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The Panel Co-integration Analysis between the Logistics Industry and Economics Growth in China[1]

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Abstract: Along with the recently rapid development in China, the logistics development is also accelerating. The effect of logistics is more and more important in Chinese economy. A lot of articles about the relationship between them are qualitative analysis. The thesis introduces the panel model and the theory of panel co-integration, studies and confirms the panel co-integration between logistics industry and economics growth in china from 1978 to 2008. And on FMOLS it makes positive correlation between logistics supply and demand and economics growth in china.
Key words: Logistics; Economics Growth; Panel co-integration

In the world, the huge contribute of the logistics to economics development was already approved by the practice in many countries. Especially recently, the system and intensivism of logistics also exhibits the important value of reducing environment pollution and accelerating the sustainable development. So the logistics are attracted broadly the attention by the people. In the 21st century, the Chinese logistics comes into an unprecedented development. The economic development drives the rapid development of logistics. But the researches on the relationship between the logistics and economics development are limited into the qualitative analysis, it is few to research on the quantitative analysis between them. Wen-jie Zhang (2002) exercises the economics and the trade theory to analyze the relationship between economy and logistics, finally derives that the relationship of economy and logistics represent the economic globalization, the regional economic integration, the pursuit of profit and core competence in the regional enterprise, and the status quo of Chinese economic development promoting the development of Chinese modern logistics; at the same time the development of modern logistics has changed the economic growth pattern, promoted the formation of new industrial forms, optimized regional industrial structure, promoted the formation and development of " the cities as the center" regional markets. Qun Zhang (2005) divides the stages of logistics development according to the stages of economic development, and derives the different stages of logistics development have different characteristics, the promotion of logistics to economic growth is also different, and should adopt the different logistics development strategies in the different stages of economic development. Zhao-lei Li (2007) puts forward the evaluation system of regional logistics adaptability from the point of view the matching between the regional logistics and the regional economy, marks out or improves the regional logistics system to fit the regional logistics structure, the service level, the legal policy, the infrastructure, the information network, the personnel quality. Zi-Long Wang (2007) considers that the construction and optimization of regional logistics network system can save transaction costs, and promote the formation of scale regional economy and gathering economy, and establishes the evaluation

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index system of logistics network to analyze comparatively the major nodes of logistics network in Jiangsu. The paper uses a quantitative method, the panel co-integration method, to analyze the relationship between them.

1. THE PANEL UNIT ROOT TEST AND PANEL CO-INTEGRATION TEST

The Panel data is the mix of time series and section series. As the application of panel technology the researchers achieve the large flexibility in setting and controlling the panel unit in the difference of individual action. At the same time, because the panel technology can be applied in the co-integration model, the researchers can achieve the more information, the broader freedom degree and the higher efficiency.

1.1 The Test of Panel Unit Root

On the basis of the AR(1) process of panel data:

$$y_{it} = \rho_i y_{it\text{-}1} + X_{it}\delta_i + \varepsilon_{\mathrm{it}} \tag{1}$$

where, i ($i=1,2,\ldots,N$) is the number of panel unit, t($t=1,2,\ldots,T_i$)is the time span of panel unit, X_{it} is the exogenous variable, including the fixed effect or the trend of each panel unit, ρ_i is the regression coefficient, ε_{it} is the independent heterogeneous perturbation. When $|\rho_i|<1$, y_i is a weak trend process, when $|\rho_i|=1$, y_i is a no-stationary I(0) process. According to the difference of ρ_i homogeneity (heterogeneity) hypothesis, all tests are divided into two sorts, one assumes all the panel unit contain the same unit root, some representative tests are LLC test(Levin, Lin & Chu, 2002), Breitung test (Breitung, 2000) and Hadri test (Hadri, 1999). The difference of the three tests is the original hypotheses of the LLC test and the Breitung test have the same unit root in every panel unit. The other test broadens the homogeneous hypothesis, ρ_{i} is allowed free changes in the different panel unit, compared to the first test, the kind of test broaden the hypothesis, which is close to objective reality, for example the representative tests are IPS test (Im, Pesaran&shin, 2003), Fisher-ADF test (Maddala & Wu,1999) and Fisher-PP test (Choi, 2001).

