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Location-Oriented Policies in China: Establishment of State-Level Development Zones and Enterprise Innovation Behaviors

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Abstract: The impact of state-level development zones on company innovation behaviors—specifically, innovation input, output, and quality—is examined in this research. This study utilizes the establishment of state-level development zones as a quasi-natural experiment and employs a Staggered Difference-In-Difference model to systematically evaluate the actual effects. Furthermore, this research focuses on the heterogeneous effects of state-level development zones on enterprise innovation, taking into account different functional positionings, such as the Economic and Technological Development Zone (ETDZ), the High-Tech Industrial Development Zone (HIDZ), and the Special Customs Supervision Zone (SCSZ). The results of previous research indicate that the establishment of state-level development zones may effectively foster company innovation and have a noteworthy effect on the input, output, and quality of innovation. The establishment of ETDZs and HIDZs can significantly encourage enterprises to increase their investment in innovation. The innovation incentive effect of HIDZs is stronger than that of ETDZs. On the other hand, the establishment of SCSZs is more beneficial for improving the output and quality of innovation in enterprises. ETDZs can promote innovation output by adjusting industry agglomeration in the region. HIDZs can encourage enterprises to increase their innovation input by intensifying tax preferences and reducing the level of industry agglomeration. SCSZs can effectively promote the innovation input, innovation output, and innovation quality of enterprises by increasing government subsidies and the intensity of tax preferences.

Keywords: state-level development zones; enterprise innovation behavior and sustainable development; high-tech industrial development zone; economic and technological development zone; staggered difference-in-difference

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1. Introduction

As the world's second-largest economy, China's growth rate and overall economy have a significant impact on the international economy. At the same time, China is an important link in the global supply chain and plays a key role in global trade. Innovation, as a main driving force of China's rapid development in recent years, is the key for China to rapidly increase productivity and narrow the gap with developed countries. Obviously, state-level development zones are an important institutional design for China to improve its autonomous innovation capacity. At the same time, state-level development zones serve as the engine of economic development and the facilitator of opening up to the outside world. Therefore, emphasizing research on development zone policies plays an important role in promoting enterprise innovation. Throughout more than four decades of China's reform and opening up, "crossing the river by groping the stones" has been the consistent approach of the central and local governments in promoting various reforms. The exploration and implementation of development zones have become one of the notable achievements of the reform and opening up. They serve as important platforms for

testing and showcasing the progress of these reforms. By the beginning of 2022, the State Council approved the establishment of 627 state-level development zones, which included 218 Economic and Technological Development Zones, 168 High-Tech Industrial Development Zones, 143 Special Customs Supervision Zones, 19 Border/Cross-border Cooperation Zones, 18 Pilot Free Trade Zones, 19 State-level New Areas, 19 Self-created Zones, and 23 other types of development zones. The number and scale of China's development zones are the largest in the world. Relying on traditional low-cost advantages, such as demographic dividends, land dividends, and policy dividends, China has developed a vast production and manufacturing capacity. This has been achieved by utilizing various types of development zones as a means of facilitating economic growth and establishing a large inward and outward cyclic pattern. Through the establishment of development zones, the needs for industrial transformation, upgrading, and innovation can be better met, and they can provide a constant impetus for urban development, mainly in terms of attracting foreign investment, enterprise agglomeration, and urban function construction. In the face of China's development challenges and the new situation of global economic changes, development zones are also adapting to the "new needs of the innovation-driven development strategy" [1]. Under the new circumstances of global economic changes, development zones must adopt a new functional positioning [2]. As a policy tool, in the long term, development zones will continue to play an important role as the engine of China's economic development.

Currently, China's strategy of developing state-level development zones is encountering several issues as well. First of all, while luring investments, certain development zones prioritize capital and scale over the goal of modernizing the industrial structure. This results in the zones' low-end functional positioning and intense isomorphic rivalry among enterprises. For example, the number of labor-intensive enterprises occupies more than half of the number of enterprises in the development zone, with low value-added and a low technological level, which deviates from the positioning of the development zone as a development frontier. Secondly, additional environmental protection regulations have to be suggested by the government. Because some development zones are dominated by energy-consuming industries, such as coal, electricity, and raw materials, and because the technology for handling pollutants is still not mature enough, more efforts are needed to achieve green development. Finally, due to the excessive policy-oriented introduction of foreign capital, some development zones also face an over-reliance on external investment for capital or technology, and core technologies are imported from other countries. Long-term technical dependency will prevent local enterprises from achieving autonomous R&D, which is a very detrimental element to China's efforts to reform its industrial structure. Consequently, it is imperative to create regulations that support autonomous innovation.

State-level development zones, as important leading zones and drivers of innovation-driven development, offer a unique perspective for comprehending local government behavior, enterprise innovation strategies, and China's economic growth model. Clarifying the actual effects of China's development zone policies on enterprise innovation and understanding the mechanisms of these policies has significant practical value for policymakers and enterprise managers. For policymakers, accurately evaluating the true impact of China's development zones in fostering enterprise innovation and identifying the necessary prerequisites and conditions for the policies to yield results can offer valuable insights for both central and local governments in formulating effective development zone policies. Furthermore, it can provide a solid foundation for the implementation of future policies. State-level development zones can be considered as a comprehensive set of preferential policies. Understanding the specific mechanisms that drive the interactions between state-level development zones and enterprise innovation not only provides theoretical support for the government in formulating scientifically reasonable policies but also helps policymakers coordinate various preferential policies more effectively. This coordination allows for a more impactful combination of policies and enhances the overall design of public policies. Enterprise managers will find it easier to make decisions about

innovation investments at the enterprise level if the link between the creation of state-level development zones and enterprise innovation is made clear. In terms of internal enterprise, each enterprise has different innovation costs and leading products. The key to enterprise management is how to allocate investment resources to continuously improve innovation ability. In terms of external enterprises, there are various types of development zones. The redundancy of policies between the central government and local government can cause confusion in enterprise innovation management. Decisions such as whether to enter state-level development zones and what type of state-level development zone to enter are crucial for enterprise management. This study can provide a reference basis and theoretical guidance for enterprise managers.

In assessing the effectiveness of government policies, particularly location-oriented policies such as the establishment of development zones, the self-selection of enterprises for policy and the picking-the-winner strategy employed by government departments often result in policy endogeneity. This paper examines the impact of state-level development zones on enterprises' innovation behaviors, such as innovation input, innovation output, and innovation quality. It treats the establishment of these zones as a quasi-natural experiment and evaluates both the net effects and dynamic effects. This study employs a Staggered Difference-In-Difference model to analyze the heterogeneous impacts on enterprises' innovation behaviors based on the different functional orientations of state-level development zones (e.g., ETDZs, HIDZs, SCSZs). Additionally, this paper explores the mechanism of differentiated effects. As a unique quasi-natural experiment that combines the characteristics of an emerging economy and a developing country, China's state-level development zones provide the most comprehensive, valuable, and persuasive observational samples for analyzing location-oriented spatial intervention policies. This study finds that the establishment of ETDZs and HIDZs can significantly incentivize enterprises to invest more in innovation. Furthermore, the innovation incentive effect of HIDZs is stronger than that of ETDZs. On the other hand, the establishment of SCSZs is more beneficial for improving enterprises' innovation output and innovation quality. ETDZs can promote the output of innovation by adjusting the level of industry agglomeration in the region. HIDZs can incentivize enterprises to increase their input in innovation by offering greater tax preferences and reducing the level of industry agglomeration. SCSZs can effectively enhance the input, output, and quality of innovation in enterprises by increasing government subsidies and intensifying tax preferences.

