ARTICLE IN PRESS

Transportation Research Part A xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Delays in the New York City metroplex

Ashish Lall

Lee Kuan Yew School of Public Policy, National University of Singapore, 469C Bukit Timah Road, Singapore 259772

ARTICLE INFO

Keywords:
New York airports
New York metroplex
Aviation delays
Negative binomial regression
Count regression model

ABSTRACT

Aviation delays impose significant external costs on society. This paper represents one of the first attempts to use a count regression model to study delays at the three New York city area airports – Liberty (Newark), John F. Kennedy and LaGuardia. Explanatory variables are drawn from an extensive literature survey and reflect a range of environmental and operational causal factors. Adverse weather has the largest impact on expected delay, followed by congestion during the metroplex peak. Airport operations peaks matter if they occur at times when the metroplex is busy. Other significant causal factors include surface congestion and arrivals from congested domestic hubs. The impact of the latter appears to be driven by the proportion of domestic traffic. The complex causal factors of delays suggest that regardless of the empirical approach, airport specificities are important in reducing delays.

1. Introduction

In 2007, civil aviation in the U.S. generated approximately $1.3 trillion in economic activity employing 11.5 million individuals who earned $396 billion (Federal Aviation Administration (FAA), 2009). However, the sector also imposes external costs on society, such as environmental impacts as well as aviation delays. Two studies (Ball et al., 2010; Joint Economic Committee, 2008) estimated the costs of aviation delays to the U.S. economy in 2007 as amounting to $30–40 billion. Both studies sought to capture the direct and indirect costs of flight delays, which include higher operational costs to airlines; value of lost time to passengers; individuals shifting to other modes of transport such as road and the associated external costs of congestion; environmental costs from additional jet fuel use and spill-overs to other sectors of the economy, which use aviation services to move either goods or people. Britto et al. (2012) estimated the welfare effects of block delays in the U.S. for the period 2003–2006.[1] They found that on a cost per passenger basis, a 10 percent reduction in block delays would increase consumer welfare (surplus) by $1.48 and producer welfare by $4.44. The total welfare gain represents about 4.5% of the mean fare ($92.91) in that study.

The Bureau of Transportation Statistics (BTS) in the U.S. reports airline on-time performance using 'counts'. A flight is counted as being on-time if it arrives (departs) less than fifteen minutes later than the scheduled arrival (departure) time. Likewise, a flight which arrives (departs) fifteen or more minutes later than the scheduled arrival (departure) time is counted as being delayed. For the sample period of this study (May through August 2013), on average, for all U.S. airports, 75.8% of arrivals and 76.7% of departures were on-time. During the same time-period, on-time performance at the three airports studied here; John F. Kennedy International Airport (JFK), LaGuardia Airport (LGA) and Newark Liberty International Airport (EWR) was below the national average. On average, 67% of arrivals and 71.6% of departures at these three airports were on-time. Flights that were not on-time were delayed for

E-mail address: ashish.lall@nus.edu.sg.

[1] Block time is the time elapsed between brake release (push-back) at the departure airport and brakes set (and engines shut off) at the arrival airport. Block delay is the difference between actual block time and scheduled block time.

https://doi.org/10.1016/j.tra.2017.12.006

Please cite this article as: Lall, A., Transportation Research Part A (2017), https://doi.org/10.1016/j.tra.2017.12.006

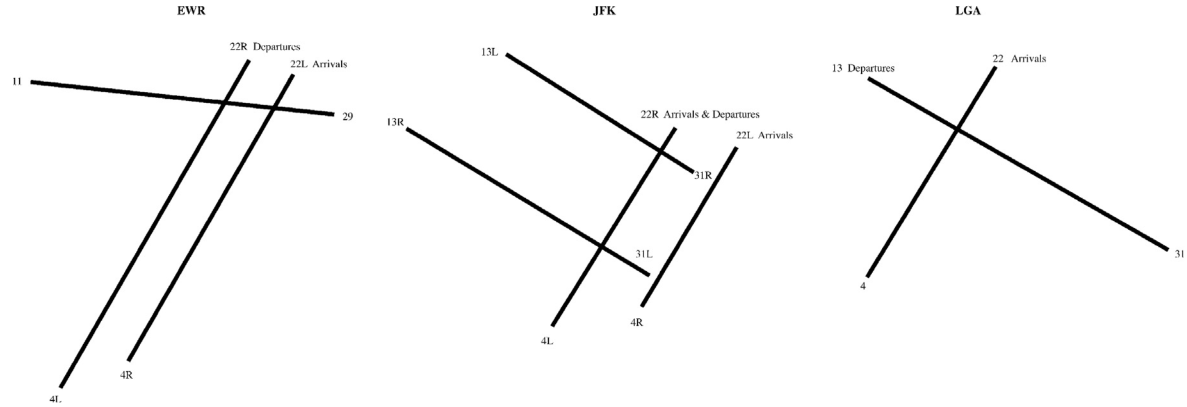

Fig. 1. Runway configurations. Note: This figure is illustrative and not drawn to scale. The terms "Arrivals" and "Departures" identify the most frequently used runway configurations.

several reasons: late aircraft arrival, national aviation system delay, air carrier delay, weather delay and security delays.[2] As well, some flights were either cancelled or diverted.

