

Analysis Of the Evolution of Urban Form in Modern Hefei City and Its Dynamics Mechanism

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Abstract. As the capital of Anhui Province and the sub-center of the Yangtze River Delta urban agglomeration, Hefei has been increasing its regional status in recent years, and the city's spatial planning has gradually matured and becomes unique. This paper takes Hefei city as an example to explore the process of urban morphological evolution and its dynamic mechanism, describe the unique fan-type morphology of the city, and discuss the key factors and laws of its spatial and morphological development. Results show that Hefei was mainly a "doughnut-shaped" city before the founding of the People's Republic of China. After its founding, Hefei gradually formed a "fan-shaped" urban, extending to the present. The "fan-shaped" urban form can be subdivided into three modes: one-center with three-fan, one-center with multiple-cluster, and double-center with multi-cluster. In terms of the dynamics of urban form, modern urban planning theory lays the foundation of spatial form development, industrial development is the main driving force of spatial form development, and the economic system is the way to regulate spatial form development. The current spatial form pattern of Hefei is the result of the interaction of these factors.

Keywords: Hefei city, fan-shape, urban morphology, dynamic mechanism.

1. Introduction

In world globalization, metropolitan areas and urban agglomerations have become the basic spatial units for each country to participate in international competition. So cities are constantly restructuring and expanding outward, hoping to connect with neighboring cities. With rapid urbanization, the traditional urban industrial structure needs to be transformed into a multiform, multifunctional, and multiple-centered urban space. A series of systems in the process of reform and improvement have made China's urban space undergo rapid transformation.

With urban development, many large and medium-sized cities have experienced the "enclosure" construction phase of various development zones. Among the many Chinese cities in transition, Hefei, unlike first-tier cities such as Shanghai, is a secondary city in the Yangtze River Economic Belt and links east to west and north to south. As the geometric center of Anhui province, it becomes the economic and political center of the province and the center of transportation organization. It has a solid regional radial power responsible for driving the province's development [1].

Although Hefei has a long history of city building, it has yet to be developed continuously, so it has received relatively little attention at the regional scale. The mechanisms and laws of urban spatial morphology evolution have been less studied and less systematic [2]. Therefore, this paper takes Hefei as an example to describe urban morphology, discuss the urban development process and its dynamic mechanism, and explore the key factors and laws of its spatial and morphological development. This study will provide a theoretical basis for the designation of suitable spatial development patterns for other cities.

2. Characteristics of urban spatial layout evolution

Like most cities, Hefei's urban expansion is gradually transitioning from the interior to the exterior. However, due to the unique natural factors and economic development conditions, Hefei was mainly a "doughnut-shaped" city before the founding of the People's Republic of China. After its founding, Hefei gradually developed into a "fan-shaped" city, which has been extended to the present day. The

fan-shaped urban form can be subdivided into one-center with three-fan, one-center with multiple-cluster, and double-center with multiple-cluster. According to the urban morphology, we divide the urban spatial evolution of Hefei into four stages.

2.1. Stage 1: "doughnut-shaped" urban form (before 1949)

As a small town of a specific scale, Hefei has a rich cultural heritage dating back to more than two thousand years ago. It was small in scale during the Han Dynasty and did not develop into a regional economic center. During the Tang Dynasty, it was expanded on the southern bank of the Nanfeihe River, which became the basis for the development of the city of Hefei, which was the prototype of today's Hefei Ring Road. Before the founding of the People's Republic of China, the built-up area was less than 5 square kilometers, mainly within the city park, which had a "doughnut" shape (Fig. 1). At that time, the population was less than 50,000, and economic development was slow [3].