This study may have three contributions: First, the innovation of research perspective. Enterprise innovation input and innovation output belong to the relationship between process and result, and they cannot be simply equated. This paper examines the impact of state-level development zones on enterprise innovation from the perspectives of innovation input, innovation output, and innovation quality. It aims to assess the influence of development zone policies on the enterprise innovation process and outcomes, contributing to the theoretical and empirical research on the factors influencing enterprise innovation. Second, the innovation of research content. While existing studies focus on analyzing the relationship between development zones and enterprise innovation, this paper takes a step forward by analyzing the heterogeneous impacts and differentiated mechanisms of state-level development zones with various functional positions on enterprise innovation. This study fills the gap in the existing literature by addressing the lack of research on this topic. Third, the innovation of the identification strategy. Identifying whether an enterprise is located within a state-level development zone is crucial for evaluating the policies of such zones. Based on the "latitude and longitude identification" method, this paper further optimizes the identification strategy by integrating data from multiple sources, thereby enhancing the accuracy and reliability of the study results.

The purpose of this paper is to assess the net effects and dynamic effects of state-level development zones affecting enterprises' innovative behavior by establishing a Staggered Difference-In-Difference model and focusing on the heterogeneous effects of state-level development zones on enterprise innovation. This model offers a more logical and realistic

explanation of how enterprises behave. It also serves as a guide for enterprises looking to boost productivity and innovate more effectively. These benefits have both theoretical and practical implications. At the same time, we expect that the incentive mechanism of the development zone can guide the green behavior of enterprises and contribute to the sustainable development of the economy. The structure of this paper is as follows: Section 2 briefly introduces the theoretical basis of this paper; Section 3 presents the research hypotheses; Section 4 analyzes the Staggered Difference-In-Difference model and enterprise identification in development zones, as well as the data descriptions; Section 5 presents the analysis and test of the experimental results; Section 6 provides the analysis of the heterogeneity of development zones and the mechanism; finally, this paper concludes with an overview of the conclusions of this paper and the future outlook. The structure of this article can refer to Figure 1.

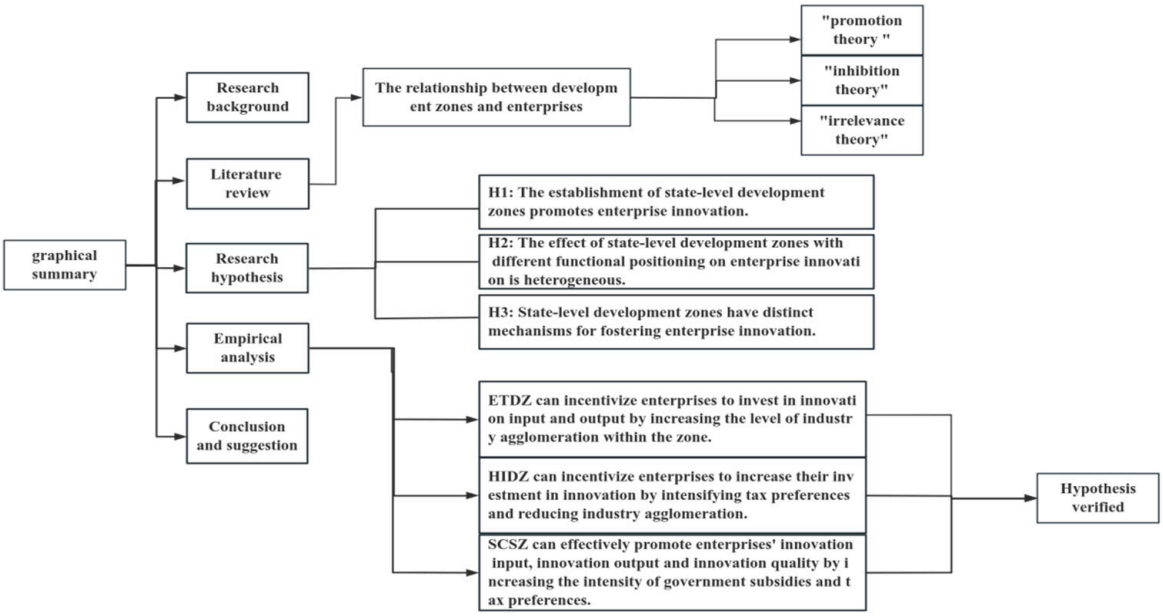


Figure 1. Graphical summary.

2. Literature Review

2.1. Theory of Development Zones

The development zone, as an important policy tool in China and worldwide, has a multidisciplinary and multi-perspective theoretical background. The formation of development zones relies on enterprises, and changes in inter-enterprise relations are important factors that affect the development of these zones. For this reason, scholars have successively put forward the "growth poles theory" to explain the interaction between development zones and enterprises, the "new industrial zone theory" which focuses on the formation of competitive relationships between enterprises in industrial agglomeration, the "new economic geography theory" which considers the factors of scale economy and imperfect competition, and the "'new' new economic geography theory" which introduces the concept of the microheterogeneity of enterprises. Contrary to the "equilibrium theory" of neoclassical economics, the "growth poles theory" emphasizes the non-equilibrium nature of development. It outlines the belief that different geographic spaces will generate varying economic growth due to external economic triggers, resulting in the emergence of economic growth poles. The "growth poles theory" of development zones mainly includes the "diffusion effect" and the "echo effect" [3]. The diffusion effect explains that factors continuously spread outward from the growth poles, driving regional economic growth. On the other hand, the echo effect refers to the core enterprises and leading industries in the development zone, which, through their advantages, attract factors from other regions to gather locally, further enhancing the strength and scale of the growth poles. The "new

industrial zone theory" primarily focuses on the agglomeration law of economic entities within industrial zones in the geographical dimension, the innovation law of the industrial zone system, and the impact of industrial zones on the sustainable development of the regional economy. It specifically examines the competition and cooperation relationship between enterprises operating within industrial zones. The emergence of high-tech small- and medium-sized enterprises, the innovation cooperation and risk sharing among enterprises, as well as the establishment of industry associations, have led to certain differences between the "new industrial zone" and the traditional concept of industrial zones in terms of internal characteristics and external conditions. The theory of new industrial zones can provide a more targeted explanation for the formation and development of China's development zones. The "new economic geography theory" takes into account economies of scale and imperfect competition, providing a new theoretical basis for explaining the dynamic and complex process of agglomeration in development zones. When enterprises gather in a development zone, they not only attract more enterprises to join the zone, resulting in further concentration of industrial activities but also create imperfect competition due to conflicts of interest between the existing and new enterprises. The combined effect of these two forces ultimately determines the scale and development performance of the development zone. The framework of the "new economic geography theory" has focused on explaining "macro-heterogeneity" [4], but it has overlooked the potential variations among enterprises within each region [5]. For this reason, some scholars have integrated the microheterogeneity of enterprises into the new economic geography model and called it the "new" new economic geography [6]. This theory focuses on studying economic activities from the perspective of micro-enterprises. It identifies the productivity advantages of agglomerated areas [7] and provides a new perspective for exploring the relationship between government development zone policies and innovation in heterogeneous enterprises. This is achieved by studying the economic differences between regions and industries, shifting the focus from "quantity" to "quality".

2.2. Effects of Development Zone Policies

Evaluating the effects of development zone policies has been an international hot topic in recent years [8,9]. Empirical studies based on samples from both developed and developing countries have not reached consistent conclusions. These studies have found that the effects of development zone policies on labor employment, economic growth, and enterprise productivity can be insignificant, significantly positive, or negative [10]. The state-controlled promotion of trade and investment taking place through special economic zones represents a complex compromise between the liberalization and protection of economic sovereignty. Special economic zones have been employed by states both as an alternative and as a complement to trade and investment promotion through the instruments of international economic law [11]. Most studies on China's development zones have confirmed the positive effects of these zones on the economy, foreign direct investment, industrial output, industrial upgrading, and other macro-level indicators. However, the impact of development zones at the micro-level is still inconclusive [12].