To ensure the solidity of the result, the paper respectively introduces LLC test, Breitung test, Hadri test, IPS test, Fisher-ADF test and Fisher-PP test to test the panel unit root of the logistics, GDP and other variables.

1.2 The Panel co-Integration Test

To compare with the test of panel unit root, the panel co-integration analysis is still in the developing phase. At present, the literatures of panel co-integration are focus on the method research on the residuals. The panel co-integration test is the same as the panel unit root test. It also establishes the hypothesis of the heterogeneity and the homogeneity. The paper uses the Pedroni test.

1.2.1 Pedroni co-integration test

Pedroni(1999,2004) constructed the seven statistics on the basis of regression residuals of the integration function., which test the co-integration among the variables, if the test refuses the original hypothesis, it means there are the co-integration among the variables. In the seven statistics, the four are described by the with-dimension measure, such as Panel v, Pane1 rho, Panel PP and Panel ADF statistics, the three are described by the between-dimension measure, such as Group rho, Group PP and Group ADF statistics. In the process of test there are not only the different long-term co-integration coefficients but also every standard statistics is the gradual standard normal distribution.

$$\frac{x_{N,T} - u\sqrt{N}}{\sqrt{v}} \to N(0,1) \tag{2}$$

Where, μ and v are the mean and variance respectively of the underlying individual series. The values μ and v are simulated and provided by Pedroni (1999, 2001) and their numerical values depend upon the presence of a constant, time trend, and the number of regressors in the co-integration regression. Pedroni research indicates that the Pane1 ADF statistics and Group ADF statistics have the changing feature of small samples, compared with the other statistics.

To the following panel co-integration function:

$$y_{i,t} = \alpha_i + \delta_{i,t} + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + \cdots + \beta_{Mi} x_{Mi,t} + \mathrm{e}_{\mathrm{i,t}} \qquad (3)$$

where *t* (*t=l,2，…,T)* refers to the time span, *i* (*i=1,2,…,N*) refers to the number of panel units, *m* (*m=l,2,…,M*) refers to the number of regression variables. Because the number of different panel units is *n*, the co-integration coefficients of the *N* function are allowed to change freely in the different panel units. The coefficient α_i refers to a individual special constant, that is, the fixed effect parameters are allowed to change freely in different panel units.

1.2.2 Pedroni panel co-integration estimation

Fully Modified Ordinary Least Squares (FMOLS) is extensively used in the time series analysis. It can effectively revise the estimation error of the system disturbance correlation. On the basis of FMOLS, Pedroni（2000,2001）put forward two panel co-integration estimation methods: the one is the panel within-group FMOLS estimation, the other is the panel between-group FMOLS estimation. At the same time, Pedroni（2000）indicates the panel between-group FMOLS estimation method is more flexible and distinctly small sample feature, compared with panel within-group estimation method. Therefore, the article uses the panel between-group FMOLS method to estimate the panel co-integration.

Considered the following panel co-integration function:

$$Y_{it} = \alpha_i + \beta x_{it} + \mu_{\mathrm{it}} . \qquad (4)$$

$$X_{it} = X_{it-1} + \varepsilon_{\mathrm{it}} \qquad (5)$$

where i (i=l,2.…,N) refers to the number of panel unit, let $Z_{it} = (Y_{it}, X_{it})' \sim I(0,1)$, $\xi_{it} = (\mu_{it}, \varepsilon_{it})' \sim I(0,1)$, there is the co-integration relationship which coefficient matrix β is co-integration coefficient among the no-stationary series, and αi refers to the different fixed-effects among the co-integration of all panel units. Ωi is the long covariance matrix between Zit and ξit, at the same time, the covariance matrix is further decomposed, and that is $\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_{\mathrm{i}}^{/}$, which Ωi0 refers to the same period covariance matrix, Γ_i refers to the weighted sum of autocovariance matrix.

