Incumbents' pricing and non-pricing responses to high-quality product entry

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Abstract

I investigate incumbents' pricing and non-pricing responses to the entry of high-quality establishments in the international airline markets. I find the post-entry price decline is driven primarily by low-end (connecting flights and discounted coach class) rather than by high-end products (nonstop flights and first/business class). Instead of deterring entry or driving new entrants out of the market, the price cut is associated with quality downgrading by low-end products. I also generalize the idea that incumbents' response is selective in terms not only of the aggressiveness but also the type of response (pricing and non-pricing responses). In addition, I use multiple sets of sub-sample analyses (state- vs. privately owned incumbents, experienced vs. less experienced incumbents, markets with strong vs. those with weak barriers to entry, large vs. small market size) to investigate how heterogenous incumbents' own characteristics and market conditions affect pricing and non-pricing responses.

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1 Introduction

Incumbents' entry response is a widely theoretically and empirically studied topic. Recently, researchers have argued that incumbents respond selectively to entry and that the aggressiveness of such responses depends on their incentives to do so. A majority of existing empirical studies focus on the pricing response, while surprisingly little attention is paid to non-price responses. In this paper, I analyze incumbents' price and non-price responses to the entry of a high-quality establishment in the international airline industry.

[Figure 1 about here.]

Our market definition is similar to that of Dunn (2008): a directional origin-destination pair in which both nonstop and connecting products are included. In contrast to the domestic market, the vast majority of international travelers do not live in cities that serve as large international hubs. Moreover, in most cases, foreign carriers are not permitted to operate routes within the domestic market. Thus, a large number of products are offered as connecting tickets. Figure 1 presents the fraction of nonstop services across different geographical regions: flights departing from European countries have the highest share, which is approximately 25% and exhibits a downward trend over time, while the shares of flights departing from Asia and North America are fairly low, representing approximately 5% and 7%, respectively. This implies that nonstop incumbents do not serve as a good representative of all incumbents in the market. Therefore, conclusions drawn from nonstop incumbents' responses are incomplete.

There are numerous advantages of studying the international airline industry. First, I can minimize the impacts of the entry of low-cost carriers (LCCs hereafter) and frequent mergers in the domestic market. The impact of the LCCs on the performance and pricing strategies of the air transport industry has been documented in a number of studies (Windle and Dresner, 1999; Goolsbee and Syverson, 2008; Huse and Oliveira, 2012). Failing to account for LCC entry will lead to a spurious correlation between price cuts and nonstop flight entry, while excluding such routes results in sample selection bias. On the other hand, the merger wave experienced in the U.S since 2001 significantly reshaped domestic air transportation markets. Merger-induced cost shocks and endogenous entry decisions could also affect incumbents' responses.

International routes are less affected by these two factors: international routes are usually long-haul flights for which LCCs do not enjoy a cost efficiency advantage over legacy carriers, and therefore, there are significantly fewer entries of LCCs in international markets than in domestic markets. Merger would significantly change the market structure, especially on overlapping routes. While the chance of merging carriers operating on overlapping routes in international markets is much less than in domestic markets.

Second, the domestic airline industry is composed of relatively homogenous markets, and demand-side features (consumer characteristics such as income per capita) affect the strategic interaction between incumbents and a new entrant. The substantial variation in international airline markets allows us to investigate how incumbent and market characteristics affect incumbents' response.

Among studies on the airline industry, Joskow et al. (1994) found that incumbents cut prices in the post-entry period. Goolsbee and Syverson (2008), Gayle and Wu (2013) and Huse and Oliveira (2012) also found that major airline carriers reduce prices following the entry of an LCC. Geroski (1995) suggested that incumbents respond selectively to different new entrants. While most airline studies focus on incumbents' responses to the entry of LCCs, studying incumbents' response to nonstop flight entry allows us to determine whether the above conclusion on price cuts can be generalized to high-quality establishment entry.

I assume vertical product differentiation in two dimensions: nonstop/connecting service (Dunn, 2008) and different ticket classes. The tradeoff between price adjustment and quality differentiation is ignored by most studies on preemptive or post-entry pricing response: minimizing vertical product differentiation leads to intensive price competition (Bergemann, 2002). On the other hand, incumbents could lower quality provision and increase product differentiation to relax the price response.

Some airline studies use a flight's departure/arrival time or on-time performance to measure quality (Borensteina and Netz, 1997; Prince and Simon, 2015; Forbes et al., 2015). However, I argue that neither departure/arrival time nor on-time performance is the appropriate measure of non-price response in international airline markets. A flight's departure/arrival time is more akin to a horizontal differentiation measure for long-haul international routes, as there is no uniformly preferred departure/arrival time for a given day. In addition, a connecting flight's on-time performance largely depends on the last segment, and consumer utility is additive and based on all the segments travelled, which means that on-time performance is not a proper choice. Our measure of quality is similar to that of Dunn (2008); Reiss and Spiller (1989); Borenstein (1989): I use the total distance in miles of each connecting segment to measure flight quality [1].

Similar to previous work studying incumbents' responses to an LCC's entry, I find significant price reduction after entry. However, our results do not support the preemptive entry deterrence hypothesis: the significant price cut and total segment distance increase start from the first quarter after entry and persist over time.

To better understand the mechanisms behind the price cut, I first estimate the incumbents' responses for different ticket classes. The entry deterrence and game-theoretic approaches predict the first/business ticket class has the strongest incentive to deter entry or drive nonstop entrants out of the market; however, I find that discounted coach class tickets respond most aggressively to nonstop flight entry, which is accompanied by significant increases in total segment distance.

In addition, I divide the sample into nonstop and connecting services. These results are consistent with those for the different ticket classes in the sense that low-end products respond more aggressively to nonstop entry. This finding implies that the price cut is not to deter entry or force new entrants out of the market. I argue that the associated quality adjustment by low-end products leads to the price cut.

By estimating sub-samples created according to incumbent characteristics and market conditions, I demonstrate that state-owned incumbents are more likely to deter entry by lowering ticket prices even before a new entrant arrives, while privately owned incumbents respond by differentiating product quality. I separate the sample into markets with stronger and weaker entry barriers, where entry barriers are defined by whether both endpoints are under slot control restrictions. I find that in markets with stronger barriers to entry, incumbents respond more aggressively in price. Markets with weaker barriers to entry are associated with incumbents downgrading prod-

[1] It is common to think total flight time or some on-time performance measure at a connecting airport would be a more accurate measure of quality. As Dunn (2008) pointed out it is not clear whether these measures are exogenous to competition. Therefore, an improved on-time performance of total flight time could either due to increased competition in the market (Mazzeo, 2003) or different connecting services are offered. Another reason of using total segment distance is data availability. The on-time performance is usually recorded by flight segment. The total flight time which includes layover time of connecting flights, to our best knowledge, is not available.

uct quality after a new entry.

2 Literature Review and Hypothesis

Entry is one of the most important market-shaping forces; entry by competitors increases competition and lowers profitability. The literature studying pricing response to entry can be divided into two categories: pre-entry response and post-entry response. Limit pricing models emphasize deterring entry before it occurs (Bain, 2199; Modigliani, 1958; Sylos-Labini, 2199), suggesting that incumbents that face the threat of entry would set their prices sufficiently low to make entry unprofitable. However, the empirical evidence does not support this conjecture. Smiley (1988) found limit pricing to be the least used of seven potential entry-deterring approaches. A survey of U.K. firms also found little evidence that firms keep prices low in an effort to affect the decisions of potential entrants (Singh et al., 1997). However, Goolsbee and Syverson (2008) found that in the airline industry, major carriers cut prices in response to the threat of entry by Southwest Airlines, and Bagchi and Sivadasan (2017) also found preemptive actions for reforms of cable franchising regulations.

Two implicit assumptions of limit pricing theory are, first, that potential entrants use current industry profits as an indicator of future profits (Masson and Shaanan, 1982), and second, incumbents should credibly commit to a low-price strategy post-entry. However, game-theoretical models suggest that under complete information, limit pricing is not a credible deterrent. Maintaining low prices is not profit-maximizing. Incumbents have an incentive to raise the limited price to the post-entry equilibrium level, making the pre-entry low price not credible. Models motivated by game theory suggest several competition strategies that could make a low pre-entry price credible. Spence (1977) assumed that incumbents invest in excess capacity to deter entry. The excess capacity allows incumbents to commit to a low post-entry price. However, this hypothesis has also received little empirical support. Masson and Shaanan (1982) and Smiley (1988) found no evidence that incumbents increase capacity pre-entry as a deterrence approach. Goolsbee and Syverson (2008) also found no significant increase in either available seats or the number of flights.

Another strand of studies motivated by game theory (Milgrom and Roberts, 1982; Kreps and Wilson, 1982) suggest that incumbents reduce prices to drive out entrants and prevent future entrants by developing a reputation for low prices. The signaling game hypothesis argues that provided that the new entrant is not perfectly informed about incumbents' payoffs, incumbents have the incentive to cut prices to develop a reputation for toughness. In line with this hypothesis, Bresnahan and Reiss (1991) found that tire retailers reduce prices following entry in local retail markets.

More recent studies argue that an incumbent's response is selective (Yamawaki, 2002), depending on the characteristics of the incumbent, new entrant and market (Simon, 2005; Mccann and Vroom, 2010). Yamawaki (2002) finds that some car manufacturers cut prices in response to entry while others did not. Gielens et al. (2008) also found heterogenous responses from incumbents when facing Wal-Mart's entry into the U.K. In an attempt to reconcile the previous findings and explain variation among responses by incumbents, Simon (2005) suggested a more general explanation: a response's aggressiveness depends on incumbents' incentives and proposed that newer/ multi-market incumbents cut prices more in response to entry and that incumbents in concentrated markets or those with higher entry barriers cut prices more. Mccann and Vroom (2010) found that incumbents may even raise prices when facing entrants whose agglomeration benefits are more likely to outweigh their competitive effects. The agglomeration effect leads to higher demand overall for the incumbents and results in a higher price.

