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Analysis of Factors Affecting the Development of China's Air Freight Industry

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Abstract: The sustained development of China's economy has contributed to the thriving growth of China's air freight industry, though the same is also faced with a myriad of challenges. Based on the 2009-2019 data depicting the development of air freight in China, this paper employs unit root test, cointegration test and regression analysis to examine the impact of logistics demand, government support and transportation infrastructures on the development of the air freight industry. The results show that China's economic boom has emerged as the important driver underlying the burgeoning development of its air freight industry, and that China's efforts to increase the fiscal expenditure on transportation and civil aviation routes will have positive and significant long-term effect on the civil aviation freight traffic, only the expected results are yet to be achieved at the current stage. In general, it's clear that China's air freight market has not been fully tapped and is far from maturity.

1. Introduction

Over the past years, with the changes in China's trade and logistics policies, China's air freight industry has ushered in burgeoning growth, with air transportation capability improving significantly, freight transport routes increasing tremendously, and the number and types of cargo aircrafts both expanding constantly. China is attaching increasing importance to the development of its air freight industry. In 2010, the Civil Aviation Administration of China (CAAC) put forward the "Strategic Plan to Build a World Power of Civil Aviation", following which the State Council released the "Several Opinions on Promoting the Development of the Civil Aviation Industry" in 2012, "Division of Key Tasks for the Development of the Civil Aviation Industry" in 2013, and the "Medium and Long-term Plan for the Development of the Logistics Industry (2014-2020)" and the "Opinions of CAAC on Promoting the Coordinated Development of Civil Aviation Industry in Beijing, Tianjin and Hebei" in 2014. In May 2018, the "Guiding Opinions of CAAC on Promoting the Development of Air Freight Industry" came into being. The promulgation and implementation of these policies have prepared the ground for the thriving development of air transport. The research into the status quo and future trends of China's air freight industry are conducive to understanding the development history of China's air freight industry, analyzing the future development strategy for the same and seizing the opportunities at hand that would help the industry thrive.

Air freight is the process of efficient and effective movement and storage of goods from the supplying place to the receiving place by aircrafts to meet the needs of customers. By organically combining transportation, warehousing, handling, processing, sorting, distribution, information and other functions, a complete supply chain is formed to provide users with multi-functional and integrated comprehensive services. Domestic scholars mainly focus their air freight research on regional logistics development or air freight system. For example, Wu Zhixia [1] studied the development of air freight at Ganzhou Airport; Qin Yan [2] systematically examined the development of China's air freight industry with the aid of relevant theories and scientific methods; Guan Renxia [3] employed systematic analysis to examine the evolution and operation of the air freight industry; and Wu Huijun [4] put forward insightful suggestions on hastening the interactive development of port logistics and free trade zone construction in Fujian Province.

China's air freight industry is characterized by simplex freight services, a small market and uneven distribution, which account for the different air cargo and mail throughputs in different regions. Over the past 20 years, China's air freight industry has witnessed burgeoning growth and is gearing up for the long-awaited shift to integrated logistics services. Although the industry is still in its growth stage, there have been uniform industry standards and diversified products and services, with service coverage expanding constantly and the integrated transportation system improving gradually. While ratcheting up and making great strides in the construction of its logistics infrastructures, China is still in a relatively backward position compared with developed countries [5].

2. Research Scope and Methodology

This paper employs unit root test, cointegration test, Granger causality test and regression analysis to examine factors affecting the development of China's air freight industry.

3. Empirical Research

3.1 Variable Selection

3.1.1 Dependent Variable

Civil aircrafts within a certain period of time. It can reflect the status quo of the air freight industry and the pace of economic development. This paper uses civil aviation freight traffic to measure the development of the air freight industry.

3.1.2 Independent Variable

Derived from social and economic activities, the demand for air freight services is dependent on the situations of economic development. Therefore, this paper uses GDP (denoted in 100 million RMB) to measure the logistics demand in China. Since government support directly determines how the air freight industry would develop, this paper uses the national fiscal expenditure on transportation (denoted in 100 million RMB) to measure the government support for the air freight industry. Air transport facilities underlie the efficient operation of the air freight industry, and is the most fundamental part amid the development of the air freight industry. Accordingly, this paper uses the number of civil aviation routes to measure the development of the air transport facilities.

