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Research Article

Urban Industrial Land Expansion and Its Influencing Factors in Shunde: 1995–2017

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The change in the industrial land is of great significance to the sustainable development of cities. However, scholars have done relatively little research on this subject, especially on the urban industrial land expansion process and its influencing factors. This article selects Shunde, a typical Chinese industrial city of the Guangdong province, using remote sensing interpretation to analyze the spatiotemporal evolution of industrial land expansion from 1995 to 2017 and applies the multiple regression model to analyze the influencing factors. The main conclusions are as follows: the industrial land in Shunde has experienced the development trend of "slow expansion-rapid expansion-slow expansion," and the "fragmentation" of the industrial land space is still prominent. Decentralization, marketization, capital, and labor force have passed the significance test of the model, which are important factors influencing the expansion of the industrial land in Shunde. Among them, decentralization is the primary factor, while marketization has the greatest impact on industrial land expansion in Shunde. The influence of globalization and technical progress is not significant.

1. Introduction

After the Second World War, the developed countries represented by the United Kingdom and the United States experienced the process of deindustrialization successively, and the output value of the service industry accounted for more than two-thirds of GDP [1]. The process of deindustrialization has caused the great loss of the industrial land in cities. For example, Atlanta lost 800 acres, which is 12% of the industrial land, during 2004 to 2009. Baltimore's industrial land has been squeezed by new mixed-use housing and office space. Seattle's industrial land was lost due to the pressure of real estate development [2]. After the financial crisis in the US led to the global economic crisis in 2008, there were more and more discussions on the revival of the manufacturing industry in Western developed countries [3]. Meanwhile, the decline of the influence of the manufacturing industry and the loss of the industrial land once again attracted the attention of academia [4]. In addition to reemphasizing the importance of manufacturing, some economic development planners wonder whether there is enough industrial land in urban areas to support the development of manufacturing (e.g., [5]). However, little attention has been paid to the urban industrial land. As Leigh and Hoelzel pointed out, the industrial land has not received much attention and is the "blind spot" of urban smart growth [2]. Gilmore also pointed out that the literature on the sustainable urban form focused on the residential and commercial mixed-use development without considering the industrial land [6].

The economic reform and the opening-up policy implemented by China in 1978 rapidly stimulated the country's urbanization and industrialization process [7]. Under the influence of these two driving forces, China's

urban land expansion has also become a research hotspot for many scholars, which shows the urban expansion process in the space and is relatively mature in methods [8, 9]. However, there is also a lack of research on the expansion of the urban industrial land, and only a little literature mainly focuses on evaluating the efficiency of the industrial land use in certain cities and regions by using statistical data or field investigation [10, 11]. The main reason is that the spatial data of the urban industrial land used by local governments in China are not disclosed to the public. Relevant data can only be obtained when participating in the special planning of local governments.

Understanding the urban industrial land expansion process and its influencing factors is very important to the sustainable development of cities [12]. There is still a knowledge gap in China's policy of urban industrial land use change and the influencing factors with other countries [7]. Only Kuang et al. was found studying the spatial expansion of the industrial land in Chinese cities from 1990 to 2010 by means of manual visual interpretation [7], which still lacks case studies of typical cities. This paper selects the Shunde district in Foshan, a powerful industrial city in Guangdong province, China, and uses the data of GF-1, Landsat TM/ETM, and HJ-1A to analyze the spatiotemporal evolution process of industrial land expansion from 1995 to 2017 by manual visual interpretation. Multiple regression model is also adopted to analyze the influencing factors. Compared with the study by Kuang et al., we pay more attention to the analysis of the typical city.

The paper is structured as follows. Section 2 deals with the literature review, including theoretical basis, urban industrial land and deindustrialization and reindustrialization, and urban industrial land and sustainable development, together with the analytical framework. We then explain the study area, data, and methods. Next, we present and discuss our results and finally arrive at some conclusions.

2. Literature Review

2.1. Theoretical Basis. The use and location of the industrial land and its influence on the urban form have a long theoretical history. After the beginning of the industrial revolution, the early theories of economic geography and urban planning were greatly influenced by industrial activities, and many classical theories were formed in this period. The first representatives are Burgess's Concentric Circle Theory [13], Hoyt's Fan Theory [14], and Harris and Ullman's Multicore Model [15]. These three theories all believed that every urban economic activity (including industry) has a specific space or area. The second representative is by Weber, who, taking economic factors into consideration, believed that market and demand determine the location of industrial regions [16]. Modern methods of the urban form and industrial location are mainly based on these two theories.

2.2. Urban Industrial Land and Deindustrialization and Reindustrialization. After the 1960s, most developed countries and many newly industrialized countries experienced the process of "deindustrialization," but the real public discussion on deindustrialization began in the late 1970s [1]. There are two understandings about deindustrialization in academia: (1) deindustrialization in the geographical sense. It mainly refers to job opportunities especially the work of the manufacturing department transferring from developed countries to developing countries or the metropolis, once known for its traditional manufacturing activities, facing a recession because its traditional manufacturing plants have closed, gone bankrupt, or transferred to other areas where production costs are lower [17]. (2) Deindustrialization in the economic sense. It can be understood in a narrow sense and a broad sense. In a narrow sense, deindustrialization mainly refers to the gradual decline of the advanced manufacturing industry, which used to be the basis of the economic prosperity of industrialized developed countries. It includes the continuous decline of the employment share and output share of manufacturing [17, 18]. In a broad sense, deindustrialization mainly refers to the change in the development stage. Rowthorn and Coutts argued that deindustrialization is the transformation from the industrial economy to the service economy or the economic development stage in which the share of the manufacturing industry declines, while that of the service industry increases in the process of industrialization [19].

