

Research on the Productivity Effect of Inter-Regional Industry Transfer

—Taking Guangdong Province as an Example

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Abstract

This paper empirically tests the influence of the inter-regional industrial transfer policy which was promoted by local government in Guangdong Province in 2005 on total factor productivity by using the double-difference and triple-difference models, based on the panel data of 120 counties in 21 prefecture-level cities in Guangdong Province from 2001 to 2016. The study found that the inter-regional industrial transfer policy of Guangdong Province has increased the total factor productivity of the area with industry transferring out, but has a negative impact on the TFP of the land with industry transferring in, and there are differences in the effects of total factor productivity in the four regions: the periphery of the Pearl River Delta, Eastern Guangdong, Western Guangdong, and Northern Guangdong. And the industrial transfer has the greatest negative effect on the eastern Guangdong region, and the least negative effect on the western Guangdong, which has a positive impact on the TFP in northern Guangdong. Through further analysis of single factor productivity, the study found that the decline in total factor productivity of the industry is mainly caused by the decline in capital productivity. The experience of inter-regional industrial transfer in Guangdong Province has implications for China's ascendant inter-regional industrial transfer. How to encourage the government to play a more active guiding role in promoting industrial transfer, promote the increase of total factor productivity and achieve sustainable and stable economic development, is a question worthy of further discussion.

Keywords

Inter-Regional Industrial Transfer, Total Factor Productivity, Industrial Transfer Area, Industrial Undertaking Area

1. Introduction

Guangdong Province is the vanguard of China's reform and opening-up. While the economy has developed at a high speed, it has also created a serious imbalance in regional economic development. In March 2005, the Guangdong Provincial Government officially established a regional industrial development policy in which local governments jointly promoted the orderly transfer of industries. The main measures are to transfer the labor-intensive industries and other resource-based industries which have lost their competitive advantages from the Pearl River Delta region to the less developed regions through local government jointly building industrial transfer parks, to achieve reciprocal advantages, improving resource allocation efficiency and promoting productivity growth, and narrowing the regional economic development gap.

Industrial transfer policies are widely used in economic development at home and abroad. However, different scholars have different views about the effects of regional industrial transfer policies, and have not reached consistent conclusions. In addition, total factor productivity can reflect the quality and efficiency of regional economic growth, and research about the impact of inter-regional industrial transfer on TFP is still rare. From the perspective of enterprise agglomeration formed by industrial transfer, Moretti [1], Greenstone *et al.* [2], Glenn and Ellison [3], Combes, Duranton, and Gobillon [4] think that the transfer of enterprises makes them approaching, which will result in the benefits of human capital agglomeration and external economy, generating productivity spillover effects and promoting economic development. However, some scholars put forward different views. They believe that regional industrial policies are not conducive to productivity improvement and have a negative effect on economic development. Baldwin and Okubo [5] think the industrial subsidy policies attract more enterprises with low productivity to migrate to underdeveloped regions, which does not drive the productivity in the industrial undertaking, but enlarge the productivity gap between the center and the peripheral area. Bondonio and Greenbaum [6], Boldrin and Canova [7], Dallerba and Gallo [8], Martin *et al.* [9], Bernini and Pellegrini [10], Toshihiro Okubo and Eiichi Tomiura [11] suggest that regional industrial policies have not promoted productivity gains in the implementation of policy areas with researches on the empirical level of the US Economic Development Zone, the EU regional industrial policy, the French industrial cluster policy, the Italian industrial subsidy policy, and the Japanese manufacturing enterprise migration policy respectively.

However, Siqi Zheng [12] makes an empirical analysis of 110 industrial parks in eight major cities in China, which shows that the effect of industrial transfer on total factor productivity is heterogeneous: The industrial park established between 1998 and 2007. Among them, 70% of industrial parks have a positive TFP effect, while the remaining 30% have a negative or insignificant TFP effect. Zhang Xiusheng [13] suggests that China's regional industrial transfer did not promote the overall level of regional TFP in the past decade. There is a signifi-

cant positive impact on the industrial transfer area, and a significant negative impact on the industrial undertaking.

In 2005, Guangdong Province began to adopt local government cooperation to build industrial parks to promote inter-regional industrial transfer, which can really improve total factor productivity and promote regional economic development? The research results of this paper show that the local government cooperation in promoting the industrial transfer policy implemented in Guangdong Province in 2005 has the opposite effect on the industrial transfer and industry undertaking, and improves the total factor productivity of the industrial transfer land, while decreases the TFP in the industry undertaking. The degree of influence on the total factor productivity of the periphery of the Pearl River Delta, the eastern Guangdong, the western Guangdong, and the northern Guangdong is different. Industrial transfer has the greatest negative effect on the eastern part of Guangdong, followed by the outer periphery of the Pearl River Delta and the least negative effect on western Guangdong. And the total factor productivity of northern Guangdong increases. In addition, further research in this paper finds that the decline in total factor productivity of the industry is mainly caused by the decline of capital productivity.

The rest of the paper includes: The second section briefly introduces relevant literature research; The third section briefly explains the institutional background of inter-regional industrial transfer in Guangdong Province; The fourth section presents empirical research data and model settings; The fifth section discusses The results of empirical research, including benchmark estimation and robustness test; the sixth section is the conclusion, discussing the significance of the inter-regional industrial transfer in Guangdong.

2. Literature Review

China's inter-regional industrial transfer is in the ascendant and has become a hot topic in academic research. There are rich researches related to industrial transfer at home and abroad, but the current literature mainly focuses on the influencing factors of industrial transfer and its impact on economic growth. Domestic and foreign scholars have a debate on the economic effects of regional industrial transfer. Total factor productivity is an important indicator for measuring sustainable economic development, but the existing research on the impact of industrial transfer on TFP is relatively rare. Therefore, based on the contributions of relevant scholars, there is a realistic research significance to further explore the economic effects of regional industrial transfer and its impact on total factor productivity.

In terms of the positive impact of industrial transfer regional policies on the economy, some scholars believe that the agglomeration benefits of industrial transfer will play an important role in promoting economic growth. Moretti [1] believes that the cluster of enterprises will attract talents, which will agglomerate human capital, creating the productivity spillover effects. Greenstone, Michael *et al.* [2] suggests that the establishment of high-productivity and large-scale man-

ufacturers has a productivity spillover effect, which helps to improve the total factor productivity of the current manufacturers, and the closer the spillover effect of the enterprise is more obvious. Glenn and Ellison [3] conducted empirical research on the US manufacturing sector, which finally confirmed that the geographical proximity of the company can reduce the cost of products, manpower and ideas, contributing to the external economy. Combes, Duranton and Gobillon [4] proposed by close geographical location, we can get the benefits of innovation by reducing transportation costs, and increasing the exchange of learning experiences. Alder *et al.* [14] find that the special economic zone mainly exerts positive economic effects through material capital accumulation, and has a positive impact on total factor productivity based on the 1988-2010 Chinese city-level city data. Siqi Zheng [12] conducted an empirical analysis of 110 industrial parks in eight major cities in China, and found that industrial parks can help firms solve land collection problems and cross-enterprise coordination problems, reducing transaction costs, and improve land utilization, which also can produce local production and consumption agglomerations to stimulate economic growth.

