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The Impact of the Upgrading of High-tech Zones on the Total Factor Productivity of Enterprises: Evidence from Guasi-natural Experiments

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Abstract

High-tech Zones are widely regarded as an effective mechanism to promote innovation and development of industrial clusters and new ventures. As a change in the external institutional environment, the upgrading of Provincial High-tech Zones promotes the 'metabolism' of enterprises in the High-tech Zones. This paper regards the upgrading of Provincial High-tech Zones as an external policy impact, constructs a quasi-natural experiment to evaluate the micro-policy effect of upgrading the Provincial High-tech Zones to the National High-tech Zones. Based on the data of enterprises in High-tech zones from 2005 to 2014, this paper uses Propensity Score Matching and Difference-in-Difference methods to analyze the impact of the upgrading of Provincial High-tech Zones on the total factor productivity of enterprises and explores the mechanism of action between the two through the mediation effect model. The results show that the upgrading of Provincial High-tech Zones distorted the total factor productivity of enterprises. Besides, compared with state-owned enterprises, the upgrading of Provincial High-tech Zones has a greater impact on the total factor productivity of non-state-owned enterprises. From the perspective of the intensity of government intervention, the higher the intensity of local government intervention, the greater the distortion effect. Further analysis shows that this distortion effect comes from adverse selection and moral hazard caused by information asymmetry between government and enterprises. The research results of this paper provide a realistic basis for the development of enterprises located in the newly upgraded National High-tech Zones.

JEL classification numbers: D24 R58.
Keywords: Upgrading of Provincial High-Tech Zones,Total Factor Productivity of Enterprises, Propensity Matching Score (PSM), Difference in Difference Method (DID).

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1. Introduction

The global new round of scientific and technological revolution and industrial transformation is accelerating, and the industrial structure of various countries is gradually shifting from resource-led to innovation-led (Hekkert, Suurs et al. 2006, Hanson and Rohlin 2013). It has become a consensus of the international community that high and new technology can drive sustained economic growth (Wang, Pan et al. 2020). Many countries have set up or expanded science parks to improve global competitiveness(Bai, Yan et al. 2015, Lamperti, Mavilia et al. 2017). Today, science parks are spread all over the world (Etzkowitz, José Manoel Carvalho de Mello et al. 2005, Wonglimpiyarat 2016), including Silicon Valley in the United States, Cambridge Science Park in the United Kingdom, Sophia Antipolis Science Park in France, Munich and Heidelberg Science Park in Germany, Bangalore Science Park in India, Biotechnology Park in Brazil, etc.

China's science parks are called high-tech zones(HTZs), which refer to exclusive spaces with policy privileges and management advantages granted by the state or local government (Clark 2014, Zhuang and Ye 2020). The HTZs is a momentous carrier of national technological innovation and industrial upgrading (Xie, Song et al. 2018). The HTZs mainly include national high-tech zones (NHTZs) and provincial high-tech zones (PHTZs). NHTZs are different from PHTZs in terms of policy breadth, policy strength, and strategic objective(Li and Wu 2018). On the one hand, NHTZs are subordinate to the central government and enjoy national-level preferential policies, while PHTZs are subordinate to local governments(Lin, Xiang et al. 2018). On the other hand, the preferential policies of PHTZs are far smaller than those of NHTZs, such as tax incentives, credit support, financial subsidies, land incentives, talent introduction, patent protection, and scientific and technological incentives (Jiang 2018, Xiao and Xiong 2018, Tan and Zhang 2019). Therefore, the impact of NHTZs and PHTZs on the regional economy or enterprise performance is also different (Jiang and Xu 2009, Zhang, Liu et al. 2020).

As the NHTZs have demonstrated strong anti-risk ability and competitiveness during the financial crisis, showing the value of its existence and expansion (Chen and Liu 2014). The quantity and quality of PHTZs have also increased significantly, and most of them have become the growth poles of the regional economy (Gao 2011). Based on these, China formulated and implemented the 'Upgrading of PHZs' policy in 2009 (Feng and Li 2013). So far, 113 PHZs have been successfully upgraded to NHZs. The upgrading of PHTZs to NHTZs means the optimization of the institutional environment. Because under the comparative advantages of policies, the NHTZs can obtain more development resources, capital investment, and development space (Cao 2020).

Besides, the essence of the upgrading policy of PHTZs is a typical location-oriented industrial policy (Deng, Yu et al. 2019). The micro-effects of the industrial policy will ultimately be reflected in the total factor productivity (TFP) of enterprises (Melitz and Polanec 2015). Therefore, it is a significant research perspective to evaluate the policy effects of PHTZs based on the enterprise level. The state grants

the NHTZs with administrative approval as the core regulatory power, which enables the NHTZs to maintain independence in vital areas such as investment promotion, and can regulate the entry and exit barriers of enterprises (Wang and Shen 2020). Therefore, relying on preferential policies, the newly upgraded NHTZs government actively selects enterprises with a bigger scale and development prospects (Guo and Shen 2020). Enterprise clusters form agglomeration effect and selection effect, thereby increasing the TFP of enterprises (Melo, Graham et al. 2008, Arimoto, Nakajima et al. 2014). On the one hand, the agglomeration effect can save transportation costs, generate knowledge spillovers, and bring technological progress. Those are conducive to improving the TFP of enterprises (Ye and Lin 2014, Shao, Zhang et al. 2019). On the other hand, the clustering of enterprises in HTZs also strengthens the pressure of competition among enterprises in the same industry, which is conducive to forming a selection mechanism for the survival of the fittest (Wang and Zhang 2016). In this process, low-efficiency enterprises are eliminated, which promotes the flow of scarce resources from low-efficiency enterprises to high-efficiency enterprises, realizes the optimal allocation of resources, and promotes the improvement of the overall productivity of enterprises in the HTZs (Baldwin and Okubo 2014).

However, the industrial policy is essentially an incomplete contract signed between the government and the enterprise (Yang and Hou 2019). The asymmetry of information among policy subjects will affect the effect of contract implementation (Hou and Yang 2019). The government of each HTZ correctly evaluates the operating conditions of enterprises and selects high-efficiency enterprises to settle in the HTZs, which is the key to achieving agglomeration and selection effects (Zhao, Wang et al. 2015). Generally speaking, due to high information costs, it is difficult for the governments of HTZs to grasp the complete information chain, which is at an information disadvantage (Wu 2006).Enterprises benefit from market information resources, which is at the advantage of information acquisition (Jin and Yuan 2011). In the presence of information asymmetry, the government cannot make correct judgments on the profitability and development prospects of the enterprises due to cognitive limitations, which leads to government failure (Li, Gao et al. 2015). Therefore, information asymmetry may distort the positive effects of the upgrade policy and have a negative impact on the TFP of enterprises (Yang and Rui 2020).

Therefore, the purpose of this study is to evaluate the micro-effects of the upgrading of PHTZs, mainly focusing on the following three issues:

- Is the upgrading of PHTZs an incentive or a distorting effect on the TFP of enterprises in the HTZs?
- What is the mechanism by which the upgrading of PHTZs affects the TFP of enterprises?
- Is there any heterogeneity in the impact of the upgrading of PHTZs on the TFP of enterprises?

The answers to these questions are conducive to deepening our understanding of the PHTZs upgrading policy, and provide a decision-making reference for the

transformation and upgrading of enterprises and the formulation of high-quality development plans for HTZs.

This paper regards 'upgrading of PHTZs' as a quasi-natural experiment, taking the year of HTZs upgrading as the point of policy impact. This paper defines the successfully upgraded PHTZs as experimental groups and uses the propensity score matching (PSM) method to match the unsuccessfully upgraded PHTZs as the control group. On this basis, this paper uses a multi-period difference in difference (DID) model to evaluate the impact of PHTZs upgrade on the TFP of enterprises, and uses the mediation effect model to analyze the mechanism between the two. These provide microscopic evidence for the effect of the HTZs policy implementation.

The marginal contributions are as follows: First, due to the poor availability of enterprise data in HTZs (Lin, Xiang et al. 2018), few literatures focus on the micro-effects of HTZs policies. According to the postal codes and latitude and longitude information of the HTZs and enterprises, this paper identifies the enterprises located in the HTZs as enterprise-level data, which provides a micro data basis for subsequent related research. Second, the existing literature mostly evaluates the policy effect of the establishment of HTPs (Alder, Shao et al. 2016, Yuan and Zhu 2018). However, this paper takes the new perspective of ‘upgrading of PHTZs’ as an entry point, placing the upgrading of HTZs and TFP of enterprise in the same research framework, enriching the research on the micro-effects of HTZs policies. Third, the upgrading of PHTZs is carried out in batches and different years, with multiple policy shock points in time. The traditional DID model is not suitable for evaluating the effect of the PHTZs upgrade policies, so this paper adopts the DID model (Li, Dong et al. 2020). Besides, considering that the sample may have selectivity bias, this paper adopts a combination of multi-period DID and PSM in the empirical method to more accurately measure the impact of the upgrading of PHTZs on the TFP of enterprises in HTZs. This research provides policy enlightenment for improving the productivity of enterprises in HTZs and the high-quality development of HTZs.

