

Airports and Regional Economy in China

Subjects: **Others**

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China is the second largest aviation country in the world. The Chinese aviation industry and economy both developed quickly in the last two decades. However, the interaction mechanisms of aviation and the regional economy were different in each province. Jiangsu was the most important province in the Yangtze River delta region. The GDP of Jiangsu ranked second in China, but air transportation didn't have the same leading position in the last decade.

airport

regional economy

granger causality analysis

impulse response

1. Interactions between Aviation and Regional Economy

Airports have been associated with four main types of economic impact: direct impact, indirect impact, induced impact, and catalytic impact [\[1\]\[2\]](#). The impacts are mainly due to the employment and income generated by different sources. **Table 1** shows the sources of the four types of impact.

Table 1. The sources of four economic impacts.

Economic Impacts	Sources
Direct Impact	The direct construction and operation of airports.
Indirect Impact	The chain of suppliers of goods and services.
Induced Impact	The spending of income by employees created by the direct and indirect effects.
Catalytic Impact	The role of airports as a driver of productivity growth and then as an attractor of new firms.

Good airline services in a region contributed significantly to urban economic development [\[3\]](#). An increase in flights was favorable to promoting foreign investment and improved the employment rate of a city. The empirical results showed that a 10% increase in passenger enplanements in a metro area led to 1% increase in employment rate in related service industries. Kasarda and Green (2005) examined the role of air cargo in economic development, and showed that air service liberalization, improving customs quality, and reducing corruption could enhance air cargo's positive impact [\[4\]](#). Blonigen (2012) exploited time variation in the long-term growth rate to estimate the effect of airline traffic on the local population, income, and employment growth by using the data of almost 300 Metropolitan

Statistical Areas (MSAs) over the last two decades. The results showed that a 50% increase in an average city's air traffic growth rate generated an additional stream of income over 20 years, which equaled 7.4% of real GDP [5].

Providing empirical support for the direction of causality between the development of air services and regional economic growth has important policy implications for governments in the development of air transport infrastructure along with its link to regional economic policies. There are four main types of causal relationships between airports and economic growth [6]. The arrows indicate the direction of the impacts, as shown in **Figure 1**.

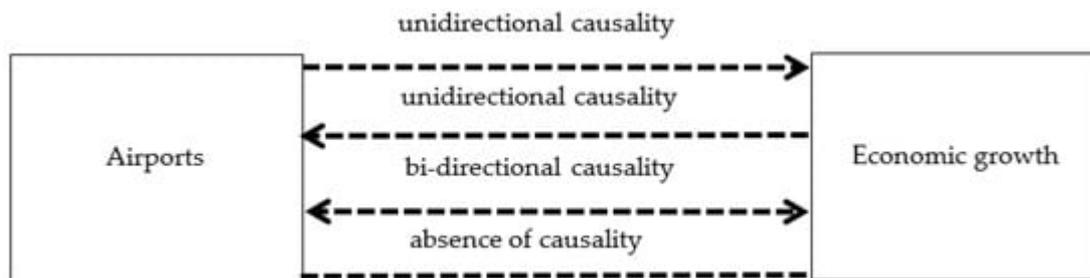


Figure 1. Four main types of causal relationships.

Richard and Charlotta (2015) examined the role of airports in regional development and found that the impact of airports on regional development varies with their size and scale [7].

Focusing on different areas, Douglas Baker (2015) found that there was a significant bi-directional relationship between regional aviation and economic growth in Australia: airports had an impact on regional economic growth, and the economy directly impacted regional air transport [8]. Hakim and Merkert (2016) examined the causal relationship between air transport (total air passenger and air freight) and GDP in South Asian countries and found a long-run unidirectional Granger causality from GDP to air passenger and air freight volume [9]. Yingigba (2019) examined the causal relationship between economic and domestic air travel demand in Nigeria [10].

A review of studies on the economic impacts of airports included mainly three types of methods: (1) input-output models, (2) the collection of benefits, and (3) catalytic methods. In the catalytic methods, various econometric models were developed, including regression models, 2-stage least square regression [11]; dynamic panel data models [12]; short-run Granger causality analysis and long-run Granger causality analysis [13].

