THE DRIVING FORCE OF INDUSTRIAL LAND DEVELOPMENT AMONG URBAN GROWTH：A CASE STUDY OF ZHEJIANG PROVINCE

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ABSTRACT

During the past three decades, with the sustained and high-speed economic growth, urbanization rate is constantly increasing in China. As the same time, the scale of cities is quickly expanding in many regions of China. As the driving force of urban growth, the expansion of industrial land influences the change of urban spatial structure. Taking Zhejiang province as a case, this paper aims to study the "double effect" that the expansion of industrial land brings to urban scale. The "double effect" means the direct effect that the expansion of industrial park brings to urban expansion, as well as industrial economy's pulling effect on the other industries. Finally, some strategies for urban development are proposed, such as changing the expansion mode of industrial land and enhancing competitiveness in economic environment.

KEYWORDS

urban growth; industrial land; intensive land use ; Zhejiang province

INTRODUCTION

In parallel with the extraordinary economic development since reform and opening, China has witnessed an unprecedented urbanization. Until the year of 2008, the rate of urbanization, namely the ratio of urban population, rose from 20% in 1978 to 44.9%, and the urban population reached 590,000,000. At the end of 2008, the area of urban built-up district had reached 29,400 square kilometres1. Urbanization has become one of the most important means of promoting economic growth and social progress in China.
Urbanization is closely connected with industrialization. Industrial development is widely recognized as one of the important driving forces of urban growth and development (Zhou *et al*, 2008). Industrial parks, as the main form of industrial land use, are developing rapidly in China. According to the comprehensive survey of industrial land in 2003, there were 6024 industrial parks, including more than 200 approved by the State council, covering an area of 34,500km^2, with 754 industrial parks located in Zhejiang province. However the industrial land use is inefficient accompanying with the high-speed growth. Many reasons behind have been identified. For example, the regional excessive competition forced the price of industrial land down from place to place. The peasants' interests suffered from cultivated land loss in the process of industrial land expansion. The mode of industrial land use, which is led by the government, lacked competitive mechanism. The inefficiency caused urban border "extending" and agricultural land border "shrinking".

There are many studies on urban growth and industrial land. As early as 1909, Weber has elaborated the relation between industrial location and enterprise site selection (Weber, 1997). After Weber, Welch computed the area of urban built-up district through visually interpreting TM false colour composite graph, and further analyzed the relation between area of urban built-up district and urban population, measuring urban development through migration of employed population. Zhou and Meng pointed out that "The expansion of metropolis in China, such as Beijing, Shanghai, Guangzhou, Shenyang etc. had showed the typical trend of suburbanization."(Zhou and Meng,1998). Guo opined that "City growth expresses population gathering in cities, above all, because the old industrial enterprises move to suburbs in a large scale per se the land price disciplines."(Guo *et al*.2004). Hao identified population increase, economic development, industrial agglomeration and structure adjustment of industry as the driving forces of the expansion of urban built-up district in Nanjing (Hao *et al*.2004). Lu believed that the development of industrial land guides the expansion of residence and business land, thus determines the

[1] China statistical yearbook(2009)

speed of city expansion (Lu *et al*. 2006).

Urban spatial structure is the spatial projection of all kinds of activities of human and functional organizations on the urban land. Urban spatial structure can be interpreted from many aspects such as land use structure, economic spatial structure, spatial distribution of population, spatial distribution of employment, transportation stream structure, social spatial structure, life spatial structure (Chen and Li, 2010). The dramatic change on urban spatial structure caused by industrial revolution makes the study on urban spatial structure approach a new stage of systematization and theorization. Meanwhile, the research focus turns from urban functional space to ecological environment, then to regionalization and networked (Wu and Zhu, 2001).

