International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

Analysis of the Influence of Industrial Structure Change in Hebei Province on GDP

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Abstract: ***Industrial structure and economic growth are closely related, the change of industrial structure affects the speed of economic growth, and economic growth will also affect the change of industrial structure to a certain extent. This paper mainly uses the output value of three industries and the total value of GDP in Hebei Province from 1987 to 2016 to directly reflect the relationship between industrial structure and GDP through descriptive statistical analysis. At the same time, the marginal effect of the three industries on GDP, namely elasticity, is obtained by the least square method, which verifies that the second and third industries play an important role in the process of GDP growth in Hebei Province. The empirical analysis of the change of industrial structure in Hebei Province on GDP uses the analysis method of time series data, mainly including the unit root test, co-integration test and other empirical studies. At last, the author puts forward the idea of economic development in Hebei province: to improve the benign economic growth of Hebei province by increasing the output value of the second and third industries, and to promote the transformation of the industrial structure from "second, third and first" to "third, second and first".***

Keywords: Industrial structure; GDP; Descriptive statistics; The empirical analysis

1. Introduction

Since the reform and opening up, with the increase of industrial investment, the industrial structure adjustment process of Hebei Province has been accelerated, and the opening-up pattern has been formed. The industrial economy has grown from scratch, from weak to strong, and has made brilliant achievements. the proportion of the industrial in the regional GDP is steadily increasing, driving the economic development of the province is strong. However, due to the natural endowment, there are still some problems in the development of its industrial structure, such as the low rate of industrial structure optimization and upgrading, the unoptimistic development of technology-based industries, and the prominent problems of resource-consuming industries with low technological content and labor-intensive industries. In order to further adapt to the overall trend of current economic development, increase the economic growth rate of Hebei Province, and give full play to Hebei Province's own advantages, this article will apply descriptive statistics, multiple regression analysis, time series and other methods to make an empirical study on the impact of Hebei Province's three industrial changes on GDP so as to put forward corresponding suggestions for the optimization and upgrading of the industrial structure of Hebei Province.

2. Development status of industrial structure in Hebei Province

2.1 Development Status of Output Value of Three Industries

Hebei Province is close to the Bohai Sea and Beijing - Tianjin, with superior geographical location and relatively rich resources. It not only has rich ecological resources but also rich mineral resources, and its economic development momentum has been rapid in recent years. The regional GDP of Hebei Province increased from 521.92 in 1987 to 34016.32 in 2017, and the per capita GDP increased from 921 yuan to 44,138 (see Figure 1). As of 2017, the added value of the Three industries in Hebei Province was divided into 3,129.98,15,846.21 and 15,040.13 respectively. It can be seen that the primary industry in Hebei Province has gradually withdrawn from the stage of history, but its industrial structure is still "two-three-one" as the gradient, the proportion of the secondary industry is still too high, and the tertiary industry is underdeveloped to keep up with Beijing and Tianjin.

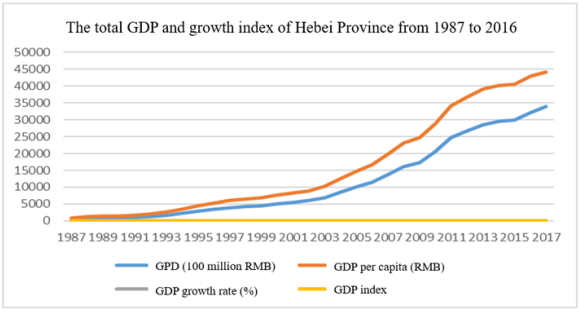

Figure 1: Total GDP and Growth Index of Hebei Province from 1987 to 2016

2.2 Changes of Industrial Structure

With the adjustment of industrial structure in Hebei Province, the ratio of the output value of the Three industries to the total GDP has also undergone significant changes. It can be seen from Figure 2 and Figure 3 that the proportion of the tertiary industry in GDP is gradually increasing, that is, t the industrial structure of Hebei Province is changing from "two-three-one" to "three-two-one". Among them, the primary industry dropped from 23.14 percent to 10.89 percent, the tertiary industry accounted for a significant increase, and the secondary industry remained around 50 percent since 1993. In 2016, the proportion of the tertiary industry increased to 41.54%, and the gap with the secondary industry narrowed from 15.36 percentage points in 1988 to 6.03 percentage points. Therefore, it can be judged that the second and third have become the important factors of economic growth in Hebei Province, and substantial progress

has been made in supply-side reforms.

