Do Strategic Alliances Induce Exit? Welfare and Anti-Competitive Concerns in the American Airline Industry

By Jonathan Thibault

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Abstract

Although concerns have been raised that strategic alliances (such as codeshare agreements and the sharing of frequent flyer programs amongst airlines) may cause competitors to compete less vigorously, this has yet to be tested empirically. Using a linear probability model, I find evidence that airlines are more likely to exit, and also less likely to enter, markets which are being serviced by their allied partners. Although these types of alliances often involve benefits for the consumer, in certain markets passengers may face higher fares and lower service quality.

Queen's University
Kingston, Ontario, Canada
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List of Acronyms

ATI..........Anti-Trust Immunity

DOT........Department of Transportation

FFP..........Frequent Flyer Program

IATA.......International Air Transport Association

LCC.........Low Cost Carrier

LPM.........Linear Probability Model

NWC.......Network Carrier

1 Introduction

Many different forms of strategic alliances have become common in the airline industry over the past two decades. Strategic alliances provide a fruitful area of research because they can take on many forms, from small short term agreements of cooperation between firms, to alliances that nearly resemble a full merger. Goetz & Shapiro (2012) define a strategic alliance as “any voluntary partnership that represents neither a simple transactional relationship, nor a significant structural merging of the entities” (p. 735). Because firms in alliances cooperate together, there is potential for a substantial lessening of competition, and therefore anti-trust legislation has played a large role in regulating and monitoring many aspects of such alliances. Many scholars have studied the effects of international airline alliances, mostly transatlantic alliances between American and European carriers (Whalen, 2007; Brueckner & Proost, 2010; Brueckner, Lee & Singer, 2011). Others have studied the effects and regulations regarding domestic alliances between firms within the same country (Ito & Lee, 2007; Gayle, 2008; Czerny, 2009; Bilotkach & Huschelrath, 2012; Goetz & Shapiro, 2012)

Strategic alliances can involve, but are not limited to: cost sharing of airport facilities (gates, lounges, etc), codesharing agreements, or sharing of frequent flyer loyalty programs (FFPs) among carriers (Ito & Lee, 2007). Internationally, it is not uncommon for airlines from different countries to engage in joint ventures that include cost, revenue, and profit sharing; however, the American Department of Transportation (DOT) has prohibited this practice domestically due to the severe overlap of partners’ routes and potentially harmful anti-competitive effects (Gillespie & Richard, 2011, p.5). This paper analyzes the effects of FFP and codeshare alliances in the American domestic airline industry.

Domestic codesharing in the United States began in the 1990s and exploded in 2003; the percentage of segments that were codeshared rose to over 30% (Goetz & Shapiro, 2012, p. 737). Codesharing is a practice where the marketing carrier and the operating carrier of a particular segment differ. The companies agree to allow their partner to market and sell their seats at a predetermined fare, and the marketing carrier receives a small fee to cover their costs. The second type of alliance I will be considering is FFP alliances. There are six large network carriers (NWCs) in the American airline industry and each of them has their own FFP. Most of these NWCs (all except for Hawaiian Airlines) have at least one FFP partner airline, where passengers on the partner's flights earn the NWC's FFP rewards. I consider airlines to be engaged in a FFP alliance if passengers earn the *same* FFP rewards when travelling on either of the airlines' flights. The benefits of strategic alliances can vary from simply reducing costs, increasing revenues, lowering fares, improving service quality, and increasing flight frequency, to creating brand loyalty and expanding an airline's network scope, all of which will be explained shortly.

Codesharing and FFP alliances have garnered some attention from the American anti-trust authorities; however, strict regulations have been set in place that allow the efficiency benefits to be reaped by such alliances, while severely minimizing any anti-competitive effects. Unlike international alliances, no domestic alliance is granted anti-trust immunity, and revenue sharing/joint ventures are prohibited (Gillespie & Richard, 2011). There exists a substantial amount of literature analyzing the price and quality effects of airline alliances; however, there has been mention but very little investigation into their effects on route entry and exit. This paper is concerned with how FFP and codeshare alliances affect entry and exit decisions, which have effects on both airfares and service quality. Using a linear probability model (LPM), I estimate the effect that alliances have on airlines' decisions to enter and exit certain segments. I find that although the benefits of alliances are likely to outweigh the cons, there exists some evidence that alliances cause airlines to exit some segments, and reduce the probability of entering others, leading to lower service quality and higher prices on some routes.

The paper is structured as follows. Section two gives the reader a background of airline alliances and anti-trust regulations. Section three reviews the literature regarding alliances' effects on airfares, service quality, and entry/exit. Section four provides a few simple illustrations to motivate the model being tested. Section five explains the data being used and presents the model. Section six discusses the regression's results. Finally, section seven provides some concluding remarks.

2 Background

2.1 Airline Alliances

Benefits of Airline Alliances

There are many advantages associated with codeshare alliances for both consumers and airlines alike. Airlines that codeshare can gain a marketing advantage because both the operating carrier *and* their marketing carrier partner advertise on the computer reservation systems, therefore doubling their presence and making passengers much more likely to select that *one* flight (Ito & Lee, 2007, p. 365; Goetz & Shapiro, 2012, p. 738). Another benefit noted by Ito & Lee (2007) is that a codeshared itinerary may be an inferior product to a pure online itinerary; and thus codesharing is an effective way to segment a market. Airlines can charge higher prices for the online itinerary (where one carrier markets *and* operates the flight), and price the codeshared itinerary (where the marketing and operating carriers differ) lower as an inferior generic product, capturing demand from the price sensitive traveller (p. 367). Codeshared itineraries do not always contain the same benefits as online ones: customers may not always earn FFP rewards, have lounge access, or be offered upgrades (Ito & Lee, 2007, p. 358). By attracting passengers from both airlines, codesharing expands each partner's customer base and allows them to benefit from "economies of density"; marginal cost is driven down because each aircraft is utilized at a higher capacity when offered at the same frequency (Bilotkach & Huschelrath, 2012, p. 82; Goetz & Shapiro, 2012, p. 738). Finally, probably the most significant benefit of codesharing is to expand the carrier's network scope (Ito & Lee, 2007, p. 365; Goetz & Shapiro, 2012, p. 739; Bilotkach & Huschelrath, 2012, p. 82). Rather than investing into new airport facilities to service a new segment, it is much less costly to engage in codesharing to expand the network by making new and seamless connections for passengers with a new ally (Goetz & Shapiro, 2012, p. 738).

The major benefit to consumers come from the reduction (or partial internalization) of double marginalization (Ito & Lee, 2007, p. 367; Bilotkach & Huschelrath, 2012, p. 802; Goetz & Shapiro, 2012, p. 737). In the absence of an alliance, each airline seeks to maximize their own profits, without taking into account the effect on their rival's profits. When in an alliance, each airline considers lowering their fares to increase demand on the connecting segments operated by their allied partner, leading to lower interline fares. Partners often negotiate to sell each other's seats below International Air Transport Association (IATA) prorated prices (Whalen 2007, p. 41). Also, due to coordination between the airlines, the passenger experiences "seamless travel" where baggage handling is coordinated and handled for the entire duration of all segments and connecting layover and wait times are shorter; overall quality of the service is improved (Goetz & Shapiro, 2012, p. 737). Finally, passengers with FFP loyalty cards can often claim rewards on all segments that they travel.

Types of Airlines that Engage in Alliances

Many smaller airlines are wholly owned subsidiaries of larger ones. In the literature it is common practice to reconsider all wholly owned subsidiaries as their parent company, because they act strategically and share revenues as one entity. When not considering subsidiary and parent airlines together as alliance partners, the most common types of codeshare or FFP alliances observed are between NWCs and smaller regional carriers (internationally the most common are between multiple NWCs from different countries). NWCs service hub-spoke networks, and engage in codesharing with regional airlines to complement their existing networks. Domestically, it is rarer for two NWCs to engage in codeshare or FFP alliances; often they compete on overlapping high density hub-hub routes. Historically, if such alliances existed they have evolved into outright mergers (consider the Delta/Northwest 2010 merger, or Continetntal/United Airlines 2012 merger). Alliances between NWCs and LCCs are rare but do exist. Currently in the American airline industry there are no codeshare alliances between two LCCs, however, Southwest has acquired AirTran (another LCC). Finally, there is a strategy called "Airlines in Airlines" where a NWC owns a low cost subsidiary, together they segment the market and compete against LCCs (Homsombat, Lei & Fu, 2014, p. 1-2). In the United States such a strategy has been highly unsuccessful due to the conflicting business models of the two entities within one company (Homsombat, Lei & Fu, 2014, p. 3). In analyzing the effects of alliances on route entry/exit, I pay particular attention to the effects for NWCs because they represent approximately two thirds of the domestic market share (Huschelrath & Muller, 2011).

2.2 Anti-Trust Regulation

Due to many countries imposing cabotage laws (a form of domestic airline protectionism), foreign firms are often restricted from offering service between two points within a country other than their own. For a passenger to fly between two cities internationally, if either the origin or destination is not a major hub city, it is highly likely that they must purchase separate interline tickets (see figure 1). This passenger would suffer from higher fares due to double marginalization, because each airline would maximize their own profits without taking into account how this would affect the other airline's profits. The passenger would also suffer from poor service due to lack of coordination between the airlines of each segment. Many airlines have been able to create international anti-trust immunity (ATI) alliances to eliminate this problem faced by the passenger in the previous example (Brueckner & Proost, 2010, p. 657). Such an alliance allows passengers to purchase codeshared itineraries and fly seamlessly between countries, and in many cases earn FFP rewards on each segment. ATI in this situation works because the airlines from each country were never in direct competition on the domestic segments, so there is little anti-competitive concern on the non-overlapping portions of the itinerary. Also, many of these alliances come with "carve-outs", which allow ATI except on certain, often hub to hub competing routes; which allows for efficiency gains without harming competition (Brueckner & Proost, 2010, p. 658). International ATI alliances are desirable; however ATI is not desirable domestically between two or more American carriers. Every American airline is capable of expanding into new territory within the United States, thus creating new competition and offering high quality online service. Domestic ATI alliances would be tantamount to granting mergers in an industry already characterised as less than perfectly competitive. No domestic alliance is granted ATI (Ito & Lee, 2007, p. 360; Gillespie & Richard. 2011, p.8) by the DOT, and our discussion regarding anti-trust legislation is largely focused on codeshare and FFP alliances.