On the other hand, some scholars have proposed that regional industrial transfer is not conducive to productivity improvement in the perspective of regional industrial policies of subsidies and taxation. Subsidy policy is an important and universal regional industrial policy tool, and the relevant research literature shows that it has no positive or even negative impact on the economy. Baldwin *et al.* [15] proposed that when a country's foreign trade openness gradually increases, the industrial subsidy policy in remote areas does not change accordingly, which will increase the distortion of industrial space allocation and hinder economic development. Baldwin and Okubo [5] explained the theoretical heterogeneous trade model: because high-productivity enterprises leave the industrial clusters with higher opportunity costs, so the industrial migration subsidy policy attracts more enterprises with low productivity. The migration of enterprises from the central area to the underdeveloped peripheral areas has led to an increase in the productivity gap between the central and peripheral regions, which, to some extent, violates the traditional assumptions of regional industrial policies. At the same time, some scholars have done empirical research on the impact of regional industrial policies on productivity in different countries. As a typical regional industrial policy, the economic development zone plays an important role in regional economic development. Bondonio and Greenbaum [6] find that the economic development zone in the United States does have an expanding effect of employment and output, but the worker's wage level is declining, which indicates that the economic development zone has absorbed more low-wage and low-skilled workers, and has not formed a high concentration of human capital, which is not conducive to the formation of productivity spillover effects; Boldrin and Canova [7], Dallerba and Gallo [8] find that regional policy in the EU has not improved productivity, and does not promote economic growth; Martin *et al.* [9] finds that French industrial cluster policy did not have a

major impact on the productivity of enterprises, and the average productivity in the industrial cluster target area is lower than that in the non-target area; Bernini and Pellegrini [10] find that the productivity of enterprises enjoying subsidy policy in Italy is declining. Toshihiro Okubo and Eiichi Tomiura [11] find that corporate relocation policy is really no significant positive impact on business productivity using Japanese manufacturing firms' data in the 1970s to the 1980s. Siqi Zheng [12] empirically finds that the effect of industrial transfer on total factor productivity is heterogeneous. 70% of industrial parks established between 1998 and 2007 have positive effects of TFP. The remaining 30% of the industrial parks have a negative or insignificant TFP effect. Zhang Xiusheng [13] using the panel data of 347 prefecture-level cities in China from 2005 to 2014, finds that China's regional industrial transfer has not promoted the overall level of regional total factor productivity. There is a significant positive impact on the industrial transfer area, and it has a significant negative impact on the industry undertaking. It is also pointed out that Chinese industrial transfer pays more attention to the growth mode of the "quantity" transfer of the industry. This resource consumption and the predatory backward industry transfer are not conducive to the improvement of total factor productivity. This provides a new perspective and research ideas for the analysis of the impacts of inter-regional industrial transfer on TFP.

3. Institutional Background

According to data from Guangdong Statistical Yearbook from 1979 to 2018, since the reform and opening-up, Guangdong's economy has developed rapidly with an average annual economic growth rate of 17%. The per capita GDP has increased from 370 yuan in 1978 to 80,932 yuan in 2017. The proportion of the first and second industries has from 1978. 29.8%, 46.6% fell to 4% and 42.4% respectively in 2017. The proportion of the tertiary industry rose sharply, reaching 53.6% in 2017. The industrial structure was continuously optimized and adjusted, and Guangdong is a pioneer in the national economic development. However, at the same time of the rapid economic development of Guangdong Province, the economic structural problems of serious imbalance in the development of the Pearl River Delta and the eastern and western regions of Guangdong are becoming more and more prominent, and the industry is in urgent need of transformation and upgrading under the new economic normal, and solving these two major problems is very necessary for the long-term sustainable and stable development of Guangdong Province.

The imbalance of regional economic development is the bottleneck of Guangdong's economic development. Guangdong Statistical Yearbook data displays that the area of the Pearl River Delta accounts for only 30%, but the east and west wings and mountainous areas are 70% of all the area in Guangdong with the population accounting for about 45%. However, due to the obvious disadvantages of geographical location, industrial chain structure, infrastructure construction and policy environment, the eastern and western regions of Guang-

dong have obvious disadvantages. It is not conducive to attracting foreign investment, and the poor investment environment has led to a growing gap between it and the Pearl River Delta region. After more than 20 years of reform and opening-up, in 2001, the per capita GDP of the Pearl River Delta reached 31,040 yuan, and the east and west wings and the mountainous areas of northern Guangdong were only 7519 yuan and 6031 yuan respectively. The ratio of the per capita production in the Pearl River Delta, the east and west wings, and the northern Guangdong region is 5.1:1.2:1 in 2001 and the ratio becomes 3.8:2.4:1 in 2016. The regional economic gap has narrowed, but the characteristics of regional development imbalance are still obvious.

The economic development of the Pearl River Delta region is facing the pressure of industrial transformation and upgrading. In the early stage of reform and opening up, the Pearl River Delta region implemented an export-oriented development strategy, using cheap labor and superior geographical advantages to attract a large number of foreign investment and undertaking a large number of industrial transfer from developed countries or regions, establishing a large number of “three capitals” and “three compensation” enterprises. This exogenous industrial agglomeration development model has indeed driven the rapid growth of the province’s economy. However, with the gradual formation of China’s all-round opening pattern, the level of opening up has been continuously improved, and the advantages in the geosphere of the Pearl River Delta are gradually weakened, and the high concentration of industry and population also leads to the tight supply of energy and land resources, labor costs and environmental costs, which is not conducive to the sustainable development of the economy and poses great challenges to the development of the Pearl River Delta. According to Liu Zhenjie [15] calculation, in 2015, the construction land area of the Pearl River Delta Plain reached 573,900 hm², accounting for 10.36% of the total land area; cultivated land and unused land area is 1.38 million hm², and unused area is 220,000 hm². Assume that these cultivated land and unused land are all developed as construction land, according to the average rate of construction land increase of 3.58% between 1990 and 2015, and the longest supply period is only 25 years. In addition, energy is an important support for economic development. According to the data of Guangdong Power Company of China Southern Power Grid, the total electricity consumption of Guangdong in 2018 is as high as 595.9 billion kWh, more than half of the electricity consumption of the five southern provinces (Guangdong, Guizhou, Guangxi, Hainan, Yunnan). In addition, the problem of labor shortage in the Pearl River Delta region has become increasingly prominent. With the disappearance of the demographic dividend, the Pearl River Delta region began to experience a “labor shortage” in 2003. According to the statistics of the Dongguan Human Resources Bureau, there are nearly 10,000 job positions of more than 800 enterprises, the proportion of absent general workers is 73%. While in eastern Guangdong, western Guangdong and mountainous areas, there is still a large amount of rural surplus labor, and the labor resources are relatively abundant. Therefore, in the case of

increasingly constrained resources, the Pearl River Delta region will transfer traditional labor-intensive industries or low-value-added industries to underdeveloped regions. Industrial transfer may be a self-issued or an external economic development strategy. In order to narrow regional gaps and balance regional economic development, the government generally adopts measures to promote industrial transfer. The main means of implementation include regional policy tools and industrial cooperation between different local governments. The industrial transfer in the Pearl River Delta region of Guangdong Province has gone through two stages: from the late 1990s to 2005, it's mainly small-scale spontaneous transfer behavior under the influence of market mechanisms, and the main transfer destination is the outer region of the Pearl River Delta (Mainly in Jiangmen, Huizhou, Zhaoqing and Qingyuan areas); since 2005, the government's policy promotion and market selection have jointly promoted the scale of industrial transfer, and gradually showed the characteristics of industrial clustering and park industrialization.