3. Empirical analysis of the impact of industrial structure change in Hebei Province on GDP

In order to further verify the empirical relationship of the impact of industrial structure changes in Hebei Province on GDP, this paper selects relevant data of Hebei Province from 1987 to 2016 ,from the "2017 Hebei Province Economic Yearbook", a total of 30 years of relevant data 1 (see appendix 2), by using stationarity test, cointegration test, error correction model and granger causality test and a series of methods for the empirical test.

3.1 Empirical test

3.1.1 Stationarity test

In EVIEWS7.2, the ADF test is used to perform unit root test on the original sequence of each variable. If the sequence is stable, it will be processed according to classic econometrics; if it is not stable, the original data will be tested for cointegration, and if there is a cointegration relationship, the variable will be explained. There is a long-term equilibrium in the statistical sense, and error correction is required for short-term deviations from the equilibrium state. On the contrary, there is no co-integration relationship, indicating that there is a problem with the selected data, and there is no way to continue to analyze the problem under study.

Therefore, the hypothesis and model proposed in this article are as follows:

Null hypothesis: the original sequence has unit root, that is, the sequence is not stationary;

The alternative hypothesis: the original sequence does not have a unit root, that is, the sequence is stationary.

The test model of ADF is as follows:

$$Y_t = \gamma Y_{t\ 1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t\ i} + \varepsilon_t$$

$$Y_t = \alpha + \gamma Y_{t\ 1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t\ i} + \varepsilon_t$$

$$Y_t = \alpha + \beta t + \gamma Y_{t\ 1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t\ i} + \varepsilon_t$$

Among them, the third model contains both the trend term and the intercept terms; the second model contains only the intercept terms; the first model contains neither trend terms nor intercept terms.

(1) ADF test

The unit root test sequence is model 3, model 2, model 1 (see appendix 3 for the unit root test flowchart). The unit root test combines the values of AIC, SC, and HQ of the three models without rejecting the null hypothesis (see appendix 4, 5, 6, 7), choose the smallest value of AIC, SC, HQ in the three cases to determine which case the variable contains the unit root process.

(2) Analysis of EVIEWS results

It should be noted here that the t-test of ADF test is the left-hand test. If the T statistic of the ADF is on the right side of the critical value, that is, greater than the critical value, the null hypothesis that there is a unit root cannot be rejected.

Table 1: ADF test results

Variable	ADF value	1% Critical value	5% Critical value	10% Critical value	Conclusion
LNY	1.762583	-2.650145	-1.953381	-1.609798	Non-stationary
LNX1	1.631626	-2.66072	-1.95502	-1.60907	Non-stationary
LNX2	1.723051	-2.650145	-1.953381	-1.609798	Non-stationary
LNX3	-0.812547	-4.323979	-3.580623	-3.225334	Non-stationary
DLNY	-2.830172	-3.689194	-2.971853	-2.625121	steady
DLNX1	-3.501803	-4.374307	-3.603202	-3.238054	steady
DLNX2	-3.325508	-4.323979	-3.580623	-3.225334	steady
DLNX3	-7.012476	-3.689194	-2.971853	-2.625121	steady

It can be learned from Table 1:

(1) The GDP growth rate, that is, the T statistic of ADF of LNY is 1.76, which is greater than the critical value of 5% -1.95, so the null hypothesis of unit root is accepted. Similarly, the value of T statistic of ADF of the growth rates of LNX1, LNX2 and LNX3 industries are 1.63, 1.72 and -0.81 respectively, which are all greater than the critical value. Therefore, the null hypothesis is not rejected, and it can be obtained that the level series of the growth rates of the three industries are all non-stationary series. Meanwhile, according to the AIC, SC and HQ of Appendix 4, 5, 6 and 7, it can be known that LNY, LNX1, LNX2 and LNX3 are all unit root processes with intercept terms.