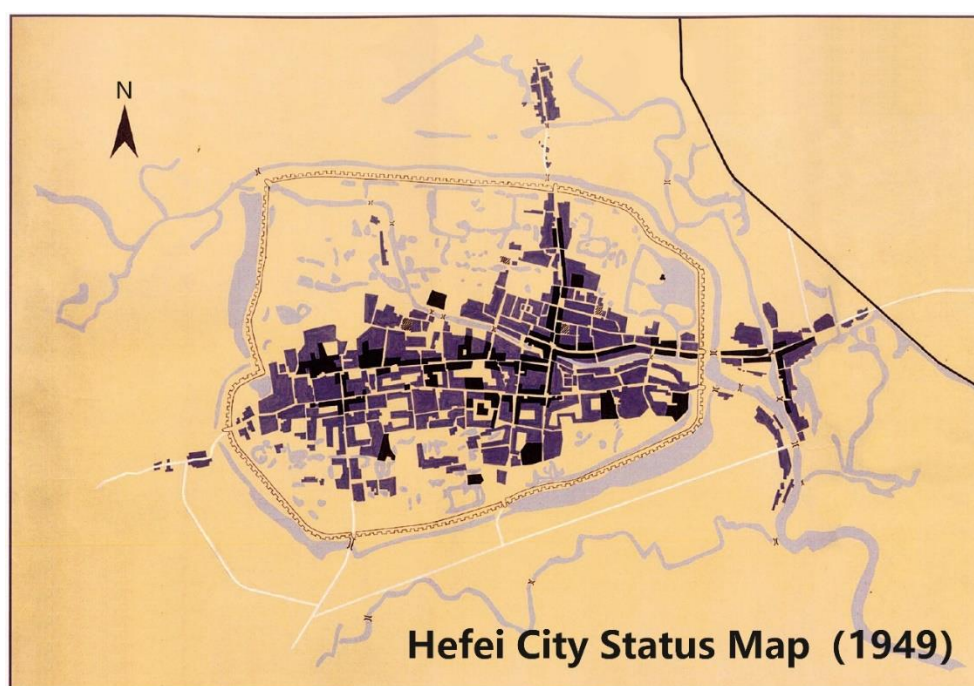


Fig. 1 Hefei space layout in 1949

2.2. Stage 2: "one-center with three-fan" urban form (1949-1990)

From 1949 to 1990, the "single-center with three-fan" model was mainly presented, subdivided into three phases according to the development of the pattern.

2.2.1 Formation period (1949-1958)

In 1952, Hefei was established as the capital of Anhui Province, and the city started to enter the development stage. With industrialization, the nature of Hefei city changed from a small consumer-oriented town to an industrial-oriented one. During this stage, along with industry development, the city's eastern suburbs began to be built, and the city gradually developed along the Datong Road and Heping Road. The organization of pesticide factories, five small businesses, and storage facilities led to the development of the northern suburban manufacturing region, which was made possible by the movement of manufacturers from Shanghai to Hefei for construction. With the construction of the southwest industrial zone, the city has expanded from the city park to the north, southeast, and southwest sides.

In terms of urban location, Huancheng Park's industrial neighborhood is gradually being built to the east, while the ancient city serves as the region's cultural and commercial hub. A well-shaped arterial road network forms inside the city, and an outer ring-shaped radial network forms in terms of

the road system. The overall urban form is developed in pieces around the old city, and the classic "fan-shaped" urban form of Hefei City begins to take shape.

2.2.2. Stabilization period (1958-1978)

In 1958, against the background of the "Great Leap Forward Movement," the city's overall development was slow. The expansion of Hefei in the east, north, and southwest directions was slowed down, and public service facilities were mainly added. In the southeastern area, where the city park is connected to Chaohu Lake, wedge-shaped green areas were added to introduce southeastern winds. At the early stage of reform and opening, China's first urban green space system plan was compiled based on Huancheng Park. The "emerald necklace" development strategy was established by combining the ring of woodlands and several parks connected to it [4]. Open parks were used to connect the old and new urban areas to beautify the city and meet the recreational needs of the residents.

In 1961, China entered a period of national economic adjustment. With a national emphasis on science and education, Hefei built a college district southwest of the old city. The city remained the "fan-shaped" urban form (Fig. 2).

