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Mutual forbearance: The moderating effect of multimarket contact on incumbent response to entry in the U.S. airline industry

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Abstract

This paper examines incumbent response after market entry. Specifically, this paper investigates the moderating effect of multimarket contact on the incumbent pricing response; the so-called 'retaliatory response' as hypothesized by mutual forbearance theory. This crucial premise on which the theory rests, has yet received little attention in empirical research. Employing a fixed effect model using panel data on the U.S. airline industry, I find conclusive results in support of the mutual forbearance theory. In line with the theory's expectations, the degree of multimarket strengthens the negative effect of market entry on the incumbent's pricing strategy. This study is the first to specifically investigate this alleged retaliatory response of mutual forbearance theory, and provides additional support for the theory. Further research into the validity of these findings across industries and for different attack and response behavior is encouraged.

Introduction

When competitors simultaneously meet each other in more than one distinct market, this situation is commonly referred to as 'multimarket contact.' The degree of multimarket contact has important implications for the strategic behavior of firms. Already in 1955, antitrust expert Corwin Edwards noted that conglomerate enterprises that meet each other in many markets will tend to be less rivalrous to each other than rivals that only meet in one market (Edwards, 1955). This is now widely known as 'mutual forbearance.' The rationale behind this concept is that a competitive action in one market may induce a rivals' retaliatory response in another. The threat of a retaliatory response thus withholds firms from rivalrous behavior, consequently leading to non-cooperative (i.e., tacit) collusive market outcomes.

In the past decennia, this theory has been empirically tested in economic and strategic management literature alike. In line with Edwards' theoretical foundation, researchers have for example established a positive relationship between the degree of multimarket contact and average price levels (e.g. Evans and Kessides, 1994; Singal, 1996; Jans and Rosenbaum, 1997; Kang et al., 2010), as well as between multimarket contact and firm performance (e.g. Feinberg, 1985; Kim and Singal, 1993; Hughes and Oughton, 1993). Moreover, both Prince and Simon (2009) and Van Reeven and Pennings (2016) find that multimarket contact decreases the service quality of airlines. Whether the multimarket contact is purposeful or unintended, however, does not affect the outcomes of multimarket contact (Gimeno, 2002).

Although the concept of mutual forbearance has received much attention in scientific research in the past decades, little research has been performed on a fundamental premise of multimarket contact theory: the retaliatory response that would follow after a competitive attack – precisely the reason why firms are expected to forbear from rivalrous behavior. While some researchers found that the level of multimarket contact increases the response speed after a competitive attack – indications of a retaliatory response – others discovered that firms most regularly do not show a price response or even respond by a price leadership strategy – not exactly a 'relatiatory' response as predicted by Edwards' mutual forbearance theory.

Considering that the retaliatory response is the vital premise on which the mutual forbearance theory rests, it is remarkable that within the literature on mutual forbearance, there are only few papers that investigate this (alleged) retaliatory response – and these studies also do not seem to concur (Smith and Wilson, 1995; Yu and Cannella, 2007; Kang et al., 2010). It is for this very reason that this paper is concerned with investigating the (moderating) effect of multimarket contact on the retaliatory response of a firm after a competitive attack of its rival. While the findings of Yu and Cannella (2007) and Kang et al. (2010) indicate that multimarket contact strengthens firm responses,[1] Smith and Wilson (1995) do not find that incumbents respond more aggressively in cases of multimarket contact. Since they do not specify multimarket contact as a variable in their model, it remains unclear whether their conclusions are indeed correct. By specifying multimarket contact as a distinct measure in the econometric model, the current study aims to find more conclusive results regarding the effect of multimarket contact on incumbent response.

The empirical results of this study are consistent with mutual forbearance theory. After a competitive attack, which is operationalized as a rival's market entry, the incumbent responds with a stronger price decrease when the level of multimarket contact is higher. Exploiting the panel structure of data on the U.S. airline industry from 1993 to 2016, the current study finds robust results in support of a fundamental premise of the mutual forbearance theory. Absent valid instruments, the research was unable to account for endogeneity caused by simultaneity bias, one of the main limitations of this paper.

The remainder of the paper is structured as follows. In the next section, I embed hypotheses and expectations in a theoretical framework. Subsequently, the dataset is discussed and the chosen methodology motivated. This is followed by the presentation of the main results, as well as robustness checks to guarantee the validity of the main results. Finally, limitations and conclusions of this analysis are discussed, together with suggestions for further research.

Theoretical Framework

The theoretical foundation for the concept of mutual forbearance was first led by Corwin Edwards in 1955. He noted that when large enterprises meet rivals in more than one distinctive market, their strategic behavior will be different from a situation in which rivals only meet in one market. When rivals meet each other in many markets the competitive intensity tends to be less fierce, because a competitive action in one market may lead to a retaliatory response in another market (Edwards, 1955). The threat of a possible retaliatory response thus withholds multimarket contact firms from rivalrous behavior. Building on Edwards' theoretical notions, Bernheim and Whinston (1990) provide game-theoretical evidence in support of the mutual forbearance theory. The authors show that when markets and firms are identical and constant returns to scale exist, collusive market outcomes are not sustainable. When these (strong) assumptions are relaxed,[2] however, multimarket contact facilitates tacit collusion.

These predictions of mutual forbearance theory have been empirically tested by various researchers.[3] The degree of multimarket contact leads to an increase in prices (e.g. Evans and Kessides, 1994; Singal, 1996) and a decrease in (service) quality (e.g. Prince and Simon, 2009;

[1] Yu and Cannella (2007) find that multimarket increases response speed and Kang et al. (2010) show that a high degree of multimarket contact enhances product introductions rather than price responses.

[2] For example in plausible situations when production costs differ across firms and markets; when the amount of competitors differs across markets; when some firms have absolute cost advantages; when growth rates differ across markets.

[3] Yu and Cannella (2013) provide an extensive overview of the literature.

Van Reeven and Pennings, 2016). In addition, multimarket contact has a positive effect on firm performance (e.g. Feinberg, 1985; Kim and Singal, 1993; Hughes and Oughton, 1993). According to theory, these non-cooperative collusive market outcomes exist because of mutual forbearance: competitors refrain from rivalrous behavior because a competitive action would be followed by a retaliatory response – leading to suboptimal outcomes for all parties involved. However, little empirical research has been conducted on the existence of this (alleged) retaliatory response, which is the key premise on which the mutual forbearance theory rests.

Exceptions include Young et al. (2010) and Yu and Cannella (2007), who find that multimarket contact increases the response speed after a strategic attack. Also, Kang et al. (2010) investigated the U.S. personal computer industry and discovered that when firms are challenged by a competitor with a high level of multimarket contact, firms are more likely to respond with product innovations than with price cuts. These results are somewhat in line with the notion of a retaliatory response and a theoretical exploration by Karnani and Wernerfelt (1985).