However, "deindustrialization" does not always bring positive effects and may have a significant negative effect on economic growth, investment, and employment, thus reducing the economic growth rate [20]. Especially, the impact on employment is more significant. Cowie and Heathcott also pointed out that for most American unemployed workers, deindustrialization means disaster [21]. In this context, developed countries such as the US and Europe, which once vigorously implemented "deindustrialization" measures began to reexamine the relationship between the real economy and the virtual economy and took "reindustrialization" as an important strategy to rebuild competitive advantages [4].

Changes in economic activities will lead to changes in the space [22–24]. Both "deindustrialization" and "reindustrialization" will bring about changes in the industrial land space. The changes in the industrial land brought by "deindustrialization" include the following: (1) the direction of economic development based on the service industry has brought an impact on cities with relatively developed industries and made them decline. Detroit, a once-prosperous industrial city, is still struggling with large-scale urban decline [25]. (2) The economic transition leads to the transformation of a large amount of the urban industrial land into the consumption space such as residential or commercial areas [4]. The change in the industrial land brought by "reindustrialization" can be understood from two aspects: (1) "deindustrialization" after the "reindustrialization." For example, the US has experienced the process of "deindustrialization" and currently implements the strategy of manufacturing reflow, which needs the industrial land as support [4]. (2) "Reindustrialization" requiring industrial upgrading. To implement the Made in China 2025 strategy,

China needs to transform and upgrade its traditional manufacturing sector. The intensity of construction and development in many developed regions of China is too high, and there are many inefficient industrial land due to historical reasons, which makes it difficult for the advanced manufacturing industry project, and the supply of the space for the effective industrial land is seriously inadequate [26].

2.3. Urban Industrial Land and Sustainable Development. Despite the obvious service economy transition brought by deindustrialization, industrial activities remain crucial in the urban space [27]. Howland believed that despite the structural changes in the economy of metropolitan areas, industrial activities are still the core of sustainable economic development in these areas [28]. Leigh and Hoelzel also put forward a similar point of view, believing that industrial activities incessantly maintain a city's "daily life" [2]. Crack noted, "ironically, that many people who moved to the city center still want a variety of industrial services nearby" [29]. Thus, she suggested that specific industrial activities be incorporated into regional planning to prevent the loss of industrial services in urban areas. Without these industrial activities, it is difficult for a city or region to achieve sustainable development. In other words, without certain industrial land serving as a guarantee, these industrial activities are difficult to carry out effectively.

Some scholars have discussed the impact of the industrial land, the most important of which is employment, and they believe that the industrial land is still an important source of local employment [30]. Deindustrialization led to mass unemployment in some cities in the US, such as Detroit, but this decline was the result of a large-scale shift of industrial manufacturing overseas [31]. In most cities, there are still considerable people who are engaged in industrial production. Although only 13% of the urban land is zoned for industrial use in Metro Vancouver, it provides 25% of the employment in the area. They call the industrial land as an employment land [6].

Others argue that the industrial land provides low-cost space for innovation and high-tech manufacturing [30]. Bronstein noted that "scientists and engineers account for 9% of the US manufacturing workforce, twice as much as any other sector" and nearly two-thirds of all private R&D in the US" [30]. Generally speaking, the demand for the space for such new industries comes from the industrial land, such as the Guangdong Industrial Design City, the largest industrial design base in China, which is located in Beijiao, Shunde. Hutton and Paddison explored how knowledge on innovation industry clusters that occur on the industrial land can benefit from spatial connections with other like-minded or related businesses and services [32]. Thus, the local economy can benefit from having a protected industrial land that provides the space for those companies and turns them into industrial clusters.

Smart growth is a growth management strategy aiming at balancing the economic, social, and environmental requirements for sustainable development of cities by promoting compact urban development [33]. Leigh and Hoezel reviewed the 10 of the most popular books on smart growth, and 8 of them were written by the Smart Growth Network [2]. These works described the urban industrial land as "function obsolete, underutilized, and inadequate to support intensive and mixed-use development of smart growth." However, their research suggested that the industrial land is the "blind spot" of urban smart growth, and there is no reason not to incorporate the industrial land into smart growth.

2.4. Analytical Framework for the Influencing Factors of Urban Industrial Land Expansion. The spatial expansion of the industrial land is essentially a process of urban restructuring. A broad array of studies have been carried out in recent years, mainly focusing on the spatiotemporal changes [34–36]. Moreover, studies on driving forces have gradually increased attention. Wei regarded China's economic transition as a triple process of globalization, marketization, and decentralization [37] and believed that the three forces of economic transition had greatly changed the urban and regional spatial structure of the Guangdong province [38].

2.4.1. Globalization. Since the reform and opening up in 1978, globalization has greatly promoted China's opening up to the outside world, especially the rapid growth of the foreign investment and trade on a global scale [37, 39]. Over the past three decades, Guangdong's development has been driven by an export-oriented economy and foreign direct investment inflows [38].

2.4.2. Marketization. Before the reform and opening up, China implemented the planned economic system. The enterprise has neither a strong motivation to pursue profit maximization nor a corresponding economic responsibility and risk [40]. After the reform and opening up, with the introduction of the market competition mechanism, the government's restrictions on factor flow and commodity trade have also been gradually eliminated, and enterprises have become the market players of independent operations [37]. Research evidence shows that the degree of marketization in the Guangdong province is very high in China [38].

2.4.3. Decentralization. China's decentralization process gives provincial and municipal governments more decision-making power [37]. In China, the cities of different levels have different decision-making power, and their acquired resources are also different. This is a consensus in China's urban and regional development.