To shed light on the inconsistent empirical results on pricing response, I investigate the non-price response. Shaked and Sutton (1982) assumed a simultaneous entry model in which incumbents engaged in product differentiation. Donnenfeld and Weber (1992) extended the simultaneous entry model and used a sequential entry game to show that dominant firms will engage in maximal product differentiation. Bergemann (2002) argues that what the optimal deterrence strategy is depends on the current position of the new product on the quality spectrum. Prince and Simon (2015) found incumbents worsen on-time performance in response to entry, and even entry threats when facing the entry of Southwest Airlines.

Simon (2005) claimed that if firms substitute non-price responses for price cuts, then the negative relationship between entry and price response will not hold. I complement this statement by arguing that when facing the entry of a high-quality establishment, there are at least two possible mechanisms whereby non-price responses will also lead to price cuts. The quality response is measured by total segment distance, but the "minimum" distance is similar for nonstop entrants and nonstop incumbents. Therefore, the nonstop distance is a "maximum" quality bar for the route. Instead of extending the quality spectrum, nonstop flight entry will certainly reduce product differentiation, especially among nonstop incumbents. This results in more aggressive price competition at the high-value end of the market. Similar to limit pricing, Bergemann (2002); Noh and Moschini (2006) proposed the "limit quality" strategy to deter entry. Incumbents intensify competition by providing less-differentiated products and take a more aggressive stance toward potential entrants.

Under the second mechanism, the low-value end's incumbents would choose to further differentiate product quality away from those of high-quality establishments. Mazzeo (2002) endogenized product choice and extended the equilibrium entry models estimated by Bresnahan and Reiss (1991); Berry (1992). Based on oligopoly motel markets, he found that the empirical evidence strongly supports product choice theories, which predict that firms will offer products unlike those of their competitors. Donnenfeld and Weber (1995); Lutz (1997) proposed a more general hypothesis: incumbents' product differentiation depends on a new entrant's fixed cost. If the entrant's fixed costs are high, incumbents will set quality at a level lower than or equal to the optimal quality under either duopoly or monopoly. The results are completely different when the entrant has substantially lower costs. Therefore, quality downgrading would force low-value end incumbents to cut prices through either cost-saving strategies or more intensive competition at the low-value end of the market.

3 Methods and Data

3.1 Data

The main data source is Official Airline Guide (OAG), which provides the complete flight schedules of all international routes within/between the following regions: Asia, Europe, Middle East and North America[2]. In other words, our data cover all routes departing from Asia and arriving at any airport globally, including countries in Africa, Southwest Pacific, the Caribbean, Central

[2] The OAG Schedules Analyser uses IATA's regional definitions and divides the world into the following regions: North Africa, Southern Africa, Central/Western Africa, Eastern Africa, Antarctica, Southwest Pacific, South Asia, Central Asia, South East Asia, North Asia, Eastern/Central Europe, Western Europe, Caribbean, Central America, Upper South America, Lower South America, Middle East, North America.

America and South America. The data also include routes departing from any airport globally and arriving in Asia. The scenario applies to Europe and North America. Due to data quality and availability, international routes within/between countries in Africa, Southwest Pacific, the Caribbean, Central America and South America are not included in the sample. The OAG data allow us to identify nonstop tickets and connecting tickets for a directional origin-destination pair. For instance, for the directional route *Los Angeles-Shanghai*, I observe the number of passengers who purchase nonstop or connecting tickets, which carrier they fly with and under which class, and the aggregated average quarterly ticket price. In addition, I also observe the number of stops and the airport at which the consumer makes a connection. Specifically, Im able to identify the exact ticketing carrier, operating carrier and dominant carrier[3] of each connecting segment.

Reiss and Spiller (1989) argues that in the airline market, the type of service (direct or indirect flights) is an important determinant of the level of competition in the market, in addition to the number of airlines in the market. An analysis that aggregates across service segments may produce incorrect inferences about the profitability of entering a market. In this analysis, I specifically compare the response from nonstop and connecting incumbents to shed light on this difference. I aggregate the sample into cells based on the dominant carrier, origin, stopping airport, destination and time. In other words, connecting tickets with different connecting airports or for which a segment of the connecting flight is operated by different dominant carriers represent different products. That is, *NYC-Shanghai* connecting at *Beijing* and *NYC-Shanghai* connecting at *Los Angeles* are two different products. Moreover, connecting tickets *NYC-Los Angeles-Shanghai* with the longer segment (*Los Angeles-Shanghai*) operated by different carriers are also considered different products. I aggregate data at a detailed level to maintain most of the uniqueness of the tickets. The ticket price data are available at each ticket class level: first class, business class, economy full, economy premium and discounted economy[4]. I do not observe the price dispersion within each class, but I observe the average ticket price for each class category. I complement the OAG data with International Civil Aviation Organization (ICAO) Economic Development Internal Database to model airline characteristics such as an airline's original country/region, total

[3] The dominant carrier is defined as the airline that flies the longer segment of the connecting ticket

[4] I combine first class and business class to form the high ticket price class to improve the representativeness of the data.

government shares[5] and years of formation. Finally, I incorporate World Bank Indicators (WBI) data to account for country-level GDP, GDP per capita and total air passengers carried[6]. Summary Statistics are reported in Table 2.

Our merged sample spans from the first quarter of 2011 through the final quarter of 2016, for a total of 24 quarters. I limit the sample to markets with exactly one entry in the sample period (the first quarter of 2011 is excluded). The main analytical problem with multiple entries is the ability to distinguish the impact of each entry at a given time. I only observe the average total impact of all the entries: the impact of a second entry is actually the combined effect of the first and second entry at a given time. Even if I were to assume that impact of each entry is additive, estimating the average impact of multiple entries would remain problematic. For example, given a route with two nonstop entries, since I estimate the entry response at each point in time, the second entry's first-quarter impact also captures the impact of the first entry.

[Figure 2 about here.]

One caveat of restricting the sample to single entry is that the number of entrants is endogenous and will affect incumbents' responses. It is possible that routes with certain characteristics are more attractive to nonstop entry and that these route attributes may affect incumbents' response. Firm-specific skills and knowledge are developed through on-the-job learning and training (Williamson, 1979). Learning by doing may offer older incumbents a competitive advantage over newer incumbents and new entrants (Spence, 1977; Simon, 2005). Therefore, incumbents' responses to different entries are likely to be nonlinear.

Figure 2 presents the number of routes with single and multiple nonstop flight entries by departure region. Western Europe experiences the most single and multiple nonstop flight entry, over 22,000 routes departing from Western European are entered by at least one nonstop flight carrier. Although focusing on single nonstop flight entry limits the external validity of our con-

[5] Governmental shareholders include national, state, local or municipal governments (including their agencies) and state-owned companies. Our definition of state-owned enterprise (SOE) follows the Trans-pacific Partnership (TPP) definition: the firm is principally engaged in commercial activities, and a state (i) directly owns more than 50 percent of the share capital; (ii) controls, through ownership interests, the exercise of more than 50 percent of voting rights; or (iii) holds the power to appoint a majority of the members of the board of directors or any other equivalent management body.

[6] This measure includes both domestic and international aircraft passengers of air carriers registered in a country.

clusions, our sample is nevertheless representative, as overall nearly 50% of routes experience a single nonstop flight entry.

3.2 Variables

For each route in our sample, I consider a rolling window of the 16 quarters pre-entry and 8 quarters post-entry surrounding the the quarter in which the nonstop flight enters the route (4 years before to 2 years after). To properly model the market structure change resulting from merger& acquisition, I follow Prince and Simon (2017) to assign a unique identifier to denote merging carriers if one of the merging carriers operate under another brand's name or one of the two carrier brands is eliminated. For instance, when Continental Airlines merged with United Airlines and kept United name, I create a new identifier "COUA" to represent the two merging carriers pre- and post-merger.[7] In addition, I combine the carriers' pre-merger operations by taking a weighted average of their pre-merger data, such that the combined pre-merger values would be comparable with the consolidated post-merger data.

I apply the following criteria to screen the outliers either due to "punch-error" or consumer purchase through "frequent-flier program" mileage credits: I drop aggregated observations with an average ticket price less than $50 and discounted economy class tickets when their fare is higher than those of other ticket classes. To distinguish an actual entry from a temporary operation, I require the total number of passengers of the nonstop entrant be at least 400 per quarter.[8]

[Table 1 about here.]

Table 1 presents the summary statistics of ticket price, total segment distance in miles. Ticket prices of all classes, as well as the average fare, experience a price cut after entry. There is no clear pattern: discounted coach class experiences the largest price cut, of approximately 17.2%, first/ business class also experienced a price decline of 13.7%, while the coach premium and coach full

[7] The mergers in the sample periods are as follows: Air Berlin acquired flyNiki in 2011, Air Jamaica was acquired by Caribbean Airlines in 2010, Alaska Airlines acquired Virgin America in 2016, American Airlines merged with US Airways in 2015, Avianca acquired AeroUnion in 2014, Bulgaria Air merged with Hemus Air in 2010, Continental Airlines merged with United Airlines in 2012, LAN and TAM merged and formed LATAM, and Lufthansa Airlines acquired Brussels Airlines in 2016.

[8] The results are robust to the use of 300 or 500 total passengers as the threshold.

ticket classes show the smallest price drops, at 5.8% and 4.6%, respectively. Compared to discounted coach class, first/ business class, coach premium and coach full do not respond more aggressively, although these are less different from nonstop counterparts than is the case for discounted coach. Total segment distance also decreases after entry. Statistics are weighted by the number of passengers in each ticket class. The average total segment distance of first/ business class is the longest, suggesting there are more first/ business class passengers who purchase long-haul tickets than is the case for other classes. Coach premium and discounted coach class have similar total route distances, while coach full class has a significantly lower total route distance and its change in distance is also the smallest among all ticket classes.