2.2.1. Macro Level

First, from an economic development and scale standpoint, Liu et al. discovered that the establishment of development zones in China can effectively stimulate regional economic growth [13]. Deng et al. evaluated the impact of the development zone cleanup and reorganization policy on the regional economy in 2003 and found that the policy promoted the short-term role of the regional economic aggregate in narrowing the gap [14]. Wu and Huang conducted a study to investigate the impact of development zones on regional economic growth [15]. The study utilized data from the county level, as well as aggregate and sub-county sub-industry data, to examine the effects of establishing provincial development zones on county industrial performance. The findings of the study confirmed that the establishment of development zones can significantly enhance

the industrial economy scale of the counties in which they are located, particularly in the leading industries. Second, in terms of resource allocation efficiency and industrial agglomeration, Li and Shen discovered that the establishment of development zones can effectively facilitate regional industrial restructuring [16]. This leads to the reallocation of production factors from inefficient departments to efficient ones. Meng analyzed the impact of development zone policies on the spatial agglomeration of the industry [17]. The study confirmed that being a target industry of a development zone significantly inhibited industry agglomeration. Third, from the perspective of commodity prices and residents' consumption, Zheng found that development zones significantly increased real estate prices and retail prices in the neighboring areas and promoted regional socio-economic development [18]. Sun found that the development zones had a significant promotional effect on the total consumption of urban residents, as well as their living expenses, housing expenses, and expenditures on children's education [19]. This was determined by examining the consumption-driven impact of development zone policies. Fourth, from the perspective of regional investment and export, Wang examined the impact of establishing development zones on the attraction of foreign direct investment (FDI) and urban productivity [20]. The study found that development zones have a significant effect on FDI and urban productivity. Chen and Xiong utilized the 1998–2007 Chinese industrial enterprises database to correlate data on development zones and arrived at the conclusion that the development zone policy has, on average, enhanced the export value of the supported industries by 11% [21].

2.2.2. Micro Level

First, from the perspective of enterprise growth, Li and Wu tested the causal relationship between the development zone policy and the growth of enterprises [22]. They confirmed that the establishment of development zones effectively promotes the growth of enterprises. Other scholars have pointed out that the establishment of development zones not only facilitates the growth of enterprises but also significantly improves the resource allocation efficiency of enterprises [23]. Secondly, from the perspective of enterprise exports, Huang and Wang examined the impact of development zone policies on enterprise exports [24]. They found that upgrading provincial development zones can significantly promote the total export volume and export propensity of enterprises in those zones. Bian conducted an empirical test to determine whether the development zone policies promoted the export participation of local enterprises [25]. They found that the effect of state-level development zones on promoting the export participation of enterprises followed an inverted U-shape over time, initially rising and then declining. Secondly, from the perspective of enterprise productivity, Tan and Zhang have confirmed that the development zone policy has a positive impact on enhancing the productivity of enterprises in the zone [26]. Yuan confirmed that the development zone did not significantly promote the enhancement of enterprise productivity during the study period [27]. Chen has confirmed that the development zone policy is not conducive to enhancing enterprise productivity [28]. It can be seen that testing the effectiveness of China's development zone policies at the micro level does not lead to a consistent conclusion. How can we explain this conclusion? In addition to the differences in data sources and estimation methods, it also includes variations in the assessment object. Most scholars either do not refine and differentiate development zone policies or only focus on specific types or levels of development zones.

2.3. Development Zones and Enterprise Innovation

With the increasing availability of micro-data, scholars have gradually begun to study the innovation effects of development zone policies at the micro level. However, the discussion on the question of whether development zones can promote enterprise innovation has not yet reached a consistent conclusion. It can be mainly categorized into the "promotion theory", the "inhibition theory", and the "irrelevance theory". Scholars who support the "promotion theory" argue that development zones serve as catalysts for enterprise

innovation [29]. They believe that these zones can stimulate enterprise innovation by promoting the geographic concentration of enterprises, leading to the formation of industrial agglomeration and competition effects. Additionally, development zones provide a range of preferential policies to offset the positive externalities of enterprise innovation. Participating in an innovation ecosystem helps startups deal with market contingencies by allowing them to fit such externalities [30]. Scholars who adhere to the "inhibition theory" argue that the preferential policies of the development zones reduce the barriers to entry and attract a significant number of inefficient enterprises [31]. This will seriously hinder normal competition and cooperation among enterprises in the development zones [32], which in turn inhibits innovation output and efficiency [33]. Some scholars hold the view of "irrelevance theory", arguing that there is no obvious correlation between development zones and enterprise innovation and that it is difficult to effectively promote enterprise innovation [34,35]. However, scholars who support either the "promotion theory", the "irrelevance theory", or the "inhibition theory" regard the subjects of implementation and management of development zones as homogeneous and do not take heterogeneity into account. This paper aims to examine the relationship between various types of state-level development zones and enterprise innovation. In addition, enterprises have different paths of innovation in terms of input, output, and quality [36,37]. However, most of the existing literature focuses on only one of these aspects, neglecting the multidimensional relationship between development zones and enterprise innovation [38]. Enterprises should pay more attention to innovation efficiency, which represents the level of technology development and commercialization process and reflects more comprehensively the technological innovation capability [39]. At the same time, whether the level of innovation efficiency in high-tech zones can maintain sustained growth over a long period is also the key to economic development [40].

3. Research Hypotheses

The government provides a set of incentives to support the innovative behavior of enterprises through development zones and the strategic adjustments will improve the innovative capacity and core competitive advantage of enterprises. Development zones serve as pilot zones for China's reform and opening up, as well as for the exploration of economic development. Enterprises located in development zones often benefit from excellent infrastructure construction, access to perfect legal services [41], and a wealth of innovative resources [42]. This not only creates a favorable environment for exchanges and cooperation among enterprises in the development zones but also enables the development zones to function as "incubators" for enterprise innovation [43]. State-level development zones are typically able to provide enterprises with ample government subsidies and favorable tax policies [44]. At the same time, the development zone has formulated policies to promote international trade, which makes enterprises' foreign trade activities freer. Enterprises in the context of foreign trade are both "importers" and "consumers". Unilateral trade liberalization has enabled domestic enterprises to have access to high-quality products and advanced technologies from abroad and to attract foreign investment, which has provided external conditions for enterprises' innovative behavior [45]. Accordingly, this paper proposes the following hypothesis.

H1. *The establishment of state-level development zones promotes enterprise innovation.*

Different types of state-level development zones often have different development priorities and policy orientations. When enterprises "land" in different types of development zones, the innovative behavior and performance of their innovation activities are affected by the development focus of the zones and the policy orientation of the local government. State-level development zones with different positioning have different impacts on enterprise innovation. Currently, China's state-level development zones are mainly categorized into ETDZs, HIDZs, and SCSZs. Among them, ETDZs are considered key

areas for investment attraction. ETDZs primarily focus on promoting industrial agglomerations and expanding economic output, with the main goal of driving regional economic growth. HIDZs, as important carriers of the national strategy of innovation-driven development [46], are characterized by being knowledge-intensive and technology-intensive [47]. Their main goal is to incubate and cultivate innovative enterprises and promote technological cooperation [48]. SCSZs are positioned to undertake international industrial transfers and connect domestic and international markets [49]. Differences in the construction objectives of state-level development zones and their varying functional positioning will change the impact of establishing development zones on enterprise innovation. Therefore, this paper proposes the following hypothesis.

