Impact Analysis of Supply-side Structural Reform on Sulfur Dioxide Emissions in Chengdu Based on Leap Model

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Abstract. In order to clarify the socio-economic pollution of the global atmospheric environment, as far as Chengdu is concerned, there is a lack of strategic scenario analysis of long-term changes in industrial sulfur dioxide emissions. Therefore, this article builds on Chengdu based on existing research. Based on the social development background from 2015 to 2025, the Leap model is used to evaluate the long-term impact of supply-side reforms on the sulfur dioxide emissions and emissions intensity of the Chengdu industry. This paper builds a Leap-Chengdu industry sulfur dioxide emission model, which predicts different scenarios and different scenarios. Different energy consumption between sectors, so as to predict the sulfur dioxide emissions and emissions intensity between different industrial sectors under different scenarios in Chengdu.

Keywords: leap-Chengdu industrial sulfur dioxide emission model, supply-side structural reform, atmospheric environment.

1. Introduction

Today's rapid economic development, the contradiction between the environment and economic development is becoming increasingly prominent. In particular, the excessive exploitation and unreasonable use of natural resources in the heavy industry have created environmental pollution problems that cannot be ignored, the more serious of which are atmospheric pollution and Sulfur dioxide is the main target of air pollution.

The traditional environmental governance model has had very little effect. In order to reduce the invasion of harmful substances such as sulfur dioxide and adapt to the high level of economic development, the effective collection and utilization of energy, reasonable reform of resource allocation, and the establishment of technologies to optimize the use of resources and sulfur dioxide emissions. Reform will effectively reduce sulfur dioxide emissions and achieve optimal resource allocation.
2. Literature review
Today's global atmospheric environment is not optimistic. In order to clarify and scientifically manage the global atmospheric environmental pollution, IPCC has specially developed a socio-economic and technological scenario [1] on the impact of energy and gas emissions. Using relevant scenarios not only analyzes future cumulative emissions and emission reductions. The degree of distribution of emissions in different countries and sectors [2], and explored the extent of emissions reductions that will be achieved by different technical means in the future. The leap model has played a significant role [3-6].

In the context of the country's supply-side structural reforms, Chengdu has deeply implemented the national policies and policies, implemented energy power, and supported importantly to reduce the production costs of energy companies. Based on this, a price floating system has been established to promote the use of clean resources [7].

In addition, some scholars pointed out that in order to implement a classified and orderly treatment of zombie enterprises [8] in Chengdu, the government should actively guide enterprises to merge and reorganize. Fully match the major policies of the country to go global, and take advantage of the country's Belt and Road policy to bring advantages At the same time as the introduction of production capacity, encourage the country's advantageous production capacity to go global, and guide Chengdu's industry to move towards high-end industries [9].

On the basis of the predecessors, this paper uses the Leap model to study the optimization and upgrading of Chengdu's industrial structure and the amount of sulfur dioxide emitted by the sector under the background of structural reforms on the supply side of Chengdu. The achievements made in the reform of environmental protection and the important impact of Chengdu's supply-side structural reform on the governance of air pollution are discussed.

3. Model building:
The leap model is an energy-environment model developed by the Stockholm Environment Research Institute in the 1960s, which is mainly used to calculate consumer demand and energy conversion and the energy resource consumption and pollutant emissions caused by it. Researchers can use the existing data, research The characteristics of the object, the research direction, etc. are used to build the model, so the leap model has a more flexible structure. At the same time, the model can not only be used to make a certain plan for the national energy environment, but also calculate the energy emissions during the consumption process. Pollutants are extremely greenhouse gases.

3.1. Calculation formula
In the leap model, the calculation formula for sulfur dioxide emissions from the industrial sector is:

\[ e = \sum_{j=1}^{n} n_j NVC_j C_j O_{ij} \frac{44}{12} \]

Among them, e represents the amount of sulfur dioxide emitted by the sector's energy consumption. NVCj represents the net calorific value of energy j per physical quantity. \( C_j \) represents the potential carbon content of energy j per calorific value. Oij represents the energy j in sector i The rate of carbon oxidation when consumed. 44/12 represents the conversion factor that converts carbon to sulfur dioxide.