The urban land rent theory reflects the competitive mechanism of land among different types of land use. Generally speaking, the land which is closer to downtown area with better accessibility has higher land value. As a result, traditional downtown area is always the target that service sector with high profit such as business, and finance pursues. However, with the modernization of transportation and communication, rate of industrial output makes hardly any difference in downtown district and suburban district. Therefore it is possible for industrial enterprises transfer to suburban district from downtown district for lower rent and labour cost (Gu *et al*.2000). The expansion of industry has become the chief reason for city expansion. According to basic economic theory, the more products and service the basic industry of a city provide to other districts, the larger the scale of the city will be (Yan and Xu, 1999). With industrial as the leading industry, outward-oriented economy provides products and services mainly for district outside the city. The industrial development further drives the circulation of employed population and guides the constant expansion of residence and business land by "multiplier effect". Then basic industries such as service, education, and recreation will appear in the new space of the city, which accelerates the expansion of urban scale.

Few studies have investigated city scale growth from the aspect of industrial land use, although industrial land development is critical for urban growth. Therefore, this study aims to explore urban growth from the aspect of industrial land use by referring to urban land rent theory and basic economic theory. This paper will conduct an empirical analysis of the “promoting effects” of industrial land on the expansion of the urban size. Zhejiang Province will be used as an example to demonstrate the analysis.

METHODOLOGY AND CASE

The method of this paper is the combination of theoretical and empirical and the combination of quantitative and qualitative analysis. From an empirical point of view, Zhejiang Province will be used as an example to demonstrate the analysis. The paper will conduct an empirical analysis of the “promoting effects” of industrial land on the expansion of the urban size. It aims to study the "double effect" that the expansion of industrial land brings to urban scale."Double effect" means the “direct effects” and the “indirect effects”. This paper studies the “direct effects” by making correlation analysis between the industrial parks size and the proportion of secondary industry employment. After that, the “indirect effects” is analysed by using location quotient to compare the two periods of industrial structure in Zhejiang province.

During the 11th Five-Year Plan period, industry has rapid growth in Zhejiang province and it helps tertiary industry develop. Figure 1 shows the changes of added value of the secondary industry and the tertiary industry from 1979 to 2009. From 1992 to 2007, Zhejiang province boasted a rapid growth of total industrial output value, and especially from 2002 to 2007, the average annual growth rate reached 16.61%. The Industrial Park of Zhejiang Province has entered a new stage of rapid development since 2000. According to a survey, there were 140 industrial parks established in 2000, 185 in 2001, 167 in 2002 in Zhejiang (Huang, 2004). The total industrial output value has enjoyed a rapid growth till 2008, but decrease after that year. It is partly caused by the financial crisis, and partly due to economic structure adjustment. As the rapid expanding space for industrial land is becoming saturated, the industrial economic form is beginning to transform to a service-based economic one, and the tertiary industry is growing rapidly (Gu, *et al*. 2004). Figure 1 shows that the output value-added of the tertiary sector such as the commercial and residential housing and service industry has grown at an accelerating speed, which surpassed that of the industrial output value-added. This shows that the expansion of industrial land is promoting new urban space, propelling people to move in the new urban district, which facilitate the development of the tertiary sector such as housing, commerce, and infrastructure.

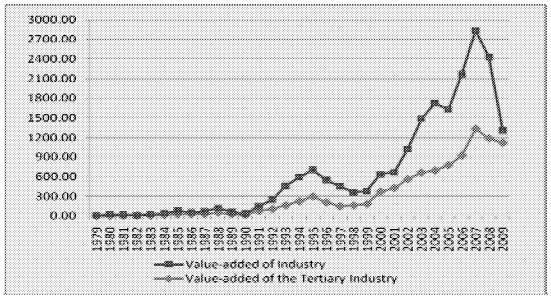

Figure 1 Value-added of industry and value-added of the tertiary industry in Zhejiang from 1979-2009(unit: 10^2 million yuan)

Data sources: Zhejiang statistical yearbook (2010)