In 2007 just three alliances made up over two thirds of all domestic travel (Ito & Lee, 2007, p. 356). If codeshare partners were competitors on overlapping segments, or were likely to be competitors in the future, competition may be reduced if they are able to operate cooperatively as allies (for example restricting output and/or raising fares) (Ito & Lee, 2007, p. 357). Although such concerns are legitimate, Gayle (2008) points out that all revenues in codeshare agreements go to the operating carrier, so each partner, although they are marketing each other's seats, are in fact competing (p. 748). Although Gayle does make a point, partners often agree to split arrangements so that each carrier is the marketing carrier only half the time, this way they each gain evenly (Ito & Lee, 2007, p. 364). If this behaviour is present, by agreeing not to infringe on each other's select segments, there is potential for a severe lessening of competition, which could lead to higher prices and lower quality than in the absence of such an agreement.

For a welfare enhancing merger or strategic alliance, Bilotkach & Huschelrath (2012) argue that airlines should be required to justify synergies that would not be feasible unilaterally; specifically stating that economies of scale are not accepted as real synergies (p. 79). Following most anti-trust procedures, they should also be required to quantify benefits, and achieve them in a timely fashion. It is then up to the anti-trust authorities to understand the motivations of the alliance to ensure that it is not predatory or exclusionary (Bilotkach & Huschelrath, 2012). In evaluating an alliance, the authority must evaluate the benefits of eliminating/reducing double marginalization and the efficiencies associated with economies of density, shared FFP rewards, shared marketing, and shared operational functions against the concerns of increased market power and reduced competition in the relevant markets (Bilotkach & Huschelrath, 2012).

Because codesharing is not associated with revenue sharing, and carriers are still competing to a certain extent, codesharing has not been a major concern of the anti-trust authorities. Much of the literature (which will be discussed shortly) is in support of codesharing because efficiencies and consumer benefits are realized without any significant anti-competitive effects, especially when the networks of the partners are complementary with little degree of overlap (Bilotkach & Huschelrath, 2012, p. 77-78). In this paper I specifically address whether or not overlapping alliances induce exit by one partner, and also, if alliances reduce the potential of future overlap. The consequences could be two-fold, resulting in less competition on certain segments, as well as increasing the probability that passengers will be required to purchase an allied-interline itinerary rather than an online one.

3 Literature

3.1 Price and quality (welfare) effects of alliances

Although this paper is concerned with alliances affecting entry/exit decisions, these decisions only matter for consumers insomuch as they affect price and service quality. Ito & Lee (2007) analyze domestic airfare differentials between many different types of itineraries, outlined in table 1. Figure 2 illustrates the different types of itineraries.

Table 1. Itinerary types

Itinerary	Definition
pure online	1 operating carrier
non-allied interline	2 operating carriers
allied interline	2 operating carriers that share FFP
traditional (interline) codeshare	2 operating carriers, at least one segment codeshared
semivirtual codeshare	1 operating carrier, one segment codeshared
fully virtual codeshare	1 operating carrier, all segments codeshared

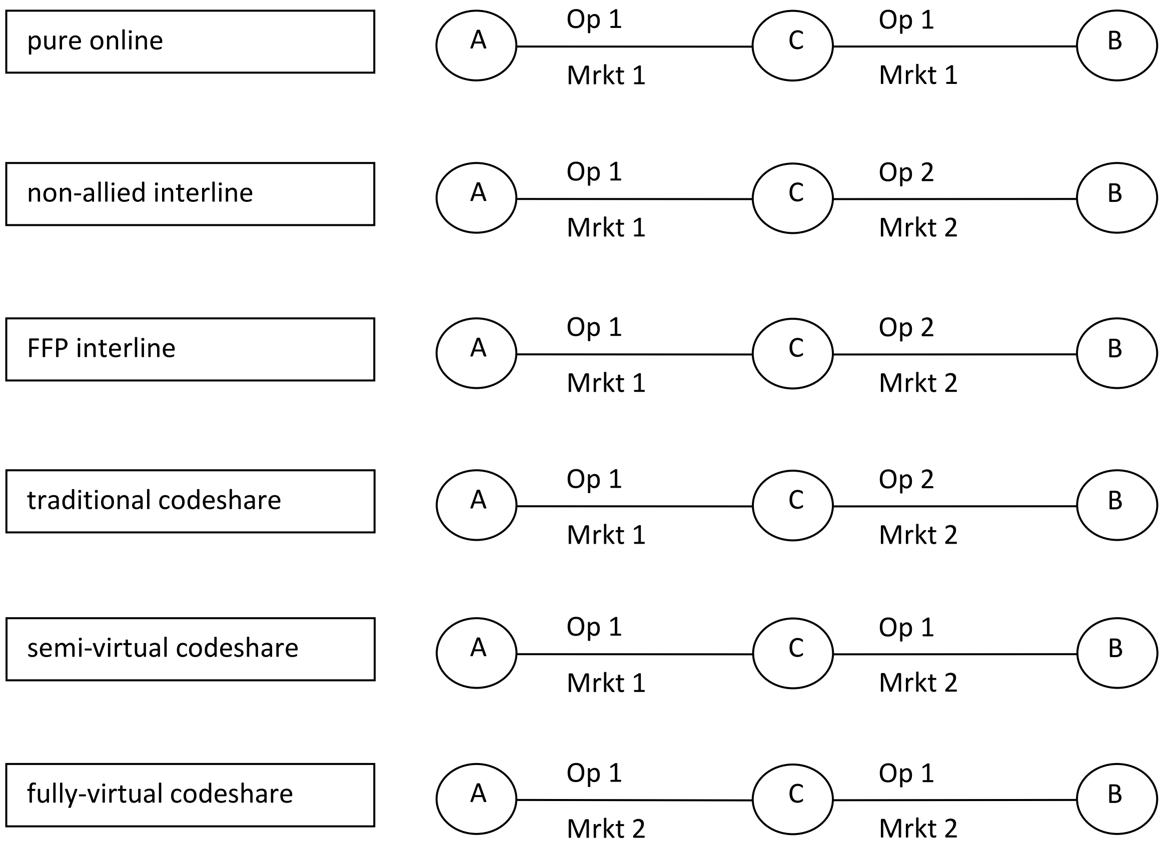

Fig. 2. Itinerary Types

Using pure online as the base category, Ito & Lee (2007) find that non-allied interline fares are on average 18% more expensive (p. 372). They find that FFP alliances and codesharing internalize part of the double-marginalization problem of non-allied interline fares, with fares being only 12% and 6.4% more expensive than online itineraries, respectively (Ito & Lee, 2007, p. 372). It becomes very clear that alliances are desirable for passengers; they pay lower fares, earn more FFP rewards, and receive higher quality seamless travel. Ito & Lee (2007) also find that virtual codeshared itineraries are 4.6% to 5.6% less expensive than pure online itineraries (p. 372). Overall, consumer welfare is greatest when itineraries only involve one operating carrier, and if this type of service is not offered, they would prefer their interline service to involve two allied partners. Performing a *static* analysis, this would suggest that alliances are beneficial to the consumer; however, this approach may be naive. If alliances reduce incentives for partners to infringe on each other's segments, passengers may be forced to accept allied-interline service, whereas in the absence of such an alliance there may have existed online service. (I will refer to online service as pure online or virtually codeshared itineraries. More generally, the important defining characteristic is whether or not there is a single operating carrier, which completely internalizes the problem of double marginalization). This is plausible, rather than investing into new routes to expand the scope of their networks, airlines may rather increase frequency on certain routes, and allow their scope to expand simply through forming alliances. This would ultimately lead to higher fares and lower quality service for the consumer.

Similar analysis has been performed for international itineraries. Brueckner, Lee & Singer (2011) find that online fares are 14.4% to 18.9% less expensive than non-allied interline fares (p. 588). They also find that alliances and codesharing internalize much of the double marginalization problem, with codeshared fares being 3.6% to 3.9% less expensive, and when partners codeshare and are involved in another form of alliance (there are three major international alliances) fares are 11.2% to 15.9% less expensive than non-allied interline fares. Whalen (2007) finds similar results, online itineraries being approximately 17.6% to 25% and codeshared itineraries 4% to 10% less expensive than non-allied interline itineraries, respectively (p. 50). Similar to the domestic case, in a static analysis alliances appear to be welfare enhancing. These forms of international alliances do not have any significant adverse affects on entry/exit due to cabotage laws restricting entry on routes within the foreign markets; therefore, they are very desirable.

Gayle (2008) tests whether or not airlines use alliances (domestic) to increase market power, and raise prices and/or restrict output. Gayle (2008) finds that NWC's alliances with regional airlines are associated with fare reductions, traffic increases, and quality improvements. For allied interline service, Gayle (2008) observes price drops, and finds no evidence of price increases for the markets where the alliance overlaps. Gayle (2008) finds that traffic in overlapping markets actually increased between 10.7 to 12.3 percent (p. 758), which suggests that it is unlikely that partners restrict output or collude on price. In Whalen's (2007) international study, he finds that codesharing increases passenger levels by up to 41% (p. 40). Overall, cartel like behaviour is unlikely to be a concern of codeshare alliances.

The overwhelming majority of the literature supports that codesharing enhances consumer welfare, but Czerny (2009) finds that codesharing can lead to higher prices for non-interline passengers. Czerny (2009) notes that in the absence of codesharing, airlines are unable to price discriminate between interline and direct passengers. He argues that codesharing enables airlines to lower prices to attract interline passengers, and can raise prices for non-interline passengers (p. 194). Ito & Lee found that price discrimination (offering a normal and an inferior product) made possible through codeshare agreements can be welfare enhancing; whereas Czerny, looking from a different angle finds that price discrimination (between direct and connecting passengers) can lead to welfare reductions.

The overwhelming majority of the literature that focuses on prices while neglecting the entry/exit effects supports that codesharing enhances consumer welfare. The next section will complicate this claim by investigating how strategic alliances may be used to try and block entry of rivals, or cause former competitors to compete less vigorously.

