise's strategic decisions and execution path.

Table 5.3 Mediating effect test results

	Model 3.4.1 selection	Model 3.4.2 selection	Model 3.4.3 selection	Model 3.6.1 action	Mdoel 3.6.2 action	Model 3.6.3 action	Model 3.5 InnP	Model 3.7 InnP
Selection							28.421***	
							(9.473)	
Action								20.131*
								(11.109)
Fg	0.001**			0.001**				
	(0.001)			(0.001)				
Dl		0.005***			0.003***			
		(0.002)			(0.001)			
Zj			0.001**			0.001**		
			(0.000)			(0.000)		
_cons	0.000	0.000	0.001	0.003***	0.003***	0.004***	1.043***	0.965***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.304)	(0.311)
Control variable	Y	Y	Y	Y	Y	Y	Y	Y
Year	yes	yes	yes	yes	yes	yes	yes	yes
Industry	yes	yes	yes	yes	yes	yes	yes	yes
N	1321	1321	1321	1321	1321	1321	1321	1321
r2	0.228	0.228	0.230	0.241	0.235	0.242	0.440	0.432

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.2.2.2 Robustness tests

For the robustness test on the mediatining effects, this study referred to the words identified to reflect the TMT's attention to innovation in M. Wu (2019) and used a two-step approach to test their mediating effect. The vocabulary is shown in Table 5.4. For more details, see Table 5.5.

Table 5.4 Keywords in previous research

	List of Keywords
Selective Attention	Technology, utility model, science and technology, innovation, market competition, intangible assets, core technology, intellectual property rights, high technology, technicians, innovation ability, high performance, leading position, scientific research, patent number, reform, science, technology level. Research Institute, key technology, patent application, biotechnology, artificial intelligence, emerging industry, technical support, excellent talents, technical reserves, industry-academia-research, new technology, copyright, professional talents, patent right, technology development zone, high technology, scientific research institute, research institute, science and technology, technological strength, continuous innovation, technological content, State Intellectual Property Office, scientific and technological achievements, high technology, high tech, high technology, patent certificate, Patentee, high level, scientific research project, Ministry of Science and Technology, technical standard, frontier technology, technical equipment, Huawei, major breakthrough, high level, scientific and technological progress, National Torch Program, creativity, high efficiency, exclusive, R&D department, qualification certificates, technological innovation, pioneering, improve efficiency, scientific research results, innovation, creation, academician, scientification, scientific and technological development, technology introduction, researcher, human resources, driving force, software park, scientific research organization, process level, deepening reform, development fee, learning.
Executive Attention	R&D, development, technological innovation, technological transformation, talent training, research, technological transformation, exploration, creation, product upgrading, technology transfer, learning, software development, technology promotion, technology upgrading, technology training, patent application, introduction of talents, in-depth research, development of technology

Table 5.5 Robustness tests for mediating effects

	(1) selection_ before	(2) selection_ before	(3) selection_ before	(4) action_ before	(5) action_ before	(6) action_ before	(7) InnP	(8) InnP
selection_before							22.679*	
							(11.611)	
action_before								41.400**
								(18.760)
Fg	0.001*			-0.001				
	(0.001)			(0.000)				
Dl		0.002**			0.001*			
		(0.001)			(0.001)			
Zj			0.001**			0.000***		
			(0.000)			(0.000)		
_cons	0.007***	0.007***	0.007***	0.004***	0.004***	0.005***	0.889***	0.923***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.324)	(0.324)
Control variable	Y	Y	Y	Y	Y	Y	Y	Y
Year	yes	yes	yes	yes	yes	yes	yes	yes
Industry	yes	yes	yes	yes	yes	yes	yes	yes
N	1321	1321	1321	1321	1321	1321	1321	1321
r2	0.421	0.415	0.419	0.369	0.365	0.374	0.441	0.432

Note: Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In this study, the mediation effects of the words reflecting TMT's attention to innovation extracted from previous study were examined in a two-step approach. The results were consistent with the empirical results regarding the mediation of TMT's attention to innovation between board structure and the innovation performance of SOEs, which indicates the robustness of the mediating effect findings of this study.

5.2.3 Moderation of CEO duality

This study examined the moderating effect of CEO duality on the relationship between the proportion of non-state directors, independent directors, and expert directors and SOEs' innovation performance, respectively. Model 3.8.2 in Table 5.6 shows that the regression coefficient of the interaction term between the proportion of independent directors and CEO duality was significantly positive (= 8.083, $p < 0.01$), which indicates that CEO duality had a positive moderating effect on the relationship between the proportion of independent directors and the innovative performance of enterprises. Model 3.8.3 in Table 5.6 shows that the regression coefficient of the interaction term between the proportion of expert directors and CEO duality was significant and positive (= 1.222, $p < 0.01$), indicating that CEO duality had a positive moderating effect on the relationship between the proportion of expert directors and enterprise innovation performance. Thus, a part of Hypothesis H3 was supported. However, the regression coefficient of the interaction term between the proportion of non-state directors and CEO duality was not significant, indicating that CEO duality had no moderating effect on the relationship between the proportion of non-state directors and enterprise innovation performance, and thus, a part of Hypothesis H3 was not supported. The results show that to a certain extent, CEO duality is conducive to an effective execution of the relevant decisions of the board of directors, which can further enhance the innovation performance of enterprises. Figures 5.1 and 5.2 illustrate the partial moderating effect of CEO duality on the relationship between board structure and innovation performance of SOEs.

Table 5.6 Moderating effects of CEO duality and organizatinal slack

	Model 3.8.1 Inn P	Model 3.8.2 Inn P	Model 3.8.3 Inn P	Model 3.9.1 Inn P	Model 3.9.2 Inn P	Model 3.9.3 Inn P
Fg×Dual	-0.207					
	(-0.222)					
Dl×Dual		8.083***				
		(3.137)				
Zj×Dual			1.222***			
			(2.627)			
Fg×Liquid				0.284***		

	Model 3.8.1 Inn P	Model 3.8.2 Inn P	Model 3.8.3 Inn P	Model 3.9.1 Inn P	Model 3.9.2 Inn P	Model 3.9.3 Inn P
				(3.236)		
Dl×Liquid					0.468*	
					(1.703)	
Zj×Liquid						0.099*
						(1.685)
Lev	0.913***	0.684***	0.659***	0.295	0.480	0.111
	(4.269)	(3.200)	(3.065)	(1.034)	(1.582)	(0.388)
Growth	-0.189	-0.156	-0.242*	-0.195	-0.186	-0.287**
	(-1.446)	(-1.203)	(-1.801)	(-1.490)	(-1.418)	(-2.120)
Top5	0.012***	0.010***	0.011***	0.013***	0.010***	0.012***
	(4.891)	(4.069)	(4.501)	(5.181)	(4.049)	(4.765)
ListAge	0.161**	0.166**	0.227***	0.202***	0.194***	0.241***
	(2.334)	(2.400)	(3.243)	(2.937)	(2.800)	(3.433)
_cons	0.913***	1.139***	1.208***	1.403***	1.237***	1.568***
	(2.731)	(3.537)	(3.982)	(3.777)	(3.250)	(4.563)
year	yes	yes	yes	yes	yes	yes
industry	yes	yes	yes	yes	yes	yes
N	1321	1321	1321	1321	1321	1321
r2	0.380	0.404	0.405	0.389	0.406	0.411