[Figure 3 about here.]

I use a 50% threshold of total governmental share to define state-owned and privately owned firms[9]. Figure 3 depicts the histogram of total governmental shares and number of years since an airline company was formed. The left histogram shows that most airlines are either 100 percent owned by the state or wholly owned by a private firm. The right panel presents the distribution of years since an airline was formed. The histogram suggests that 50 years is a good threshold: a large number of airline firms were founded at least 50 years ago, and relatively few companies are near the threshold. The results are also robust to varying the threshold within the range of 40 to 60 years.

[Table 2 about here.]

In total, I observe 55,378 routes with nonstop flight entry, among which 24,922 are single entries, which accounts for 45% of total nonstop flight entry. This yields 502,733 *dominant carrier-origin-connecting-airport-destination-time observations*.

3.3 Empirical Specifications

The basic empirical approach is similar to that of Goolsbee and Syverson (2008) which separately uses route-carrier and carrier-quarter fixed effects. I use a three-way *dominant carrier-route-time*

[9] I also use 100% and 0% to define state-owned and privately owned, respectively, and the estimation results are robust to this definition.

fixed effect to account for time-varying unobserved heterogeneity across routes and carriers. By doing so, Im able to control for time-varying *dominant carrier-route* level unobserved characteristics, such as advertising at either endpoint of the route, cost shocks such as gasoline/diesel price increases, or demand-side shifters such as changes in income per capita.

Our baseline empirical model estimates an incumbent's response during periods before, during and after actual entry with *dominant carrier-route-time* three-way fixed effects while simultaneously controlling for country-level characteristics and cost shock variables. I use the following model:

$$y_{ocdi,t} = \gamma_{ri,t} + \sum_{\tau=-m}^{+j} \beta_\tau (nonstop\ entry)_{r,t_e+\tau} + X_{ri,t}\alpha + O_{o,t}\sigma + D_{d,t}\lambda + \epsilon_{ocdi,t} \tag{1}$$

where r denotes a route with origin o and destination d, and I use c to represent the connecting airport. $y_{ocdi,t}$ is the outcome of interest for incumbent carrier i on route r (with origin and destination of o and d and an option of connecting at c in quarter t). The dependent variables are log ticket price and total segment distance in miles. $\gamma_{ri,t}$ is the *dominant carrier-route-quarter* fixed effect. $nonstop\ entry_{r,t_e+\tau}$ are time dummies surrounding the actual nonstop carrier entry period, and all the time dummies are mutually exclusive. As in Goolsbee and Syverson (2008), the implied effects on the dependent variable given by their coefficients are not additive. The time dummies are assigned value one for time periods $t_e + \tau$, $\tau = \{-m, ..., -1, 0, 1, ..., +j\}$, with t_e being the time period in which the nonstop flight actually enters the market. If nonstop entrants choose to enter airports where the operating cost is decreasing, this will lead to a spurious correlation between nonstop flight entry and declines in incumbent fares. To account for this cost shock, I follow Goolsbee and Syverson (2008) and control for the incumbents' average fares on other routes with same airport on one end and all the other airports on the other endpoint. For instance, in the American Airlines *Los Angeles-Shanghai* example, one of the cost control variables is the average log fare on American Airlines' routes between *Los Angeles* and airports other than *Shanghai* to which American Airlines flies. The second is similarly defined for routes between *Shanghai* and airports other than *Los Angeles*. In addition to average ticket price, follow the same logic I also construct average total segment distance as the cost shock control variable since the quality shock may also be reflected in the price change. $X_{ri,t}$ represents these cost shock control variables.

Mazzeo (2002) suggest that demographic variables representing the influence of demand factors help predict both how many firms can operate profitably in a market and a firm's product-type decisions. Our sample includes developing and developed countries with heterogenous social and economic conditions, and it is reasonable to suspect that unobserved national-level characteristics are correlated with a competitor's nonstop flight entry decision. For instance, countries that heavily rely on international trade are more likely to introduce policies welcoming international air transportation. Moreover, fast-paced economic growth or government subsidies in developing countries would increase the desire for international travel and the opening up of new nonstop routes.

$O_{o,t}$ and $D_{o,t}$ are origin and destination country-level controls, including GDP, GDP per capita and total passengers carried by air transport. I use country-level variables to proxy for general economic development, per capita income and market size to control for factors related to potential shifts in consumer quality preferences, propensity to travel after the competitor's entry and the consequent emergence of a new segment of consumers.

The estimation models are weighted by the number of passengers in each aggregated cell; for example, to estimate the average ticket price response, I weight the model by the total number of passengers of each *dominant carrier-route-time* combination and weight the model by the total number of discounted passengers to analyze the response of an incumbent's discounted coach class. The standard errors are clustered at *dominant carrier-route-time* level to account for intertemporal correlation in the error terms.

In sum, our model uses a three-way *dominant carrier-route-quarter* fixed effect and controls for cost shock variables to rule out a spurious relationship between competitor entry and positive operating cost shocks. In addition, to account for national-level time-varying characteristics, I control for both origin and destination countries' GDP, GDP per capita and total number of air passengers. The $nonstop\ entry$ dummies represent the incumbents' response during each time period before, during and after the actual entry. Although I do not specifically test for whether incumbents' respond to the threat of nonstop entry, our long pre-entry timeframe (16 periods) allows us to determine when the actual response starts.

4 Main Results

4.1 Baseline Estimation: Incumbents' Price and Non-price Response

Table 3 presents the baseline results of incumbents' response to the entry of high-quality competitors. Model 1 separately controls for traditional carrier-route and time fixed effects and includes cost shock variables. Its results show incumbents' response in both the quality and price dimensions: a significant log ticket fare decrease is associated with entry by nonstop competitors, and the impact is persistent over time with an increasing trend. Recall that the base period is 15 to 16 periods before entry, the coefficient for periods 7 to 8 indicates an approximately 9 percent decrease in price after entry relative to the base period. I also observe a significant increase in total segment distance after entry; however, this result is likely to be driven by unobservables. With the rapid price changes in the international airline industry, it is unlikely the incumbents respond 13 to 14 periods before actual entry.

[Table 3 about here.]

To mitigate omitted variable bias, in models 2 and 3, I use a three-way fixed effect, controlling for *dominant carrier-route-time* fixed effects with both endpoint countries' characteristics. Comparing column 3 to column 5, failing to control for cost shock variables results in significantly over-estimating incumbents' price response. Based on model 3, I do not find strong support for entry deterrence since incumbents' price and quality responses start after the first quarter of entry by a high-quality product.

[Figure 4 about here.]

Columns 5 and 6 of Table 3 document incumbents' price and non-price responses when facing a nonstop flight entry. As expected, the coefficients of the average fare at the departure and arrival endpoints are both significant for estimating the price response. Consistent with previous studies of low-cost entry, the log ticket fare decreases significantly, by approximately 7 percent 7 to 8 quarters after entry. Figure 4 provides the incumbents' price and non-price responses to entry over each time period before and after actual entry. The actual entry coefficients are not additive, the price drop is on average 6 percent, and the impact is monotonically increasing from 5 percent immediately after the entry to 7 percent after 7 to 8 quarters. As a comparison, Goolsbee and Syverson (2008) found a 29 percent price drop after actual LCC entry, and Huse and Oliveira (2012) found a drop of approximately 30 percent after LCC entry. Although our study differs from the existing literature in multiple respects (e.g., sample period, route coverage), the dramatic difference in the magnitude of the price cut suggests that incumbents that experience entry by a high-quality establishment will set a higher price than those that experience entry by a low-quality establishment (Mccann and Vroom, 2010).

Column 6 presents the impact of nonstop flight entry on total segment distance. I find that incumbents increase the average total distance by approximately 23 miles after entry. Although most empirical studies focus on either pricing or non-pricing response, I show the two are not mutually exclusive: incumbents' pricing and non-pricing responses are both statistically significant after the first quarter of entry. However, the average effect does not indicate how pricing and non-pricing responses interact with one another. For instance, it is possible that these two approaches are not related: some incumbents exclusively choose to respond in price, while others only respond in non-price ways. While another possibility is that the pricing response is driven by product differentiation. To explore this issue, I perform the following sub-sample analysis.

4.2 Incumbents' Product Quality and Response

Our baseline estimation shows that incumbents cut prices and increase total segment distance after nonstop entry. The literature usually interprets a price cut as an attempt to deter entry (during the pre-entry period) or drive new entrants out of the market or prevent future entry (during the post-entry period), and the extent of the price cut indicates the aggressiveness of the response. I emphasize the role of non-price responses and argue that product differentiation could also lead to price cuts.

[Table 4 about here.]

Simon (2005) contends that incumbents respond more aggressively to entry when their incentives to do so are greater. The entry deterrence hypothesis predicts that largest price cut should be observed for high-value ticket classes to prevent entrants from stealing incumbents' high-end customers.

Exploiting the data on the prices of different ticket classes, Table 4 reveals that discounted coach class responds most aggressively to entry. Incumbents reduce prices for discounted coach class starting 3 to 4 quarters before actual entry, on average by 6 percent post-entry, and the cut increases monotonically over time. However, there are no significant price adjustments for other ticket classes.

[Table 5 about here.]

I further divide the sample into nonstop and connecting flight incumbents. Following a logic similar to that presented above, nonstop incumbents should respond most aggressively to deter nonstop entrants. Table 5 investigates how nonstop and connecting incumbents respond to entry by nonstop flights. All the models control for a three-way *dominant carrier-route-time* fixed effect and use cost shock controls to rule out the possibility of cost reduction induced by a spurious relationship. Column 1 of Table 5 shows no significant price response from nonstop incumbents, whereas column 3 documents a significant cut price (6% on average) by connecting incumbents.