2. Airports Development and Regional Economy in China

Airports are the important elements of national and provincial air transportation infrastructures. They not only provide effective air transportation to meet travel demands but also promote the development of the local economy, including employment opportunities, industrial upgrading, and social welfare improvement. The goal of the 13th five-year aviation development plan from Civil Aviation Administration of China (CAAC) was to build a safe, convenient, efficient, and green modern civil aviation system to meet the demands of a moderately prosperous society (www.caac.gov.cn (accessed on 15 July 2019)). According to the National Transportation Airports Plan

(www.caac.gov.cn (accessed on 15 July 2019)), there will be more than 260 civilian airports in 2022. The high quality and intensive sustainable development of airports and airline service are vital for the sustainable development of the transportation system and the national economy. It requires the regional economy and aviation industry to experience a virtuous circle.

Hong (2011) examined the linkage between transport infrastructure and regional economic growth by using data from a sample of 31 Chinese provinces from 1998 to 2007, and the result showed that the contribution of airway transport infrastructure is weak ^[14].

Long and Shi (2013) collected data from 1978 to 2010 to study the relationship between civil aviation and the economy of China ^[15], which showed that a long-term stable relationship had not been established. Yang (2014) pointed out that the increased volume of air passengers had promoted the development of the urban economy by using 15 years of data of 35 large and medium-sized cities in China ^[16]. Li (2015) found that economic growth benefited from the development of civil aviation using a co-integration test, a Granger causality test, an impulse-response and a variance decomposition test using a data set of the national turnover volume of air transportation and GDP from 2002 to 2012 ^[17]. Shen and Zou (2016) showed that the Granger causality between air transportation and the economy in China was bidirectional. In particular, economic growth in China promoted the growth of air transportation more than the opposite direction of causality ^[18]. Hu et al. (2015) applied a bi-variate panel Vector Error Correction Model (VECM) to analyse both short and long-run equilibrium and Granger causality relationships between economic growth and domestic air passenger traffic based on quarterly panel data for 29 provinces in China for the period 2006Q1–2012Q3. The authors found a long-run cointegration and bi-directional Granger causal relationship between the two series ^[19]. Lu and Li (2016) reported that there was a long-term stable equilibrium relationship between aviation mileage and the national income level in China. The increase in national income levels had promoted the growth of aviation mileage ^[20]. Li and Li (2016) found that air transportation significantly improved as a result of local economic development by using the Granger causality test with the data of airport passenger throughput, cargo throughput, and GDP from 1990–2014 in China ^[21].

Ryerson and Ge (2014) showed that turboprops could serve the second tier and emerging cities with lower fuel costs and reduced environmental impact to balance the increase in travel time for the passenger by undertaking a spatial analysis of the Chinese short-haul aviation network ^[22].

The published literature was in good agreement that aviation development was influenced by the economic growth. However, the economic growth in different regions had different characteristics ^[23]. This led to the complex development and evolution of aviation and also affected future policy settings. Therefore, the causality relationship test results were highly influenced by the data of specific time-series and regions.

3. Research Data and Processing

The nine airports of Jiangsu were selected as research objects, and included Nanjing, Lianyungang, Yancheng, Xuzhou, Nantong, Changzhou, Wuxi, Huai'an and Yangzhou. Nanjing, the capital city of Jiangsu, is the metropolitan

region, with a population of 8.4 million compared with the total population of 80.3 million for Jiangsu province. Wuxi, Changzhou, and Nantong are the southern city clusters, which are very close to the most developed city: Shanghai. Xuzhou, Lianyungang, Huaian and Yancheng are the northern city clusters, which are less developed compared to Nanjing and the southern city clusters. Yangzhou City is located in the center of Jiangsu province, which is a well-known tourist destination.

An empirical analysis was conducted by using quarterly data of airport passenger throughput (PAX), and the local Gross Domestic Product (GDP) of the Jiangsu province. To test the causal relationship between airports and regional economic development, PAX was employed as an index to measure the development of airports, and GDP was used as a measurement of the regional economic development. Quarterly data of the total PAX of the nine selected airports and GDP of Jiangsu province from 2008 to 2018 was collected from the Statistical Yearbook by the Civil Aviation Administration of China and the China Statistical Yearbook by the National Bureau of Statistics. (all of the data were downloaded from www.caac.gov.cn (accessed on 15 July 2019) and www.stats.gov.cn (accessed on 15 July 2019)).

4. Model Development

4.1 Granger Causality Test

The test results showed that there was bi-directional short-run Granger causality in lag order 1, 3 and 4 at the 10% significance level. These results indicated that there was a bi-directional Granger causality relationship between GDPSA and PAXSA in Jiangsu province. It also concluded that the airports and regional economy in Jiangsu province were mutually promoting growth.

