Research on the Relationship between Industrial Structure and Regional Growth in Shanxi Province Based on VAR Model

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Abstract: This article has performed the empirical test in relationship between industrial structure and economic growth of Shanxi during 1978 to 2012 with the econometric analysis method of VAR model. The result points to the fact: In a long term, there is a stable balance between industrial structure and economic growth in Shanxi; Industrial structure plays a significant role in economic growth, but this kinds of influence requires a long time to show; The structural change of primary industrial always shows an opposite change direction to its economic growth. It aims to bring forward some guiding advice for making a rational industrial policy, ultimately, to make contribution to economic growth.

1. Introduction

According to the traditional economic theory, a certain stage of economic growth corresponds to a certain industrial structure, economic growth is inevitably along with the changes and upgrades of industrial structure, and the changes of industrial structure will affect the degree and path of economic growth directly, which has been proven by the economic growth process of many countries. Over the past 40 years of Opening-up, Shanxi has reached a speedy economic growth with its industrial structure made a corresponding changes and upgrades. Per capita GDP growth from 291 yuan in 1978 to 38608.5 yuan in 2012, three major industrial ratio by the early time of Opening-up (30.5: 51.9: 17.6(changes to 2014(8.85: 54.78: 36.38(, the proportion of primary industry is declining while the proportion of secondary and tertiary industries is rising, which the second industry dominates and the third industry has a rapid growth, the industrial structure gradually evolves into a rational "231" pattern. Currently, with the international economic situation goes complex, domestic economy slows down, stepping into a new stage. As the core area of "Belt and Road" initiative and Western Development Strategy, the effect of ShanXi has never been so important, to the nation's economic healthy growth, the sustainable development, and the leading effect of the western area. Nowadays, all kinds of reports in academic field shows that there is still a huge gap, the industrial structure and the path industrial structure changes, among ShanXi and developed countries and their provinces, which infers that our structure is relatively unreasonable. So it remains significant meaning to realize fact of ShanXi, make a reasonable and long-term strategy for upgrading the industrial structure and activates its economic growth by researching whether there is a dynamic relationship between the industrial structure and economic growth, finding out the utility mechanism in such dynamic relationship.

The first part is introduction, the second part is theoretical analysis and literature review, the third part is making analysis, finally pushing out the conclusion.

2. Theory analysis and literature review

2.1 Theory analysis

Foreign academic field started the research of industrial structure and economic growth in 17th century. William is the first person who discovered the structural change in economic growth, then

Clerk based on the finding of Petty, make the conclusion of 40 countries and district, involving the data of labor input and output in three different period, summarized the tendency that with the development of economy and national income per head, the workforce transmit from primary industrial to second industrial, then to the third industrial. What's more, in early 1930s, Germany economist Hoffman extrapolated the change trend of industrial structure in some stage industry to the later stage of industrialization based on experience of early time and middle time in industrialization. By setting the Hoffman index, he made statistics on relative rank in many countries, involving their consumption and capital industry in their industrialization periods, concluded that the ratio of net output in consuming district and capital goods district is towards down. Namely the regulation of capital goods proportion is rising and beyond the consuming good in industry. And the famous U S economist explained the trend and reason to trend in public income and the workforce in different industry in his book "national income and its composition". Those theories provide the constructive basement to the following chasers to make further researches of industrial construction and economic growth.

2.2 Literary review

Going abroad, Krugman (1976) used Keynesain Model to make the research of correlation of the industrial structure and economic growth in developing countries, PhilipKofiAdom (2012) analyzed the short-term causality and long-term equilibrium among carbon emissions, economic growth, technological efficiency and industrial structure in three African countries, Ghana, Senegal and Morocco, by using the boundary co-integration analysis method. Domestically, Chunhui Gan (2011) constructed an econometric model of industrial structure change and economic growth on the basis of measuring the rationalization and upgrading of industrial structures and discussed their effects on economic fluctuation. It shows that both the rationalization and upgrading of industrial structure have obvious effects on economic growth. Stage characteristics. Binbin Yu (2015) used two economic growth models, utilized the statistical data of 285 prefecture-level cities a in China from 2003 to 2012, and used the dynamic spatial panel model to test the economic growth effect of industrial restructuring and productivity improvement. It was concluded that the spatial spillover effect is an important factor to examine the fact of industrial restructuring and productivity improvement influences the economic growth.

3. Empirical Analysis

3.1 Variable Selection, Source and Pretreatment

The basic data of this paper comes from the "Statistical Yearbook of Shanxi Province" (in Chinese). Considering the economic system reform in our nation since 1978 and the corresponding changes happened in industrial structure, so the sample interval is selected from 1978 to 2012.