In both product differentiation dimensions (nonstop/connecting service and different ticket classes), low-end products respond more aggressively to nonstop flight entry. These two sub-sample analyses suggest that a price cut does not always represent an effort to deter entry. To demonstrate that the price cut is driven primarily by low-end incumbents, I estimate the non-price responses of different ticket classes and service types. Column 4 of Table 4 and column 4 of Table 5 present the non-price responses of incumbents' discounted coach class (24 miles on average) and connecting service (20 miles on average): the total segment distances both significantly increase following the first quarter after actual entry. Although I do not claim that this represents a causal relationship, the sub-sample analysis provides suggestive evidence that price cuts and entry-induced quality differentiation are correlated.

First, I argue that it is feasible for incumbents to differentiate products after nonstop entry. By definition, nonstop flights' total segment distances are relatively consistent and exhibit less variation than do connecting flights, which have a dramatically changed total segment distance due to changes in the connecting endpoint, which entails only a low switching cost. Thus, quality response is a valid tool for connecting incumbents but not for nonstop incumbents. Product choice theory predicts that to maximize profits, firms will offer products unlike those of their competitors (Mazzeo, 2002). By exploiting their own route networks and partnerships with other airline carriers, incumbents can easily offer a different product by using a different connecting airport. For instance, routes with endpoints *NYC-Shanghai* and connecting at *Beijing* and *Tokyo* are viewed as two different products. Switching the connecting airport from *Beijing* to *Tokyo* does not significantly increase the cost if these two airports are already served by the carrier. The total distance of a nonstop flight is the minimum bar that one can reach to "keep up with the Joneses" and requires connecting incumbents to increase their fixed costs.

Second, a new entrant's fixed cost affects incumbents' product differentiation strategy (Lutz, 1997); entrants with high fixed costs force incumbents set quality lower than the equilibrium level. Compared to domestic low-cost entry, which is the focus of most existing literature, the fixed cost associated with nonstop flight entry in the international airline market is higher.

Instead of engaging in intensive price competition to compete for high-end customers, incumbents maximize profits by implementing a significant price cut in discounted economy class coupled with longer total travel distance. This strategic response leads to more intense competition in the low-value end of the market, causing a decline in the discounted coach ticket price. First/business, coach premium and discounted coach all show longer total travel distance, suggesting that non-price responses are more common when facing nonstop flight entry. The magnitude of the distance increase is negatively correlated with the average price of each ticket class: the first/business ticket class shows an increase in the total great circle distance of more than 30 miles, while that for the discounted coach class is approximately 25 miles on average.

4.3 Heterogenous Responses by Incumbent Characteristics

Building on the argument advanced by Simon (2005), I contend that a price cut cannot be interpreted as an entry deterrence action or a tool to force new entrants out of the market. In this section, I further generalize this argument: the choice to respond by using pricing and/or non-pricing tools also depends on incumbents' characteristics and market conditions. Table 6 investigates two cases according to incumbent characteristics. I first discuss how an incumbent carrier's ownership affects its response.

[Table 6 about here.]

Based on the grocery store market, Khanna and Tice (2000) found that privately owned firms respond less aggressively to Wal-Mart's entry. Although they have shown considerable improvement over time, state-owned firms are known for low efficiency and high government subsidies (Dewenter and Malatesta, 2001). Compared to privately owned firms, which are driven by profit-maximization, state-owned airline firms could serve international endpoints due to political or social motives. State-owned incumbents also serve routes that are not economically feasible without large state or municipal subsidies. For instance, to receive a subsidy from the municipal government of *Qingdao (China)*, which does not have enough demand for a long-haul international flight, Hainan Airlines has to fly route *Qingdao-San Francisco*.

The first four columns of Table 6 present the pricing and non-pricing response with respect to firm ownership. State-owned incumbents cut prices in response to the threat of entry: I observe an approximately 6.4% drop in price at 4 quarters before entry. The price cut continues after actual entry and increases monotonically, reaching 14.6% 8 quarters after entry. Privately owned incumbents significantly adjust their quality provision. I tentatively propose two explanations: first, although the cost of scheduling a new connecting service is low, state-owned incumbents are likely to do so due to their lower efficiency than private-owned carriers. Second, state-owned carriers may have stronger incentives to maintain monopoly power, while privately owned carriers' management would be more interested in maximizing current profits.

[Table 7 about here.]

The airline industry is geographically diversified, and competitors interact with one another in multiple markets. It is possible for incumbents to develop reputation, accumulating experience through learning-by-doing. I define "experienced" as a firm-level variable instead of focusing on any particular route: it is defined as the difference between the year that the airline company was formed and the current year (2018). Experienced firms have more of the resources needed to differentiate their products; in the context of international routes, this means experienced incumbents with larger route networks face a lower cost to switch connecting endpoints and provide a differentiated product.

Due to the time compression, it is diseconomies to invest more to create reputations more quickly (Simon, 2005). Newer firms also have higher costs because they lack firm-specific resources and know-how that older incumbents possess (Geroski, 1995). Empirical evidence supports the view that new firms are more vulnerable to entry. From 1963 to 1982, nearly 80 percent of all new firms in the United States failed within 10 years (Geroski, 1995), with new entry being a primary cause. Because of their increased vulnerability to new entrants and lack of ability to differentiate in product quality, newer firms are more likely to aggressively compete through price cuts. The last 4 columns of Table 6 confirm this pattern: because they have more resources to differentiate their own products, experienced incumbents increase the total distance by approximately 28 miles after new entry and show no significant price cut. Inexperienced incumbents exhibit the opposite pattern: they reduced prices by 12 percent on average with an increasing trend over time, and total distance remains unchanged after entry.

4.4 Incumbents' Response and Market Characteristics

When an entrant's fixed cost is low, the incumbent's optimal strategy is to accommodate entry and select extreme qualities to differentiate its product from that of the entrant. When an entrant's setup costs are high, incumbents engage in entry deterrence (Donnenfeld and Weber, 1995). The first four columns of Table 7 investigate how market entry barriers affect an incumbent's response to entry. Airlines operating at airports with air traffic control must reserve a spot for flights during peak hours, which is called a "slot". Slot control policy was introduced to reduce airport congestion by assigning a certain number of slots to each airline. Despite efforts to prevent monopolization of the allotment of slots[10], the slot control barrier grants incumbents a competitive edge over new entrants. I define a market as having strong barriers to entry if both endpoint air-

[10] For instance, in the U.S, the FAA implemented a more systematic procedure for slot allocation in 1985 by establishing a Buy/Sell Rule. The Buy/Sell rule allows carriers to trade, buy, sell, and lease slots at their discretion. To ensure that incumbents do not monopolize the allotment of slots, the FAA complemented the Buy/Sell rule with another condition that would guarantee new entrants a certain number of the available slots. Despite this antitrust effort, however, the FAA has constantly been criticized by new entrants and small carriers for its inability to guarantee fair distribution of slots.

ports are under the slot control policy, and our weak entry barrier market dummy is defined as at most one endpoint being under slot control restriction.

The threat imposed by nonstop entry is greater in markets with strong entry barriers: in markets with weak or no barriers to entry, competition among incumbents is high and will force the price towards the marginal cost. Columns 1 and 3 report the price response in markets with strong and weak barriers to entry. The ticket price decreases by 14% on average in markets with strong barriers to entry, while prices barely change in markets with weak barriers to entry. Without investigating the non-price response, it is tempting to conclude that incumbents accommodate entry. However, I find that incumbents in markets with weak barriers significantly increase their total segment distance. Because in markets with low entry barriers, the price is close to the marginal cost. Intense price competition forces incumbents to differentiate on product quality, resulting in an approximately 30 mile increase in total segment distance.

Quality differentiation also varies with respect to market size: if quality is produced with fixed costs, the average quality of products increases with market size (Berry and Waldfogel, 2010). Bresnahan and Reiss (1991); Berry (1992) suggest competitive behavior changes rapidly as market size and the number of incumbents increase. To investigate incumbents' response to entry with respect to market size, I also divide the sample according to the total number of air travelers. Air passengers carried include both domestic and international aircraft passengers of air carriers registered in a country. I define a market as large if the national number of air passengers is above the world average, and I define small markets analogously.

According to the hypothesis advanced by Bresnahan and Reiss (1991); Berry (1992), as market size increases, there is sufficient room for incumbents to differentiate on vertical quality. I expect to observe a quality response in small markets and a pricing response in large markets. I find that incumbents in large markets tend to accommodate entry through both price and non-price methods. The story is reversed in small markets: incumbents reduce prices by approximately 6% at 4 quarters before entry, and the price cut continues after entry, reaching 14% 8 quarters after entry. The increase in total segment distance is coupled with price cuts.

Taken together, evidence shows that incumbents respond selectively (Simon, 2005; Geroski, 1995), and I generalize this idea to non-pricing responses. Incumbents not adjusting total segment distance does not mean that I can rule out other non-price responses. Although travel distance is arguably one of the most important measures in the international airline industry, nonstop incumbents could respond in other non-price ways that I do not observe, such as in-flight amenities.

5 Discussion and Conclusion

Consistent with previous studies that focus on LCC entry (Joskow et al., 1994; Goolsbee and Syverson, 2008; Huse and Oliveira, 2012), our evidence shows that incumbents cut prices after entry. The price and non-price responses are not mutually exclusive, and more important, low-end products respond most aggressively to nonstop entry, which suggests that incumbents' price cuts are driven by product differentiation rather than by a desire to deter the entry of high-end products. Consistent with Geroski (1995); Simon (2005); Yamawaki (2002), I also find evidence that incumbent responses vary across incumbent characteristics and market conditions. I complement this explanation by arguing that whether incumbents respond through price or non-price methods also depends on their incentives. State-owned and less experienced airline carriers respond more aggressively in price, while privately owned and experienced incumbents seek to differentiate themselves from new entrants by using product quality. I also find that incumbents in markets with strong entry barriers use a pricing response strategy to drive out new entrants. Relative to incumbents in small markets, incumbents in large markets are more likely to accommodate entry.