3.2 Entry and Exit effects

3.2.1 Alliances to accommodate or thwart entry

Over the last couple of decades the American airline industry has witnessed the proliferation of successful LCCs. From 1997 to 2009, LCC's increased their domestic market share from 13% to 28% (Huschelrath & Muller, 2013). LCCs are fierce competitors, and since the 1990s LCC entry has been associated with fare reductions between 29% to 48% (Goolsbee & Syverson, 2008, p.1620; Huschelrath & Muller, 2013, p.223) Used strategically, NWCs and regional carriers can engage in codesharing and create FFP alliances to try and lower costs, improve service quality, and gain customer loyalty when threatened by LCC entry. NWCs have even created low cost subsidiaries to fight LCCs head on in an attempt to preserve market power (Homsombat, Lei, & Fu, 2014). If successful, strategic alliances could be used to thwart entry of rival low-cost airlines.

When a LCC has presence in both endpoints, their probability of entering that route is 70 times higher than for other routes (Goolsbee & Syverson, 2008, p. 1612). Goetz & Shapiro (2012) use endpoint presence to detect a LCC threat (p. 736). Because codeshare efficiencies always exist, they argue that the timing of alliance creation correlates with anti-competitive behaviour (p. 736). Goetz & Shapiro (2012) find that when an incumbent detects a threat, they are 25% more likely to engage in codesharing (p. 736). Codesharing can lower prices in an attempt to make entry seem less profitable for the LCC, which would be harmful for passengers if entry were successfully thwarted, because LCC entry is associated with significant price drops. In addition to codesharing, offering FFP rewards on each segment increases switching costs for passengers, making entry a little less profitable for the LCC (Goetz & Shapiro, 2012, p. 744).

Goolsbee & Syverson (2008) perform a similar study, analyzing how incumbents react pre-emptively to LCC threats; however, their dependent variable is the level of pre-emptive price cutting, rather than codeshare engagement. They find that deterrence is largely unsuccessful, and when Southwest Airlines (the largest LCC) announces entry on a route, they always follow through and enter (Goolsbee & Syverson, 2008, p. 1629). In most cases the incumbents didn't lower prices until the LCC had already entered, providing support that price cutting is used to accommodate entry and match the prices of the new LCC (Goolsbee & Syverson, 2008, p. 1618). Confirming the above claim, Huschelrath & Muller (2013) find that there is little to no evidence that increasing capacity or price cutting are effective at deterring entry (p. 224).

3.2.2 Entry and exit within alliances

Strategic alliances may be ineffective at deterring entry from rival airlines; however, they may be welfare reducing if they restrict entry or induce exit among the partners within the alliance. Some scholars have acknowledged that alliances may cause partners to compete less vigorously on overlapping routes or to refrain from infringing on each other's routes; however, none have modeled this empirically. Their concerns are briefly mentioned, for example:

> "codesharing could serve as a tacit agreement not to expand into each other's markets. Allocating the codeshared segments evenly amongst each of the airline's flights acts as a commitment mechanism so that each party has equal incentive not to expand" (Goetz & Shapiro, 2012, p. 738)

> "In the absence of an alliance, potential partners may have expanded their own service either between cities to which they already have service or between other city pairs. If this argument is true, then an alliance may well serve to reduce future competition" (Gayle 2008, p. 761)

> "If alliance partners chose to compete less vigorously...fares offered by code-shared partners in these markets could increase" (Ito & Lee, 2007, p. 365).

Huschelrath & Muller (2013) study the entry and exit patterns of NWCs and LCCs in the American market over a sample period from 1996 to 2009. From 1996 to 2003 the number of segments entered by NWCs was always greater than entries by LCCs; however, since 2004 the number of entries by LCCs has been greater than those by NWCs (Huschelrath & Muller, 2013, p. 226). As stated earlier, codesharing began to explode in 2003, and NWCs are much more likely to engage in codesharing than LCCs; thus suggesting that codesharing may have played a significant role in the decline of NWC route expansion. Also, since 2005 LCCs have become more likely than NWCs to enter into segments that were previously never offered as a direct flight, this "innovative entry" is very desirable for passengers (Huschelrath & Muller, 2013, p. 227). Huschelrath & Muller (2013) state that "an important part of an individual airlines' market success is the identification and realisation of additional profit opportunities through the entry into new routes" (p. 227). The fact that NWC entry has been in decline since the proliferation of codesharing suggest that rather than allocating new investments to expand the scope of their networks, NWCs may find it more profitable to use resources in order to increase traffic on existing routes and simply engage in codesharing in order to expand their network's scope.

4 Motivational Examples

This section provides a few simple illustrations as to how strategic alliances may induce exit, and/or reduce the probability of entering a market. When airlines engage in codeshare agreements it is typical for service quality to improve, and for prices to be reduced. However, if over time such agreements induce exit by one of the airlines, or reduce the probability of one entering a new route and becoming a new competitor, consumer welfare may be reduced. I treat airport presence as fixed, and only consider entry/exit decisions for routes where an airline has presence at both endpoints. *Presence at both endpoints is a prerequisite for servicing a route.*

Since 2003, when codesharing became common practice in the American airline industry, the industry began to witness fewer and fewer entries by NWCs (Huschelrath & Muller, 2013), who are very likely to engage in codeshare agreements with regional carriers. Figures 3 and 4 illustrate how codesharing may cause one airline to exit a market, and figure 5 and 6 illustrate how codesharing may reduce the probability of one airline entering a market. In figures 3, 4, 5, and 6, Y and Z represent multiple cities that connect to city A and city B, respectively. There are two airlines in the examples. Consider airline 1 as a NWC, airline 2 as a regional carrier; also consider A and B as large cities, and C as a small city. The dashed line in each figure represents the segment being analyzed for either entry or exit.

CODESHARING CAUSING EXIT

Airline 1 exit A-C

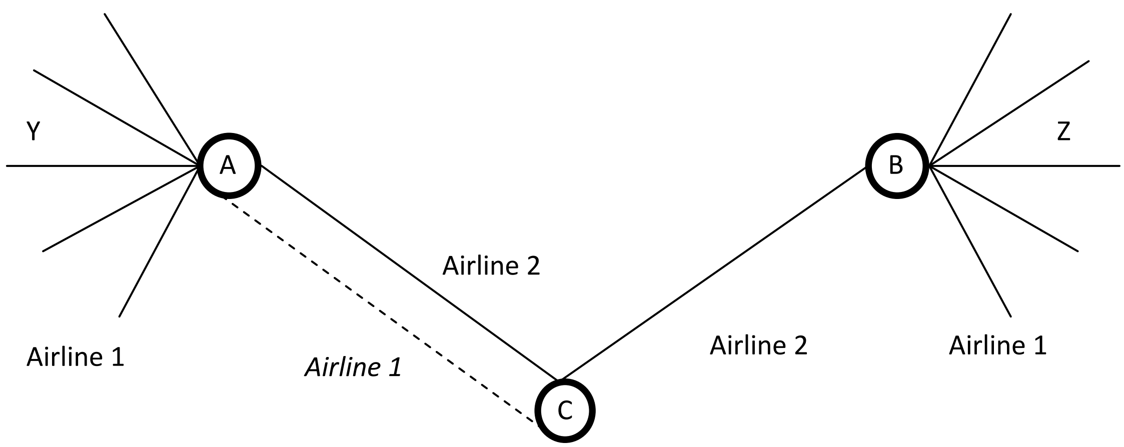

Fig. 3

Fig. 3. Airline 1 does not service A-B or C-B, but does service A-C in the initial period

In this initial period, we notice that there is a disconnect in airline 1's network; passengers cannot purchase an online itinerary to get from Y/A to B/Z. In this initial period, passengers wishing to fly from Y/A to B/Z would need to purchase a traditional non-allied interline itinerary, switching airlines at C. As noted by Ito & Lee (2007), this type of itinerary is the most expensive, due to double marginalization. In addition to the high price faced by passengers, because the airlines are not in cooperation, the quality of service is low (schedules are not coordinated so layover times at C may be long, passengers must re-check their luggage, etc). If the airlines enter into a codeshare agreement, consumer welfare immediately increases for many reasons. As noted earlier, traditional codeshared interline itineraries are less expensive than non-allied interline ones (Ito & Lee, 2007). Any passenger making a connection at C will benefit from lower interline prices, as well as higher quality service due to this agreement. Also, passengers may benefit from being able to purchase a virtually codeshared itinerary, which is typically less expensive than a pure online itinerary (Ito & Lee, 2007).

Concerns arise when considering whether or not the codeshare agreement may induce airline 1 to exit the A-C market. The agreement allows airline 1 to connect its two networks (stemming from hubs A and B). Rather than servicing the A-C market itself, airline 1 may find it more profitable to exit this market in order to invest in increasing frequency on its existing A-Y and B-Z spoke routes. If this is the case and airline 1 does exit A-C, passengers who were previously able to purchase an online itinerary between Y-C would now need to purchase a traditional codeshared itinerary, which is typically more expensive. In analyzing the overall welfare effects of codeshare agreements, it is important to take account of which passengers benefit and to what degree, as well as which passengers are likely to be adversely affected and to what degree.

Another concern is regarding competition. The agreement may cause one of the two airlines to exit the overlapping market, turning a duopoly into a monopoly. Even if airline 1 does not exit the market, the alliance may allow the two airlines to compete less vigorously, raising anti-competitive concerns. An airline is less likely to undercut and force an allied partner out of the market (relative to a rival); it would likely make more sense to maintain a positive relationship because these agreements extend into many other routes, and are renewed on an ongoing basis.