2. Literature Review

With the construction of science parks around the world, evaluating the effect of science parks policies has become a hot issue. Relevant research mainly focuses on the two aspects of the regional economy and enterprise performance. As far as the regional economy is concerned, the science park policy enables economic activities to be re-distributed between regions which is conducive to promoting the development of the regional economy (Neumark and Kolko 2010, Busso, Gregory et al. 2013). As far as the productivity of enterprises is concerned, the introduction of enterprise projects in science parks has a positive spillover effect on the productivity of existing enterprises (Greenstone, Hornbeck et al. 2010). However, the preferential policies of the science park have attracted a large number of transfer enterprises from other regions, but have not attracted newly established enterprises,

indicating that the science park policy has no creative effect, only a substitution effect (Hanson and Rohlin 2013). Besides, the gains gained by cities with science parks offset the losses incurred by other cities. This means that the science park policy has not exerted the spillover effect of the agglomeration economy, and has no obvious promotion effect on the overall economic development and social welfare of the region (Kline and Moretti 2014).

In China, the literature evaluating the policy effects of HTZs mainly focuses on the impact of the establishment of NHTZs on economic growth(Alder, Shao et al. 2016), industrial structure (Li and Shen 2015, Yuan and Zhu 2018), urban innovation capabilities and innovation efficiency (Xiong and Jin 2019, Wang, She et al. 2020), urban productivity (Xu, Wu et al. 2019, Zhou and Ge 2020), and enterprise productivity (Yuan, Liu et al. 2015, Yu and Hu 2017, Lin, Xiang et al. 2018). Besides, some documents also confuse established NHTZs with the newly upgraded NHTZs (Tan and Zhang 2019).

However, these studies have not noticed the essential difference between the established NHTZs and the upgraded NHTZs. The established NHTZs and the newly upgraded NHTZs belong to two generations of HTZs, and the two have epochal differences (Liu 2011). On the one hand, due to many irregularities in the construction and management of HTZs, low-level redundant construction has appeared. In 2003, China launched the 'clean up and rectification of HTZs' and suspended the approval of various newly established and expanded HTZs. The clean-up and rectification work will continue until 2009. After 2009, all NHTZs were upgraded from PHTZs, while before 2009, NHTZs were directly established by the state. On the other hand, the NHTZs established in the early stage were set up in provincial capitals, municipalities, and other areas with dense intellectual institutions such as universities and research institutes, so the layout is not random. Therefore, in terms of evaluating policy effects, it is more reasonable to choose newly upgraded NHTZs as the sample than pre-established NHTZs as the sample. However, little literature is focusing on the effects of the upgrading of PHTZs.

In recent years, a few scholars (Chai and Kong 2020, Sun, Wu et al. 2020, Zhang, Liu et al. 2020) have noticed a gap in the research field of the effect of development zone upgrading policies. Zhang and Liu (2019) discussed the impact mechanism of the upgrading of development zones on resource allocation efficiency; Chai and Kong (2020) based on the data of Chinese industrial enterprises, explored the heterogeneity of the effect of the upgrading policy of development zones. However, development zones include various types of development zones such as HTZs, economic and technological development zones, bonded zones, and export processing zones. Different types of development zones differ in their development directions, missions granted by the state, and policy support (Shen, Gu et al. 2017). The upgrading of the development zones includes ‘the upgrading of the economic and technological development zones’ and ‘the upgrading of the HTZs’. The economic and technological development zones focus more on the laws of economic development, intending to drive regional economic development (Zheng, Yeerken et al. 2019), while the HTZs pay more attention to the law of industrial

development to promote the development of the high-tech industry (Liu and Zhao 2015). If the two are studied together, it may lead to deviations in the estimation of the effect of the policy. Since the NHTZs are the main position for China to implement the innovation-driven development strategy and is also the first demonstration zone for high-quality development of the country, this paper chooses 'the upgrading of HTZs' as the research perspective.

3. Materials and Methods

3.1 Data

To evaluate the impact of the upgrading of PHTZs on enterprises, this paper matches industrial enterprise database (issued by the National Bureau of Statistics) with HTZs data to identify enterprises located in HTZs, and then obtain the enterprise data set of this paper. This data set covers Chinese manufacturing enterprises located in the sample HTZs from 2005 to 2014. First, this paper needs to clean the industrial enterprise database. Second, sort out the list of two types of HTZs: the list of NHTZs upgraded from PHTZs and the list of PHTZs that have not been successfully upgraded. Third, combine HTZs data and enterprise data to identify the enterprises located in the HTZs.

First, industrial enterprise database. The enterprise data in this paper comes from the industrial enterprise database that is the product of annual surveys conducted by the National Bureau of Statistics (NBS) , and the sample interval is from 2005 to 2014. The database provides information about industrial enterprises in China. This paper screened the database as follows:

- Delete the enterprises in the mining, electricity, gas, and water production and supply industries, and keep only the manufacturing industry samples.
- Remove the observations with less than 8 employees (Brandt, Biesebroeck et al. 2011).
- Deflate all variables measured in currency, and the deflation index is taken from the 'China Economic Network Statistics Database'.
- To avoid interference abnormal value, the original data of the main process variables winsorize on 1% and 99% quantile.
- Excluding the sample of industrial enterprises in 2010, because the enterprise data in 2010 in the Chinese industrial enterprise database is incomplete (Chen 2018).

Second, the list of high-tech zones. The list of newly upgraded NHTZs is collected from the official website of the Ministry of Science and Technology of China (www.most.gov.cn), including 51 NHTZs upgraded from 2009 to 2012. The list of PHTZs that have un-upgraded comes from the 'China Development Zone Review Announcement Catalogue' (2018 edition) (www.ndrc.gov.cn), which includes 54 un-upgraded PHTZs.

Third, Identification of enterprises in the high-tech zones. Enterprise-level data in the HTZs is vital data for calculating the TFP of enterprises in this paper. To identify whether which enterprises are in the HTZs, it is necessary to match the data of

industrial enterprises with the data of the HTZs. At present, the academic community has four methods to identify enterprises in HTZs:

If the words 'high-tech zone' appears in the address of an enterprise, it is considered that the enterprise is located in the HTZs (Xiang and Lu 2015).

If the county where the enterprise is located has HTZs, the enterprise is located in an HTZ. Conversely, if the county where the enterprise is located does not have HTZs, the enterprise is not located in an HTZ (Zhang, Wang et al. 2016).

Matching the postcode of the HTZs with the postcode of the enterprise to identify the enterprises in the HTZs (Lin, Xiang et al. 2018).

Compare the regional boundary information of the HTZs and the longitude and latitude information of the enterprises. According to the corporate address information and the 'Announcement Catalogue of the Four Scopes of National Development Zones' (2018 Edition) published by the Ministry of Natural Resources, parse the corporate latitude and longitude and geographic scope (longitude and latitude information) of the HTZs. On this basis, enterprises in the HTZs are identified (Tan and Zhang 2019).

However, the first and second identification methods are too rough to accurately identify enterprises in HTZs, which may cause sample bias; The third method uses postcode to identify enterprises in the HTZs with relatively high accuracy and feasibility, but maybe mixed with a small number of enterprises that are not in the HTZs; Besides, the Chinese industrial enterprise database has a large amount of data, and the workload of the fourth identification method is tedious. Therefore, this paper uses a combination of postal code matching and latitude and longitude matching methods to identify the enterprises in HTZs. Specific steps are as follows:

The first step, this paper collects and sorts the postal codes of the HTZs and enterprises, matches the postal codes of the HTZs with the postal codes of enterprises, and initially identifies the enterprises located in the HTZs. Some HTZs have multiple districts and multiple postal codes, but an enterprise has only one postal code. Therefore, as long as the postal code of the enterprise is consistent with the postal code of a district of HTZ, the enterprise is to belong to this HTZ.

The second step, according to the 'Announcement Catalogue of the Four Scopes of National Development Zones' (2018 Edition) published by the Ministry of Natural Resources (www.mnr.gov.cn), this paper parses the boundary and latitude and longitude information of the HTZs. Then，this paper calls the forward and reverse address coding service in the Baidu Map API to convert the addresses of the enterprises in the HTZs identified in the first step into latitude and longitude coordinates. Finally, this paper matches the latitude and longitude of the HTZs and the enterprise to exclude the enterprises that are not in the HTZs.