3.2 Unit Root Test

For time series data, the stationarity of the data is crucial for model construction. The unit root test of the time series is to test the stationarity of the time series. If a non-stationary time series has a unit root, the unit root can generally be eliminated by the method of difference, thereby obtaining a stationary series. It can be found that variable undergoing logarithmic transformation will look better than the original variable, so the subsequent analysis will only target variables undergoing logarithmic transformation.

The final results of PP test are shown in Table 1, which shows the results of the Phillips-Perron (PP) unit root tests of variables "lair", "lgdp", "d2.lgov" and "d.line".

Table 1: Results of PP test of variables.

	Z(t)	1% critical value	5% critical value	10% critical value	P
lair	-3.801	-4.380	-3.600	-3.240	0.017
lgdp	-3.801	-4.380	-3.600	-3.240	0.004
d2.lgov	-6.660	-3.750	-3.000	-2.630	0.000
d.line	-3.238	-3.750	-3.000	-2.630	0.018

The null hypothesis of PP test is that the data has a unit root. It can be seen from the above table that the P values of variables "lair", "lgdp", "d2.lgov" and "d.line" are 0.017, 0.004, 0.000 and 0.018 respectively, which all significantly reject the null hypothesis of a unit root. This can also be verified by observing the value of Z(t). The actual Z(t) values of "lair" and "lgdp" are both -3.801, which both fall between the confidence level of 1% (-4.380) and that of 5% (-3.600), rejecting the null hypothesis. The actual Z(t) value of "d2.lgov" is -6.660, which falls between the confidence level of 1% (-3.750) and that of 5% (-3.000), rejecting the null hypothesis. The actual Z(t) value of "d.line" is -3.238, which falls between the confidence level of 1% (-3.750) and that of 5% (-3.000), rejecting the null hypothesis. Therefore, variables "lair", "lgdp", "d2.lgov" and "d.line" do not have a unit root.

According to the process and results of analysis, we can draw the following conclusions: 1) the logarithm of national fiscal expenditure on transportation and the logarithm of civil aviation routes both have a unit root; and 2) the logarithm of civil aviation freight traffic, the logarithm of gross domestic product, the second-order difference of the logarithm of the national fiscal expenditure on transportation and the first-order difference of the logarithm of the civil aviation routes do not have a unit root.

3.3 Regression Analysis

3.3.1 Build the Model Equation

Based on the previous analysis, the following model equation is built:

$$lair=\alpha lgdp+\beta d2.lgov+\gamma d1.line+lnAt+\mu \quad (1)$$

Where: "air", "gdp", "gov" and "line" refer to the civil aviation freight traffic, gross domestic product, national fiscal expenditure on transportation and civil aviation routes respectively; "α", "β" and "γ" refer to the output elasticity of gross domestic product, national fiscal expenditure on transportation and civil aviation routes respectively; and lnAt is a constant term and μ is the random error.

3.3.2 Estimating Equation

It can be seen from the regression analysis results shown in the above table that F (3, 5) = 46.00 and P (Prob> F) = 0.0005, indicating that the model is acceptable on the whole. The coefficient of determination (R-squared) of the model is 0.965, and the adjusted coefficient of determination (Adj R-squared) is 0.944, indicating that this model has a satisfactory explanatory ability.

The regression equation of this model is:

$$lair=0.52*lgdp+0.008*d2.lgov+0.322*d1.line-0.579 \quad (2)$$

Results of regression analysis are shown in Table 2. The standard error of the coefficient of variable "lgdp" is 0.0446, with t = 11.65 and P = 0.000, indicating that the coefficient is very significant, and the 95% confidence interval is [0.405, 0.634]. The standard error of the coefficient of variable "d2.lgov" is 0.068, with t = 0.12 and P = 0.909, indicating that the coefficient is very insignificant, and the 95% confidence interval is [-0.167, 0.183]. The standard error of the coefficient of variable "d1.lline" is 0.258, with t = 1.25 and P = 0.267, indicating that the coefficient is insignificant, and the 95% confidence interval is [-2.141, 0.983]. The standard error of the coefficient of constant term is 0.608, with t= -0.95 and P =0.384, indicating that the coefficient is relatively insignificant.