CODESHARING CAUSING EXIT

Airline 1 exit A-B market

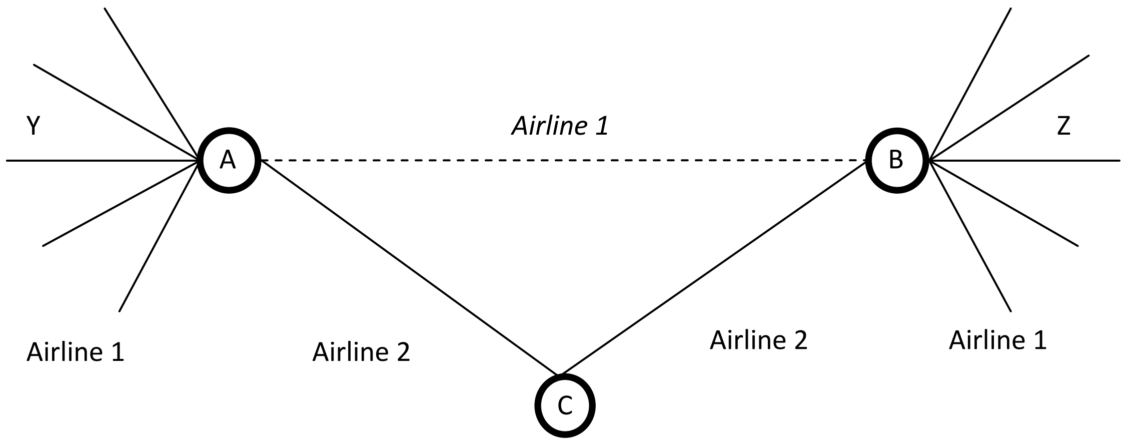

Fig. 4

Fig. 4. Airline 1 services A-B, but does not service A-C or B-C in the initial period

Airline 1's A and B networks are initially connected by A-B, and passengers enjoy pure online service between Y/A to B/Z. Airline 2 offers indirect service from A to B through C. There are two airlines offering differentiated services between A-B, and passengers have the option between the direct and indirect services of the two airlines. If the airlines enter into a codeshare agreement, airline 1's networks may be connected by airline 2's indirect A-B route. Rather than servicing the A-B market itself, airline 1 may find it more profitable to exit this market in order to invest in increasing frequency on its existing A-Y and B-Z routes. Passengers who are originating or destined for a Y or Z city will now be required to purchase a traditional codeshared interline itinerary. In addition to facing higher prices, passengers would also receive lower quality (less direct) service due to the extra connection at C. Prior to the agreement, the two airlines offered differentiated products, but were in fact competing on the A-B market. If the agreement causes airline 1 to exit A-B, there is one less competitor in that market. The only source of potential consumer gain from the alliance would come from virtual codesharing.

CODESHARING PREVENTING ENTRY

Airline 1 not enter C-B

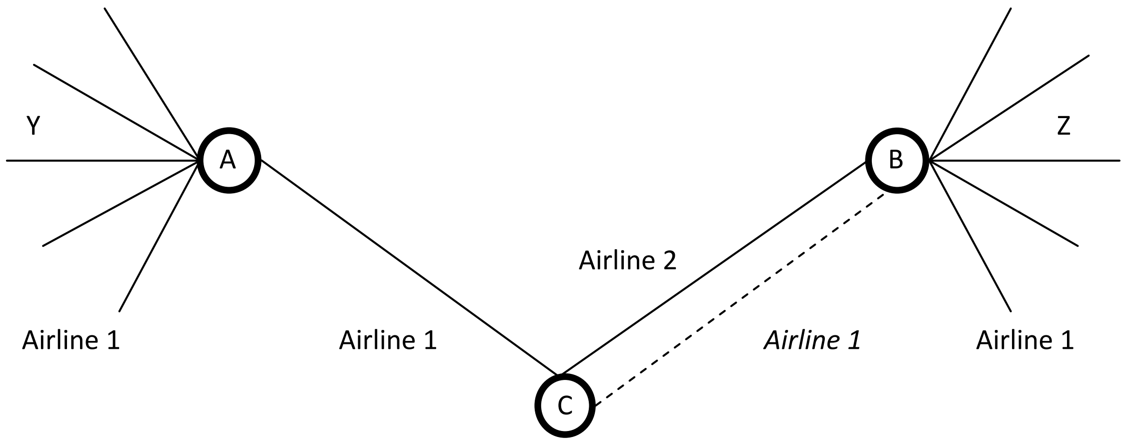

Fig. 5

Fig. 5. Airline 1 services A-C, but does not service A-B or B-C in the initial period

All passengers flying more than one segment involving C-B are required to purchase non-allied interline itineraries, because airline 1 does not service C-B. By entering into a codeshare agreement, all these passengers will benefit from being able to now purchase a traditional codeshared interline itinerary. Also, passengers flying only a single segment may benefit from virtual codesharing.

The concern with the codeshare agreement arises if we consider whether or not, in the absence of the agreement, airline 1 would have entered the C-B market. Codesharing allowed airline 1 to connect its networks without investing into the C-B market, so the agreement reduced its incentive to now enter. If airline 1 had entered the C-B market, all passengers flying between any two points in this figure would have enjoy pure online service.

The codeshare agreement could serve to preserve airline 2's monopoly on the C-B segment, whereas in the absence of an agreement the airlines would have likely been future competitors.

CODESHARING PREVENTING ENTRY

Airline 1 not enter A-B

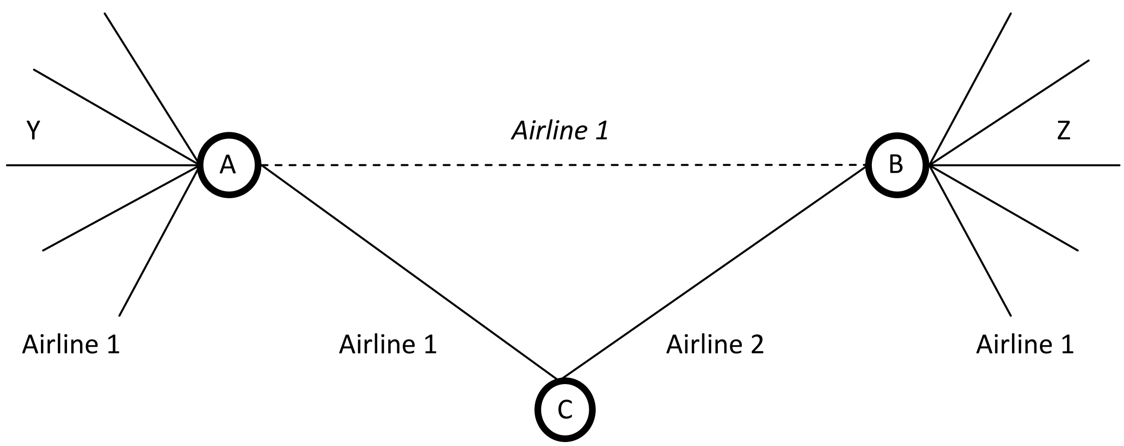

Fig. 6

Fig. 6. Airline 1 services A-C, but does not service A-B or B-C in the initial period

All passengers flying more than one segment involving C-B are required to purchase non-allied interline itineraries, because airline 1 does not service C-B. By entering into a codeshare agreement, all these passengers will benefit from being able to now purchase a traditional codeshared interline itinerary. Also, passengers flying only a single segment may benefit from virtual codesharing. So far the scenario is identical to figure 5.

The only difference in this example is that we are acknowledging that the agreement may also reduce airline 1's incentive to enter the A-B market. Similar to figure 5, the agreement allowed airline 1 to connect its networks without investing into a new route. If airline 1 had entered the A-B market, all passengers flying between Y/A to B/Z would have enjoyed pure online service.

FFP

There is a strong correlation (coefficient of 0.753) between codeshare alliances and FFP alliances. When a NWC and regional carrier have a codeshare alliance, passengers on the regional carrier are also very likely to earn the NWC's FFP rewards. The reason the correlation is not so close to 1, is that two NWCs may engage in codesharing (for example Delta/Hawaiian and Delta/Alaskan), but each offer their own FFP rewards. Although the above figures considered codeshare alliances, the same reasoning can be used considering FFP alliances for two reasons. First, there is a considerably strong correlation between the two types of alliances. Second, an airline can "connect" its network not only by codesharing, but by allowing customers to receive full FFP rewards on all segments of their itinerary. If passengers receive FFP rewards on each segment, they will be more likely to purchase that particular itinerary. The empirical model will analyze the effects of both types of strategic alliances.

5 Data and Model

5.1 Data

To obtain all the variables of interest, it was necessary to gather data from multiple different sources. The primary source of data came from the Department of Transportation's (DOT) T-100 domestic segment survey. This survey contains monthly data on which airlines service different segments. For each airline-route, the survey includes the number of departures performed and passengers carried. Data on distances and fares were gathered from the DOT's DB1B domestic origin and destination survey. Current active codeshare agreements were obtained from the U.S. General Services Administration website. Although it was tedious, it was necessary to explore each airline's website to identify which FFP rewards passengers earn on their flights, which cities are used as hubs (or focus cities), and whether the airline is a NWC, LCC, or regional carrier (I include commuters in the regional definition).

5.1.1 Preliminary cleaning of the data

The first step was to follow common practice and recode all the wholly owned subsidiaries as their parent airline (see table 2). It would be incorrect to treat these airlines as separate entities, because they act strategically and share costs, revenues, and profits as one entity.

Table 2. Subsidiary and Parent Airlines

Subsidiary	**Parent**
Horizon Air	Alaskan Airlines
Envoy Air	American Airlines
Endeavor Air	Delta Airlines
ExpressJet	SkyWest Airlines
AirTran Airways	Southwest Airlines
Commutair	United Airlines
PSA Airlines	US Airways
Piedmont Airlines	US Airways
Chatauqua Airlines	Republic Airways
Shuttle America	Republic Airways
Compass Airlines	Trans States Holdings
GoJet Airlines	Trans States Holdings

A market can be defined as an airport-pair, or a city-pair. The former is used for analysing business class passengers, who have strong preferences for primary airports (usually located closer the city's central business district). When analysing entry and competition, it is much more reasonable to use city-pair markets, because rivals often enter secondary airports to compete with incumbents (Dunn, 2008, p. 1079). For these reasons, this paper focuses on city-pair markets. Also, following Gayle (2008) and Dunn (2008), a market is defined by its origin and destination. For example, A-B is the same market as A-C-B. This allows for indirect service to compete with direct service.

It is common in the literature to narrow down the number of routes being analyzed, by eliminating routes that are only offered infrequently or at very low volumes. Dunn eliminated observations where the airline offered less than 52 departures, or carried less than 500 passengers per quarter. This paper is dealing with monthly data, so these thresholds were reduced accordingly and applied a bit more generously. I eliminated observations with less than 12 departures, or those which carried less than 100 passengers per month.

