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An Empirical Analysis on the Relationship Between Logistics Industry and Economic Development of Henan Province

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Abstract

In view of modern logistics industry in economic development playing an increasingly important role, in order to explore the relationship between logistics industry and economic development of Henan province, this paper selects its relevant data of 1990-2010, establishing econometric model, quantitatively studying the relationship between economic development and its logistics industry, in the end we draw conclusions with logistics industry leading to a significant contribution to the economic development of Henan Province. According to the conclusion, we can be more effective in considering the status of logistics industry in the economic development of the Henan Province, providing basis which related with decisions making for logistics policy. Finally, we make corresponding suggestions according to the conclusions.

Keywords: *logistics, economic development, correlation, econometric model*

1. Introduction

The famous American economist Peter Ferdinand Drucker points out: “50% percent of the costs that consumers spending on commodity is associated with the circulation of commodities activities, so area of logistics industry is the last area to reduce costs”. In Japan, the area of logistics industry is considered inferior to the field of resource along with field of human, which is being "the third profit source", therefore, logistics industry has significant influence on cost control and economic development. Similarly, modern logistics industry is also the pillar industry of Henan economy as well as its new economic growth point. Relying on the transport hub location of its provincial capital-Zhengzhou, Henan has the unique conditions in advancing the development of logistics industry. The logistics industry of Henan has indeed made great progress after construction for more than 10 years, however, compared with the coastal provinces and economically developed areas, modern logistics industry of Henan Province is still lagging behind a lot, which is still in the initial stage, problems such as blind investment, redundant construction and so alike still exist. In this paper, we use the method of empirical study, trying to find out the extent of correlation between logistics industry and economic development of Henan Province, so as to provide basis for decision making on related policies.

2. Literature Review

2.1. Foreign Research

In terms of the relationship between logistics industry and economic development, foreign research focus on the study of logistics system of regional economic benefits, mainly from the following two aspects:

(1) They are focusing on the effect of logistics infrastructure especially traffic carriage facilities on regional economic development. As of Jack R Meredith (1998) is the first to combine logistics industry with regional economy to go on his analysis and research, who gives the final conclusions as the following: the transportation infrastructure facilities and the development of the logistics industry of the whole city will be playing an important role in

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enhancing the overall competitiveness of regional economy as well as improving its environment for investment [1]. Mudit Kulshre shtha (2004) focus on both the significant influence that India railway transportation logistics brings to its economic development and the correlation between the two [2]. Paul D. Larson (2003) surveys the role of logistics infrastructure playing on the regional economic development by establishing a multilayer model OECD [3].

(2) They have been exploring the the relationship between overall regional logistics industry development and economic development. Mrijam Iding (2001) focus on the relationship between regional rapid economic development and its logistics industry of Singapore [4].

2.2. Domestic Research

At present, the domestic research with regard to the correlation between logistics industry and regional economic growth are both qualitative and quantitative analysis. While here we just review related quantitative analysis literatures, the following summary provides the major issues and findings in the literature.

Liu Nan and Li Yan (2007) examine the inactive relationship between modern logistics industry and economic development from perspective of the promotion of supply and pull of demands the case of Zhejiang Province as an example. In particular, they address that there is indeed interactive relationship between the two with the method of Grainger causality test [5]. Zhang Hongbo and Peng Yan (2009) using logistic model with empirical research method to analysis the mechanism that modern logistics on regional economic growth [6]. Lin Haihua and Lin Haiying (2010) collect the relevant data of Inner Mongolia region 1988 to 2007, establishing econometric model, in addition, the author adopts the mathematics tool of stationarity test and cointegration test, then construct an error correction model, finally they draw the conclusion that logistics industry of Inner Mongolia plays a long-term and stable role on its economic growth [7]. Zhu Wei, Tang Zhen and Wang Shuyun (2012) investigate the correlation between logistics industry and economic development, take Shandong Province as an example. The article adopts method of empirical analysis, demonstrating that there is mutual promoting relationship between logistics industry and its economic development of Shandong Province [8].