While the total industrial output value is growing rapidly, the urban construction area and industrial area has also enjoyed a corresponding growth (see Figure 2). The total area of construction land in Zhejiang increased from 7918.93 km^2 in 2000 to 10130.91 km^2 in 2007 with an average annual growth of 3.99% or 2211.98 km^2. The area of residential and industrial and mining land has increased from 5877.42 km^2 to 7864.52 km^2. The ratio of residential and industrial and mining land to the construction land increased from 74.22% in 2000 to 77.63% in 2007. However, the expansion of industrial land is inefficient. From 2000 to 2007, the construction area per capita has increased from 175.93 m^2 to 217.43 m^2. From 2000 to 2002, the GDP per square kilometer in the urban were respectively RMB 0.564、0.537、0.546 billion (Li,Li,2004), which showed a downward tendency and it kept the tendency from 2003 to 2007. The economic growth and the construction land expansion were not proportional. The reason is that Zhejiang has taken a form of rural industrialization, which implies that urbanization was determined by the selection of industrial location (Yang, 2000). The rural land use efficiency during industrial development determined the speed of urban expansion.

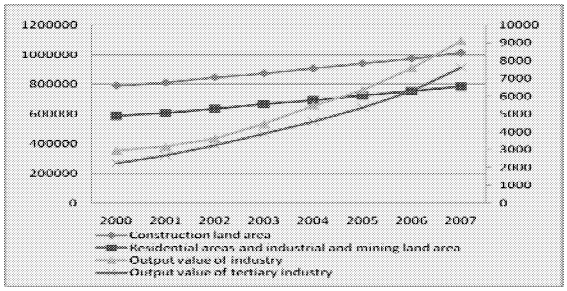

Figure 2 The construction land area and output value of industry and tertiary industry in Zhejiang province from 2000-2007(unit: hectare, 10^2 million yuan)

Notes: Output value of industry and output value of tertiary industry use the right axis, and the others use the left axis.

Data sources: Zhejiang Territorial Resources Statistics 2000-2007

THE "DIRECT EFFECTS OF URBAN GROWTH" DRIVING FORM INDUSTRIAL LAND DEVELOPMENT IN ZHEJIANG PROVINCE

In order to simplify the analysis, this paper chose 23 typical industrial parks in various counties and districts in Zhejiang. This study will demonstrate the industrial land expansion through industrial parks development scales and discuss its relation with urban growth. The planning area of each industrial park is used to represent the industrial land scale, and the urban built-up area and the proportion of workers in the secondary sector are used to characterize urban size as shown in Table 1.

Figure 3 shows the scale characteristics of industrial park based on Table 1. By comparison, Figure 4 illustrates the high-tech parks and their sizes in major cities around the world.

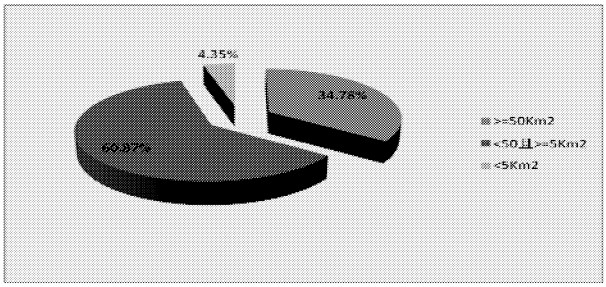

Figure 3 The proportion of the scale of Zhejiang industrial parks

Data sources: Wu,Y. (2005)." Research on the scale of High-tech parks and space benefits" *Tongji university*.

Table 1 Part of city industrial parks in Zhejiang and the scale (unit: km^2, 10^2 million yuan, %)