In their paper on what they call 'multiple point competition,' Karnani and Wernerfelt (1985) develop a conceptual framework for analyzing the strategic choices and outcomes of multimarket competition. They formalize that when multimarket contact is present, a firm broadly has four different response strategies after a competitive attack. Focusing on price responses only, the challenged firm has the choice to (i) do nothing, (ii) decrease its price in the market of attack, (iii) decrease its price in another market it shares with the attacker, or (iv) decrease its prices in all markets it shares with the attacker (the authors describe these strategies as *do nothing*, *defend*, *counterattack* or *total war*, respectively). The authors expect that with high levels of multimarket contact, the *defend* and *counterattack* strategy are the most commonly observed responses in the real world, leading to a *limited war equilibrium* and *mutual foothold equilibrium*, respectively. In the *limited war equilibrium*, the rivalry is contained to the market of attack only and losses are limited. In the *mutual foothold equilibrium*, each firm keeps a small market share (a 'foothold') in the market of its rival, in order to be able to counterattack quickly if necessary.

Smith and Wilson (1995) explicitly test these predictions and propositions of Karnani and Wernerfelt (1985) on multipoint competition in the U.S. airline industry. Although the Karnani and Wernerfelt model predicts that an incumbent will counterattack after another firm's market entry, Smith and Wilson (1995) show that in 57% of the cases, the incumbent did not change its price at all. Even more contradicting to Karnani and Wernerfelt's predictions, in 22% of the cases the incumbent responded with a price increase – not exactly a retaliatory response. Their findings differ from those of Joskow et al. (1994) and Windle and Dresner (1995), who both find that incumbents cut prices following a market entry in the U.S. airline industry. Since neither of the authors specifically research the effect of multimarket contact on strategic firm behavior, it is difficult to assess whether these findings are in line with mutual forbearance theory.

One author that, to some extent, does specify the effect of multimarket contact in his model is Simon (2005). In his analysis on magazine subscriptions, he aims to offer a more general explanation for earlier inconsistent findings regarding incumbent post-entry pricing strategies. In one of his models, he includes the number of markets that an incumbent is active in and finds that "multimarket incumbents cut prices more in response to entry" (Simon, 2005, p. 1234). However, the multimarket variable he uses is rather a measure for scope economies than for multimarket contact. Moreover, his main entry variable turns insignificant because of multicollinearity. Besides, the magazine subscription market is atypical: due to low entry barriers, in 92% of his observations a market entry occurs. It is therefore debatable whether these results are robust across industries and correctly indicate a retaliatory response as a result of multimarket contact.

The aforementioned studies do not provide unambiguous results in support of the main premise of mutual forbearance theory: a competitive attack from a rival is met with a retaliatory response, and therefore firms refrain from rivalry. This paper aims to address this gap in mutual forbearance literature by specifically investigating the effect of multimarket contact on strategic firm responses after a competitive attack. To establish comparability with previous mutual forbearance research, this research tests hypotheses and expectations on the U.S. airline industry. In the current study, a competitive attack will be operationalized as a firm's entry in an established market. After such an attack, an incumbent firm may respond in the same market or – as a result of the multimarket contact – in any other market it shares with the entrant. Since the average number of markets that two established U.S. carriers share is substantial, it is empirically challenging to consider all competitive responses in all markets that are shared by incumbent and entrant – as well as to control for all alternative explanations for these actions. Moreover, Karnani and Wernerfelt (1985) propose that the best alternative for an airline is to respond in the route in which the attack takes place, thus employing the *defend* strategy. For these reasons, the present research only considers the incumbent response in the focal market (the market of entry). The effect of multimarket contact will then be included as a separate variable, that is expected to influence the strategic firm behavior in the market of interest.

After a competitive attack, the incumbent may choose to compete on price or quality (or, of course, both). This research will consider price rather than quality responses for the following reasons.[4] Foremost, in the airline industry, a price change is a more direct competitive action than a change in service quality. In order to increase the service quality, investments in "check-in, baggage and/or maintenance staff and equipment" (Prince and Simon, 2009, p. 350) need to be made. The effect of these investments on consumer demand is not as direct as the effect of price changes since there is a time lag between an investment and the resulting increase in performance. Besides, changes in service quality are not as easily observable to consumers (and rivals) as are changes in prices. Second, a consumer airflight has some commodity-like characteristics – it is not easily differentiated from competitors. It is for that reason that after the U.S. airline deregulation of 1978, the competition in the industry shifted from quality to price competition (Gimeno and Woo, 1999). Additionally, it is well established that price competition is one of the most prevalent competitive instruments (e.g. Kuester et al., 1999; Bengtsson and Marell, 2006). Finally, from a practical perspective, prices are more easily observable and measurable than non-price responses and theory offers better testable predictions regarding price responses (Simon, 2005).

Given the research focus and empirical decisions described above, I present the following main research question:

Does the degree of multimarket contact strengthen the negative effect of market entry on the incumbent's pricing strategy in the U.S. airline industry?

The airline industry provides excellent conditions for studying the effect of multimarket contact on strategic firm behavior (Bernheim and Whinston, 1990). First, the airline industry satisfies the condition of full observability: prices and quantities are easily observable by competitors, so deviant behavior can be detected. Due to route-specific economies of scale, which is partly a result of the so-called 'hub-and-spoke' model[5] that most major carriers employ, the industry is asymmetric across market players. This means that carriers have relative cost advantages over competitors, which can be exploited in a multimarket setting to facilitate tacit cooperation. Moreover, the product and

[4] Since this research is interested in the retaliatory response after a competitive attack, I will not consider pre-entry pricing, such as limit pricing strategies. Moreover, little empirical evidence has been found in support for limit pricing strategies (see Simon, 2005).

[5] By transmitting traffic through central hubs, carriers achieve cost savings.

market can be precisely defined, there are differences in the amount of market players across markets, the product is rather substitutable and relatively few players compete over the majority of the markets. These characteristics offer excellent conditions for nurturing multimarket contact (Singal, 1996). Importantly, there is also considerable variation in levels of multimarket contact across markets, allowing for econometric analysis (Prince and Simon, 2009). Lastly, repetitive interactions over multiple markets raise awareness of mutual dependence and increase knowledge on competitor responses (Gimeno and Woo, 1999).

As mentioned, a competitive attack will be operationalized as a market entry by a competitor. After a market entry, an incumbent can choose between three main price responses: do nothing, increase or decrease its price. As noted by Simon (2005), empirical research on incumbent response to entry is not conclusive. Most theoretical support has been found for post-entry price cutting: the incumbent would decrease its price after a market entry to drive out the current entrant as well as discourage potential entrants from entering the market. Theoretically, in markets with differentiated products, this negative effect is expected to be weaker since incumbents have alternative competitive weapons to combat entrants (Gruca et al., 1992). However, empirical research finds mixed results. In some industries, for example, researchers find that incumbents may increase their prices post-entry (Frank and Salkever, 1997), while in other industries incumbents do not respond to market entry in their price setting (e.g. Smith and Wilson, 1995; Yamawacki, 2002). In the U.S. airline industry, however, most empirical evidence has pointed towards post-entry incumbent price cutting, as proposed by theory (e.g. Joskow et al., 1994; Windle and Dresner, 1999; Tan, 2016). Since the most support has been found for post-entry incumbent price cutting, the present research will follow this line of reasoning. The first hypothesis is herewith presented:

Hypothesis 1: An incumbent will respond to a market entry by a decrease in its average ticket price in the market of entry[6]

As noted earlier, little research has been conducted on the specific effect of multimarket contact on incumbent price response after a competitive attack. Simon (2005) does include the logarithm of the number of markets a firm is active in as a measure for multimarket contact, and finds this variable is negative and significant, but this variable measures corporate scope rather than multimarket contact. In a study on the U.S. airline industry, Smith and Wilson (1995) find that in most cases the incumbent does not respond after a market entry – or even pursues a price leadership strategy. However, these authors do not specify multimarket contact as a variable in their model.