5.1.2 Variables of interest

Table 3. Airline Status

Airline	Status
Air Wisconsin Airlines Corp	Regional
Alaska Airlines Inc.	NWC
Allegiant Air	LCC
American Airlines Inc.	NWC
Cape Air	Regional
City Wings Inc dba Seaflight	Regional
Delta Air Lines Inc.	NWC
Era Aviation	Regional
Falcon Air Express	Regional
Frontier Airlines Inc.	LCC
Great Lakes Airlines	Regional
Hawaiian Airlines Inc.	NWC
JetBlue Airways	LCC
Mesa Airlines Inc.	Regional
Multi-Aero, Inc. d/b/a Air Choice One	Regional
Omni Air Express	Regional
Peninsula Airways Inc.	Regional
Republic Airlines	Regional
Seaborne Aviation	Regional
SeaPort Airlines, Inc. d/b/a Wings of A	Regional
Silver Airways	Regional
SkyWest Airlines Inc.	Regional
Southwest Airlines Co.	LCC
Spirit Air Lines	LCC
Sun Country Airlines d/b/a MN Airlines	LCC
Trans States Airlines	Regional
United Air Lines Inc.	NWC
US Airways Inc.	NWC
Virgin America	LCC
Vision Airlines	Regional

Performing the steps outlined above reduced the analysis to thirty remaining airlines (see table 3). Fifteen of the thirty airlines engaged in at least one codeshare agreement, and eleven of these fifteen also share FFP rewards with at least one other airline.

Table 4 shows which airlines are in FFP alliances. For example, Delta is only in a FFP alliance with 3 other carriers, whereas SkyWest has FFP alliances with 10 other carriers. As we can see, none of the 6 NWCs (Hawaiian airlines not shown because they share FFP with no other carrier) are in FFP alliances with one another.

Table 4. FFP Alliances

Carrier	Aadvantage	Dividend Miles	Mileage Plan	Mileage Plus	Skymiles
American Airlines	1				
SkyWest Airlines Inc.	1	1	1	1	1
Air Wisconsin Airlines Corp		1			
US Airways Inc.		1			
Republic Airlines	1	1		1	1
Trans States Airlines		1		1	1
Era Aviation			1		
Alaska Airlines Inc.			1		
Peninsula Airways Inc.			1		
United Air Lines Inc.				1	
Delta Air Lines Inc.					1

Unlike FFP alliances, some NWCs engage in codeshare alliances together, such as Delta/Hawaiian and Delta/Alaskan (see table 5). No LCCs engaged in FFP alliances, however we see that Silver Airways (a LCC) is in a codeshare agreement with United Airlines.

This paper is concerned with how these alliances affect entry and exit decisions. For example, if US Airways and Air Wisconsin both offer the same service, does the codeshare alliance or FFP alliance between the two airlines increase the probability that one of them will exit the overlapping market? If US airways offers a direct flight, and by engaging in codesharing with Air Wisconsin is able to offer an indirect codeshared flight, will this agreement make US

Table 5. Codeshare Alliances

Carrier	Air Wisconsin Airlines Corp	Alaska Airlines Inc.	American Airlines	Delta Air Lines Inc.	Era Aviation	Frontier Airlines Inc.	Hawaiian Airlines Inc.	Mesa Airlines Inc.	Peninsula Airways Inc.	Republic Airlines	Silver Airways	SkyWest Airlines Inc.	Trans States Airlines	United Air Lines Inc.	US Airways Inc.
Air Wisconsin Airlines Corp															1
Alaska Airlines Inc.				1	1				1			1			
American Airlines					1					1			1		
Delta Air Lines Inc.		1					1			1		1	1		
Era Aviation		1	1												
Frontier Airlines Inc.										1					
Hawaiian Airlines Inc.				1											
Mesa Airlines Inc.														1	1
Peninsula Airways Inc.		1													
Republic Airlines			1	1		1								1	1
Silver Airways														1	
SkyWest Airlines Inc.		1		1										1	
Trans States Airlines			1	1										1	1
United Air Lines Inc.								1		1	1	1	1		
US Airways Inc.	1							1		1			1		

Airways more likely to exit their direct route? These types of questions will be addressed formally and tested empirically in the next section.

Following Dunn (2008), markets of less than 300 direct miles were eliminated. This is done because in shorter markets direct flights are more likely to compete with ground transportation, rather than indirect flights (Dunn, 2008). For markets of more than 300 miles, I constructed the variables for indirect service and traditional codeshare service. An airline offered indirect service if they offered two segments, that when combined they connect the origin and destination city, and their combined distance sums to less than 1.75 times the direct distance. For example in figure 7, A-C-B constitutes an indirect flight between A-B, but A-D-B does not, because its total distance is greater than 1.75 the direct A-B distance. For the indirect

A-C-B route, if one airline offers one segment, and one of their codeshare partners offers the other segment, it is said that both airlines offer codeshared service for the A-B market.

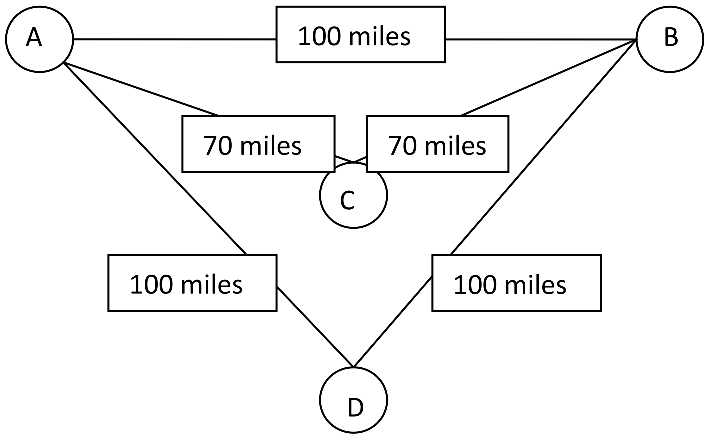

Fig. 7. Indirect Service

5.1.3 Control variables

The data set contains 30 airlines and 3233 markets, generating 96990 observations which are (directional) airline-market pairs. The number of airlines offering direct service for a given market range from 0 to 10, with a mean of 1.8. To offer a service an airline must have presence at an airport in both the origin and destination cities. For this reason, I eliminate observations where the airline does not have presence at both endpoint cities, because keeping these observations allows us to perfectly predict failure. In doing so, we are left with 7,017 observations, which are airport-market pairs where the airline does have presence at both endpoints.

Dunn (2008) argues that spoke routes out of a hub are essentially fixed, “hub carriers at their hub had an exit rate of 1.33% in their spoke markets, compared to an exit rate of 19.45% in non-hub markets” (p. 1078). When an airline exits one of its spoke routes, they lose revenue from passengers on that route, as well as on all connecting routes through the hub which they would have travelled. I obtained data on hubs and focus cities from the airlines’ websites.

Another important variable to control for is population. It is common practice to use the geometric mean of the origin and destination cities to compute the population for that market (Dunn, 2008; Brueckner, Lee, & Singer, 2011). The geographic areas used to define the city-markets from the DOT's surveys do not match the areas used for census population data. For example, Baltimore and Washington D.C. are the same city according to the market ID in the DOT's survey, so are Miami and Fort Lauderdale, Oakland and San Francisco, Los Angeles and Long beach, etc. For this reason I chose to use the number of passengers originating in a city to proxy for its population, and then compute the geometric mean. This is a good proxy, as larger cities are likely to have more airline passengers. This variable is denoted as "market volume".

Another consideration is the profitability of servicing a route. I include the variable "itinerary yield", which is fare per mile paid by each passenger. This is gathered from the DOT's DB1B survey. To compute the itinerary yield, I take the average itinerary yield of all passengers travelling the particular market. To rid the calculation of unreliable fare data, I follow Goetz & Shapiro's (2012) process of eliminating all non-credible fares and bulk-fares from the calculation of the average itinerary yield. I also eliminated all remaining fares which were less than $10 or more than $3000, as I deem these extreme values non-credible. The itinerary yield variable may not be a perfect proxy for profitability because there are both fixed and variable costs associated with servicing a route. Also, whether or not the aircraft is filled to capacity will make a large difference for profitability (for example, a route with a lower itinerary yield but aircrafts filled to higher capacity may be more profitable than a route with a high itinerary yield but aircrafts fly with many empty seats).

The final control variable is the direct miles from origin to destination.

5.2 Introducing the Linear Probability Model (LPM)

The existing literature that examines airline alliances mainly focuses on their price effects. Although concerns have been mentioned that such alliances may affect entry/exit decisions, this has yet to be formally analyzed econometrically. By analyzing how alliances affect entry/exit, we can make reference to the existing literature to infer the welfare consequences. For example, if we find that alliances induce exit where multiple airlines offer direct flights, we know that when there is one less competitor in the market the price will be higher. Or, if an alliance induces exit and forces passengers to purchase traditional codeshared itineraries rather than pure online itineraries, prices will be higher and service quality lower.

I perform separate regressions for NWCs, LCCs, and regional carriers because they all have different business models, and act very different strategically. NWCs focus on servicing hub and spoke networks, servicing larger cities, and catering to economy and business class passengers alike. LCCs specialize in point to point service, often out of secondary airports, catering to economy passengers. Regional carriers specialize in certain regions within the country, and often form alliances with NWCs. Separating the different types of airlines allow variables to affect their entry and exit decisions differently.

All the independent variables are from the time period April 2013. I estimate a Linear Probability Model (LPM), where the dependent variable is whether the airline offers direct service in December 2013. There are many reasons for structuring the model in this way. If we were to only analyze one cross sectional time period, offering a direct flight, indirect flight, and/or codeshared flight would all be endogenous to each other. So would the number of rivals offering service, allies offering service, and the itinerary yield and city volumes. To correct for endogeneity I take all these variables from April 2013, which are clearly exogenous to offering direct service in December 2013, 8 months later. The 8 month period was chosen because it takes at least 6 months to make an entry/exit decision (Goolsbee & Syverson, 2008, p. 1260). If passengers purchased tickets for future flights, the airline would not want to cancel service and deal with reimbursing the passengers. If the airline is deciding whether or not to enter a market, they must first announce entry and try to sell tickets for the upcoming new flights, which takes time. By controlling for whether or not the direct service was offered 8 months prior, the results will indicate whether the explanatory variables increase the probability of exit, or reduce the probability of entry. If an explanatory variable has a negative sign, it either induces exit or prevents entry; if an explanatory variable has a positive sign, it either reduces the probability of exit or promotes entry.