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

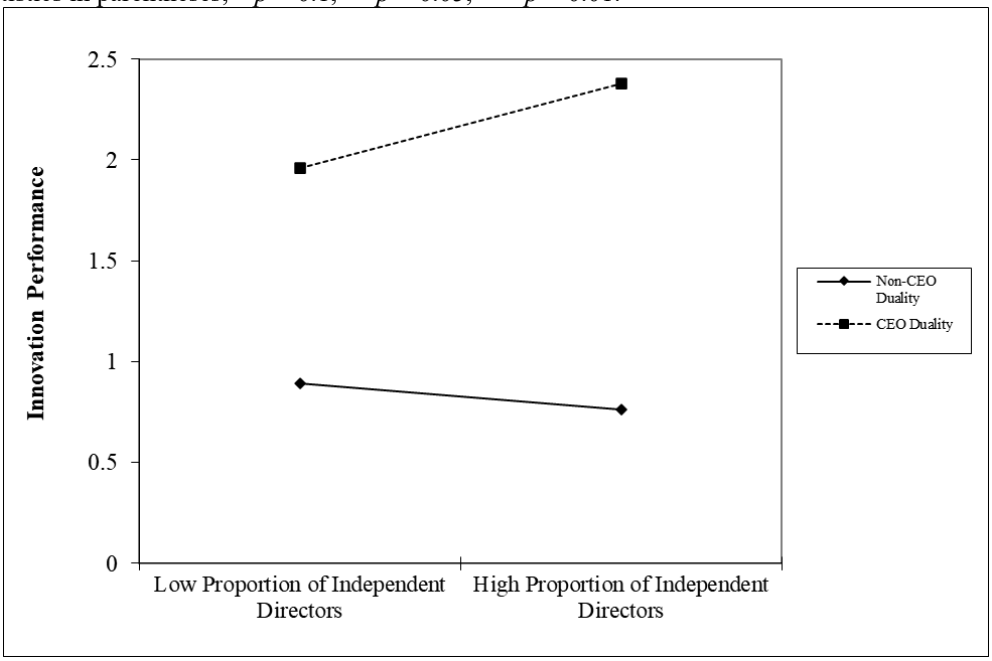

Figure 5.1 Moderating effects of CEO duality on the relationship between the proportion of independent directors and enterprise innovation performance

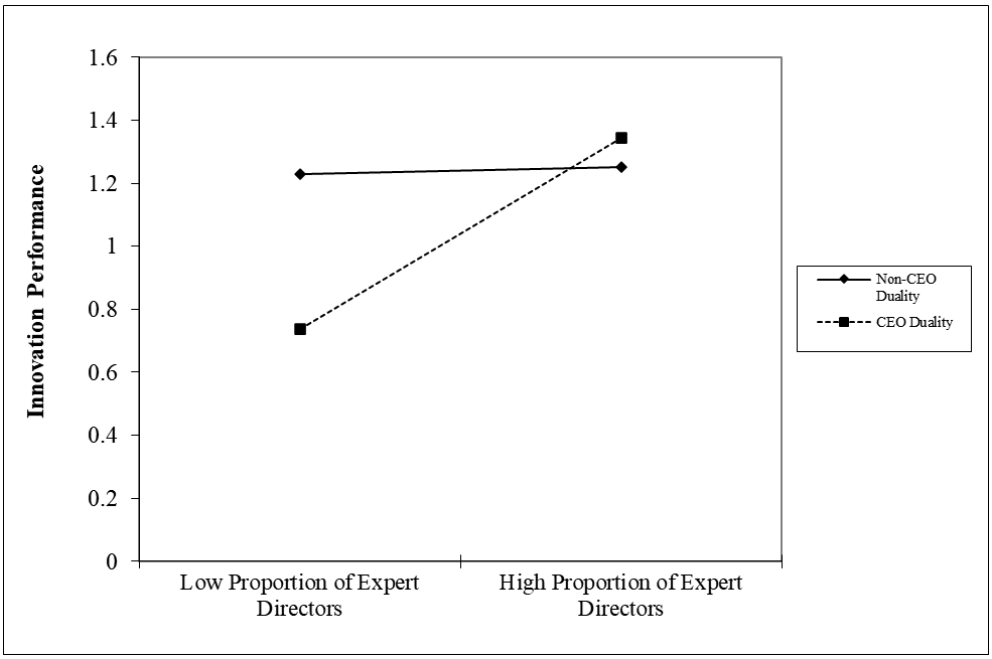

Figure 5.2 Moderating effects of CEO duality on the relationship between the proportion of expert directors and enterprise innovation performance

5.2.4 Moderation of organizational slack

This study examined the moderating effects of organizational slack on the relationship of the proportion of independent directors, the proportion of non-state directors, and the proportion of expert directors with enterprise innovation performance, respectively. As can be seen from Model 3.9.1 in Table 5.6, the regression coefficient of the interaction term between the proportion of non-state directors and organizational slack was positively significant (= 0.284, $p < 0.01$), indicating that organizational slack positively moderated the relationship between the proportion of non-state directors and enterprise innovation performance. From Model 3.9.2 in Table 5.6, the regression coefficient of the interaction term between the proportion of independent directors and organizational slack was significantly positive (= 0.468, $p < 0.1$), indicating that organizational slack positively moderated the relationship between the proportion of independent directors and enterprise innovation performance. Model 3.9.3 in Table 5.6 shows that the regression coefficient of the interaction term between the proportion of expert directors and organizational slack was significantly positive (= 0.1, $p < 0.1$), indicating that organizational slack had a positive moderating effect on the relationship between the proportion of expert directors and enterprise innovation performance. Thus, Hypothesis H4 was supported. Figures 5.3, 5.4, and 5.5 illustrate the moderating effects of organizational slack.

It can be summarized that enterprises' innovation activities require continuous resource investment in the early stage, and the higher the organizational resource slack, the richer the

disposable resources owned by the enterprise, the more it can meet the needs of the enterprise to conduct R&D and innovation, thereby ensuring sufficient resources available to the enterprise to support more high-quality innovation activities. Organizational slack therefore increases the confidence of enterprises to actively engage in innovation activities and enables them to be more proactive in improving their innovation output.