For substantiating the theoretical foundation for this research, I stay close to the mutual forbearance theory and the findings of other authors that investigated the effect of multimarket contact on non-price firm responses (e.g. Young et al., 2000; Kang et al., 2010). In this line of thought, it can be argued that a market entry (a competitive attack) will be followed by a (significant) price reduction from the incumbent (the retaliatory response) in the focal market (the market of entry). This strategy is also put forward by Karnani and Wernerfelt (1985, p. 88): "the best alternative for airline B is to respond in the very same routes where airline A first attacked." According to the theoretical model of the authors, this results in a *limited war equilibrium*, in which the airline is able to "signal its determination to fight while avoiding both the costs of total war and the risks of misunderstood friendliness" (Karnani and Wernerfelt, 1985, p.89). An incumbent with a high level of multimarket contact with the entrant thus has a greater incentive to build and maintain a reputation for opposing entry than a single-market firm (Simon, 2005). In agreement with this line of argumentation, the second and main hypothesis is presented:

[6] This hypothesis is rather included for theoretical completeness than for its novel contribution.

Hypothesis 2: A high degree of multimarket contact strengthens the negative effect of market entry on the incumbent's average ticket price in the market of entry

Methods

Data

Data collection

The main data for this research is retrieved from the Airline origin and destination survey (DB1B Market), publicly provided by the U.S. Department of Transportation. This dataset is a ten percent sample of all the domestic flights by U.S. airlines.[7] All available data is used from the first quarter of 1993 up until the end of 2016. The dataset does not offer daily price data – the analysis is restricted to aggregate prices per quarter, resulting in a total of 96 quarters over the time period of the study.[8] From DB1B Market, I retrieve information about the origin and destination city and airport, the non-stop distance between the origin and destination airport, the ticket price and the ticket carrier (the airline).

Supplementary data from the U.S. Department of Transportation is added to the main dataset to obtain further information on route- and carrier-specific characteristics. From the T-100 Domestic Segment database, I deduct information on carrier's scope economies and load factor. The T-100 contains non-stop segment data, as reported by certificated U.S. carriers on a monthly basis. This data is aggregated to quarterly observations on the route-carrier level, in order to merge with the main dataset. Financial data is retrieved from the Form 41 Financial Schedule database, which contains quarterly financial information on large U.S. carriers. I use income statement data from schedules P-1.2 to retrieve reported carrier operating expenses. The Form 41 data only includes U.S. carriers with annual operating revenues of more than $20 million. Small airlines are therefore excluded from this analysis, as is common in the literature. The Metropolitan Statistical Areas (MSA) database from the U.S. Census Bureau is used to collect information on the metropolitan area population at origin and destination airports. The final sample is restricted to observations for which the data from T-100, Form 41 or MSA is not missing – excluding 4.1% of the observations of the original dataset.

Construction of the final sample

From the DB1B Market data, a market (route) is defined as a directional origin-destination pair, on which multiple airlines may be active. Literature shows two main approaches in defining the market: airport-pairs and city-pairs. Adjacent airports within the same metropolitan area may be regarded by consumers as a product substitute rather than a distinct market. These competitive spillovers lead to the suggestion of Brueckner et al. (2014) to define a market on a city-to-city basis instead of an airport-to-airport basis. While the present research acknowledges these suggestions, a market is defined on basis of the airport-pair rather than a city-pair for reasons described later.

I drop observations on routes that have a non-stop distance of less than 100 miles to avoid for the substitution effect of ground transportation. Conform Singal (1996), routes with fewer than 300 passengers per quarter are excluded. Observations with a ticket fare of less than $20 are also excluded, as is common in the literature since these tickets most likely relate to frequent-flyer discounts. Following Borenstein (1989) and others, a carrier is considered active on a route if it operates more than 5% of the passenger traffic on that given route. Following previous studies and because of merging with T-100, the analysis is further restricted to only consider non-stop routes. I will only consider the entry valid if the entrant did not operate on the route in the four quarters prior to entry, and if the entrant remains active on the route four quarters post-entry. This precludes false

[7] Gimeno and Woo (1996; 1999) offer a detailed description of the data.

[8] Given the quarterly structure of the data, it would be inaccurate to use response speed as a proxy for incumbent response intensity, identical to Young et al. (2010) or Yu and Cannella (2007).

positives[9] and instances of predatory pricing.

Bresnahan and Reiss (1991, p. 1007) show that post-entry competition is most affected when entry takes place in a monopolistic or duopolistic market setting: "most of the increase in competition comes with the entry of the second and third firms." The present research will therefore only consider duopoly routes.[10] Monopoly routes are excluded because this research is specifically interested in the moderating effect of multimarket contact on an incumbent's post-entry price response, as will be clarified in the specification. The researcher can not assign a value of multimarket contact to a monopoly firm or market. Evidently, there is no competitor within that market to have multimarket contact with (i.e., multimarket contact is a concept that only exists as a result of the interaction between actors, and not within an actor). This prevents the researcher to extricate the effect of multimarket contact in a monopoly market setting, leading to the exclusion of a considerable part of the data (Gimeno and Woo, 1999; Prince and Simon, 2009). As in Borenstein and Rose (1994), a market will be defined as a duopoly if two carriers cumulatively operate more than 90% of all passenger traffic on a particular route.[11]

The DB1B Market data is at the level of individual passenger tickets, so I aggregate these to quarterly observations connected to the route and carrier. The unit of analysis is therefore defined as carrier-route-yearquarter. A unique observation in the dataset is for example AA LAX-BOS 2005Q3, representing an American Airlines flight on the route from Los Angeles International to Boston Logan International airport in the third quarter of 2005. To ensure that the aggregated dataset will render identical results as the original dataset, the estimations will be weighed by the number of individual passenger tickets. After cleaning, the dataset contains 218,722 observations for 65 carriers on 3,395 U.S. domestic routes during 96 quarters.

Dependent Variable

The dependent variable of this analysis is the logarithm of the average ticket price that the focal carrier charges on a route during a specific quarter. Formally, this is the natural logarithm of the arithmetic mean of all tickets sold by a carrier during the focal quarter.

Explanatory Variables

Entry

Conform mutual forbearance literature in the airline industry, this research considers a carrier to be active on a route when it operates more than 5% of the traffic during a quarter (Singal, 1996). In this line of reasoning, a market entry occurs when another firm enters the market with, or accumulates its passenger traffic to, a market share of more than 5%.[12] An entry will only be considered valid if the entrant remains in the market for a minimum of four quarters.[13] A dummy variable was constructed to indicate market entry during the focal quarter, as well as for the four quarters after the quarter of entry. Up to four quarters after market entry are included since the incumbent response is likely to prevail for a period of at least

[9] Since the data comes from a 10% sample, there are some routes for which observations of a carrier intermittently ceases to exist in the data (Tan, 2016). It is undesirable to consider those instances as an entry occurance. Moreover, this criterion precludes market entry by charter airlines that, for example, consequently appear during the one quarter but do not operate in the other three quarters (e.g., a charter airline that only operates during the summer months).