The index to measure the economic growth of a country or region is usually gross national product (GNP) or gross domestic product (GDP). Therefore, this paper uses the GDP of Shanxi Province as the index to measure the economic growth of Shanxi Province. The indicators of industrial structure change include the output value structure, employment structure, asset structure and technology structure of the first, second and third industries. These variables explain the industrial structure from different angles. Therefore, in order to fully reflect the relationship between industrial structure and economic growth, this paper uses two indicators to measure industrial structure: the output structure adjustment coefficient (PS), i.e. the proportion of primary industry GDP to GDP, and the employment structure adjustment coefficient (LS), i.e. the proportion of primary industry employment to the total number of social employment. Changes. For data comparability, the GDP of economic growth index is converted to 1978 constant price, and the conversion formula is Y (current constant price) = (previous GDP index/1978 GDP index) *1978 GDP. In addition, in order to eliminate the possible heteroscedasticity and improve the fitting degree, the data are digitalized and recorded as LNY, LNPS and LNPS respectively.

3.2 Data stationarity test

For non-stationary time series, the digital characteristics of time series change with time, and their stochastic laws are different at each point. It is difficult to grasp the randomness of the whole sequence through the known information of the sequence. Direct use of sequence analysis will result in "Fake-regression" and make the conclusion invalid. Therefore, before that, we need to test the stationarity of the data, that is, unit root test. Eviews6.0 provides ADF method, PP method, ERS method, KPSS method and other six testing methods. This paper adopts the most commonly used ADF testing method. The results are shown in Tables1and 2.

Table.1. ADF Test Results for Horizontal Sequences

variate	Test type	ADF test value	1%level	5%level	10%level	Conclusion
LNY	(C,T,0)	-0.5066	-4.2529	-3.5485	-3.2071	unstable
LNPS	(C,T,0)	-1.9911	-4.2529	-3.5485	-3.2071	unstable
LNLS	(C,T,0)	-1.2655	-4.2529	-3.5485	-3.2071	unstable

Table.2. ADF test results of first order difference

variate	Test type	ADF test value	1%level	5%level	10%level	conclusion
DLNY	(C,T,0)	-4.6507	-4.2627	-3.55297	-3.20964	Stable
DLNPS	(C,T,0)	-4.3733	-4.2627	-3.55297	-3.20964	Stable
DLNLS	(C,T,0)	-3.8485	-4.2627	-3.55297	-3.20964	Stable

The results shows that the original sequence LNY, LNPSL and NLS failed the test at the significance level of 5%, indicating that the sequence was unstable. In table 2, it can be seen that the original sequence passes the unit root test at the significance level of 5% after first-order difference processing, that is, it is stable. This indicates that the original sequence is a first-order integral, which meets the conditions for establishing the VAR model, and the VAR model can be established on the basis of first-order difference.

3.3 Establishment of VAR model

Vector autoregression (VAR) is a model established based on the statistical properties of data. The VAR model takes each endogenous variable in the system as a function of the lagged value of all endogenous variables in the system to build the model, so as to extend the single-variable autoregression model to the "vector" autoregression model composed of multivariate time series variables. It overcomes the defect that traditional econometric method is based on economic theory and cannot provide a strict explanation of the dynamic relation between variables due to its imperfection and determines the dynamic structure of economic system directly through the actual economic data. The mathematical expression of VAR (p) model is as following:

$$\mathbf{Y}\,t = \boldsymbol{\Phi}\,1\,\mathbf{Y}\,t\,1 + \boldsymbol{\Phi}\,p\,\mathbf{Y}\,t\,p + \mathbf{H}\,\mathbf{X}\,t + \boldsymbol{\varepsilon}\,t$$

Among them: Y_t is the k-dimensional endogenous variable vector, X_t is the D-dimensional exogenous variable vector, P is the lag order, the number of samples is T. The k * k dimension matrices &1... &P and K * D dimension matrices H are the coefficient matrices to be estimated. It is assumed it is a covariance matrix of t and is a positive definite matrix (k * k).

Before establishing the VAR model, we first have to confirm the lag order of the VAR model. On the one hand, we should make the lag order large enough to fully reflect the dynamic characteristics of the constructed model. On the other hand, the larger the lag order, the more parameters to be considered, and the less the degree of freedom of the model, which directly affects the validity of the estimated parameters. Therefore, when choosing the appropriate lag order, we should consider comprehensively, not only a sufficient number of lag terms, but also a sufficient number of degrees of freedom. Based on various information criteria, this paper judges the optimal lag period. The output of Eviews is shown in Table 3.

