

An Empirical Study on the Relationship between Industrial Structure and Air Pollution in Xi'an

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Abstract—The air pollution in Xi'an is serious. Adjusting industrial structure has become one of the important strategies to improve the quality of atmospheric environment. Therefore, it is of great significance to study the relationship between industrial structure and air pollution. To this end, this paper uses the industrial structure and air pollution data of Xi'an from 2000 to 2016, and discusses the two-way influence relationship between the two by establishing a VAR model. It is concluded that the upgrading of industrial structure in Xi'an can alleviate air pollution to a certain extent, and the intensification of air pollution can force the upgrading of industrial structure.

Keywords—Industrial Structure; Air Pollution; VAR Model; Economic Growth

I. INTRODUCTION

Broke out across the country in recent years, the serious fog weather, Xi'an is not exceptional also, ambient air quality in 2016 days to 192 days, fine rate was 52.5% haze weather for People's Daily life work and so on, greatly increases the probability of residents of the respiratory system disease, according to reports in December 2016 the second affiliated hospital of Xi'an JiaoTong University respiratory clinic, the number of daily clinic is as high as more than 150 people, fifty percent more than usual. Adjusting the industrial structure become a new means to govern the haze, so the article from the perspective of industrial structure, to explore the industrial structure of Xi'an and mutual influence of the relationship between the air pollution, for the industrial structure development of Xi'an haze governance are proposed.

There are many researches on the relationship between industry and environment at home and abroad. Grossman(1995) believed that environmental problems must be solved if industrial adjustment is to be promoted^[1]. Kais Saidi (2016) believes that with the upgrading and optimization of the industrial structure itself, the environmental quality will be continuously improved and the emission of atmospheric pollutants will be reduced^[2]. Zhenxin Wu, Hongju Yan and Xuefeng Zhang (2016) using space vector autoregressive model, in view of the Bohai Sea economic circle of the industrial structure and analyzes the relationship between atmospheric pollution, two-way influence relationship in between is found^[3]. On the one hand, air pollution will promote the upgrading of industrial structure. On the other hand, the upgrading of the industrial structure will alleviate air pollution in the long term, while it will aggravate air pollution in the short term.

II. AN OVERVIEW OF AIR POLLUTION IN XI'AN

The total emission of air pollutants in Xi'an is large. Although the industrial emissions of sulfur dioxide and nitrogen oxide emissions dropped year by year, but industrial waste gas emissions continue to increase, industrial emissions in 2016 a total of 2016 cubic meters, is 1.4 times that of 2009. Total industrial sulfur dioxide emissions, nitrogen oxide emissions, and soot emissions have increased in some years, but overall they have continued to decrease.

Particulate matter (PM10) is most severe in Xi'an as the main pollutants, SO₂ and NO₂ concentration during 16 years were below the national secondary standard of air environmental quality, but the particulate matter (PM10) is the primary pollutants in ambient air, annual average more than 16 national secondary standard of air environmental quality. And annual average concentration of main pollutants present reduce first, after aggravating, to reduce the trend.

The concentration of major pollutants is seasonal. The concentration of the three major pollutants in Xi'an reached the maximum concentration in winter, while the pollution concentration in summer was the lowest, while the pollutant concentration in spring and autumn was the same. Visible, atmospheric pollution condition of Xi'an evident along with the change of season, this is mainly because the winter heating mainly adopts the polluting coal strong energy, combined with dry climate, cold winter, atmospheric pollutants accumulate lingering in the air, thus causing the poor atmospheric conditions in winter.

III. THE INDUSTRIAL STRUCTURE OF XI'AN

The rapid growth of the economy in Xi'an and the continuous expansion of output value reached 625.718 billion yuan in 2016. Moreover, the industrial structure has been continuously optimized, showing the industrial pattern of "three, two and one". The tertiary industry has contributed more and more to economic growth. The contradictions within the industry are extremely serious, and the heavy industry accounts for too much, hindering the optimization of the industrial structure. The internal development of the tertiary industry is in good condition. Business types have been continuously adjusted, industrial fields have been continuously expanded, and the internal structure of the tertiary industry has been significantly improved. The traditional and new service industries are booming, and the financial and insurance industries are developing rapidly. In a word, with the

continuous increase of industrial output value and the continuous optimization of industrial structure, the contribution rate of the tertiary industry to economic growth has increased. From the perspective of the internal structure of the industry, the development of the secondary industry is highly dependent on heavy industry. The internal development of the tertiary industry is sound and the internal structure of the industry is increasingly reasonable.

IV. AN EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN INDUSTRIAL STRUCTURE AND AIR POLLUTION

A. Selection of Indicators

The industrial structure optimization index uses the industrial structure coefficient built by Deyun Xu to measure the degree of industrial structure upgrading. The calculation formula is as follows: $R_i = \sum_{i=1}^n C_i * i$, where R is the coefficient of industrial structure upgrading, C_i is income share of industry i ^[4]. According to the formula, if the proportion of primary industry agriculture in the industrial structure is high, the coefficient of industrial structure upgrading is close to 1. If the proportion of secondary industry is high, the coefficient of industrial structure upgrading is close to 2. Similarly, the upgrading coefficient of industrial structure is close to 3, namely the high level of industrial structure.

