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Determinants of air cargo traffic in California ☆

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ABSTRACT

Studies on the economic impacts of air cargo traffic have been gaining traction in recent years. The slowed growth of air cargo traffic at California's airports, however, has raised pressing questions about the determinants of air cargo traffic. Specifically, it would be useful to know how California's air cargo traffic is affected by urban economic characteristics. Accordingly, this study estimates the socioeconomic determinants of air cargo traffic across cities in California. We construct a 7-year panel (2003–2009) using quarterly employment, wage, population, and traffic data for metro areas in the state. Our results reveal that the concentrations of both service and manufacturing employment impact the volume of outbound air cargo. Total air cargo traffic is found to grow faster than population, while the corresponding domestic traffic grows less than proportionally to city size. Wages play a significant role in determining both total and domestic air cargo movement. We provide point estimates for traffic diversion between cities, showing that 80% of air cargo traffic is diverted away from a small city located within 100 miles of a large one. Using socioeconomic and demographic forecasts prepared for California's Department of Transportation, we also forecast metro-level total and domestic air cargo tonnage for the years 2010–2040. Our forecasts for this period indicate that California's total (domestic) air cargo traffic will increase at an average rate of 5.9% (4.4%) per year.

1. Introduction

The air cargo industry is seldom brought up in the literature without mention of its remarkable growth and its importance to global trade and commerce. The rapid maturation of air cargo markets in the 1990s led industry analysts to project an average 5% annual growth in domestic air cargo traffic between 1998 and 2017 (FAA, 2000; Boeing, 1998). [1] This pace of growth instilled great concern in California's policy makers and airport planners, seeing that four of California's international hubs, Los Angeles (*LAX*); Metropolitan Oakland (*OAK*); San Francisco (*SFO*); Ontario (*ONT*), rank amongst the country's top sixteen airports in handling cargo traffic.[2] Regional and state-wide studies have mostly been interested in assessing the impacts of increased air cargo traffic on the state's economy and, more immediately, on capacity-constrained airports (TranSystems, 2010; Tsao, 1998; BAEF, 2000a,b; Erie et al., 2005). While the expansion of air cargo transportation initiated numerous studies on the role of goods movement by air, current numbers show that the growth of air cargo traffic in California has slowed down markedly over the 2000–2009 period (TranSystems, 2010).

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[1] The FAA's March 2000 long-range forecasts anticipated air freight *revenue ton-miles* to increase from 26.6 million to 36.5 million by 2005, and to 48.4 million by 2010 (FAA, 2000).

[2] Ranks are based on our calculation of airport-specific shares of outbound-cargo tonnage from all airports in the United States. For the years 2003–2009, national ranks of the four airports are as follows: (4) *LAX*; (12) *SFO*; (13) *OAK*; (16) *ONT*. Data source: *Bureau of Transportation Statistics* (BTS, 2015).

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California's air cargo demand was comprehensively explored by a TranSystems (2010) report prepared for the state's Department of Transportation (*Caltrans*). The report underscored the industrial, demographic, and geographical diversity of California's economic zones, advising transportation planners to attune their air cargo demand forecasts to changes in the unique economies of the regions served by the state's airports. Therefore, this paper seeks to explain how the total air cargo traffic at airports in California is affected by the characteristics of their corresponding metropolitan economies.

At the national scale, Brueckner (1985) examined the effects of metro-level socioeconomic and demographic factors on passenger air transport, while Alkaabi and Debbage (2011) sought to identify specific employment, establishment, and wage variables that explain the geographic distribution of air freight. Recent studies have shifted away from cross-sectional analyses to gain advanced insights into the demand for air transport from panel data. Button and Yuan (2013) employed Granger causality tests on a panel dataset to identify causal links between air freight services and regional economic development. Using a fixed effects model to control for unobserved and city-specific heterogeneity, Lakew (2015) explored the determinants of both passenger and cargo airport traffic. Our research aims to extend the foundational work of these studies, while addressing the research needs for understanding how regional economies impact air cargo traffic in California.