Justifying the LPM

When regressing a binary dependent variable, econometricians have the choice between using a Probit, Logit, or LPM. One critique of the LPM is that it imposes heteroskedasticity, whereas this problem does not exist in the Probit/Logit models. However, this problem with the LPM can easily be addressed and corrected for by using heteroskedasticity-robust standard errors, which I use. Another major difference between the models is that in the LPM the marginal effects are constant across all values of the independent variables, whereas in the Probit/Logit the marginal effects vary depending on where (at which values of the independent variables) they are being evaluated. Some scholars argue that if the main interest of the regression is to estimate marginal effects, then the case for using LPM is strong; especially if the majority of the independent variables are discrete, which is true for our case (Goetz & Shapiro, 2012, p. 741). To evaluate the suitability and accuracy of the LPM, it is necessary to consider the percentage of predicted probabilities that lie outside the unit interval. If many values lie outside the zero to one range, the LPM may produce biased and inconsistent estimates. Table 6 shows the percentage of predicted probabilities that lie within the unit interval in all twelve of the regressions. On average, approximately 90% lie within the zero to one range; this result (along with our main interest in the average marginal effects) strengthens our case to use the LPM. As a robustness check, all twelve regressions are re-performed using a Probit model (see appendix).

Table 6. Predicted Probabilities

Regression	# Observations	Mean	Std. Dev.	Min	Max	% within unit interval
NWC (1)	2692	0.77	0.38	-0.06	1.03	92.94
NWC (2)	2692	0.77	0.38	-0.06	1.02	90.19
NWC (3)	2692	0.77	0.38	-0.06	1.02	92.57
NWC (4)	2692	0.77	0.38	-0.06	1.02	89.30
LCC (1)	1950	0.78	0.37	-0.04	1.05	87.08
LCC (2)	1950	0.78	0.37	-0.08	1.07	85.28
LCC (3)	1950	0.78	0.37	-0.04	1.05	87.28
LCC (4)	1950	0.78	0.37	-0.08	1.07	85.28
Regional (1)	2375	0.68	0.31	-0.03	1.13	96.97
Regional (2)	2375	0.68	0.32	-0.06	1.12	96.34
Regional (3)	2375	0.68	0.32	-0.08	1.14	95.88
Regional (4)	2375	0.68	0.32	-0.08	1.09	96.34

5.3 Specification

I specify four different regressions. All regressions have seven variables in common: Offer Direct, Offer Indirect, Offer Traditional Codeshare, Nonstop Miles, Market Volume, Itinerary Yield, and Hub. Specifications (1) and (2) analyze the effects of codeshare alliances. Specification (1) estimates the linear impact of each ally and each rival offering either direct or indirect service. Rather than estimating the effect of each ally or rival, specification (2) estimates the effect of having at least one ally or rival offering direct or indirect service, simply using a dummy variable. I am more confident in specification (2), because I believe that the effect of each additional ally beyond one will only have a very small effect on causing entry/exit. If a NWC is in a codeshare alliance with two regional carriers, the effect of one of the carriers offering service versus both of them offering service, are likely to have a similar for the NWC's enty/exit decisions. This is hypothesized because the benefits of the codeshare alliance are realized immediately once just one partner offers a service (their network's scope is expanded, the codeshared segments bring connecting passengers to the NWC's routes, etc). Specifications (3) and (4) analyze FFP alliances rather than codeshare alliances; in all other regards specification (3) is analogous to specification (1), and specification (4) analogous to specification (2).

(1) Codeshare Alliances and Number of Allies and Rivals

P(Offer Direct After 8 Months = 1 | χ) = β_1 (offer direct) +
β_2 (offer indirect) +
β_3 (offer traditional codeshare) +
β_4 (# codeshare allies offer direct) +
β_5 (# codeshare allies offer indirect) +
β_6 (# codeshare rivals offer direct) +
β_7 (# codeshare rivals offer indirect) +
β_8 (nonstop miles) +
β_9 (market volume) +
β_{10} (itinerary yield) +
β_{11} (hub) +
Error

(2) Codeshare Alliances and Dummy Variables for Allies and Rivals

P(Offer Direct After 8 Months = 1 | χ) = β_1 (offer direct) +
β_2 (offer indirect) +
β_3 (offer traditional codeshare) +
β_4 (codeshare ally offer direct) +
β_5 (codeshare ally offer indirect) +
β_6 (codeshare rival offer direct) +
β_7 (codeshare rival offer indirect) +
β_8 (nonstop miles) +
β_9 (market volume) +
β_{10} (itinerary yield) +
β_{11} (hub) +
Error

(3) FFP Alliances and Number of Allies and Rivals

$$
\begin{aligned}
P(\text{Offer Direct After 8 Months} = 1 \mid \chi) = \ & \beta_1 \text{ (offer direct)} \ + \\
& \beta_2 \text{ (offer indirect)} \ + \\
& \beta_3 \text{ (offer traditional codeshare)} \ + \\
& \beta_4 \text{ (\# FFP allies offer direct)} \ + \\
& \beta_5 \text{ (\# FFP allies offer indirect)} \ + \\
& \beta_6 \text{ (\# FFP rivals offer direct)} \ + \\
& \beta_7 \text{ (\# FFP rivals offer indirect)} \ + \\
& \beta_8 \text{ (nonstop miles)} \ + \\
& \beta_9 \text{ (market volume)} \ + \\
& \beta_{10} \text{ (itinerary yield)} \ + \\
& \beta_{11} \text{ (hub)} \ + \\
& \text{Error}
\end{aligned}
$$

(4) FFP Alliances and Dummy Variables for Allies and Rivals

$$
\begin{aligned}
P(\text{Offer Direct After 8 Months} = 1 \mid \chi) = \ & \beta_1 \text{ (offer direct)} \ + \\
& \beta_2 \text{ (offer indirect)} \ + \\
& \beta_3 \text{ (offer traditional codeshare)} \ + \\
& \beta_4 \text{ (FFP ally offer direct)} \ + \\
& \beta_5 \text{ (FFP ally offer indirect)} \ + \\
& \beta_6 \text{ (FFP rival offer direct)} \ + \\
& \beta_7 \text{ (FFP rival offer indirect)} \ + \\
& \beta_8 \text{ (nonstop miles)} \ + \\
& \beta_9 \text{ (market volume)} \ + \\
& \beta_{10} \text{ (itinerary yield)} \ + \\
& \beta_{11} \text{ (hub)} \ + \\
& \text{Error}
\end{aligned}
$$

6 Results

Table 7 provides summary statistics for all the independent variables. Airlines offer direct service on 80% of the segments for which they have presence at both endpoints. Airlines are much less likely to offer indirect service (16%), or traditional codeshare service (4%), according to the restriction that the total distance be less than 1.75 times the direct distance. In approximately one third of the markets (30% for codeshare allies, 35% for FFP allies), airlines compete (overlap) in offering direct service with at least one ally. In approximately two thirds of the markets (65% for codeshare rivals, 61% for FFP rivals), airlines compete in offering direct service with at least one rival. The average direct distance of all the 3233 markets is 940 miles. The average itinerary yield (fare per passenger) is $0.37 per mile. The average market size (market volume) is 255,000 passengers, which is use as a proxy for population (although this number is not meant to estimate the population, it is a good alternative measure of demand). The estimation results are summarized for NWCs, LCCs, and regional carriers in tables 8, 9, and 10, respectively. The proceeding analysis will assess how each explanatory variable affects airlines' decisions to offer direct service (after 8 months).

Table 7. Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Offer Direct	0.80	0.40	0.00	1.00
Offer Indirect	0.16	0.36	0.00	1.00
Offer Traditional Codeshare	0.04	0.19	0.00	1.00
# Codeshare Allies Offer Direct	0.39	0.69	0.00	4.00
# Codeshare Allies Offer Indirect	0.07	0.29	0.00	3.00
# Codeshare Rivals Offer Direct	1.55	1.65	0.00	10.00
# Codeshare Rivals Offer Indirect	0.32	0.68	0.00	5.00
Codeshare Ally Offer Direct	0.30	0.46	0.00	1.00
Codeshare Ally Offer Indirect	0.07	0.25	0.00	1.00
Codeshare Rival Offer Direct	0.65	0.48	0.00	1.00
Codeshare Rival Offer Indirect	0.23	0.42	0.00	1.00
# FFP Allies Offer Direct	0.58	0.96	0.00	6.00
# FFP Allies Offer Indirect	0.12	0.37	0.00	3.00
# FFP Rivals Offer Direct	1.36	1.57	0.00	10.00
# FFP Rivals Offer Indirect	0.28	0.64	0.00	5.00
FFP Ally Offer Direct	0.35	0.48	0.00	1.00
FFP Ally Offer Indirect	0.10	0.30	0.00	1.00
FFP Rival Offer Direct	0.61	0.49	0.00	1.00
FFP Rival Offer Indirect	0.21	0.41	0.00	1.00
Nonstop Miles (1,000s)	0.94	0.61	0.30	5.09
Market Volume (100,000s)	2.55	1.99	0.03	9.30
Itinerary Yield	0.37	0.20	0.08	1.97
Hub	0.75	0.43	0.00	1.00

Direct Service

As expected, the strongest determinant of whether or not an airline offers direct service is whether or not they offered it in the recent past. NWCs, LCCs, and Regional carriers are 92%, 91%, and 74-75% more likely to offer direct service if they did so 8 months ago, respectively.

The reason this effect is smaller for regional carriers, is because they may offer flights at lower frequencies, and carry less passengers. It may be the case that in some months they offer more (or less) than 12 departures, and/or carry more (or less) than 100 passengers. This could cause the results to overestimate the number of route entry and exits; however, this is not likely to be a problem for the larger NWCs and LCCs. Although this result is uninteresting in itself, it acts as a good control variable, and the other independent variables can be interpreted as affecting entry and exit decisions.