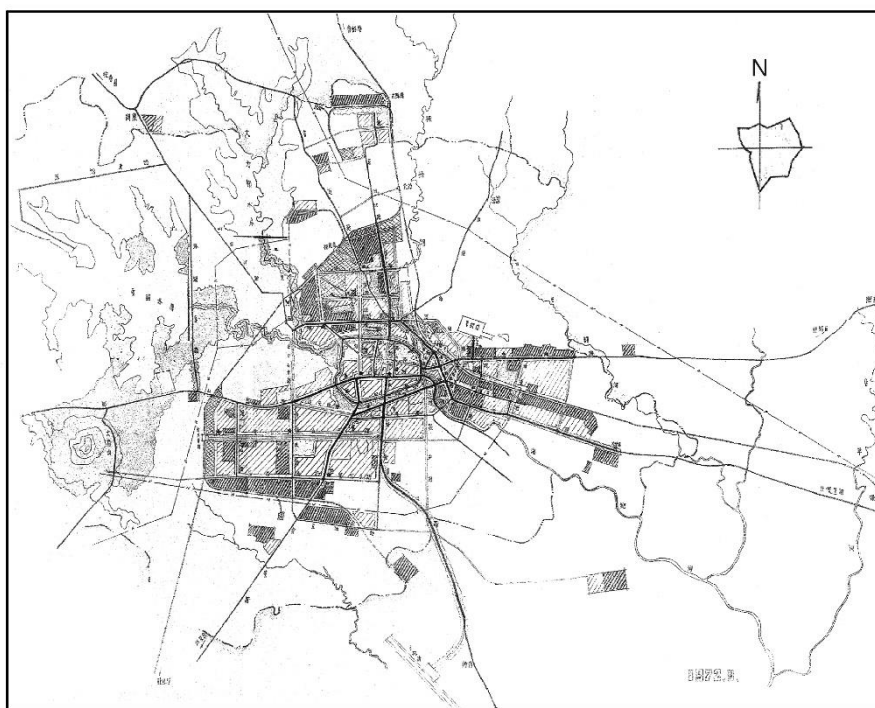


Fig. 2 Schematic diagram of the general plan of Hefei City in 1972 (wide grain area: industrial area; close grain area: residential area)

2.2.3. Growing period (1978-1990)

In 1978, against the background of the gradual rebound of the national economy, Hefei gradually resumed urban construction and entered an upward stage of development. In addition to the political center of Anhui Province, the overall positioning of the city was expanded to include a scientific research base and a transportation and railroad hub. The "one-center with fan-shaped" city form was further expanded, but the development was not in all directions. Influenced by the development concept of the industrial city, the construction of Hefei is focused on industrial and related public service facilities. The related land is expanded, with the southwest direction developing faster than the east-to-north direction [5]. In general, the urban form still maintains the old city as the core of development, with development in three directions beyond the city park, maintaining extensive development flexibility and showing a "one-center with three-fan" urban form (Fig. 3).