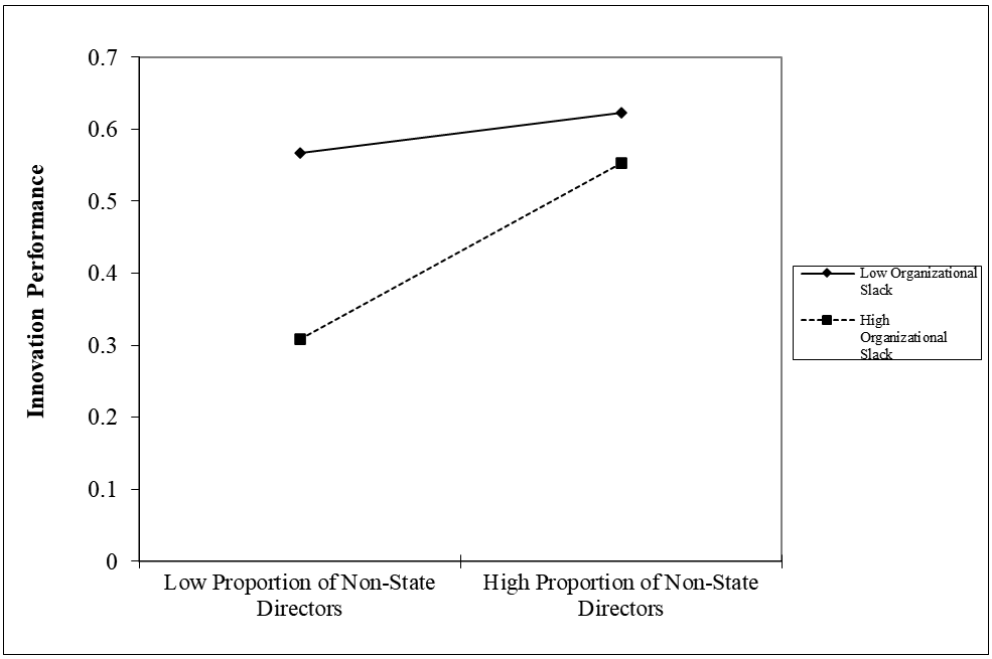

Figure 5.3 Moderating effects of organizational slack on the relationship between the proportion of non-state directors and enterprise innovation performance

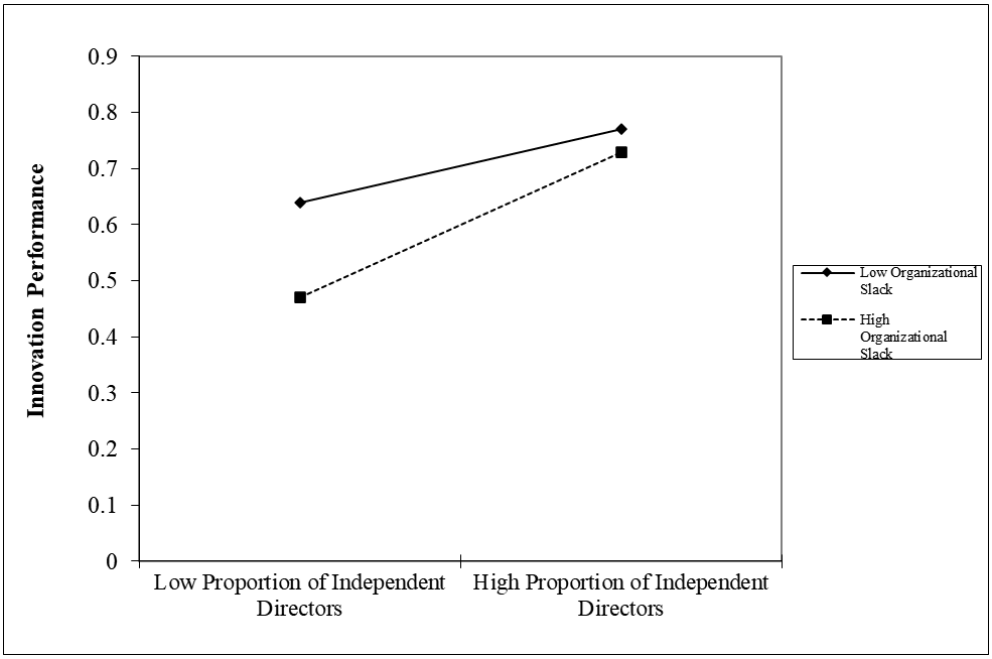

Figure 5.4 Moderating effects of organizational slack on the relationship between the proportion of independent directors and enterprise innovation performance

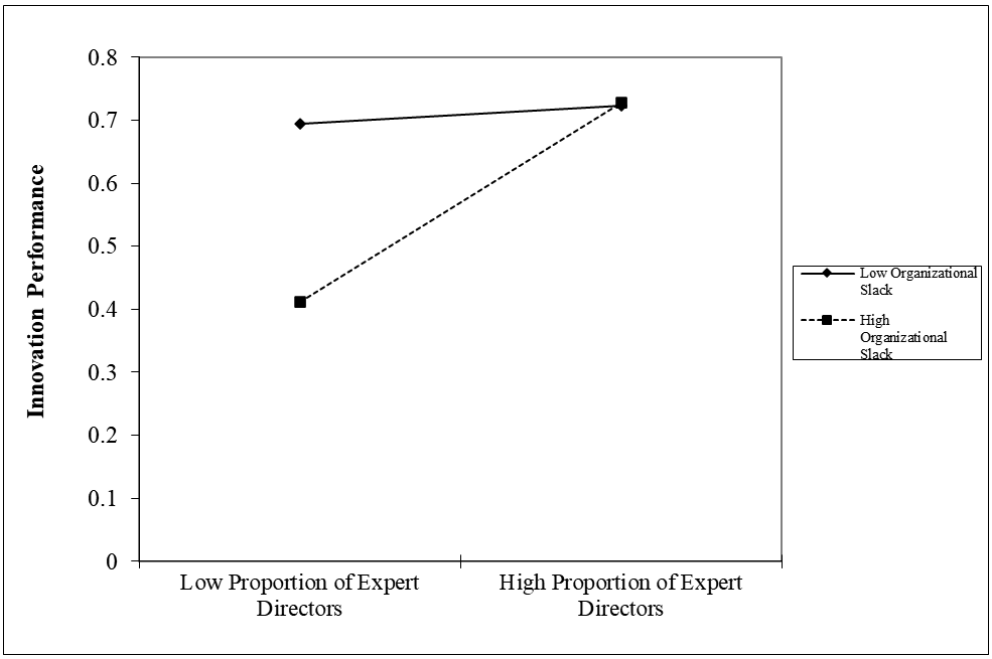

Figure 5.5 Moderating effects of organizational slack on the relationship between the proportion of expert directors and enterprise innovation performance

5.3 Robustness tests

5.3.1 Replacement of independent variables

According to Hou et al. (2022), the directors of listed enterprises can be categorized into executive directors, independent directors, and non-executive directors, with non-executive directors performing the duty of monitoring and controlling in terms of managers' infringement of shareholders' interests. Referring to C. Li et al. (2020), this study used the proportion of non-executive directors to the number of board members (Fz) to replace the independent variable board structure, and the regression results are shown in Model 1 in Table 5.7. The coefficient of the proportion of non-executive directors was 0.997, and it was significant at 1% level, which indicates that the proportion of non-executive directors positively influenced the innovation performance of the enterprise, i.e., the more the non-executive directors, the higher the enterprise's innovation performance.

