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An empirical analysis of delays in the Turkish Airlines network

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ABSTRACT

This paper investigates the determinants of delays on international and domestic routes of Turkish Airlines in 2014, focusing on the effects of airport market share and airport market concentration. When examining the impact of airport market share, we find that delays are decreasing in market share for both domestic and international routes. We use market concentration to test whether airlines internalize the cost of the delays for their passengers. We find results that are consistent with the internalization hypothesis on domestic routes; however, on international routes, our estimates are inconsistent with the internalization hypothesis. We propose that these results may be due to market share being more critical than market concentration in determining delays and that the internalization effect is limited. Additionally, we find that delays are lower at airports that connect to more destinations.

1. Introduction

The International Air Transport Association's (IATA) 2015 global passenger survey suggests that on-time performance is the most critical factor in passengers' preferences over airlines (IATA, 2016a). Connectivity is another key factor because airlines that offer service to more destinations are more appealing to passengers. By providing service to additional destinations, the greater connectivity increases the value of airline service for passengers traveling from the original airports and creates new demand for flights from the additional destinations. The increased connectivity has a cost due to the additional delays that passengers face as a result of increased congestion at the original airports. Delays occurring as a result of congestion have become a common problem in the airline industry. In this paper, we examine the determinants of delays, focusing on how airport market share, airport market concentration, and connectivity affect delays in the Turkish Airlines network.

Understanding the causes of delays is important because delays are costly for airlines and their passengers. According to the US Department of Transportation, in the US airline industry in 2007, the direct operating cost of scheduled delays of an hour was estimated to be around $3600 (Belobaba et al., 2009). The increased costs occur due to additional fuel usage and maintenance, an idle crew and aircraft, and other related expenses (Belobaba et al., 2009). Morrison and Winston (2008) show that flight delays are even more costly for passengers than for airlines. These additional costs cause passengers to change their preferences over airlines, thereby affecting the airline's market share and profit (Suzuki, 2000). Congestion is a leading cause of these delays, and it is something that policy could aim to address.

A policy maker concerned about congestion-related delay costs incurred by airlines and passengers could consider intervening to reduce the delays due to congestion, using mechanisms such as congestion fees. However, if airlines already take into account the congestion externality, policies intended to reduce delays could prove harmful. Under the internalization hypothesis, when there is a single airline, the airline will have an incentive to choose the efficient level of congestion (Daniel, 1995; Brueckner, 2002). Passengers will take into account their expected delay cost when selecting an airline. When airlines select the number of flights, they have an incentive to consider the congestion cost they place on their passengers because it affects their passengers' airline choice; therefore, the airline will choose the efficient level of congestion. However, when there are multiple airlines present, airlines will not consider the costs their congestion imposes on other airlines and

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the passengers of those airlines. Therefore, airlines with larger concentration at an airport have a greater incentive to consider the increased congestion cost resulting from an additional flight. Under the internalization hypothesis, a higher market concentration at an airport will tend to lead to shorter delays at the airport because the dominant airline internalizes the portion of the congestion cost they impose on themselves when adding flights.

Subsequent work on the internalization hypothesis has found a variety of mechanisms that limit or eliminate incentives for airlines to internalize delay costs. When there are passengers with different costs of delays, the inability for airlines to capture all of the benefits that consumers receive from reduced delays will lead to too little internalization (Czerny and Zhang, 2011). In airports where multiple airlines compete, each airline will only have an incentive to take into account the effect of its action on its own profit, leading only to partial internalization (Brueckner, 2002). In a dynamic setting, a dominant airline may benefit from committing to a high level of flights, providing incentives for other airlines to choose a lower number of flights or discouraging them from offering flights altogether (Molnar, 2013). Dominant airlines will also have a particularly strong incentive to maintain a large number of flights when slots are controlled and are allocated on a use-it-or-lose-it basis, as they are in many European airports (Gillen et al., 2016) because there are a fixed number of slots available. Due to these mechanisms, the internalization of delays may be limited or nonexistent.

An alternative possibility is that an airline's airport market share is more important than its market concentration in determining delays. Airlines with a greater market share may have more options available to deal with delays and may be able to manage these delays better than their smaller rivals. An airline with a larger market share can devote more resources, such as additional staff and maintenance personnel, to problems that may cause delays. If an airline has a significant market share at an airport, they may also have reserve aircraft they can use when mechanical issues arise. Finally, an airline that has a significant market share would also have more slots and may be able to reduce delays by shifting the slots between its routes.