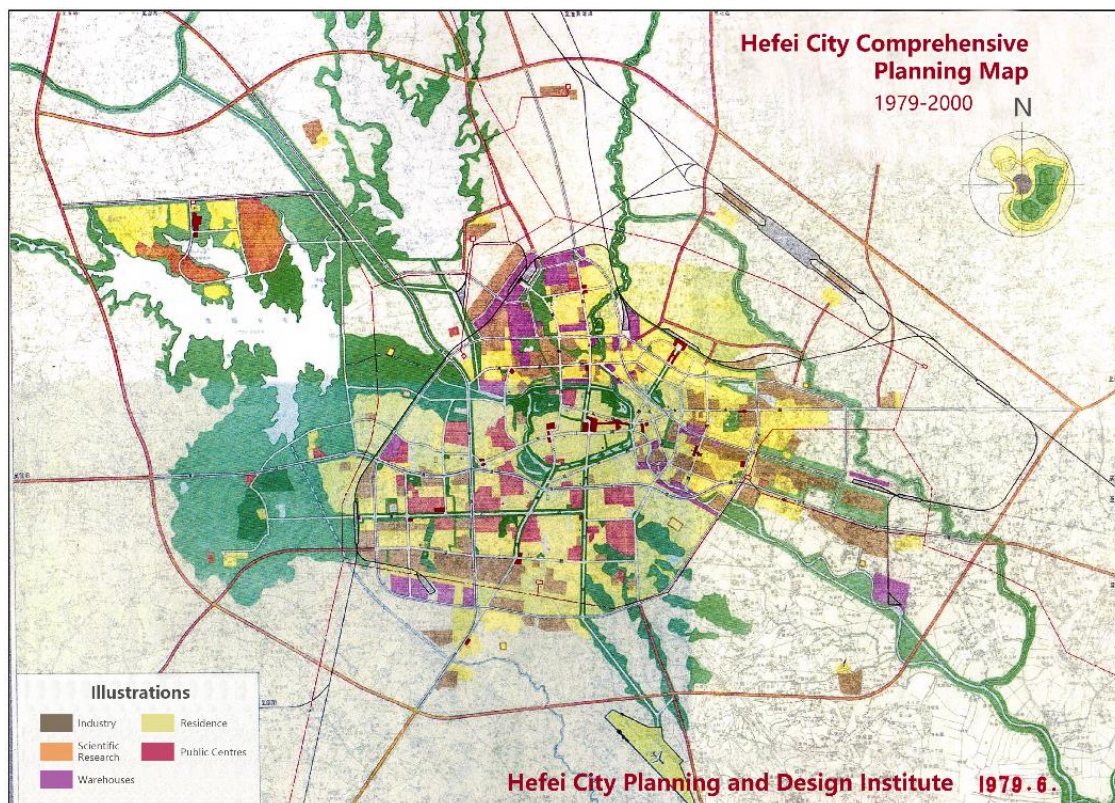


Fig. 3 Comprehensive Planning Map of Hefei City during 1979-2000

2.3. Stage 3: "one-center with multiple-cluster" urban form (1991-2000)

In the 1990s, with the deepening of the national economic system reform, Hefei ushered in a period of rapid development. With the reform of the national housing system, residential land was continuously expanded, and the scale of the city rapidly expanded. In 1995, the master plan proposed a "one-center with multiple-cluster" model, determining that Hefei would develop mainly to the southwest and appropriately to the east and west. With the old urban area as the center, four new sub-centers in the east, north, southwest, and new urban areas are newly established. In these sub-center areas, a group-like layout is gradually formed, similar to the overall urban land layout (Fig. 4).

In this case, the pressure of the urban industry was relieved to a certain extent. However, the public resources of the city as a whole were still concentrated inside Huancheng Park. At the same time, as a transportation hub, some contradictions and obstacles occurred in the central area. This phase of the built-up area of Hefei began to show blind expansion and a slow development trend [6].