3.2 Methodology

To evaluate the impact of the upgrading of PHTZs on the TFP of enterprises, the intuitive strategy is to compare the changes in the TFP of enterprises before the upgrade of the PHTZs and after the upgrade of the PHTZs. However, policy effect

research is different from ordinary scientific research. It has a more significant feature, that is, the experimental group and the control group may have ex-ante differences before the implementation of the policy. Only a single before-and-after comparison or a horizontal comparison will ignore the ex-ante differences, leading to biased estimates of the effect of policy implementation (Ye and Wang 2013).The DID model is based on the data obtained from natural experiments, through modeling to effectively control the ex-ante differences of research objects, effectively separate the real results of policy influences, and can better overcome the endogeneity problem in policy evaluation (Zhao, Chen et al. 2018). Therefore, the DID model is considered to be an effective method for evaluating policy effects (Delgado and Florax 2015, Jonathan and Jeremy 2016, Jiménez, Ongena et al. 2017). Since the upgrading of PHTZs has been carried out in batches since 2009 and has multiple policy impact points, this paper uses a multi-period DID method (Li, Gao et al. 2021) to analyze the policy effect. The latest year of Chinese industrial enterprise data used in this article is 2014, and the multi-period DID model requires at least two years of data before and after the implementation of the policy, so this article selects 2009-2012 for four consecutive years as the time point for policy impact.

Besides, the heterogeneity among enterprises is difficult to meet the characteristics of consistent time effect. Before using the multi-period DID model to evaluate the policy effect, this paper first uses the PSM method to find the control group enterprises similar to the treatment group enterprises to eliminate the problem of sample selection bias. Therefore, this paper combines the PSM method and the multi-period DID method to estimate the real effect of the PHTZs upgrade policy on the TFP of the enterprises, which guarantees the accuracy of the results to a greater extent. Therefore, this paper combines the PSM method and the multi-period DID method to estimate the real effect of the PHTZs upgrade policy on the TFP of the enterprises, which guarantees the accuracy of the results to a greater extent.

3.2.1 Propensity score matching

The purpose of matching is to find enterprises in the control group that have similar characteristics to those in the treatment group, so as to construct counterfactual results. The purpose of PSM is to match the control group with similar characteristics to the treatment group. This facilitates the construction of a counterfactual experiment. Specifically, during the matching process, the samples are divided into two groups. One group is the treatment group (T), which represents the enterprises in the NHTZs that have been successfully upgraded. The other group is the control group (C), which represents the enterprises in the PHTZs that have not been successfully upgraded. Let $a = \{T, C\}$, denote all the enterprises in the HTZs. Then, select enterprises with similar upgrade probability from the control group to eliminate selection bias. Suppose the probability formula for the successful upgrade of the PHTZs is:

$$P = Pr\{A = T\} = \phi\{X_{i,t-1}\} \tag{1}$$

Among them, P is the probability of successful upgrade, $\phi\{X_{i,t-1}\}$ is the normal cumulative distribution function. $X_{i,t-1}$ is the matching variable, which indicates the variable that affects the successful upgrade of the PHTZs.

3.2.2 Multi-period DID

After the PSM, we got the control group sample $A_P = \{T, C_P\}$. Among them, T represents the enterprises in the PHTZs that have successfully upgraded, C_P indicates the enterprises in the PHTZs that have not been successfully upgraded. This paper constructs upgraded dummy variables $Prom_{i,t}$, take 1 when $i \in T$, or 0 when $i \in C_P$. At the same time, define the time dummy variable $Time_t$, the value is 1 after the upgrade, and the value is 0 before the upgrade. On this basis, the following multi-period DID model can be constructed:

$$TFP_{it} = \alpha_0 + \alpha_1 did + \theta X_{it} + \tau_i + \lambda_t + \varepsilon_{it} \tag{2}$$

Among them, $TFP_{i,t}$ is the dependent variable and represents the TFP level of the i th enterprise in the i th year. did ($Prom_{i,t} \times Time_t$) is the dummy variable for the upgrading of PHZs. $x_{i,t}$ is a set of control variables. λ_t is the time fixed effect. τ_i is the individual fixed effect of each enterprise. a_1 is the core estimation parameter and represents the net effect of the upgrading of PHTZs on the productivity level of enterprises in the zones. If a_1 is a positive number, it indicates that the upgrading of PHTZs is conducive to promoting the productivity level of enterprises in the zone. Conversely, it will restrain the productivity of enterprises.

3.2.3 Variable definition

The dependent variable of this paper is the TFP. The higher the TFP of an enterprise means that the higher the production capacity of the enterprise. The greater the output under the condition of the same production input. The traditional method of estimating TFP is to use 'Solow residuals', but the samples used to calculate 'Solow residuals' are not random, which will cause 'selection bias' and 'synchronization bias' (Lin, Xiang et al. 2018). Based on the above problems, researchers proposed different improvement methods (Olley and Pakes 1996, Blundell and Bond 2000, Petrin, Poi et al. 2004):

1) Fixed effect estimation technology.
2) Olley-pakes (OP) method.
3) Levinsohn-Prtrim (LP) method.
4) GMM method.

However, the fixed effect estimation technique and the GMM method cannot effectively solve the problem of endogeneity and sample selection bias in the least square estimation. The LP method uses intermediate inputs as the instrumental

variable is not significantly better than the OP method that uses the investment amount as the proxy variable (Lu and Lian 2012). Therefore, this paper adopts the OP method to estimate the TFP of enterprises.

The relevant data indicators of the OP method are selected as follows: Total output Y is measured by gross industrial output. Labor L is measured by employees. Capital K is measured by fixed assets. Enterprise investment is measured by the perpetual inventory method, specifically:

- The depreciation rate refers to the depreciation rate of 15% used by Yu and Hu (2017) to calculate the productivity of Chinese manufacturing enterprises.
- For enterprises that appear continuously in the database, the current year's capital investment is equal to the capital investment in the current year minus the capital investment in the previous year and the corresponding 15% capital depreciation.
- For enterprises that are discontinuous or appearing for the first time in the database, the growth rate of the capital investment in the previous year refers to the annual fixed asset growth rate of the manufacturing industry in the second digit. And suppose that all the enterprises established before 2005 began to invest in 2005, and then based on the capital investment of enterprises to calculate the capital investment of the lack of capital investment of the enterprise, so as to calculate the current investment amount of the enterprises (Li and Yang 2018).

The independent explanatory variable is the interaction term $Prom_{i,t} \times Time_t$. The dummy variable for PHTZs upgrade is $Prom$, when the PHTZs are successfully upgraded, it is taken as 1, and the PHTZs that are not successfully upgraded are taken as 0. At the same, the time virtual variable $Time$ is defined, the value of the year after the upgrade is 1, and the value of the year before the upgrade is 0. The NHTZs upgraded in 2009，When $t \geq 2009$, the value is 1, and when $t \leq 2009$, the value is 0. The NHTZs upgraded in 2011, when $t \geq 2011$, the value is 1, and when $t \leq 2011$, the value is 0. The NHTZs upgraded in 2012，When $t \geq 2012$, the value is 1, and when $t \leq 2012$, the value is 0.

Since many factors are affecting the TFP of enterprises, in order to control these factors, we introduce the following control variables, enterprise profit margin (*profit*), liquidity ratio (*lip*), return on assets (*roa*), asset-liability ratio (Petrin, Poi et al. 2004), tax burden (*tax*). The specific definitions and descriptive statistics of each variable are shown in Table 1.

Table 1: Descriptive statistics of main variables

Variable		Definition	Mean	Std. Dev.	Min	Max
TFP	Total factor productivity	Calculated using OP method	5.1247	1.0237	2.6417	7.8371
Pro	'Upgrade'd ummy variable	1for successful upgrade, 0 for unsuccessful upgrade	.2299	.4208	0	1
Time	Time dummy variable	Take 1 before upgrading and 0 after upgrading	.6246	.4842	0	1
lev	Enterprise leverage ratio	Total liabilities / total assets	.5527	.2772	.0143	1.3665
profit	Enterprise profit margin	Operating profit/operating income	.0407	.08689	-.3562	.3457
roa	Return on assets	Operating profit/total assets	.1225	.2251	-.1803	1.1974
lip	Liquidity ratio	Logarithm of the ratio of liquid assets to current liabilities	2.1058	3.6201	.0945	27.7927
tax	tax burden	(income tax payable + VAT payable) / industrial sales output value	.0464	1.6668	-38.954	410.7530

4. Results

4.1 Propensity score matching

By referring to the existing literature and based on the principle of maximization, this paper selects the liquidity ratio (lip), the return on assets (roa), the debt to assets ratio (lev), and the scale of fixed assets (ppe) as matching variables. Based on the non-replaceable one-to-one nearest neighbor matching method, this paper uses the Logit model to estimate the propensity score and matches the enterprises in the control group. As the PHTZs have been upgraded from 2009 to 2012, this paper uses the year-by-year matching method(Blundell and Bond 2000, Heyman, Sjöholm et al. 2007) to find a matched control group for each year's treatment group. Figure 1 shows the density distribution of propensity scores of the experimental group and the control group before and after matching. It can be seen that the propensity scores of the experimental group and the control group are consistent after matching.

To verify the reliability of the matching results, this paper tests the balance hypothesis of PSM, and only reports the test results in 2009. It can be seen from Table 2 that the absolute value of the deviation of all matching variables after matching is less than 5%, which effectively reduces the deviation of the two groups of sample covariates, indicating that the matching variables and matching method selected in this paper are reasonable. Therefore, the matched control group meets the conditions of being a counterfactual individual of the treatment group, and an ideal sample can be screened for the multi-period DID model.