[10] For this reason, in this research a market is defined as an airport-to-airport rather than a city-to-city origin to destination pair. Since many of the larger metropolitan areas (such as New York, Los Angeles, Miami) encompass multiple airports, defining a route as a city-pair instead of an airport-pair leads to excluding many important and well-traveled markets from the analysis. Since this analysis only considers duopoly markets, combining multiple airport-pairs to one city-pair would exclude these relevant routes.

[11] As a robustness check, alternative cut-off points (such as 85%, 95%) have been used. Results were similar to the original results and are presented in the appendix.

[12] Alternative definitions have been considered and are discussed in the robustness section.

[13] Alternative requirements, such as a minimum of two or six quarters of post-entry activity, have also been considered. Results are discussed in the robustness section.

four quarters post-entry (Tan, 2016).[14] After these five 'entry-quarters,' all observations of triopolies are excluded from the dataset up until a market exit takes place and the route turns into a duopoly again.

Multimarket Contact

During the past decades of mutual forbearance research, various different approaches have been used to measure multimarket contact.[15] Three levels of measurement can broadly be distinguished: the dyad, firm-market and market level of measurement. These respectively measure the level of multimarket contact between two competitors, between a firm and all its competitors in the focal market, or between all firms in the focal market. The dyad level of measurement is often not appropriate because other variables are measured at a different level (Gimeno and Jeong, 2002). For example, although in some cases a market entry may be considered a competitive action targeted at a specific rival, more often it is targeted at more than one incumbent – or it is difficult for the researcher to assess at which incumbent the entry is directed. For this reason, the firm-market and market level of analysis are more prevalent in mutual forbearance research.

Gimeno and Jeong (2002) note that is important to align the level of measurement of multimarket contact to the level of measurement of the dependent variable. Since the dependent variable of this research is the average ticket price charged by a carrier on a specific route, multimarket contact will be measured at the firm-market level. That is, for firm A in triopoly ABC, the average multimarket contact of dyad AB and dyad AC will be considered, while the multimarket contact of dyad BC will be disregarded. This decision hinges on the assumption that firm A's pricing decision is not affected by the number of markets that firm B and C meet outside of the focal market.

Many prior studies use a count measure for multimarket contact: the level of multimarket contact between carrier A and B is the number of markets these rivals meet (e.g. Gimeno and Woo, 1996; 1999; Prince and Simon, 2009). This count measure for multimarket contact is inappropriate because it is highly correlated with the carrier's size and the measure does not capture the (relative) importance of the contacts to the focal carrier (Baum and Korn, 1996). Measuring multimarket contact as a ratio rather than count enables the researcher to correct for differences in carrier size and reflect the importance of the contact to the carrier's overall presence.[16] In this research, multimarket contact will therefore be measured as the number of markets the focal carrier meets its focal market rivals outside of the focal market, relative to the total amount of markets the focal carrier is active in. I exclude the focal market in this calculation to avoid muddled causality[17] (Gimeno and Jeong, 2002; Kang et al., 2010). This ratio measure corrects for multimarket contact that exists merely through chance (i.e., random multimarket contact).

Some contact between rivals may be considered more important than other contact. In line with Singal (1996), I believe that the importance of multimarket contact increases with market size. For this reason, the multimarket contact variable will be weighted by the population at both end cities on the focal route. I choose to measure market size by population rather than revenues to normalize for differences between legacy and low-cost carriers, as well

[14] A total of five dummies is thus included per entry occurrance. For robustness, I also consider to employ a larger number of post-entry dummies.

[15] Gimeno and Jeong (2002) provide an excellent overview of the different measures.

[16] For example, if carrier A and B meet each other in 20 markets, while carrier A is active in 200 markets and carrier B is only active in 60 markets, the multimarket contact between the rivals is of greater importance for carrier B than for carrier A. The ratio measure thus better reflects the relative importance that multimarket contact has for each firm. Moreover, one could speculate that carrier B may have more deliberately sought contact with carrier A, while the latter merely has multimarket contact with carrier B as a result of scope economies.

[17] Gimeno and Jeong (2002) note that when contacts are weighted, researchers prefer to exclude the focal market because the inclusion may significantly alter the distribution of the variable. Since this research is interested in the effect of non-focal market contacts on the focal market rivalry, including the focal market contact in the variable is undesirable.

as price variation in short versus longer hauls. Disregarding the time subscripts for reasons of clarity, the measurement of multimarket contact is then given by

$$MMC_{im} = \frac{I_{im} * I_{jm} * \sum_{n \neq m} I_{in} * I_{jn}}{\sum_{n} I_n}$$

where i indexes focal carrier, m indexes the focal market, j indexes all focal-market rivals and n indexes all nonfocal markets. *MMC* represents the level of multimarket contact between the focal carrier and its competitors in the focal market. The dummy variable I takes the value 1 if a carrier is active in a market (i.e., has a market share greater than 5%). Note that the minimum value of *MMC* is 0, while the theoretical maximum is 1.

Control Variables

Several control variables are included in the model to account for effects found to be significant in prior research.

The concept of multimarket contact is highly related to scope economies. Gimeno and Woo (1999) show that the intensity of rivalry is determined by the confluence of economies of scope and multimarket contact, and request future researchers to address the topics jointly. Being active in multiple markets can lead to resource sharing, which in turn results in cost savings – also known as scope economies. In the airline industry, economies of scope are realized through the hub-and-spoke network that many carriers employ. By transmitting traffic through central hubs, carriers increase load factors and consequently cut costs. Moreover, resources – such as airport facilities – can be shared when routes connect through the hub (Gimeno and Woo, 1999). Connecting airports to the main network is thus a core objective for many carriers. For this reason, multimarket contact often exists through chance rather than strategic intent. To control for (dis)economies of scope, a count variable is included to represent the number of routes served by the carrier that share an origin or destination end-airport with the focal route.

To control for the cost position of a carrier, I include the previous quarter load factor since this may influence the carrier's price-setting behavior. For instance, if the previous quarter load factor was below the profit-maximizing optimum, the carrier may choose to decrease ticket prices to increase the load factor. In line with Gimeno and Woo (1999), the average cost per available-seat-mile is used to reflect the carrier's marginal costs in a given quarter.[18] To control for the effect of demand characteristics, market growth is included – defined as the percentage increase (or decrease) in market size from the prior to the current year, and market size as the sum of the route's end-cities population in the given year. Theory is inconclusive on the effect of market growth. Demand is expected to increase with market growth, leading to higher prices if supply stays stable. However, market growth can also be a factor leading to market entry. The effect of market structure is controlled for by including a Herfindahl–Hirschman index for market concentration as well as the number of potential entrants in a market, defined as the number of carriers present at one (or both) end-airport(s). A carrier's market share is included to correct for the effect of market power, as is common in literature.[19]

The 1978 U.S. airline deregulation enabled airlines to compete on price instead of service quality. Moreover, the deregulation reduced the barriers to entry on routes that were previously regulated. The deregulation therefore triggered the emergence of low-cost airlines: carriers that offer flights at the lowest possible price by cutting out all additional 'frills' – or offering these extras at a separate price. Since research suggests that an incumbent's price response is stronger when the entrant is a low-cost carrier (Windle and Dresner, 1995; Tan, 2016), it would be appropriate to include a dummy variable that takes the value 1 if the entrant is a low-

[18] Instead of average costs, which would be measured by the cost per revenue-passenger-mile.