The between-dimension FMOLS estimation of the co-integration coefficient β shows as bellow:

$$\hat{\beta}_{GFM} = N^{-1} \sum_{i=1}^{N} \left[\sum_{i=1}^{T} (X_{it} - \overline{X}_i)^2 \right]^{-1} \left[\sum_{i=1}^{T} (X_{it} - \overline{X}_i) Y_{it}^* - \hat{T}_{\tau i} \right] \qquad (6)$$

Which $Y_{it}^* = (Y_{it} - \overline{Y}) - \frac{\hat{L}_{21i}}{\hat{L}_{22i}} \Delta X_{it}$, $\hat{\tau}_i = \hat{\Gamma}_{21i} + \hat{\Omega}_{21t}^0 - \frac{\hat{L}_{21i}}{\hat{L}_{22i}} (\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^0)$.

In (6) the between-dimension estimation can be restated $\hat{\beta}_{GFM} = N^{-1} \sum_{i=1}^{N} \hat{\beta}_{FM,i}$, where $\hat{\beta}_{FM,i}$ is the traditional FMOLS estimation of panel unit i, when *T* and *N* tend to the infinity. The corresponding t-statistics follows the standard normal distribution.

2. THE EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN LOGISTICS INDUSTRY AND ECONOMY DEVELOPMENT IN CHINA

2.1 Index Selection

To describe the level of logistics and economy development in all regions, the article introduces the logistics indexes, showing as below:

The logistics supply scale is measured by the simply sum of the length of highway, railway and waterway. The logistics demand scale is measured by the freight ton-kilometers. The level of economy development is measured by the gross domestic product which is the 1952 unchanged price as a basic period.

The data are from China Statistical Yearbook 2004-2008 and China Compendium of statistics 1949-2004. Because of the absence in the statistical data, the data of the Xizhang, Taiwan, Hong Kong and Macau are not included. The time span is from 1978 to 2008.

2.2 The Panel Unit Root Test of Variables

The panel data of variables in 30 provinces are tested by Eviews 6.0. The results are showed as follow:

Table 1: The Unit Root Test of Panel Data

	Levin, Lin&Chu t*	Breitung t-stat	Im, Pesaran and Shin W-stat	ADF-Fisher Chi-square	PP-Fisher Chi-square
gdp	21.9207	13.0524	29.4767	3.67624	14.6992
Prob.	1.0000	1.0000	1.0000	1.0000	1.0000
△gdp	11.8035	11.8380	8.41081	22.8219	75.7517
Prob.	1.0000	1.0000	1.0000	1.0000	0.0826
△△gdp	-11.2411	-3.43048	-13.259	274.259	539.097
Prob.	0.0000	0.0003	0.0000	0.0000	0.0000
ltr	2.28479	8.03315	6.68943	23.0725	16.9908
Prob.	0.9888	1.0000	1.0000	1.0000	1.0000
△ltr	-13.4423	-2.12212	-15.6984	347.675	1133.72
Prob.	0.0000	0.0169	0.0000	0.0000	0.0000
△△ltr	-18.5296	-4.08153	-26.6952	778.650	5075.07
Prob.	0.0000	0.0000	0.0000	0.0000	0.0000
ftk	11.0423	8.86958	8.70307	31.8023	15.0647
Prob.	1.0000	1.0000	1.0000	0.9990	1.0000
△ftk	-1.63466	-5.33083	-4.08403	162.056	202.722
Prob.	0.0501	0.0000	0.0000	0.0000	0.0000
△△ftk	-16.6701	-2.26347	-16.6771	418.118	2065.75
Prob.	0.0000	0.0116	0.0000	0.0000	0.0000

Note: 1. "△" refers to the first–order difference of variables; "△△" refers to second-order difference of variables.

2. Test form is individual intercept and trend, Schwarz is chosen in the lag length, Bartlett is chosen in Kernel method, Newey-West is chosen Bandwidth selection.

3. gdp refers to Gross Domestic Product; ltr refers to Length of Transport Routes; ftk refers to Freight Ton-Kilometers.