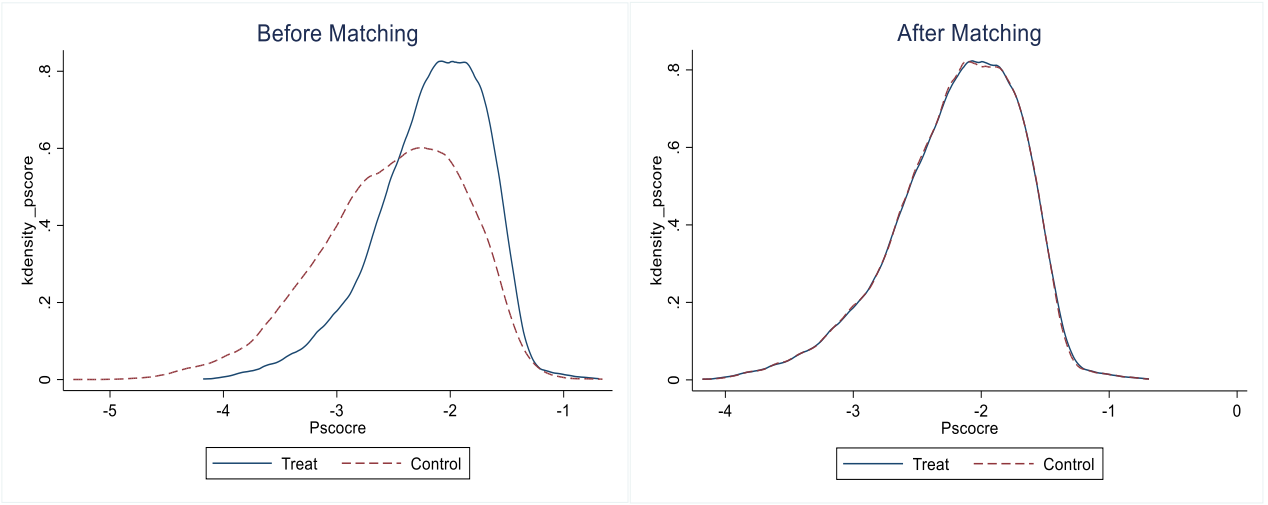

Figure 1:Propensity score kernel density map before and after matching in 2009.

Table 2: PSM balance test results in 2009

Variable	Unmatched	Mean		(%)	(%) bias reductio	t-test	
	Matched	Treate	Contro	Bias (%)		t	p>|t|
lip	U	.1491	.3245	-21.0000	95.3000	-8.3900	0.0001
	M	.1491	.1408	1.0000		0.3600	0.7170
roa	U	.1021	.1762	-29.8000	98.1000	-12.0600	0.0001
	M	.1021	.1007	0.6000		0.2300	0.8180
ppe	U	.2819	.3789	-46.1000	98.1000	-18.7900	0.0001
	M	.2819	.2837	-0.9000		-0.3100	0.7560
lev	U	.6167	.5158	37.6000	98.2000	15.7100	0.0001
	M	.6167	.6185	-0.7000		-0.2300	0.8190

4.2 The result of multi-period DID estimation

After successful mat ching, this paper estimates formula (2), and the estimated results are reported in Table 3. Model (2) adds control variables on the basis of model (1) to examine how the impact of PHTZs upgrade policies on enterprises' TPF changes with the addition of control variables. The results show that, whether control variables are added or not, the sign of the estimated coefficient of the core explanatory variable $Prom_{i,t} \times Time_t$ is significantly negative at the 1% level, indicating that the upgrading of PHTZs has a direct impact on the TFP of enterprises, but this impact is negative, that is, the upgrading of PHTZs reduces the TFP of enterprises. This result shows that the upgrading of PHTZs has a distorting effect on enterprises in HTZs. This paper argues that the upgrading of PHTZ to NHTZ has attracted a large number of enterprises, but it does not produce an agglomeration economy, and it does not give full play to the selection effect of survival of the fittest in the process of enterprise agglomeration. Therefore, the upgrading policy of PHTZs has not improved the productivity level of enterprises. Based on this, this paper conjectures that as an incomplete contract, the information asymmetry of the upgrading policy of PHTZs may lead to adverse selection and moral hazard, which will lead to distortion effects. This paper confirms this conjecture in sect ion 4.5.

Besides, we find that the return on assets (roa) and enterprise profit rate (profit) are significantly positive at the level of 1%, that is, the higher the return on assets or the higher the corporate profit rate, the higher the level of corporate productivity. These results show that the enterprises with good performance have more funds for scale expansion, increasing R&D investment, introducing new equipment, etc., which are easier to improve their productivity. The liquidity ratio (lip) is significantly positive at the level of 1%, indicating that the better the liquidity of assets, the higher the efficiency of asset utilization, and the more conducive to improving the productivity of enterprises. The coefficient of tax burden (tax) is negative and significant at the level of 1%, which is consistent with the expected result. The reduction of enterprises' tax burden stimulates enterprises to increase R&D investment and improve corporate productivity; on the contrary, the increase of tax burden restrains the improvement of enterprise productivity. Generally speaking, the higher the asset-liability ratio of an enterprise, the higher the financial risk, which is not conducive to the long-term operation and development of the enterprise, and will have a negative effect on the productivity of the enterprise. However, this paper finds that the asset-liability ratio is significantly positive at the level of 1%, which is inconsistent with the expected result. The reason is that the research object of this paper is the enterprises in the HTZs. The enterprises in the HTZs can enjoy special financial support policies before the upgrading of the HTZs, thus reducing the financial risk caused by the high asset-liability ratio.

Table 3: The result of DID estimation

Variable	TFP	
	(1)	**(2)**
did	-.0176*** (.0039)	-.0141*** (.0037)
roa		.2024*** (.0083)
lip		.0233*** (.0018）
tax		-.3159*** (.0424）
lev		.0734*** (.0068)
profit		.1287*** (.0221)
Constant term	1.666088*** (.0035）	1.5989*** (.0055）
Time fixed effect	YES	YES
Firm fixed effect	YES	YES
N	39,618	39,574
R^2	0.2683	0.3529

Note: ***, **, and * are significant at 1%, 5%, and 10%, respectively.

4.3 Heterogeneity analysis

To further investigate the relationship between the upgrading of PHTZs and TFP of enterprises, this paper introduces 'the intensity of government intervention' and 'the nature of enterprises' to conduct a heterogeneous analysis. Regarding the nature of the enterprise, this paper divides the sample into three groups: state-owned enterprises, foreign-funded enterprises, and private enterprises for group testing. The intensity of government intervention in the province where the enterprise is located is measured using the government intervention index compiled by Gang Fan (Fan, Wang et al. 2016). The larger the index, the weaker the intensity of government intervention. This paper selects the government intervention index of the year before the implementation of the policy (2008), divides the sample into a strong intervention group and a low intervention group according to the median, and conducts a group test on this basis.

Perform regression analysis based on sub-samples of different enterprise ownership properties. The results are shown in Part A of Table 4. We found that the impact of the upgrading of PHTZs on the TFP of foreign-funded enterprises and private enterprises was significantly negative at 1% and 10%, but the impact on state-owned enterprises was not significant. This shows that the upgrading of PHTZs reduces the TFP of foreign-funded enterprises, private enterprises and other enterprises. But

it has no obvious impact on the TFP of state-owned enterprises. The explanations given in this paper are as follows: (1) As a quasi-government organization, state-owned enterprises already enjoy a lot of high-quality resources and policy support. Therefore, the comparative advantage of the HTZs has a low or zero marginal effect on state-owned enterprises (Jiang 2018). (2) Compared with state-owned enterprises, most foreign-funded enterprises have technological advantages from their overseas parent companies (Dachs, Bernhard et al. 2008). They do not need to make continuous large-scale R&D investments. Also, foreign-funded enterprises usually adopt asset development strategies in their production and operation activities in China (Wu 2012), and tend to choose asset purchase methods for mergers and acquisitions. The upgrade of the PHTZs is to broaden the financing channels and increase the financial support of foreign-funded enterprises，which stimulates asset M&A activities. Due to information asymmetry, companies also have legal risks, value risks, tax risks and benefit risks in asset mergers and acquisitions, which is not conducive to the improvement of corporate productivity. (3) Private enterprises have narrow financing channels, shortage of production factors, poor anti-risk ability, and insufficient investment in technological innovation. The upgrading of PHTZs to NHTZs can broaden corporate financing channels，thereby stimulating private enterprises to increase R&D investment, and enhance their independent innovation capabilities. However, policy support cannot improve the ability of private enterprises to resist risks(Mao and Xu 2016). Thus, they are more inclined to invest in projects with a lower rate of return, leading to inefficient capital allocation and lower productivity.