The air pollution index, which uses the three main pollutant indexes of Xi'an to construct the comprehensive index P of the air environmental pollution status of Xi'an. The calculation method is as follows: $P = \sum_{i=1}^n P_i, P_i = C_i/S_i$, where C_i is the measured concentration of the pollutant in item i , S_i is the corresponding environmental standard limit value of item i pollutant, n is the number of air pollutants involved in the assessment^[5].

B. Data Declaration

The data used in this paper are mainly from the Shaanxi statistical yearbook from 2000 to 2016 and the Shaanxi environmental statistical bulletin. The software used for statistical analysis is EVIEWS 5.0.

Although the air pollution index of Xi'an City in 2000-2016 has a tendency of rising and rising in some years, it still shows a downward trend as a whole, and the air pollution situation has improved; at the same time, due to the improvement of the industrial structure upgrade coefficient. The small increase and the upgrading coefficient of the industrial structure are close to 2.5, indicating that Xi'an City is in the transition period from the second industry to the third industry, and the proportion of the secondary industry is still relatively large.

C. Test of stationarity of variables

This article analyzes the relationship between Xi'an environmental pollution index P and industrial structure upgrade coefficient R by establishing a VAR model.

TABLE I ADF UNIT ROOT TEST RESULTS

sequence	ADF statistics	1% threshold	5% threshold	10% threshold	conclusion
DLNP	-5.076801	-4.886426	-3.828975	-3.362984	smooth
DLNR	-3.435548	-4.004425	-3.098896	-2.690439	smooth

D. Lag structure inspection

To establish a VAR model for a stationary sequence, the lag order P of the model needs to be determined. Generally, the Akaike Information Criterion (AIC) and the Schwartz criterion (SC) are used to determine the lag order value. Table 2 shows that the AIC and SC values are When the lag order is chosen to 2, it reaches the minimum at the same time. Therefore, the optimal lag order is chosen to be 2.

TABLE II LAG MODEL SELECTION CRITERIA OF VAR MODEL

Lag	LogL	AIC	SC	HQ
0	51.12292	-7.017559	-6.926265	-7.026010
1	59.68709	-7.669584	-7.395702	-7.694936
2	69.08732	-8.441045	-7.984576	-8.483300

E. The establishment of VAR model

This article should establish a VAR model with a lag order of 2, namely VAR(2) model. Using EVIEWS 5.0 software to run the VAR model estimates that the goodness of fit of both equations is around 0.8, so the next step can be analyzed. In order to test the stability of the model, a unit root test of the model is required. This paper uses the AR root map test and finds that all unit roots fall within the unit circle, which can be used to determine that the VAR model is stable. As shown in Figure 1.

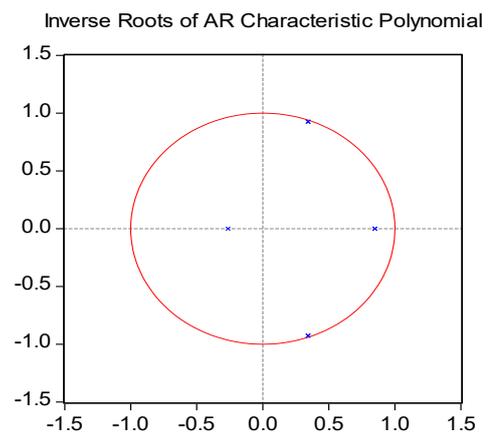


Fig. 1 Root diagram of the AR

F. Pulse response function analysis

Analyze the impulse response function of the VAR model established in this paper. In the figure, the vertical axis indicates the magnitude of the pulse function, the horizontal axis indicates the lag time, and the upper and lower dashed lines indicate the standard deviation band that is