While these literatures in domestic provide different qualitative and quantitative research perspectives on the interactive relationship between logistics industry and regional economic development. However, owing to different regional scope the relationship between the two may exhibit different regional differences, what's more, so far, literatures related to this regard of Henan Province are only a limited number of research: Shang Huifang and Wang Fei (2009) survey the contribution that logistics industry makes to economic development of Henan Province, using principal component and regression analysis, the conclusions demonstrate that the former produces significant contribution to the latter, however, it lacks of certain objectivity in determining the principal component factors [9]. Zhang Pengwei (2010) also adopts the method of principal component analysis, basing on the following three factors as demand, physical capital investment and human capital investment, concluding that the logistics industry in Henan Province has a role in promoting on its economic development [10]. Wu Lijun et al. also study the relationship between logistics and regional economic development [11-13]. Compared with the above literatures researching on Henan Province, this article is more comprehensive and objective in selecting the explanatory variables, in addition the sample data (1990-2010) are more complete, thus conclusions of an empirical study on Henan Province drawing from this paper have the practical reference value.

3. Model Construction

3.1. Metrics Selection and Source of Data

(1) The index system of logistics industry: In general, the development of the logistics industry is mainly determined by transportation, warehousing and level of logistics management. Given maneuverability of the model as well as accessibility of the data, we select freight traffic volume, passenger traffic volume, freight turnover volume and passenger turnover volume to be measure indexes in this paper.

Freight (passenger) traffic refers to in a certain period of time, the actual shipment quantity by a variety of means of transport (passenger).The index is a quantity of service index which reflects the transport industry for the national economy and people's living, but also are the main indicators that can instruct related department to work out and examine production

plans of transportation as well as study the scale and speed of transportation development. Freight (passenger) turnover volume refers to in a certain period of time, by all means of goods transport (passenger) number corresponding to the sum of the product of distance. This index can reflect the total outcome of transportation production. It's also the main basic data to work out and examine production plans of transportation as well as calculate the transport efficiency, labor productivity and transport unit cost accounting. Therefore, the above indexes can in a certain level reflect the development level and process of logistics industry of a country or an area. given this situation we select the above indexes as measurement of the logistics industry in Henan province.

Taking the freight and passenger traffic volume in the same country or area can be in a high correlation into consideration, we process the two to be unified passenger traffic volume equivalent. Similarly the freight turnover volume and passenger turnover volume are unified to be passenger turnover volume equivalent.

(2) The index of economical development: Economic development can be simply defined as products or services a country produced increase in total, namely refers to the increase in the number of all the final products that a country or a region by using a variety of various productive factors. In this article we still take the method of common econometric analysis, select the regional GDP as the economic development indicator.

(3) Source of data: Statistical Yearbook of the National Bureau and Henan Province Statistics (1990---2011).The data is given in Table 1.

Table 1. 1990-2010 GDP of Henan province and indexes of its logistics industry

year	y	x1	x2	x3	x4	y1	y2
1990	934.65	38111.00	53567.00	423.46	1169.44	95525.69	1788.559
1991	1045.73	39923.00	53846.00	459.53	1199.31	95977.90	1811.418
1992	1279.75	44081.00	58096.00	511.40	1302.34	102977.80	1859.585
1993	1660.18	47347.00	61285.00	538.45	1337.03	108367.20	1891.862
1994	2216.83	50988.00	62826.00	566.29	1432.97	111013.70	1930.205
1995	2988.37	53582.00	61964.00	573.85	1538.82	109529.90	1941.515
1996	3634.69	55920.00	66490.00	584.25	1603.52	117416.30	1957.699
1997	4041.09	56113.00	69863.00	620.28	1547.18	123447.70	2019.378
1998	4308.24	58150.00	74182.00	640.16	1452.74	131362.60	2057.137
1999	4517.94	59218.00	78009.00	689.89	1432.08	138556.10	2163.198
2000	5052.99	60678.00	83912.00	740.98	1476.51	149983.70	2289.431
2001	5533.01	65191.00	85412.00	779.93	1573.28	152951.70	2397.137
2002	6035.48	68397.00	90334.00	820.83	1649.22	162873.60	2521.781
2003	6867.70	69689.00	81323.00	822.92	1891.73	144922.00	2528.437
2004	8553.79	73796.00	91013.00	963.09	2107.26	164264.30	3041.680
2005	10587.42	78827.00	98099.00	1000.70	2282.60	179095.80	3201.811
2006	12362.79	86608.00	108060.00	1113.77	2415.89	200926.30	3740.352
2007	15012.46	101410.00	122557.00	1264.10	2729.30	234747.70	4589.128
2008	18018.53	138392.00	130436.00	1517.33	5215.84	254147.70	6361.540
2009	19480.46	169643.00	144666.00	1645.18	6146.09	291004.70	7419.752
2010	23092.36	202470.00	167804.00	1840.64	7141.82	355931.70	9249.460