number	About the city					About the industry park	
	city	Build-up area of the city	Output value of industry	Output value of tertiary industry	The proportion of the second industry employed person	The name of industrial park	Planning area
1	Hangzhou District	344.48	1613.35	2135.72	48.85	Hangzhou Economic and Technological Development Zone	104.70
2	Ningbo District	221.40	898.04	1086.82	44.77	Ningbo Chemical Industrial Zone	58.00
3	Taizhou District	113.87	320.00	353.62	38.79	Taizhou Luqiao Central Industrial Zone	23.00
4	Jiaxing District	78.50	211.00	211.41	45.24	Jiaxing Xiuzhou Industrial Park	50.00
5	Huzhou District	71.70	256.54	193.13	31.40	Huzhou Economic and Technological Development Zone	66.00
6	Jinghua District	68.79	134.50	159.35	28.10	Jinghua Industry Park	18.38
7	Zhoushan District	49.17	134.78	180.58	31.05	Marine Food and Drug Industrial Park	66.70
8	Quzhou District	44.70	110.81	98.93	15.87	Quzhou Economic and Technological Zone	9.80
9	Shaoxing	44.50	370.84	223.12	53.82	Shaoxing Binhai Industry Park	100.00
10	Yuyao	35.00	269.48	184.46	37.29	Yuyao Economic and Technological Zone	31.60
11	Linhai	34.30	126.79	106.83	23.90	Linhai Economic and Technological Zone	30.00
12	Cixi	32.57	351.47	222.71	54.19	Cixi Economic and Technological Zone	120.00
13	Shengzhou	32.30	114.05	81.27	37.88	Shengzhou Economic and Technological Zone	38.50
14	Yueqing	22.30	240.91	150.41	24.53	Yueqing Economic and Technological Zone	28.12
15	Shangyu	20.30	190.63	122.73	45.29	Hangzhou Bay Fine Chemical Zone	80.00
16	Deqing	17.80	111.01	62.46	27.09	Moganshan Economic and Technological Zone	7.50
17	Anji	15.73	67.28	64.13	27.19	Tianzihu Industry Park	18.50
18	Fenghua	12.58	85.06	83.45	36.32	Fenghua Economic and Technological Zone	60.00
19	Jinyun	11.70	48.90	29.75	18.15	Jinyun Xinbi Industry Park	24.97
20	Yunhe	5.66	11.31	10.57	28.51	Yunhe Wooden Toys Industrial Zone	1.20
21	Qingyuan	5.50	8.59	10.43	13.93	Qingyuan Songyuan Industry Park	10.00
22	Suichang	5.18	18.99	19.36	15.14	Suichang Metal Products Industrial Zone	15.00
23	Panan	4.54	17.63	12.53	24.33	Panan Industry Park	48.00

Data sources: Chinese industrial real estate nets, Zhejiang statistical yearbook (2010)

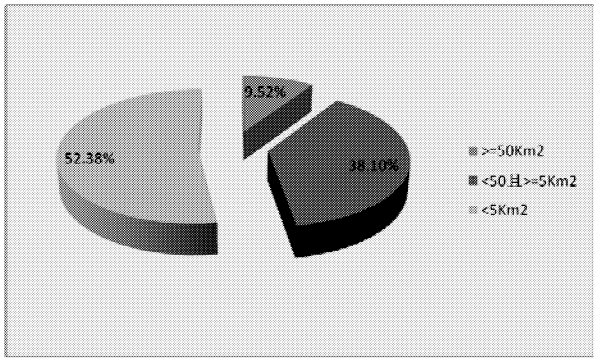

Figure 4 The proportion of the scale of city industrial parks around world

Data sources: Wu,Y. (2005)." Research on the scale of High-tech parks and space benefits" *Tongji university*.

By comparing Figure 3 with Figure 4, we conclude that 95.65% industrial parks in Zhejiang have an area size over 5 km2, and most of industrial parks are less than 1/3 of the built-up area. However, 90.48% industrial parks

around world have an area size less than 5 km^2, which is quite different from that in Zhejiang. Many emerging and developed industrial countries and regions have a small scale of industrial park. For example, Korea, an emerging industrial country, the average total area of technological park is 3.1 km^2 While that for Hong Kong 0.76 km^2, Taiwan 4.48 km^2 , and Japan 0.32 km2 (Wu, 2005). It is obvious that Zhejiang has a significantly larger industrial park area compared with that in other countries and regions. However, in 2009, the unit output value of industrial land was RMB 1.59 billion/km^2 in Zhejiang, while that for Tokyo RMB 8.1 billion/km^2, New York RMB 5.24 billion/km^2, Paris RMB 4.69 billion/km^2. The unit output value of industrial land of Zhejiang is far less than that of many developed regions.