Perform regression analysis based on sub-samples of different local government intervention intensity. The results are shown in Part B of Table 4. The coefficient of the key explanatory variable (did) of the higher government intervention intensity group and the lower government intervention intensity group was significantly negative at the levels of 5% and 1%, but the absolute value of the coefficient of the latter was significantly smaller than the former. This shows that, compared with the control group enterprises, the upgrading of PHTZs has significantly reduced the TFP of the enterprises in the treatment group, but this impact is more significant for the enterprises in areas with a higher degree of local government intervention. This paper argues that there are two reasons for this phenomenon: first, as an 'economic participant', the local government hopes to expand the regional economic aggregate and increase fiscal tax revenue and employment rate; Second, local governments are also 'political participants' who value political promotion and political benefits. The evaluation system of local government officials in China takes economic performance as the evaluation standard. Under this assessment method, local governments pursue their own political goals by intervening in enterprises to obtain benefits. One of the most effective is to manipulate the excessive investment of enterprises, and then internalize the goals of public utilities in the operation of enterprises. For example, the government requires enterprises to actively participate in local economic construction and invest in basic projects such as energy and

transportation. The government's guidance of enterprise investment is conducive to increasing local taxation, promoting regional GDP growth, increasing employment, and investing in emerging industries. These are the essential indicators for performance evaluation. Therefore, the stronger the local government intervention, the more companies may over-invest, causing a misallocation of internal capital, which is not conducive to the improvement of the TFP of the enterprises.

Table 4: Heterogeneity test results

	TFP				
	Group by enterprise ownership attribute			**Grouped by intensity of government intervention**	
	State-owned enterprise	**Foreign enterprises**	**Private enterprises**	**High intensity of government intervention**	**Low intensity of government intervention**
	(1)	(2)	(3)	(5)	(6)
did	-.0044 (.0219)	-.0186* (.0105)	-.0223*** (.0057)	-.0205** (.0081)	-.0111*** (.0042)
control	YES	YES	YES	YES	YES
Constant term	1.6575*** (.0242)	1.6099*** (.0154)	1.5941*** (.0085)	1.5986*** (.0095)	1.5969*** (.0067)
Time fixed	YES	YES	YES	YES	YES
Firm fixed	YES	YES	YES	YES	YES
N	4,422	7,651	18,846	9,695	29,879
R^2	0.3748	0.3856	0.3246	0.4074	0.3380

Note: * *, * *, and * are significant at 1%, 5%, and 10%, respectively.

4.4 Robustness test

4.4.1 Change the matching method

One-to-one nearest neighbor matching may be affected by random pruning(King and Nielsen 2019), so this paper uses radius matching to replace one-to-one nearest neighbor matching to re-match the propensity score, and then use the matched samples for DID estimation to test whether the benchmark results are robust. First, the balance test results of radius matching are shown in Table 5. After matching, the absolute values of the bias of the matching variables are less than 5%, which effectively reduces the bias of the two groups of sample covariates, indicating that radius matching is reasonable. Besides, the t-statistic after matching is not significant, indicating that there is no significant difference between the control group and the experimental group in the matched variable. This indicates that the

control group matched by the radius matching method meets the conditions of being a counterfactual individual of the experimental group. Second, this paper conducts DID estimation based on the radius matching results. The estimation results are shown in Table 6. Regardless of whether the control variable is added or not, the estimated coefficient sign of the core explanatory variable(did) is significantly negative at the 1% level. It shows that the upgrading of PHTZs inhibits the TFP of enterprises, which is similar to the benchmark results in Table 3, indicating that the original results are robust.

Table 5: PSM balance test results (Radius Matching)

Variable	Unmatch	Mean		Bias	(%) bias	t-test	
	Matched	Treat	Contr	(%)		t	p>|t|
lip	U	.1491	.3245	-21.0000	92.0000	-8.3900	0.000
	M	.1491	.1631	1.7000		0.6100	0.541
roa	U	.1021	.1761	-29.8000	97.5000	-12.0600	0.000
	M	.1021	.1003	0.7000		0.2900	0.772
ppe	U	.2819	.3789	-46.1000	99.8000	-18.7900	0.000
	M	.2819	.2821	-0.1000		-0.0400	0.969
lev	U	.6167	.5158	37.6000	92.9000	15.7100	0.000
	M	.6167	.6095	-2.7000		0.9000	0.368

Table 6: The result of DID estimation (Radius Matching)

	TFP	
	(1)	(2)
did	-.0223*** (.0032)	-.0161*** (.0030)
Constant term	1.6699*** (.0028)	1.5874*** (.0043)
control variable	NO	YES
Time fixed effect	YES	YES
Firm fixed effect	YES	YES
N	61,258	59,166
R^2	0.2500	0.3321

Note:***, **, and * are significant at 1%, 5%, and 10%, respectively.

4.4.2 Change the policy evaluation method

The benchmark model of this paper is a multi-period DID model, in order to verify the robustness of its results, this paper will conduct single-point DID tests on HTZs enterprises upgraded in different years in 2009, 2011, and 2012. As shown in Table 7, the *did* coefficients are all significantly negative, indicating that no matter in which year the HTZs are upgraded, it has significantly inhibited the increase in the TFP of enterprises in the zones, so the benchmark results are robust.

Table 7: Single-point DID test results

TFP			
	2009	**2011**	**2012**
did	-.0179*** (.0056)	-.0213** (.0089)	-.0383*** (.0056)
Constant term	1.6408*** (.0063)	1.6378*** (.0068)	1.5792*** (.0064)
control variable	YES	YES	YES
Time fixed effect	YES	YES	YES
Firm fixed effect	YES	YES	YES
N	25,279	18,207	24,997
R^2	0.4338	0.4427	0.3323

Note: ***, **, and * are significant at 1%, 5%, and 10%, respectively.

4.4.3 Placebo testing

This paper further uses counterfactual methods and artificially sets a time point for the upgrading of PHTZs to test the impact of the upgrading on the productivity of enterprises. Specifically, this paper selects the time (2006-2008) before the implementation of the upgrading policy as the research interval, and takes 2007 as the time point of policy impact for the counterfactual test. If $treat \times year07$ does not pass the significance test, it shows that the decline of enterprise productivity in HTZs is caused by the upgrading of PHTZs. The test results (Table 8) show that the $treat \times year07$ term is no longer significant under different artificial time, which indicates that the previous results are robust.

Table 8: Placebo test results

TFP		
	(1)	**(2)**
$treat \times year07$	-.0014 (.0037)	-.0035 (.0036)
Constant term	1.6062 (.0016)	1.5442 (.0086)
control variable	NO	YES
Time fixed effect	YES	YES
Firm fixed effect	YES	YES
N	15,164	15,163
R^2	0.0789	0.1611

Note: ***, **, and * are significant at 1%, 5%, and 10%, respectively.

4.5 Mechanism analysis

The main finding of this paper is that the upgrading of PHTZs reduces the TFP of enterprises in the HTZs. At the same time, this paper uses different methods to prove the robustness of this result. The next question is why the upgrading of PHTZs reduces the TFP of enterprises, and what is the mechanism? The in-depth exploration of this issue will help us deepen our understanding of the relationship between regional industrial policies and enterprise productivity, taking the PHTZs upgrade policy as an example. According to the previous analysis that as an incomplete contract, the information asymmetry of the upgrading policy of PHTZs may lead to adverse selection and moral hazard, which will lead to distortion effects. Therefore, by constructing a mediating effect model (Li and Wu 2018), this part focuses on analyzing whether the adverse selection and moral hazard are truly the mechanisms for the upgrading of PHTZs to affect the TFP of enterprises.

The main steps to construct the mediating effect model are as follows: The first step is to regress the explained variable to the explanatory variable. The second step is to regress the mediators to the explanatory variables. The third step is to regress the explained variables to the mediating variables and the explanatory variables at the same time. Therefore, based on the previous summary of benchmark regression, this paper constructs the following mediating effect model：

$$M_{it} = \beta_0 + \beta_1 did + \theta X_{it} + \tau_i + \lambda_t + \varepsilon_{it} \tag{3}$$

$$TPF_{it} = \gamma_0 + \gamma_1 did + \theta X_{it} + \gamma_2 M_{it} + \tau_i + \lambda_t + \varepsilon_{it} \tag{4}$$

Among them, M_{it} is the proxy variable of the mediating effect. The basis for determining whether there is an intermediary effect is:

- The coefficient α_1 in formula (2) is significant.
- The coefficient β_1 in formula (3) is significant.
- The coefficient γ_2 in formula (4) is significant.

If the above three conditions are met at the same time, the mediating effect is significant. If the above three conditions are met at the same time, γ_1 is not significant in formula (4), it is a complete mediation effect. The relevant test results are shown in Table 9. Under the problem of adverse selection, the governments of the HTZs are at an information disadvantage and cannot effectively identify the real situation of the enterprises that have settled in it. This may attract some low-quality enterprises, thereby lowering the productivity of the overall enterprises in the HTZs. This paper uses the ‘proportion of low-efficiency enterprises among new entrants each year (role)’ as a proxy variable to explain whether the adverse selection problem exists. As shown in column (1) of Table 9, the coefficient of *did* is significantly positive, indicating that after the PHTZs are upgraded, the ratio of low-efficiency enterprises among newly entered enterprises has increased significantly. However, the estimated coefficient of ln_role in column (2) is significantly negative, which means that the increase in the ratio of low-efficiency enterprises inhibits the

TFP of enterprises, which indicates that the upgrading of PHTZs has caused low-quality enterprises to gather in HTZs, thereby lowering the productivity of enterprises in the HTZs. It can be seen that because the government is limited by the high cost of information and cannot effectively distinguish the true status of the enterprises that have settled in. Therefore, in the case of prior information asymmetry, the upgrading of PHTZs does bring about adverse selection problems, and adverse selection is precisely an important factor that inhibits the improvement of enterprise productivity in HTZs.