[19] Formal definitions of the control variables can be found in Appendix A1.

cost carrier. This variable is excluded from the regression due to multicollinearity, however, because for each observation for which the value of the low-cost dummy is 1, the *entry* variable would be 1 as well.

Methodology

In order to address the first hypothesis, the following specification will be employed:

$$lnPrice_{imt} = \beta_0 + \beta_1 * Entry_{mt} + \theta_{imt} + \gamma_{it} + \nu_{im} + \epsilon \quad (1)$$

The dependent variable, *lnPrice*, here represents the natural logarithm of the average ticket price that is charged by carrier i on route m at time period t. *Entry* is a dummy variable that takes the value 1 if an entry occurred on route j in the current or previous four quarters. The vector θ represents all the control variables, as described in the above. I include carrier-yearquarter fixed effects (γ) as well as route-carrier fixed effects (ν). As discussed in the theoretical framework, the coefficient β_1 is expected to be negative and significant.

In order to test the second and main hypothesis, the basic specification is extended by including a measure for multimarket contact and an interaction term:

$$lnPrice_{imt} = \beta_0 + \beta_1 * Entry_{mt} + \beta_2 * MMC_{imt} + \beta_3 * Entry_{mt} * MMC_{imt} + \theta_{imt} + \gamma_{it} + \nu_{im} + \epsilon \quad (2)$$

In specification (2), the variable *MMC* denotes the average degree of multimarket contact for carrier i in market m, relative to its overall presence. The coefficient β_2 is expected to be positive and significant, indicating that prices increase with multimarket contact (Evans and Kessides, 1994). The main coefficient of interest of this research is β_3, which needs to be negative and significant in order to confirm the second hypothesis. If β_3 is significant and negative while β_1 and β_2 are significantly negative and positive, respectively, this demonstrates that incumbent response to entry is indeed more fierce when the level of multimarket contact between entrant and incumbent is high.

Model

The data is structured as an unbalanced panel, with multiple observations for each route, carrier and quarter, allowing for panel data analysis. Specifically, specification (1) and (2) will be estimated by employing a fixed effects model. It is appropriate to perform a fixed effects model rather than a random effects model, because I assume that (some of the) independent variables are correlated with the individual specific effects (Hsiao, 2007). Moreover, this research is particularly interested in the (whether or not retaliatory) incumbent response, for which a within estimator is most appropriate. Particularly, the estimates are identified by price changes over time for a carrier on a specific route.[20] The fixed effects model allows to control for unobserved heterogeneity across routes and carriers, making it a valuable tool for econometric analysis. A disadvantage of the fixed effects model is the inability to include time-invariant characteristics that are not already covered by the fixed effects identifiers.

In order to control for unobserved heterogeneity in carriers, routes and time, I include route-carrier fixed effects as well as carrier-yearquarter fixed effects. Fixed effects enable the researcher to control for variation that is otherwise difficult to account for. For instance, carrier-yearquarter fixed effects control for changes over time in macroeconomical or political conditions and its specific effects on individual carriers. Moreover, these fixed effects capture managerial and strategic changes that influence a carrier's price determination. Route-carrier fixed effects control for time-invariant route and carrier specific characteristics, such as a route's strategic importance for a specific carrier, or the route-carrier specific price elasticity. By including route-carrier

[20] A Hausman test validated the fixed effects instead of a random effects model at p=0.000.

and carrier-yearquarter fixed effects, a considerable part of the unobserved heterogeneity is controlled for.

Results

The descriptive statistics of the dependent, independent and control variables are presented in table 1. Included are the means and standard deviations of the variables, as well as a Pearson correlation matrix. The univariate analysis indicates that the variable *Scope* has a notable correlation with the variable *CountMMC*, which is a count measure of the average amount of markets a carrier meets its focal market rivals, while the correlation between *Scope* and the *MMCRatio* variable, as defined above, is nonalarming. This finding validates the decision for using a ratio measure for multimarket contact rather than a count measure.

The number of potential entrants shows a positive bivariate association of 0.19 with the carrier's load factor. This correlation can arguably be explained by route characteristics. The number of potential entrants is likely to be high when the origin and destination airports are large (serving many other destinations). On routes between these types of airports, one can expect frequent flights and predictable demand, leading to higher load factors. The correlation between *Scope* and *Marketshare* of 0.27 indicates that carriers operating more connecting routes with the focal route also tend to have a higher market share in the focal route.

Although some considerable correlations among explanatory variables can be observed, the empirical validity of this study is not threatened since (i) multicollinearity is reduced by the panel data method used, and (ii) the variance inflation factors (VIF) of all explanatory variables are always smaller than 4 – well below the 'rule of thumb' of 10.

Table 2 reports the regression estimates for the specifications on the effect of market entry and the level of multimarket contact on the average ticket price charged by a carrier. In the regression results for specification (1), the coefficient β_1 appears negative and significant,

Table 1 *Means, Standard Deviations and Pearson Correlation Matrix for All Variables*

	Variable	**Unit**	**Mean**	**S.D.**	1	2	3	4	5	6	7	8	9	10	11
1.	*lnPrice*	Logged dollars	5.23	0.42	1.00										
2.	*Entry*	Dummy (0,1)	0.07	0.25	-0.01	1.00									
3.	*CountMMC*	Count	33.88	26.79	0.12	-0.07	1.00								
4.	*RatioMMC*	Range (0,1)	0.22	0.18	-0.03	-0.08	0.54	1.00							
5.	*Marketgrowth*	Percentage	1.23	0.84	-0.19	-0.01	0.08	0.06	1.00						
6.	*Pot.entrants*	Count	21.4	5.80	0.18	0.06	-0.12	-0.09	-0.12	1.00					
7.	*Marketshare*	Percentage	44.87	22.97	0.09	-0.08	0.06	-0.08	0.03	-0.05	1.00				
8.	*Scope*	Count	117.7	60.02	0.34	0.01	0.41	0.12	0.08	-0.04	0.27	1.00			
9.	*HHI*	Range (0,1)	0.57	0.14	-0.08	-0.24	0.04	0.05	0.06	-0.01	0.08	0.03	1.00		
10.	*Loadfactor*	Range (0,1)	0.74	0.14	0.21	0.02	0.06	-0.05	-0.02	0.19	0.04	0.16	-0.02	1.00	
11.	*Marg.costs*	Cents / mile	11.31	4.79	0.15	0.03	-0.03	0.02	-0.12	0.10	0.03	0.10	-0.03	0.05	1.00

$N = 218,722$

Table 2 *Main regression: Effects on lnPrice*

VARIABLES	(1)	(2)
Entry	-0.0222***	-0.0152***
MMCRatio		0.0647***
Entry x MMCRatio		-0.0343***
Marketgrowth	-0.0002	-0.0005
Pot.entrants	0.0009***	0.0011***
Marketshare	0.0010***	0.0010***
Scope	-0.0001***	-0.0002***
HHI	0.0115***	0.0123***
Loadfactor	-0.2234***	-0.2226***
Marg.costs	-0.0530	-0.0531
Constant	6.1850***	6.1782***
Observations	218,722	218,722
R-squared	0.6511	0.6516
Number of Route-Carrier FE	15,772	15,772
Route-Carrier FE	YES	YES
Carrier-Yearquarter FE	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

supportive of hypothesis 1. This finding corresponds with the expectation that an incumbent responds to a competitive attack with a decrease in its prices (Simon, 2005). The first hypothesis is therefore supported: an incumbent responds to a market entry with an initial price decrease.