Table 1 shows the test results can't refuse to the null hypothesis when the panel horizontal values of all variables data gdp, lpv, ltr, ftk are tested. Then all panel data are the no-stationary series. After the first-order difference of all panel data are tested, the results show that the other series all refuse to the null hypothesis at the level of 5%, except the GDP series, then the panel data was stationary series. The second-order difference of the GDP time series are tested again, the results show that the null hypothesis is significantly refused. Thus the GDP increment, the length of transport routes and the freight ton-kilometers are the,I(1) process, that is the integrated of order 1 process.

2.3 The Panel co-Integration Test among the Variables

After the panel unit root test, we introduces the Pedroni (1999, 2004) method to set up the seven statistics to test the panel co-integration among the variables on the basis of the regression residual. The result shows on the Table 2:

Table 2: The Panel co-Integration among the Variables

	Within-dimension				between-dimension		
	Panel v-stat	Panel rho-stat	Panel PP-stat	Panel ADF-stat	group rho-stat	group PP-stat	group ADF-stat
△gdp,ltr	3.9287	-14.1230	-40.3372	-8.2925	1.3883	-4.5181	-3.2046
Prob.	0.0040	0.0000	0.0000	0.0000	0.9175	0.0000	0.0007
△gdp,ftk	2.7478	-12.8479	-45.8131	-11.7780	-6.9605	-7.4699	-6.0898
Prob.	0.0570	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ltr,ftk	2.9741	6.6899	0.1783	-1.4023	8.0199	0.6504	-1.1391
Prob.	0.0015	1.0000	0.5708	0.0804	1.0000	0.7423	0.1327
△gdp,ltr,ftk	1.1106	-3.7154	-3.1132	-3.6485	-3.3352	-6.1427	-4.3493
Prob.	0.1313	0.0053	0.0009	0.0001	0.0005	0.0000	0.0004

Note: The test type: Pedroni (Engle-Granger based), the Individual intercept and trend, the lag length: user specified 1, spectral estimation Kernel method: Bartlett, Bandwidth selection: Newey - West automatic.

(1) △gdp and ltr, namely, the increment of the gross domestic product and the length of transportation routes, all other statistics refuse to the null hypothesis in 1% level, except that the group roh-stat do not pass the significant test in 1%. Thus the relationship between the increment of the gross domestic product and the length of transportation routes is co-integration.

(2) △gdp and ftk, namely, the increment of the gross domestic product and the freight ton-kilometers, all other statistics refuse to the null hypothesis in 1% level, except that the Panel v-stat do not pass the significant test in 1% level. Thus the relationship between the increment of the gross domestic product and the freight ton-kilometers is co-integration.

(3) ltr and ftk, namely, the length of transportation routes and the freight ton-kilometers, all statistics do not refuse to the null hypothesis. Thus the relationship between the length of transportation routes and the freight ton-kilometers is not co-integration.

(4) △gdp and ltr,ftk, all other statistics refuse to the null hypothesis in 1% level, except that the Panel v-stat do not pass the significant test in 1% level. Thus the relationship between the increment of the gross domestic product and all variables is long-term co-integration.

2.4 The Individual and Panel co-Integration Estimation among the Variables

According to the co-integration analysis we educe the relationship among the increment of the gross domestic product, the length of transportation routes and the freight ton-kilometers are co-integration. Therefore the equilibrious relation in the academic model can be trusted.

We make use of Winrats7.0 to estimate the model parameter. First of all, make use of the traditional FMOLS method to estimate the unit sample, the results are showed in Table 3; then introduce Pedroni's between-dimension-FMOLS method to do the co-integration of panel data, the results are showed in Table 4:

Table 3-a: The Individual FMOLS Estimation between △gdp and ltr,ftk

Province	constant	ltr	ftk	Province	constant	ltr	ftk
Peking	-62.009	0.018	0.007	Henan	-45.200	0.001	0.004
	-8.934	9.741	1.413		-2.698	1.815	1.186
Tianjing	-6.926	0.001	0.009	Hubei	-17.858	0.000	0.005
	-0.740	0.699	1.522		-1.698	1.536	1.456
Hebei	-200.744	0.005	0.005	Hunan	-24.933	0.001	0.007
	-4.484	3.886	1.184		-3.696	4.111	0.883

