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Are passengers less willing to pay for flying turboprops? An empirical test of the "turbo aversion hypothesis"

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ABSTRACT

Turboprop airplanes are known for their fuel efficiency on short-haul routes and thus naturally have a competitive advantage over jets in regional air transport. In Brazil, however, the market share of turboprops has considerably decreased in regional routes since the early 2010s. One possible explanation for this trend is the "turbo aversion hypothesis" (TAH), in which passengers dislike flying in turboprops, making carriers in regional markets more prone to operate either regional or smaller narrow-body jets based on demand-side economics. We empirically test this hypothesis by employing an econometric model of air travel demand in Brazilian regional markets. We find strong evidence rejecting the TAH, suggesting that the cost-side economics of the falling fuel prices apparently fully explains the observed erosion of the turboprop participation in the market.

1. Introduction

Regional air transport is usually associated with low-to-medium density and short-haul routes and, as a subset of the airline industry, is widely recognized as relevant to the promotion of economic growth and the connection of remote regions of a country (Baker et al., 2015). Participating carriers in this market typically operate either regional jets or twin-engine turboprops (Ryerson and Ge, 2014),[1] and with the intensifying competition in the 70 to 130 seat segment, the choice set for airlines operating denser routes has been considerably amplified.

Turboprops are typically regarded as more fuel efficient than jets (Babikian et al., 2002; Hanlon, 2007), especially on short-haul routes and in hub feeding, which represents a notable competitive advantage in most markets of the regional airline segment. In Brazil, however, the market penetration of turboprops has recently decreased to its lowest historical levels after reaching an almost sixty percent market share when oil prices increased in the late 2000s. This "crowding out" effect of regional and smaller narrow-body jets replacing turboprop airliners is consistent with the experience of other regions in the world and has been noted in the literature (Ryerson and Hansen, 2010). Offering similar capacity, the aircraft types have key differences regarding operating performance. For example, jets are faster and usually have a greater maximum total range than turboprops. Turboprops, on the other hand, are more fuel efficient than regional jets on short-haul routes (Bonaccorsi and Giuri, 2000; Babikian et al., 2002), but their economic advantage over jets vanishes with distance (Brueckner and Pai, 2009; Ryerson and Hansen, 2010). Additionally, jets are known for having higher productivity as measured by seat-miles per hour flown (Hanlon, 2007). In sum, it is possible that lower fuel prices, along with operational shortcomings associated with shorter ranges and lower cruising speeds, may constitute the sources of the observed shift away from turboprops that allowed the notable growth of jet flights in Brazil.

One possible explanation for the decline of turboprops in regional markets is the "turbo aversion hypothesis" (TAH), in which passengers dislike flying in turboprops, making carriers more prone to operate jets than turboprops based on demand-side economics (Hanlon, 2007; Brueckner and Pai, 2009; Ryerson and Hansen, 2010). Hanlon (2007) discusses the passengers' perceptions of propeller aircraft "as being 'old' and relatively less safe."[2] The author also observes that turboprops are usually perceived as being less comfortable than jets, with the in-flight experience of passengers being "affected by noise, vibration and pressurization to a far greater extent in propeller aircraft" (Hanlon, 2007, p. 179). All these factors motivate the possible existence of a turboprop aversion component in the preference formation of passengers. In contrast, anecdotal evidence suggests that such a phenomenon may be geographically determined, with some regions, such as the Middle

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[1] Jets technology has evolved, and there are at least three different types of them currently available: pure jets, turbojets and turbofans.

[2] Hanlon (2007), p. 179.

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Eastern airline market, being marked by a high turbo aversion of passengers compared to other regions, such as South America.[3]

We examine the issue of passenger aversion related to turboprops by empirically investigating the behavior of demand in the regional air travel markets of Brazil via an econometric model. In particular, we estimate the price elasticity of demand in regional markets and its possible variations associated with the presence of turboprop aircraft operations. By inspecting the possible shifts in the price elasticity of air travel demand caused by changes in the proportion of turboprop flights in the markets, we aim to examine whether the attribute "aircraft engine type" would be related to actual changes in the passengers' willingness-to-pay. As far as we know, we are the first to formally test the validity of the TAH. Our analysis allows investigation of the relative importance of demand and cost economics in explaining the preferences for airlines regarding the existing aircraft technologies available in the market.

The remainder of this paper is organized as follows: Section 2 presents a literature review and a conceptual discussion of the TAH; Section 3 presents the research design, with a description of the evolution and characteristics of the regional air transportation industry in Brazil, the available data set, the empirical model development and the estimation strategy. Section 4 presents the estimation results and their discussion. Section 5 presents some robustness checks. Section 6 describes some additional challenges to the empirical approach by estimating extended versions of the main econometric model. Finally, in Section 7, we present concluding remarks.