Note that incumbents tend to take preemptive price-based entry deterrence actions as long as there is no non-price response involved. For instance, in our analysis of barriers to entry, incumbents start to cut prices 2 years before actual entry. To secure access to slot-controlled airports, a new entrant first needs to either trade for or purchase slots, and doing so makes their entry a credible threat to incumbents. State-owned incumbents start to decrease prices approximately one year before actual entry, and less experienced incumbents cut prices a year and half before actual entry.

However, in many cases I do not observe any preemptive actions if incumbents respond through both price and non-price measures. Although incumbents differentiating themselves on product quality is a credible commitment to low entry prices, this finding implies that the cost of improving low-end product quality would outweigh the gains from deterring entry. Goolsbee and Syverson (2008) argues that the manner in which either deterrent or accommodative price cuts might operate is an open question. I can only rule out quality differentiation being the mechanism through which incumbents cut prices preemptively, whereas what actual mechanism is at work remains an open question.

Our findings are based on the international airline market, which is characterized by high fixed costs for new nonstop entrants and low switching costs for incumbents to offer different connecting service. Studies show that a new entrant's fixed cost affects incumbents' quality differentiation decisions (Donnenfeld and Weber, 1992; Lutz, 1997; Noh and Moschini, 2006). Although it is beyond the scope of this paper, it would be interesting to see how incumbents in markets with high switching costs, such as the automobile, newspaper, and computer industries, would behave when facing entry by high-quality establishments.

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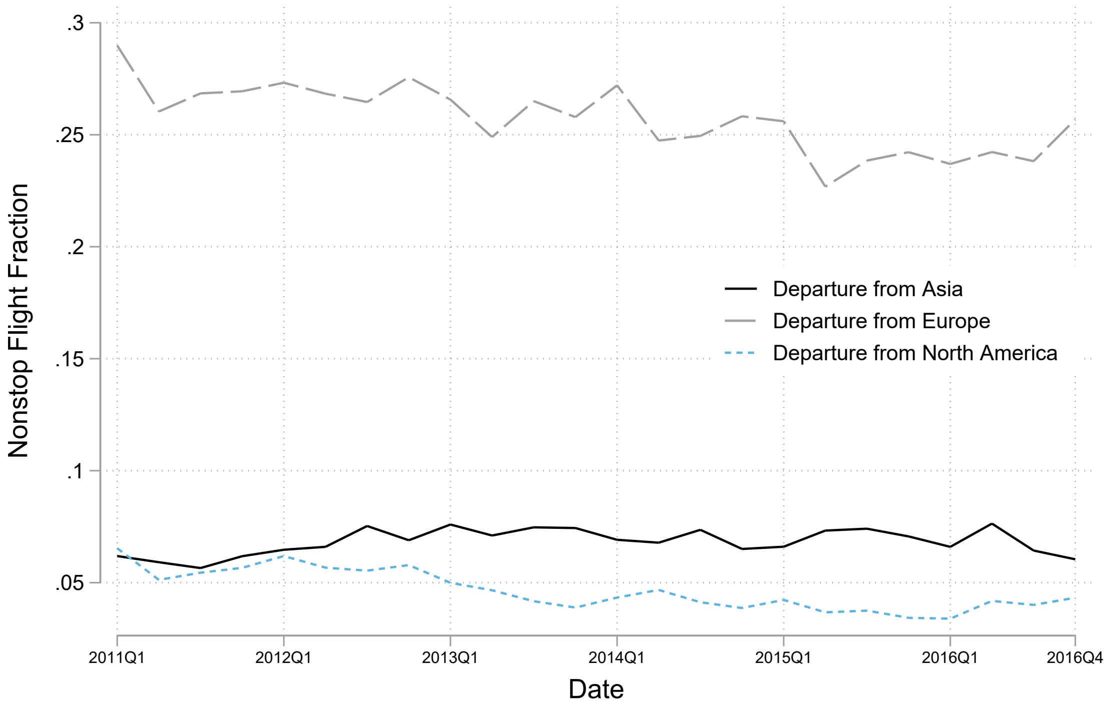
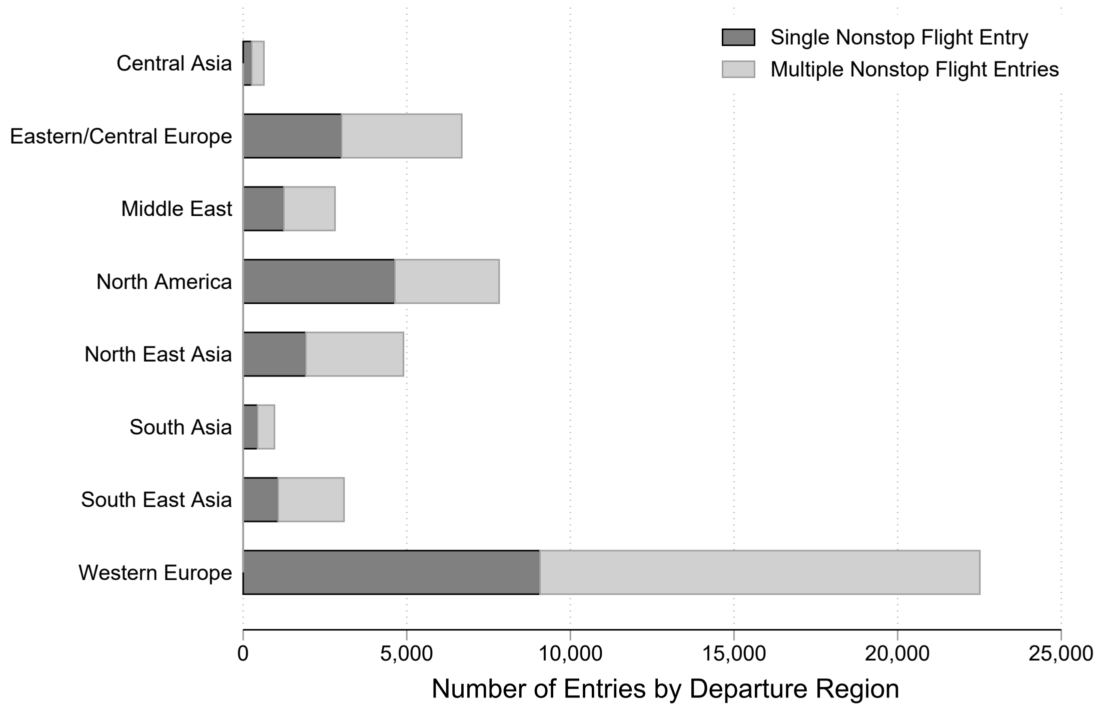
Figure 1: Shares of nonstop flight in different regions



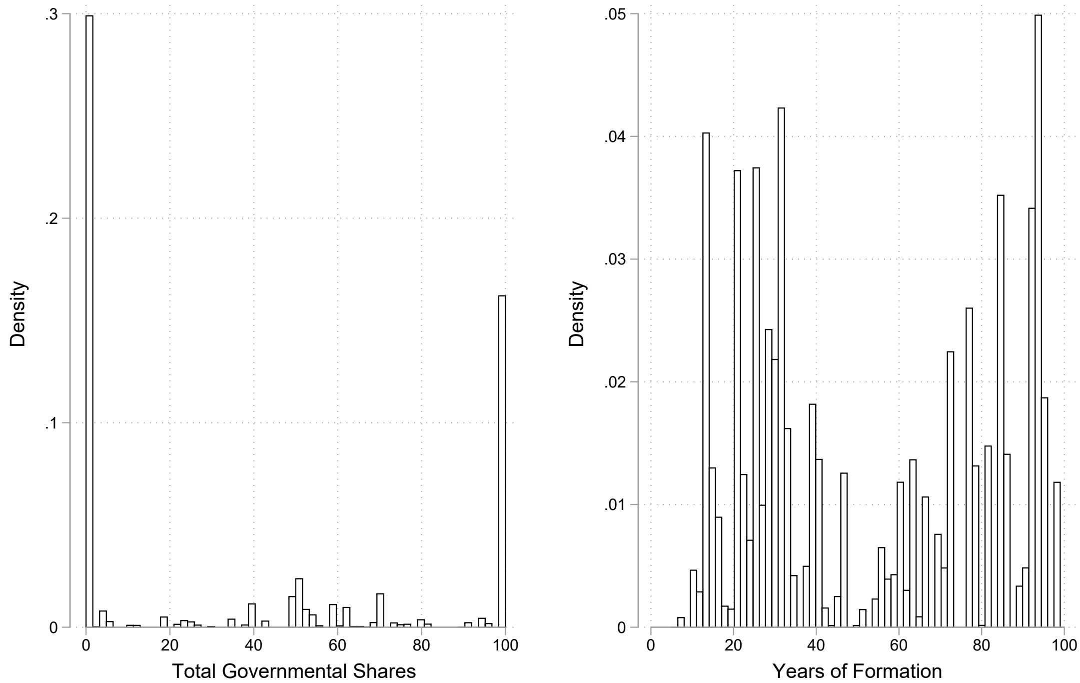
Notes: The OAG Schedules Analyser uses IATAs regional definitions: North Africa, Southern Africa, Central/Western Africa, Eastern Africa, Antarctica, Southwest Pacific, South Asia, Central Asia, South East Asia, North Asia, Eastern/Central Europe,Western Europe, Caribbean, Central America, Upper South America, Lower South America, Middle East, North America. Departure from Asia refers routes departing from Asia and arriving at any country in the above regions. Same definition applied to "departure from Europe" and "departure from North America". I follow the same data cleaning process description in Section 3 to generate this figure.