Shunde is the frontier of Guangdong province's development [26]. We believe that the spatial expansion of the industrial land in Shunde will also be affected by those three forces. In addition, each city's own capital investment, workforce level, technical progress, and other factors also influence the process of urban restructuring in various degrees, which have become common exploratory variables used by scholars [41–43]. We refer to the research by Wang and Zhao and conceptually call them "localization" [44]. To sum up, factors influencing the spatial expansion of the industrial land in Shunde will be analyzed from four aspects: globalization, marketization, decentralization, and localization (Figure 1).

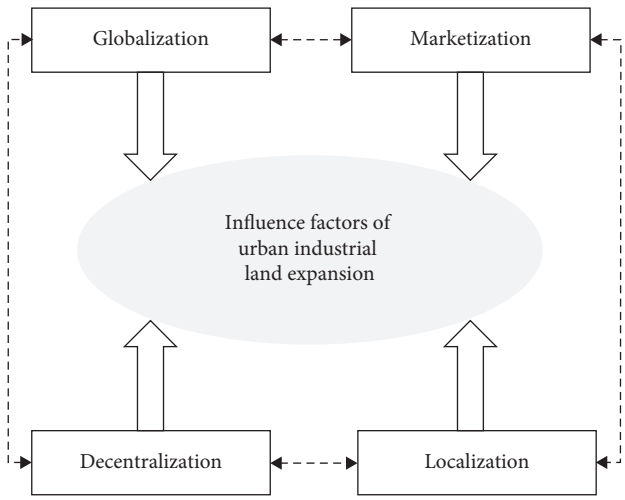

Figure 1: Analytical framework.

3. Methodology

3.1. Study Area. The research area of this paper is the Shunde district in the Guangdong province. For a long time, located in the west bank of the Pearl River Delta, Shunde has been known nationwide for the waterside area of the traditional Lingnan culture. In 1993, Shunde took the lead in establishing Policies on Establishment of Village Shareholding Cooperatives [26] and began its rural industrialization. With the constantly advancing of globalization, industrialization, and urbanization, a series of industry brands such as Midea and Galanz have emerged. The economic development of Shunde has become a typical development model in the Pearl River Delta and even the whole country, known as the "Shunde Model." Its development course has also attracted the attention of many scholars [26, 45–47].

Shunde is now one of the five districts of Foshan, located in the middle of the west bank of the Pearl River Delta, bordering on Guangzhou in the east, Jiangmen and Zhongshan in the south, the Gaoming district in Foshan in the west, and the Chancheng district in the north. It is 32 km from Guangzhou, 118 km from Hong Kong, and 80 km from Macao and is an important part of the Guangzhou-Foshan metropolitan area and the Guangdong-Hong Kong-Macao Economic Zone (Figure 2). The district now has jurisdiction over 4 streets and 6 towns, with a total area of 806 km^2. By the end of 2017, there were 2.614 million permanent residents, including 1.374 million registered residents. In 2017, its gross domestic product (GDP) reached 305.93 billion yuan, with an increase by 8.5 percent over the previous year, ranking first among China's top 100 districts with comprehensive strength. GDP structure of the three industries was 1.5 : 56.5 : 42.0. The total industrial output value was 172.965 billion yuan.

3.2. Data and Methods

3.2.1. Research Thinking. In 1993, the Policies on Establishment of Village Shareholding Cooperatives in Shunde marked the beginning of its rapid economic development [26]. Therefore, the industrial land expansion in Shunde studied in this paper started in 1995 and ended in 2017. Using satellite remote sensing data and industrial land survey data and adopting manual visual interpretation and field survey methods, this paper obtained the spatial and temporal change characteristics of industrial land expansion in Shunde from 1995 to 2017 and analyzed the influencing factors of industrial land expansion, applying the multiple regression model with statistical data over the years.

3.2.2. Data. Early land surveys relied on low-resolution Landsat series of satellite data. With the development of China's commercial satellite remote sensing market, the application of high-resolution satellite remote sensing data has been gradually popularized in recent years. In this paper, the time span of the survey of the industrial land is from 1995 to 2017. The satellite data used are not only high spatial resolution satellite remote sensing data, such as GF-2 PMS and GF-1 PMS, but also low-resolution data, such as GF-1 WFV and Landsat TM/ETM (Table 1). After data preprocessing, such as geometric correction and spectral enhancement, the satellite remote sensing data were processed into the digital orthophoto map (DOM) data of the Gauss Kruger projection, which is the standard data product for manual visual interpretation. In this paper, a total of 23 data sets of industrial land use change in Shunde from 1995 to 2017 were made, among which the data of 2015 were the survey data of industrial land use provided by the government of Shunde, and the data of other years were the results of remote sensing interpretation.

The paper established a multitemporal remote sensing survey technology system for the industrial land. Based on the results, a multiple regression model was used to analyze the related factors affecting the expansion of the industrial land. The technical route is divided into three parts: the first part is the establishment of remote sensing interpretation rules for the industrial land; the second part is the remote sensing interpretation of the industrial land for several years; the third part is the analysis of the influencing factors of industrial land expansion (Figure 3).