2. Air travel demand in regional markets and the "turbo aversion hypothesis"

As in the United States and Europe, liberalization has brought about major changes in Brazilian air transport. The process began in the early 1990s and has increased competition, which has led to lower fares and higher flight frequencies. Some routes became unprofitable, and airlines ceased to serve them. Due to this new higher competition scenario, airlines had to be more stringent about costs and aircraft selection, usually based on aircraft attributes and market characteristics, since it could cause significant financial loss if not backed by the expectations of consumers (Han and Choi, 2014).

Aircraft models have their economics characteristics that consider acquisition and operational costs. Acquisition costs, assumed as fixed, are a direct cost expended by the consumer to purchase the aircraft and the inventory of repairable parts offered by the aircraft manufacturer. Operational costs are variable and include the pilot, cabin crew, maintenance and fuel, and when calculated per trip, they increase across aircraft size for short-haul flights (Swan and Adler, 2006).[4]

In relation to engine type, interest in turboprops has been renewed due to high fuel costs (until 2014) and airlines' need to reduce operational costs. Lower costs diminish the break-even point at which trips are cost-effective, allowing airlines to serve routes with lower load factors. According to Arnoult (2001), however, "passengers have a clear preference for jets over turboprops, viewing the former as quieter, faster, safer and more comfortable." Brueckner and Pai (2009) also add that turboprops provide significantly less comfort, especially because of higher noise levels and aircraft dimensions. Thus, manufacturers have worked to reduce in-flight noise and cabin comfort in order to increase passenger's comfort while flying (Ryerson and Ge, 2014).

Jets fly at approximately 485 knots, while turboprops travel at approximately 300 knots. Since turboprops are slower, the total travel time by turboprop for the same distance is greater than that by jet. Longer flight duration could increase passengers' disutility, and for short-haul routes, the travel time would be comparable to other means of transport if one includes the time expended in airports before and after the flight.[5] Merkert and Beck (2017) explored the travel behavior of Australian regional aviation through a stated preference experiment with realistic data and found that a leisure passenger is willing to pay extra AU$99 for a flight which can save 1 h in his/her trip. Additionally, as jets are faster, it is possible to increase frequency – Brueckner and Pai (2009) and Fageda and Flores-Fillol (2012) – which improve aircraft productivity and diminishes specific operational costs. According to Wong et al. (2005), the most likely result of increasing flight frequency is the rise of demand, as it is easier to accommodate passengers' timetables. Dresner et al. (2002) affirm that regional jets are mainly used on new hub-and-spoke routes and appear to increase demand on dense routes when they replace turboprops.

Hess (2010) finds that respondents to his online stated-choice survey have a strong dislike for turboprops compared to widebody jets, narrow-body ("standard") jets, and regional jets. The results of the author indicate a clear materialization of what is known as a "turbo aversion" by passengers, i.e., a disutility of flying with turboprops because they are associated with old aircraft that are slower, noisier, less comfortable and less safe than jets (Hanlon, 2007; Brueckner and Pai, 2009; Ryerson and Hansen, 2010), which induces carriers to prefer operating jets over turboprops based on demand-side considerations.

Therefore, on the one hand, jets could attract more passengers based on their supposed better service, and on the other hand, airlines could increase the utilization of turboprops due to recognized costs savings in regional markets, particularly in a scenario of high fuel prices. The question that we pose is would passengers' clearly stated preference for jets over turboprops result in a lower willingness-to-pay for flights operated with turboprops? In other words, does the stated preference regarding "turbo aversion" by passengers ultimately translate into higher price elasticity of demand when airlines operate turboprops? We believe that a better understanding of this dimension of passenger preference formation could add greater confidence to airlines when assigning the proper aircraft, mainly in a segment that has a good range of aircraft options. We therefore raise the following hypothesis:

Turbo aversion hypothesis (TAH): Passengers have lower willingness-to-pay for flights operated with turboprop airliners than by jets because, to them, traveling with turboprops constitutes a lower-quality service experience based on their perceptions regarding in-flight comfort, cabin noise, sensations related to pressurization, safety, flight speed or aircraft "age".

Using aggregate data, we suggest approaching the issue of the possible passenger aversion related to turboprops by empirically examining the demand in regional air travel markets via an econometric model. In particular, we propose estimating the price elasticity of demand and to empirically test its possible variations associated with turboprop operations. We believe that such a methodology is not only easy to implement but also very straightforward for testing the raised TAH.

3. Research design

3.1. Application

We develop an econometric model to empirically examine and test the "turbo aversion hypothesis" of passengers in Brazilian regional airline markets. Our empirical model aims to test the possible effects of turboprop aircraft operations on the market price elasticity of demand.

[3] Source: "*Turbo aversion, turbo reversion*" - The Economist, Feb 16th, 2012.

[4] It is important to highlight that Swan and Adler (2006) have studied aircraft manufactured by Boeing and Airbus, which are not normally considered as regional aircraft. In their presented results, they have classified flights shorter than 1000 km as short-haul flights. This distance is close to the upper limit capability of some turboprops assayed in the current work.

[5] Check-in, security scanning, embarking, disembarking and baggage reclaim can easily overcome one hour (Kemp, 2009).