H2. *The effect of state-level development zones with different functional positionings on enterprise innovation is heterogeneous.*

By combing through the existing studies, we believe that the impact of state-level development zones on enterprise innovation can be broadly categorized into government subsidies, tax preferences, and industrial agglomeration. Among these, government subsidies and tax preferences are among the policy benefits provided by the development zones, which apply to all aspects of enterprise establishment, production, R&D, and product commercialization [50]. Among these policy preferences, government subsidies are the most common. They involve a gratuitous transfer of funds from the government to enterprises, aiming to incentivize innovation investment by directly increasing the amount of funds owned by enterprises [51]. Tax preferences indirectly help enterprises gain a cost advantage, which enhances their ability to break-even and increases their willingness to innovate [44]. The external economy of agglomeration originates from knowledge and technology spillover, labor market sharing, and sharing of intermediate goods inputs. Accordingly, state-level development zones have an impact on enterprise innovation through various channels, including industry agglomeration. This impact is mainly manifested in the following ways: knowledge spillover and technology diffusion, economic scale of factor inputs, and competition and cooperation of industrial linkages [52]. It is worth noting that industry agglomeration is a double-edged sword. While it brings positive agglomeration effects, it may also result in congestion utility [53], especially when the agglomeration is characterized by high congestion and low technological externality [54]. Moreover, excessive industry agglomeration may inhibit enterprise innovation [55]. Combined with the aforementioned possible ways for state-level development zones to influence enterprise innovation, this paper further proposes the following hypothesis.

H3. *State-level development zones have distinct mechanisms for fostering enterprise innovation.*

4. Research Design

4.1. Identification Strategy

This paper examines the impact of establishing state-level development zones on the innovation behaviors of enterprises. It uses the establishment of these zones as a quasi-natural experiment and evaluates the net effect on innovation input, innovation output, and innovation quality. This is performed by constructing a Staggered Difference-In-Difference model. The Staggered Difference-In-Difference model is an effective method to assess the effect of policy implementation, the mechanism of which is to compare the difference between the sample before and after policy implementation and the sample without policy implementation, obtaining the estimation result of the "difference in difference", so as to effectively quantify the "net effect" of policy implementation. The endogeneity problem can be avoided by using the Staggered Difference-In-Difference model. Compared with the traditional policy assessment methods, the Staggered Difference-In-Difference model is more scientific and accurate in estimating policy effects. The main concept is that the creation of state-level development zones can impact the innovation behaviors of enterprises

situated within these zones. This impact can be attributed to three key factors: firstly, the "grouping effect" resulting from the differences between enterprises; secondly, the "time effect" caused by the long-term inertia of enterprises on China's economic development; and thirdly, the "policy treatment effect" arising from the establishment of state-level development zones in the region where the enterprise is located, as well as the influence of the policies implemented within these zones. If there are other non-development zone enterprises, these enterprises, which are not subject to policy intervention in the establishment of state-level development zones, can be treated as a control group. By using the Difference-In-Difference method, the "policy treatment effect" can be isolated, allowing for the identification of the net effect of the establishment of state-level development zones on enterprises' innovations.

When utilizing the Staggered Difference-In-Difference model to determine the impact of the establishment of development zones on the input, output, and quality of innovation in enterprises, it is crucial to satisfy the "randomness assumption" and "parallel trend assumption". The randomness assumption requires that enterprises are affected by the establishment of development zones randomly. Since the approval of development plans for state-level development zones is determined by the State Council and the review process varies, enterprises are unable to predict in advance when and where state-level development zones will be established. Furthermore, none of the enterprises included in this study have experienced any significant changes in location (such as moving from outside the development zone to within it or relocating to a new location across the province). Therefore, the selection of enterprise addresses is unrelated to the establishment of state-level development zones. The parallel trend assumption states that if there were no state-level development zones, the innovation trends of enterprises inside the development zones would have been roughly parallel to the innovation trends of enterprises outside the zones. This assumption will be tested later.

State-level development zones are established at different times and the scope of urban agglomerations undergoes dynamic adjustments. To account for the variation in approval time and scope adjustment of state-level development zones, this paper utilizes the Staggered Difference-In-Difference to estimate the policy impact of establishing development zones. The details are as follows:

$$Y_{it} = \rho \cdot Setup_{it} + \theta \cdot \sum X_{it} + \tau_i + \gamma_t + \varepsilon_{it} \quad (1)$$

where Y_{it} is the outcome variable, covering enterprises' innovation behavior in terms of innovation input, innovation output, and innovation quality. Subscripts i and t denote enterprises and time, respectively; $\sum X_{it}$ denotes control variables that vary over time and individuals; τ_i, γ_t, and ε_{it} denote individual fixed effects, time fixed effects, and error, respectively. $Setup_{it}$ denotes a dummy variable for the treatment period that varies from individual to individual. If the enterprise i in the t year within the scope of the state-level development zone when the enterprise enters the treatment period, the value of the current year and the subsequent period is 1; otherwise, the value is 0.

Determining if an enterprise is situated within the boundaries of a state-level development zone is crucial for evaluating the effectiveness of development zone policies. Currently, there are four primary methods for identification: "area identification", "address identification", "distance identification", and "latitude and longitude identification". The area identification method identifies enterprises in development zones by examining whether there is a development zone in the county (district or city) where the enterprise is located [56]. However, this method is prone to misidentifying non-development zone enterprises as development zone enterprises, leading to errors. The address identification method recognizes whether an enterprise belongs to a development zone by examining whether its address information contains keywords such as "development zone", "industrial zone", "park", or "HIDZ" [57,58]. However, this method may miss enterprises in development zones that do not include keywords like "development zone" in their addresses. The distance identification method uses the administrative committee of the

development zone as the center and a certain radius from the development zone to identify the enterprises within it [59]. However, the boundaries of the development zone may not be regular shapes, which can result in larger errors for this method. The latitude and longitude identification method determines if an enterprise is situated within the development zone by comparing the information on the four boundaries of the development zone announcement with the latitude/longitude data of the enterprise [18]. This method is more precise in identifying enterprises within the development zone compared to the previous three methods. To optimize and improve the identification of "latitude and longitude", we follow these steps: First, we organize the information on the establishment time and other details of each state-level development zone by combining the two editions of the "China Development Zone Audit Bulletin Catalogue" released in 2006 and 2018 (The boundaries of provincial-level development zones in the "Four Boundaries of China's Development Zones' Announcement Catalogue" (2006 edition) and the "Four Boundaries of State-level Development Zones' Announcement Catalogue" (2018 edition), as well as other relevant policy documents, are ambiguous. Therefore, it is not appropriate to identify enterprises in provincial-level development zones using the "latitude and longitude identification method"). Second, we use ArcGIS software (version 10.5) to depict the boundary shape outline and the four boundaries of the zone information based on the government's official release of the state-level development zones. Finally, we import the latitude and longitude information of the sample enterprises into ArcGIS software and identify enterprises located within the boundary of the development zone as development zone enterprises.