y, x_1, x_2, x_3 and x_4 represent respectively GDP, freight traffic volume, passenger traffic volume, freight turnover volume passenger turnover volume. y_1 and y_2 are the data after processing.

(4) Processing method of the data: Taking the freight traffic volume x_1 and passenger traffic volume x_2 in the same country or area can be in a high correlations into account, we make regression analysis after observing scatter program of the two, finally find while regression formula is x_1 (estimate value of x_1)=$5.78*10^{-6}*x_2^2$+25373.42, goodness-of-fit is higher, and it also in accordance with the economic significance, passes the statistical test, then we get a new variable: passenger turnover volume equivalent $y_1=x_2+x_1'=x_2+5.78*10^{-6}*x_2^2+25373.42$. Similarly there is x_4 (estimate value of x_4)=$-3.326916*x_3+0.003353*x_3^2$+2172.66, here we get another new variable passenger turnover volume equivalent $y_2=x_3+x_4'-2.326916*x^3+0.003353*x_3^2+2172.66$).

Source of data: 1990-2011 years of National Bureau of Statistics "statistical yearbook of Henan province" and "Statistical Yearbook" related data to be processed.

3.2. Construction and Modification of the Model

This paper we select relevant data of Henan Province from 1990-2010 annual year. Where GDP is chosen to be dependent variable, passenger traffic equivalent y_1 and passenger traffic turnover equivalent y_2 are respectively regarded as independent variables. We establish the initial regression model as below:

$$y = \beta_0 + \beta_1 * y_1 + \beta_2 * y_2 + \mu \quad (1)$$

y, y_1 and y_2 respectively represent GDP, passenger traffic equivalent and passenger traffic turnover equivalent. While β_0 is constant, μ_t is random error.

3.2.1. Establish Regression Model

(1) Preliminary analysis of the scanter programs

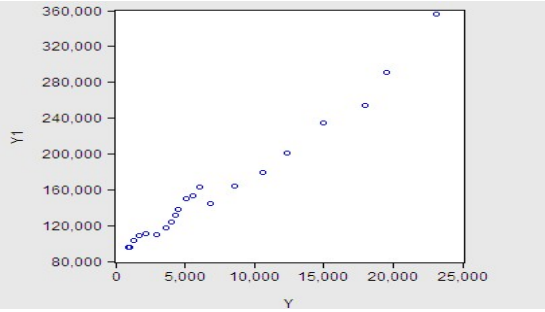

Figure 1. Scanter Program of y and y_1

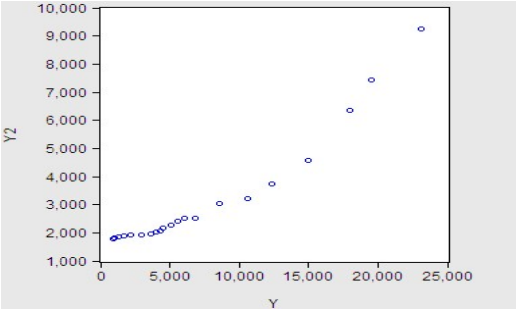

Figure 2. Scanter Program of y and y_2

Figure 1 and Figure 2 show that there exist approximately liner relationship between GDP with its passenger volume equivalent and passenger turnover volume equivalent of Henan Province, given this situation, we might first consider model of multiple liner regression. Result of regression shown as Figure 3 by software of Eviews 6.0.