Moreover, the relationship of the industrial park size and the employed workers in the secondary industry was explored through linear regression as shown in Figure 5. It is found that the industrial park scale is positively correlated to the workers in the secondary sector. Because the industrial parks cannot totally represent the total industrial land use, the positive correlation property is not that obvious (with R^2 is only 0.6494).

Furthermore, the study investigated the relationship of the total industrial output value and that of the tertiary sector with the built-up area as shown in Figure 6. Both are positively correlated with the built-up area and the explaining power is relatively strong. On the one hand, this shows that industry is the main factor driving urban growth, and on the other hand it explains that the increasing portion of the tertiary sector is mainly due to the contribution of the production industry. In addition, this is also a rebuilding process of the urban industrial space. Since the benefit generated from industrial land is less than that of commercial and residential land, the expansion of the industrial enterprises force the traditional industrial centres gradually to decline. The industrial enterprises move from the centre of the city to the urban fringe, where they concentrate in broader space (Gu, *et al*, 2000). New industrial activities generate new production space, thus promotes the growth of the numbers of cities.

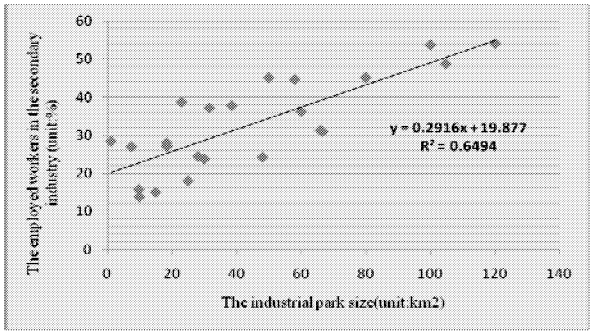

Figure 5 The correlation between the scale of industry park and the proportion of the secondary industry employed

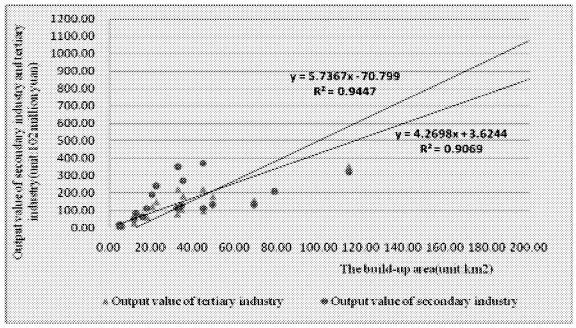

Figure 6 The correlation between the build-up area of the city and output value of secondary and tertiary industry

However, the oversized but low efficient industrial parks are inappropriate therefore the urban growth is not scientific. The scale of industrial parks should be based on the city size, economic foundation, and location (Wu, 2005). If the industrial parks are too large surpassing the total capacity of the city and its total supply to the parks, the economic benefits of the parks will be reduced.

THE "INDIRECT EFFECTS OF URBAN GROWTH" DRIVING FORM INDUSTRIAL LAND DEVELOPMENT IN ZHEJIANG PROVINCE

The development of industrial parks will lead to the transfer of the rural surplus labor while the transfer of the non-agricultural labor is one of the signals of the degree of industrialization. The work population from every profession and trade is the important bond linking urbanization and the process of industrialization. The changes of the structure of the work population reflect the trend of local economic activities. The transfer of the work population injects vigor into the regional economy, promotes the total output value of the tertiary sector, and increases the employment in the tertiary sector, thus raising the demand of industrial and residential land and infrastructure with the increasing population and expanding city. The changes of the employees reflect the indirect effects of the industrial land expansion casting on urban growth.

The location quotient can reflect the input-output relationship between the economic sectors and the exterior zones (Yan, Xu, 1999). When the location quotient is less than or equal to 1, the sector enjoys net input and conducts non-basic economic activities; and when the location quotient is more than 1, the sector has output and conducts basic economic activities.