Adverse selection refers to the unfavorable choice made by one party due to the disadvantage of information, which is caused by the ex-ante information asymmetry (Qi and Rao 2021). Under the problem of adverse selection, the governments of the HTZs are at an information disadvantage and cannot effectively identify the real situation of the enterprises that have settled in it. This may attract some low-quality enterprises, thereby lowering the productivity of the overall enterprises in the HTZs. This paper uses the 'proportion of low-efficiency enterprises among new entrants each year (role)' as a proxy variable to explain whether the adverse selection problem exists. As shown in column (1) of Table 9, the coefficient of *did* is significantly positive, indicating that after the PHTZs are upgraded, the ratio of low-efficiency enterprises among newly entered enterprises has increased significantly. However, the estimated coefficient of ln_role in column (2) is significantly negative, which means that the increase in the ratio of low-efficiency enterprises inhibits the TFP of enterprises, which indicates that the upgrading of PHTZs has caused low-quality enterprises to gather in HTZs, thereby lowering the productivity of enterprises in the HTZs. It can be seen that because the government is limited by the high cost of information and cannot effectively distinguish the true status of the enterprises that have settled in. Therefore, in the case of prior information asymmetry, the upgrading of PHTZs does bring about adverse selection problems, and adverse selection is precisely an important factor that inhibits the improvement of enterprise productivity in HTZs.

Moral hazard is caused by the ex-post information asymmetry. After the party with the information disadvantage (the government of the HTZs) makes a decision, the other party (the enterprise) has taken unpredictable behavior, which brings adverse consequences to the party with the information disadvantage. Under the problem of moral hazard, after the upgrading of PHTZs, enterprises in NHTZs can enjoy a large number of preferential policies, such as tax incentives, financial subsidies, financial support and so on. These policies are easy to breed rent-seeking behavior, crowd out enterprise innovation investment, thus resulting in the decline of TFP of enterprises. However, there is no unified standard for the measurement of rent-seeking cost. Wang and Chen (2010) thought that it might exist in the management and sales expenses of enterprises. Therefore, this paper uses Wang and Chen (2010)'s method to measure the rent-seeking cost of enterprises, and uses the ratio that the sum of management expenses and sales expenses to the sales revenue to measure the rent-seeking cost of the enterprise. It can be seen from column (3) of Table 9 that the *did* coefficient is significantly positive, that is, the upgrading of

the PHTZs has significantly increased the rent-seeking cost of the enterprises. The estimated coefficient of ln_rsc in column (4) is significantly negative, indicating that the increase in rent-seeking costs reduces the TFP of enterprises. The explanation of this paper is: in order to improve the employment rate, the governments may require enterprises to employ more employees to undertake more social responsibilities. From the perspective of enterprises, on the one hand, rent-seeking enterprises employ more labor, pay more labor remuneration and taxes, which increases the marginal cost of enterprises; On the other hand, the executives of rent-seeking enterprises pursue other goals that are harmful to the interests of the enterprises, grab rent from the enterprise and increase the burden of the enterprises. When the marginal cost of rent-seeking is higher than the marginal income, the productivity will decrease. Besides, if entrepreneurs find that rent-seeking activities can bring more resources and benefits than technological innovation, enterprises will cater to government policies for rent-seeking and resist innovation. This leads to a decline in the TFP of enterprises, which is contrary to the original intention of the HTZ government. At this time, when the HTZ governments are in an information disadvantage, leading to moral hazard issues caused by the ex-post information asymmetry afterward.

Table 9: Regression results of mediating effect model

	(1) **ln_role**	(2) **ln_TFP**	(3) **ln_rsc**	(4) **ln_TFP**
did	.0044*** (.0023)	-.0208*** （.0036）	.0629*** （.0218）	-.0112*** （.0035）
ln_role		-.25693*** （.0159）		
ln_rsc				-.0446*** （.0015）
control variable	YES	YES	YES	YES
Time fixed effect	YES	YES	YES	YES
Firm fixed effect	YES	YES	YES	YES
N	33,035	33,035	39,574	39,574
R^2	0.4654	0.4323	0.0596	0.4018

Note: ***, **, and * are significant at 1%, 5%, and 10%, respectively.

5. Discussion

The new finding in this research is that the upgrading of PHTZs has no significant impact on the improvement of the TFP of enterprises in the zones, which denies the effectiveness of the upgrading policy of PHTZs at the micro-level. This is different from the previous studies on the policy effects of HTZs (Lin, Xiang et al. 2018, Lu, Chen et al. 2020, Wang and Shen 2020). Previous studies mainly focused on the

effects of tax policy, land policy, financial policy and export policy of HTZs at the same administrative level, and their conclusions showed the positive effects of the policy effects of HTZs. Regarding this difference, this paper believes that the previous literature is a mixture of newly upgraded NHTZs and early-established NHTZs for policy effect evaluation. However, this paper takes 'upgrading of PHTZs' as the breakthrough point, distinguishes the newly upgraded NHTZs from the PHTZs established earlier, and only takes the newly upgraded NHTZs as the research object to explore the micro policy effect of upgrading, so it brings about the difference of research results.

This paper takes the upgrading policy of PHTZs as an incomplete contract to explore whether the incompleteness of the contract distorts the micro effect of the upgrading policy of PHTZs. The information asymmetry of incomplete contracts brings about adverse selection and moral hazard, which leads to the reduction of the productivity of enterprises in HTZs. However, for the explanation of the distorting effect of HTZ policies on enterprise productivity, the previous literature has been attributed to the entry of rent-seeking enterprises (Zhang, Liu et al. 2020) or the destruction of the selection mechanism of the survival of the fittest in the HTZs (Wang and Shen 2020). No scholars explain it from the perspective of the incompleteness of the contract. The specific explanations of this paper are as follows:

First, the information asymmetry in the process of policy implementation causes adverse selection problems. As significant participants in the market economy, HTZ governments and enterprises have different levels of mastery of market information, leading to the adverse selection problem. On the one hand, the government is limited by the high cost of information. It is difficult to grasp the complete information chain, so it is unable to effectively screen the quality of the settled enterprises. On the other hand, as the direct targets of preferential policies, enterprises benefit from the advantages of obtaining market information resources and may deliberately conceal their real conditions. As a result, the HTZ government, as a party at an information disadvantage, may accept a large number of low-quality enterprises and inert companies to settle in (Bondonio and Engberg 2000). It lowers the average TFP of enterprises in the HTZs. At the same time, low-quality and inert enterprises are in a state of isolation and isolation, and their degree of agglomeration and sharing is insufficient, which causes repeated construction and waste of resources and a decline in the level of enterprise productivity.

Second, in the case of information asymmetry, moral hazard is also a significant factor that affects the implementation effect of the upgrading policy of PHTZs. The newly upgraded NHTZs can enjoy a variety of preferential policies, such as tax incentives, financial subsidies and financial support, which can easily breed the rent-seeking behavior of enterprises in the zones. Generally speaking, the greater the policy support, the stronger the enterprise rent-seeking motivation. However, rent-seeking needs cost, which mainly refers to the non-productive expenditure of enterprises(Bhagwati 1982). Brou and Ruta (2013) believed that the increase of non-productive expenditure will produce a crowding-out effect and substitution

effect. If entrepreneurs find that rent-seeking activities can bring more considerable resources and benefits compared with the technological innovation of the enterprise, they will cater to government policies for rent-seeking and resist innovation. At this time, enterprises invest more resources in rent-seeking activities to replace innovation inputs, thereby reducing the level of TFP. However, the original intention of the HTZ governments is to improve the independent innovation capabilities of enterprises, and develop the HTZs into an important base for technological innovation and industrialization. The rent-seeking behavior of enterprises deviates from the original intention of the HTZ governments, resulting in moral hazard issues.

This study is based on adverse selection and moral hazard under incomplete contract to explain the distortion effect of upgrading policy. On the surface, it is quite different from the analysis of distortion effect in other literature. In fact, the two are interlinked in the mechanism. Specifically, under the problem of adverse selection, the government cannot effectively identify the quality of the enterprises settled in, thereby attracting some low-efficiency enterprises to settle. To a certain extent, it will destroy the survival of the fittest mechanism in the HTZs, which is not conducive to the improvement of enterprise productivity in the HTZs. Under the problem of moral hazard, enterprises will cater to government policies for rent-seeking and resist innovation. At this time, enterprises will put more resources into rent-seeking activities to replace innovation investment, resulting in the decline of TFP. Therefore, this paper replaces the previous literature's explanation of the distorting effect of industry-oriented policies into a new theoretical framework.