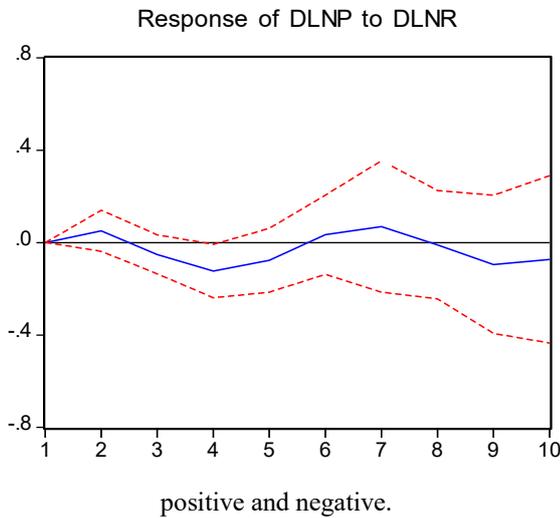


Fig. 2 Response of DLNP to DLNR

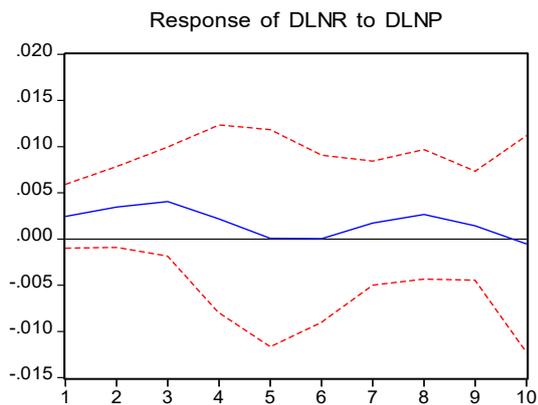


Fig. 3 Response of DLNP to DLNR

Figure 2 shows the impulse response function of atmospheric pollution on the upgrading of the industrial structure. In general, the impact of the upgrading of industrial structure in Xi'an on atmospheric pollution includes both positive and negative shocks. In the current period of a positive impact on the upgrading of the industrial structure, atmospheric pollution will not respond in the first phase, and there will be a positive impact on atmospheric pollution in the second phase, that is, upgrading of industrial structure will increase atmospheric pollution. After the third period, the impact on air pollution was negative, and reached the minimum in the fourth

period, which reduced air pollution. In the sixth and seventh periods, there will be a positive impact on atmospheric pollution, and then there will be a negative impact. That is, the upgrading of industrial structure will relieve air pollution to some extent, but this mitigation effect is not obvious.

Figure 3 shows the impulse response function of the upgrade of the industrial structure to air pollution. A positive impact on atmospheric pollution in the current period, the upgrading of industrial structure is gradually in a constant trend, and reached its maximum value in the third period, indicating

V. RELATED RECOMMENDATIONS FOR SMOG GOVERNANCE AND INDUSTRIAL STRUCTURE OPTIMIZATION IN XI'AN

A. Control the scale of economy and change the mode of economic development

Xi'an City should continue to change the traditional mode of extensive development, take an intensive approach, control the speed of economic growth, and reasonably view the slowdown in economic growth. Controlling the size of the economy is not a simple administrative order to limit production, cut production, or suspend production, but it must take into account the coordinated development of economic efficiency and ecological environment. Control the scale of economy, form a mode of economic growth, make comprehensive use of resources, and encourage the rapid development of enterprises with low resource utilization and energy consumption.

B. Accelerate the upgrading of agricultural industry and enhance the strategic position of agriculture

Agriculture is the foundation of the national economy and the basic guarantee for the sustained and rapid development of the entire national economy^[6]. For a long time, Xi'an's weak agricultural foundation, backward production methods, and low productivity have created serious obstacles to the optimization of Xi'an's industrial structure. Therefore, we must adjust the agricultural structure to realize the sustainable development of agriculture and realize the coordinated development of urban and rural economies. Adhere to technological innovation, deepen the reform of the agricultural scientific research and extension system, promote the integration of agricultural science, education, and production, study, and research, speed up the transformation and popularization of agricultural scientific and technological achievements, and actively develop the enthusiasm of farmers in science and technology farming and farming.

C. Vigorously develop modern service industry and upgrade the internal level of the tertiary industry

The greater the proportion of the tertiary industry in the overall economic structure is, the stronger the enhancement of regional economic strength, and the tertiary industry is a "clean industry", with the advantages of high output and low pollution as a whole. Xi'an should continue to vigorously develop the tertiary industry, expand the tertiary industry, continuously improve the internal level of the tertiary industry, rationally develop the traditional service industry, and vigorously

develop new service industries^[7]. Utilizing the advantages of having a large number of science and education resources, vigorously develop tertiary industries such as modern logistics, finance and insurance, information services, business conventions and exhibitions, and cultural and creative industries, actively promote the development of new environmental protection service industries, and cultivate a group of high-quality, low-pollution and high-integration strengths.

D. Optimize the internal structure of the secondary industry and reduce the proportion of heavy industry

Although the industrial structure of Xi'an has already presented the "three-one to one" structure, the proportion of heavy industry in the secondary industry is too large. Therefore, the internal structure of the secondary industry should be optimized. However, it is not possible to suppress the development of industry blindly but to guide the optimization within the industry. Adhere to the development of industrialization driven by informatization, vigorously develop new industries with high technological content and information intensive, and speed up the development of new industrialization. In respect of energy conservation and emission reduction, enterprises should be encouraged to increase scientific and technological research and development techniques, control pollution at the source, eliminate high-pollution, high-energy-consuming production techniques and equipment, and vigorously develop clean technologies and green technologies.

VI. CONCLUSION

Through the research of this paper, it is found that the upgrading of the industrial structure in Xi'an will mitigate atmospheric pollution to a certain extent, but the degree of relief is low. This is mainly due to the fact that the proportion of the secondary industry in Xi'an is still relatively large, and the proportion of heavily polluting heavy industry accounts for Extremely unreasonable. At the same time, the increase in the level of atmospheric pollution will also force the government and companies to pay attention to the problem of environmental pollution, and actively adjust the industrial structure, but will promote the upgrading of the industrial structure. Therefore, Xi'an City should continue to deepen the upgrading of industrial structure and make the internal structure of the industry more reasonable.

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