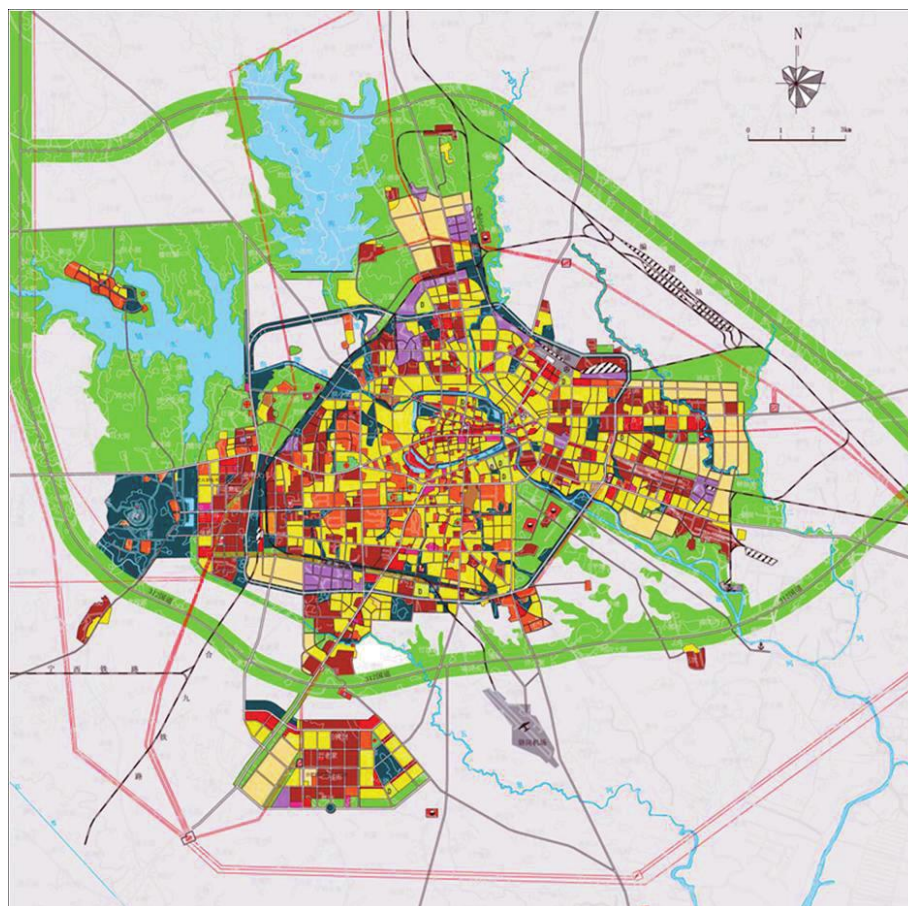


Fig. 4 Comprehensive Planning of Hefei City in 1995

2.4. Stage 4: "double-center with multiple-cluster" + "circum-lake" urban form (after 2000)

After the 21st century, the urban form of Hefei gradually began to expand further to the south. The city is centered on the old city, relying on the original fan-shaped structure to rapidly expand the surrounding areas and fill the outer open space. In 2005, to take full advantage of Hefei's location on the shore of Chaohu Lake, the fifth largest freshwater lake in China, a plan was formulated to draw the lake into the city and start the development of a new lakeside area in the southeast. A new pattern of one main urban area, four urban sub-centers, and one new lakeside area was eventually formed [7].

In 2011, with the adjustment of administrative regions, the urban form gradually developed into a double-center model: the center of the old city and the new Binhu District. The main developing urban groups included Luogang Park in the south, the new center in the east, the new canal city in the west, and the sizeable scientific device concentration area in the northwest. With the addition of parts of the former Chaohu City and the expansion of Binhu New District, Hefei has expanded by 40%, and the city has become more functional and radiant. In 2016, the Anhui provincial government moved to the Binhu New District. With the national tourist and leisure area construction around Chaohu Lake, the focus of urban construction is gradually shifting to Binhu. Finally, the current development model of "double-center with multiple-cluster" + "circum-lake" was formed.

3. The evolution of the internal space of the city

With the evolution of the urban morphological pattern, the internal space has been adjusted accordingly, especially in industrial and residential land. The layout of industrial land is consistent with the development direction of crucial industries in the city, and the overall trend is from the northeast to the southwest. In contrast, the residential land expands from the old city to the outside year by year and shows the development trend to the southeast towards Binhu New District. The

dynamic mechanism of urban evolution can be clarified by analyzing the evolution and characteristics of the two types of land.

3.1. Layout evolution of industrial land

After the liberation in 1949, Hefei's industry was still in its initial stage, and most of the industrial types belonged to a vacant state with a relatively weak industrial foundation. After the First Five-Year Plan (1953), Hefei introduced some of the industrial enterprises that had moved inward from Shanghai, enabling the development of urban development zones. From 1978, Hefei's industry mainly developed in three directions of east, west, and southwest. Among them, Hedian Road in the east and suburban industrial bases in the north were the primary development areas. After the 1990s, the lands in the east and north were gradually transformed into residential land, while the southwest continued to develop as industrial land. After 1995, except for extending to the southwest along the main road, most industries relied on industrial parks for development. From 1995 to 2005, the scale of the high-tech zone on the west, the economic development zone on the southwest, and the industrial park in Shushan District was further expanded, and the trend of rapid development in the west and southwest was still maintained. After 2005, Hefei joined the "Pan-Yangtze River Delta" economic circle, and the scale of industrial land increased substantially based on industrial parks, forming a cluster layout similar to the overall urban land layout (Figure 4).

3.2. Layout evolution of residential land

In the early period of the country's founding, residential land distribution was mainly located within the city park, and residential construction was mainly for improving the living environment. After 1978, under the planned economy system, residential land was set up in combination with government agencies to support the industrial land at the edge of the city center. The overall layout was consistent with the layout of urban development, with a fan-shaped distribution. After the reform and opening, the number of residential lands in Hefei increased rapidly due to the influence of the "unit system" housing.

In the early 1990s, with the construction of the economic development zone and the high-tech zone, the real estate near the development zones was enhanced in order to avoid long commuting distances for workers and to relieve the traffic pressure in the central city. The residential land developed from the central city to the development zones during this period. After 2000, with the development and construction of the Binhu New Area, the residential land expanded further to the southeast.

4. Dynamic mechanism of evolution

The spatial and internal evolution of the city is influenced and limited by various factors. The evolution process of Hefei city can also reflect the influence of urban planning theory, industrial development, and the regulation of the economic system on the urban form.

4.1. Modern urban planning theory

East German and Soviet experts, as well as Chinese scholars who were influenced by modern western planning theories, played an important role in the planning of Hefei. So the urban planning of Hefei has a certain degree of foresight based on rationality, which lays the theoretical foundation for forming the "fan-type" urban form.