Turning to the control variables, the coefficient of *Marg.costs* appears insignificant, remarkably inconsistent with expectations and earlier literature suggesting a positive and significant relationship. While the number of potential entrants has earlier been found to negatively influence airfares, the current results indicate a positive relationship. In line with Gimeno and Woo (1996, 1999), *Marketshare* and *HHI* were found positive and significant while the previous quarter load factor indeed has negative and significant effect on the carrier's ticket price. Market growth from the prior to the current year is found negative and insignificant, as is also reflected by the findings of Gimeno and Woo (1999).

The third column shows the regression results of the second, and main, specification. As in (1), the negative coefficient β_1 indicates that incumbents decrease the average ticket price post entry. The results further show that the level of multimarket contact is positively related to the natural logarithm of average ticket price, with $\beta_2 = 0.0647$. This illustrates that when a carrier meets its focal market competitors in a large number of other markets, relative to its overall market presence, its prices are generally higher. This finding follows earlier research (e.g. Evans and Kessides, 1994; Singal, 1996) and is in line with the mutual forbearance theory.

The coefficient of interest of this study, β_3, is negative and significant, and thus – in confluence with a negative β_1 and a positve β_2 – in support of the second hypothesis. This finding demonstrates that a competitive attack is indeed met with a retaliatory response if the level of multimarket contact between competitors is high. This interaction term illustrates that multimarket contact, albeit having a general positive effect on prices (β_2), strengthens the negative effect of market entry on incumbent's post-attack pricing strategy. Significant at $p = 0.01$, this coefficient provides evidence for one of the central premises of mutual forbearance theory.

Endogeneity

Although the main results are in line with the hypotheses, the analysis does not address one major endogeneity concern. While market entry leads to an incumbent's price decrease, high market prices attract potential entrants. These concurrent effects, formally known as simultaneity bias, create unwanted endogeneity which should be corrected for. In particular, the endogeneity creates a positive bias on the coefficients β_1 and β_3, therefore overestimating the negative influence of market entry on incumbent price response. In an attempt to address this issue, the current paper follows Gerardi and Shapiro (2009) in employing instrumental variables (IV) in a two-stage least squares (2SLS) model. The two-stage least squares fixed effects model captures part of the endogeneity of the entry variable, reducing the bias in the coefficients.

The 2SLS model requires an instrument that is both valid and relevant (strong). That is, the instrument should (i) be exogenous to the model (i.e., the instrument should not be correlated with the error term: $Cov(Z, \epsilon) \neq 0$) and (ii) be correlated with the endogenous explanatory variable, *Entry*. This analysis follows Borenstein and Rose (1994) and Gerardi and Shapiro (2009) in employing three instrumental variables. The endogenous variable $\widehat{Entry}$ is instrumented by the total enplaned passengers on a route, the arithmetic mean of the end-cities' population and the geoshare (the carrier's enplanements relative to all enplanements in the origin and destination airports).[21]

The results of the two-stage least squares regression are presented in Table 3. Even though nearly all coefficients are statistically significant, the regression results of both specifications appear inconsistent with the main regression. There are substantial differences not only in sign and significance, but also in effect sizes of the coefficients. Since the results of the 2SLS model differ considerably from the main regression, it is recommended to formally test the relevance and validity of the instruments.

The Anderson LM statistic and Cragg–Donald Wald F statistic[22] show that the three instruments are relevant; i.e., correlated with the endogenous variable $\widehat{Entry}$. Under the Anderson LM statistic, the null hypothesis that the equation is underidentified is rejected at $p = 0.0000$. Weak identification is rejected as well since the Cragg–Donald Wald F statistic is considerably higher than Stock–Yogo's critical values at a rejection rate of 0.05.

However, the instruments do not fulfill the criteria of validity: the null hypothesis of the Sargan–Hansen test of overidentification, that the instruments are valid, is rejected at $p = 0.0000$. This shows that the two-stage least squares fixed effects model is significantly biased – the instruments are not exogenous to the model. The bias induced by the invalidity of the instruments is presumably greater than the simultaneity bias of *lnPrice* and *Entry* in the main model. Although the 2SLS model supposedly corrects for the positive bias of the endogeneity of *Entry*, the main specification is preferred.

Robustness

Alternative analyses are performed to verify the robustness of the main results. This is to assure that the observed effects are a true reflection of actual firm behavior instead of the outcome of arbitrary decisions by the researcher.

As described in the data section, an entry is only considered valid in case the entrant remains active on the route for a minimum of four quarters. As explained earlier, this decision is made in order to preclude false positives and predatory pricing. Alternative minimum requirements have been considered as well: table B1 in the appendix shows the main specification with a minimum entrant activity requirement of two, four and six quarters. The observed effects are similar to the main results, with a noticeable decline in the size of coefficient β_3 as the

[21] A detailed description of the instruments can be found in appendix A2.

[22] The 2SLS test results are not reported but are available upon request.

Table 3 2SLS*: Instrumented effects on lnPrice* †

VARIABLES	**(1)**	**(2)**
$\widehat{Entry}$	-2.3141***	-4.0428***
MMCRatio		-0.3576***
$\widehat{Entry}$ *x MMCRatio*		18.1107***
Marketgrowth	0.0373***	0.0010
Pot.entrants	-0.0121***	-0.0049***
Marketshare	-0.0043***	-0.0022***
Scope	-0.0000	-0.0009***
HHI	-1.5524***	-0.8979***
Loadfactor	-0.1148***	-0.1225***
Marg.costs	-0.0232	0.1378
Observations	218,722	218,722
Number of Route-Carrier FE	13,778	13,778
Route-Carrier FE	YES	YES
Carrier-Yearquarter FE	YES	YES

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

† The statistical software omits the constant

requirement increases.

In accordance with Borenstein and Rose (1994), in this research a market is defined as a duopoly if two carriers together operate more than 90% of the traffic on that route. Alternative thresholds have been considered, too, and are presented in table B2 of the appendix. Results are largely in line with the main results. As the market share threshold increases, less routes are included in the analysis and the retaliatory effect of multimarket contact, the interaction term *Entry x MMCRatio*, increases.

In the main regression, a carrier was considered active only if it operated a minimum of 5% of the traffic during that quarter. Alternative cut-off points have been considered as well and are presented in table B3 of the appendix. The effect sizes fluctuate but are in line with the main findings.

Dummies up to four quarters after the market entry were included, since research suggests that the effect of market entry would prevail for at least a year. Table B4 in the appendix shows two additional specifications including up to 7 or up to 9 entry dummies (corresponding to respectively 1.5 and 2 years after the quarter of entry). It appears that the effect of market entry on incumbent pricing, as well as the moderating effect of multimarket contact, becomes stronger as more dummies are included.

The results of the alternative analyses are in line with the main regression results. The findings are robust to different thresholds definitions, endorsing that multimarket contact induces a retaliatory response once a firm is met with a competitive attack.

Discussion

Although the mutual forbearance theory has withstood several decades of economics and strategic management research, not all question marks have yet been resolved. With much knowledge already accumulated on the precedents and outcomes of multimarket contact (Yu and Cannella, 2013), this research aimed to shed more light on one of the key premises of mutual forbearance theory: the retaliatory response that supposedly induces incumbents towards non-cooperative collusive market outcomes.