In the context of unbalanced regional economic development and industrial transformation and upgrading, in order to achieve the complementary resources of the Pearl River Delta and the eastern and western regions of Guangdong, and promote regional coordinated development, the Guangdong provincial government has begun to adopt the economic development strategy of local governments to jointly build industrial transfer parks. Governments guide the industry to carry out regional transfer orderly to transform economic growth mode, improve productivity level and optimize industrial structure. In 2001, the "10th Five-Year Plan for Mountain Development in Guangdong Province" proposed that mountainous areas should create conditions to undertake industrial transfer in the Pearl River Delta and coastal economically developed areas. In 2004, the Guangdong Provincial Party Committee and the Provincial Government first proposed the construction of an industrial transfer industrial park in the Pearl River Delta region with the east and west wings and the mountainous areas to promote the transfer of the industry in order to achieve comprehensive, coordinated and sustainable development. However, until March 2005, Guangdong Province issued the document "Opinions on Promoting Industrial Transfer between the Mountainous Areas and the East and West Wings of the Province and the Pearl River Delta" (hereinafter referred to as the "Opinions"), and officially established the implementation of local government cooperation and construction of the industry for the first time in the country. The economic development strategy of the park to promote the orderly transfer of industries has effectively promoted the large-scale crowded transfer process of the industry. The main purpose of the Opinions is to accelerate the transfer of labor-intensive industries that have lost their competitive edge in the Pearl River Delta region to the less developed and backward regions of Guangdong through industrial transfer parks, and to realize the labor, technology, brand and land resource complementarity, improving the efficiency of resource allocation and creating a new impetus for economic growth. In order to promote industrial transfer and pro-

mote the industrial agglomeration development of the park, the provincial government implements a series of preferential policies such as enterprise transfer incentives, electricity and land, and in order to attract more resources, strengthen financial support in the industrial transfer industrial park and improve the park. This local government cooperation to build an industrial transfer park model has created a benefit-sharing mechanism for the local governments of the Pearl River Delta and the eastern and western regions of Guangdong, which switches the local government's relationship from competition to cooperation, achieving "win-win" result in the Pearl River Delta and underdeveloped regions.

Since then, Guangdong Province has successively issued a series of related industrial policies, and has continuously promoted the construction of industrial transfer parks and industrial transfer. In 2008, Guangdong Province issued the "Decision on Promoting Industrial Transfer and Labor Transfer" and seven supporting documents to support the "Double Transfer Strategy", and the provincial government has invested 40 billion yuan to support the promotion of industrial transfer park within 5 years. The rapid development has promoted the "double transfer" economic development strategy. Due to the shift of the industry, the industry is divided according to the different advantages of industrial allocation and natural resources in the north and south of Guangdong, achieving agglomeration and development, forming a new industrial cluster and becoming a new economic growth point. In 2013, the People's Government of Guangdong Province issued the "Decision on Further Promoting the Revitalization and Development of Guangdong's East and West Regions" and the "Promoting Work Plan for Capacity Expansion and Efficiency Improvement of Industrial Parks in the East and West of Guangdong", further accelerating the expansion of industrial transfer parks. And the "Every County Expressway" and "Full Coverage of the Park" have been basically realized in the eastern and western regions of Guangdong. The industrial undertaking capacity and investment attractiveness have been significantly enhanced.

The basic principle of the Guangdong Provincial Government to establish an industrial transfer park is to promote orderly the transfer of industrial by the dual forces of the market and the government, thereby promoting industrial upgrading in the Pearl River Delta region and promoting the formation of new and distinctive industrial clusters in the east and west wings and the northern Guangdong region, and forming the advantages of industrial park clustering and creating new economic growth poles. Since 2005, Guangdong Province has started to cooperate with local governments to build industrial transfer parks, and has invested heavily in supporting the construction of the park to promote the industrial transfer process. The distribution of provincial-level industrial transfer parks in Guangdong Province from 2005 to 2016 is shown in **Figures 1-4**. At present, 87 provincial-level industrial parks (including independent industrial clusters) are identified in the outer regions of the Pearl River Delta (Jiangmen, Zhaoqing and Huizhou) and 12 cities in the other parts of Guangdong (Guangdong Industrial Park Network, 2018). As shown, in 2016, the

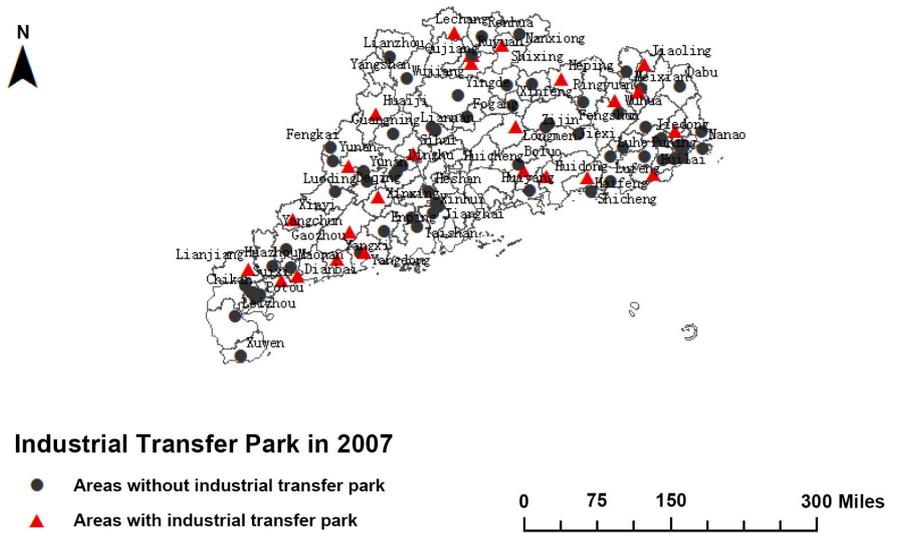


Figure 1. Industrial transfer park distribution in industrial undertaking area in 2007.

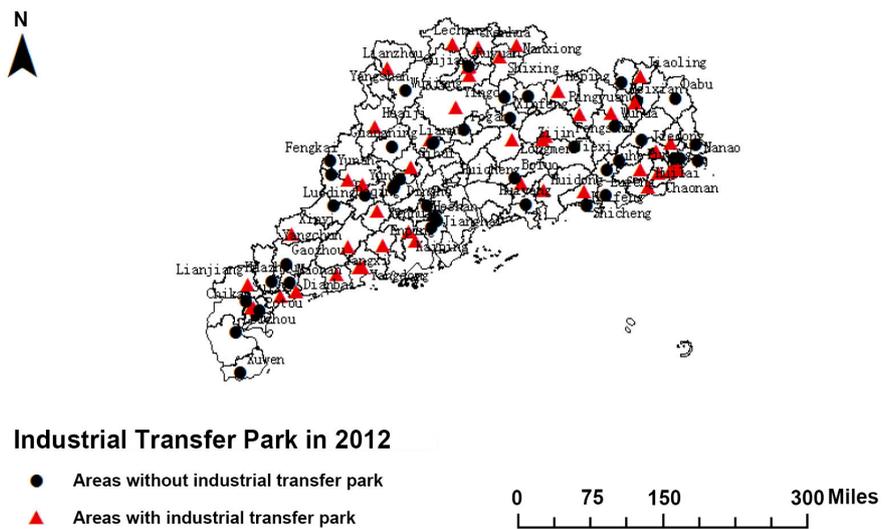


Figure 2. Industrial transfer park distribution in industrial undertaking area in 2012.

province has achieved the industrial parks coverage rate of about 98% counties in the industrial undertaking areas.