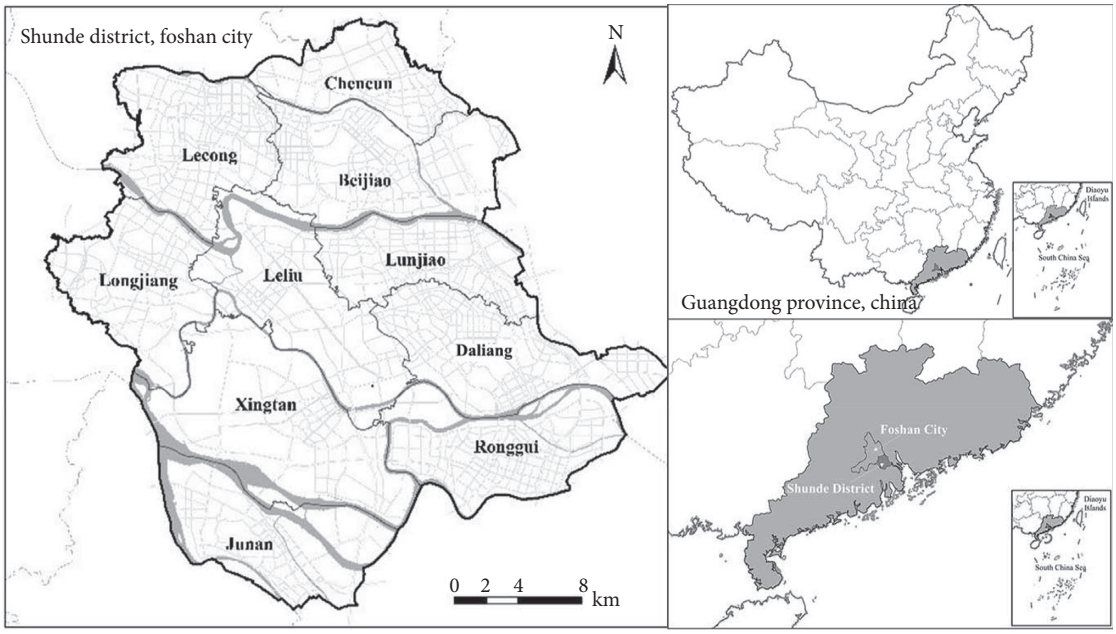

Figure 2: Geographical location of the Shunde district.

Table 1: Remote sensing data of the paper.

Year	Data sources	Spatial resolution (m)
1995–2012	Landsat TM/ETM	30
2013–2014	GF-1 WFV	16
	Official industrial land survey	—
2015	GF-1 WFV	16
	GF-1 PMS	2
2016	GF-1 PMS	2
2017	GF-2 PMS	0.8

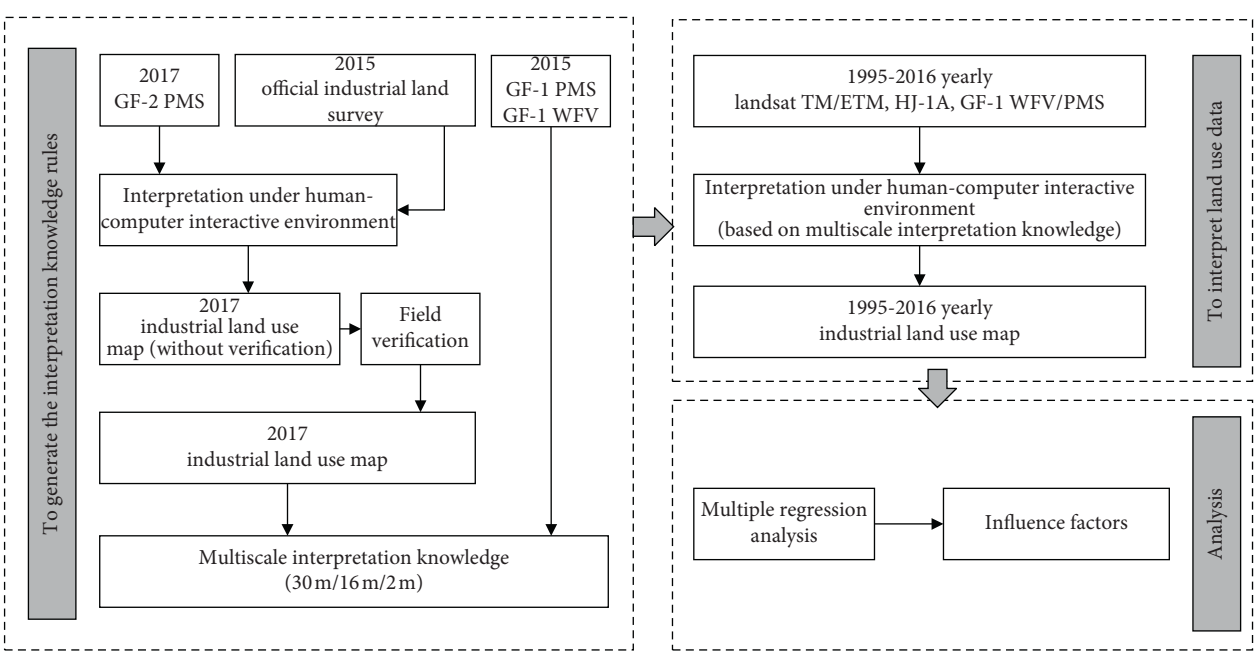

Figure 3: Data processing.

3.2.3. Establishment of Remote Sensing Interpretation Rules for Industrial Land. Referring to the official industrial land survey data in 2015, this paper adopted the method of manual visual interpretation to interpret GF-2 0.8 m DOM data in 2017 and obtained the interpretation results of the current situation of the industrial land in 2017. Compared with the survey data in 2015, 1,138 changing map spots were added to the interpretation results of the current situation in 2017. We conducted on-site investigations on all the changing spots, obtained 4,362 photos of the current situation, and updated the present data of the industrial land in 2017 to ensure its accuracy.

Since the time series studied is relatively long and the data have a wide variety, covering a scale of 0.8 m–30 m, in order to ensure the continuity and comparability of data in different years, we established an empirical knowledge set for the interpretation of the industrial land. We collected GF-1 PMS and GF-1 WFV data in 2015, with GF-2 PMS and GF-1 WFV data in 2017, and studied remote sensing interpretation landmarks of the industrial land at the scales of 0.8 m/2 m and 16 m/30 m.