Since enterprises in the development zones may have a tendency to change their innovations before the establishment of the development zones, it is necessary to test for parallel trends and examine the dynamic effects of the policy on the establishment of state-level development zones and its impact on enterprises' innovations over time. Taking the year of the zone's establishment as the benchmark, the estimated dynamic effects in the years before and after the zone's establishment are as follows:

$$Y_{dit} = \sum_{-3 \le j \le 15} \rho_j \cdot Setup_{dit}^{t-birthyear_d=j} + \theta \cdot \sum X_{it} + \eta_d + \tau_i + \gamma_t + \varepsilon_{dit} \quad (2)$$

where Y_{dit} denotes the innovation behavior indicators (including innovation input, innovation output, and innovation quality) of enterprises i in state-level development zones d in the year t. η_d is the fixed effect of state-level development zones and $birthyear_d$ denotes the year of establishment of state-level development zones d. The indicative function $Setup_{dit}^{t-birthyear_d=j}$ takes the value of 1 when the superscript $t - birthyear_d = n$, otherwise it is 0. In addition, we can define the possible range of values of j by combining the length of the data sample and the time of the development zone's establishment.

4.2. Data and Variables

The data used in this study consist of two parts: data from listed enterprises and data from state-level development zones. The data from listed enterprises come from the CSMAR and Wind databases. Based on the consideration of the completeness and validity of the enterprise data, we used Chinese Shanghai and Shenzhen A-share listed enterprises from 1996 to 2019 as the research sample. We then pre-processed the raw data as follows. First, we excluded ST-type and PT-type enterprises, as well as financial listed enterprises. Second, we excluded enterprises in industries with small sample sizes, such as agriculture, forestry, fishery, animal husbandry, and non-metallic mining. Third, we excluded samples of enterprises with significant changes in their location during the study window period (moving from outside the development zone to inside the development zone or relocating across provinces, etc.). Then, we excluded samples with outliers and applied winsorization (winsorization is a data preprocessing technique that deals with outliers by replacing extreme values in data with values close to their neighbors) treatment to continuous variables, shrinking them by 1% on both sides. Finally, 18,742 valid samples were obtained. The data on state-level development zones were

obtained from the "China Development Zone Audit Bulletin Catalogue" and "Four Boundaries of China's Development Zones' Announcement Catalogue", which were jointly issued by the National Development and Reform Commission, the Ministry of Science and Technology, and the former Ministry of Land and Resources in 2006 and 2018. When organizing the information on the development zones, we discovered that certain development zones have undergone changes in their names, codes, and properties. For this reason, we cross-checked and corrected the development zone data using the information provided by the official government website, as well as Baidu Maps and Gaode Maps.

In this study, enterprise innovation was measured in terms of three dimensions, respectively: innovation input, innovation output, and innovation quality. Enterprise innovation input ($Input$) was measured by taking the natural logarithm of the total amount of R&D expenditures of listed enterprises in the year (period t). Considering that it takes a process for enterprises to move from innovation inputs to innovation outputs, we measured enterprises' innovation output ($Output$) and innovation quality ($Quality$) by taking the natural logarithm of the total number of patent applications and the number of invention patents filed in the lagged period (period $t+1$), respectively. In addition, in order to exclude the influence of "bad control variables", we referred to existing related studies [60] and selected enterprise age (Age), enterprise shareholding structure (Top), the proportion of independent directors ($Indept$), and the state-owned enterprise (Soe), as enterprise control variables. In addition, we used the natural logarithm of the number of government subsidies, the natural logarithm of the number of government tax rebates, and the Herfindahl index to measure the intermediary variables: government subsidy (Sub), tax preference (Tax), and industry agglomeration (HHI), respectively. Among them, a larger value of HHI represents a higher degree of industry agglomeration. The symbols and definitions of the above variables are organized in Table 1. Descriptive statistics of the relevant variables are presented in Table 2.

Table 1. Description of variables.

Variable Type	Variable Name	Notation	Define
Outcome variables	Innovation input	$Input$	Ln(total amount of R&D expenditures)t
	Innovation output	$Output$	Ln(total patent applications)t + 1
	Innovation quality	$Quality$	Ln(patent invention patents)t + 1
Treatment variable	Establishment of development zones	$Setup$	In the year of the establishment of the development zone and thereafter, if the location of the enterprise is within the boundary of the development zone, it is defined as 1, otherwise it is defined as 0.
Control variables	Enterprise age	Age	Ln(year of enterprise establishment)
	Shareholding structure	Top	Shareholding ratio of top ten shareholders
	Proportion of independent directors	$Indept$	Number of independent directors/total number of board members
	Enterprise ownership	Soe	State-owned enterprise take the value of 1, otherwise 0
Mediating variables	Government subsidy	Sub	Ln(amount of government subsidy)
	Tax preference	Tax	Ln(amount of government tax rebates)
	Industry agglomeration	HHI	Sum of squares (enterprise revenue/total industry enterprise revenue)

Table 2. Descriptive statistics of variables.

Variable	Mean	Median	Variance	Min	Max	Observations
Input	17.520	17.499	1.396	13.368	21.121	9231
Output	2.458	2.303	1.217	0.693	9.242	7660
Quality	1.861	1.609	1.039	0.693	8.693	6060
Setup	0.010	0.000	0.101	0.000	1.000	18,742
Age	2.524	2.639	0.559	0.693	3.401	18,742
Top	59.441	61.023	15.084	24.030	89.767	16,063
Indept	0.341	0.333	0.101	0.000	0.556	17,630
Soe	0.486	0.000	0.500	0.000	1.000	18,742
Sub	11.385	14.980	7.117	0.000	19.547	16,065
Tax	12.660	15.379	6.638	0.000	20.175	15,115
HHI	0.104	0.074	0.099	0.014	0.633	16,804

5. Empirical Explorations

5.1. Impact of the Establishment of State-Level Development Zones on Enterprises Innovation

Table 3 reports the estimation results of the impact of the establishment of state-level development zones on enterprise innovation. The outcome variables in columns (1)–(3) represent innovation input, innovation output, and innovation quality, respectively. The establishment of state-level development zones plays a significant role in stimulating innovation in terms of input, output, and quality. This provides empirical evidence that the government strongly supports the construction of development zones and verifies theoretical hypothesis 1. In addition, Table 3 has confirmed that enterprise age (*Age*), shareholding structure (*Top*), and the proportion of independent directors (*Indept*) make a significant contribution to enterprise innovation output and innovation quality. This suggests that enhancing enterprise innovation output and innovation quality requires long-term accumulation, a stable management structure, and strong supervision of enterprise management.

Table 3. Benchmark results.

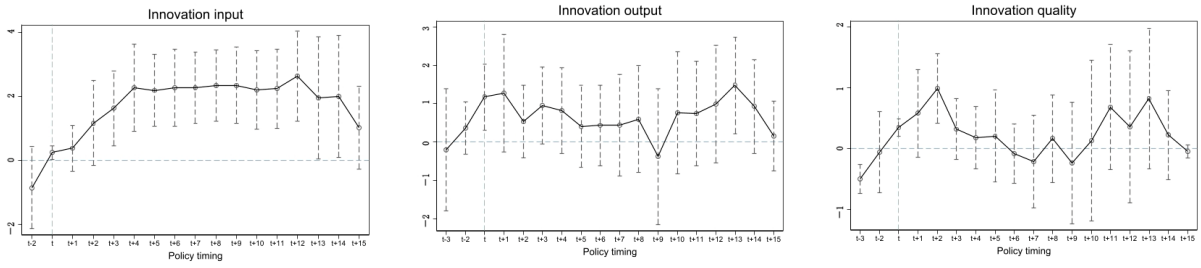
Variable	(1) *Input*	(2) *Output*	(3) *Quality*
Setup	0.908 ***	0.413 ***	0.214 **
	(6.80)	(3.88)	(2.18)
Age	−0.028	0.173 ***	0.081 **
	(−0.68)	(4.15)	(2.05)
Top	0.000	0.005 ***	0.003 ***
	(0.07)	(5.47)	(3.00)
Indept	−0.277	0.425 *	0.551 **
	(−1.07)	(1.65)	(2.28)
Soe	0.544 ***	0.157 ***	0.256 ***
	(15.47)	(4.67)	(8.07)
Constant	17.539 ***	1.450 ***	1.161 ***
	(107.81)	(8.98)	(7.61)
Year	yes	yes	yes
Industry	yes	yes	yes
Province	yes	yes	yes
Observations	9225	7357	5944
R-squared	0.173	0.104	0.103

***, **, and * indicate significance at the 1%, 5%, and 10% statistical levels, respectively; t-statistics corrected for heteroskedasticity are in parentheses.