3.2. Background settings
General Secretary Xi Jinping emphasized that China's economy has been transformed from a high-speed growth stage to a high-quality development stage. China is in an important period of research to transform the development mode, transform the growth momentum and optimize the economic structure. Key strategic goals of the pass.

Supply-side structural reforms (hereinafter referred to as supply-side reforms) aim to adjust the economic structure, realize the optimal allocation of resources, and improve the quantity and quality of economic growth. Promoting supply-side reforms in depth is a major innovation leading the new normal
of economic development in the new era. At the same time, it is also a breakthrough point and an important focus for China to complete economic transformation and upgrading.

However, how will the supply-side structural reform measures affect the achievement of the SO2 emissions and energy conservation and emission reduction goals of the Chengdu regional industry? How will the reform measures affect the regional industrial transformation and upgrading? How will the supply-side reforms be further improved in the future? Measures? To answer such questions scientifically and reasonably, it is necessary to build a relevant background and analyze in depth the changes in the sulfur dioxide emissions and intensity of the industry in the Chengdu region under the background of the implementation of supply-side structural reforms.

4. Model solving

| Table 1. Chengdu is guided by Xi Jinping's thoughts on socialism with Chinese characteristics in the new era |
|--------------------------------------------------------|
| background | Background description |
| Reference background | First of all, in the context of China's proposed supply-side reform in 2017, it is necessary to achieve the "two hundred-year" strategic goal as soon as possible. The GDP growth rate will remain at a medium and high level compared with the national average. With the same industrialization development strategy, the proportion of the secondary industry in gdp will continue to rise, and will start to decline by 2030. The proportion of energy consumption by coal will decline between 2015 and 2030, and the proportion of energy consumption by clean energy will have As a result, the energy structure and industrial technology have improved, but relatively slowly. Technical progress has been slow after 2030. |
| Supply-side structural reform background | Chengdu will focus on the development of the tertiary industry and actively adjust the industrial structure. Through the supply measurement reform, the proportion of tertiary industry in gdp continues to increase, the energy consumption of coal is rapidly decreasing, and the proportion of clean energy energy consumption is rapidly increasing. 2015 From 2030 to 2030, the technology of the industrial sector will increase rapidly, and after 2030, the technology will increase. |

Chengdu is guided by Xi Jinping's thoughts on socialism with Chinese characteristics in the new era. In-depth promotion of supply-side structural reforms, vigorously promoting quality change, efficiency change, and power change, accelerating the construction of a modern and open industrial system, and achieving high-quality development are the most important in the Midwest Forefront goals.

Chengdu deeply implements the supply-side structural reforms, gives full play to the decisive role of the market in the allocation of resources, and closely follows the important ideological instructions of the country to build a central city. The goal is to expand the effective supply of Chengdu's industry and lead by comprehensive innovation. It turns out that Chengdu's backward and unscientific industrial structure improves the flexibility and adaptability of Chengdu's industrial supply to changes in the structure of Chengdu's people's needs. It improves the overall social productivity of Chengdu and promotes the sustainable and healthy development of Chengdu's economy.

Under the guidance of the party's important ideas, Chengdu reorganized the strategic layout of the industrial structure, reshaped the strategic location of the industrial economy, and accelerated the construction of Chengdu's industrial function zones.
Table 2. Setting the background parameters of Chengdu's economic development from 2015 to 2050