6. Conclusions

This paper is the first work containing such analysis, which allows filling the existing research gap, especially the empirical and contextual ones. Based on the data of enterprises in the HTZs from 2005 to 2014, this paper constructs a quasi-natural experiment to evaluate the upgrading policy of the PHTZs, and empirically studies its impact on the TFP of enterprises in the zones. The basic conclusions are as follows: first, the upgrading of PHTZs has a significant inhibitory effect on the TFP of enterprises in the experimental group, that is, the upgrading of PHTZs significantly reduces the TFP of enterprises in the zones. Second, the impact of the upgrading of PHTZs on TFP is heterogeneous. On the one hand, compared with state-owned enterprises, upgrading has a more obvious inhibitory effect on non-state-owned enterprises; On the other hand, the higher the intensity of local government intervention in the area where the enterprise is located, the greater the negative effect of upgrading on the TFP of enterprises. Third, the upgrading of PHTZs inhibits the increase in TFP of enterprises in HTZs is caused by adverse selection and moral hazard under asymmetric information.

This paper only studies the upgrade effects of HTZs, and does not study the upgrade effects of other types of Development Zones, such as the impact of the upgrading of Economic and Technological Development Zones on enterprise productivity.

Therefore, the research results are not universal. Besides, this paper only analyzes the impact of the upgrading of HTZS on the enterprises in the HTZs, but does not analyze whether there is a spillover effect on the surrounding enterprises in the HTZs. The micro-individuals studied are too single. Therefore, I hope this paper can stimulate readers' research interest in this field and analyze the effectiveness of Development Zones upgrading policies through more empirical research.

References

[1] Alder, S., Shao, L. and Zilibotti, F. (2016) Economic reforms and industrial policy in a panel of Chinese cities. Journal of Economic Growth 21(4), 305-349.

[2] Arimoto, Y., Nakajima, K. and Okazaki, T. (2014). Sources of productivity improvement in industrial clusters: The case of the prewar Japanese silk-reeling industry. Regional Science and Urban Economics 46, 27-41.

[3] Bai, X., Yan, W. and Chiu, Y. (2015). Performance evaluation of China's Hi-tech zones in the post financial crisis era — Analysis based on the dynamic network SBM model. China Economic Review 34, 122-134.

[4] Baldwin, R.E. and Okubo, T. (2014). Tax Competition with Heterogeneous Firms. Spatial Economic Analysis 9(3), 309-326.

[5] Bhagwati, J.N. (1982). Directly Unproductive, Profit-Seeking (DUP) Activities. Jagdish N. Bhagwati 90(5).

[6] Blundell, R. and Bond, S. (2000). GMM Estimation with persistent panel data: an application to production functions. Econometric Reviews 19(3), 321-340.

[7] Bondonio, D. and Engberg, J. (2000). Enterprise zones and local employment: evidence from the statesâ programs. Regional and Urban Economics 30(5), 519-549.

[8] Brandt, L., Biesebroeck, J.V. and Zhang, Y. (2011). Creative accounting or creative destruction? Firm-level productivity growth in Chinese manufacturing. Journal of Development Economics 97(2), 339-351.

[9] Brou, D. and Ruta, M. (2013). Rent-Seeking, Market Structure, and Growth. The Scandinavian Journal of Economics 115(3), 878-901.

[10] Busso, M., Gregory, J. and Kline, P. (2013). Assessing the Incidence and Efficiency of a Prominent Place Based Policy. American Economic Review 103(2), 897-947.

[11] Cao, Q. (2020). Driving Effects of National New Zone on Regional Economic Growth-Evidence from 70 Cities of China. China Industrial Economics (07), 43-60.

[12] Chai, Z. and Kong, L. (2020). Does the Enterprises of Development Zones Have Productivity Advantages? Based on a Quasi-experiment of the Upgrading Policy of Development Zones. Business Management Journal 42(10), 59-76.

[13] Chen, L. (2018). Re-exploring the Usage of China’s Industrial Enterprise Database. Economic Review (06), 140-153.

[14] Chen, X. and Liu, Z. (2014) Observation Development Levelover of Science Parks in China: Perspective of Innovation Ecosytem. China Soft Science (11), 151-161.
[15] Clark, J.J. (2014). Siting 'Scientific Spaces' in the US: The Push and Pull of Regional Development Strategies and National Innovation Policies. Environment and Planning C: Government and Policy 32(5), 880-895.
[16] Dachs, B., Ebersberger, B. and Lööf, H. (2008).The innovative performance of foreign-owned enterprises in small open economies. Journal of Technology Transfer 33(4).
[17] Delgado, M.S. and Florax, R.J.G.M. (2015). Difference-in-differences techniques for spatial data: Local autocorrelation and spatial interaction. Economics Letters 137, 123-126.
[18] Deng, H., Yu, Y. and Zhao, J. (2019). Are Place-Based Policies Effective? Evidence from China's Development Zones. Journal of Finance and Economics 45(01), 4-18.
[19] Etzkowitz, H., José Manoel Carvalho de Mello and Almeida, M. (2005). Towards "meta-innovation" in Brazil: The evolution of the incubator and the emergence of a triple helix. Research Policy 34(4), 411-424.
[20] Fan, G., Wang, X. and Yu, J. (2016). China's marketization index report by province. Social Science Literature Press.
[21] Feng, B. and Li, Y. (2013). Research on China's High-tech Zone Industical Policies and the Effect of Institutional Changes:Based on Sceran Analysis of Bayesian Network Method Industrial Economic Review 4(03), 5-15.
[22] Gao, G. (2011). Research on the Regional Distribution and Development Thinking of the Upgrade of Provincial Development Zones in my country. Gansu Social Sciences (06), 36-40.
[23] Greenstone, M., Hornbeck, R. and Moretti, E. (2010). Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings. Michael Greenstone;Richard Hornbeck;Enrico Moretti 118(3), 536-598.
[24] Guo, X. and Shen, T. (2020). R&D Investment, Technology Accumulation and High-tech Enterprise Market Performance. Studies in Science of Science 38(09), 1630-1637.
[25] Hanson, A. and Rohlin, S. (2013). Do spatially targeted redevelopment programs spillover? Regional Science and Urban Economics 43(1), 86-100.
[26] Hekkert, M.P., Suurs, R.A.A., Negro, S.O., Kuhlmann, S. and Smits, R.E.H.M. (2006). Functions of innovation systems: A new approach for analysing technological change. Technological Forecasting & Social Change 74(4), 413-432.
[27] Heyman, F., Sjöholm, F. and Tingvall, P.G. (2007). Is there really a foreign ownership wage premium? Evidence from matched employer–employee data. Journal of International Economics 73(2), 355-376.
[28] Hou, F. and Yang, R. (2019). A Review of Research on the Effectiveness of Industrial Policy. Economic Perspectives (10), 101-116.

[29] Jiang, B. (2018). Does enterprises improve the innovation performance by entering high-tech zone?: an empirical research based on propensity score matching method Science and Technology Management Research 38(13), 138-146.
[30] Jiang, C. and Xu, K. (2009). Empirical Research on Location Conditions, Central Policy and High-tech Zone Performance. The Journal of World Economy (05), 56-64.
[31] Jiménez, G., Ongena, S., Peydró, J.L. and Saurina, J. (2017). Macroprudential Policy, Countercyclical Bank Capital Buffers, and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments. Gabriel Jiménez;Steven Ongena;José-Luis Peydró;Jesús Saurina 125(6), 2126-2177.
[32] Jin, T. and Yuan, J. (2011). A Government-Enterprise Exchange Model and Its Evolutionary Laws:A Micro Perspective for Examining the Underlying Mechanism of Corruption. Social Sciences in China (01), 102-118+222.
[33] Jonathan, M. and Jeremy, W. (2016). Effects of the Minimum Wage on Employment Dynamics. Journal of Human Resources 51(2), 500-522.
[34] King, G. and Nielsen, R. (2019). Why Propensity Scores Should Not Be Used for Matching. Political Analysis 27(4), 435-454.
[35] Kline, P. and Moretti, E. (2014). People, Places, and Public Policy: Some Simple Welfare Economics of Local Economic Development Programs. Annual Review of Economics 6, 629-662.
[36] Lamperti, F., Mavilia, R. and Castellini, S. (2017). The role of Science Parks: a puzzle of growth, innovation and R&D investments. The Journal of Technology Transfer 42(1), 158-183.
[37] Li, B. and Yang, X. (2018).Trade facilitation and firm productivity: perspective from industrial agglomeration. The Journal of World Economy 41(03), 54-79.
[38] Li, F. and Wu, L. (2018). Development zone and firms' growth: research on heterogeneity and mechanism. China Industrial Economics (04), 79-97.
[39] Li, L., Gao, H. and Chen, J. (2015). Signaling Games for High-tech Enterprises Bank Lending. Economic Research Journal 50(06), 162-174.
[40] Li, L. and Shen, G. (2015). Special Economic Zones, Comparative Advantage, and Industrial Structural Transformation. China Economic Quarterly 14(03), 885-910.
[41] Li, Q., Dong, W. and Liu, B. (2020). Does the Establishment of the Economic Functional Zone Increase the Domestic Value-added Rate of Corporate Exports? World Economy Studies (12), 31-47+132-133.
[42] Li, Y., Gao, D. and Wei, P. (2021). Dose the Central Environmental Inspection induce green innovation in firms? Studies in Science of Science, 1-16.
[43] Lin, Y., Xiang, W. and YU, M. (2018). Place-based industrial and firm productivity. China Economic Quarterly 17(02), 781-800.
[44] Liu, H. (2011). Thoughts on the development and management of provincial high-tech zones after upgrading to national high-tech zones. Science & Technology Industry Parks (03), 18-22.