4.2 Impulse Response and Variance Decomposition

1. Impulse response

Impulse responses are the most commonly applied tools for describing these dynamic reactions in vector autoregressive analysis. The impulse response function is used to reflect the response of an endogenous variable on the impact of innovation (shock) in an exogenous variable. Specifically, if a standard deviation impact is given to the random error term, it will affect the current and future values of the endogenous variables.

Figure 4 showed the impulse response of PAXSA and GDPSA to Cholesky one S.D. innovation. The blue line was the impulse response estimate for the horizon period, and the two red lines were the one-standard error confidence bands. From Figure 4a, when there was an innovation on GDPSA for horizon periods $H = 30$, the response of PAXSA fluctuated greatly, which reached a peak in the fourth period and stabilized after the 20th period. Therefore, the impact of GDPSA on PAXSA was persistent and stably increasing in the long-term development. From Figure 4b, when there was an innovation on PAXSA, the response of GDPSA also fluctuated significantly in the first six periods, which reached the peak in the second period, then dropped quickly to the lowest in the fourth, and gradually stabilized. But after the 20th period, the response was unstable. These results indicated that the impact

of PAXSA on GDPSA existed for a long period and was uncertain. The mutual impacts of passenger throughput and economic growth were positive in Jiangsu province, and there was a more substantial impact in the short period. The impact of economic growth on passenger throughput was more significant than the impact of passenger throughput to economic growth. This result showed that airport growth was more sensitive to the change of economy in Jiangsu province.

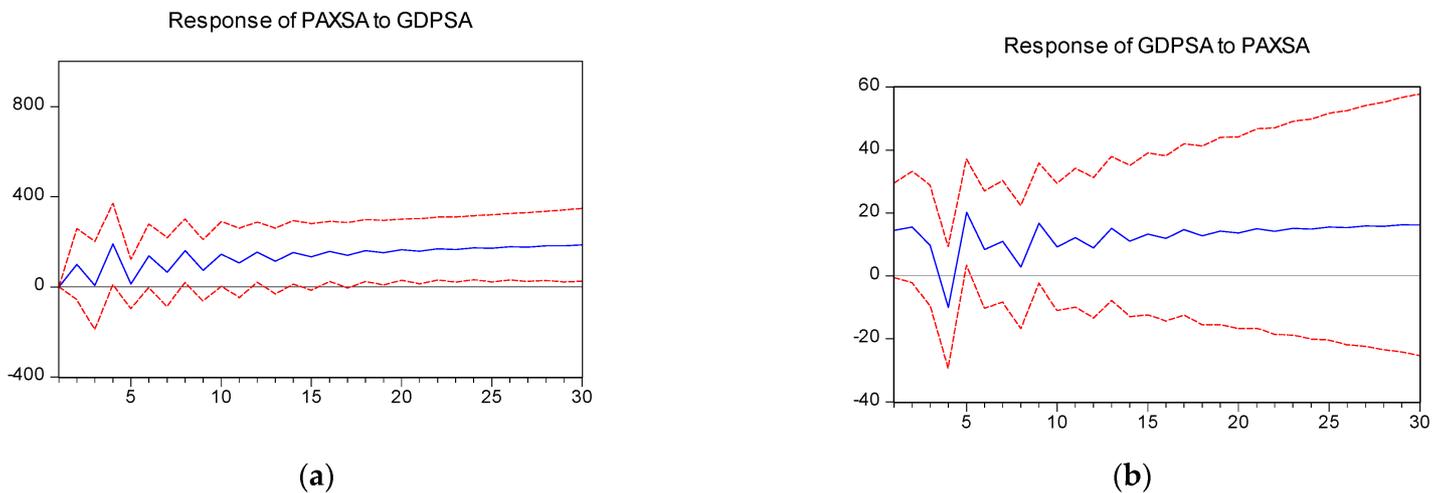


Figure 4. (a) Impulse Response of PAXSA to GDPSA; (b) Impulse Response of GDPSA to PAXSA. The blue line was the impulse response estimate for the horizon period, and the two red lines were the one-standard error confidence bands.

