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Study on the Relationship between Economic Growth and Urban Carbon Emission

Xin Luo

Chengdu University of Technology, Chengdu, Sichuan, China

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Abstract: As the global economy continues to grow and urbanization processes accelerate, the issue of urban carbon emissions is becoming increasingly prominent. In response, this study aims to investigate the relationship between economic growth and urban carbon emissions, with a focus on providing theoretical support for sustainable urban development. China's cities were selected as the research object, and a panel data model was used to empirically analyze the relationship between economic growth and urban carbon emissions. The results reveal that economic growth has a significant positive impact on urban carbon emissions, while other factors such as urban scale, population density, and industrial structure also play important roles. Furthermore, the acceleration of urbanization and the transformation of energy consumption structure are key factors contributing to the increase in carbon emissions. Based on these findings, the study proposes policy suggestions, including strengthening urban planning and management, promoting energy consumption structure transformation, and promoting low-carbon lifestyles, to mitigate the trend of increasing urban carbon emissions and promote sustainable urban development. This study has both theoretical and practical value, offering new ideas and methods for sustainable urban development. Further research is recommended to deepen our understanding of urban carbon emissions and to promote the green and low-carbon transformation of cities.

1. Introduction

1.1. Research Background

In recent years, with the deterioration of the global environment, the issue of climate warming has gradually attracted the focus of various governments around the world. Emissions of greenhouse gases are the main cause of the problem, which have the highest content of carbon dioxide, so reducing carbon dioxide emissions has become an important agenda in national development strategies [1].

Over the past few decades, China's economy has developed rapidly, with an average annual GDP growth rate of 9.7% [2]. However, while the economic benefit has been improved significantly, the region has also paid a large environmental cost. In 2006, China became the world's largest carbon dioxide country. In order to prevent environmental deterioration, China has actively curbed the

continuous rise in carbon dioxide emissions. In 2009, China announced at the Copenhagen conference that it would take certain measures to reduce its carbon intensity, with the specific target of reducing units by 40%-50% from 2005 levels. In addition, at the Paris Climate Conference in December 2012, China made the following commitments: First, China will achieve a "carbon peak" by 2030; second, carbon emissions per unit of GDP will be reduced by 60% -65% from 2005 levels [3]. This shows that China's determination on carbon dioxide emissions and action, now in 2030 and ten years, however, China is still in the middle stage of industrialization development, the rapid development of economy cannot leave the city of industrialization, in balance the relationship between economic growth and emissions, China is still facing huge challenges [4].

1.2. Study Significance

In a practical sense, China's commitment to peak carbon dioxide emissions by 2030 or earlier. Cities, cities, as the carrier of carbon dioxide emissions, is the basis of China's transition to a low-carbon economy [5]. However, since the official urban carbon emission data have not been published, the research in this area is mostly based on the national and provincial level, and the research area is large. But in recent years, due to the continuous efforts of scholars, accumulated certain data base, so this paper from the perspective of city level, through the economic growth, industrial structure and urban carbon dioxide emissions system analysis, make up the shortage of research scope, provide industrial structure optimization Suggestions, in order to achieve urban economic growth and the balanced development of carbon dioxide emissions provide a new direction [6].

2. Definition of Relevant Concepts

2.1. Carbon Emissions

Carbon dioxide is a common greenhouse gas. Greenhouse gases can not only absorb the sunlight reflected from the earth's surface, but also release the absorbed radiation again, causing the earth's surface temperature to rise. Common greenhouse gases such as carbon dioxide (C O 2), methane (CH 4), water vapor (H 2O), nitrous oxide (N 2O), ozone (O 3), freon, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), etc. Direct emissions and indirect emissions are two ways of greenhouse gas emissions, direct emissions usually occur in the process of fossil energy combustion, this process will directly produce greenhouse gases; and indirect emissions usually occur in the process of outsourcing electricity or heat, often produce a large number of greenhouse gases. Carbon dioxide accounts for as much as 70% of many greenhouse gases, so inhibiting carbon dioxide emissions can also curb global warming to some extent. This paper uses per capita carbon emissions as a measure of carbon dioxide emissions [7].