These two alternative causes of delays lead to different results. Under the internalization hypothesis, the main mechanism for a higher market concentration leading to lower delays is that the dominant airline responds to a higher market share by reducing its number of flights. When the dominant airline reduces its number of flights at an airport, the congestion at the airport decreases and all airlines have lower delays. Therefore, under the internalization hypothesis, the effect due to an increase in concentration is shared by all airlines at an airport. Alternatively, when an increased market share is driving reductions in delays, the airline maintains the same number of flights but uses other mechanisms to reduce delays. The benefits from a higher market share are primarily received by the airline that increases its market share. If market share is driving reductions in delays, the market share-based tools it uses to reduce delays do not benefit other airlines.

When analyzing the aggregate data of an airline market, these two alternative explanations could give similar empirical results. When market share is driving delays, the empirical results of a market concentration regression may incorrectly suggest that market concentration is driving delays. Concentrated markets tend to have a dominant airline with many flights. The dominant airline's large number of flights have a greater influence on the regression results, allowing delays due to market share to appear to be caused by market concentration. Similarly, results due to market concentration could seem to be caused by market share. While these two explanations could give similar results when examining a market as a whole, they give different results when examining airlines that are small players at most of the airports where they operate. By examining airlines that are small players at the airports where they operate, we can distinguish whether airport market share or airport market concentration is driving delays.

Another important issue is whether airports with higher connectivity have longer delays. Mayer and Sinai (2003) argue that at airports with a large number of connections, airlines have an incentive to bunch arrivals and departures together. This bunching will lead to longer delays at airports that have high connectivity at these peak times. Mayer and Sinai (2003) develop the hubbing hypothesis, which suggests that airports with a large number of destinations will have longer delays due to the bunching of flights. However, whether delays are higher at hub airports depends on the time that flights are scheduled. When an airline schedules flights at off-peak times, the delays at hub airports will be shorter than the peak delays (Daniel, 1995). At these times the hubbing hypothesis may not hold.

Most previous studies have analyzed how airport concentration affects congestion in airports in developed countries, with a majority of studies focusing on the US airline industry (Mayer and Sinai, 2003; Rupp, 2009; Brueckner, 2002). Daniel (1995), Daniel and Harback (2008) examine delays at airports using stochastic bottleneck models. Ater (2012) looks specifically at US hub airports. There has been less research on the European airline industry. Extending Mayer and Sinai's methodology to the European case, Santos and Robin (2010) test the internalization hypothesis using European data. Bubalo and Gaggero (2015) use panel data to analyze delays in Europe. The only study looking at an emerging economy is Bendinelli et al. (2016). Using panel data, they look at the effect of low-cost carriers on delays in the Brazilian airline market.

There is mixed evidence for the internalization hypothesis. Mayer and Sinai (2003), Brueckner (2002), Santos and Robin (2010), and Bendinelli et al. (2016) show that delays are lower at concentrated airports, providing evidence for the internalization hypothesis. Ater (2012) finds that at hub airports the dominant airlines distribute congestion throughout the day to internalize congestion. Daniel (1995) and Daniel and Harback (2008) find that the observed route timing is more consistent with the major airlines not internalizing the cost of their congestion. Rupp (2009) and Bubalo and Gaggero (2015) provide evidence against the internalization hypothesis as they find that increased concentration does not lead to lower delays.

We build upon the previous literature by studying air traffic delays of a specific airline based in an emerging economy. We are fortunate enough to have access to a rich data set including all delayed international and domestic flights operated by Turkish Airlines during 2014, allowing us to analyze the delays in both markets. Turkish Airlines is the dominant airline at domestic airports but is a relatively small player at international airports. This dual status allows us to analyze the behavior of the same airline as an airline with both a large market share and a small market share, providing a natural way to test whether airport market share or airport market concentration is the more important factor in determining delays.

We extend Mayer and Sinai's methodology to investigate the determinants of delays on both the international and domestic routes of the Turkish Airlines network. We use the robust regression technique with instrumental variables. In addition to looking at market concentration, as in Mayer and Sinai, we focus our attention on the role that Turkish Airlines' market share plays as a driver of the expected delay. We also include flight-specific variables and daily demand variables that are not present in Mayer and Sinai. Our results suggest that the market share is the more