4. Estimation Strategy

4.1. Estimation Framework

This paper uses the data from 2001 to 2016 in a total of 120 counties in 21 cities in Guangdong Province, and uses the dual differential (DID) method to test the impact of industrial transfer on the total factor productivity TFP. Based on the perspective of total factor productivity, this study can not only make up for the research vacancies of the TFP impact effect of inter-regional industrial transfer, but also enrich the research content of the relevant inter-regional industrial transfer policy, what's more, using the relevant data of 120 counties and districts

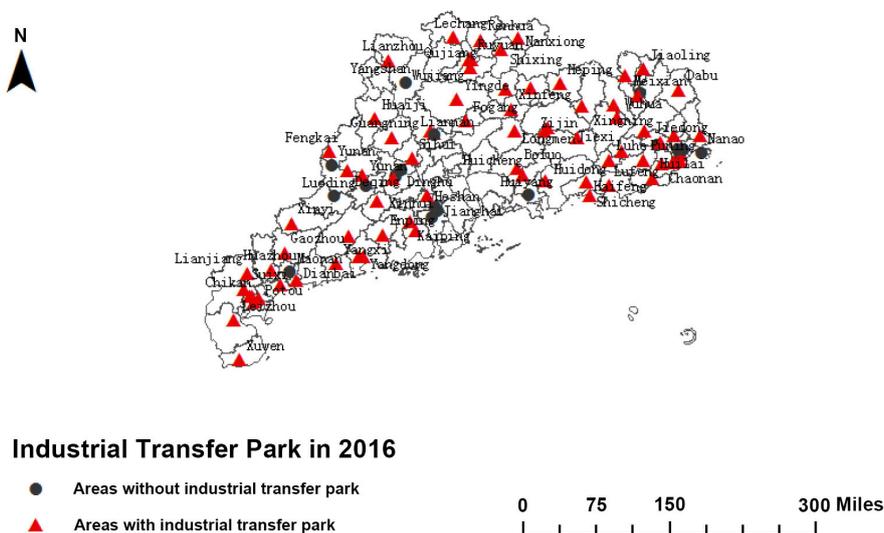


Figure 3. Industrial transfer park distribution in industrial undertaking area in 2016.

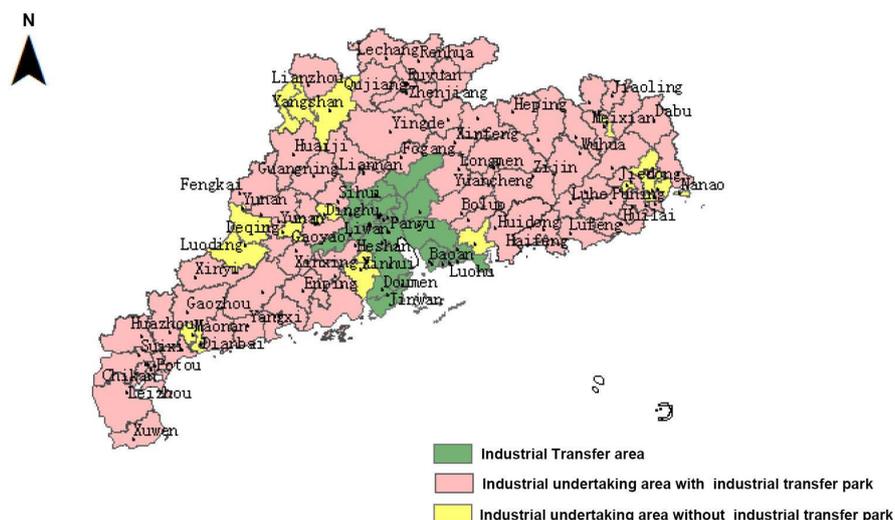


Figure 4. Industry transfer distribution in 2016.

in 21 prefecture-level cities in Guangdong Province from 2001 to 2016 to conduct panel data research and analysis can better confirm the problem. And the double-difference method can solve the endogenous problem of policy as an explanatory variable.

The basic model settings are as follows:

$$TFP_{it} = \alpha_0 + \alpha_1 \cdot \text{Transfer area}_c \cdot \text{Post05}_t + \beta \cdot X_{it} + \delta_i + \gamma_t + \varepsilon_{it} \quad (1)$$

where, TFP_{it} as an indicator of production efficiency, refers to the total factor productivity of the county i at year t ; Transfer area_c equals 1 if city c is the industry undertaking and 0 otherwise; Post05_t takes a value of 1 if $t \geq 2005$ and 0 otherwise; δ_i is the county fixed effect, capturing all time-invariant differences across counties; γ_t is year fixed effect, capturing all yearly factors that are common to counties such as macro level shocks; X_{it} denotes other control va-

riable vectors that may affect total factor productivity, including export volume, foreign direct investment and highway mileage.

The Guangdong Provincial Government's support for industrial parks in underdeveloped areas is not only reflected in various preferential policies and measures, but also in the construction of transportation infrastructure. The investment improvement of transportation infrastructure systems in various industrial parks can not only drive related materials and service needs, but also reduce the transportation cost of materials, which helps to improve the operational efficiency and quality of companies, thereby improving the total factor productivity of enterprises and related industries. In addition, Wang Dexiang and Xue Guizhi [16] found that FDI has technology spillover effects, demonstration effects, etc., which can accelerate the technological development of the host country and increase productivity. As the first place for reform and opening-up, in the initial stage, Guangdong Province experienced the export-led economic growth, expanding firms markets through exports and improving the level of specialization and resource allocation efficiency. These export enterprises have more opportunities to access and exchange advanced technologies and management, which is an important way to improve the total factor productivity of enterprises. In addition, the model simultaneously controls the regional fixed effect and the annual fixed effect to control the fixed features of the region that do not change with time and the time effects that do not change with the city.

In order to further understand the impact of industrial transfer with the industrial transfer park as a carrier on regional total factor productivity, we narrowed the sample, using time variables (before and after policy implementation), regional variables (industry transfer and industry undertaking), and county Variables (countries with and without industrial parks) carry out a triple differential test. The basic model settings are as follows:

$$TFP_{it} = \alpha_0 + \alpha_1 \cdot \text{Transfer area}_c \cdot \text{County}_i \cdot \text{Post05}_t + \beta \cdot X_{it} + \delta_i + \gamma_t + \varepsilon_{it} \quad (2)$$

where, County_i equals 1 if there is industrial transfer park in the county i and 0 otherwise.

4.2. Data and Variables

Data for the empirical analyses presented in this section were collected by the author from Guangdong Province Statistical Yearbook and the statistical yearbook of cities and counties from 2002 to 2017. Using these data sources, we construct a data set of 120 prefectures in 21 cities in Guangdong Province spanning the period from 2001 to 2016.

Due to the existence of some counties or economic zones that were added, reopened, or merged with other counties to form a county, we have adjusted the counties. For the new economy districts which were established from 2001 to 2016, we incorporate them into the jurisdiction to collect statistical data; for those who have been revoked into other counties, their data will be directly incorporated into the county to be included; for the case of county mergers, the

county data before the merger will be summarized into the combined county data. After adjusting the counties and districts, statistics were collected from 120 counties and districts in Guangdong Province.

Total factor productivity (TFP). We use the Solow Complementary method to calculate TFP of each county, which is an explanatory variable to measure the regional production efficiency. Simplify production factors into two elements of labor and capital and use Cobb-Douglas production function model to get TFP: $Y_{it} = A_{it} \cdot K_{it}^{\alpha} \cdot L_{it}^{\beta}$. The number of social laborers at the end of each county is used as a measure of labor input L. The amount of capital should be the flow of capital used each year, which is difficult to obtain, so we use the perpetual inventory method to estimate the capital stock as the capital input K . The formula is: $K_{it} = I_{i,t} + (1 - \delta) \cdot K_{i,t-1}$, K and I respectively represent the capital stock and the newly added social fixed assets investment in county i at year t , and the calculation formula of the base period capital stock is $K_1 = I_1 / (\delta + g)$, g is the average annual growth rate of fixed assets investment in county i . δ is the depreciation rate of fixed assets, and it equals 9.6%, following the treatment method of Zhang Jun *et al.* [17]. Detailed TFP summary statistics are reported in **Table 1**. Output value Y , labor input L and the newly added social fixed assets investment all were collected by the author from Guangdong Province Statistical Yearbook and the statistical yearbook of cities and counties.

Control variables include transportation infrastructure (road mileage through vehicles), foreign investment (FDI), and export trade (exports). This paper uses the actual amount of foreign capital to reflect the level of foreign direct investment in the county. Export trade can affect the increase of total factor productivity through export competition effect and export imitation effect, so this paper controls the export volume variable. The above data comes from the “Guangdong Province Statistical Yearbook” and the statistical yearbooks of cities, counties and districts.