(2) the growth rate of GDP and three industrial growth rate of the first order difference sequence of horizontal, unit root test was carried out on the first order difference sequence, It is obtained that the values of the ADF T statistics of DLNY, DLNX1, DLNX2, and DLNX3 all fall within the rejection range, and the original Assume that the first-order difference series of DLNY, DLNX1, DLNX2, and DLNX3 are stationary series, namely LNY~I(1), LNX2~I(1), LNX3~I(1).

From this, we can examine whether there is a co-integration relationship between them, that is, test whether there is a stable relationship between the growth rate of the three industries and the growth rate of GDP to avoid spurious regression.

3.1.2 Co-integration test

JJ co-integration test process[4]:

1) Unit root test. After the above unit root test, it can be known that the level series of GDP growth rate and industrial structure growth rate are non-stationary series, and they are single integration of the same order, so the co-integration test can be carried out.
2) Establish VAR model, select a lag interval according to the number of variables and sample size, and perform VAR model regression;
3) Determine the optimal lag order of VAR model;
4) Carry out the Johansen cointegration test and obtain the cointegration equation between the variables.

The results obtained are as follows:

Table 2: Determining the optimal lag order of VAR

Lag order	LogL	LR	FPE	AIC	SC	HQ
1	234.0976	NA	6.14E-13	-16.77674	-16.00253	-16.5538
2	258.5702	33.88503	3.44E-13	-17.42847	-15.88005	-16.98258
3	285.9983	29.53797	1.78E-13	-18.30756	-15.98492	-17.63872
4	322.572	28.13362*	6.12e-14*	-19.89015*	-16.79330*	-18.99837*

It can be seen from Table 2 that there are more asterisks in lag order 3, so the optimal lag order of VaR is 4, namely VaR (4).

Then, the co-integration test is carried out, first View--Cointegration test. In the dialog box of co-integration test, [lag intervals] is the setting of the lag term of difference of endogenous variable, so it is one order less than the lag interval in the VAR model, that is, [1,3].The results are as follows:

Table 3: Co-integration test results

Number of null hypothesis cointegration vectors	Eigen values	Trace statistics	Critical Value below 5%	Probability
Zero	0.951869	126.4285	47.85613	0
At most one	0.744493	47.54896	29.79707	0.0002
At most two	0.330255	12.07184	15.49471	0.1535
At most three	0.061473	1.649536	3.841466	0.199

It can be concluded from Table 3:
(1) 0, at most one, at most two, and at most three in Table 3 are the numbers of the co-integration relationship between GDP growth rate and the growth rate of the three industries.
(2) According to the probability P value in Table 3, there are at least two co-integration relationships among LNY, LNX1, LNX2 and LNX3.Therefore, there is a long-term synergistic relationship between variables, and it makes sense to build economic models.

The two cointegration equations of variables available in Table 4 are, where $VECM_{1,t-1}$ $VECM_{1,t-2}$ is the error correction term of the equation.

$$VECM_{1,t-1} = LNY_{t-1} - 0.5436LNX1_{t-1} - 0.4245LNX2_{t-1} - 1.1943$$

$$VECM_{2,t-2} = LNY_{t-2} - 0.7119\,LNX1_{2} + 0.0047LNX2_{t-2} - 1.2296$$

Table 4: Cointegration Equation

Cointegrating:Eq	CointEq1	CointEq1
LNY(-1)	1	0
LNX1(-1)	0	1
LNX2(-1)	-0.543562	-0.711878
LNX3(-1)	-0.424454	0.004706
C	-1.194323	-1.229634

