



# Logistics sprawl in Chinese megacities: evidence from Wuhan, China

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**Abstract.** The paper aims to investigate how the warehousing industry in Chinese megacities responds to new demand from customers, ever-changing urban structure, as well as public policies and government interventions. Analysis on land use survey data in Wuhan in 1993, 2004 and 2014 shows a clear pattern of logistics sprawl during the last two decades, and warehousing land uses decentralized more in the second period, Year 2004-2014. Multivariate model results further indicate that transport access, industrial connection, land availability, and government policy variables were shown significant in estimating where warehousing land uses were located. But the role of public policies is particularly outstanding in the context of Chinese cities, where land is owned and allocated by the government. Case studies on two districts in Wuhan, the Jiangnan District and the Dongxihu District also justified these findings. Our research would provide an up-to-date reference for researchers to investigate and compare the patterns and causes of logistics sprawl with other cities in the world.

## 1. INTRODUCTION

In the era of globalization, countries and cities are so intimately connected that our everyday life may largely depend on production activities thousands of kilometres away. To accommodate the growing demand for goods movement, logistics services have been continuously upgraded and improved. The subsequent spatial expansion of warehousing industry is rather impressive in the trade hub cities during the last decade. Meanwhile, the changing urban form and local institutional factors increasingly affect the distribution of warehousing facilities within metropolitan areas. As the largest logistics market in the world, China has seen its large metros not only concentrating intensive manufacturing and retail activities, but also becoming home to a large number of warehousing establishments. While the country is experiencing an unprecedented urbanization in the human history, it would be highly interesting to understand how the warehousing

industry in those megacities respond to new demand from customers, ever-changing urban structure, as well as public policies and government interventions. However, empirical evidence on this topic is still largely absent.

## 2. LITERATURE REVIEW

Logistics sprawl is a newly raised concept that essentially describes the spatial decentralization of logistics land uses during the recent decades in major metropolises<sup>[1]</sup>. Such a concept defines a trend that has been reshaping the urban form, and helps develop a framework to evaluate the social and environmental impacts of the massive spatial expansion of the logistics industry<sup>[2][3]</sup>. A series of studies have documented various methods to measure the extent of logistics sprawl<sup>[4]</sup>. Based on results from empirical analyses, scholars have discussed factors that contribute to the changes,

and how the interactions between logistics developers, local authorities and real estate agents matter in the dynamics [5] [6]. Nevertheless, the logistics sprawl patterns vary in different geographical and institutional contexts. Research is needed to systematically examine how locational characteristics, socioeconomic factors, and the institutional conditions affect the spatial distribution of warehousing facilities.

### 3. DATA AND SPATIAL ANALYSIS

In this paper, we focus on Wuhan, the biggest metropolis in the Central China and a national transport hub since more than one thousand years ago. As one of the nationally designated core cities for logistics functions, Wuhan has long been famous for its industrial progress. However, the city has determined to devote more efforts to the growth of service industries, particularly in the urban core. Driven by the policy changes, the spatial distribution of the warehousing industry, which consumes much land and generates relatively low per-square-kilometre revenues, has been dramatically changing in the last two decades.

We employ land use data surveyed in 1993, 2004 and 2014 to identify changes in warehousing land uses. The data contains the land use type of each parcel within the prefecture boundary of Wuhan, which consists of 13 districts and covers around 8,500 square kilometres. We aggregate parcels used as logistics and warehousing (L&W) by village level (the lowest administration level) in two periods, 1993-2004 (Period I) and 2004-2014 (Period II). Note that the latter period witnessed major policy changes in favour of service industries as well as a sharper rise in land values. The overall land areas used as logistics and warehousing were 14.0 km<sup>2</sup>, 16.3 km<sup>2</sup> and 22.9 km<sup>2</sup> respectively in 1993, 2004 and 2014, suggesting a much faster

growth rate during the Period II. We find the major clusters of warehouses and distribution centers gradually shifted outwards from inner districts. Given the four-ring road network in Wuhan, these clusters were found moving out of the third ring but not yet reached the outer suburbs outside the fourth ring. Newly added L&W land uses also tended to be located near transport infrastructure including river ports, and highways. The mean centre of warehousing land uses moved away from the city centre of Wuhan, and the standard distance to centre increased from 9.2 km in 1993 to 11.6 km in 2004 and further reached 17.1 km in 2014 (See Figure 1). The warehousing land uses clearly decentralized more in the Period II.

### 4. MULTIVARIATE MODEL

We further developed a model to investigate the major determining factors that affect the spatial distribution of warehousing facilities. The 2014 data is used in this model. The conceptual model is shown in the Equation 1. In general, transport access, industrial connection, land availability, and government policy variables were shown significant in estimating where warehousing land uses were located (see Table 1). While access to freight rail stations and airports appear to have insignificant coefficients, access to freeways and river ports are strongly related to warehousing concentration. L&W land uses tend to locate away from public (including education, media and so forth), and commercial land uses, which pay high land rent. Out of three types of manufacturing land use types, only heavy manufacturing is significantly spatially associated with warehousing land uses. Land availability is highly important, especially in suburban areas with limited infrastructure for industrial development. Finally, planning policies have been deeply