Figure 2: Histogram of total governmental shares and firm age



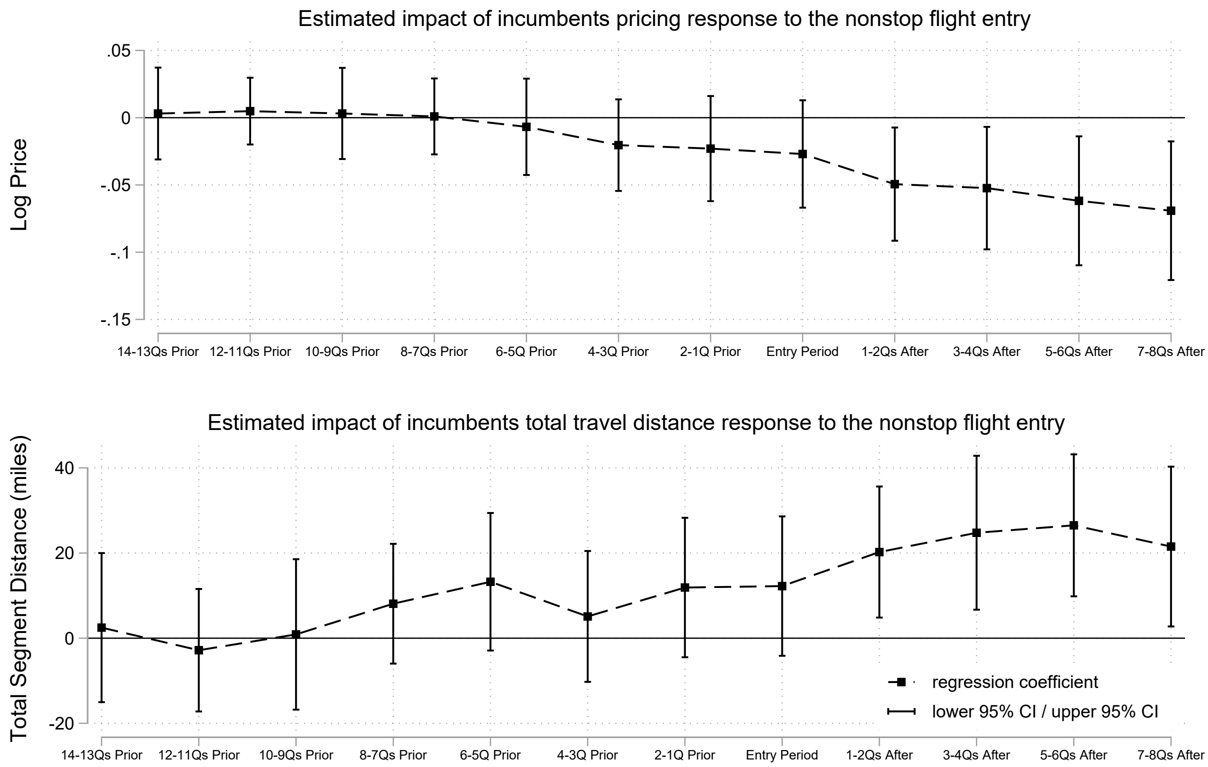
Notes: The OAG Schedules Analyser uses IATAs regional definitions: North Africa, Southern Africa, Central/Western Africa, Eastern Africa, Antarctica, Southwest Pacific, South Asia, Central Asia, South East Asia, North Asia, Eastern/Central Europe,Western Europe, Caribbean, Central America, Upper South America, Lower South America, Middle East, North America. Central Asia refers routes departing from Central Asia and arriving at any country in the above regions. I follow the same data cleaning process description in Section 3 to generate this figure. To calculate *single nonstop flight entry*, I restrict the sample to routes where exactly only one nonstop flight enters the market during the sample period. While *multiple nonstop flights entries* counts total number of routes with more than one nonstop flights enters the market during the sample period.

Figure 3: Histogram of total governmental shares and years of formation



Notes: Governmental shareholders include national, state, local or municipal governments (including their agencies) and state-owned companies. Our definition of state-owned enterprise (SOE) follows the Trans-pacific Partnership (TPP) definition: the firm is principally engaged in commercial activities, and a state (i) directly owns more than 50 percent of the share capital; (ii) controls, through ownership interests, the exercise of more than 50 percent of voting rights; or (iii) holds the power to appoint a majority of the members of the board of directors or any other equivalent management body. Years of formation is defined as the difference between the year that the airline company was formed and the current year (2018).

Figure 4: Incumbents response to nonstop flight entry in price and total segment distance over time



Notes: The upper panel and lower panels are based on column (5) and (6) of Table 3 respectively. Estimated impact on log price and total segment distance over periods before, during, and after actual entry.

Table 1: Summary Statistics by Different Ticket Classes Before and After Nonstop Flight Entry

Variable	Before Entry	After Entry	All Sample
Fare ($)			
Average Ticket Fare	462.826	394.734	433.439
	(437.907)	(370.831)	(411.689)
First/Buesiness Ticket Fare	2207.070	1941.769	2099.869
	(1660.804)	(1563.102)	(1627.242)
Discounted Coach Ticket Fare	334.313	285.057	312.876
	(248.168)	(200.394)	(229.907)
Coach Premium Ticket Fare	787.346	744.091	769.496
	(745.134)	(735.417)	(741.443)
Coach Full Ticket Fare	792.728	757.235	778.811
	(644.376)	(569.267)	(616.251)
Distance (miles)			
Average Ticket Distance	4171.142	3927.546	4066.011
	(2585.316)	(2510.655)	(2556.208)
First/Buesiness Ticket Distance	4540.283	4227.306	4410.657
	(2518.125)	(2502.292)	(2516.301)
Discounted Coach Ticket Distance	4145.001	3909.504	4042.510
	(2585.256)	(2509.040)	(2555.032)
Coach Premium Ticket Distance	4264.375	3985.457	4146.987
	(2592.299)	(2513.891)	(2563.289)
Coach Full Ticket Distance	3337.479	3300.031	3322.004
	(2515.558)	(2438.090)	(2483.898)

All statistics are weighted by passengers. Standard Errors reported in parentheses.

Table 2: Summary Statistics of Country Level Variables

Variable	Destination country	Origin country
GDP (current US$ in 100 billion)	30.409	29.860
	(47.698)	(47.095)
GNI per capita, PPP (current international $)	33,965.058	33,884.919
	(19043.241)	(18982.595)
Air transport, passengers carried (in 100 million)	1.279	1.261
	(2.135)	(2.111)

GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Data are in current U.S. dollars. Dollar figures for GDP are converted from domestic currencies using single year official exchange rates. GNI per capita based on purchasing power parity (PPP). PPP GNI is gross national income (GNI) converted to international dollars using purchasing power parity rates. Air passengers carried include both domestic and international aircraft passengers of air carriers registered in the country.

Table 3: Estimated Models of Pricing and Non-pricing Responses to Nonstop Flight Entry

	Model 1		Model 2		Model 3	
	(1) *ln(P)*	(2) Distance	(3) *ln(P)*	(4) Distance	(5) *ln(P)*	(6) Distance
Quarters Before Entry						
t_0 - 14 to t_0 - 13	-0.001	15.067*	-0.002	2.898	0.003	2.486
	(0.013)	(8.055)	(0.017)	(8.767)	(0.017)	(8.934)
t_0 - 12 to t_0 - 11	0.010	10.716	-0.009	-2.832	0.005	-2.822
	(0.014)	(7.693)	(0.013)	(7.071)	(0.013)	(7.337)
t_0 - 10 to t_0 - 9	-0.001	17.567**	-0.019	0.949	0.003	0.888
	(0.016)	(8.282)	(0.017)	(8.751)	(0.017)	(9.016)
t_0 - 8 to t_0 - 7	0.001	28.349***	-0.031**	7.639	0.001	8.099
	(0.018)	(8.221)	(0.014)	(6.737)	(0.014)	(7.176)
t_0 - 6 to t_0 - 5	-0.016	32.177***	-0.050***	12.968*	-0.007	13.251
	(0.020)	(8.297)	(0.018)	(7.879)	(0.018)	(8.241)
t_0 - 4 to t_0 - 3	-0.026	28.888***	-0.076***	4.598	-0.020	5.109
	(0.022)	(8.325)	(0.017)	(7.235)	(0.017)	(7.838)
t_0 - 2 to t_0 - 1	-0.043*	25.008***	-0.090***	11.880	-0.023	11.900
	(0.025)	(8.563)	(0.019)	(7.907)	(0.020)	(8.354)
Quarters After Entry						
t_0	-0.037	34.666***	-0.103***	11.865	-0.027	12.235
	(0.026)	(8.557)	(0.019)	(7.462)	(0.020)	(8.353)
t_0 + 1 to t_0 + 2	-0.075***	40.239***	-0.134***	19.230***	-0.049**	20.227***
	(0.028)	(8.698)	(0.020)	(7.047)	(0.021)	(7.852)
t_0 + 3 to t_0 + 4	-0.069**	47.674***	-0.146***	23.768***	-0.052**	24.760***
	(0.031)	(10.088)	(0.022)	(7.973)	(0.023)	(9.221)
t_0 + 5 to t_0 + 6	-0.088***	47.131***	-0.163***	25.190***	-0.062**	26.508***
	(0.033)	(10.624)	(0.023)	(7.655)	(0.024)	(8.507)
t_0 + 7 to t_0 + 8	-0.092***	45.144***	-0.183***	20.108**	-0.069***	21.519**
	(0.035)	(11.150)	(0.024)	(8.541)	(0.026)	(9.573)
Total passengers,	0.012**	-0.560			0.005	-0.139
Departure endpoint	(0.006)	(3.616)			(0.007)	(2.839)
Average ticket fare	0.223***	-0.897			0.188***	-6.649
Departure endpoint	(0.016)	(11.141)			(0.017)	(6.735)
Total passengers,	0.019***	-3.871			0.003	-5.898**
Arrival endpoint	(0.006)	(3.509)			(0.007)	(2.525)
Average ticket fare	0.241***	-9.020			0.215***	-3.263
Arrival endpoint	(0.019)	(10.336)			(0.016)	(5.730)
Route-carrier fixed-effects	Yes	Yes	No	No	No	No
Time fixed-effects	Yes	Yes	No	No	No	No
Route-carrier-time fixed-effects	No	No	Yes	Yes	Yes	Yes
Observations	447,945	491,606	457,418	502,773	447,945	491,606
R^2	0.711	0.981	0.868	0.995	0.869	0.995

Notes: All regressions are weighted by passengers. Column (1) and (2) include cost shock controls at both endpoints, route-carrier and quarter fixed effects. This table reports estimates of average logged fares and total segment distance for our baseline model. Column (3) and (4) include dominant carrier-route-quarter fixed effect. Column (5) and (6) include cost shock controls at both endpoints and dominant carrier-route-quarter fixed effects. The dependent variable in column (1), (3) and (5) is log fares, and dependent variable in column (2), (4) and (5) is total segment distance in miles. I follow the same data cleaning process description in Section 3 to generate this Table. Standard errors are in parentheses and are clustered by route in column (1) and (2), while they are are clustered by dominant carrier-route-quarter in column (1), (2), (3) and (4). * Denotes significance at a 10% level. ** Denotes significance at a 5% level. *** Denotes significance at a 1% level.