In the early period (1949-1990), among the three classical models of land use, the fan-shaped model proposed by Hoyt in 1939 could be regarded as the ideal monocentric urban spatial form and the prototype of the spatial development of Hefei city. Because the former Soviet Union was the industrial powerhouse at that time, Hefei's urban planning philosophy was profoundly influenced by the "industrial city" theory. It was reflected in the arrangement of industrial land following

geographical features, the organic combination of the natural environment and functional zoning, and the complete application of urban topography.

In the late period (after 1991), the central planning was influenced by the theory of urban functional zoning, and the functions of the inner and outer parts of the Hefei Huancheng Park gradually became different, which led to the development and expansion of the city and further guided the expansion of the city. After 2000, the overall urban planning was guided by the polycentric city theory, and the city was divided into a central area and multiple clusters for development [8]. The city finally integrates surrounding resources to form a well-defined and coordinated urban layout.

4.2. Industrial Development

The industrial development of Hefei, especially the industrial development and the adjustment of industrial structure, has directly promoted the evolution of spatial form.

In terms of secondary industry, the city's early development was mainly industries. The industries introduced by the government from Shanghai brought the city's industry on track. The industrial lands on both sides of the northeast are the focus of urban development. With the introduction of the market economy in China, Hefei gradually changed from a "production city" to a "consumption city". The flourished tertiary industry led to the relocation of industrial land in the old city and changes in the urban form [9].

After the 1990s, development zones began to move to the west and southwest of the city, indicating the city's industrial development to the west and south. Industrial parks became the main body of industrial development in Hefei. The establishment and development of the economic development zone and the high-tech zone led to the trend of the southwest side faster than the east and the north sides. With Hefei joining the "Pan-Yangtze River Delta" economic circle, industrial land has increased further, showing a trend of continuous development.

4.3. Economic System

First, the government's allocation of urban resources also affects the urban form. The government's emphasis on science and technology industries in Hefei broadly promoted land use for science and education. For example, the University of Science and Technology of China and the Hefei Branch of the Chinese Academy of Sciences were established in the 1980s. It promoted science and technology development and laid the foundation for the construction of high-tech zones in the next period.

Secondly, the market-led development model created more jobs and improved urbanization by attracting and absorbing investment capital [10]. For example, with the construction of Binhu New Area, the relocation of the provincial government, the introduction of a large number of financial institutions, first-class educational resources, and commercial support, the city residents take the initiative to choose a suitable living space for themselves. The residential environment could be better developed, subtly affecting the urban form.

5. Conclusion

This paper describes the evolution of urban form in Hefei city and discusses the dynamic mechanisms in the development process from three aspects.

The evolution of urban form has gone through four stages. In the first stage, before the founding of the People's Republic of China, Hefei was mainly a "doughnut-shaped" city with a slow economic development as a small consumer-oriented town with a textile industry. After founding New China, Hefei gradually formed a "fan-shaped" urban form, which has been extended to the present day. Among them, the "fan-shaped" urban form can be subdivided into three patterns: one-center with three-fan, one-center with, and double-center with multiple-cluster corresponding to three stages. During 1949 and 1990, the city developed axially in three directions: east, north, and southwest, and the increase in urban population and industrial scale were relatively small. During 1991 and 2000, the establishment of the high-tech zone and the economic development zone guided the development

of industrial land to the west and southwest of the city park, which further led to the change of the overall urban layout and the formation of a "one-center with multiple-cluster". After 2000, Hefei city maintained a high development rate, the scale of the urban population and construction land increased significantly, and the construction of the urban sub-center clarified the functions of multiple clusters gradually. The construction of Binhu New District led to the transformation of the urban structure from "circum-city" to "circum-lake", finally forming a double-center with multiple-cluster model.

There are three main driving mechanisms for the morphological evolution of Hefei city. Firstly, modern urban planning theories, especially western modern urban planning theories, have contributed significantly to establishing the "fan-shaped" urban form of Hefei city, laying the foundation for developing spatial form. Secondly, industrial development is the main driving force of spatial form development, and the evolution of industrial land can reflect the change of urban form to a certain extent. The adjustment of industrial structures is also essential for urban spatial adjustment. Finally, the economic system can regulate spatial form development, and the constraints and balance between government and market can prompt cities to adjust their spatial forms. The above three interact with each other and become the driving mechanism of urban development in Hefei city.

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