



# Domestic air passenger traffic and economic growth in China: Evidence from heterogeneous panel models



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## ABSTRACT

This paper applies recent panel methodology to examine the short-run dynamics, the long-run equilibrium relationships and the Granger causal relationship between economic growth and domestic air passenger traffic. It is based on the quarterly panel data of 29 provinces in China from the period of 2006Q1 to 2012Q3. Tests for panel unit roots, cointegration in heterogeneous panels and panel causality are employed in a bi-variate panel vector error correction model (PVECM), which is estimated by the system generalized moment method (SYS-GMM). The results show evidence of a long-run equilibrium relationship between economic growth and domestic air passenger traffic. Specifically, 1% increase in the air passenger traffic is found to lead to an increase of 0.943% in real gross domestic product (GDP). A long-run and strong bi-directional Granger causal relationship is found between these two series. It is also found that there is a short-run uni-directional Granger causality running from the domestic air passenger traffic to the economic growth.

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## 1. Introduction

With high levels of population growth, urbanization, and industrialization, the air transportation has emerged as an important factor in a country and region's growth prospects. In recent years, many empirical studies have presented evidence of correlation between air transportation and the economic development and growth level. Nevertheless, a high correlation does not necessarily imply a causal relationship. Thus, understanding the causal relationship between air transportation and economic growth is important when elaborating air policies.

There has been a growing interest in studying air transportation. Most of the empirical research in this area has focused on the demand for air travel. Analyzing air traffic plays an important role for airlines to make long-term plans, for aircraft manufacturers to arrange production, for governments to construct the whole system

of airspace and infrastructure, and so on (Carson et al., 2011). In regards to the development of infrastructure facilities and in order to reduce airport risk, it is important to evaluate and forecast the volume of air passenger in the future. However, there can be a lack of proper diligence in choosing air transport predictors, and very often spurious correlations among time series can be used to justify forecasts' accuracy (Fernandes and Pacheco, 2010). As a proxy for economic growth, GDP is commonly used for forecasting air traffic (Grosche et al., 2007; Alekseev and Seixas, 2009, etc.), but literature lacks analysis for the causal relationship between air traffic and GDP.

The causality between domestic air traffic and economic growth has several important policy implications. This study will help us better understand the role of air traffic in a country's economic growth. The results of causality tests can shed light on future air policies, such as airport infrastructure planning, aviation strategic planning, etc. Hence, it is important to understand the relationship between air traffic and income. Nevertheless, to the best of our knowledge, there are few studies of the relationship between economic growth and domestic air traffic using panel data. The

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purpose of this paper is to fill the gap in the empirical literature on the causal relationship between domestic air traffic and economic growth by studying the specific situation in China.

The choice of China is motivated by the fact that the country has become the second largest air travel market in the world, in terms of both the number of passenger-kilometer flown and the number of tonne-kilometers flown. As a developing country, China is one of the world's fastest growth economies and it has experienced a significant growth in the civil aviation industry in recent decades. During the period 1978–2012, the average annual growth rate of GDP is about 9%, while the average annual growth rate of the total tonne-km performed increased by about 17%. By 2012, the cargo throughput and passenger throughput handled by Chinese airports were 11.99 million tons and 679.8 million persons, of which 7.85 million tons and 623.8 million persons were domestic.<sup>1</sup> Therefore, we examine the relationship in domestic air traffic-income nexus, which has good policy implications for the long-term planning of the aviation industry in China.

In this paper, we use the quarterly panel data of 29 provinces in China from the period of 2006Q1 to 2012Q3 to examine the short-run dynamics, the long-run equilibrium relationships and the Granger causal relationship between economic growth and domestic air passenger traffic. First, we identify the order of integration of these series using panel unit root tests, and find that the proxy variables of economic growth and domestic air traffic are both I (1). Second, panel cointegration tests are used to check the long-run equilibrium relationship between the two variables, and we find that economic growth and air traffic move together in the long-run. Third, we estimate the long-run equation by fully modified OLS (FMOLS). Fourth, based on the residuals of long-run equations, we use system GMM to estimate the panel error correction models. Then, we check the source of causation by testing the significance of the coefficient of the independent variables in the panel error correction models. And we find that there are long-run and strong bi-directional Granger causal relationship between economic growth and domestic air passenger traffic, and short-run uni-directional Granger causality running from the domestic air traffic to the economic growth.