| project                  | parameter                                      | Base year | Reference background | Supply-side reform |
|--------------------------|------------------------------------------------|-----------|----------------------|--------------------|
| economic Level           | GDP (Billion yuan)                             | 2015      | 10801.2              | 2020               |
|                          |                                                | 2020      | 21332                | 2030               |
|                          |                                                | 2030      | 40916                | 2050               |
|                          |                                                | 2050      | 115609               |                    |
| industry structure       | Proportion of primary industries (%)          | 2015      | 3.5                  | 2020               |
|                          |                                                | 2020      | 1.3                  | 2030               |
|                          |                                                | 2030      | 0.7                  | 2050               |
|                          |                                                | 2050      | 0.5                  |                    |
|                          | Proportion of the secondary industry (%)       | 2015      | 43.7                 | 2020               |
|                          |                                                | 2020      | 46.4                 | 2030               |
|                          |                                                | 2030      | 51                   | 2050               |
|                          |                                                | 2050      | 45.7                 |                    |
|                          | Proportion of tertiary industry (%)            | 2015      | 52.8                 | 2020               |
|                          |                                                | 2020      | 52.3                 | 2030               |
|                          |                                                | 2030      | 48.3                 | 2050               |
|                          |                                                | 2050      | 53.8                 |                    |
| Energy status of key sectors | electric power transport (%)                   | 2015      | 72.6                 | 2020               |
|                          |                                                | 2020      | 71.6                 | 2030               |
|                          |                                                | 2030      | 71.6                 | 2050               |
|                          | Proportion of coal (%)                         | 2015      | 64                   | 2020               |
|                          |                                                | 2020      | 51.4                 | 2030               |
|                          |                                                | 2030      | 44.4                 | 2050               |
|                          | Proportion of natural gas (%)                  | 2015      | 4.1                  | 2020               |
|                          |                                                | 2020      | 7.2                  | 2030               |
|                          |                                                | 2030      | 10.2                 | 2050               |
|                          | Proportion of oil (%)                          | 2015      | 18.5                 | 2020               |
|                          |                                                | 2020      | 20.7                 | 2030               |
|                          |                                                | 2030      | 19.6                 | 2050               |
|                          | Proportion of oil (%)                          | 2015      | 18.5                 | 2020               |
|                          |                                                | 2020      | 19.4                 | 2030               |
|                          |                                                | 2030      | 17.5                 | 2050               |
|                          | Proportion of oil (%)                          | 2015      | 15.5                 | 2020               |
|                          |                                                | 2020      | 13.4                 | 2030               |
|                          |                                                | 2030      | 13.4                 | 2050               |
|                          | Proportion of natural gas (%)                  | 2015      | 13.4                 | 2020               |
|                          |                                                | 2020      | 13.4                 | 2030               |
|                          |                                                | 2030      | 13.4                 | 2050               |
|                          | Proportion of natural gas (%)                  | 2015      | 13.4                 | 2020               |
|                          |                                                | 2020      | 13.4                 | 2030               |
|                          |                                                | 2030      | 13.4                 | 2050               |

First, the current research mainly stays in the more developed areas of the central and eastern regions, and pays little attention to the sulfur dioxide emissions of industries in the western region. Second, most of the existing studies are aimed at a specific sector, which lacks the entire industrial system of society. Finally, as far as Chengdu is concerned, there is a lack of strategic scenario analysis of long-term changes in industrial sulfur dioxide emissions. Therefore, this article builds on Chengdu's social development background from 2015 to 2025 based on previous studies. Based on the Leap model, the long-term impact of supply-side reforms on the sulfur dioxide emissions and emissions intensity of Chengdu's industry is evaluated.

Secondly, according to the "Chengdu Boiler Air Pollutant Emission Standard", in 2018, Chengdu's air quality was at the middle and lower levels across the country, and the ranking of the comprehensive air quality index was even more optimistic. With effective control, under such conditions, the prevention and control of air pollution in Chengdu is gradually entering an important tackling phase, and new development goals have been set: deepening structural reforms on the energy supply side, promoting green and low-carbon development, and promoting enterprises to reduce factors Cost, foster new momentum for industrial development.