In addition to identifying fundamental socioeconomic features of cities that influence air cargo volume, this study addresses the traffic impact of city-level employment composition. While an examination of all U.S. cities is more generalizable, the size and unique economic characteristics of California suggest that a state-level analysis is also appropriate. Further, successful air cargo operations must maintain a balance between outbound and inbound loads, even while the transported products are significantly different. California provides a sufficiently-large market for carriers to comfortably meet this condition.[3] Hence, this paper will examine the socioeconomic determinants of outbound total and domestic air cargo traffic for a sample of 22 airports across 15 metropolitan areas in California, using seven years of quarterly data (2003Q1–2009Q4). Based on the key determinants of traffic identified in this study, and using county-level economic forecasts prepared for *Caltrans* as input data, we also provide insights into the expected short- and long-term growth in the state's cargo tonnage.

Consistent with the past literature, we find empirical evidence confirming a direct relationship between metropolitan socioeconomic factors and air transport. Specifically, manufacturing and service-related employment concentrations have considerable impacts on air cargo traffic. Despite the sharp fall of high-technology manufacturing employment, subsequent to the collapse of the *internet bubble* in 2000, California's manufacturing firms are believed to still be important drivers of traffic. We also expected the role that other employment areas play in determining air cargo demand to be nontrivial, although not as clear *a priori*. Our results demonstrate that, analogous to the passenger air-travel literature, metropolitan characteristics such as city size, income, age distribution, and hub operations have sizeable impacts on air cargo traffic. These findings can be used to inform policies related to airport expansion, and to gain some understanding of the demand and spatial distribution of air cargo in California. Our metro-level traffic forecasts for the 2010–2040 period indicate that California's total (domestic) volume of air cargo will grow at an average rate of 5.9% (4.4%) per year.

2. Data and empirical framework

By associating airports to their corresponding metro areas, we can assess the impacts of urban-socioeconomic factors on outbound air cargo traffic (total and domestic) across cities in California. Hence, the dependent variable for our model is the total cargo tons (freight and mail) that is flown from airports in chosen metro areas.[4] The cargo tons carried by aircraft operating at the airports in our sample are obtained from the U.S. Department of Transportation's (DOT) *Form 41 Traffic T-100 Segment* tables (BTS, 2015), which can be found on the Bureau of Transportation Statistics (BTS) website. Freight and mail volumes are aggregated to the metro-area level by service type (*all-cargo* or *passenger-cargo*). Our sample begins in Quarter 1 of 2002, since the largest integrator, *FedEx Express*, did not report complete data on its freight volumes to the DOT until Quarter 4 of 2002. Using these time-series data, we constructed a quarterly panel spanning seven years (2003Q1–2009Q4) with metropolitan area cross-sections. In addition, *FedEx Express* does not sufficiently differentiate between freight, express freight, and mail in the *Form 41 Traffic* data (TranSystems, 2010). Therefore, we analyzed the two outputs of the industry (freight and mail) together as *cargo*.

Our metro-area definitions are based on the 2009 metropolitan and micropolitan statistical area (MSA) delineations created by the U.S. Office of Management and Budget (OMB). Under the umbrella of *Core Based Statistical Areas* (CBSA), metro areas correspond to urban regions with more than 50,000 people in the core, while the core-population of micro areas is between 10,000 and 50,000. This level of aggregation is chosen for our study's socioeconomic variables, as well as most of the aforementioned studies, since the inherent geographical definition of the areas is based on a consolidation of counties that contain the core-urban population and maintain high levels of socioeconomic interactions (Census, 2013).

We restricted our sample to cities that depart more than 50 U.S. tons (100,000 lbs.) of freight annually, which is consistent with the cutoff point used by Alkaabi and Debbage (2011). This threshold eliminates noisy data that may arise from including cities that account for insubstantial amounts of freight traffic. Hence, our sample is restricted to approximately 22 primary airports, contained in 15 MSAs across California. The exact number of MSAs in our sample varies over the periods and regression specifications of our study. The airports and MSAs represented in our study are summarized in Table 1.

[3] We thank an unnamed conference proceedings referee for this insight.

[4] The difference between *air cargo* and *air freight* should be distinguished as they are sometimes used interchangeably in the literature. According to the *Airport Council International* (*ACI*), air cargo is defined as the sum of freight, mail, and passenger-baggage revenue tons. This definition is consistent with the *U.S. Department of Transportation*'s and *Government Printing Office*'s description of air freight as only being property (excluding express, mail and passenger baggage) that is transported by air.