Table 2: Results of regression analysis.

lair	Coef.	Std. Err.	t	P>|t|
lgdp	0.520	0.045	11.65	0
lgovD2.	0.008	0.068	0.12	0.909
llineD1.	0.322	0.258	1.25	0.267
_cons	-0.579	0.608	-0.89	0.384

The civil aviation freight traffic can mirror the status quo and the economic value of the air freight industry. According to the logistics theory, the logistics demand (gross domestic product), government support (national fiscal expenditure on transportation) and transportation capability (civil aviation routes) will all have a certain impact on the civil aviation freight traffic. A wealth of information can be obtained from this model. Firstly, the coefficient of gross domestic product is positive and very significant, indicating that economic situations in China has a positive effect on the changes in civil aviation freight traffic, and that the overall economic picture of China is the important driver underlying the growth of the logistics industry—the faster the economic growth, the quicker the growth of civil aviation freight traffic. Secondly, the effect of government support on the civil aviation freight traffic is insignificant in the short term, indicating that the fiscal support from the Chinese Government is not effective in the short term, or that the government support has failed to emerge as an immediate driver boosting the development of China's air freight industry. The effect of transportation capability on the civil aviation freight traffic is also insignificant in the short term, indicating that the increase in civil aviation routes doesn't have a significant effect on the development of the air freight industry in the short term, or that the improvement in transportation capability has failed to become an immediate driver to bolster the air freight industry.

3.4 Cointegration Test

Since the cointegration test can indicate the existence of a long-run equilibrium relationship, if we can find a reliable connection between several variables that seem to have separate and random trends, we can eliminate the random trends and obtain their long-term trends.

The PP test shows that the logarithm of the national fiscal expenditure on transportation is non-stationary and integrated of order two, and the logarithm of civil aviation routes is non-stationary and integrated of order one. Therefore, this paper uses the trace test and cointegration test to examine whether the long-run equilibrium relationship between the dependent variable and these two variables exists.

Table 3: Analysis results of the variable lag order.

lag	LL	LR	df	FPE	AIC	HQIC	SBIC
0	23.3424	.	.	2.30E-07	-6.781	-7.198	-6.885
1	160.12	273.56	9	1.7e-25*	-49.373	-51.041	-49.7899
2	587.203	854.17*	9	.	-189.734*	-192.235*	-190.359*

Table 3 shows the analysis results of the variable lag order determined pursuant to the information criterion. The "lag" in the leftmost column refers to the lag order; "LL" and "LR" refer to the statistical values; "df" refers to the degree of freedom; "P" refers to the significance of the model under the corresponding lag order; and "FPE", "AIC", "HQIC" and "SBIC" refer to the 4 kinds of information criteria (the smaller the better), with the "*" sign implying the optimal lag order under this information criterion.

In conclusion, it is appropriate to select the lag order of 1 or 2. Next, the specific cointegration ranks under the two lag orders will be examined.

When the lag order is 1, according to cointegration ranks obtained with the abovementioned lag order, the trace statistic marked with "*" is found to be 13.304, and the corresponding cointegration rank is 1, meaning that there is a co-integration relationship between the logarithm of civil aviation freight traffic, the logarithm of national fiscal expenditure on transportation, and the logarithm of civil aviation routes.

Table 4 show the estimated results of the model equation describing the long-run equilibrium relationship between civil aviation freight traffic and national fiscal expenditure on transportation & civil aviation routes.

Table 4: Estimated results of the model equation describing the long-run equilibrium relationship.