I hypothesized that an incumbent would respond to a competitive attack with a price reduction, and that a high degree of multimarket contact would moderate (strengthen) this main effect. The results demonstrate a confluence of a negative coefficient β_1, a positive β_2 and a negative β_3. This indicates that, while multimarket competitors tend to charge higher prices due to mutual forbearance, when faced with a competitive attack are likely to respond more fiercely than competitors that share less mutual markets.

The main coefficient of this study β_3 appeared negative and significant in the main regression and upheld several robustness checks, providing support for the second hypothesis. Indeed, sharing a relatively large amount of markets with the entrant will induce the incumbent towards a price decrease, in order to "signal its determination to fight" (Karnani and Wernerfelt, 1985, p. 89).

Although robustness checks validate the main findings, the current analysis is not without limitations. Mainly, the analysis suffers from simultaneity bias: while market entry leads to lower prices, high prices attract entrants into the market. In an attempt to address this issue, a two-stage least squares estimation was employed, using three instruments. Unfortunately, the instruments do not fulfill the validity requirement, resulting in inconsistent estimators. Absent instruments that are both relevant and valid, the 2SLS model is rejected in favor of the main regression. The positive bias incurred by the endogeneity of *lnPrice* and *Entry* is a central limitation of this paper.

Moreover, since the DB1B Markets is only a ten percent sample of airline tickets, the dataset does not contain observations on every route during all yearquarters. As a result, for some routes or carriers there are missing quarters while there is information present on the adjacent quarters, an issue known as interval censoring.[23] The missing data is unlikely to hamper the main results of this study, however, since the censoring is rather producing false negatives than false positives. For instance, the researcher may disregard an entry occurrence while the entrant actually stayed in the market for more than four quarters.

The results should be considered in light of the context of the airline industry. Although the airline industry offers excellent conditions for studying the effects of multimarket contact, the results are not one-on-one generalizable across industries. The U.S. airline industry is heavily concentrated, with a vast majority of routes served by only one or two carriers. The focus of this analysis was deliberately restricted to duopoly routes.[24] Results may however differ under other market structures, as Bresnahan and Reiss (1991) illustrate in their paper. Moreover, this paper excluded carriers with revenues below $20 million and excluded airports situated in areas absent in the U.S. Census metropolitan statistical area data. These decisions hamper external validity, but allow for a more exhaustive analysis.

Another limitation lies in the research focus. Although multimarket contact is a phenomenon which – as the name suggests – has its effect on multiple markets simultaneously, this research is intentionally limited to study in-market firm responses. By doing so, multimarket contact is operationalized as a moderator on the main relationship. In this way, an important characteristic of multimarket contact – the possibility to compete over various markets – was disregarded. By restricting this research to in-market competition, the researcher may have neglected valuable insights in other markets shared by entrant and incumbent.

For the reasons listed above, further research into this topic is crucial for substantiating the mutual forbearance theory. In an ideal situation, a researcher should consider not only the focal market, but also all other markets that incumbent and entrant share. In this way, a more complete understanding of multimarket competition can be formed. Furthermore, I encourage future studies to identify instruments that are

[23] For example, for a specific route-carrier we may have information on 2004Q1-2007Q2 and 2008Q1-2010Q4, but miss observations on quarters 2007Q3 and 2007Q4.

[24] By focusing on duopoly routes only, this research was restricted to 56.6% of all traffic between 1993 and 2016.

both valid and relevant. These instruments can be employed in a two-stage least squares model to address the simultaneity bias caused by the competitive intensity on a route. Since strategic competition consists of many determinants, other attacks than market entry and other competitive responses than price responses should also be considered. Although the airline industry offers outstanding conditions for studying the mutual forbearance theory, it is encouraged to also consider alternative industries with different characteristics to research this phenomenon. This would increase the external validity of current findings, and is likely to offer additional insights.

Conclusion

In this paper, I intended to test whether one of the key premises of mutual forbearance theory actually holds in practice. In particular, this research investigates whether the degree of multimarket contact strengthens the negative effect of a competitive attack on a rival's response, the 'retaliatory response' as theorized by Corwin Edwards in 1955. Remarkably little research has yet been conducted on this topic, which highlights the relevance of the present study. Employing a fixed effects estimation, this research finds conclusive results in support of the mutual forbearance theory. Data on the U.S. airline industry indicates that when an incumbent carrier is faced with a market entry, its negative post-entry price response increases with multimarket contact; responding more fiercely as multimarket contact increases. Although the main results suffer from simultaneity bias, the findings are found robust across threshold definitions. This paper thus finds evidence in support of one of the key premises that forms the foundation of mutual forbearance theory.

References

Bengtsson, M. and Marell, A. (2006). Structural conditions for static and dynamic competition after deregulation. *Competitiveness Review*, 16(1), p.20-31.

Bernheim, B. and Whinston, M. (1990). Multimarket Contact and Collusive Behavior. *The RAND Journal of Economics*, 21(1), p.1-26.

Borenstein, S. and Rose, N. (1994). Competition and Price Dispersion in the U.S. Airline Industry. *Journal of Political Economy*, 102(4), p.653-683.

Bresnahan, T. and Reiss, P. (1991). Entry and Competition in Concentrated Markets. *Journal of Political Economy*, 99(5), p.977-1009.

Brueckner, J. (2010). Schedule Competition Revisited. *Journal of Transport Economics and Policy*, 44, pp.261-285.

Edwards, C. (1955). Conglomerate bigness as a source of power. In: *Business concentration and price policy*, p.331-352.

Evans, W. and Kessides, I. (1994). Living by the "Golden Rule": Multimarket Contact in the U. S. Airline Industry. *The Quarterly Journal of Economics*, 109(2), p.341-366.

Feinberg, R. (1985). "Sales-at-Risk": A Test of the Mutual Forbearance Theory of Conglomerate Behavior. *The Journal of Business*, 58(2), p.225-241.

Frank, R. and Salkever, D. (1997). Generic Entry and the Pricing of Pharmaceuticals. *Journal of Economics & Management Strategy*, 6(1), p.75-90.

Gerardi, K. and Shapiro, A. (2009). Does Competition Reduce Price Dispersion? New Evidence from the Airline Industry. *Journal of Political Economy*, 117(1), p.1-37.

Gimeno, J. (2002). The performance effects of unintended and purposive multimarket contact. *Managerial and Decision Economics*, 23(4-5), p.209-224.

Gimeno, J. and Jeong, E. (2001). Multimarket Contact: Meaning and Measurement at Multiple Levels of Analysis. *Multiunit Organization and Multimarket Strategy*, 18, p.357-408.

Gimeno, J. and Woo, C. (1996). Hypercompetition in a Multimarket Environment: The Role of Strategic Similarity and Multimarket Contact in Competitive De-Escalation. *Organization Science*, 7(3), p.322-341.

Gimeno, J. and Woo, C. (1999). Multimarket Contact, Economies of Scope, and Firm Performance. *Academy of Management Journal*, 42(3), p.239-259.

Gruca, T., Kumar, K. and Sudharshan, D. (1992). An Equilibrium Analysis of Defensive Response to Entry Using a Coupled Response Function Model. *Marketing Science*, 11(4), p.348-358.