Since 2005, Guangdong Province has implemented an industrial transfer policy based on industrial transfer parks, mainly to transfer industries that have lost competitive advantage in the Pearl River Delta region to underdeveloped regions, including the peripheral regions of the Pearl River Delta (Jiangmen, Huizhou and Zhaoqing), Eastern Guangdong, Western Guangdong and Northern Guangdong. Therefore, according to the transfer place and the grounding of the industry, the changes in the distribution of total factor productivity in the two regions are shown in **Figure 5** and **Figure 6**. At present, Guangdong Province has identified 87 provincial-level industrial transfer parks distributed in the industrial undertaking areas, and further divided the industrial bases according to the presence or absence of industrial transfer parks: there are counties with industrial transfer parks and counties without industrial transfer parks. **Figure 7** and **Figure 8** show the change in the probability distribution of TFP in the county with or without industrial transfer in the industrial undertaking area.

We firstly compare the productivity distribution of the industrial transfer area and the industrial undertaking area in 2005 and 2016 through the nuclear density

Table 1. Descriptive statistics of TFP variables.

TFP	Observations	Mean	S.D.	Min	Max
Pre-industrial transfer: 2001-2004					
Industrial transfer area	104	37.9159	18.6335	3.8721	87.353
Industrial undertaking area	376	33.2612	21.3705	2.8637	141.6191
Counties with industrial park	324	34.3722	22.1625	2.8637	141.6191
Counties without industrial park	52	26.3384	13.8051	9.7568	63.5807
After industrial transfer: 2005-2016					
Industrial transfer area	312	44.0209	16.2364	20.1674	99.947
Industrial undertaking area	1128	26.8762	10.78	3.5416	99.2953
Counties with industrial park	982	26.855	10.5008	3.5416	99.2953
Counties without industrial park	146	27.0192	12.5374	9.0569	59.565

Note: The author calculated from the relevant statistics of the Guangdong Statistical Yearbook and the statistical yearbooks of various cities in Guangdong Province.

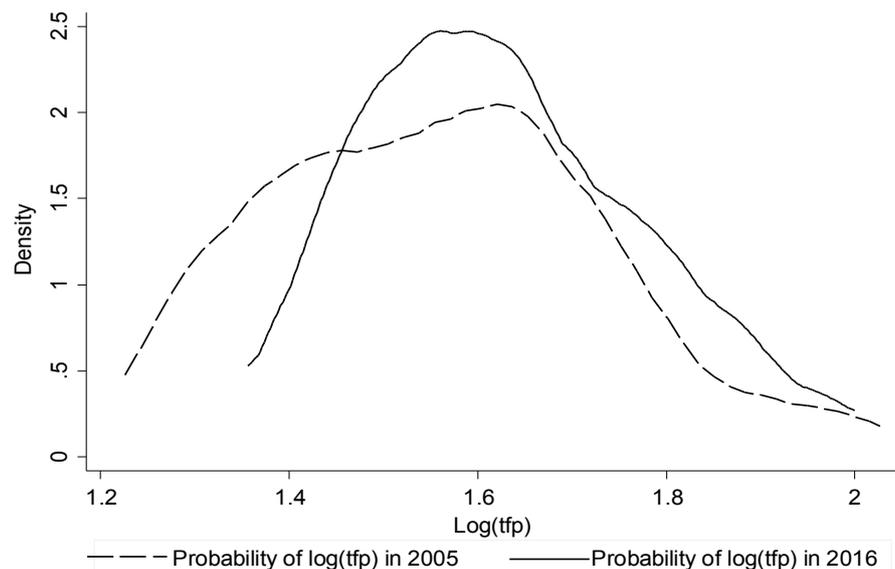


Figure 5. Kernel density of TFP in industrial transfer area. Note: in the figure, the horizontal coordinate is the log (TFP) of the county and the vertical coordinate is the probability density of the log (TFP).

map. The nuclear density of the logarithmic productivity of the industrial transfer area in **Figure 5** shows that, after the implementation of the industrial transfer policy in 2005, the overall average productivity of the six core cities in the Pearl River Delta in 2016 increased, and the density of counties with low productivity levels decreased sharply. **Figure 6** shows the probability distribution of logarithmic productivity in the industrial undertaking area in 2005 and 2016. In 2016, the productivity distribution of the industry undertaking area shifted to the left, and the distribution was more concentrated, in which the density of the county with low productivity level is significantly reduced, and the probability density of high productivity is also decreasing.

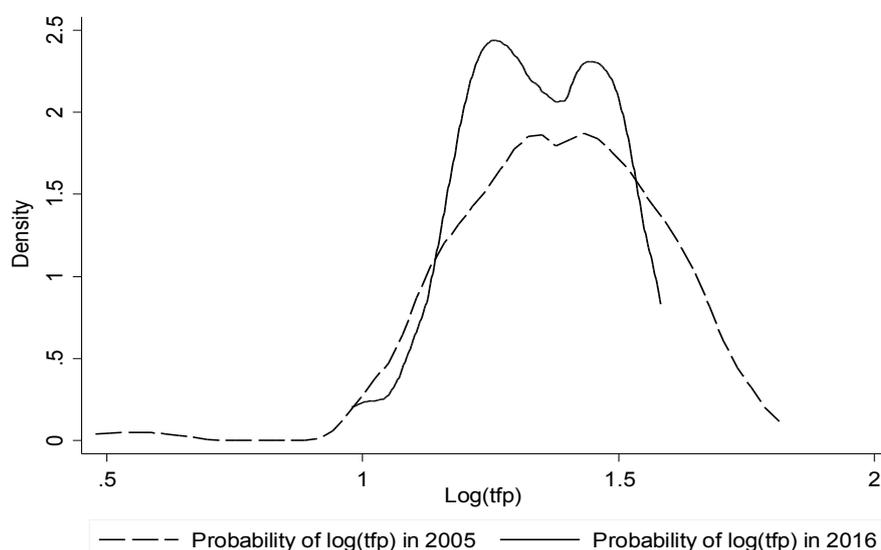


Figure 6. Kernel density of TFP in industrial undertaking area. Note: in the figure, the horizontal coordinate is the log (TFP) of the county and the vertical coordinate is the probability density of the log (TFP).

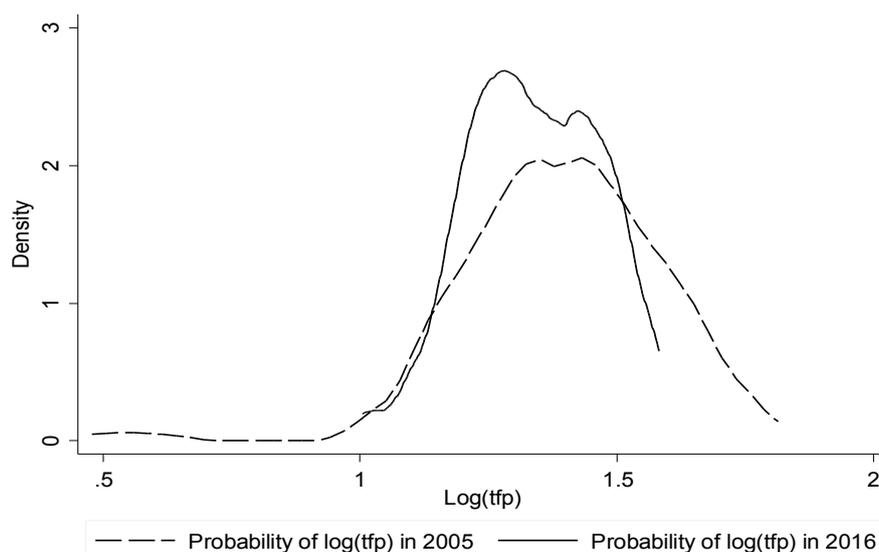


Figure 7. Kernel density of TFP in counties with industrial park. Note: in the figure, the horizontal coordinate is the log (TFP) of the county and the vertical coordinate is the probability density of the log (TFP). All counties are in industrial undertaking area.