The early industrial land in Shunde was generated by farmers spontaneously engaged in manufacturing activities, mostly near the residential land. The construction of industrial plants presented a disordered state, and the roofs were mostly made of blue color steel. Some industrial land is located in the area where water or land transportation is convenient. Later, in order to standardize management, industrial parks emerged, with a large land area, orderly spatial layout, and developed traffic network. The most typical remote sensing interpretation landmarks of the industrial land are the buildings related to the manufacturing industry, which have the characteristics of a large area of single buildings which are generally relatively low (see Figure 4). From the perspective of the spatial layout of the interpretation target, the interpretation units mainly include industrial parks under centralized construction, independent industrial land, and residential and industrial mixed construction.

3.2.4. Remote Sensing Interpretation of Industrial Land for Several Years. Historically, the property of the industrial land already built has not changed basically; that is, the industrial land has not been converted for other uses. According to the interpretation method of this paper, the scale of the industrial land was reduced year by year from 2017 to 1995 according to the results of manual visual interpretation. Comparing the data of the current year with the ones of the previous year, if the previous year is an industrial plot and the geometric and spectral characteristics of the plot have not changed significantly, we shall identify the plot as an industrial land, which is completed by manual visual interpretation. Other interpretation principles include the following: as for the industrial land under construction, the part already constructed is classified as an industrial land; nonindustrial land and unused land in industrial parks at all levels shall be excluded; the boundary of the industrial plot is the regular plot separated by the main road and the large building. Based on remote sensing interpretation markers and interpretation rules, we have completed remote sensing interpretation of the industrial land from 1995 to 2014 and 2016.

3.2.5. Multiple Regression Analysis. According to the above analysis framework, variables were selected to explain the influencing factors of industrial land expansion in Shunde: (1) globalization (FDI): the actual amount of utilized foreign capital is applied to measure the globalization degree [38]. (2) Decentralization (DECEN): the ratio of per capita budget expenditure of the local budget and the one of the provincial government is selected to measure the decentralization degree of Shunde [38]. (3) Marketization (NSOE): the influence of marketization is captured by the share of non-SOE enterprises above the designated size in the total employment. (4) Investment (FIX): the total amount of fixed asset investment is selected to measure the capital investment of Shunde [41]. (5) Labor force (LF): considering the data availability, the number of industrial employees is used to measure the workforce level in Shunde. (6) Technological progress (TP): considering the data availability, the R&D expenditure of industrial enterprises is selected to measure the technological progress of Shunde. Data of all variables from 1995 to 2017 were provided by the Shunde District Statistics Bureau.

Scholars often use multiple regression models to analyze the influencing factors of spatial change [48–50]. This paper still adopts the multiple regression model to analyze the influencing factors of spatial expansion of the industrial land in Shunde. The formulas are as follows.

Let the dependent variable be y and k-independent variables be $x_1, x_2, \ldots, x_k$. The equation describing how the dependent variable y depend on independent variables $x_1, x_2, \ldots, x_k$ and error term ε is called the multiple regression model, and its general form can be expressed as

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon, \tag{1}$$

where $\beta_0, \beta_1, \beta_2, \ldots, \beta_k$ represents the parameters of the model and ε is the error term.

According to the specific indicators selected in this paper, the multiple regression model can be set as

$$\begin{aligned}\ln(\mathrm{IL}) = {} & \beta_0 + \beta_1 \ln(\mathrm{FDI}) + \beta_2 \ln(\mathrm{DECEN}) + \beta_3 \mathrm{NSOE} \\ & + \beta_4 \ln(\mathrm{FIX}) + \beta_5 \ln(\mathrm{LF}) + \beta_6 \ln(\mathrm{TP}) + \varepsilon,\end{aligned} \tag{2}$$

where IL is the dependent variable which represents the area of the industrial land and $\beta_k (k = 1, \ldots, 9)$ represents the influence coefficient.

4. Results and Discussion

4.1. Spatial and Temporal Evolution Characteristics of Industrial Land Expansion in Shunde from 1995 to 2017. According to Figure 4, the industrial land area of Shunde from 1995 to 2017 is interpreted (Table 2 and Figure 5). As shown in Table 2 and Figure 5, the expansion of the