Table2 The employees in urban units and location quotient of Zhejiang in 2000 and 2009 (unit: 10^3, %)

Industrial sector	2000			2009		
	Number of employed person	Proportion of employed person	location quotient	Number of employed person	Proportion of employed person	location quotient
Farming, Forestry, Fishing animal husbandry	3.4	0.64	0.67	14.9	0.18	0.06
Mining and Quarrying	0.6	0.11	0.04	16.6	0.20	0.05
Industry	154.7	29.45	0.82	3330.8	40.92	1.47
Electricity, gas and water production and supply industry	2.8	0.54	0.84	124.7	1.53	0.63
The construction Industry	150.4	28.63	1.59	1558.5	19.15	2.04
Transportation and telecommunication services	17.4	3.31	0.85	239.4	2.94	0.58
Wholesale and retail trade and restaurants	77.7	14.80	0.75	43.02	5.29	1.97
Financial and insurance	36.5	6.94	1.48	279.8	3.44	0.96
Real estate	02.2	0.42	0.95	103.9	1.28	0.84
Social services	26.6	5.06	1.21	255.4	3.14	1.69
Heath, sports and welfare	36.1	6.87	1.78	298.1	3.66	0.77
Education, arts and culture and television	5.4	1.04	0.30	637.4	7.83	1.28
Scientific research and comprehensive technical services	2.1	0.40	1.06	104.8	1.29	0.59
Information transmission, computer services and software				100.3	1.23	0.89
Management of water and environment				83.0	1.02	0.62
Public management and social organization				561.4	6.90	0.62
State organs, party organs and social groups	0.8	0.15	0.45			
Geological and water management	0.8	0.16	1.23			
Others	7.8	1.49	1.32			
Total	52.51	100.00		813.93	100.00	

Data sources: China statistical yearbook (2001, 2010)

Table 2 shows the comparison of the changes of employees of each sector from various industries in the cities and towns of Zhejiang between 2000 and 2009, reflecting the structure and changes of non-basic and basic economic activities. In 2000, most the sectors' location quotient was less than 1, which implies that these sectors are non-basic industries which firstly satisfy the needs of the development of city. Until 2009, the location quotient of agriculture, mining, and electricity and gas supply industry decreased markedly, which shows that the scale of the basic economic activities of the first sector has went down, while the scale of the basic economic activities of the secondary sector such as the manufacturing and building industry has gradually increased. This increase reflects that there existed a large amount of output in these sectors, including the basic and non-basic activities, which not only serve the operation of the city per se, but the regions out of the city as well. The economic scale serving the regions outside of the city is expanding. Besides, the social services, wholesale and retail, catering, public welfare and other tertiary industries also have a tendency to grow. These changes, to some extent, reflect the development trend of the city: with the promotion of the urban industrialization, the economy has turned to a service-oriented one. The growth of the economic activities of the tertiary sector has made it a new economic foundation of the city, thus the industry has no longer held a monopoly position as a urban economic base and (Yan and Xu, 1999). Therefore, the growth of the basic economic activities of the service sector is the indirect effect brought by the industrial development to the urban growth.

The recent direction of the state-owned land supply in Zhejiang has also illustrated the aforementioned issues. In 2007, the state-owned land supply was 1.3 times more than that in 2005. The newly added supply was 1.6 times more than that in 2005, with 4110.86 hectare of mining storage land, 319.51 hectare of developers to use land and 388.42 hectare of residential housing land[2]. Figure 7 shows the leasing situations of the state-owned land for four consecutive years in Zhejiang. The proportion of mining land use is over 70%, and the total land use of industrial and mining, commercial service and residential housing is over 90%. The leasing land for residence, business and service trade also shows an upward trend. The economic activities of the tertiary sector are becoming increasingly active.