In addition to these causes, delays may stem from airline scheduling strategies, airspace management protocols and insufficient airside capacity. The allocation of runway capacity also has implications for delays. In the U.S., flights are handled on a first-come, first served basis while, in contrast, airports in the European Union (EU) use slot controls, where the number of aircraft movements per unit of time are limited by the "declared capacity" of an airport. The American approach results in higher capacity utilization whereas the European approach results in more predictability and fewer delays (Odoni and Morisset, 2010).

Air traffic has grown at a rapid rate over the past two decades. The International Air Transport Association (IATA) reported that scheduled flights increased by 5.5 percent in 2015 and were forecast to increase by 4.9% per annum thereafter, to reach 38.4 million by the end of 2017 (IATA, 2016). Countries are responding to the higher traffic in different ways. Some have built new airports or added runways whereas others have developed new tools and procedures to better utilize airspace capacity. China has built new airports and a select few airports have added runways (e.g. Frankfurt airport). However, airports in the largest markets—North America and Europe, have not expanded runway capacity to any great extent. Britain has not built a runway for 60 years and a decision to expand Heathrow will be subject to continual challenges.[3] There are various initiatives to refurbish or lengthen runways but most airport capacity expansion has been aimed at building new terminal capacity.[4]

The ability of an airport to process more flights per unit of time can also be achieved through investments in facilities complementary to runways; such as taxiways, aprons and holding bays, which interact to influence airport operational capacity (de Neufville et al., 2013). In 2014–15, the Port Authority of New York and New Jersey added 728 feet of pavement to runway 4L/22R (Fig. 1) at JFK.[5] The runway was also widened by 50 ft. (to 200 ft.) and several high-speed taxiways were added in the rehabilitation program (DY Consultants, 2011). Improved traffic management efforts such as the NextGen program developed by the Federal Aviation Administration (FAA) in the U.S. also help to mitigate delays. The NextGen program has increased the ability of controllers to handle more flights by shifting the National Airspace System (NAS) to satellite based navigation and adopting fully integrated information management systems (FAA, 2016). Some implementations in the New York (NY) airspace which were completed in 2011 allow a reduction in separation from 5 nautical miles (nm) to 3 nm in low altitude (below 18,000 ft.) airspace. A study of the impact on arrivals one year after implementation (comparing 2011 to 2012) found that vector delays were 41% lower.[6] There were also reductions in hold durations, taxi-in times and block delays (FAA, 2013). In the EU, the single European sky initiative in Eurocontrol is seemingly stalled as each EU member state still has its own airspace management infrastructure. The EU has 38 air navigation service providers whereas a single provider in the U.S. handles a similar geographical area. Flight routes in the EU are circuitous due to the different national airspaces and 'special use' (e.g. military) airspaces. Nonetheless, Eurocontrol has been developing approaches to better manage the current system (SEO Amsterdam Economics, 2016).

The literature on aviation delays is cross-disciplinary and scholars have used a variety of parametric and non-parametric techniques in their analysis. Many econometric studies use minutes of delay to measure delays whereas a few use the number of delayed

[2] National aviation system delays refer to a variety of causes including non-extreme weather conditions, airport operations, heavy traffic volume and air traffic control issues.

[3] The decision by Britain to leave the European Union has created some uncertainty regarding the runway expansion decision.

[4] Many cities including Istanbul, Mexico City, Dubai, Chengdu, Beijing, St. Petersburg and Bogota have recently completed or are building new airports. See CAPA (2015) for further details.

[5] Fig. 1 provides illustrative runway maps for the three airports studied in this paper. Runway numbering at airports is standardized. The runway number refers to the (rounded) magnetic heading of the runway, divided by 10. For example, the south west (SW) to north east (NE) runway for JFK – 4L has a heading of 044°, which is rounded to 040° and divided by 10 to yield runway 4. The "L" indicates that it is the left runway of two parallel runways. From the opposite direction (NE to SW) the same runway has a heading of 224° and is referred to as runway 22R (right). To incorporate both headings, the runway is referred to as 4L/22R.

[6] Vector delay refers to the circuitous routing of an aircraft using directional vectors provided by air traffic control to manage congestion in the airspace around an airport.