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2. Variance decomposition

Impulse response functions trace the effects of a shock on one endogenous variable on the other variables in the VAR. Variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR. From Figure 5 a,b, it could find that the interaction between airport passenger throughput and the local economy was lagging. Figure 5a showed the percentage of GDPSA variance explained by self-change that was decreasing gradually, however, it became stable at about 60% after the 35th period. The proportion of variance explained by PAXSA increased gradually, and stabilized at 40% after 35 periods. Taken together, the proportion of passenger throughput contribution to the change of GDP was 40%. Figure 5b showed the change variance of PAXSA, which was mostly caused by its fluctuation in the beginning. The proportion of self-disturbance decreased from 92% to 50% in the 50th period. On the contrary, the proportion of variance explained by the change of GDPSA increased from 0% to about 30%. In the long term, the proportion of GDP contribution to passenger throughput was about 45%. Therefore, the inter-contribution of GDP and aviation development was sustainable and increasing over time.

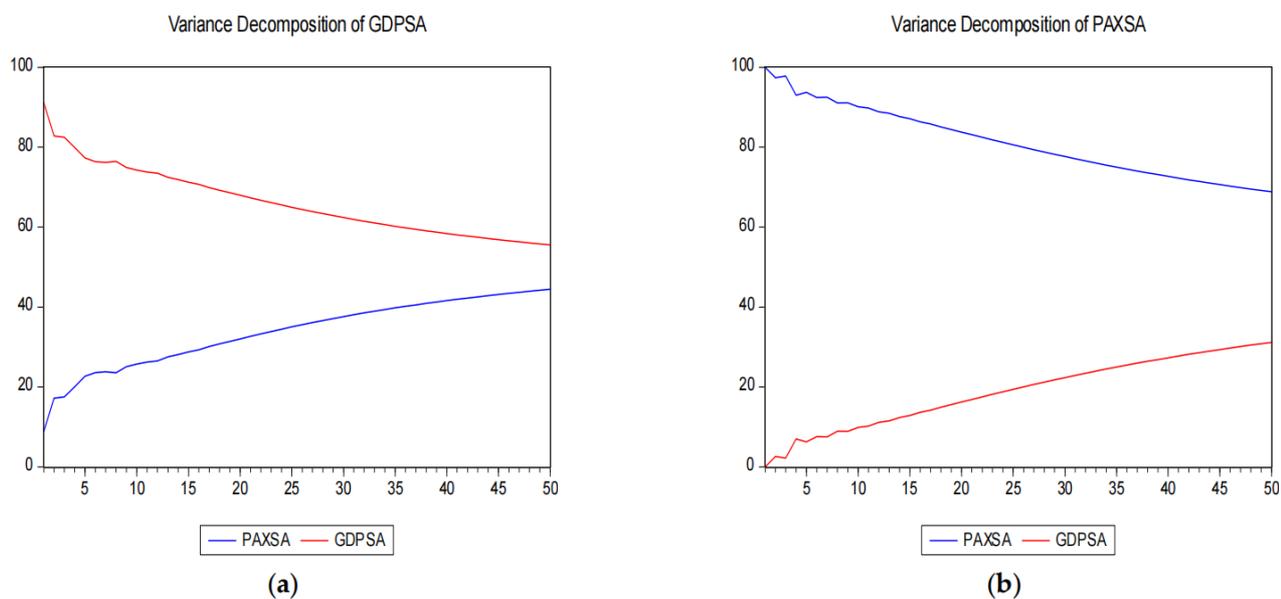


Figure 5. (a) Variance Decomposition of GDP; (b) Variance Decomposition of PAX.

5. Conclusions

This entry aimed to establish empirical evidence for determining the causal relationships between aviation/airports and economic growth in a typical Chinese provincial area—Jiangsu province. Using a VAR model and a Granger causality test, it found that economic growth and the development of airports were interdependent and mutually promoting. The results of Impulse Response and Variance Decomposition showed that the impact of GDP on airport passenger throughput was persistent and stably increasing in the long-term development; the impact of airport passenger throughput on GDP also existed for a long period but was unstable. Jiangsu is located in the core of the Yangtze River delta region, which is the polycentric urban region. Jiangsu faces regional economic competition from Shanghai and the Zhejiang province. Jiangsu airports are less competitive than the Shanghai and Zhejiang airports. From the research, the GDP had a long-term impact on airport development, but the impact of airports on the GDP was less. It is therefore important to leverage airport development to improve the regional economy. The contribution of aviation is not only about the airport itself but also about the induced and catalytic impacts, such as the funding of infrastructure and the attraction of new firms. Governments could support some kind of long-term strategic spatial framework to inform key investment decisions of airport-based sub-centers in regional polycentric growth and promote closer collaboration in the Jiangsu provincial airports, including the airline network, flight schedules and air service quality.

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