Indirect services

The results suggest that indirect and direct services are not close substitutes. Offering indirect service has no significant effect on entry/exit decisions for all three types of carriers. Offering traditional codeshared service does not have any significant effect on causing exit; and for regional carriers actually induces entry (albeit only at the 10% level of significance). In all specifications, for all three types of carriers, the number of indirect allies and indirect rivals, the dummy variables for indirect ally and indirect rival, are all insignificant. If direct and indirect service were closer substitutes, we would expect these variables to have more significance.

Codeshare Alliances

The results provide strong evidence that overlapping alliances induce exit, or prevent entry. NWCs, LCCs, and regional carriers are 5.73%, 3.21%, and 5.46% less likely to offer direct service that is provided by at least one of their ally partners, respectively (see specification (2)). Rather than using a dummy variable, specification (1) linearly estimates the impact of each additional ally. For each partner that offers direct service, NWCs, LCCs, and regional carriers are 3.01%, 2.13%, and 3.26% less likely to offer the same service themselves, respectively. The results confirm the hypothesis that codeshare alliances may act as a tacit agreement not to infringe on each other's territory, and compete less vigorously. Codeshare alliances are effectively reducing competition, and with fewer competitors in a given market, prices are likely to be higher. Also, if an airline exits a segment causing passengers to now purchase codeshared interline itineraries rather than pure online ones, consumer welfare is likely to be reduced.

We would like to analyze how the presence of rivals affects entry/exit. The effect of rivals in the market appears to have no significant effect on deterring NWCs from offering competing service. The presence of each direct rival actually increases the probability that the NWC offers service, however the magnitude of this effect is less than 1% and is only significant at the 10% level. The presence of a rival airline makes LCCs and regional carriers 5.28% and 5.48% less likely to offer direct service, respectively. This suggests that competitive pressures may force these smaller airlines out of these specific markets.

FFP Alliances

The results show that the effects of FFP alliances are almost identical to those of codeshare alliances. Similar to the codeshare alliance results, there is strong evidence that FFP alliances induce exit, or prevent entry, on overlapping segments. None of the seven LCCs have a FFP alliance. NWCs and regional carriers are 5.97% and 6.14% less likely to offer direct service that is provided by at least one of their ally partners, respectively (see specification (4)). Rather than using a dummy variable, specification (3) linearly estimates the impact of each additional ally. For each partner that offers direct service, NWCs and regional carriers are 2.93% and 3.32% less likely to offer the same service themselves, respectively. These results are qualitatively and quantitatively equivalent to the codeshare alliance results. Part of this is due to the fact that many codeshare alliances also involve a FFP alliance (or vise versa).

Table 8. NWCs Offer Direct Service After 8 Months

	(1)	(2)	(3)	(4)
	Codeshare	**Codeshare**	**FFP**	**FFP**
Offer Direct	0.920***	0.921***	0.919***	0.919***
	(0.0160)	(0.0160)	(0.0160)	(0.0161)
Offer Indirect	0.000811	0.000149	0.000685	0.000309
	(0.00688)	(0.00695)	(0.00683)	(0.00683)
Offer Traditional Codeshare	-0.0140	-0.0112	-0.0162	-0.0154
	(0.0129)	(0.0130)	(0.0128)	(0.0129)
# Allies Offer Direct	-0.0301***		-0.0293***	
	(0.00620)		(0.00629)	
# Allies Offer Indirect	-0.00149		0.0000634	
	(0.00844)		(0.00807)	
# Rivals Offer Direct	0.00591*		0.00519	
	(0.00268)		(0.00267)	
# Rivals Offer Indirect	-0.00555		-0.00610	
	(0.00519)		(0.00507)	
Ally Offer Direct		-0.0573***		-0.0597***
		(0.00987)		(0.0106)
Ally Offer Indirect		-0.0100		-0.00500
		(0.0131)		(0.0122)
Rival Offer Direct		0.00353		0.00272
		(0.00751)		(0.00777)
Rival Offer Indirect		-0.00434		-0.00729
		(0.00775)		(0.00789)
Nonstop Miles (1,000s)	0.00151	-0.000552	0.00102	-0.00168
	(0.00273)	(0.00277)	(0.00285)	(0.00293)
Market Volume (100,000s)	0.00410*	0.00708***	0.00457*	0.00743***
	(0.00208)	(0.00195)	(0.00207)	(0.00205)
Itinerary Yield	0.00963	0.0248	0.0157	0.0337*
	(0.0126)	(0.0137)	(0.0135)	(0.0151)
Hub	0.0375*	0.0357*	0.0366*	0.0368*
	(0.0161)	(0.0160)	(0.0161)	(0.0160)
N	2692	2692	2692	2692
adj. R-sq	0.961	0.961	0.961	0.961

i) Robust standard errors are in parentheses

ii) ***,**,* denote significance at the 1%, 5%, and 10% levels, respectively

Table 9. LCCs Offer Direct Service After 8 Months

	(1) Codeshare	(2) Codeshare	(3) FFP	(4) FFP
Offer Direct	0.911***	0.912***	0.911***	0.912***
	(0.0148)	(0.0147)	(0.0148)	(0.0147)
Offer Indirect	-0.00504	-0.00351	-0.00534	-0.00389
	(0.0155)	(0.0153)	(0.0155)	(0.0153)
Offer Traditional Codeshare	-0.00145	0.000346	0.00684	0.0107
	(0.0187)	(0.0154)	(0.0228)	(0.0222)
# Allies Offer Direct	0.0213***		0	
	(0.00613)		(.)	
# Allies Offer Indirect	0.0184		0	
	(0.0133)		(.)	
# Rivals Offer Direct	-0.00498		-0.00450	
	(0.00316)		(0.00306)	
# Rivals Offer Indirect	-0.00842		-0.00805	
	(0.00567)		(0.00542)	
Ally Offer Direct		0.0321***		0
		(0.00792)		(.)
Ally Offer Indirect		0.00904		0
		(0.00946)		(.)
Rival Offer Direct		-0.0528***		-0.0517***
		(0.0129)		(0.0128)
Rival Offer Indirect		-0.0173		-0.0172
		(0.0108)		(0.0107)
Nonstop Miles (1,000s)	-0.0243*	-0.0173	-0.0244*	-0.0178
	(0.00961)	(0.00936)	(0.00961)	(0.00934)
Market Volume (100,000s)	0.0134***	0.0162***	0.0132***	0.0162***
	(0.00296)	(0.00270)	(0.00291)	(0.00270)
Itinerary Yield	0.0292	0.0682**	0.0284	0.0678**
	(0.0220)	(0.0240)	(0.0219)	(0.0239)
Hub	0.0465**	0.0494***	0.0469**	0.0498***
	(0.0150)	(0.0149)	(0.0149)	(0.0149)
N	1950	1950	1950	1950
adj. R-sq	0.954	0.955	0.954	0.955

i) Robust standard errors are in parentheses

ii) ***,**,* denote significance at the 1%, 5%, and 10% levels, respectively

Table 10. Regional Carriers Offer Direct Service After 8 Months

	(1)	(2)	(3)	(4)
	Codeshare	**Codeshare**	**FFP**	**FFP**
Offer Direct	0.741***	0.745***	0.738***	0.752***
	(0.0214)	(0.0212)	(0.0214)	(0.0215)
Offer Indirect	-0.00322	-0.00273	-0.0106	0.000637
	(0.0214)	(0.0213)	(0.0214)	(0.0214)
Offer Traditional Codeshare	0.0726*	0.0766*	0.0564	0.0710*
	(0.0322)	(0.0322)	(0.0323)	(0.0321)
# Allies Offer Direct	-0.0326*		-0.000980	
	(0.0131)		(0.00698)	
# Allies Offer Indirect	-0.0398		-0.00598	
	(0.0283)		(0.0172)	
# Rivals Offer Direct	-0.0140*		-0.0332***	
	(0.00604)		(0.00786)	
# Rivals Offer Indirect	-0.00385		-0.0219	
	(0.0122)		(0.0179)	
Ally Offer Direct		-0.0546**		-0.0614***
		(0.0179)		(0.0167)
Ally Offer Indirect		-0.0372		0.00612
		(0.0288)		(0.0210)
Rival Offer Direct		-0.0548***		-0.0385*
		(0.0161)		(0.0168)
Rival Offer Indirect		-0.0103		-0.0462
		(0.0203)		(0.0251)
Nonstop Miles (1,000s)	-0.0571***	-0.0415**	-0.0514**	-0.0375*
	(0.0160)	(0.0158)	(0.0161)	(0.0157)
Market Volume (100,000s)	0.0384***	0.0368***	0.0378***	0.0351***
	(0.00575)	(0.00479)	(0.00573)	(0.00471)
Itinerary Yield	0.128***	0.149***	0.106***	0.140***
	(0.0287)	(0.0295)	(0.0287)	(0.0295)
Hub	0.0532**	0.0541**	0.0598***	0.0487**
	(0.0176)	(0.0175)	(0.0177)	(0.0175)
N	2375	2375	2375	2375
adj. R-sq	0.824	0.825	0.825	0.825

i) Robust standard errors are in parentheses

ii) ***,**,* denote significance at the 1%, 5%, and 10% levels, respectively

The effects of FFP rivals are similar to those of codeshare rivals. Rival service has no significant effect on NWC's entry/exit decisions. For LCCs, the presence of at least one direct rival reduces the probability of offering service by 5.17% (which is almost identical to the codeshare rival effect of 5.28%). For regional carriers, the presence of at least one direct rival reduces the probability of offering service by 3.85%.

Control Variables

Unsurprisingly, all types of carriers were more likely to offer service if one of their hubs (or focus cities) was located at either endpoint of the market. All types of airlines preferred servicing higher volume markets. The itinerary yield did not have any significant effect for NWCs, whereas regional carriers, and to a lesser extent LCCs, were attracted to servicing markets with higher itinerary yields.