Table 5.7 Results of robustness and endogeneity tests

	Model 1 Inn P	Model 2 Inn P	Model 3 Inn P	Model 4 Inn P	Model 5 Inn P	Model 6 Inn P	Model 7 Inn P
FZX	1.001***						
	(3.26)						
Fg		1.072***			9.325**		
		(2.58)			(2.08)		
Dl			0.419*			12.924***	
			(1.94)			(3.24)	
Zj				0.126*			3.041***
				(1.68)			(3.28)
Lev	0.648**	0.658**	0.738***	0.694**	0.554	-0.258	0.383
	(2.45)	(2.39)	(2.68)	(2.47)	(1.64)	(-0.67)	(1.09)
Growth	-0.097	-0.110	-0.125	-0.145	-0.351*	0.057	-0.521**
	(-1.09)	(-1.17)	(-1.33)	(-1.49)	(-1.58)	(0.35)	(-2.22)
Top5	0.011***	0.009***	0.011***	0.009***	0.024***	-0.004	-0.006
	(3.01)	(2.66)	(3.00)	(2.63)	(3.70)	(-0.71)	(-0.84)
ListAge	0.024	0.037	0.057	0.083	0.484***	-0.020	0 .759***
	(0.23)	(0.36)	(0.55)	(0.80)	(2.76)	(-0.21)	(3.84)
ROE		0.187	0.240	0.161			
		(0.78)	(1.00)	(0.65)			
_cons	0.024	0.018	0.080	0.445	-5.331**	-2.956***	1.428*
	(0.04)	(0.03)	(0.14)	(0.77)	(-2.05)	(-2.91)	(1.77)
Year	yes	yes	yes	yes	yes	yes	yes
Industry	yes	yes	yes	yes	yes	yes	yes
Kleibergen-Paap rk LM statistic					16.383 [0.005]	12.251 [0.001]	23.125 [0.000]
Kleibergen-Paap rk Wald F statistic					11.710***	22.434 ***	14.671***
N	1339	1339	1339	1339	1339	1339	1339
r2	0.356	0.350	0.350	0.348	0.162	0.116	0.162

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

5.3.2 Possible missing variables

A regression analysis was conducted after adding the control variable, return on equity (ROE, i.e., net profit / average balance of shareholders' equity), and the results are shown in Model 2, Model 3, and Model 4 in Table 5.7. The results are consistent with the results of the benchmark regression test in Table 5.2, indicating that the core fi0ndings of this study are robust.

5.4 Endogeneity analysis

From the analysis of theoretical logic, it can be inferred that there may be two aspects of endogeneity in this study. One is reverse causation, which means that as enterprises' innovation

performance improves, it will impose new requirements on the board structure, resulting in a positive feedback effect. The second is missing variables, which means enterprises' innovation performance may be affected by certain unobservable factors. Both cases can lead to biased estimation. In view of this, this study employed the instrumental variable method (2SLS) to robustly test the results of the benchmark regression in an attempt to address the endogeneity issue.

Referring to W. Li and Yi (2024), this study chose the level of regional economic development as an instrumental variable for the proportion of non-state directors considering that the the level of regional economic development affects the progress of mixed ownership reform. The more active the economy is, the faster the process of marketization is, which will lead to more in-depth mixed ownership reform, resulting in non-state directors' higher levels of participation in enterprise governance. Moreover, the level of regional economic development does not directly affect the innovation performance of enterprises, which meets the requirements of exogenous variables. According to Model 5 in Table 5.7, the results showed that the F-value of the weak instrumental variable test was greater than 10, which indicates that there was no weak instrumental variable problem. In addition, the non-state directors were significant at the 5% level, which indicates that Hypothesis H1a remained valid after endogeneity was taken into account.

Referring to X. Liu and Zhang (2019), this study selected the average age of board directors (TMTAge) as an instrumental variable for the proportion of independent directors, mainly based on the following two considerations.

First, the older the independent directors are, the longer they are likely to stay in office. In addition, the possibility of reappointment of an independent director is n aclosely related to an older age, richer experience, and deeper understanding of the enterprise. Secondly, the general trend in the HR market is that older employees are more reluctant to change jobs, and older independent directors are more likely to stay with the same enterprise and extend their tenure (Eisenhardt & Schoonhoven, 1990). Therefore, the age and tenure of independent directors are highly correlated, while the average age of independent directors, as an exogenous variable, is not correlated with CEO excess compensation. Based on the above analysis, TMTAge is acceptable as an instrumental variable for the proportion of independent directors. According to Model 6 in Table 5.7, the results showed that the instrumental variable passed the unidentifiable test and the over-identifiable test, and independent directors were significant at the 1% level, indicating that Hypothesis H1b remained valid after accounting for endogeneity.

Drawing on J. Xu et al. (2023), this study tested for endogeneity by conducting a two-stage

regression with the number of higher education institutions in the enterprise's location as an instrumental variable for the proportion of expert directors. This is based on two considerations. On the one hand, with a greater number of higher education institutions in the enterprise's location, more potential academic directors are available; the higher the cost of academic directors' off-site posting, more preference is given to local academics, who have greater potential of becoming expert directors, thus satisfying the endogeneity requirement. On the other, there is no direct link between the number of "211 Project" colleges and universities in the location of the enterprise and enterprise performance, satisfying the exogeneity requirement. According to Model 7 in Table 5.7, the results showed that the instrumental variable passed the unidentifiable test and the over-identifiable test, and the expert directors were significant at the 1% level, indicating that Hypothesis H1c was still valid after endogeneity was taken into account.

In summary, board structure had a positive and significant effect on innovation performance and the instrumental variables passed the weak instrumental variable test and over-identifiable test. It can be seen that the instrumental variables selected in this study are reasonable and reliable, and after considering the possible reverse causation, missing variables, measurement error, and other factors, the facilitating influence of board structure on enterprise's innovation is still valid, indicating that the findings of this study are relatively robust.

5.5 Heterogeneity analysis

The empirical results presented above revealed that board structure positively affected enterprises' innovation performance. Is there regional heterogeneity in this effect? This study divided the sample by region and conducted regression to answer this question. First, we divided the full sample into three subsamples: eastern region, central region, and western region. Specifically, the eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan, which is the most economically developed region in China, with a more open and transparent market, a better system, and a higher concentration of talent. The central region includes Shanxi, Jilin, Heilongjiang, Henan, Hubei, Hunan, Anhui, and Jiangxi. The western region includes Inner Mongolia, Chongqing, Sichuan, Guangxi, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, and Tibet. The regression results are shown in Table 5.8.