2.2. Economic Growth

Economic growth refers to the increasing number of the number of labor and economic production in a country or region over a certain time span, that is, the increase of national wealth proposed by Adam Smith, the "father of economics". Normally, economic growth is expressed using GNP, so economic growth is reflected as growth in GNP and GDP. As an important prerequisite for national development, the economy is of great significance. The speed of economic growth not only reflects the quality of life of the people, but also reflects the strength of a country. In this paper, the per capita GDP of each city is used as the measure of urban economic development. In order to reflect the actual situation of regional economic growth and eliminate the

influence of exchange rate fluctuations and price changes, the actual per capita price is used to measure [8].

3. Development Status of Economic Growth and Urban Carbon Emissions

3.1. The Development Status of the Sample Urban Economy

Since the reform and opening up in 1978, China's economy has developed rapidly and the quality of life of the people has been effectively improved. As the most important macroeconomic indicators, per capita GDP is often used to measure a region's economic development, so this paper selects the name of 35 cities GDP (ten thousand yuan) and at the end of the permanent population (ten thousand), by calculating the name of each city per capita GDP, and the 2000-201735 cities economic development, Figure 1 shows 35 cities per capita GDP and economic growth [9].

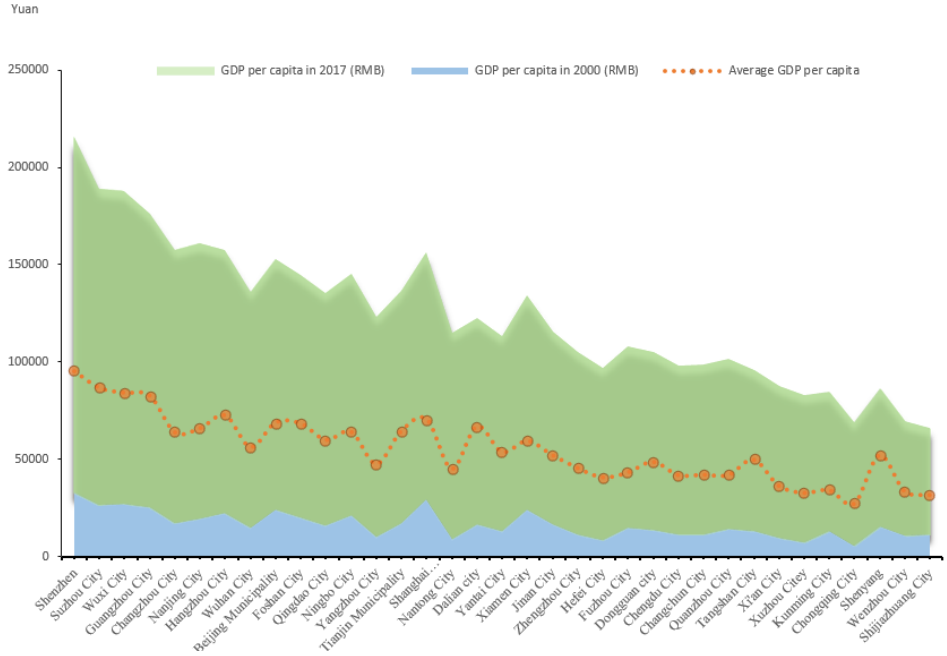

Figure 1: Growth trend of per capita GDP in 35 cities.

As can be seen from Figure 1, the per capita GDP of 35 cities from 2000 to 2017 generally showed a stable upward trend. Among them, the economic development of Shenzhen was significantly faster than that of other cities, and its per capita GDP increased by 150,326.7 yuan from 2000 to 2017, with an obvious growth trend. The economic growth trend is more obvious in Suzhou, Wuxi and Guangzhou, which increased by 135,696 yuan, Wuxi by 133,596.7 yuan and Guangzhou by 125,051.6 yuan. The per capita GDP in Dalian and Shenyang fell significantly in 2015, but recovered the next year, while some cities, such as Shijiazhuang, Wenzhou and Kunming, increased slowly. In general, in the past 18 years, although the 35 cities have different economic growth rates, but the overall steady growth, even in the outbreak of the 2008 international financial crisis [10].