Dependent Variable: Y
Method: Least Squares
Date: 06/10/12 Time: 20:36
Sample: 1990 2010
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7930.357	1113.431	-7.122448	0.0000
Y1	0.097631	0.017174	5.684737	0.0000
Y2	-0.159184	0.576679	-0.276037	0.7857

R-squared	0.972340	Mean dependent var	7486.879
Adjusted R-squared	0.969266	S.D. dependent var	6527.728
S.E. of regression	1144.378	Akaike info criterion	17.05467
Sum squared resid	23572833	Schwarz criterion	17.20389
Log likelihood	-176.0741	Hannan-Quinn criter.	17.08706
F-statistic	316.3755	Durbin-Watson stat	0.907712
Prob(F-statistic)	0.000000		

Figure 3. Results of Multiple Liner Regression

It can be seen from the regression results by observing Figure 3: economic significance of passenger traffic turnover equivalent y_2 is not accordance with actual situation, and its t-statistics also doesn't pass the test. Thus multiple linear regression results is not satisfactory, then the following we correct the model above.

3.2.2. Model Updating and Verification

Combined with the scatter diagram and practical experience, after numerous adjustments, finally we get the regression results shown as Figure 4.

Dependent Variable: Y
Method: Least Squares
Date: 06/10/12 Time: 20:46
Sample: 1990 2010
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-128151.7	9035.338	-14.18339	0.0000
LOG(Y1)	5113.322	1436.525	3.559508	0.0022
LOG(Y2)	9416.539	1080.931	8.711505	0.0000

R-squared	0.993431	Mean dependent var	7486.879
Adjusted R-squared	0.992701	S.D. dependent var	6527.728
S.E. of regression	557.6995	Akaike info criterion	15.61708
Sum squared resid	5598517.	Schwarz criterion	15.76630
Log likelihood	-160.9794	Hannan-Quinn criter.	15.64947
F-statistic	1361.010	Durbin-Watson stat	1.104930
Prob(F-statistic)	0.000000		

Figure 4. Regression Results After Correction

$$y = -128151.700 + 5113.332 * \log(y1) + 9416.539 * \log(y2)$$
$$t = (-14.183) \quad (3.560) \quad (8.712)$$
$$R^2 = 0.993 \quad F = 1361.010 \quad DW = 1.105 \quad n = 21 \text{（1990-2010）} \qquad (2)$$

1) Economic significance test

Under normal circumstances, GDP would increase as the passenger traffic equivalent increases or the passenger traffic turnover equivalent increases. It can be easy to find from the modified regression results in Figure 4: coefficient symbols of passenger traffic volume equivalent y_1 and passenger traffic turnover volume equivalent y_2 are both positive, thus both of them are fit in with real economic significance, indicating that the model can pass economic significance test.

2) Statistical significance test (significance level α =5%)

□ F = 1361.010> $F_{0.05}(2,18)$=3.55, demonstrating the model as a whole is significant, that's to say the combined effect of passenger traffic volume equivalent y_1 and passenger traffic turnover volume equivalent y_2 on GDP is significant.

□ R^2=0.993, indicating the model has a higher goodness of fit.

□ The corresponding P values of t-statistics of independent variables y_1 and y_2 respectively are 0.0022, 0.0000, evidently both are less than significance level 5%, thus indicating the regression parameters are significant, namely their respective impact on GDP is significant.