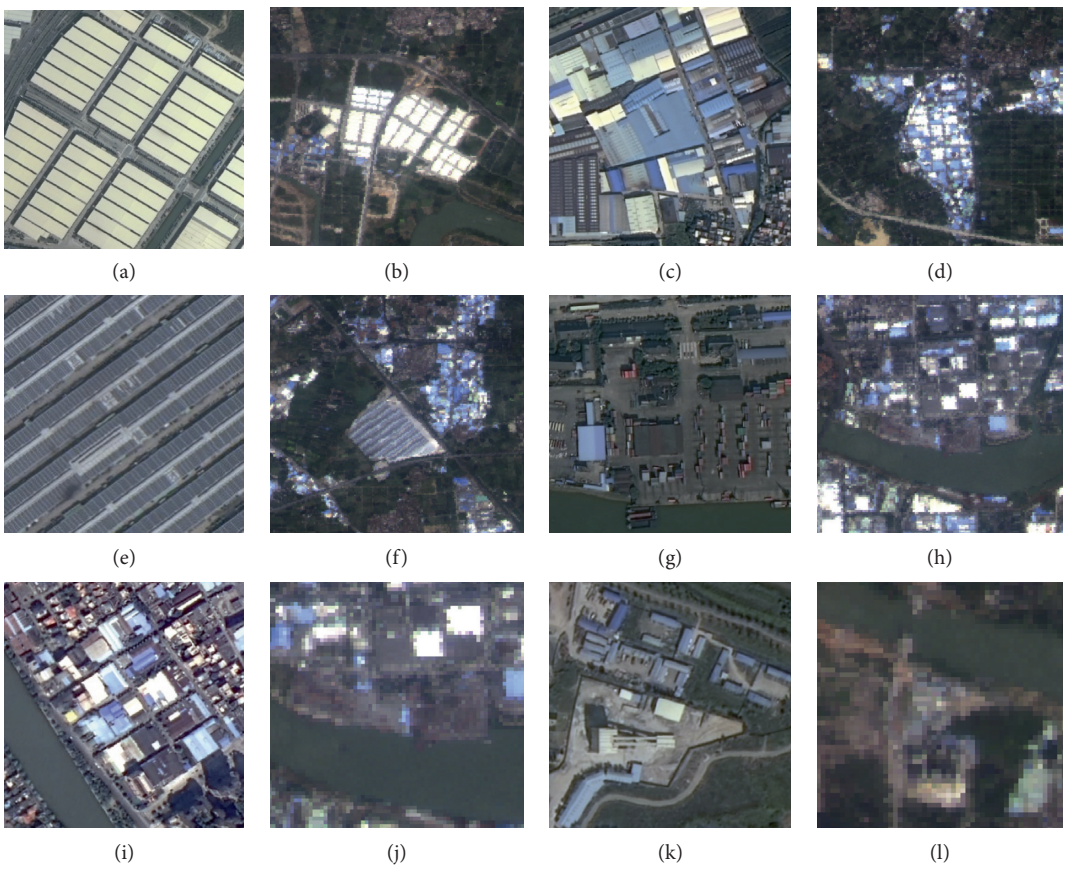

Figure 4: Display of different remote sensing images.

Table 2: The area of the industrial land in Shunde from1995 to 2017.

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Area (km^2)	29.3	31.5	36.0	39.0	42.9	51.5	56.2	64.4	67.2	87.4	98.3	104.6	105.1	108.5	112.7	113.4	126.1	129.9	132.3	133.7	138.9	140.5	141.9

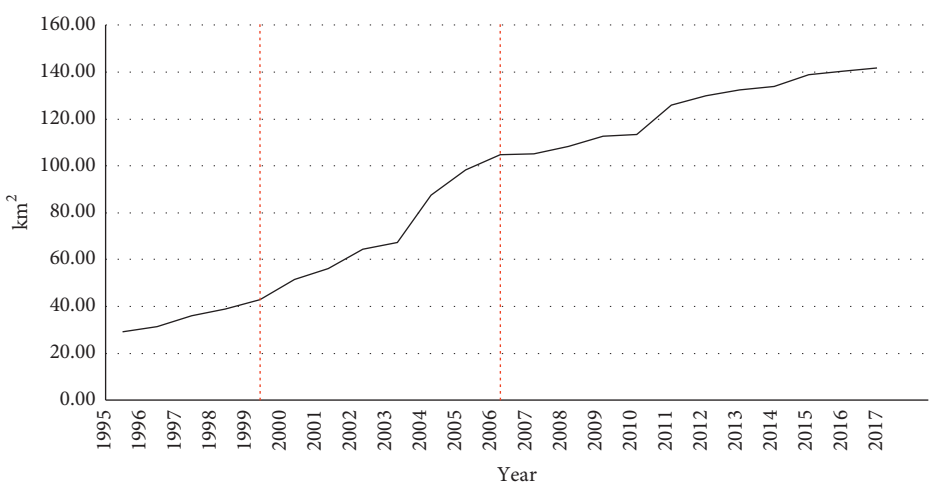

Figure 5: Variation trend of the industrial land area in Shunde from 1995 to 2017.

industrial land in Shunde from 1995 to 2017 has roughly gone through three stages: (1) during the slow expansion period (1995–1999), the expansion area of the industrial land in Shunde was 13.62 km^2, with an average annual expansion rate of 3.40 km^2. This period was the reform period of township enterprises and the property right system in

Shunde, which further activated the development vitality of enterprises and laid a foundation for the later rapid expansion of the industrial land. (2) During the period of rapid expansion (1999–2006), the expansion area of the industrial land in Shunde was 61.72 km^2, with an average annual expansion of 8.82 km^2. During this period, the government began to actively guide the development of the urban industry and built a market-oriented economic system, which greatly promoted the expansion of the industrial land. (3) During the period of slow expansion (2006–2017), the expansion area of the industrial land in Shunde was 37.35 km^2, with an average annual expansion rate of 3.36 km^2. The outbreak of the global financial crisis in 2008 affected the export-oriented economy in the Pearl River Delta region, which had an impact on the demand of the manufacturing industry and slowed down the economic growth rate. Because the previous rapid expansion of the industrial land area has reached a saturation value, the corresponding expansion rate slowed down. In general, the expansion of the industrial land area in Shunde from 1995 to 2017 experienced a development trend of "slow expansion-fast expansion-slow expansion."

As shown in Figures 5 and 6, we can see the spatial changes of industrial land expansion in the above three stages:

(1) From 1995 to 1999, the industrial land space in Shunde showed an obvious "fragmented" feature. Shunde established the land shareholding cooperatives relatively early in China. The system contributes to the concentration and the large scale of land of rural collective organizations, which compensates for the incomplete and vague property right of the collective land ownership [26]. The village collective introduced a large number of enterprises to villages through cheap lease of land, increased the villagers' income by charging rent, and rural industrial land scale was further expanded [51]. Rural industrialization began everywhere in the village. Although during this period, rural industrialization of Shunde became more prosperous, the "fragmented" spatial characteristics brought challenges to the management of the whole city. The government lacked the ability of large-scale infrastructure investment and construction. Rural infrastructure construction of road and traffic failed to meet the demand of spatial distribution of rural industrialization in time. Market spontaneously relied on the external road, giving full play to the advantages of the flexibility of "road economy." Low-cost trade market along the road and the distribution of industrial production sites presented a "multipoint and loop propagation" type [52].