7 Conclusion

The study of strategic alliances in the American airline industry is both intriguing and complex. Airlines may be perfect substitutes in certain markets (overlapping), whereas they may be perfect complements in others (connecting/interline). Since the proliferation of codesharing, the industry has witnessed significant improvements in interline service, both domestically and internationally. Passengers are able to fly seamlessly from origin to destination, often by simply purchasing one itinerary, and in many cases redeeming FFP rewards on all segments of their trip. Codesharing as well as other types of alliances (FFP) alliances have also been associated with significant fare reductions.

Although there are notable benefits of such alliances, there are concerns that these types of alliances may be anti-competitive. The formation of strategic alliances may not be effective at deterring entry from rivals; however, our results suggest that they induce exit and reduce the probability of entry by allies on overlapping routes. The LPM found significant evidence that airlines are much more likely to exit routes, or not enter routes, that were operated by their allied partners. This results in less competition on select routes, which drawing from the literature (or from standard microeconomic theory) suggests that fares will be higher. Also, in the absence of such alliances, airlines would be more likely to enter (and less likely to exit) certain routes and create high quality online service for passengers.

The goal of this paper was not to formally conclude whether strategic alliances are welfare enhancing or welfare reducing for the consumer. Rather, this paper formally tested (and confirmed) the suspicion that strategic alliances may cause airlines to compete less vigorously. There has been a substantial amount of research that has analyzed the price effects of codeshare agreements and FFP alliances (as well as other forms of alliances), but what is missing from the analysis is the consideration of how these agreements affect entry and exit patterns over time. This paper stresses the importance of taking into account the dynamic effects of alliances when performing a proper welfare analysis.

Appendix

As a robustness check, I re-perform all the twelve regressions using Probit models. The results for our variables of interest are quite similar between the LPM and the Probit. Indirect services of allies and rivals are insignificant in the NWCs' and LCCs' regressions. For the regional carriers, if an ally offers indirect service they are slightly more likely to offer their own direct service (4.12% compare to LPM's 4.23%).

For NWCs the effect of allies offering direct service are almost identical to the LPM results. For each codeshare or FFP ally offering direct service, they are 2.52% (compare to LPM's 3.01%) and 2.52% (compare to LPM's 2.93%) less likely to offer direct service, respectively. When direct service is provided by at least one codeshare or FFP ally, NWCs are 4.93% (compare to LPM's 5.73%) and 5.13% (compare to LPM's 5.97%) less likely to offer their own service, respectively.

The results between the LPM and Probit are very similar for LCCs as well; however, due to larger standard errors in the Probit model, certain variables with similar coefficients have lost significance. For example, for each additional codeshare ally offering direct service, LCCs are 2.13% less likely to offer service using the LPM (which is significant at the 1% level), whereas they are 2.71% less likely to offer service using the Probit (which is a larger coefficient, but do to a larger standard error is insignificant). When at least one codeshare ally offers service, LCCs are 3.21% less likely to offer service using the LPM (significant at the 1% level), whereas they are 2.9% less likely in the Probit (which is insignificant). The variables for rivals offering direct service are nearly identical. So although not all the coefficients are significant in the Probit model, they are very similar to the LPM, confirming the validity of the LPM approach.

The results between the LPM and Probit are almost identical for regional carriers. When a regional carrier offers a traditional codeshare flight, they are also more likely to offer a direct flight using the LPM, and this is confirmed (again weakly at the 10% level of confidence) using the Probit. When a codeshare ally offers direct service, regional carriers are 3.21% less likely to offer their own direct service using the Probit (compare to 3.26% in the LPM). When at least one codeshare or FFP ally offers direct service, regional carriers are 5.22% (compare to LPM's 5.46%) and 6.33% (compare to LPM's 6.14%) less likely to offer their own service. When at least one codeshare of FFP rival offers direct service, they are 6.83% (compare to LPM's 5.48%) and 5.19% (compare to LPM's 3.85%) less likely to offer their own service.

The coefficient estimates for our variables of interest are very similar between the LPM and the Probit. Although the LPM is a simpler model, it is the appropriate model to analyze the marginal effects of the alliance and rival variables.

Table 11. Probit: NWCs Offer Direct Service After 8 Months

	(1)	(2)	(3)	(4)
	Codeshare	**Codeshare**	**FFP**	**FFP**
Offer Direct	0.277***	0.276***	0.276***	0.273***
	(0.0231)	(0.0229)	(0.0232)	(0.0227)
Offer Indirect	0.0201	0.0194	0.0187	0.0169
	(0.0166)	(0.0167)	(0.0167)	(0.0167)
Offer Traditional Codeshare	-0.0166	-0.0162	-0.0188	-0.0208
	(0.0196)	(0.0197)	(0.0193)	(0.0195)
# Allies Offer Direct	-0.0252***		-0.0252***	
	(0.00492)		(0.00510)	
# Allies Offer Indirect	-0.00472		-0.00145	
	(0.00870)		(0.00884)	
# Rivals Offer Direct	0.00734		0.00675	
	(0.00388)		(0.00394)	
# Rivals Offer Indirect	-0.00484		-0.00588	
	(0.00687)		(0.00674)	
Ally Offer Direct		-0.0493***		-0.0513***
		(0.00862)		(0.00898)
Ally Offer Indirect		-0.0124		-0.00676
		(0.0102)		(0.0101)
Rival Offer Direct		0.00594		0.00404
		(0.00823)		(0.00823)
Rival Offer Indirect		-0.00233		-0.00588
		(0.00901)		(0.00909)
Nonstop Miles (1,000s)	0.0181*	0.0133	0.0167*	0.0101
	(0.00759)	(0.00753)	(0.00767)	(0.00769)
Market Volume (100,000s)	0.00520	0.00777**	0.00527	0.00787**
	(0.00303)	(0.00265)	(0.00304)	(0.00264)
Itinerary Yield	0.0634*	0.0669**	0.0629*	0.0632*
	(0.0251)	(0.0251)	(0.0251)	(0.0248)
Hub	0.0389***	0.0351***	0.0391***	0.0372***
	(0.0109)	(0.0106)	(0.0110)	(0.0108)
N	2692	2692	2692	2692

i) Standard errors are in parentheses

ii) ***,**,* denote significance at the 1%, 5%, and 10% levels, respectively

Table 12. Probit: LCCs Offer Direct Service After 8 Months

	(1) Codeshare	(2) Codeshare	(3) FFP	(4) FFP
Offer Direct	0.267***	0.266***	0.267***	0.266***
	(0.0183)	(0.0181)	(0.0183)	(0.0181)
Offer Indirect	-0.0126	-0.0117	-0.0131	-0.0122
	(0.0122)	(0.0122)	(0.0122)	(0.0122)
Offer Traditional Codeshare	-0.0220	-0.0116	-0.00713	0.00162
	(0.164)	(0.157)	(0.137)	(0.132)
# Allies Offer Direct	0.0271		0	
	(0.0493)		(.)	
# Allies Offer Indirect	0.0595		0	
	(0.191)		(.)	
# Rivals Offer Direct	-0.00588		-0.00549	
	(0.00371)		(0.00366)	
# Rivals Offer Indirect	-0.00951		-0.00933	
	(0.00676)		(0.00669)	
Ally Offer Direct		0.0290		0
		(0.0458)		(.)
Ally Offer Indirect		0.0489		0
		(0.231)		(.)
Rival Offer Direct		-0.0537***		-0.0536***
		(0.0122)		(0.0122)
Rival Offer Indirect		-0.0187		-0.0189
		(0.0112)		(0.0112)
Nonstop Miles (1,000s)	-0.0541***	-0.0489***	-0.0550***	-0.0499***
	(0.0132)	(0.0129)	(0.0133)	(0.0129)
Market Volume (100,000s)	0.0193***	0.0223***	0.0193***	0.0227***
	(0.00456)	(0.00411)	(0.00457)	(0.00413)
Itinerary Yield	-0.101	-0.0693	-0.105	-0.0716
	(0.0541)	(0.0530)	(0.0545)	(0.0534)
Hub	0.0351***	0.0389***	0.0353***	0.0391***
	(0.0103)	(0.0103)	(0.0104)	(0.0103)
N	1950	1950	1950	1950

i) Standard errors are in parentheses
ii) ***,**,* denote significance at the 1%, 5%, and 10% levels, respectively

Table 13. Probit: Regional Carriers Offer Direct Service After 8 Months

	(1) Codeshare	(2) Codeshare	(3) FFP	(4) FFP
Offer Direct	0.513***	0.513***	0.505***	0.517***
	(0.0193)	(0.0193)	(0.0194)	(0.0194)
Offer Indirect	-0.0125	-0.0132	-0.0219	-0.0104
	(0.0242)	(0.0241)	(0.0245)	(0.0242)
Offer Traditional Codeshare	0.0825*	0.0868*	0.0643	0.0818*
	(0.0406)	(0.0404)	(0.0407)	(0.0403)
# Allies Offer Direct	-0.0321**		-0.0000990	
	(0.0124)		(0.00755)	
# Allies Offer Indirect	-0.0401		-0.00722	
	(0.0304)		(0.0181)	
# Rivals Offer Direct	-0.0167**		-0.0370***	
	(0.00558)		(0.00731)	
# Rivals Offer Indirect	-0.00422		-0.0208	
	(0.0138)		(0.0208)	
Ally Offer Direct		-0.0522**		-0.0633***
		(0.0160)		(0.0166)
Ally Offer Indirect		-0.0387		0.00480
		(0.0304)		(0.0221)
Rival Offer Direct		-0.0683***		-0.0519**
		(0.0170)		(0.0169)
Rival Offer Indirect		-0.0109		-0.0428
		(0.0212)		(0.0252)
Nonstop Miles (1,000s)	-0.108***	-0.104**	-0.114***	-0.105***
	(0.0322)	(0.0316)	(0.0320)	(0.0317)
Market Volume (100,000s)	0.0442***	0.0423***	0.0436***	0.0412***
	(0.00714)	(0.00612)	(0.00693)	(0.00594)
Itinerary Yield	0.0621	0.0612	0.0171	0.0436
	(0.0500)	(0.0498)	(0.0497)	(0.0499)
Hub	0.0503**	0.0504**	0.0578***	0.0455**
	(0.0163)	(0.0163)	(0.0164)	(0.0165)
N	2375	2375	2375	2375

i) Standard errors are in parentheses

ii) ***,**,* denote significance at the 1%, 5%, and 10% levels, respectively

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