3) Heteroskedasticity test. As for heteroscedasticity test, we adopt method of White test, the final results are shown as the above: Figure 5 Under significance level α =5%, due to nr^2=6.659< $\chi_{0.05}(5)$ =11.0705, thus we say the model doesn't exhibit heteroskedasticity

Heteroskedasticity Test: White

F-statistic	1.392878	Prob. F(5,15)	0.2823
Obs*R-squared	6.658604	Prob. Chi-Square(5)	0.2473
Scaled explained SS	1.936388	Prob. Chi-Square(5)	0.8579

Figure 5. Results of White Test

4) Autocorrelation test. With regard to autocorrelation test, we use method of LM test, the results are shown as below:

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	4.286355	Prob. F(1,17)	0.0540
Obs*R-squared	4.228693	Prob. Chi-Square(1)	0.0397

Figure 6. Results of First-order Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.017112	Prob. F(2,16)	0.1655
Obs*R-squared	4.228700	Prob. Chi-Square(2)	0.1207

Figure 7. Results of Second-order Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	5.609101	Prob. F(3,15)	0.0088
Obs*R-squared	11.10284	Prob. Chi-Square(3)	0.0112

Figure 8. Results of Third-order Autocorrelation Test

It's easy to find from Figure 6, Figure 7 and Figure 8 that the model exhibits first-order autocorrelation and third-order autocorrelation. In order to eliminate the autocorrelation of the model we then use Eviews 6.0 with method of generalized differential regression to re-estimate the model, results are as following:

Dependent Variable: Y
Method: Least Squares
Date: 06/10/12 Time: 21:54
Sample (adjusted): 1993 2010
Included observations: 18 after adjustments
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-122677.8	8855.256	-13.83804	0.0000
LOG(Y1)	3997.023	1445.231	2.765663	0.0161
LOG(Y2)	10415.15	1127.410	9.238119	0.0000
AR(1)	0.536485	0.191463	2.802026	0.0150
AR(3)	-0.607601	0.224811	-2.702720	0.0181

R-squared	0.996288	Mean dependent var	8553.574
Adjusted R-squared	0.995145	S.D. dependent var	6457.076
S.E. of regression	449.8995	Akaike info criterion	15.28606
Sum squared resid	2631325.	Schwarz criterion	15.53338
Log likelihood	-132.5745	Hannan-Quinn criter.	15.32016
F-statistic	872.1966	Durbin-Watson stat	2.799214
Prob(F-statistic)	0.000000		

Figure 9. Results of Generalized Differential Regression Results

According to the output in Figure 9, estimation equation of the generalized least squares is shown as below:

$$y = -122677.8 + 3997.02 * \log(y1) + 10415.15 * \log(y2) + 0.536 * AR(1) - 0.608 * AR(3)$$

t= (-13.838) (2.766) (9.238) (2.802) (-2.703)

R^2=0.996 F = 872.197 DW = 2.799 n = 21（1990-2010）

(In which AR(1), AR(3) respectively represent form of the random error is first-order and third-order serial correlation). The model doesn't exist first-order, second-order and third-order autocorrelation after reusing method of LM test, thus we get the final form of the regression equation as the above.

4. Conclusions

On the one hand, we can draw the following conclusions from the above regression model:

(1) There indeed exists correlation between logistics industry of Henan Province and its economic growth, qualitatively speaking, logistics industry development of Henan Province has a positive effect on its economic growth, in other words, the development of the logistics industry would in a certain extent promote its economy development;

(2) Logistics industry of Henan Province has significantly impetus on its economic growth. Specific quantitatively speaking, if other conditions remain unchanged, the passenger

traffic volume y_1 for each additional of 10 million persons will drive the total GDP an increase of 3997.0231 billion yuan; the same token, if other conditions remain unchanged under the premise, the passenger turnover volume y_2 for every increase of one billion person-kilometers, the GDP of the whole province will make an increase of 10415.151 billion yuan, indicating that logistics industry Henan Province has a significant role in stimulating on its economic development.

On the other hand, due to the logistics industry in China started relatively late, thus it has not yet established a unified index system on logistics industry, in addition the logistics industry itself would be influenced by many other factors, in addition, the definition of the index system is not entirely clear, therefore, in this article we just only select approximate index system to measure the development of the logistics industry, thus in which may exist some factors we didn't taking into account, so some problems still need further research.

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