(2) From 1999 to 2006, the spatial expansion rate of the industrial land in Shunde was relatively fast, and it can be seen spatially that many larger plots were added. Since 1999, Shunde has adjusted the development direction of urban and rural construction and implemented intensive development and construction. Government functions were also gradually transformed into infrastructure construction, social management, and the provision of public services. During this period, the government led the construction of many large industrial parks. In addition, with the continuous expansion of the scale of Midea, Galanz, and other large enterprises, they gradually expanded to surrounding areas. The scale expansion of large enterprises has driven the development of supporting and service enterprises in the upstream and downstream of the surrounding areas. In order to reduce costs, these enterprises mainly centralized around large ones.

(3) From 2006 to 2017, the industrial land expansion in Shunde was relatively slow, and the newly added industrial land decreased significantly. The main reason is that the industrial development in Shunde is relatively mature, forming a stable development pattern. The service-oriented industries such as real estate, finance, and science and technology are growing increasingly stronger. The government seems to be more inclined to the development of the service industry. However, in general, the expansion of the industrial land does not abandon the "fragmented" spatial characteristics, and the spatial spread pattern of the industrial land accumulated in the past is still very prominent.

4.2. Influencing Factors of Industrial Land Expansion in Shunde from 1995 to 2017. It can be seen from Table 3 that there are 23 annual sample data of Shunde from 1995 to 2017. In the main variables of the model, the overall standard error is small and below 1, indicating that the sample statistics are close to the values of the population parameters. The samples are representatives of the population. It is reliable to infer the population parameters with the sample statistics.

The paper made an empirical analysis on the factors influencing the industrial land expansion in Shunde using the least square method with the help of Stata 14.0. Considering the time effect, the estimated equation and relevant test values are as follows:

$$\ln \mathrm{IL} = -1.46 + 0.006 \ln \mathrm{FDI} + 0.894 \ln \mathrm{DECEN} + 3.052 \ln \mathrm{NSOE} + 0.581 \ln \mathrm{FIX} + 0.622 \ln \mathrm{LF} - 0.28 \ln \mathrm{TP}$$
$$(2.997)^{*}\ (0.183)\ (0.463)^{*}\ (1.492)^{*}\ (0.120)^{*}\ (0.273)^{*}\ (0.320)^{*}$$
$$R^2 = 0.9784\ \mathrm{Adj}\ R^2 = 0.9703\ F(6, 16) = 120.93\ F = 0.000.$$

It can be seen from the above equation that the goodness of fit of this equation is good, and all the factors have passed the significance test at the level of 5% or 10%, indicating that the totality of the equation is significant. DECEN had a positive effect on IL and passed the significance test of 10%, the impact coefficient of which was 0.894, indicating that for each 1 percentage point increase in DECEN, IL would increase by 0.894 percentage points. NSOE had a positive effect on IL, and the impact coefficient was 3.052 which passed the significance test of 10%, indicating that for each 1 percentage point increase in NSOE, IL would increase by 3.052

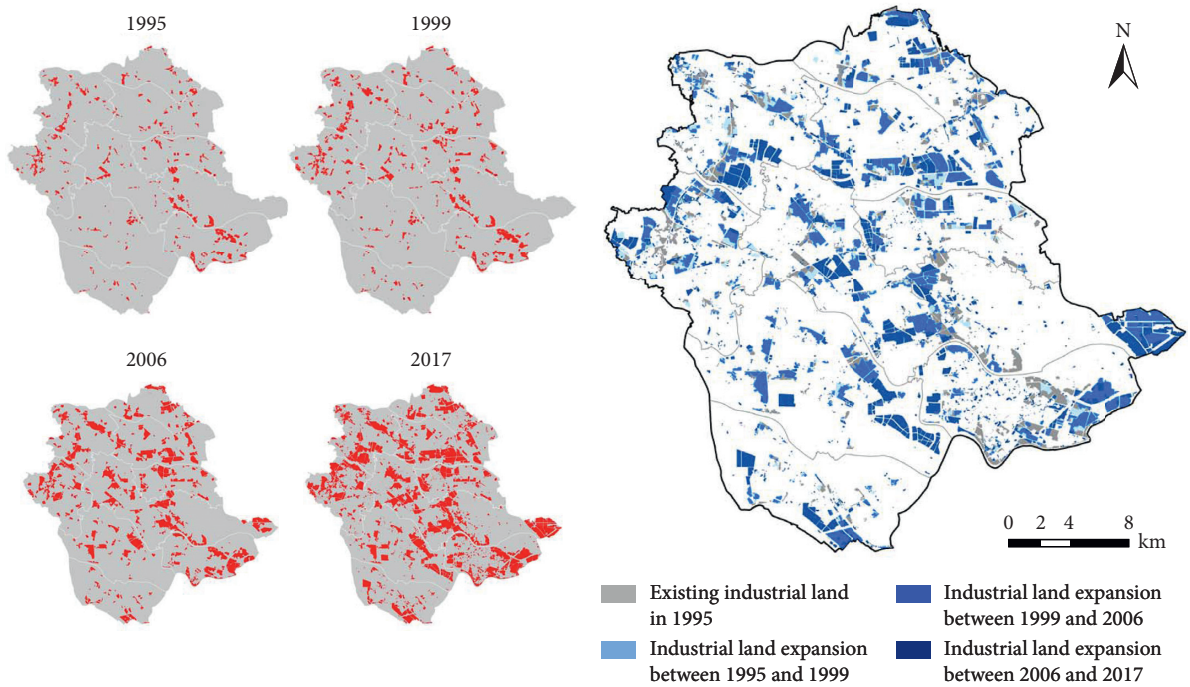

Figure 6: Spatial changes of the industrial land in Shunde from 1995 to 2017.