Table.3. Testing results of optimal lag order for VAR model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	262.2452	NA	3.45e-12	-17.87898	-17.73754	-17.83468
1	267.0798	8.335429	4.62e-12	-17.59171	-17.02593	-17.41451
2	282.2902	23.07792	3.08e-12	-18.02001	-17.02990	-17.70992
3	297.2775	19.63857	2.17e-12	-18.43293	-17.01849	-17.98995
4	331.6655	37.94535*	4.23e-13*	-20.18383*	-18.34505*	-19.60795*
5	338.9709	6.549619	5.86e-13	-20.06696	-17.80385	-19.35818

According to table 3, appropriate lag order number is selected from order 1-5. According to LR statistics, final prediction error,

AIC criterion, SC criterion and HQ criterion output results. The optimal lag order of VAR is determined to be order 4, and the VAR model is established with the optimal lag order of order 4. The estimated results of VAR (4) model are shown in table 4.

Table.4. The evaluated result of VAR (4) model

explanatory variable	Regression Function DLNY	Regression Function DLNPS	Regression function DLNLS.
DLNY (-1)	-0.308335	-0.028869	-0.122236
DLNY (-2)	-0.363952	0.119929	0.009968
DLNY (-3)	0.176275	0.037684	-0.000407
DLNY (-4)	0.388244	-0.052893	-0.069487
DLNPS (-1)	-0.641112	0.051983	0.062894
DLNPS (-2)	-0.015820	0.382397	0.159099
DLNPS (-3)	1.289734	0.170967	-0.010426
DLNPS (-4)	3.110785	-0.588401	-0.559542
DLNLS (-1)	-0.838476	-0.003015	0.017821
DLNLS (-2)	-1.337035	0.116209	-0.078525
DLNLS (-3)	-2.007870	0.209049	-0.286416
DLNLS (-4)	-1.143900	-0.262751	-0.156965
C	0.114719	-0.015018	0.006811
R^2	0.725154	0.734665	0.713748

As shown in the figure, table 4 is the estimation result of VAR model established according to the optimal lag order of order 4. In addition, the AR root diagram of the VAR model is shown in figure 1. The reciprocal of all root modules of the estimated VAR model is less than 1, that is, it is located in the unit circle and is stable.
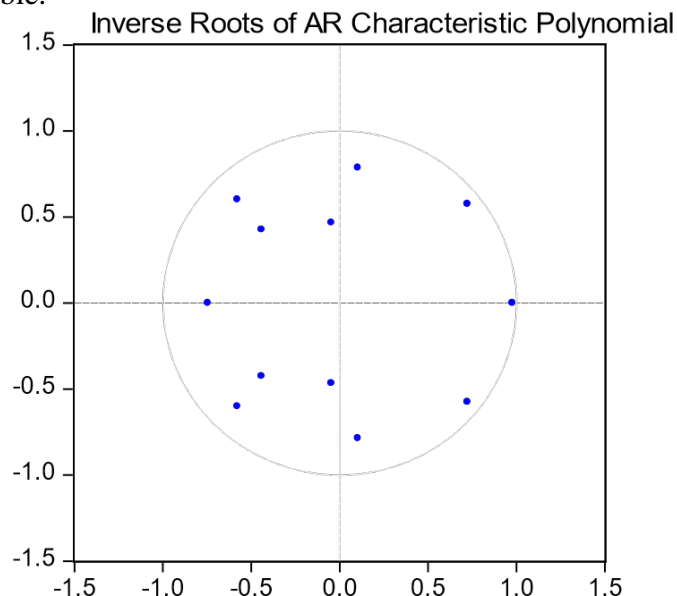

Figure 1. The result of testing stability of VAR testing

3.4 Impulse response function and variance decomposition

3.4.1 Impulse response function

In the practice, because of the VAR model is a kind of non-theoretical model, so when we are analyzing the VAR model, it is a tendency that we do not to analyze the how influence of one variable on another variable, but to analyze the dynamic effect when an error happens, or the model got sorts of impact. This analysis method called the impulse response function method.Eviews6.0 output results are shown in figure 2, 3.