Table 4: Estimated Models: Different Ticket Classes

	First/Business		Discounted Coach		Coach Premium		Coach Full	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ln(P)	Distance	*ln(P)*	Distance	*ln(P)*	Distance	*ln(P)*	Distance
Quarters Before Entry								
t_0 - 14 to t_0 - 13	-0.002	-1.801	0.002	4.405	0.045	-0.366	-0.045	-4.747
	(0.034)	(16.579)	(0.017)	(9.114)	(0.035)	(10.722)	(0.096)	(17.262)
t_0 - 12 to t_0 - 11	-0.022	-0.580	0.010	-2.185	0.017	1.685	0.026	-14.267
	(0.030)	(14.035)	(0.012)	(7.050)	(0.027)	(9.826)	(0.106)	(15.693)
t_0 - 10 to t_0 - 9	-0.028	4.642	-0.005	2.403	0.023	-3.088	0.006	1.608
	(0.036)	(16.861)	(0.017)	(9.220)	(0.037)	(10.769)	(0.095)	(17.720)
t_0 - 8 to t_0 - 7	-0.030	4.084	-0.007	9.894	0.018	8.777	0.024	-1.628
	(0.031)	(14.025)	(0.013)	(6.923)	(0.032)	(9.698)	(0.089)	(16.146)
t_0 - 6 to t_0 - 5	-0.041	16.420	-0.019	14.966*	0.013	11.225	-0.006	12.931
	(0.038)	(15.436)	(0.017)	(8.290)	(0.043)	(10.242)	(0.097)	(17.444)
t_0 - 4 to t_0 - 3	-0.056	3.458	-0.033**	6.268	0.007	7.426	-0.015	3.904
	(0.037)	(15.017)	(0.016)	(7.682)	(0.042)	(10.009)	(0.096)	(16.333)
t_0 - 2 to t_0 - 1	-0.045	16.990	-0.038**	13.121	0.033	12.490	-0.050	8.853
	(0.043)	(15.730)	(0.019)	(8.406)	(0.049)	(10.358)	(0.105)	(17.298)
Quarters After Entry								
t_0	-0.061	12.370	-0.045**	12.969	0.034	16.345	-0.027	5.760
	(0.044)	(15.609)	(0.019)	(8.204)	(0.049)	(10.971)	(0.114)	(17.284)
t_0 + 1 to t_0 + 2	-0.069	16.805	-0.088***	21.986***	0.038	19.399**	-0.047	15.808
	(0.045)	(14.771)	(0.020)	(7.886)	(0.049)	(9.753)	(0.106)	(17.136)
t_0 + 3 to t_0 + 4	-0.065	33.548**	-0.087***	25.329***	0.040	29.624**	0.002	12.927
	(0.050)	(16.692)	(0.022)	(9.159)	(0.055)	(12.617)	(0.120)	(17.856)
t_0 + 5 to t_0 + 6	-0.098*	30.426**	-0.098***	27.665***	0.040	27.545***	-0.057	19.929
	(0.054)	(15.376)	(0.023)	(8.573)	(0.056)	(10.673)	(0.122)	(17.743)
t_0 + 7 to t_0 + 8	-0.087	30.164*	-0.100***	22.097**	0.034	24.686**	-0.083	20.728
	(0.057)	(17.350)	(0.025)	(9.729)	(0.061)	(11.887)	(0.138)	(18.564)
Total passengers,	-0.015	-0.032	0.011	0.278	-0.038**	-2.714	0.006	-1.907
Departure endpoint	(0.016)	(3.769)	(0.007)	(3.090)	(0.019)	(3.371)	(0.024)	(3.019)
Average ticket fare	0.162***	14.391	0.210***	-9.399	0.106**	1.501	0.130	10.836
Departure endpoint	(0.045)	(15.751)	(0.017)	(6.893)	(0.041)	(7.898)	(0.081)	(10.925)
Total passengers,	-0.001	-6.058*	0.005	-6.051**	0.029	-6.876**	0.007	-3.874
Arrival endpoint	(0.017)	(3.621)	(0.006)	(2.689)	(0.020)	(3.405)	(0.025)	(2.686)
Average ticket fare	0.131***	9.846	0.236***	-5.002	0.075	2.391	0.010	-2.394
Arrival endpoint	(0.042)	(8.781)	(0.016)	(5.872)	(0.054)	(8.728)	(0.081)	(7.943)
Route-carrier-time fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	86,846	223,779	437,331	480,025	134,243	283,326	24,077	126,187
R^2	0.937	0.995	0.875	0.995	0.905	0.995	0.927	0.996

Notes: All regressions are weighted by passengers and include cost shock controls at both endpoints and dominant carrier-route-quarter fixed effects. This table reports varying responses from incumbents' different ticket classes. The dependent variable in column (1), (3), (5) and (7) is log fares, and dependent variable in column (2), (4), (6) and (8) is total segment distance in miles. I follow the same data cleaning process description in Section 3 to generate this Table. Standard errors are in parentheses and are clustered by dominant carrier-route-quarter. * Denotes significance at a 10% level. ** Denotes significance at a 5% level. *** Denotes significance at a 1% level.

Table 5: Estimated Models: Product Characteristics

	Nonstop		Connecting	
	(1)	(2)	(3)	(4)
	ln(P)	Distance	*ln(P)*	Distance
Quarters Before Entry				
t_0 - 14 to t_0 - 13	0.020	-5.648	-0.001	3.042
	(0.044)	(39.014)	(0.018)	(7.847)
t_0 - 12 to t_0 - 11	-0.023	-1.735	0.008	-3.872
	(0.031)	(28.075)	(0.013)	(7.196)
t_0 - 10 to t_0 - 9	-0.002	-23.447	0.001	3.896
	(0.042)	(41.622)	(0.018)	(7.611)
t_0 - 8 to t_0 - 7	0.003	18.044	-0.004	4.386
	(0.037)	(27.885)	(0.015)	(6.820)
t_0 - 6 to t_0 - 5	0.005	20.676	-0.014	9.748
	(0.048)	(34.235)	(0.019)	(7.557)
t_0 - 4 to t_0 - 3	-0.012	-18.676	-0.028	8.424
	(0.047)	(35.531)	(0.018)	(6.937)
t_0 - 2 to t_0 - 1	-0.025	6.485	-0.031	11.680
	(0.055)	(35.632)	(0.021)	(7.620)
Quarters After Entry				
t_0	-0.015	6.948	-0.037*	12.367
	(0.057)	(35.692)	(0.021)	(7.643)
t_0 + 1 to t_0 + 2	-0.063	34.436	-0.056**	16.114**
	(0.061)	(32.361)	(0.022)	(7.229)
t_0 + 3 to t_0 + 4	-0.052	43.617	-0.063***	20.002**
	(0.065)	(40.428)	(0.024)	(8.201)
t_0 + 5 to t_0 + 6	-0.076	52.204	-0.071***	19.817**
	(0.072)	(34.021)	(0.025)	(7.955)
t_0 + 7 to t_0 + 8	-0.113	15.338	-0.074***	21.055**
	(0.076)	(39.580)	(0.027)	(8.465)
Total passengers,	0.011	1.965	0.005	-0.167
Departure endpoint	(0.017)	(18.814)	(0.007)	(1.884)
Average ticket fare	0.199***	-23.534	0.182***	-3.351
Departure endpoint	(0.047)	(39.539)	(0.016)	(4.870)
Total passengers,	0.012	-11.521	0.001	-4.731**
Arrival endpoint	(0.020)	(17.577)	(0.007)	(1.950)
Average ticket fare	0.218***	37.305	0.211***	-10.418**
Arrival endpoint	(0.047)	(32.621)	(0.016)	(4.543)
Route-carrier-time fixed-effects	Yes	Yes	Yes	Yes
Observations	57,336	60,853	390,609	430,753
R^2	0.872	0.991	0.868	0.996

Notes: All regressions are weighted by passengers and include cost shock controls at both endpoints and dominant carrier-route-quarter fixed effects. This table shows how different types of services (nonstop vs. connecting) respond to nonstop flight entry. The dependent variable in column (1) and (3) is log fares, and dependent variable in column (2) and (4) is total segment distance in miles. I follow the same data cleaning process description in Section 3 to generate this Table. Standard errors are in parentheses and are clustered by dominant carrier-route-quarter. * Denotes significance at a 10% level. ** Denotes significance at a 5% level. *** Denotes significance at a 1% level.