The co-integration equation (1) and Table 4 can reveal the correctness of the co-integration relationship among variables. COINTQ1 and COINTQ2 represent the short-term adjustment of variables when they deviate from equilibrium. The specific analysis is as follows:

(1) The first co-integration equation reflects the existence of long-term co-integration relationship among time series LNY, LNX2 and LNX3.When the growth rate of the long-term primary industry increases by 1%, the GDP growth rate of Hebei Province increases by 54.36% on average. If the growth rate of the tertiary industry increases by 1%, the GDP growth rate will change by 42.45% in the same direction.

(2) The second co-integration equation shows that there exists a co-integration relationship between LNX1, LNX2 and LNX3 in the long run, that is, when the growth rate of the secondary industry changes by 1% in the long run, the growth rate of the primary industry increases by 71.19% on average, while the change direction of the growth rate of the tertiary industry is opposite to that of the primary industry.

3.1.3 Error correction model

The above JJ cointegration test results show that there is a co-integration relationship, if continues to research its short-term deviation from equilibrium how to return to equilibrium state, the use of error correction, the error model of the multivariate to do VECM error correction based on VAR model, the steps of:
(1) Select LNY, LNX1, LNX2, LNX3, open it as VAR, select VECM in the VAR dialog box that appears, select the lag interval of the difference variable [1, 3], and the setting in the VAR model is [1, 4].

(2) After the VECM model is set, the number of co-integration equations in [Cointegration] is set according to the results of co-integration test, which can be known by JJ test as 2.The result is as follows:

Table 5: Error Correction Results

Error Correction:	D(LNY)	D(LNX1)	D(LNX2)	D(LNX3)
CointEq1	0.327167	0.825975	12.11012	0.835238
CointEq2	-0.36157	-0.77814	-7.6751	-0.79316
D(LNY(-1))	0.224942	0.069151	-5.57072	-0.43487
D(LNY(-2))	-0.11443	0.560227	-2.56579	-0.23609
D(LNX1(-1))	0.216028	0.413176	2.709742	0.60346
D(LNX1(-2))	-0.1401	-0.43125	-0.79639	0.357008
D(LNX2(-1))	-0.0212	-0.00448	0.433969	0.015278
D(LNX2(-2))	-0.00648	-0.00038	0.142018	0.002746
D(LNX3(-1))	0.648171	0.289662	1.918252	0.071221
D(LNX3(-2))	-0.18162	-0.40476	-0.27935	-0.31792
C	0.051148	0.042176	0.762438	0.171234

According to the co-integration relationship between the variables, the error correction model can be derived from the autoregressive distributed lag model.

$$\Delta LNY = 0.327VECM_{1,t-1} - 0.362VECM_{2,t-2} + 0.225\Delta LNY_{t-1} - 0.114\Delta LNY_{t-2} + 0.216\Delta LNX1_{t-1} - 0.140\Delta LNX1_{t-2}$$
$$- 0.021\Delta LNX2_{t-1} - 0.006\Delta LNX2_{t-2} + 0.648\Delta LNX3_{t-1} - 0.182\Delta LNX3_{t-2} + 0.051$$

Where VECM1,t-1 and VECM2,t-1 is the above co-integration equation is (1) and (2).The error correction model is a vector matrix derived from different variables as explained variables. Since the paper studies the impact of industrial structure changes on GDP, the above error correction model takes the GDP growth rate as explained variable.

Through co-integration test, it can be seen that there is a long-term equilibrium change relationship between GDP growth rate and the growth rate of the three industries, and the short-term deviation from the equilibrium state is also corrected by VECM model.

3.1.4 Granger Causal Relation Test

Through the unit root test of GDP growth rate and the growth rate of three industries, it can be seen that each variable is a first-order single integral sequence, then Granger Causal Relation Test can be conducted.