Finally, in order to improve the atmospheric environment, thoroughly implement the supply-side structural reforms, and strengthen the governance of Chengdu's air pollution environment, Sichuan Province reorganized and compiled mandatory local environmental standards, and continued to optimize the industrial structure of Chengdu on this basis.
5. Model results

Table 3. Sulfur dioxide emission intensity of different sectors in Chengdu under different scenarios

| department          | Base year | Reference background | Supply-side reform background |
|---------------------|-----------|----------------------|------------------------------|
|                     | 2015  | 2020  | 2030  | 2050  | 2015  | 2020  | 2030  | 2050  |
| electric power      | 8.7   | 7.6   | 7     | 6.4   | 6.3   | 6.2   | 6.1   |
| Non-metal product   | 7     | 6.4   | 6.1   | 5.8   | 5.5   | 5.1   | 4.3   |
| Transportation      | 4.2   | 4     | 4.1   | 3.6   | 3.2   | 2.9   | 2.7   |
| chemical industry   | 1.4   | 1.3   | 1.1   | 1     | 0.7   | 0.7   | 0.7   |

Table 4. Different types of energy sources that contribute to the emission of sulfur in Chengdu under different backgrounds

| Energy type         | Reference background | Supply-side reform background |
|---------------------|----------------------|------------------------------|
|                     | 2015  | 2020  | 2030  | 2050  | 2015  | 2020  | 2030  | 2050  |
| Coke                | 17    | 16    | 16.4  | 15    | 17    | 18.7  | 16.6  |
| Diesel              | 14.2  | 14.1  | 16.6  | 13.2  | 14    | 13.4  | 13    |
| gasoline            | 8.4   | 8     | 15.1  | 10.4  | 8     | 8.2   | 8.1   |
| raw coal            | 55.1  | 55    | 50.8  | 54.3  | 52.3  | 51.4  | 53.5  |
| natural gas         | 4.1   | 5.6   | 5     | 5.7   | 7.4   | 7     | 7.4   |
| Total energy        | 98.8  | 98.7  | 98.9  | 98.6  | 98.7  | 98.7  | 98.6  |
| other               | 1.2   | 1.3   | 1.1   | 1.2   | 1.2   | 1.1   | 1.1   |
| Total energy        | 100   | 100   | 100   | 100   | 100   | 100   | 100   |

Chengdu vigorously promotes the use of new energy vehicles, smoothly realizes the elimination of coal-fired boilers and the transformation of clean resources, increases the operating mileage of rail transit, promotes the construction of green roads and forest parks, and innovates to create a data era. Real-time monitoring of industrial power usage data, dust on construction sites, etc., have achieved timely management and control of regional pollution sources with abnormal emissions.

Through various measures in Chengdu, not only has the air pollution environment been effectively controlled, but supply-side structural reforms have also achieved significant results. At present, Chengdu's economic restructuring has achieved remarkable results, and overall economic operations have shown a steady state and improved quality. The industrial structure has been significantly optimized and upgraded.

Under the overall pace of supply-side structural reforms, Chengdu comprehensively revolves around the overall goal of building a national center city with new development concepts, reshapes the major strategic goals of economic geography and urban spatial structure, and further effectively expands the strategic space for Chengdu's development. Has promoted the transformation and upgrading of Chengdu's traditional industries.

6. Summary

Since Chengdu is located in the marginal area of the Sichuan Basin, the mountains are surrounded by high altitudes, and the strong mountains block the invasion of cold winter air and cold waves in winter. Therefore, the average wind speed in Chengdu is relatively small, which is also the most serious cause of winter air pollution in Chengdu. One of the serious important reasons.

In China's survey over the past ten years, scientists have also concluded that an increase in the concentration of sulfur dioxide in the air will directly lead to an increase in mortality due to cardiovascular disease. Industrial and mining enterprises in Chengdu are more concentrated in urban
areas, and harmful gases. The emissions are not only large but also high in concentration, and the status of sulfur dioxide gas emissions is not optimistic.

At the same time that the country has vigorously promoted supply-side structural reforms, Chengdu's industrial structure has also been adjusted accordingly. During the Tenth Five-Year Plan period, Chengdu's industrial pollution emissions have generally declined, and due to the carbon energy shortage in recent years, sulfur dioxide emissions from industrial, domestic and other activities have been decreasing year by year.

At the same time as Chengdu vigorously realized the transformation of its industrial structure, it gradually replaced clean resources such as coal and adopted clean coal or other desulfurization and sulfur fixation measures to effectively reduce sulfur dioxide emissions.

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