Table 6: Estimated Models: Incumbent characteristics

	State-owned		Private-owned		Experienced		Less Experienced	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ln(P)	Distance	*ln(P)*	Distance	*ln(P)*	Distance	*ln(P)*	Distance
Quarters Before Entry								
$t_0 - 14$ to $t_0 - 13$	0.003	2.746	0.002	1.766	0.017	4.344	-0.033	-1.029
	(0.026)	(13.346)	(0.023)	(11.580)	(0.022)	(12.467)	(0.029)	(7.680)
$t_0 - 12$ to $t_0 - 11$	-0.012	-6.966	0.012	0.425	0.005	-4.080	-0.002	0.241
	(0.019)	(12.978)	(0.017)	(7.212)	(0.015)	(10.301)	(0.022)	(4.871)
$t_0 - 10$ to $t_0 - 9$	-0.004	1.428	0.001	-0.788	0.017	2.263	-0.039	-1.515
	(0.026)	(13.019)	(0.023)	(12.169)	(0.022)	(12.564)	(0.028)	(7.818)
$t_0 - 8$ to $t_0 - 7$	-0.034	1.191	0.014	13.188*	0.006	8.939	-0.023	6.794
	(0.021)	(12.198)	(0.020)	(7.826)	(0.018)	(10.020)	(0.024)	(5.719)
$t_0 - 6$ to $t_0 - 5$	-0.023	6.304	-0.010	17.997*	0.007	17.307	-0.055*	5.536
	(0.028)	(12.699)	(0.024)	(10.308)	(0.023)	(11.470)	(0.029)	(7.227)
$t_0 - 4$ to $t_0 - 3$	-0.064**	-0.946	-0.010	8.786	-0.014	3.549	-0.055**	8.424
	(0.026)	(13.592)	(0.023)	(8.248)	(0.022)	(10.729)	(0.028)	(7.778)
$t_0 - 2$ to $t_0 - 1$	-0.055*	5.823	-0.025	15.005	-0.008	11.617	-0.082**	12.533
	(0.030)	(13.444)	(0.027)	(9.915)	(0.025)	(11.575)	(0.032)	(7.730)
Quarters After Entry								
t_0	-0.082***	6.601	-0.016	14.900	-0.018	14.150	-0.077**	8.437
	(0.032)	(13.925)	(0.027)	(9.446)	(0.025)	(11.465)	(0.034)	(8.238)
$t_0 + 1$ to $t_0 + 2$	-0.107***	14.402	-0.040	22.710**	-0.040	24.338**	-0.103***	12.279
	(0.033)	(12.396)	(0.029)	(9.718)	(0.027)	(10.777)	(0.036)	(7.663)
$t_0 + 3$ to $t_0 + 4$	-0.118***	14.181	-0.040	30.780***	-0.039	30.706**	-0.117***	13.161
	(0.036)	(14.395)	(0.031)	(11.349)	(0.029)	(12.809)	(0.038)	(8.326)
$t_0 + 5$ to $t_0 + 6$	-0.128***	20.937	-0.057*	27.821***	-0.046	30.301***	-0.134***	19.443**
	(0.038)	(13.424)	(0.032)	(10.421)	(0.030)	(11.717)	(0.040)	(8.344)
$t_0 + 7$ to $t_0 + 8$	-0.146***	11.527	-0.060*	25.935**	-0.051	26.736**	-0.152***	11.045
	(0.041)	(14.534)	(0.035)	(11.672)	(0.032)	(13.137)	(0.044)	(9.066)
Total passengers,	0.031***	0.026	-0.018*	0.669	0.012	-0.701	0.000	1.179
Departure endpoint	(0.010)	(3.107)	(0.010)	(5.042)	(0.009)	(4.150)	(0.010)	(2.911)
Average ticket fare	0.211***	6.403	0.163***	-21.835**	0.189***	-5.691	0.188***	-8.027
Departure endpoint	(0.024)	(8.082)	(0.023)	(11.063)	(0.022)	(9.800)	(0.025)	(7.949)
Total passengers,	0.022**	-1.420	-0.009	-9.574**	0.008	-5.264	0.002	-6.523*
Arrival endpoint	(0.011)	(2.541)	(0.009)	(4.625)	(0.009)	(3.330)	(0.010)	(3.656)
Average ticket fare	0.176***	0.239	0.257***	-8.314	0.225***	1.661	0.198***	-11.491
Arrival endpoint	(0.023)	(6.192)	(0.023)	(9.943)	(0.021)	(8.060)	(0.026)	(7.029)
Route-carrier-time fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	195,252	228,003	252,693	263,603	298,506	323,632	149,439	167,974
R^2	0.873	0.996	0.860	0.992	0.864	0.993	0.870	0.997

Notes: All regressions are weighted by passengers and include cost shock controls at both endpoints and dominant carrier-route-quarter fixed effects. The dependent variable in column (1), (3), (5) and (7) is log fares, and dependent variable in column (2), (4), (6) and (8) is total segment distance in miles. I follow the same data cleaning process description in Section 3 to generate this Table. Standard errors are in parentheses and are clustered by dominant carrier-route-quarter. * Denotes significance at a 10% level. ** Denotes significance at a 5% level. *** Denotes significance at a 1% level.

Table 7: Estimated Models: Market Characteristics

	Strong Entry Barrier		Weak Entry Barrier		Large Market		Small Market	
	(1) *ln(P)*	(2) Distance	(3) *ln(P)*	(4) Distance	(5) *ln(P)*	(6) Distance	(7) *ln(P)*	(8) Distance
Quarters Before Entry								
t_0 - 14 to t_0 - 13	-0.013	0.174	0.009	3.654	0.007	-2.745	-0.007	2.247
	(0.032)	(16.791)	(0.020)	(10.582)	(0.033)	(23.615)	(0.021)	(5.633)
t_0 - 12 to t_0 - 11	-0.033	-9.647	0.021	-0.508	0.028	-12.728	-0.018	-2.408
	(0.024)	(10.172)	(0.015)	(9.485)	(0.024)	(21.264)	(0.016)	(3.542)
t_0 - 10 to t_0 - 9	-0.024	-18.452	0.012	8.545	0.022	-4.904	-0.017	-0.954
	(0.032)	(17.782)	(0.020)	(10.317)	(0.033)	(23.673)	(0.021)	(5.846)
t_0 - 8 to t_0 - 7	-0.060**	-2.280	0.025	11.493	0.021	-0.385	-0.026	7.262
	(0.026)	(10.770)	(0.017)	(9.157)	(0.029)	(20.475)	(0.017)	(4.421)
t_0 - 6 to t_0 - 5	-0.058*	6.025	0.012	15.170	0.022	9.710	-0.036	8.498
	(0.034)	(15.127)	(0.022)	(9.778)	(0.036)	(22.328)	(0.028)	(5.249)
t_0 - 4 to t_0 - 3	-0.084***	-12.079	0.003	11.170	0.023	-12.047	-0.061***	5.545
	(0.032)	(13.420)	(0.021)	(9.740)	(0.035)	(22.613)	(0.021)	(4.646)
t_0 - 2 to t_0 - 1	-0.085**	0.518	-0.002	15.671	0.042	2.153	-0.081***	8.468
	(0.038)	(14.733)	(0.023)	(10.111)	(0.040)	(23.217)	(0.024)	(5.444)
Quarters After Entry								
t_0	-0.095**	-4.710	-0.005	18.080*	0.006	1.945	-0.067***	8.318
	(0.039)	(15.128)	(0.024)	(10.297)	(0.040)	(24.212)	(0.024)	(5.547)
t_0 + 1 to t_0 + 2	-0.129***	2.036	-0.023	26.198***	0.000	13.802	-0.103***	14.702***
	(0.041)	(13.680)	(0.025)	(9.665)	(0.042)	(22.275)	(0.026)	(5.243)
t_0 + 3 to t_0 + 4	-0.125***	10.071	-0.029	29.433***	0.007	30.443	-0.108***	12.061**
	(0.045)	(21.051)	(0.027)	(10.548)	(0.046)	(27.546)	(0.027)	(5.275)
t_0 + 5 to t_0 + 6	-0.156***	5.808	-0.030	33.348***	0.027	34.560	-0.141***	13.465**
	(0.048)	(16.169)	(0.029)	(10.223)	(0.049)	(25.057)	(0.029)	(5.630)
t_0 + 7 to t_0 + 8	-0.171***	-8.034	-0.036	31.556***	0.010	15.724	-0.141***	14.260**
	(0.052)	(22.015)	(0.031)	(10.720)	(0.053)	(28.095)	(0.031)	(5.759)
Total passengers, Departure endpoint	-0.025	9.376	0.014*	-2.861	0.022	22.994**	0.012	-4.871**
	(0.016)	(9.138)	(0.007)	(2.653)	(0.017)	(10.970)	(0.008)	(2.315)
Average ticket fare Departure endpoint	0.204***	-27.639	0.178***	-1.456	0.185***	-12.833	0.192***	0.378
	(0.036)	(18.013)	(0.019)	(6.890)	(0.045)	(28.435)	(0.018)	(4.238)
Total passengers, Arrival endpoint	-0.006	-14.361*	0.006	-3.331	0.016	-13.998*	0.005	-1.021
	(0.017)	(8.557)	(0.007)	(2.295)	(0.016)	(8.310)	(0.008)	(2.327)
Average ticket fare Arrival endpoint	0.257***	7.403	0.201***	-7.668	0.166***	4.266	0.226***	-7.299*
	(0.038)	(17.186)	(0.018)	(5.626)	(0.041)	(22.757)	(0.018)	(4.279)
Route-carrier-time fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	104,139	112,658	343,806	378,948	169,637	169,738	278,308	321,868
R^2	0.866	0.994	0.870	0.995	0.782	0.980	0.882	0.996

Notes: All regressions are weighted by passengers and include cost shock controls at both endpoints and dominant carrier-route-quarter fixed effects. The dependent variable in column (1), (3), (5) and (7) is log fares, and dependent variable in column (2), (4), (6) and (8) is total segment distance in miles. I follow the same data cleaning process description in Section 3 to generate this Table. Standard errors are in parentheses and are clustered by dominant carrier-route-quarter. * Denotes significance at a 10% level. ** Denotes significance at a 5% level. *** Denotes significance at a 1% level.