Response of DLNY to Cholesky One S.D. Innovations

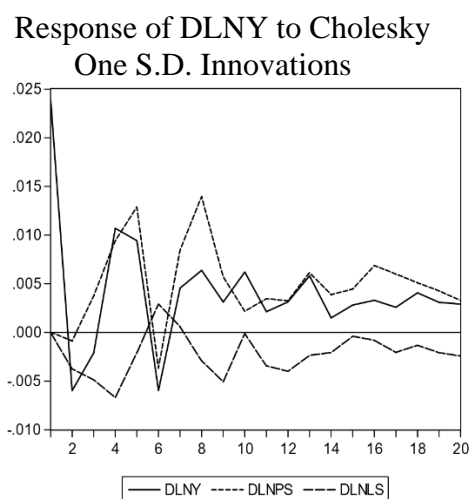Response of DLNPS to Cholesky One S.D. Innovations

Figure 2. LNY's reaction to the impact
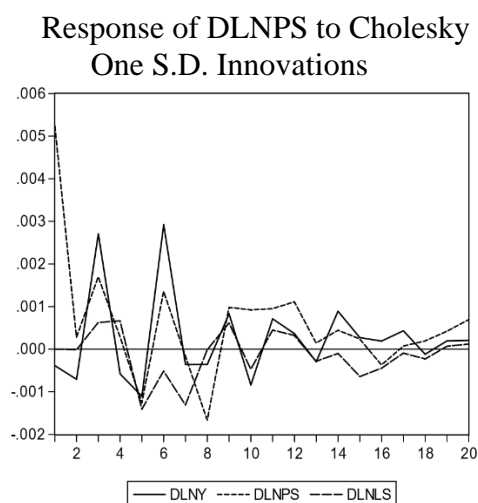Response of DLNLS to Cholesky

Figure 3. LNPS' reaction to the impact

As it can be seen from Table 2, when a positive shock befell on GDP in this period will bring a negative shock to itself, relatively large fluctuations occurred in the first seven periods, and the shock amplitude is the largest in the fourth period, and then tend to be stable .GDP has a slight negative response to the impact of output structure in the second period, which may be due to the temporary decline of output caused by the policy adjustment that makes the primary industry-related enterprises uncomfortable or make the wrong decision .After that, it reached the maximum value in the 8th period and maintained steady growth from the 10th period. This may be caused by the selected index is the primary industry and the production cycle is long, and the positive impact on it will not significantly change the GDP in the short-term. GDP has a negative impact on the response to employment shock. In the fourth period, the impact is the smallest and then came to be stable, which is consistent with the law of industrial structure evolution. With the development of economy, the distribution of labor force among industries is as follows: the primary industry will decrease, the second and third industries will increase. As it can be seen from Table 3, the positive impact of GDP on the output structure has a negative reaction at first, and it tends to be stable after several periods of fluctuations. As shown from Table 4, the positive impact of GDP on the employment structure also has a negative response, which reaches the lowest in the first period and then tends to be stable. This shows that the economic growth in Shanxi province promotes the transfer of labor force from the primary industry to the secondary and third industry that means, the economic growth contributes to the adjustment of industrial structure, but there is a short lag period.

4. Conclusion and suggestion

This paper makes an empirical study on the relationship between industrial structure and economic growth in Shanxi Province by using the dynamic econometric analysis method based on VAR model. The following conclusions are drawn: although the output value structure, employment structure and economic growth are not stable, there is a stable equilibrium relationship between industrial structure and economic growth in the long run; industrial structure has an important impact

on economic growth, but this impact needs to be demonstrated for a long time; structural changes in the primary industry The change direction of economic growth is opposite. Therefore, the following suggestions are put forward:

(1) Shanxi Province should formulate appropriate industrial policies to adjust and optimize the industrial structure in order to promote economic growth, clarify the direction of development, reduce the changes of the primary industry in the gross output value, at the same time, pay attention to the changes in the total employment population of the primary industry, and realize production by promoting the coordinated and interactive development of the first, second and third industries. Rational and efficient allocation of elements. In addition, attention should be paid to adjusting the agricultural structure, on the one hand, to determine the main adjustment direction of the agricultural structure in various areas, and to deepen the processing of agricultural products; on the other hand, to speed up the development and promotion of agricultural science and technology, and comprehensively improve the quality of agricultural products.

(2) Accelerate the transformation of the economic mode, optimize and adjust the secondary industry, accelerate the development of the tertiary industry, and cultivate innovation-oriented development mode. In the direction of industrialization, marketization and internationalization, we should increase capital and technology investment in tertiary industry, improve commodity market system and social service system, vigorously develop modern service industry, transform traditional service industry and promote industrial upgrading, strengthen talent introduction and cultivation, and improve the overall development and management level of third industry. Increase the proportion of service industry in GDP and the employment population of the whole society and improve its ability to absorb surplus agricultural labor force.

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