Through the distribution of productivity in 2005 and 2016 in the counties with the industrial transfer parks and without the industrial transfer parks in industrial undertaking area in **Figure 7** and **Figure 8**, it can be seen that the TFP changes in the industrial transfer parks and districts are similar to the overall TFP changes in the industrial undertaking areas. The high productivity probability density of the no-industrial transfer county in 2016 is significantly higher than that in 2005, and the low productivity probability density is reduced. This indicates that the overall TFP change in the industrial undertaking area is mainly caused by the county TFP with the industrial transfer park.

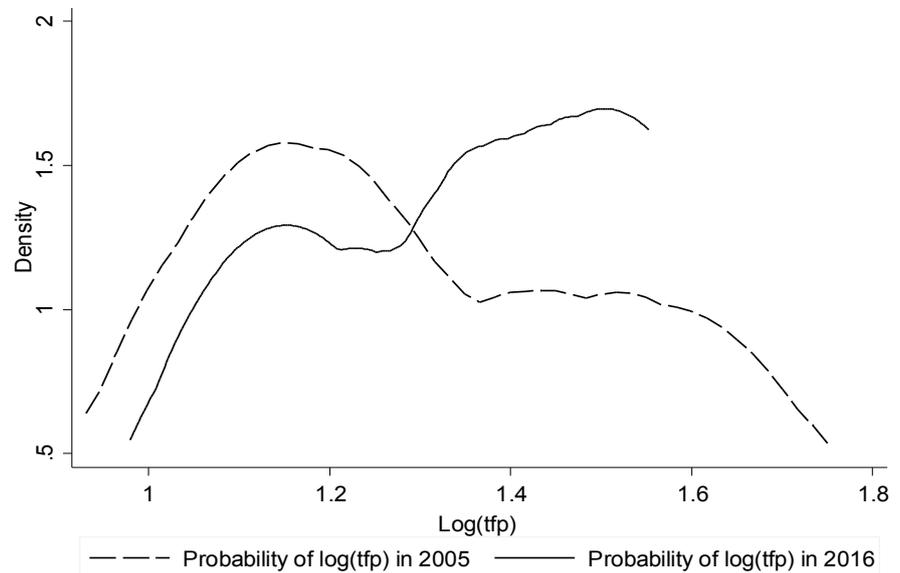


Figure 8. Kernel density of TFP in counties without industrial park. Note: in the figure, the horizontal coordinate is the log (TFP) of the county and the vertical coordinate is the probability density of the log (TFP). All counties are in industrial undertaking area.

Table 1 is a group descriptive statistical result of the variable total factor productivity TFP. From the perspective of the overall industrial transfer area and industrial undertaking area, after industrial transfer, the average total factor productivity of the industrial transfer area increased by 16.10%, while the TFP of the industrial undertaking area decreased by 19.20%. The total factor productivity of the county with industrial transfer park in the industrial undertaking area decreased by 21.87%. TFP of the counties with no industrial transfer park increased slightly by 2.58%. Therefore, the industrial transfer has led to a decline in the total factor productivity of the industrial undertaking areas or the counties with industrial transfer parks, while the TFP of the industrial transfer areas has increased.

5. Results

Based on the data of 120 counties in 21 cities in Guangdong Province from 2001 to 2016, we use the double-difference (DID) and triple-difference (DDD) method to test the impact of the “local government cooperation of promoting industrial transfer” policy in 2005 on total factor productivity. The baseline estimate is discussed first, followed by the robustness checks.

5.1. Main Results

The double-difference method requires that the treatment group and the control group must have the same trend before the policy implementation. Therefore, **Figure 9** shows the total factor productivity level of the industrial transfer area and the industrial undertaking area from 2001 to 2016. The industry transfer area includes 6 cities in the Pearl River Delta: Guangzhou, Shenzhen, Zhuhai,

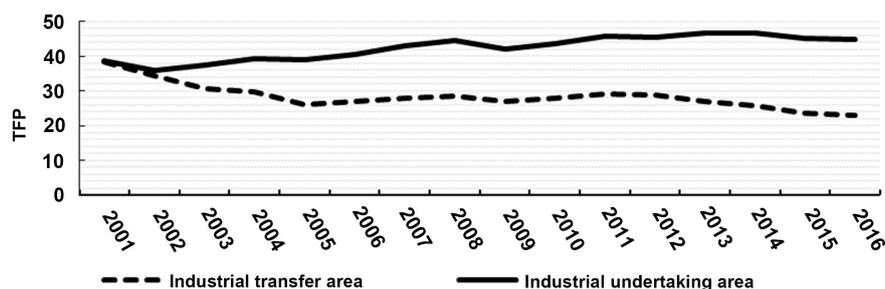


Figure 9. Comparison of TFP in industrial transfer and undertaking areas. Note: The author calculated from the relevant statistics of the Guangdong Statistical Yearbook and the statistical yearbooks of various cities in Guangdong Province.

Foshan, Dongguan, and Zhongshan. The industrial transfer area mainly includes the outer areas of the Pearl River Delta (Huizhou, Zhaoqing and Zhanjiang), the east and west wings, and the northern Guangdong region. It can be seen from the figure that in 2001-2003, the average level of total factor productivity of the six cities of the Pearl River Delta and the industrial undertaking zone have similar downward trend. However, in 2004, the Guangdong Provincial Party Committee and the Provincial Government first proposed the construction of an industrial transfer industrial park in the Pearl River Delta region with the east and west wings and the mountainous areas. Due to the influence of government policies, the TFP of the six cities in the Pearl River Delta began to rise slowly in 2004. The trend of the two groups was basically the same in 2001-2005. Therefore, this paper is based on the double-difference method to study the productivity effect of inter-regional industrial transfer in Guangdong.

Table 2 shows the results of the benchmark estimation of inter-regional industrial transfer and TFP in Guangdong. Models (1) and (2) are double-differential models, and models (3) and (4) are triple-differential models, in which (1) and (3) models do not include control variables, and (2) and (4) are added. Regardless of whether or not the control variable is added, the DID coefficient of the interaction variable between the “industry transfer zone” and year dummy variable and the DDD coefficient result indicate that the impacts of industrial transfer parks in industrial undertaking areas are significantly negative, suggesting that industrial transfer has significantly reduced the total factor productivity TFP of industrial undertaking areas. For other economic control variables on the impact of TFP, highway mileage, export volume and foreign direct investment have played a positive role in promoting TFP.

The research results show that the Guangdong interregional industrial transfer policy has not improved production efficiency, but has a negative impact on TFP. This result is consistent with other scholars’ conclusions on industrial transfer policy studies in different countries. For example, Boldrin and Canova [7], Dallerba and Gallo [8] found that EU regional policies did not increase productivity and did not promote economic growth; Martin *et al.* [9] empirically showed that France’s industrial cluster policy did not have a major impact on

Table 2. Baseline estimates.