5.2. Dynamic Effects

Based on examining the static effect of establishing state-level development zones on enterprise innovation, we further tested the dynamic effect of establishing state-level

development zones on enterprise innovation. The results of the parallel trend and dynamic effect tests are shown in Figure 2. The left figure illustrates the dynamic effect of the establishment of state-level development zones on enterprises' innovation input. The center and right figures depict the dynamic effect of development zone policies on enterprises' innovation output and innovation quality, respectively. The hollow circle in the figure represents the magnitude of the impact of the development zone policy, while the dotted line represents the 95% confidence interval. The horizontal coordinates indicate the relative time of the establishment of state-level development zones. t represents the year of policy implementation and the year when the development zones were established. $t + j$ represents the jth year after the policy implementation and $t - j$ represents the year before the policy implementation.



(**a**) (**b**) (**c**)

Figure 2. Dynamic effects. (**a**) Innovation input; (**b**) innovation output; (**c**) innovation quality.

First, we observe the differences in innovation between the control group and the treatment group prior to the establishment of the development zone. The results indicate that none of the coefficient estimates for the treatment variables prior to the establishment of the state-level development zone are statistically significant. This suggests that, in terms of innovation input, innovation output, and innovation quality, there was no significant difference between the enterprises in the treatment group and the enterprises in the control group before the establishment of the state-level development zone. Additionally, the Staggered Difference-In-Difference model passes the parallel trend test, which helps ensure the accuracy of the benchmark regression results to some extent. Secondly, by observing the dynamic changes in the innovation behavior of enterprises after the establishment of development zones, it was found that these zones have a long-term incentive effect on the innovation input of enterprises, particularly in the first four years after their establishment. During this period, the innovation input of enterprises steadily increases. Because the development zones offer a variety of incentives to attract enterprise innovation input, product development, and talent cultivation, they also require long-term capital investment to maintain. However, the impact of the establishment of state-level development zones on the innovation output and quality of enterprises only shows a short-term incentive effect, with no significant long-term effect. In the early stage of the development zone, it attracted a large number of technological achievements, reflecting the impact of the policy. However, in the middle and late stages of the development zone, the incentive effect of the development zone on innovation output and innovation quality did not last long, due to the long cycle of new product development and talent cultivation, as well as the slow development of the technology level.

5.3. Robustness Test

To further validate the reliability of the benchmark regression results, we conducted a sensitivity test and a placebo test in addition to the parallel trend test.

5.3.1. Sensitivity

State-level development zones, which are location-oriented industrial policies, may be influenced by the city in which they are established. For example, provincial capital cities,

as the focal points of resource allocation and policy implementation in each province, may exhibit systematic differences compared to other cities in terms of economic development, city size, and policy environment. We re-estimated the impact of the development zone policy by excluding the samples of enterprises from Guangzhou and Hangzhou, two important provincial capitals, from the study data. Table 4 shows that the establishment of state-level development zones has significant incentives for enterprises in terms of innovation input, innovation output, and innovation quality, after excluding certain samples. This is generally consistent with the benchmark regression results in Table 3, and the findings are robust.

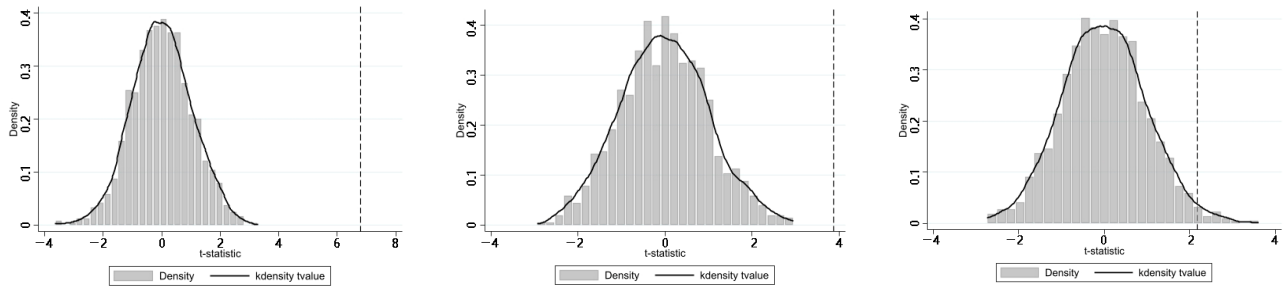
Table 4. Estimation results after excluding some samples.

Variable	(1) *Input*	(2) *Output*	(3) *Quality*
Setup	0.936 ***	0.411 ***	0.217 **
	(6.96)	(3.87)	(2.20)
Age	−0.012	0.187 ***	0.081 *
	(−0.27)	(4.30)	(1.95)
Top	−0.000	0.005 ***	0.003 ***
	(−0.32)	(5.02)	(3.01)
Indept	−0.157	0.517 *	0.599 **
	(−0.58)	(1.95)	(2.39)
Soe	0.502 ***	0.146 ***	0.242 ***
	(13.66)	(4.24)	(7.42)
Constant	17.453 ***	1.395 ***	1.144 ***
	(101.81)	(8.28)	(7.15)
Year	yes	yes	yes
Industry	yes	yes	yes
Province	yes	yes	yes
Observations	8565	6893	5564
R-squared	0.170	0.104	0.102

***, **, and * indicate significance at the 1%, 5%, and 10% statistical levels, respectively; t-statistics corrected for heteroskedasticity are in parentheses.

5.3.2. Placebo

There is another important and indispensable test in the model—the placebo test. We aimed to determine whether the incentive effect of the policy shock, resulting from the establishment of state-level development zones, on the innovative behavior of enterprises was influenced by other random factors. To achieve this, we generated random test groups. According to the implementation of the development zone policy, a treatment group was randomly generated and the experiment was repeated 1000 times. The t-value of the treatment variable was extracted, and a kernel density plot was drawn (Figure 3). The results show that only a small number of experimental results are larger than the true regression coefficients. This suggests that the establishment of state-level development zones plays a more robust role in promoting innovation input, innovation output, and innovation quality in enterprises.



(**a**) (**b**) (**c**)

Figure 3. Placebo test. (**a**) Innovation input; (**b**) innovation output; (**c**) innovation quality.

6. Heterogeneity and Mechanism

6.1. Heterogeneity

According to the "China Development Zone Audit Bulletin Catalogue" in 2018, the state-level development zones approved by the State Council are divided into five categories: Economic and Technological Development Zones (ETDZs), High-Tech Industrial Development Zones (HIDZs), Special Customs Supervision Zones (SCSZs), Border/Cross-border Cooperation Zones (B/CCZs) and other types of development zones. Different development zones with varying functional orientations often have distinct development priorities and policy orientations. Since the number of border/cross-border economic cooperation zones and other types of development zones is relatively small, and the enterprise addresses in the data sample are not within the scope of these two types of state-level development zones, this study focuses on analyzing the first three types of development zones.