Table 3-b: The Individual FMOLS Estimation between ∆gdp and ltr, ftk

Province	constant	ltr	ftk	Province	constant	ltr	ftk
Shanxi	-8.820	0.000	0.004	Guangdong	-60.283	0.001	0.005
	-1.929	0.722	0.208		-1.708	0.918	1.245
Nei Mongol	12.464	0.000	0.002	Guangxi	3.273	0.000	0.000
	0.654	-0.739	0.652		0.208	-0.469	2.169
Liaoning	-121.619	0.006	0.002	Hainan	-51.607	0.000	0.000
	-3.024	4.097	-2.278		-3.140	0.420	-1.236
Jilin	-43.453	0.002	0.000	Chongqing	-20.972	0.001	0.000
	-4.370	4.423	-0.660		-3.529	2.765	2.013
Heilongjiang	-99.044	0.002	0.002	Xichuan	-109.875	0.000	0.001
	-10.628	9.187	0.090		-4.466	3.177	3.773
Shanghai	-64.103	0.009	0.009	Guizhou	-18.427	0.001	0.001
	-2.873	0.705	2.496		-3.275	3.045	1.216
Jiangsu	-78.329	0.001	0.001	Yunnan	3.401	0.000	0.001
	-6.571	5.299	3.354		1.934	-1.229	4.146
Zhejiang	-78.972	0.002	0.005	Shanxi	-61.134	0.002	0.002
	-3.709	4.083	0.407		-2.159	1.935	1.603
Anhui	10.974	0.000	0.001	Gansu	-14.275	0.000	0.000
	1.330	-1.301	1.009		-0.818	0.509	4.125
Fujian	-47.352	0.001	0.002	Qinghai	-7.065	0.000	0.000
	-1.704	1.672	2.944		-4.503	3.475	2.440
Jiangxi	-27.823	0.001	0.003	Ningxia	-13.464	0.002	0.000
	-2.343	3.049	3.683		-2.995	2.551	0.151
Shandong	-153.507	0.005	0.005	Xinjiang	-0.050	0.000	0.000
	-4.236	5.352	0.719		-0.671	0.922	-0.581

Note: the above results are educed by Winrats 7.0

After the individual unit FMOLS estimation on △gdp and ltr, ftk, Table 3 reports:

The estimated symbols of the variables, the logistics supply scale and demand scale, are positive. The results show it is the positive relationship between the growth of GDP and the logistics supply scale, the logistics demand.

Table 4: The Panel Group FMOLS Results of △gdp and ltr, ftk

	△lpv	ltr	ftk
△gdp	1.05	0.02	0.04
t-stat	4.55	9.37	2.35

Note: the above results are educed by Winrats 7.0

After the panel group FMOLS estimation on △gdp and ltr, ftk, Table4 reports:

The estimated symbols of the variables, the logistics supply and demand scale, are positive. The results show it is the positive relationship between the growth of GDP and the logistics supply scale, the logistics demand.

3. CONCLUSIONS

According to the above results and figures, we can conclude, to extend the logistics supply scale and the logistics demand scale in the whole China and each province can accelerate all the countrywide economy and each province economy. It proves that the logistics has become one of the most important accelerated economic growth sources. The driving capacity of the logistics supply scale and demand scale to the economic growth is weak. According to the result of individual unit estimation, although the logistics supply and demand scale in each province accelerates all the economic growth, the driving capacity of economic growth in the eastern coastal regions is stronger, that in western and central regions is weaker.

And the level of logistics is higher , the economy is more developed in some regions. It accords with the fact, the economic development imbalance among regions in China.

On the results we can make other conclusions that China is still depending on expanding the logistics scale in the single and extensive way to promote the economic growth. The modern logistics network, logistics information sharing, modern logistics management and logistics operation are not given enough attention. It will impair the propulsion degree of the logistics to economic growth and block badly the Chinese sustainable development.

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