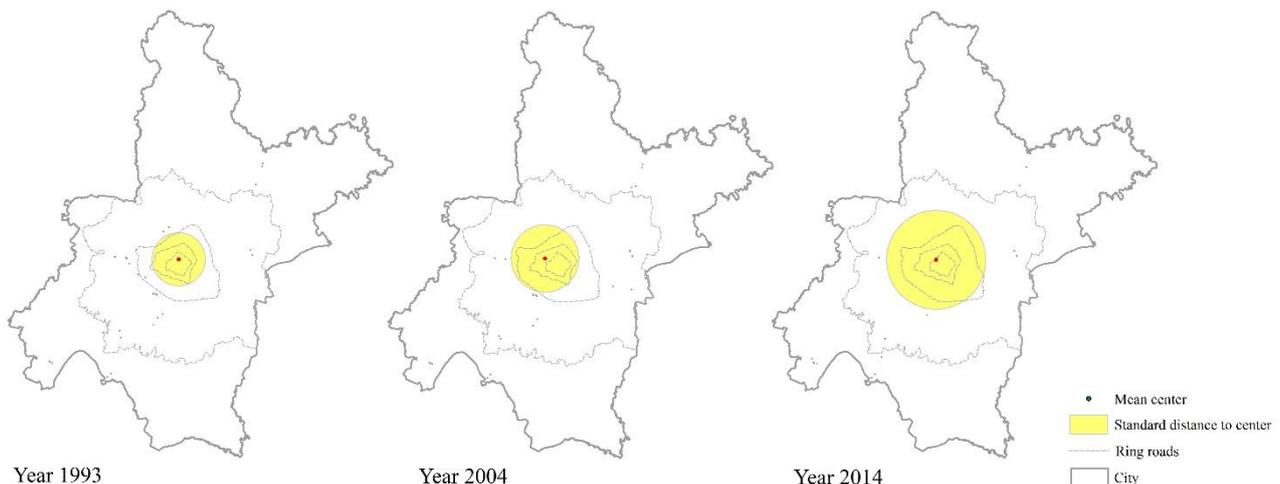


Figure 1 Mean centre and Standard distance to centre of warehousing land uses in Year 1993, 2004 and 2014.

influencing warehousing location patterns. Two rounds of master plans in Wuhan, the 1996 and 2006 versions, both highlighted areas designated to warehousing and logistics uses. It turns out that many of those areas with strong policy support were developed into warehousing hot spots. All these findings are consistent with our expectations. Compared to similar studies on other cities in the world, the role of public policies is particularly outstanding in Chinese cities, where land is owned and allocated by the government.

$$\text{Area}_{L\&W} = f(\text{transport access, land rent, industrial connections, land availability, land use policies}) \quad (1)$$

Table 1 Multivariate regression analysis result

Area used as logistics and warehousing			
	Coef.	S.E.	Sig.
Distance to freeway	-0.003	(0.001)	**
Distance to freight rail station	0.002	(0.004)	
Distance to airport	-0.003	(0.003)	
Distance to river port	-0.017	(0.003)	***
Area used as commercial	-0.132	(0.072)	*
Area used as public	-0.041	(0.009)	***
Area used as light manufacturing	-0.005	(0.016)	
Area used as medium manufacturing	0.007	(0.012)	
Area used as heavy manufacturing	0.038	(0.006)	***
Built-up area	0.016	(0.004)	***
Total area	0.004	(0.001)	**
Within the second road ring	-0.004	(0.008)	
Class-1 designated zones in 06 Plan	0.027	(0.008)	***
Class-2 designated zones in 06 Plan	0.040	(0.015)	***
Class-1 designated zones in 96 Plan	0.331	(0.035)	***
Class-2 designated zones in 96 Plan	0.093	(0.025)	***
Class-3 designated zones in 96 Plan	0.029	(0.027)	
Constant	0.037	(0.013)	***
<b>Adjusted R-squared</b>	<b>32.8%</b>		
<b>Sample Size</b>	<b>1,211</b>		

## 5. CASE STUDIES

Finally, we select two districts in Wuhan, the Jiangnan District and the Dongxihu District, and examine the role of local policies on warehousing development via case studies. The Jiangnan District is one of the seven “Central Districts” and had been a traditional centre of logistics industry in Wuhan. As one of the six “New Districts”, the Dongxihu District nonetheless has not been developing into a booming industrial cluster until the recent two decades. The “Tui Er Jin San” Policy (service industries entering the city core while the industrial industries moving towards the urban fringe) was initiated in the first round of Wuhan Urban Master Plan (1996-2020). The implementation of this policy had contributed to the differentiation of localized strategies and further triggered the decentralization of warehousing land uses. We reviewed relevant documents, including two master plans and a series of five-year plan outlines, which are regularly updated as a major guidance on land use development. These documents suggest that logistics and warehousing had been selected as a leading industry in the Dongxihu District since early 2000s. Warehousing-oriented industrial parks and special development zones were established,

suggesting the local government’s dedication to boost warehousing development in this district. On the other hand, the Jiangnan District was no longer listed among the major warehousing destinations, although the documents began to call it “a centre of modern logistics services”. Such a centre is more specialized in attracting headquarters of logistics companies or logistics departments of multinational corporations. The Jiangnan District is less relevant to on-site activities of goods storage and movement, but more focuses on managerial roles. These changes indicate a pattern of government-led reshaping of industrial specialization within a city and lead to a spatial reorganization of warehousing land uses. The intention by local authority to move warehousing activities from the city centre to the periphery is generally consistent with the expectations of the land market, but its long-term effects on the efficiency of the warehousing industry is unknown.

## 6. CONCLUSION

The findings have confirmed the logistics sprawl pattern in Wuhan as a result of interactions between government-led land policies, changes in urban structure, industrial connections, and improved transportation infrastructure. Among these factors, government interventions are found more significant than other determinants at the current stage of urban development. It suggests the crucial role of public policies in shaping the new geography of logistics industry. The analysis on land use patterns may help tailor policies and plans for more efficient warehousing development in the megacities in China. Our research findings would also provide an up-to-date reference for researchers to investigate and compare the patterns and causes of logistics sprawl with other cities in the world.

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