Table 5 presents the results of the heterogeneity test examining the impact of establishing various types of development zones on enterprises' innovation. Firstly, when observing the estimation results in columns (1)–(3), the incentive effects of establishing ETDZs, HIDZs, and SCSZs on enterprises' innovation investment are 0.602, 1.243, and 0.983, respectively. All of these values are significant at the 1% level, indicating that the establishment of ETDZs, HIDZs, and SCSZs can significantly enhance the level of enterprises' innovation investment. Furthermore, the incentive effect of establishing HIDZs is relatively stronger on enterprises' innovation investment. State-level development zones guide industrial development and resource reallocation by establishing leading industries and offering supportive policies and special incentives to enterprises operating within these industries in the development zones. The leading industries in HIDZs are primarily high-tech industries, including microelectronics and biomedicine [61]. Enterprises in these industries often have greater motivation and willingness to innovate, which results in HIDZs having a stronger effect on incentivizing innovation investment compared to ETDZs and SCSZs. By observing columns (4)–(9), it can be concluded that the establishment of SCSZs has a significant positive impact on the innovation output and quality of enterprises. On the other hand, the establishment of HIDZs does not have a significant effect on the innovation output and quality of enterprises. Additionally, the establishment of ETDZs can incentivize the innovation output of enterprises, but it does not have a significant effect on enhancing the innovation quality of enterprises. The possible reason for this is that the technological threshold for enterprises in HIDZs is higher. This leads to greater difficulty in R&D and innovation, particularly in the development of high-quality innovative products. These innovations often require a longer R&D cycle, which diminishes the incentive effect of establishing HIDZs for innovation. Compared to ETDZs and HIDZs, the enterprises in SCSZs have several advantages, including convenient international cooperation and frequent exchange of technology and human resources. These advantages strengthen the incentive effect of establishing SCSZs on innovation output and quality [62]. Overall, there is a difference in the promotional effect of ETDZs, HIDZs, and SCSZs on the innovative behavior of enterprises, thus confirming Hypothesis 2.

Table 5. Heterogeneity analysis based on the functional orientation of development zones.

	Input			*Output*			*Quality*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	**ETDZ**	**HIDZ**	**SCSZ**	**ETDZ**	**HIDZ**	**SCSZ**	**ETDZ**	**HIDZ**	**SCSZ**
Setup	0.602 ***	1.243 ***	0.983 ***	0.574 ***	−0.018	1.271 ***	0.035	0.037	1.139 ***
	(3.38)	(5.67)	(2.86)	(3.90)	(−0.12)	(4.17)	(0.25)	(0.26)	(4.27)
Control variable	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry	yes	yes	yes	yes	yes	yes	yes	yes	yes
Province	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	9180	9161	9143	7297	7281	7238	5890	5885	5850
R-squared	0.173	0.170	0.171	0.105	0.101	0.103	0.104	0.103	0.105

*** indicate significance at the 1% statistical level; t-statistics corrected for heteroskedasticity are in parentheses.

6.2. Mechanism

In this subsection, we use government subsidy (*Sub*), tax preference (*Tax*), and industry agglomeration (*HHI*) as intermediary variables to further examine whether state-level development zones with different functional orientations have distinct mechanisms of action on enterprise innovation. Tables 6–8 report the results of the mechanism test for the influence of enterprise innovation in ETDZs, HIDZs, and SCSZs, respectively.

Table 6. Mechanism analysis of the establishment of ETDZs affecting the innovation behaviors.

Mechanisms		**(1)**	**(2)**	**(3)**	**(4)**
Government subsidy		*Sub*	*Input*	*Output*	*Quality*
	Setup	0.300	0.609 ***	0.589 ***	0.051
		(0.62)	(3.43)	(4.02)	(0.36)
	Sub		0.028 ***	0.023 ***	0.024 ***
			(9.76)	(7.49)	(8.27)
	Control variable	yes	yes	yes	yes
	Observations	15,919	9179	7297	5890
	R-squared	0.564	0.182	0.112	0.115
Tax preference		*Tax*	*Input*	*Output*	*Quality*
	Setup	−0.446	0.522 ***	0.633 ***	0.112
		(−0.69)	(2.92)	(4.10)	(0.78)
	Tax		0.058 ***	0.029 ***	0.024 ***
			(23.90)	(10.92)	(9.63)
	Control variable	yes	yes	yes	yes
	Observations	13,612	8195	6578	5380
	R-squared	0.270	0.243	0.123	0.129
Industry agglomeration		*HHI*	*Input*	*Output*	*Quality*
	Setup	0.034 ***	0.629 ***	0.549 ***	0.031
		(3.84)	(3.53)	(3.73)	(0.22)
	HHI		−0.556 ***	0.591 ***	0.063
			(−3.18)	(3.41)	(0.37)
	Control variable	yes	yes	yes	yes
	Observations	15,777	9136	7297	5890
	R-squared	0.233	0.174	0.107	0.104

*** indicate significance at the 1% statistical level; t-statistics corrected for heteroskedasticity are in parentheses.

Table 7. Mechanism analysis of the establishment of HIDZs affecting the innovation behaviors.

Mechanisms		**(1)**	**(2)**	**(3)**	**(4)**
Government subsidy	*Setup*	*Sub*	*Input*	*Output*	*Quality*
		0.464	1.242 ***	−0.035	0.016
		(0.84)	(5.70)	(−0.23)	(0.11)
	Sub		0.029 ***	0.023 ***	0.023 ***
			(10.00)	(7.35)	(7.97)
	Control variable	yes	yes	yes	yes
	Observations	15,886	9160	7281	5885
	R-squared	0.564	0.179	0.108	0.112
Tax preference	*Setup*	*Tax*	*Input*	*Output*	*Quality*
		1.352 *	1.308 ***	−0.021	0.031
		(1.84)	(5.99)	(−0.13)	(0.22)
	Tax		0.060 ***	0.030 ***	0.025 ***
			(24.52)	(11.30)	(10.01)
	Control variable	yes	yes	yes	yes
	Observations	13,584	8178	6567	5376
	R-squared	0.269	0.244	0.119	0.129
Industry agglomeration	*Setup*	*HHI*	*Input*	*Output*	*Quality*
		−0.024 **	1.238 ***	−0.013	0.037
		(−2.42)	(5.65)	(−0.08)	(0.26)
	HHI		−0.536 ***	0.540 ***	0.000
			(−3.05)	(3.11)	(0.00)
	Control variable	yes	yes	yes	yes
	Observations	15,744	9117	7281	5885
	R-squared	0.234	0.171	0.102	0.103

***, **, and * indicate significance at the 1%, 5%, and 10% statistical levels, respectively; t-statistics corrected for heteroskedasticity are in parentheses.

Table 8. Mechanism analysis of the establishment of SCSZs affecting the innovation behaviors.

Mechanisms		**(1)**	**(2)**	**(3)**	**(4)**
Government subsidy	*Setup*	*Sub*	*Input*	*Output*	*Quality*
		4.136 ***	0.884 ***	1.194 ***	1.070 ***
		(3.27)	(2.58)	(3.93)	(4.03)
	Sub		0.029 ***	0.022 ***	0.023 ***
			(9.91)	(7.16)	(7.88)
	Control variable	yes	yes	yes	yes
	Observations	15,826	9142	7238	5850
	R-squared	0.563	0.180	0.109	0.115
Tax preference	*Setup*	*Tax*	*Input*	*Output*	*Quality*
		3.742 **	0.897 **	1.016 ***	0.983 ***
		(2.10)	(2.43)	(2.98)	(3.28)
	Tax		0.059 ***	0.029 ***	0.025 ***
			(24.24)	(11.13)	(9.92)
	Control variable	yes	yes	yes	yes
	Observations	13,530	8160	6524	5340
	R-squared	0.270	0.244	0.120	0.130
Industry agglomeration	*Setup*	*HHI*	*Input*	*Output*	*Quality*
		0.001	0.989 ***	1.268 ***	1.139 ***
		(0.05)	(2.88)	(4.17)	(4.27)
	HHI		−0.540 ***	0.530 ***	0.012
			(−3.08)	(3.05)	(0.07)
	Control variable	yes	yes	yes	yes
	Observations	15,684	9099	7238	5850
	R-squared	0.236	0.172	0.104	0.105

*** and ** indicate significance at the 1% and 5% statistical levels, respectively; t-statistics corrected for heteroskedasticity are in parentheses.