[45] Liu, R. and Zhao, R. (2015). Does the national high-tech zone promote regional economic development? Management World (08), 30-38.
[46] Lu, X., Chen, D., Kuang, B., Zhang, C. and Cheng, C. (2020). Is high-tech zone a policy trap or a growth drive? Insights from the perspective of urban land use efficiency. Land Use Policy 95.
[47] Lu, X. and Lian, Y. (2012). Estimation of total factor productivity of industrial enterprises in China:1999-2007. China Economic Quarterly 11(02), 541-559.
[48] Mao, Q. and Xu, J. (2016). Government subsidies, heterogeneity and enterprise risk-taking. China Economic Quarterly 15(04), 1533-1562.
[49] Melitz, M.J. and Polanec, S. (2015). Dynamic Olley - Pakes productivity decomposition with entry and exit. The RAND Journal of Economics 46(2), 362-375.
[50] Melo, P.C., Graham, D.J. and Noland, R.B. (2008). A meta-analysis of estimates of urban agglomeration economies. Regional Science and Urban Economics 39(3).
[51] Neumark, D. and Kolko, J. (2010). Do enterprise zones create jobs? Evidence from California's enterprise zone program. Journal of Urban Economics 68(1), 1-19.
[52] Olley, S. and Pakes, A. (1996).The Dynamics of Productivity in the Telecommunications Equipment Industry. Econometrica 64(6), 1263-1297.
[53] Petrin, A., Poi, B.P. and Levinsohn, J. (2004). Production Function Estimation in Stata using Inputs to Control for Unobservables. The Stata Journal 4(2), 113-123.
[54] Qi, Y. and Rao, G. (2021). Institutional Risk Preference and Asymmetric Role of Institutional Distance: An Examination on the OFDI of China. Discrete Dynamics in Nature and Society 2021, 3506404.
[55] Shao, S., Zhang, K. and Dou, J. (2019). Effects of Economic Agglomeration on Energy Saving and Emission Reduction: Theory and Empirical Evidence from China. Management World 35(01), 36-60+226.
[56] Shen, H., Gu, N. and Chen, L. (2017). Development Zones, Industrial Policies and Firm Exporting: From the Perspective of Dual Margins of Export Growth and Regional Disparity. Finance and Trade Research 28(12), 1-14.
[57] Sun, Z., Wu, J. and Gong, H. (2020) .The Consumption-Driven Effect of Place-based Industrial Policy: An Empirical Study Based on Development Zone Policy. Social Sciences in China 41(04), 44-62.
[58] Tan, J. and Zhang, J. (2019). Special economic zones and firm productivity-empirical evidence from Chinese listed companies. Economic Perspectives (01), 43-59.
[59] Wang, H. and Chen, X. (2010). Governance environment, rent-seeking and transaction cost: Evidence from the non-productive expenditures of Chinese firms. China Economic Quarterly 9(02), 553-570.
[60] Wang, Q., She, S. and Zeng, J. (2020a). The mechanism and effect identification of the impact of National High-tech Zones on urban green

innovation: based on a DID test. China Population, Resources and Environment 30(02), 129-137.
[61] Wang, Y., Pan, J.F., Pei, R.M., Yi, B.W. and Yang, G.L. (2020b) Assessing the technological innovation efficiency of China's high-tech industries with a two-stage network DEA approach. Socio-Economic Planning Sciences 71.
[62] Wang, Y. and Shen, T. (2020). Special Economic Zone Policy and Enterprise Production Efficiency Theoretical Analysis and Empirical Test. Academic Forum 43(04), 1630-1637.
[63] Wang, Y. and Zhang, G. (2016). Sources of Productivity Advantages of Special Economic Zones: Agglomeration Effect or Selection Effect? Economic Research Journal 51(07), 58-71.
[64] Wonglimpiyarat, J. (2016). Exploring strategic venture capital financing with Silicon Valley style. Technological Forecasting & Social Change 102, 80-89.
[65] Wu, Y. (2006). Incentive Effect, Information Alienation and Institutional Arrangement under Dual Structure-An Economic Investigation of Public Participation System in Environmental Impact Assessment. Research of Institutional Economics (01), 86-120.
[66] Wu, Y. (2012). Which type of ownership enterprises in China are the most innovative? The Journal of World Economy 35(06), 3-25+28-29+26-27.
[67] Xiang, K. and Lu, M. (2015). Speed versus quality: why regional dispersion tendency of development zone policy is not sustainable? Journal of Finance and Economics 41(04), 4-17.
[68] Xiao, J. and Xiong, J. (2018). Research On Fiscal Policy Efficiency In The Process of Innovation Resource Allocation——Empirical Analysis Based On Data of High-Tech Zone and New Area. The Theory and Practice of Finance and Economics 39(03), 105-111.
[69] Xie, K., Song, Y., Zhang, W., Hao, J., Liu, Z. and Chen, Y. (2018). Technological entrepreneurship in science parks: A case study of Wuhan Donghu High-Tech Zone. Technological Forecasting & Social Change 135, 156-168.
[70] Xiong, B. and Jin, L. (2019). Can national high-tech industrial development zones in China improve the urban innovation capability. Science & Technology Progress and Policy 36(04), 40-49.
[71] Xu, W., Wu, C., Zhao, Y. and Niu, R. (2019). Evaluation on innovation efficiency of high-tech zones in 6 major urban agglomerations in China-dased on DEA model and Malmquist index analysis. Science & Technology for Development 15(09), 1004-1011.
[72] Yang, G. and Rui, M. (2020).The Incentive Effect and Catering Effect of Tax-reducing Policy for High-tech Enterprises. Economic Research Journal 55(09), 174-191.
[73] Yang, R. and Hou, F. (2019). The Efficient Boundary of Industrial Policy: An Incomplete Contract Perspective. Management World 35(10), 82-94+219-220.
[74] Ye, D. and Lin, F. (2014). Study on the Synergy Mechanisms of Network Resourcein the Context Oftransformation and Upgrade of Industrial Cluster

Network. Journal of Central University of Finance & Economics (11), 101-107.
[75] Ye, F. and Wang, Y. (2013). Introduction and Application of Difference in Difference Model. Chinese Journal of Health Statistics 30(01), 131-134.
[76] Yu, M. and Hu, D. (2017). The impact of national development zones on enterprise productivity: empirical evidence from Chinese enterprises. Area Studies and Global Development 1(01), 100-117+158-159.
[77] Yuan, H. and Zhu, C. (2018). Do National High-Tech Zones Promote the Transformation and Upgrading of China's Industrial Structure. China Industrial Economics (08), 60-77.
[78] Yuan, Q., Liu, B. and Zhu, X. (2015). Research on "productivity effect" of economic function zone. The Journal of World Economy 38(05), 81-104.
[79] Zhang, G., Wang, Y. and Li, K. (2016). Special economic development zones and firm dynamic growth: research based on firm entry,exit and growth. Journal of Finance and Economics 42(12), 49-60.
[80] Zhang, X., Liu, J. and Peng, F. (2020). How does special economic zone competition affect export product quality: evidence from Chinese industrial enterprises. Industrial Economics Research (05), 14-29.
[81] Zhang, X. and Liu, T. (2019.) Development Zone Upgrading and Resource Allocation: Substitution Effect or Demonstration Effect. Modern Economic Research (06), 95-105.
[82] Zhao, C., Wang, Z., Yang, D. and Cao, W. (2015). Research on the Catering Behavior of Enterprise and Government Subsity Performance Based on the Analysis of the Enterpeise's Profitability. China Industrial Economics (07), 130-145.
[83] Zhao, S., Chen, R. and Jiang, Z. (2018). Empirical Analysis of the Low-Carbon Pilot Policies' Impact on Agricultural Carbon Emissions Based on DID Model. Ecological Economy 34(12), 22-28.
[84] Zheng, Z., Yeerken, W., Ling, Y., Zhang, R. and Liu, W. (2019). The Impact of Economic and Technological Development Zone on China's Economic Pattern. Economic Geography 39(06), 26-35.
[85] Zhou, C. and Ge, X. (2020). High-tech zones and regional green growth based on PSM-DID model. Science & Technology Progress and Policy 37(03), 43-51.
[86] Zhuang, L. and Ye, C. (2020). Changing imbalance: Spatial production of national high-tech industrial development zones in China (1988-2018). Land Use Policy 94.