Figure 2 shows the average ranking of the nominal GDP of 35 cities from 2000 to 2017, and the total GDP can represent the economic scale of the city. Although the name of the city GDP presents the trend of stable growth, but the average GDP between cities, Figure 2 first in Shanghai (1540562 billion yuan) in the name of the last GDP than Xiamen (195.531 billion yuan) increased by 687.87%, the data shows that the vast territory of China on economic development, the economic

difference between different cities is still large, it is closely related to China's national conditions, regional resource allocation and regional industrial structure.

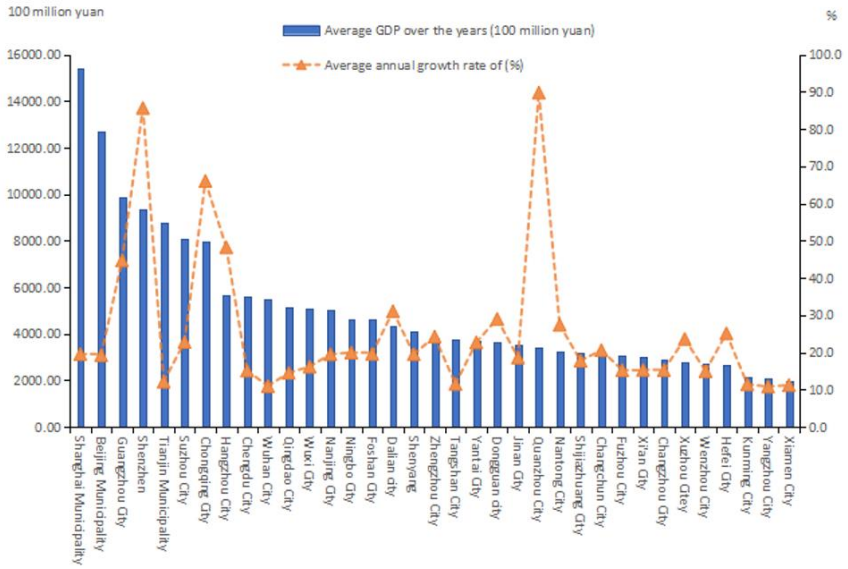

Figure 2: Average GDP ranking of 35 cities over the years.

3.2. Development Status of Sample Urban Carbon Dioxide Emissions

In order to comprehensively discuss the current situation of carbon emission in 35 cities, this paper analyzes the current situation of urban carbon emission from the following two aspects, namely, the total carbon emission and per capita carbon emission. The specific data can be seen in the appendix. Among them, the total carbon emission can be observed by Figure 3 of the total carbon emission of each city and the average annual growth rate of the total carbon emission in Table 1. The per capita carbon emissions can be observed through the Figure 3 average per capita carbon emissions of cities and the average annual growth rate of per capita carbon emissions in Table 1.

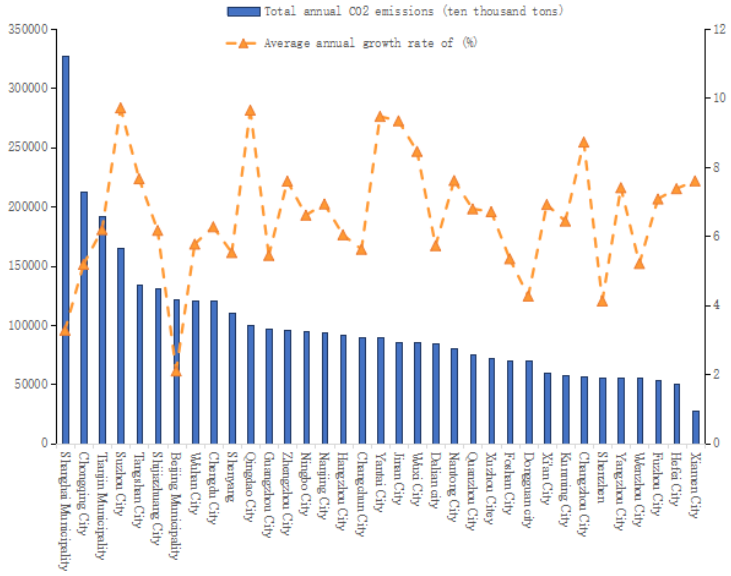

Figure 3: Total carbon dioxide emissions in the 35 cities.

Table 1: Average annual growth rate of total urban carbon emissions from 2000 to 2017 (unit:%).