Dependent Variable: TFP	(1)	(2)	(3)	(4)
DID	-12.4899*** (1.2888)	-10.1866*** (1.4123)		
DDD			-12.4367*** (1.1216)	-10.8520*** (1.1732)
Control variables	No	Yes	No	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Observations	1920	1920	1920	1920
R-squared	0.1651	0.1271	0.1101	0.1052

Note: The standard deviation is in parentheses. *, ** and *** indicate significant levels at 10%, 5% and 1%, respectively.

firm productivity; Bernini and Pellegrini [10] found that the productivity of firms that enjoyed subsidies in Italy declined. The regional industrial layout of industrial transfer in Guangdong Province is mainly to encourage the sunset industries in the Pearl River Delta, such as traditional labor-intensive industries, resource-based industries or industries that have more mature industrial clusters or production bases, to orderly transfer to the east and west wings and the northern part of Guangdong. This kind of declining industrial transfer, which is forced by the market structure adjusting pressure and costs reduction, will not have a significant positive effect on the improvement of total factor productivity. Industrial transfer may allow individual companies to maximize their benefits, but not to maximize regional interests. The Guangdong Provincial Government has invested a large amount of construction support funds for the construction of industrial parks to promote industrial transfer, and implemented high-intensity subsidy policies to attract enterprises. This may lead to the production of enterprises for the purpose of seeking subsidies. And the opportunity cost of getting subsidies for higher productivity enterprises is high at the cost of leaving the agglomeration area, so the subsidy policy attracts more low-productivity enterprises, which will seriously reduce the efficiency of capital allocation and is not conducive to the improvement of the total factor productivity of enterprises. In addition, the government's excessive intervention in the construction of industrial parks and industrial transfer, restricts the autonomy of enterprises, resulting in the company's acclimatization. What's more, local governments have excessive investment in the idle industrial parks, which may have a negative impact on total factor productivity to some extent (Table 2).

5.2. Robustness Checks

It can be seen from the previous benchmark estimation results that the local government that implemented the industrial transfer policy in Guangdong Prov-

ince since 2005 has had a negative effect on the TFP of the industrial undertaking area. This section will examine the robustness of the estimates.

Firstly, the counties and districts of Guangdong Province are regarded as DMU. The fixed capital stock and employment number of each county are taken as capital and labor input respectively. The output data is the regional GDP of each county. The DEA method is used to measure TFP of 120 counties in 2001-2016. The results are shown in **Table 3**. It can be seen that, whether or not the control variable is added, the DID coefficient of the interaction variable between the “industry transfer zone” and the “year dummy variable” and the DDD coefficient result indicate that, the industrial transfer has significantly reduced the TFP in the industrial undertaking area, which gives us reason to believe that the results and conclusions of the baseline estimate are robust.

Secondly, we use four provinces, Guangxi, Fujian, Jiangxi and Hunan Province as a reference group to investigate the effect of local government’s implementation of the industrial transfer policy in 2005 on the industrial transfer areas and the total factor productivity. The results are shown in **Table 4**. In addition, the inter-regional industrial transfer in Guangdong Province mainly uses the industrial transfer park as a carrier to transfer the uncompetitive industries in the Pearl River Delta region to the outer regions of the Pearl River Delta, the less developed areas of Yuedong, Yuexi and Yuebei, while the peripheral areas of the Pearl River Delta and the eastern and western regions of Guangdong have their own advantages and disadvantages in terms of geographical location, resources and industrial support. Therefore, the industries they undertake have their own focuses, and their total factor productivity may be affected differently. Therefore, we use the four surrounding provinces of Guangdong Province as a reference group to further investigate the effects of inter-regional industrial transfer on TFP in the peripheral areas of the Pearl River Delta (Jiangmen, Zhaoqing and Huizhou), Yuedong, Yuexi and Yuebei. The specific results are shown in **Table 5**.

Table 3. DEA method to measure TFP.

Dependent Variable: TFP	(1)	(2)	(3)	(4)
DID	-0.0844*** (0.0133)	-0.0598*** (0.0146)		
DDD			-0.0905*** (0.0116)	-0.0753*** (0.0122)
Control variables	No	Yes	No	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Observations	1920	1920	1920	1920
R-squared	0.2004	0.1378	0.1589	0.1321

Note: The standard deviation is in parentheses. *, * and *** indicate significant levels at 10%, 5% and 1%, respectively.

Table 4. Impact of inter-regional industrial transfer on TFP.

Dependent Variable: TFP	(1)	(2)	(3)	(4)
	Industrial transfer area	Industrial undertaking area	Counties with industrial park	Counties without industrial park
DID	-6.5010*** (0.9945)	-4.8365*** (0.9646)	-9.2650* (1.3463)	4.3496*** (0.6692)
Control variables	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Observations	949	1833	1053	780
R-squared	0.4662	0.0051	0.0120	0.4402

Note: The standard deviation is in parentheses. *, * and *** indicate significant levels at 10%, 5% and 1%, respectively.

Table 5. Heterogeneous tests.

Dependent Variable: TFP	(1)	(2)	(3)	(4)
	Periphery areas of the Pearl River Delta	Eastern Guangdong	Western Guangdong	Northern Guangdong
DID	-4.9081*** (0.6898)	-6.4944*** (0.8670)	-2.1076* (1.2188)	1.9824*** (0.4796)
Control variables	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Observations	871	1040	910	845
R-squared	0.3614	0.3127	0.2354	0.5110

Note: The standard deviation is in parentheses. *, * and *** indicate significant levels at 10%, 5% and 1%, respectively.

The study found that the inter-regional industrial transfer policy has a positive TFP effect on the industrial transfer area, and has a negative impact on the overall total factor productivity of the industrial undertaking area, which is consistent with the research results of Zhang Xiusheng [13]. Further, the total factor productivity of counties with industrial transfer parks is significantly reduced, while the TFP of counties without industrial transfer parks is significantly improved; in addition, the total factor productivity of the four regions, the periphery of the Pearl River Delta, Yuedong, Yuexi and Yuebei, was significantly affected to varying degrees, which is basically consistent with the baseline estimation results of the differential model. And inter-regional industrial transfer has the greatest negative impact on eastern Guangdong, followed by the outer periphery of the Pearl River Delta and western Guangdong. However, compared with the four surrounding provinces, inter-regional industrial transfer has significantly increased the TFP level in northern Guangdong.

Finally, we use the counterfactual method to test results. We artificially set the time point of the implementation of the inter-regional industrial transfer policy,

and test its effect on TFP. If the coefficient is not significant, it indicates that the reduction of TFP is caused by the inter-regional industrial transfer policy, and conversely, the conclusion is not stable. The results show that if the implementation time of the industrial transfer policy is set to 2002 and 2003, the coefficient of the difference is not significant, which indicates that the reduction of TFP in the counties of Guangdong Province is indeed brought about by the local government to promote the industrial transfer policy. Therefore, through the robustness test, there is reason to believe that the benchmark results and conclusions of this paper are very robust (Table 6).

5.3. Analysis of Single Factor Productivity

From the above regression results, it suggests that inter-regional industrial transfer in Guangdong Province has different degrees of impact on the total factor productivity of the Pearl River Delta, the East and West, and the North Guangdong. Therefore, we further analyze the causes from labor productivity and capital productivity aspects. According to the results of Table 7, in the sample interval from 2001 to 2016, the average annual growth rate of total factor productivity in Guangdong Province and China was negative, -0.27% and -0.79% , respectively, showing a significant decline. The labor factor productivity has increased year by year, the average annual growth rate is around 10% , while the capital factor productivity is declining, with an average annual growth rate of -3.33% and -8.93% , respectively, indicating that the capital factor input has reached the stage of diminishing returns. The reason for the decline in total factor productivity is mainly the continuous decline in the productivity of capital factors. The results of this study are consistent with the conclusions obtained by Wang Dexiang [16]. Capital factor productivity is an important driving force for the change of urban total factor productivity. Zhang Jun [18] believed that in the 1980s, excessive investment and competition led to a decrease in the efficiency of capital allocation, accelerated the deepening of capital, and prevented the balanced structure of capital and labor factors. The long-term over-investment in

Table 6. Counterfactual test.