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Table 5.8 Results of heterogeneity analysis

	Eastern Region			Central Region			Western Region		
	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
	Inn P	Inn P	Inn P	Inn P	Inn P	Inn P	Inn P	Inn P	Inn P
Fg	0.757***			-0.186			-0.270		
	(2.77)			(-0.30)			(-0.56)		
Dl		1.244**			1.015			0.233	
		(2.46)			(0.95)			(0.21)	
Zj			0.183*			0.180			-0.112
			(1.81)			(0.97)			(-0.64)
Lev	0.730*	0.596	0.695*	1.499**	1.519**	1.495**	0.278	0.245	0.217
	(1.93)	(1.57)	(1.78)	(2.22)	(2.28)	(2.16)	(0.55)	(0.49)	(0.43)
Growth	-0.196	-0.189	-0.259*	0.012	0.047	0.022	0.032	0.031	0.033
	(-1.56)	(-1.50)	(-1.96)	(0.06)	(0.22)	(0.11)	(0.19)	(0.18)	(0.19)
Top5	0.011**	0.009*	0.009*	0.007	0.007	0.006	-0.007	-0.007	-0.006
	(2.19)	(1.80)	(1.80)	(0.82)	(0.82)	(0.65)	(-0.90)	(-0.89)	(-0.82)
ListAge	-0.028	-0.064	-0.019	0.173	0.166	0.278	-0.152	-0.145	-0.150
	(-0.20)	(-0.47)	(-0.14)	(0.58)	(0.56)	(0.91)	(-0.55)	(-0.52)	(-0.55)
_cons	0.728	0.921	1.302	-0.817	-1.271	-0.684	1.826*	1.606	1.761*
	(0.74)	(0.93)	(1.34)	(-0.58)	(-0.91)	(-0.47)	(1.67)	(1.44)	(1.65)
Year	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry	yes	yes	yes	yes	yes	yes	yes	yes	yes
N	765	765	731	251	251	244	317	317	316
r2	0.333	0.329	0.329	0.298	0.300	0.298	0.481	0.484	0.484

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

As shown in Model 8, Model 11, and Model 14 in Table 5.8, the increase in the proportion of non-state directors had a significant positive impact on the innovation performance of mixed ownership SOEs, which indicates that the introduction of non-state directors has a positive effect on stimulating the innovation vitality of the enterprises and enhancing their innovation performance. Further regional heterogeneity analysis showed that this positive effect was particularly pronounced in the eastern region, reaching the 1% significance level. This may be due to the fact that the eastern region, as one of the most economically developed and market-oriented regions in China, its SOEs are more effective in absorbing the advanced management experience, market-oriented thinking, and innovation resources brought by non-state directors in the process of mixed ownership reform, which significantly promotes the innovation activities of the enterprises.

In contrast, for enterprises in the central and western regions, increased proportion of non-state directors did not significantly contribute to the enterprises' innovation performance. This may be related to a variety of factors, such as the market environment, resource endowment, policy implementation strength, and enterprises' own capabilities. For example, market competition in the central and western regions may be relatively less intense, the policy transmission mechanism may not be smooth enough, and enterprises themselves may have limitations in absorbing and utilizing the resources brought by non-state directors.

As can be seen from Model 9, Model 12, and Model 15 in Tables 5.8, in the eastern region, the positive effect of the increase in the proportion of independent directors on innovation performance was significant at the 5% level, which, to some extent, can be attributed to the more open market environment, higher levels of economic development, and better enterprise governance structure in the eastern region. In contrast, for enterprises in the central and western regions, the proportion of independent directors did not significantly contribute to innovation performance, which, to some extent, can be attributed to the relatively weaker market mechanism, resource endowment, and enterprise governance capacity in these regions, which are unfavorable factors that limit the role of independent directors.

As can be seen from Model 10, Model 13, and Model 16 in Tables 5.8, when we further differentiated between eastern, central, and western regions for heterogeneity, we found that there were significant regional differences in the impact of expert directors on the innovation performance of SOEs. Specifically, for enterprises in the eastern region, an increase in the proportion of expert directors had a significant positive effect at the 10% level. This is largely related to the more open market environment, higher level of economic development, and more adequate enterprise governance structure in the eastern region, which enables expert directors

to more effectively utilize their professional strengths to promote the innovation activities of enterprises.

In contrast, for enterprises in the central and western regions, increased proportion of expert directors did not significantly contribute to innovation performance. This may be due to factors such as the relatively closed market environment, limited resource endowment, and relatively low levels of enterprise governance in these regions, which limit enterprises' capabilities in absorbing and utilizing the resources of expert directors. In addition, it may also be related to certain limitations in the integration and influence of expert directors and the fulfillment of their roles in enterprises in these regions.

These results further highlight the impact of regional differences on the relationship between board structure and enterprise innovation performance, suggesting that we need to take regional differences into full consideration when formulating relevant policies in order to better leverage the positive role of expert directors in enterprises from different regions.

Chapter 6: Results and Discussion

Against the backdrop of the Chinese government's ongoing efforts to deepen the reform of state-owned enterprises (SOEs), promoting the high-quality development of these enterprises has become a key part of the national economic strategy. Innovation activities, as a core element in driving long-term development and maintaining market competitiveness, have increasingly come to the forefront. However, the path to innovation is not without challenges; it is fraught with risks and obstacles. In this process, a well-structured top management team (TMT) is regarded as a crucial guarantee for enhancing an enterprise's innovation performance. In light of this, based on existing research, this study delves into the impact of TMT structure on enterprise innovation performance and its underlying mechanisms within the specific context of China's mixed ownership reform.

6.1 Summary of hypothesis testing results

This study proposed a total of eight specific hypotheses, aiming to fully uncover the complex relationship between the TMT structure and enterprise innovation performance, while attempting to reveal the underlying logic and influencing factors behind this relationship.

Using an empirical study based on data from Chinese A-share listed enterprises on the Shanghai and Shenzhen stock exchanges from 2018 to 2022, the study employed a multiple regression analysis method to test the proposed hypotheses. The results showed that seven out of the eight hypotheses were supported, indicating that most of the theoretical expectations align with the actual situation. Several aspects of the TMT structure indeed have a significant impact on enterprise innovation performance. Additionally, one hypothesis was partially supported, suggesting that this hypothesis may hold true under certain conditions or specific contexts, but further research is needed to verify its general validity.

The detailed results of the hypothesis testing are presented in Table 6.1. These findings not only provide a new theoretical perspective and empirical evidence for understanding the improvement of innovation performance in China's mixed ownership SOEs but also further enrich the application scenarios of the Upper Echelons Theory and Attention-Based View (ABV).

Table 6.1 Summary of hypothesis testing results

Code	Hypotheses	Testing Results
H1a	The proportion of non-state directors positively affects enterprise innovation performance.	Supported
H1b	The proportion of independent directors positively affects enterprise innovation performance.	Supported
H1c	The proportion of expert directors positively affects enterprise innovation performance.	Supported
H2a	The attention of TMT mediates the relationship between the proportion of non-state directors and enterprise innovation performance.	Supported
H2b	The attention of TMT mediates the relationship between the proportion of independent directors and enterprise innovation performance.	Supported
H2c	The attention of TMT mediates the relationship between the proportion of expert directors and enterprise innovation performance.	Supported
H3	Organizational slack accentuates the relationship between board structure and enterprise innovation performance.	Supported
H4	CEO duality accentuates the relationship between board structure and enterprise innovation performance.	Partially Supported

6.2 Discussion of results

6.2.1 The relationship between TMT structure and enterprise innovation performance

Based on previous research, this thesis conducted an in-depth and refined classification of the TMT structure in enterprises, aiming to explore the potential impact of different TMT structures on enterprise innovation performance. Specifically, this study categorized the TMT structure into three dimensions: the proportion of non-state-owned directors on the board, the proportion of independent directors on the board, and the proportion of expert directors on the board. These three dimensions collectively constitute the core characteristics of the TMT structure, providing a clear research framework for subsequent empirical analysis.