Combining the estimation results in Tables 6–8, we can draw the following conclusions. First, ETDZs can incentivize enterprises to invest in innovation input and output by increasing the level of industry agglomeration within these zones. Secondly, HIDZs can incentivize enterprises to increase their investment in innovation by intensifying tax preferences and reducing industry agglomeration. It can be observed that the impact of the ETDZs and HIDZs on influencing the industry agglomeration is the opposite. This is due to the fact that HIDZs have higher requirements for core technology and the establishment of HIDZs tends to intensify the flow of innovation resources from inefficient enterprises to high-efficiency enterprises. As a result, some inefficient enterprises are eliminated from the market, leading to a reduction in the concentration ratio. Furthermore, the innovation willingness of high-efficiency enterprises will be further strengthened as they gain access to additional innovation resources. As a post-incentive for enterprise innovation, tax preferences can theoretically not only motivate enterprises to increase their investment in innovation but also help promote the output and quality of their innovation. However, for HIDZs, which are dominated by high-tech enterprises, the impact of tax preferences on innovation output, particularly innovation quality, is significantly limited [63]. Third, SCSZs can effectively promote enterprises' innovation input, innovation output, and innovation quality by increasing the intensity of government subsidies and tax preferences. The effect of government subsidies and tax preferences on enterprise innovation in the SCSZs is particularly evident when compared with the ETDZs and HIDZs. The reason for this may be that the proportion of capital-intensive enterprises in the SCSZs is higher. Additionally, the government subsidy and tax preferences in the SCSZs can effectively alleviate the financing constraints of capital-intensive enterprises, providing a strong guarantee for the development of innovation activities within these enterprises. Overall, the development zones with different functional positions have different mechanisms for enterprise innovation, and Hypothesis 3 has been confirmed.

7. Conclusions and Policy Implications

7.1. Conclusions

This paper examines the impact of state-level development zones on the innovation behaviors of enterprises using a quasi-natural experiment approach. This study utilizes data from China's A-share listed enterprises from 1996 to 2019 and employs a Staggered Difference-In-Difference model to evaluate the net effects and dynamic effects of state-level development zones on innovation input, innovation output, and innovation quality. This study also explores the heterogeneous effects of state-level development zones with different functional positions (e.g., ETDZs, HIDZs, SCSZs) on the innovation behaviors of enterprises, as well as the underlying mechanisms of differentiation. This study finds that the establishment of state-level development zones is beneficial for improving the innovation capacity of enterprises. It significantly promotes the input, output, and quality of innovation in these enterprises. The impact of state-level development zones on enterprise innovation is associated with the functional orientation of the zones. The establishment of ETDZs and HIDZs can significantly stimulate enterprises to increase their level of investment in innovation. The innovation incentive effect of HIDZs is stronger than that of ETDZs. On the other hand, the establishment of SCSZs is more beneficial for improving the output and quality of innovation in enterprises. ETDZs can promote the innovation output of enterprises by adjusting the industrial agglomeration in the region. HIDZs can incentivize enterprises to increase their innovation inputs by increasing the intensity of tax preferences and decreasing the degree of industrial agglomeration. SCSZs can effectively promote the innovation input, output, and quality of enterprises by increasing the strength of government subsidies and the intensity of tax preferences.

7.2. Policy Implications

The appropriate and reasonable utilization of development zone policies has a significant impact on incentivizing enterprise innovation and promoting an innovation-driven

environment. In order to maximize the impact of state-level development zones on enterprise innovation, the government should take the following factors into consideration during the construction of these zones.

(1) Promoting the functional transformation of the government in the development zone from an interventionist government to a service-oriented government. The government should respect the general laws of the market economy and reduce direct intervention in economic activities. Furthermore, SCSZs should be established to increase the enthusiasm of enterprises for innovation. At the same time, this should improve macro-control and compensate for market failures so as to reduce the institutional costs of enterprise development and create a fair and just environment for enterprise growth. Increasing government subsidies and tax preferences can effectively enhance enterprises' innovation input, innovation output, and innovation quality.

(2) The government should focus on solving environmental problems in the development zones and contribute to the world's environmental protection. The government should increase policy support for green industries and bring more energy-saving enterprises to the development zones; local governments can increase the recycling rate of pollutants and reuse resources through policies that set targets for pollutant reuse rates [64]. The government should promote the use of green energy, regularly monitor pollution in the development zones, and give more incentives to low-polluting enterprises. While pursuing the increase of innovation output, the development zones should take into account ecological protection and adhere to the concept of sustainable development.

(3) The government should formulate different policies according to different types of development zones. Combined with the experimental results of this paper, ETDZs can promote the innovation output of enterprises by adjusting the industrial agglomeration in the region. HIDZs can incentivize enterprises to increase their innovation inputs by increasing the intensity of tax preferences and decreasing the degree of industrial agglomeration. By analyzing the characteristics of different development zones and drawing conclusions from the findings, policymakers can anticipate potential scenarios by considering the current situation and the unique attributes of industrial agglomeration. They can develop tailored policies that guide enterprises to implement the enterprise innovation plan at the most opportune moment [65]. SCSZs can incentivize enterprises to invest more in innovation by enhancing tax preferences and reducing industrial agglomeration. Preferential tax policies can effectively reduce the actual tax burden of high-tech enterprises [66]. In addition, the government should provide sufficient financial support to enterprises in the development zone, such as strengthening the bank credit support for R&D activities of enterprises and improving the information disclosure system related to research and development [67]. This will enable the provision of suitable innovation platforms and sustainable innovation environments and promote the collaborative enhancement of enterprise innovation at all levels of development zones. These suggestions can serve as references for special economic zones in other countries.

This study still has the following shortcomings that need to be addressed. First, this paper selects China's A-share listed companies as the research sample, which may not accurately reflect the relationship between the establishment of state-level development zones and innovation in middle- and small-sized enterprises. In the future, we can gather data from medium- and small-sized enterprises or enterprises listed on the New Third Board to examine the impact and mechanisms of state-level development zone policies on the innovation input, innovation output, and innovation quality of these enterprises. Second, this paper only examines the impact of the establishment of state-level development zones on enterprise innovation. This paper adopts companies from 1996 to 2019 as the research sample, considering the large time span and the lack of analysis of new data from 2019 to 2024 there is still room for improvement. The Staggered Difference-In-Difference model also has limitations, such as the fact that the control group samples are all subject to policy experiment shocks or the problem of synchronization where the explanatory variables are highly correlated with the explained variables. Third, we can combine prospect theory,

mental accounting, and evolutionary game theory to establish a hypothetical model for enterprises and governments involved in state-level development zones [68], thereby enabling the prediction of corporate and government behavior through simulation experiments. In the future, we can include these dynamic changes in development zones in our studies to thoroughly examine the relationship between the construction process of development zones and enterprises' innovation.

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