Johansen normalization restriction imposed						
beta	Coef.	Std.Err	z	P>|z|	[95% Conf.	Interval]
lair	1	.	.	.	.	.
lgov .D1	-1.286	0.206	-6.25	0.000	-1.688	-0.883
lline	-0.697	0.085	-8.24	0.000	-0.863	-0.531
_cons	-0.680	.	.	.	.	.

The cointegration equation obtained by observing and analyzing the results is shown below:

$$e=lair-1.286*d.lgov-0.697*lline-0.680 \quad (3)$$

This equation describes the long-run equilibrium relationship between civil aviation freight traffic and national fiscal expenditure on transportation & civil aviation routes. Let e=0 and deform the model to obtain:

$$lair=1.286*d.lgov+0.697*lline+0.680 \quad (4)$$

This equation points to the positive and significant long-term effect of national fiscal expenditure on transportation and civil aviation routes on the civil aviation freight traffic.

According to the results of the Granger causality test in Table 5, the model equation describing the long-run equilibrium relationship between civil aviation freight traffic and national fiscal expenditure on transportation & civil aviation routes is shown below:

$$d.lair=0.0126*l.e+0.0322 \quad (5)$$

where:

$$e=lair-1.2855*d.lgov-0.6969*lline-0.6797 \quad (6)$$

$$d.lair=0.0126*(l.lair-1.2855*l.d.lgov-0.6969*l.lline-0.6797)+0.0322 \quad (7)$$

The coefficients preceding l.d.gov and l.lline are both negative, indicating that more fiscal expenditure on transportation and increased civil aviation routes will drag down the civil aviation freight traffic. To a certain extent, this echoes our conclusion drawn previously: China's efforts to increase the fiscal expenditure on transportation and civil aviation routes will have a positive and significant long-term effect on the civil aviation freight traffic, only the expected results are yet to be achieved at the current stage. To conclude, China's air freight market is far from maturity, and the connection between government support and transportation infrastructures needs be further improved.

Table 5: Granger causality test.

	Coef.	Std.Err.	z	P>|z|
D_lair				
_ce1 L1.	0.013	0.080	0.160	0.876
_cons	0.032	0.011	2.910	0.004
D2_lgov				
_ce1 L1.	0.928	0.258	3.600	0.000
_cons	-0.029	0.035	-0.810	0.416
D_lline				
_ce1 L1.	0.225	0.080	2.800	0.005
_cons	0.117	0.011	10.590	0.000

4. Conclusions

The gross domestic product of China has a positive effect on the changes in civil aviation freight traffic, indicating that the overall economic picture of China is the important driver underlying the growth of China's air freight industry—the faster the economic growth, the quicker the growth of air freight industry. Second, the effect of government support on the civil aviation freight traffic is insignificant in the short term, indicating that the fiscal support from the Chinese Government is not effective in the short term, or that the government support has failed to emerge as an immediate driver boosting the development of China's air freight industry. The effect of transportation capability on the civil aviation freight traffic is also insignificant in the short term, indicating that the increase in civil aviation routes doesn't have a significant effect on the development of the air freight industry in the short term, or that the improvement in transportation capability has failed to become an immediate driver to bolster the air freight industry.

There is a co-integration relationship between the logarithm of civil aviation freight traffic, the logarithm of national fiscal expenditure on transportation, and the logarithm of civil aviation routes, indicating that China's efforts to increase the fiscal expenditure on transportation and civil aviation routes will have positive and significant long-term effect on the civil aviation freight traffic, only the expected results are yet to be achieved at the current stage. To a certain extent, this points to the stark fact that China's fiscal expenditure on transportation over the past ten years had not been properly directed to the construction of air transport infrastructures, and that the increase in civil aviation routes has not been fully utilized for air cargo transportation. Therefore, it's clear that China's air freight market has not been fully tapped and is far from maturity, and that the connection between government support and transportation infrastructures needs to be further improved. In general, China's air freight industry is still in its growth stage. Although the industry is undergoing burgeoning development for the moment, we still need to seize the opportunities at hand to gradually improve the integrated transportation system of China.

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