In the empirical analysis phase, this study employed rigorous statistical methods and models to conduct an in-depth exploration of enterprise innovation performance under different TMT structures. By comparing the innovation performance across various TMT structures, this study revealed the intrinsic connections and patterns between the TMT structure and enterprise innovation performance. The research results indicate that the three different TMT structures have a significant impact on enterprise innovation performance, with each exhibiting unique modes and degrees of influence.

Specifically, the proportion of non-state-owned directors on the board reflects the level of diversification and market orientation of the TMT in enterprises. A higher proportion of non-

state-owned directors often indicates that the enterprise places greater emphasis on market changes and customer needs, thereby driving positive performance in product and service innovation. The proportion of independent directors on the board reflects the independence and objectivity of the enterprise's governance structure. A higher proportion of independent directors helps to reduce internal conflicts of interest, enhances the scientific and effective nature of decision-making, and subsequently exerts a positive influence on the enterprise's innovation performance. Meanwhile, the proportion of expert directors on the board represents the professional capabilities and industry insights of the TMT. A higher proportion of expert directors can bring more industry knowledge and technical resources to the enterprise, facilitating continuous breakthroughs in technological research and development (R&D) as well as product innovation.

In summary, the findings of this study indicate that there is a significant and complex relationship between the TMT structure and enterprise innovation performance. The innovation performance of enterprises varies under different TMT structures, providing important theoretical support and practical guidance for enterprises to optimize their TMT structure and enhance innovation performance.

6.2.1.1 The proportion of non-state-owned directors on the board and innovation performance

Through in-depth empirical analyses and rigorous statistical tests, this study revealed a positive relationship between the proportion of non-state directors on the board and the enterprise's innovation performance.

In mixed ownership SOEs, the introduction of non-state directors and the increase in the proportion of non-state directors are regarded as one of the important measures of SOE reform. The results of this study showed that this reform measure indeed had a positive impact on the innovative performance of enterprises. The increase of non-state directors not only brings more diversified perspectives and thinking to the board of directors, but also helps to mitigate the problem of internal controllers that may exist in SOEs as a result of the absence of owners. This confirms the view of scholars such as Ren et al. (2023) and Qiao et al. (2023), that an increase in the number of non-state-owned directors can effectively alleviate agency problems, thereby enhancing enterprise innovation performance.

The introduction of non-state directors can effectively suppress the phenomenon of short-termism and personal interest maximisation in the behaviour of TMTs in SOEs. As non-state directors often have richer market experience and stronger independent decision-making ability,

their presence makes it necessary for TMTs to give more consideration to the long-term development and market competitiveness of the enterprise when making decisions, rather than reducing high-risk innovation activities for short-term personal interests. This change helps to drive TMTs of SOEs to pay more attention to the innovation and development of the enterprise, thus enhancing the innovation performance of the enterprise.

In addition, an increase in non-state directors facilitates the effective use of innovation resources by enterprises. Non-state directors tend to have wider social networks and industry resources, and thus, they can bring more innovation opportunities and partners to SOEs. At the same time, the active participation and decision-making of non-state directors in the board of directors also helps to ensure that innovation resources are more effectively allocated and utilized, thereby enhancing the innovation capability and performance of the enterprise.

6.2.1.2 The proportion of independent directors on the board and innovation performance

Through in-depth empirical analyses and rigorous statistical tests, this study revealed a positive relationship between the proportion of independent directors on the board and the innovation performance of enterprises.

In mixed ownership SOEs, as independent directors constitute an important component of the enterprise's governance structure, an increase in their proportion on the board is regarded as a key initiative to improve the enterprise's corporate governance and innovation. The results of this study showed that the proportion of independent directors on the board of directors indeed had a positive impact on the innovation performance of the enterprise. They can reduce the principal-agent cost within the enterprise by effectively performing their monitoring functions, enabling the enterprise to focus more on its long-term development and innovation investment (Gong & Peng, 2021; Shao & Yuan, 2024). Their supervisory role not only improves the decision-making efficiency of the enterprise, but also enhances the enterprise' intention to invest in R&D and innovation, thereby contributing to the improvement of the enterprise's innovation performance.

Further, this study contributes to filling the research gap. It was found that the impact of independent directors on innovation performance was significantly influenced by the region where the enterprise is located. More specifically, the contribution of independent directors to innovation performance was more significant in regions with more open market environments and higher levels of economic development. This may be due to the fact that an open market environment and a higher level of economic development provide enterprises with more opportunities and resources for innovation, and independent directors, as an important force in

corporate governance, can more effectively play their roles in innovation decision-making and monitoring, thus driving enterprises to achieve higher innovation performance under these favourable conditions.

In addition, this study highlights the importance of corporate governance structure on the role played by independent directors. Under an improved corporate governance structure, independent directors are able to fulfil their duties more effectively, thus having a more significant impact on the enhancement of innovation performance. This suggests that in order to give full play to the role of independent directors in enhancing enterprise innovation performance, it is necessary not only to increase their proportion on the board of directors, but also to further improve the governance structure of the enterprise to provide a better environment and conditions for independent directors to perform their duties.

6.2.1.3 The proportion of expert directors on the board and innovation performance

Through in-depth empirical analyses and rigorous statistical tests, this study revealed a positive relationship between the proportion of expert directors on the board of directors and the innovation performance of enterprises.

In mixed ownership SOEs, as expert directors are an important component of the board of directors, an increase in their proportion is regarded as a key factor in enhancing the innovation capability and competitive advantage of the enterprise. The results of this study showed that the proportion of expert directors on the board had a positive impact on the innovation performance of the enterprise, confirming the views of scholars such as Y. Li et al. (2022) and P. Wei and Ma (2022). With their systematic expertise and academic training, expert directors are able to capture the latest technological trends and help enterprises identify valuable technological opportunities. This expertise not only brings more innovation opportunities to the enterprises, but also effectively mitigates the possible short-sightedness tendency of managers, which is conducive to the long-term innovation development and performance improvement of the enterprise.

Further, this study found that the impact of expert directors on innovation performance was significantly influenced by the region in which the enterprise is located. More specifically, the contribution of expert directors to innovation performance was more significant in regions with more open market environments and higher levels of economic development. This may be due to the fact that an open market environment and a higher level of economic development provide enterprises with more innovation resources and opportunities for cooperation, which enable expert directors, through their professional knowledge and technological insights, to

more effectively play their roles in innovation decision-making and strategic guidance, thereby driving enterprises to achieve higher innovation performance by leveraging these favourable conditions.

In addition, this study highlights the importance of corporate governance structure on the fulfilment of expert directors' roles. Under a better corporate governance structure, expert directors are able to perform their duties more effectively and thus have a more significant impact on the improvement of innovation performance. This suggests that in order to give full play to the role of expert directors in enhancing enterprise innovation performance, it is necessary not only to increase their proportion on the board of directors, but also to further improve the governance structure of the enterprise to provide a better environment and conditions for expert directors to perform their duties.