Table 3: Descriptive statistics of analysis variables.

Variable	Obs.	Mean	SD	Min.	Max.
IL	23	4.4046	0.5047	3.5830	4.9334
FDI	23	10.4972	0.6985	9.5205	11.4407
NSOE	23	0.9996	0.0003	0.9989	0.9999
DECEN	23	0.8410	0.1722	0.5670	0.9959
FIX	23	4.0965	0.8583	2.8631	5.2187
LF	23	13.2978	0.3169	12.9814	13.7574
TP	23	12.9464	0.3464	12.6066	13.5102

percentage points. FIX had a positive effect on IL, which passed the significance test of 5%, and the impact coefficient was 0.581, indicating that for each percentage point increase in FIX, IL would increase by 0.581 percentage points. LF had a positive effect on IL, which passed the significance test of 5%, and the impact coefficient was 0.622, indicating that for each 1 percentage point increase in LF, IL would increase by 0.622 percentage points. It can be concluded that marketization has the greatest influence, followed by decentralization, labor, and capital. FDI and TP had a negative effect on IL and did not pass the significance test, indicating that both had a small effect on IL in Shunde.

Before 1995, especially before 1990, the economic development of Shunde was mainly based on agriculture, and the industrialization process was relatively slow. In 1992, Deng Xiaoping made a speech during his southern tour, sending the message that development is the absolute truth [38]. Shunde began its rural industrialization relatively early. In the context of the decentralization of national finance, approval, and other power [37], the Pearl River Delta responded positively by transferring the approval power of the land and municipal administration to villages and towns, which applied for the construction land in the name of objective demand for the development of township enterprises [51]. Under the impetus of decentralization, the industrial land in Shunde began to expand gradually, but the spatial distribution was very fragmented. Decentralization also brought spatial fragmentation of the industrial land, and the bottom-up mode was more obvious. We should say that decentralization is the primary influencing factor to promote the expansion of the industrial land in Shunde.

On the basis of vigorous development of township enterprises, in June 1993, the People's Government of Shunde District issued "Trial Measures on Transforming Enterprise Mechanisms and Developing a Mixed Economy" and began property right reform of enterprises under public and collective ownership throughout the city by means of exclusively government-owned, holding stake, equity participation management, etc., and achieved diversification of property subjects through property right transfer, capital attraction, share expansion, public auction, and establishing

shareholding system, shareholding cooperative system, mixed economy, etc. By 1997, Shunde had taken the lead in establishing a framework of the socialist market economy in the country and had become a pioneer in the reform of the property right system of Chinese enterprises. After a large number of enterprises completed the transformation, Shunde achieved property right diversification, and enterprises began its independent management and responsibility for profits and losses, which greatly activated the vigor and vitality of the enterprises, thus brought out a large number of outstanding enterprises, such as Midea, Galanz, and many other famous manufacturing enterprises. They rapidly rose in this round of reform. The increasing marketization greatly promoted the social and economic development of Shunde. With the continuous expansion of these large enterprises, the development of supporting small enterprises in the upstream and downstream of the surrounding areas was also prompted. In order to reduce the cost, these small enterprises were mainly concentrated around large ones, and the industrial land also expanded rapidly. These explanations provide strong evidence that marketization has become the most important factor influencing the industrial land expansion in Shunde [52].

FIX is an important influencing factor to the reconstruction of the urban space in China, and an indisputable consensus has been reached [53]. Shunde is no exception. Sufficient fiscal revenue is an important driving force for investment in industrial activities. With the acceleration of the industrialization process in Shunde, a large number of industrial jobs have been provided. Thus, LF has also become one of the influencing factors for the industrial land expansion in Shunde, which is consistent with some research conclusions [44]. Localization has also become an important factor for the spatial expansion of the industrial land in Shunde. The reason why FDI and TP are not significant is that the industrial land efficiency in Shunde is polarized [52]. Although large enterprises with a high output value, such as Midea and Galanz, have a higher degree of globalization, they occupy less industrial land. Most of the enterprises are in low-end manufacturing, and the output value is lower but occupy a larger industrial area. Most of them provide supporting services on machine parts for big companies such as Midea, which does not need much technical support. Therefore, the influence of FDI and TP on the industrial land expansion in Shunde is not obvious.

Globalization, decentralization, and marketization provide an important theoretical framework for the spatial reconstruction of China's macroregions [37, 38, 44]. However, in different spatial scales, the emphasis points are different. The three forces of decentralization, marketization, and localization mainly affect the spatial expansion of the industrial land in Shunde, while the impact of globalization is not significant, which is closely related to the urban development history, policies of Shunde, and other factors.

5. Conclusions

The study fills in the gaps in the study of urban industrial land expansion. Using multisource remote sensing data, the paper analyzed the spatial expansion process of the industrial land from 1995 to 2017 of Shunde, the typical industrial city in China. Adopting the multiple regression model, we analyzed its influencing factors and found that the expansion of the Shunde industrial land has experienced the "slow expansion-rapid expansion-slow expansion" trend. "Fragmented" characteristics of the industrial land space are still prominent. Our research also manifests that decentralization, marketization, capital, and labor force have passed the significance test of the model, which are the important influencing factors of industrial land expansion in Shunde. Decentralization is the primary factor promoting industrial land expansion, while marketization has the greatest influence on the expansion. The impact of globalization and technical progress on industrial land expansion is not significant. We selected a typical city and analyzed the spatiotemporal evolution process and influencing factors of industrial land expansion, in order to better guide the sustainable development of Chinese cities.

Data Availability

The satellite data used to support the findings of this study cannot be made freely available.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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