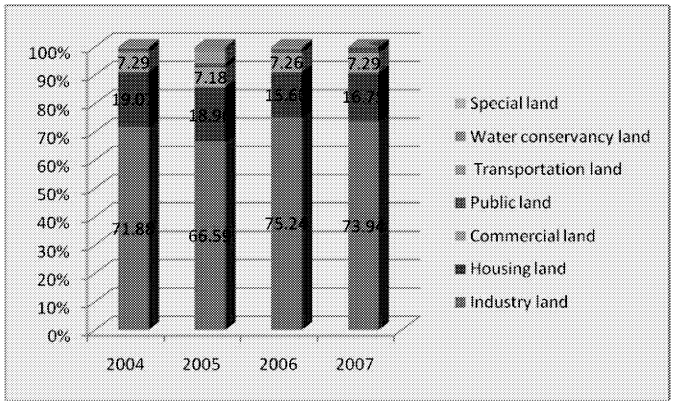

Figure 7 State-owned land transfer situation of Zhejiang in 2004-2007 (unit: %)

The movement of the work population not only reflects the changes of economic activities, but also affects the development scale of the city. At an early development stage of the city, the "multiplier effect" of the basic economic activities led by the industry is fairly obvious, which has resulted in population increase and urban sizes expansion. The city development in this period is "active". With the strengthening of the economic activities of the service sector and the non-basic economic industries, the city scale has further expanded, and this expansion is "passive" during this period.

INDUSTRIAL LAND DEVELOPMENT POLICY DISCUSSION

The expansion of industrial land is in line with the pursuit of "political achievement" of the local government to some extent. The mature development of the industry is the most effective way of optimizing the economic structure and increasing the regional GDP. Now that the expansion of the industrial land area has become an unavoidable fact, to improve the efficiency and effectiveness of industrial land use have become the important option in building the industrial parks and development zones in Zhejiang and even the whole country.
The author proposes the following policy recommendations:

(1) The government should control the supply of the industrial land from the beginning, and make measures against the behaviour of squander of land, such as reserving land illegally, selling industrial land with "zero land price".

(2) The "government-oriented" park model should be changed. The system assessing the park leaders' "political achievement" should be readjusted.

(3) Based on different clusters, industrial parks should select a reasonable development mode. The quality of the introduced enterprises and projects should be improved accordingly. Attention should be paid to the improvement of science and technology content, land investment intensity and the efficiency of land use. The development of technology-intensive industries should be encouraged.

(4) We should raise the level of urbanization through the industrial parks in development zones, and make them play a role as "growth pole" reasonably and effectively. Planning of industrial parks should be included in the urban comprehensive planning, land use planning, economic planning, and social planning etc.

[2] Zhejiang Territorial Resources Statistics 2004-2007

(5) A more competitive environment should be created for the tertiary sector, and a more appropriate urban growth mode should be found from the perspective of improving the quality of urbanization.

CONCLUSIONS

Industrialization is the way of changing the industrial structure, urbanization is the channel of reshaping the spatial structure, and the economic development is the coupling between the industrial structure and spatial structure. The industrial structure and spatial structure are closely related. Based on the urban land rent theory and the urban basic economy theory, this paper studied the "twofold effects" of industrial land expansion on urban growth and concluded as follows:

(1) The industrial land expansion has "direct effects" on urban growth. The development of industrial parks in Zhejiang is through "scale expansion." Compared with parks in other countries, Zhejiang's parks are larger in size but less in economic benefit. This study shows that the scale of an industrial park is positively related to the proportion of the working population in the secondary sector, and the built-up urban area is also positively related to the total industrial output value. The oversized planning area of the industrial parks is the immediate cause promoting the urban size.

(2) The industrial land expansion also has "indirect effects" on urban growth. The industries that mainly serve the regions outside the city, through guiding the transfer of the work population, have "multiplier effects" on the development of the non-basic industries mainly represented by the tertiary sector. The "external service" of the basic economy provides the impetus to the growth of the non-basic economy, gradually expanding the land use for residence and infrastructure, which makes the urban expansion inevitably.

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