The remainder of the paper proceeds as follows. Section 2 reviews recent literature in the area of air traffic and its relationship with economic growth. Section 3 describes the data. Section 4 explains the panel methodology. Section 5 summarizes the empirical results. Section 6 concludes and proposes some policy implications.

## 2. Literature review

During the last few decades, empirical work on air traffic has attracted considerable attention from researchers. The air traffic topic was reviewed in a few prior literature surveys (Sarames, 1973; Melville, 1998; Gillen et al., 2004). Recently, Wang and Song (2010) provided a comprehensive review of the existing air travel demand studies that were published over the period 1950–2008. Most of the studies that are referred to in these reviews primarily focus on demand measurement, demand elasticity analysis, and demand forecasting (Liu and Zeng, 2007; Lee, 2011). However, besides these topics, another important issue is the relationship between the air transport development and economic growth (Goetz, 1992; Fleming and Ghobrial, 1994; Button et al., 1999; Button and Taylor, 2000; Debbage and Delk, 2001; Hakfoort et al., 2001; Brueckner, 2003; Green, 2007; Button et al., 2010; Dobruszkes et al., 2011; Kopsch, 2012; Yao and Yang, 2012, etc.).

Most previous studies have investigated the relationship between air transport development and economic growth from one of these two perspectives: the demand side (or air travel demand function) and production side (or the aggregate production function). On the demand side, economic growth is considered to be a vital factor in assessing a future air travel demand. Fleming and Ghobrial (1994) developed an aggregate demand model that relates total annual passenger enplanements to certain economic activities, including population and per capita income, and so on. The empirical results showed a strong relationship between air travel demand and economic variables. Dobruszkes et al. (2011) found that GDP, the level of economic decision-power, tourism and the distance from a major air market are the determinants of air traffic volume in the major European urban regions. Kopsch (2012) analyzed the demand model for domestic air travel in Sweden, in which GDP as an independent variable showed a positive effect on domestic air travel demand. Yao and Yang (2012) used panel data in China to identify the key determinants of air transport. The results showed that air transport is positively related to economic growth.

On the production side, many economic activities, such as financial services, manufacturing and tourism, depend on a reliable air transport system. Goetz (1992) examined the relationship between air passenger transportation and the growth of U.S. urban areas from 1950 to 1987, finding a positive relationship between air passenger flow volume per capita and population/employment growth. Button et al. (1999) found that hub airports significantly increase the high-technology employment. Similarly, Button and Taylor (2000) used employment as the economic development variable and examined the effects of international air transportation. Brueckner (2003) studied the link between airline traffic and employment in US metropolitan areas, the results showed that a 10% increase of the passenger enplanements in a metro area leads to approximately 1% increase of employment in the service-related industries.

According to Green (2007), there is a strong correlation between air traffic and economic growth, but the direction of causation is not clear. However, only few literature have investigated this causal relationship. Chang and Chang (2009) examined the causal relationship between air cargo and economic growth in Taiwan over the period 1974–2006 and the results demonstrated a bi-directional relationship. Fernandes and Pacheco (2010) used time series data of Brazil from 1966 to 2006 to examine the causal relationship between economic growth and domestic passenger transport. The empirical results revealed that there was an uni-directional Granger causal relationship from economic growth to domestic air transport demand. Mukkala and Tervo (2013) employed the panel Granger non-causality technique to study the relationship between air transportation and regional economic performance based on European-level annual data from 86 regions and 13 countries for the period of 1991–2010. The results suggested that the causality processes are homogenous from regional growth to air traffic in peripheral regions, but not in core regions. As far as we are aware, there is no empirical analysis of the causal relationship between domestic air passenger traffic and economic growth for China, the current paper is aimed at filling this lacuna.

## 3. Data

Our empirical analysis uses a panel data of GDP and domestic air passenger traffic for 29 provinces of China using quarterly data for the period of 2006Q1 to 2012Q3. Nominal GDP and domestic air passenger traffic data for China were obtained from the CEIC database. In this paper, air passenger traffic is expressed in terms of passenger throughput (denoted by APT), and nominal GDP is

<sup>1</sup> Data sources: [http://www.caac.gov.cn/I1/K3/201303/t20130325\\_54626.html](http://www.caac.gov.cn/I1/K3/201303/t20130325_54626.html).

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