6.2.2 Mediating role of TMT's attention

Hypotheses H2a, H2b, and H2c were supported by the results in this study. Based on the reproposed search hypotheses and the empirical results, we explored in depth the mediating role of TMT's attention in the relationship between TMT structure and enterprise innovation performance. This study showed that the effect of TMT structure on enterprise innovation performance did not arise directly, but was realized through the mediation of TMT's attention. This finding not only enriches the research on the factors influencing enterprise innovation performance, but also provides a new perspective for understanding the role of the TMT in the process of enterprise innovation.

Ocasio's (1997) view provides important theoretical underpinning for this study, namely that strategic decisions made by decision makers are the result of consciously selecting areas of attention while ignoring others. As the TMT is at the core of an enterprise's strategic decision-making, the characteristics of its structure undoubtedly have a profound impact on the decision-making process. Specifically, the structure of the TMT determines the source and richness of information for decision making, which in turn affects the team's attention on external markets. A diversified TMT can bring in a wider range of information and resources, enhance the team's pursuit of new markets, new fields, and new technologies, thus increasing the level of attention to enterprise innovation (Yu et al., 2022).

Innovation-related decision-making, as a diverse and complex decision-making pocess, requires a high degree of professionalism and knowledge diversity among decision makers. Optimising the structure of the TMT, for example by adding members with different

professional backgrounds and knowledge, can significantly increase the overall level of expertise and knowledge diversity of the team (G. Song et al., 2022). This enhancement not only helps the TMT understand and assess the potential value and risks of the innovation project more comprehensively, but also provides the team with more decision-making ideas and solutions. Meanwhile, the social resources of TMT members are also an important factor in promoting innovation in the enterprise. Rich social resources can bring more innovation cooperation opportunities and resource support to the team, thus further promoting the improvement of enterprise innovation performance.

In the process of TMT structure influencing enterprise innovation performance, TMT's attention plays a key mediating role. The characteristics of the TMT structure affect the TMT's attention allocation, which in turn determines the team's attention and commitment to innovation. An optimised TMT structure can guide the team to pay more attention to enterprise innovation, enhance the attention and commitment to innovation matters, which is conducive to the improvement of enterprise innovation performance.

6.2.3 Moderating roles of CEO duality and organizational slack

6.2.3.1 Moderating effect of CEO duality

Regarding the moderation of organizational slack on the relationship between the TMT structure and enterprise innovation performance, this study hypothesized that CEO duality accentuates the relationship between the TMT structure of an enterprise and the enterprise's innovation performance.

This study tested the moderating effect of CEO duality on the relationship between the proportion of independent directors, non-state directors, and expert directors and enterprise innovation performance respectively. The results showed that CEO duality accentuated the relationship of the proportion of independent directors and the proportion of expert directors with enterprise innovation performance; however, no positive moderating effect was found on the relationship between the proportion of non-state directors and enterprise innovation performance. Thus, this hypothesis was partially supported.

The lack of a positive moderating effect of CEO duality on the relationship between the proportion of non-state directors and enterprise innovation performance may be due to the following reasons:

1) In the context of Chinese mixed ownership SOEs, the duality of the roles of chairman and CEO may worsen the principal-agent problem and hinder the positive effect of some non-

state directors on enterprise innovation (K. Li et al., 2023).

2) The board of directors of Chinese mixed ownership enterprises are institutions with their distinctive logic, protocols, and administrative traditions, and tend to be more resistant to vertical bureaucracy, and this resistance will prompt non-state directors to refuse to obey, which may result in the insignificant effect of CEO duality on the relationship between the proportion of non-state directors and enterprise innovation performance.

6.2.3.2 Moderating effect of organizational slack

The moderation of organizational slack on the relationship between the TMT structure and enterprise innovation performance is one of the core research questions in this study. The concept of organizational slack was first introduced by Cyert and March (1963). Scholars such as Ehls et al. (2020) and X. Wang & Hu et al. (2023) concluded that organizational slack could provide enterprises with more opportunities for trial and error, thus encouraging them to innovate. Therefore, this study hypothesized that organizational slack accentuates the positive relationship between the TMT structure and enterprise innovation performance.

The empirical results supported this hypothesis. More specifically, the greater the organizational slack, the more significant the positive effect of the TMT structure on enterprise innovation performance. From the perspective of TMTs, sufficient disposable redundant resources give the TMT more power to operate resources, which can help to address the risk associated with innovation failure and lead to an increase in the TMT's motivation to innovate. With the increase in resource operation power, the TMT is able to turn their innovation concerns into strategies for implementation.

This findings also supports Ocasio's (1997) claim of the principle of contextualised attention, which suggests that TMTs not only need to focus their attention on certain issues and solutions; more importantly, they should be matched with contextual factors such as generous resources.

6.3 Summary

In this chapter, we first summarized the testing results of the research hypotheses. Out of the eight hypotheses proposed in this study, seven were supported and one was partially supported.

Based on the empirical results, this chapter further discussed the relationship between the TMT structure of an enterprise and the enterprise's innovation performance, the mediating role of TMT's attention in this relationship, and the moderating role of CEO duality and

organizational slack.

The next chapter will draw conclusions of this study and presents future outlook.

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Chapter 7: Conclusions and Prospects

Against the background of the current Chinese government's continuous promotion of deepening reform of state-owned enterprises (SOEs), the promotion of high-quality development of Chinese SOEs has become an important part of the country's economic strategy. The importance of innovation activities is self-evident, as it is the core element that drives enterprises' long-term development and maintains their market competitiveness. However, the path of enterprise innovation is not a straightforward one, but full of risks and challenges. In this process, a reasonably constructed top management team (TMT) structure is regarded as a key guarantee to enhance the innovation performance of enterprises.

Based on existing studies, this research explored the impact of TMT structure on enterprises' innovation performance and its internal mechanism in the specific context of China's mixed ownership reform. This study not only revealed the complex relationship between TMT structure and enterprises' innovation performance, but also uncovered the underlying logic and influencing factors behind this relationship. Through this study, we hope to provide new theoretical perspectives and empirical evidence for understanding the improvement of innovation performance of mixed ownership SOEs in China.

The results of this study not only have important theoretical value by providing new perspectives and directions for research in related fields, but have important implications for the management practice of enterprises. Through an in-depth analysis of the impact of TMT structure on enterprise innovation performance, this study provides useful guidance and suggestions for enterprises on how to optimize the configuration of the TMT and enhance enterprise innovation capability.

7.1 Conclusions and main findings

Through an in-depth exploration on the intrinsic mechanism by which TMT structure affects enterprise innovation performance in Chinese mixed ownership SOEs, this study draws the following conclusions:

(1) The greater the proportion of non-state directors, the higher the enterprise's innovation performance. This study found that the proportion of non-state directors on the board of directors was significantly and positively associated with enterprises' innovation performance.