City	Total carbon emissions growth rate per annum	City	Total carbon emissions growth rate per annum	City	Total carbon emissions growth rate per annum
Shanghai Municipality	3.27	Wuxi City	8.45	Dalian city	5.72
Beijing Municipality	2.09	Quanzhou City	6.79	Changchun City	5.62
Shenzhen	4.12	Qingdao City	9.64	Xuzhou Citey	6.71
Guangzhou City	5.44	Zhengzhou City	7.59	Yangzhou City	7.40
Chongqing City	5.18	Foshan City	5.34	Wenzhou City	5.20
Suzhou City	9.71	Hefei City	7.37	Xiamen City	7.60
Chengdu City	6.27	Jinan City	9.34	Yantai City	9.46
Wuhan City	5.77	Dongguan city	9.26	Kunming City	6.43
Hangzhou City	6.04	Nantong City	7.61	Shijiazhuang	6.16
Tianjin Municipality	6.19	Fuzhou City	7.07	Shenyang	5.52
Nanjing City	6.93	Xi'an City	6.91	Changzhou City	8.72
Ningbo City	6.61	Tangshan City	7.66		

As can be seen from Figure 3, the city with the largest carbon emission in 2000-2017 was Shanghai, with a total emission of 3276413 million tons. The reason is that Shanghai is in a period of rapid growth of population, economy and car ownership in 2000-2017. Although the total carbon emission is the largest, it can be found from Table 1 that the total annual average growth rate of carbon emission in Shanghai is relatively low, only 3.27%, indicating that the industrial structure optimization policy and low-carbon policy are being effectively implemented. Among the 35 cities, Xiamen city has the least carbon emissions, with 277,490,700 tons, with a large gap between the first and last cities. The top 10 cities are: Shanghai, Chongqing, Tianjin, Suzhou, Tangshan, Shijiazhuang, Beijing, Wuhan, Chengdu and Shenyang. Combined with 3.1 the economic situation of the city analysis, can be found that carbon dioxide emissions in the city in the economy, that the city economic development mostly depends on energy consumption and resource utilization, and these cities are very likely to be in the capital concentration to innovation driven key period. At the same time, as can be seen from Table 1, the average growth rate of Suzhou, Qingdao, Jinan, Yantai and Dongguan is more than 9%. Therefore, these cities need to take effective carbon emission reduction measures to curb the excessive growth of their carbon emissions.

4. Conclusion and Suggestions

4.1. Conclusion

This chapter comprehensively combs, summarizes and analyzes the current situation of economic growth and carbon dioxide emission in sample cities. By collecting panel data from 35 cities from 2000 to 2017, this paper uses E xcel charts to directly reflect the development status and change trend of economic growth and urban carbon dioxide emissions in each city. Through the status quo analysis, it can be concluded that the economic development of the selected sample cities has a good momentum, maintaining the steady economic growth, but the economic development level between cities is large; there are individual differences in carbon dioxide emissions, and carbon dioxide emissions vary among different cities due to different development patterns and energy consumption conditions. Through the above analysis, this paper believes that economic growth is closely related to carbon dioxide emissions, and the adjustment of industrial structure has a positive impact on the emission reduction of carbon dioxide.

4.2. Propose

We will effectively promote the upgrading of the industrial structure. Strengthen the capital attraction between cities, and maintain the mutual exchange of superior technologies among various regions. Reduce industries with excessive energy consumption and high pollution and high emissions, formulate corresponding measures accordingly to coordinate industrial development and environmental protection; actively increase the proportion of tertiary industry, expand new sectors such as financial service and after-sales service, and modern services such as logistics and supply chain. Promote the high quality and high efficiency of industries to promote the healthy and rapid economic development, while the city can maintain low carbon and energy saving development. When introducing foreign investment, we need to give special consideration to the negative impact on the environment, rationally introduce high-quality foreign investment, resist foreign investment that harms the environment, and prevent China from becoming a paradise for environmental pollution. In the process of development, cities should speed up to achieve the "carbon peak". The earlier they achieve the target, the more conducive it will be for cities to achieve the goal of long-term low-carbon emissions. Therefore, we must take this as the goal to achieve the transformation and upgrading of industrial structure and the transformation of economic development mode, such as inhibiting the development of heavy and chemical industries such as coal power, steel and chemical industry, and improving the energy utilization rate through advanced technology.

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