Dependent Variable: TFP	(1)	(2)
	2001-2003 2002	2001-2004 2003
DID	1.2753 (1.7760)	-2.7139 (1.7746)
Control variables	Yes	Yes
County fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Observations	360	480

Note: The standard deviation is in parentheses. *, * and *** indicate significant levels at 10%, 5% and 1%, respectively. The first line represents the simulation policy time interval and the simulation policy time point.

Table 7. The average annual growth rate of TFP and single factor productivity in 2001-2016.

Region	Capital productivity	Labor productivity	TFP
Nation	-0.0893	0.1221	-0.0079
Guangdong Province	-0.0333	0.0949	-0.0027
Six core cities in the Pearl River Delta	-0.0004	0.0944	0.0298
Periphery areas of the Pearl River Delta	-0.0818	0.1006	-0.0070
Eastern Guangdong	-0.1020	0.0819	-0.0082
Western Guangdong	-0.0920	0.1146	-0.0078
Northern Guangdong	-0.0479	0.1186	-0.0007

Note: The core 6 cities of the Pearl River Delta include Guangzhou, Shenzhen, Zhuhai, Foshan, Zhongshan and Dongguan. The peripheral areas of the Pearl River Delta include Huizhou, Jiangmen and Zhaoqing.

China has led to serious social overcapacity, and some inefficiencies have begun to emerge. The decline in total factor productivity is a clear sign of inefficiency.

Under the implementation of the inter-regional industrial transfer policy, the total factor productivity of Guangdong Province is not increasing as expected, but it is declining. This paper makes a simple analysis of the reasons for this situation. In terms of infrastructure, the improvement of infrastructure can speed up the flow of input factors and improve resource utilization efficiency and productivity. Therefore, part of the industrial support funds is used for infrastructure construction in underdeveloped areas, but the infrastructure construction period is longer. Infrastructure investment may take up to a decade to achieve its “productivity”. In addition, a series of preferential subsidy policies are implemented in the industrial transfer park, and different scholars have different views on the implementation effect of the industrial subsidy policy. Bernini [19] used the local random test conditions created by the Italian industrial subsidy policy. The quasi-experimental method of capital subsidy has a negative impact on TFP growth in the short term, and it will produce positive effect signals after 3 or 4 years, and this long-term positive impact is exerted through the path of technological change. Howell [20] found that in the private sector in China, public subsidies can stimulate innovative investment in high-tech industries in the short term, but at the same time reduce the TFP of low-end and high-end industries. In addition, Baldwin and Okubo [5] theoretically believe that enterprises with high productivity levels will face higher opportunity costs when they leave industrial clusters. Therefore, industrial migration subsidy policies attract more low-productivity enterprises and further enlarge productivity gaps in developed and underdeveloped regions. However, Lin Yifu [21] used empirical research on data from China’s national economic development zones to find that regional industrial policies promoted corporate productivity through better policy environments (lower tax conditions) rather than high-productivity companies which were selected by the government entering the economic development zone. Therefore, there are still different conclusions on the impact of industrial

subsidy policies on total factor productivity.

From the perspective of the government, in the critical period of industrial transformation, the rent-seeking behavior of government departments is not conducive to the improvement of capital factor productivity. During the period of industrial adjustment, the lack of effective supervision system has led enterprises to bear high-cost corrupt rents, which not only hinders the technological progress of enterprises, but also inhibits effective investment, distorts the investment structure, and reduces the effective output of investment. In addition, the industrial transfer in Guangdong Province is mainly the economic behavior promoted by the local government through the cooperation and development of the industrial transfer park. Since the industrial transfer park co-construction model has the characteristics of multi-level government leading and benefit sharing, certain institutional barriers will exist, so the government's behavior in the process of industrial transfer may inhibit productivity increase. The government's driving force for industrial transfer is very important, but the government's intervention in industrial transfer is related to the effectiveness of the policy. The excessive intervention of the government will cause the enterprise to lose its autonomy and fail to give full play to the autonomy of the enterprise and produce the radiation effect for the economy. Another situation is the unreasonable design of the park construction policy. The industrial transfer park is less attractive to the Pearl River Delta industry transfer, and the phenomenon of "government heat and enterprise cold" appears. The park is idle, resulting in the wasted resources and decreased resource allocation efficiency. These problems will lead to the declining of the productivity in the transfer zone.

From the perspective of various regions in Guangdong Province, there are obvious regional differences in capital and labor factor productivity. Specifically, the capital productivity in eastern Guangdong has the greatest decline, and the increase in labor productivity is the smallest. The average annual growth rate of total factor productivity is -0.82% . Located in the southeast coastal area of Guangdong Province, Yuedong has obvious geographical advantages of marine resources. It has strong foreign investment capacity and technology spillover effects. However, due to the irrational industrial structure, there are mainly low-value industrial chains in Yuedong, such as the traditional textile and garment industry, ceramics and toys, food and beverage, etc. It lacks of high-tech enterprises and faces the problem of relatively insufficient development of tertiary industry. With the implementation of industrial transfer support policies, industrial competition is more intense, and Guangdong's attractiveness to foreign investment weakened, which can't exert obvious spillover effects. In the northern part of Guangdong, the decline in capital productivity is the smallest, and the increase in labor productivity is the largest. The average annual growth rate of total factor productivity is only -0.07% . It has obvious late-comer advantages with abundant land, forestry, and mineral resources, etc. The production factors such as land and labor are relatively abundant and the cost is low, which is enough to attract large number of enterprises. In addition, the northern

Guangdong region was supported by the government's industrial transfer support policy. In 2001, the "10th Five-Year Plan for Mountain Development in Guangdong Province" proposed that mountainous areas should create various conditions to undertake industrial transfer in the Pearl River Delta and coastal economically developed areas. Under the provincial government's industrial support policy for the northern part of Guangdong, a large number of surplus labor force in the northern part of Guangdong played an important role to achieve higher labor productivity, and the degree of decline in capital productivity was small with the improved investment environment. Most enterprises in the northern part of Guangdong are concentrated in low-value-added manufacturing, processing industries and labor-intensive industries. After the industrial transfer, a large number of rural surplus laborers have played a full role, and the employment of low-quality labor has increased. As the investment environment gradually improves, the degree of decline in capital productivity is small, which is conducive to the improvement of TFP. However, due to the low level of local urbanization and imperfect public infrastructure, the productivity of capital factor leads to the negative average annual growth rate of TFP in northern Guangdong.

The above analysis shows that after the local government joined forces to jointly build industrial transfer parks to promote industrial transfer in 2005, the total factor productivity of industrial transfer parks and districts in industrial transfer areas decreased significantly. The negative effect of total factor productivity of industrial transfer is mainly caused by the decline in capital productivity. The regional layout of industrial transfer in Guangdong Province and the industrial park construction system need to be further improved to achieve the positive effect of inter-regional industrial transfer on TFP.

6. Conclusions

Based on the panel data of 120 counties in 21 cities in Guangdong Province from 2001 to 2016, this paper empirically tests the impact of inter-regional industrial transfer policy on total factor productivity (TFP) using double-difference and triple-difference models. The conclusions of this paper indicate that the inter-regional industrial transfer policy in 2005 had a negative impact on the TFP of the industrial undertaking areas. The industrial transfer effects on TFP in the four regions of peripheral area of the Pearl River Delta, eastern, western and northern Guangdong are different. Further research in this paper finds that the decline in TFP is mainly caused by the decline in capital productivity.

The experience of inter-regional industrial transfer in Guangdong Province is of universal significance in China. After the rapid economic growth, the southeast coastal areas are faced with the necessary choices for industrial transformation and upgrading under the factors of labor cost pressure and limited land resources. Inter-regional industrial transfer is an effective measure. However, due to the decline in capital productivity, inter-regional production industry transfer reduces the total factor productivity. How to encourage the government to play

an active guiding role in promoting the process of industrial transfer, to promote the transformation of industrial transfer from “quantity” to “quality” is still a problem to be solved.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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