This means that as the proportion of non-state directors on the board increases, the innovation performance of Chinese mixed ownership SOEs increases accordingly. This finding revealed the important role of non-state directors in promoting enterprise innovation.

(2) The greater the proportion of independent directors, the higher the enterprise's innovation performance. This study also found that the proportion of independent directors on the board of directors was positively associated with enterprises' innovation performance. As independent directors are an independent supervisory force, an increase in their proportion helps to enhance the innovative capability and performance of enterprises.

(3) The greater the proportion of expert directors, the higher the enterprise's innovation performance. The proportion of expert directors on the board of directors has also been shown to be positively associated with enterprises' innovation performance. This suggests that expert directors with specialized background and knowledge play an important role in promoting enterprise innovation.

(4) The mediating role of TMT's attention. The study further revealed the mediating role of TMT's attention between the TMT structure and the enterprise's innovation performance. It suggests that the allocation of TMT's attention is one of the key factors affecting enterprises' innovation performance.

(5) Moderating effect of CEO duality. CEO duality (i.e., the chairman of the board and the CEO are held by the same person) was found to accentuate the relationship of the proportion of independent directors and the proportion of expert directors with enterprises' innovation performance, but did not enhance the relationship between the proportion of non-state directors and enterprise innovation performance. This finding revealed the varying effects of different TMT structure characteristics in the case of CEO duality.

(6) Enhancing effect of organizational slack. The study also found that organizational slack accentuated the positive relationship between the TMT structure and enterprise innovation performance. This means that the positive effect of TMT structure on enterprises' innovative performance is more pronounced when enterprises have sufficient organizational slack resources.

7.2 Theoretical contributions and innovations

This study makes three main contributions at the theoretical level:

First, in the specific context of China's mixed ownership reform in enterprises, this study conducted an in-depth analysis of the relationship between TMT structure and enterprise

innovation performance from the perspective of the Upper Echelons Theory. By introducing more dimensions and characteristic variables, this study not only enriches the application scenarios of the Upper Echelons Theory, but also provides a more comprehensive perspective for understanding how TMT characteristics affect enterprise strategy implementation. This contribution fills the research gap by opening the "black box" between TMT characteristics and enterprise strategy implementation and provides new ideas and directions for research in related fields.

Second, this study further integrated the Upper Echelon Theory and the Attention-Based View to provide a new explanation for the enhancement of enterprises' innovation performance at the micro level. By examining the mediating role of the TMT's attention between the TMT structure and enterprises' innovation performance, this study revealed how the TMT influences enterprises' innovation activities through their attention allocation. This finding not only enriches the current literature in this field, but also provides a new theoretical perspective for understanding the mechanism of enterprises' innovation performance enhancement.

Finally, this study is also innovative in terms of the research context. Focusing on the hot topic of mixed ownership reform in Chinese SOEs, this study conducted an in-depth analysis on the characteristics of TMT structure and TMT's attention, as well as their effects on enterprises' innovation performance. The choice of this research context not only has distinctive Chinese characteristics, but also provides a useful reference for understanding the enhancement of enterprises' innovation performance under different institutional contexts. In addition, this study also provides new theoretical support and empirical evidence for the study of enterprise innovation in the context of mixed ownership reform of Chinese SOEs.

7.3 Limitations and practical implications

7.3.1 Limitations

This study has made contributions by examininig the impact of TMT structure on innovation performance of SOEs in the context of mixed-ownership reform. It provides a new explanatory mechanism for understanding how the TMT structure affects enterprise innovation performance. However, this study also has some limitations.

First, limitations in the research design. The mixed-ownership reform of China's SOEs is being widely promoted across the country. To ensure data accuracy, authenticity, and validity, this study selected SOEs listed between 2018 and 2022 that have undergone mixed-ownership

reform as the sample. However, there are many unlisted enterprises undergoing mixed-ownership reform nationwide. Due to the difficulty in obtaining relevant data from these enterprises, this study was unable to conduct a more extensive investigation.

Second, a focus on the board of directors within the TMT. Within the corporate governance structure, this study particularly focused on the board of directors, which is responsible for making decisions related to enhancing innovation performance. However, we did not further investigate the impact of executives at the managerial level on innovation performance. Future research could further explore this topic to refine the findings.

7.3.2 Practical implications

In the process of continuous promotion of mixed ownership reform of Chinese SOEs, how to effectively improve the innovation performance of enterprises has become a core issue. Based on in-depth research, this study puts forward the following specific management insights and suggestions, with a view to providing useful guidance for SOEs to realize innovation upgrading in the process of mixed ownership reform.

First of all, mixed ownership reform is not just about “mixed capital”, but more importantly, the “mechanism reform”. While introducing non-state capital, it is necessary to appropriately increase the proportion of directors appointed by non-state capital and specify their duties and rights on the board of directors to ensure their full participation in the decision-making process of the enterprise. In order to give full play to the role of non-state capital, corresponding incentive and constraint mechanisms can be established to encourage it to contribute more wisdom and strength to enterprise development.

Second, optimizing the configuration of the TMT is the key to improving the innovation performance of enterprises. Mixed ownership SOEs should build highly heterogeneous and specialized TMTs and focus on the diversity of members in terms of their professional, technical, and academic backgrounds. In order to achieve this goal, enterprises can take a series of measures, such as broadening recruitment channels, strengthening internal training, and establishing a diversified talent pool. At the same time, enterprises should also focus on the complementarity and collaboration among team members to form a more efficient and synergistic team.

Third, the allocation of TMT’s attention to enterprise innovation is critical. TMTs should fully recognize the importance of innovation and focus their limited attention on topics that are critical to the future development of the enterprise. In order to achieve this goal, the TMT can

formulate a clear innovation strategy and plan to ensure that the enterprise maintains a continuous and stable investment in innovation. At the same time, the communication and collaboration within the team should also be strengthened to ensure that innovation issues receive adequate attention and discussion.

Fourth, the configuration of board power is also an important factor affecting enterprises' innovation performance. In the specific context of Chinese SOEs, special consideration should be given to the positions of chairman and CEO. In order to avoid the problem of supervisory failure caused by excessive centralization of operating and decision-making powers, enterprises can take a series of measures, such as establishing independent supervisory boards or audit committees and strengthening internal control and risk management. They can also consider introducing external or independent directors to increase the independence and professionalism of the board of directors.

Finally, TMTs of SOEs should pay attention to the rational allocation of organizational slack. In order to achieve this goal, enterprises can take a series of measures, such as establishing a reasonable budget and resource allocation mechanism, as well as strengthening project management and risk control. Meanwhile, they should also pay attention to cultivating employees' innovation awareness and capabilities and encourage them to put forward new ideas and suggestions, so as to drive the continuous innovation of enterprises.

In summary, in the context of mixed ownership reform, SOEs can consider multiple aspects to realize the improvement of innovation performance. By optimizing the configuration of the TMT, rationally allocating the power of the board of directors, attaching importance to organizational slack, and strengthening the allocation of TMT's attention to the enterprise innovation, in combination with the implementation of specific suggestions and measures, SOEs can more effectively achieve innovation upgrading and performance enhancement in the process of mixed ownership reform.

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