Hausman, J. (1978). Specification Tests in Econometrics. *Econometrica*, 46(6), p.1251.

Hsiao, C. (2007). Panel data analysis—advantages and challenges. *TEST*, 16(1), p.1-22.

Hughes, K. and Oughton, C. (1993). Diversification, Multi-market Contact and Profitability. *Economica*, 60(238), p.203-224.

Jans, I. and Rosenbaum, D. (1997). Multimarket contact and pricing: Evidence from the U.S. cement industry. *International Journal of Industrial Organization*, 15(3), p.391-412.

Joskow, A., Werden, G. and Johnson, R. (1994). Entry, exit, and performance in airline markets. *International Journal of Industrial Organization*, 12(4), p.457-471.

Kang, W., Bayus, B. and Balasubramanian, S. (2010). The Strategic Effects of Multimarket Contact: Mutual Forbearance and Competitive Response in the Personal Computer Industry. *Journal of Marketing Research*, 47(3), p.415-427.

Karakaya, F. and Yannopoulos, P. (2011). Impact of market entrant characteristics on incumbent reactions to market entry. *Journal of Strategic Marketing*, 19(2), p.171-185.

Karnani, A. and Wernerfelt, B. (1985). Multiple point competition. *Strategic Management Journal*, 6(1), p.87-96.

Kim, E. and Singal, V. (1993). Mergers and market power: Evidence from the airline industry. *American Economic Review*, 83, p.549-569.

Kim, B., Shi, M. and Srinivasan, K. (2001). Reward Programs and Tacit Collusion. *Marketing Science*, 20(2), p.99-120.

Kuester, S., Homburg, C. and Robertson, T. (1999). Retaliatory Behavior to New Product Entry. *Journal of Marketing*, 63(4), p.90.

Prince, J. and Simon, D. (2009). Multimarket Contact and Service Quality: Evidence From On-Time Performance In the U.S. Airline Industry. *Academy of Management Journal*, 52(2), p.336-354.

Simon, D. (2005). Incumbent pricing responses to entry. *Strategic Management Journal*, 26(13), p.1229-1248.

Singal, V. (1996). Airline mergers and multimarket contact. *Managerial and Decision Economics*, 17(6), p.559-574.

Smith, F. and Wilson, R. (1995). The predictive validity of the Karnani and Wernerfelt model of multipoint competition. *Strategic Management Journal*, 16(2), p.143-160.

van Reeven, P. and Pennings, E. (2016). On the relation between multimarket contact and service quality: Mutual forbearance or network coordination?. S*trategic Management Journal*, 37(10), p.2121-2134.

Tan, K. (2016). Incumbent Response to Entry by Low-Cost Carriers in the U.S. Airline Industry. *Southern Economic Journal*, 82(3), p.874-892.

Windle, R. and Dresner, M. (1999). Competitive responses to low cost carrier entry. *Transportation Research Part E: Logistics and Transportation Review*, 35(1), p.59-75.

Yamawaki, H. (2002). Price reactions to new competition: A study of US luxury car market, 1986–1997. *International Journal of Industrial Organization*, 20(1), p.19-39.

Young, G., Smith, K., Grimm, C. and Simon, D. (2000). Multimarket Contact and Resource Dissimilarity: A Competitive Dynamics Perspective. *Journal of Management*, 26(6), p.1217-1236.

Yu, T. and Cannella, A. (2007). Rivalry between multinational enterprises: An event history approach. *Academy of Management Journal*, 50(3), p.663-684.

Yu, T. and Cannella, A. (2013). A Comprehensive Review of Multimarket Competition Research. *Journal of Management*, 39(1), p.76-109.

Appendices

Appendix A: Variable descriptions

A1 *Main variables*

$lnPrice_{imt}$	Natural logarithm of the average dollar ticket price
$Entry_{imt}$	Dummy variable that takes the value 1 if entry takes place at t_0, or at previous four quarters t_{-1} up until t_{-4}
$CountMMC_{imt}$	Arithmetic mean of the number of markets the focal carrier meets each of its focal market rivals outside of the focal market
$RatioMMC_{imt}$	*CountMMC* divided by the total number of markets the focal carrier is active during quarter t
$Scope_{imt}$	Sum of the number of connecting routes at both origin and destination airports on which the carrier is active
HHI_{mt}	Herfindahl–Hirshman index of concentration on a route
$Marketsize_{mt}$	The sum of both end-city's metropolitan statistical area population during a year (in millions)
$Marketgrowth_{mt}$	The growth in market size (sum of end-city population) from the prior to a current year
$Loadfactor_{im,t-1}$	Number of passengers transported divided by the number of available seats during the previous quarter
$Pot.entrants_{mt}$	Number of carriers that are present at the origin or destination airport but are not incumbent in the focal market
$Marg.costs_{it}$	Average costs per available-seat-mile for the carrier during a given quarter
$Marketshare_{imt}$	The percentage of total passengers transported by a carrier on the focal route

A2 *Instruments*

$Enpl_{imt}$	Natural logarithm of total enplaned passenger on route j during time period t
Pop_{imt}	Arithmetic mean of the metropolitan area population of both endpoint cities
$Geoshare_{imt}$	$\frac{\sqrt{ENP_{io}*ENP_{id}}}{\sum_k \sqrt{ENP_{ko}*ENP_{kd}}}$ where k indexes all carriers, i is the focal carrier and o and d denote the origin and destination airport. ENP_{ko} and ENP_{kd} are the total quarterly enplanements for airline k at the origin and destination airports

Appendix B: Robustness

B1 *Robustness 2-4-6 quarters of activity*

VARIABLES	2 quarters	4 quarters	6 quarters
Entry	-0.0176***	-0.0152***	-0.0191***
MMCRatio	0.0624***	0.0647***	0.0661***
Entry x MMCRatio	-0.0204**	-0.0343***	-0.0355***
Constant	5.9520***	6.1782***	5.8140***
Observations	218,722	218,722	218,722
R-squared	0.6498	0.6516	0.6499

B2 *Robustness: Market share threshold duopoly*

VARIABLES	85%	90%	95%
Entry	-0.0155***	-0.0152***	-0.0126***
MMCRatio	0.0648***	0.0647***	0.0620***
Entry x MMCRatio	-0.0335***	-0.0343***	-0.0591***
Constant	5.9289***	6.1782***	5.7094***
Observations	225,464	218,722	208,757
R-squared	0.6486	0.6516	0.6549

B3 *Robustness: Minimum entry requirement*

VARIABLES	5%	7.5%	10%
Entry	-0.0152***	-0.0084***	-0.0166***
MMCRatio	0.0647***	0.0609***	0.0585***
Entry x MMCRatio	-0.0343***	-0.0666***	-0.0418***
Constant	6.1782***	6.1285***	6.3040***
Observations	218,722	214,710	209,451
R-squared	0.6516	0.6551	0.6535

B4 *Robustness: Number of entry dummies*

VARIABLES	5	7	9
Entry	-0.0152***	-0.0145***	-0.0162***
MMCRatio	0.0647***	0.0662***	0.0658***
Entry x MMCRatio	-0.0343***	-0.0503***	-0.0510***
Constant	6.1782***	6.0833***	6.0923***
Observations	218,722	222,726	225,555
R-squared	0.6516	0.6503	0.6495