Through the co-integration test of variables, it can be concluded that there is a long-term co-integration relationship between GDP growth rate and the growth rate of the third industry, but it cannot indicate whether the change of the growth rate of output value of the third industry has predictive ability on the explained variable, namely GDP growth rate. Therefore, this paper uses the causality test to explain the relationship [9].

Table 6: Granger causality test results

Null Hypothesis:	Obs	F-Statistic	Prob.	Conclusion
LNX1 does not Granger Cause LNY	28	2.23239	0.13	Accept the null hypothesis
LNY does not Granger Cause LNX1		13.7028	0.0001	Reject the null hypothesis
LNX2 does not Granger Cause LNY	28	0.63911	0.0536	Reject the null hypothesis
LNY does not Granger Cause LNX2		1.81543	0.1853	Accept the null hypothesis
LNX3 does not Granger Cause LNY	28	5.02807	0.0154	Reject the null hypothesis
LNY does not Granger Cause LNX3		2.91694	0.0743	Reject the null hypothesis
LNX2 does not Granger Cause LNX1	28	14.4501	9.00E-05	Reject the null hypothesis
LNX1 does not Granger Cause LNX2		0.17684	0.839	Accept the null hypothesis
LNX3 does not Granger Cause LNX1	28	9.08431	0.0012	Reject the null hypothesis
LNX1 does not Granger Cause LNX3		5.86208	0.0088	Reject the null hypothesis
LNX3 does not Granger Cause LNX2	28	2.8307	0.0796	Reject the null hypothesis
LNX2 does not Granger Cause LNX3		1.01192	0.3791	Accept the null hypothesis

3.2 Empirical conclusion

There is a long-term co-integration relationship between the growth rate of the three industries and the growth rate of GDP. The influence of the change in the layout of the three industries on GDP is given by a reliable economic and statistical tests from the perspective of econometrics. For the short-term deviation, the error adjustment term is given in the error correction model to maintain the equilibrium relationship.

Through Granger Causal Relation Test, it can be understood that the change of output value growth rate of the tertiary industry and GDP growth rate are mutually causal, that is, the increase of tertiary industry growth rate will have an effect on the GDP growth rate of Hebei Province, and the GDP growth will promote the growth of the tertiary industry. At the same time, the change of the rowth rate of the secondary industry is the Granger causality of the GDP growth rate, and vice versa. The change of the output value of the primary industry is not the Granger causality of GDP change, but the increase of GDP will also promote the increase of the primary industry.

Through the empirical study, we can know that the change of the growth rate of the second and third industries will have a certain forecasting effect on GDP, and we can predict the development degree of the third industry in Hebei Province from the change of the GDP growth rate. At the same time, changes in the growth rates of the three industries can enable us to understand the pros and cons of the internal economic structure of Hebei Province.

4. Conclusion

In order to further verify the empirical relationship between the impact of industrial structure changes on GDP in Hebei Province, this paper selects relevant data of Hebei Province from 1987 to 2016, and carries out empirical tests by using some empirical methods, such as stationarity test, co-integration test, error correction model and Granger Causal Relation Test. First, descriptive statistics are used to intuitively reflect that changes in industrial structure have an impact on GDP growth. Second, a quantitative analysis of the long-term equilibrium relationship between data is carried out. Through empirical analysis, we can learn:

The industrial structure and GDP of Hebei Province are non-stationary but both are first-order stationary series. However, the co-integration test shows that there is a statistically long-term synergy relationship between them. In addition, in practice, we know that the industrial structure and economic growth are economically significant. There is a certain regularity relationship: economic growth promotes consumer demand, and the demand structure determines what the region mainly produces, that is, which industry is the focus, because the pursuit of profit maximization is the production goal of producers. The demand structure and production structure promote the adjustment, optimization and upgrading of the industrial structure, and influence economic growth through the role of market mechanisms.

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