Asymmetric Regulation and Airport Dominance in International Aviation: Evidence from the London–New York Market

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Abstract

International airline markets have the rather unusual feature of partial deregulation with asymmetric regulatory constraints: some carriers face different entry restrictions than others do for a given route. Like domestic air travel, international travel also features hubs, where a single carrier may dominate a given airport. This paper examines the effects of asymmetric regulation and airport dominance on airlines' fares in the London - New York market, a market uniquely suited for identifying the effects of both of these issues. Comparison data from the symmetrically regulated Frankfurt - New York and Paris - New York markets enable a difference-in-differences identification strategy. Regulatory restrictions are found to decrease affected carrier's fares, while airport dominance increases a dominant airline's fares. The results have important policy implications for further deregulation of international airline markets.

Keywords: Asymmetric Regulation, Airport Dominance, International Aviation, Deregulation

JEL Codes: L13, L29, L50, L93

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I. Introduction

One of the most important recent developments in international business has been the gradual deregulation of the international airline markets. The potential benefits of allowing market forces to govern international aviation are enormous. For example, the EU has estimated that consumers will gain as much as $5.8 billion a year from establishment of the currently negotiated 'open aviation area' to include North America, the EU, and the North Atlantic Ocean (Economist, 2003). Strong political opposition to the deregulation process is, however, likely to make *partial* deregulation a reality for the near future. Further, on a number of international airline markets, regulatory restrictions have been partially removed in such a way that different players face different entry and other barriers. Such institutional structure – we will call it asymmetric regulation[2] – can compromise the idea of deregulation and fail to bring the expected welfare gains.

Another important feature of the international airline industry is that most international passengers (substantially more than on domestic markets) travel to or from the individual airlines' hub airports. This brings into consideration the airport dominance effect. The issue of airport dominance has received some attention in the literature. Borenstein (1989) showed that airlines charge higher fares for their services to/from the airport at which they have a dominant position. Additional evidence has come from Evans and Kessides (1993) and Berry, Carnal and Spiller (1996). Evans and Kessides conclude (by estimating reduced-form fixed effects price regressions) that airport dominance contributes more than route dominance to an airline's ability to charge higher fares. Berry et. al. (through structural estimation of a differentiated-product oligopoly-model) find that the dominant airlines' power to charge higher fares is restricted to business travelers. While airport dominance has been established to play a role on domestic US market, it is not clear whether this effect also applies to the more regulated international routes.

This paper uses the London–New York market to measure the price effects of asymmetric regulation on the affected carriers. To measure the effects of airport

[2] Elsewhere, the issue of asymmetric regulation has been recently studied in context of its impact on competition on telecommunications markets (Martinez et al., 2003, de Bijl and Peitz, 2002)

dominance on international airline markets, other two New York originating routes (New York-Frankfurt and New York-Paris) are used. In fact, transatlantic routes originating in New York provide an ideal environment for examining both issues. On the London-New York market, asymmetric regulation takes the form of access restrictions to London's Heathrow Airport for some airlines. Also, Continental Airlines has a dominant position at Newark's Liberty airport. London–New York market also allows to mitigate the limitations that data availability and market structure put on empirical research on the international airline markets. Abundant price data happens to be available only for US carriers. On most international routes only one US carrier offers nonstop service, with two notable exceptions: routes originating at Chicago (with two US carriers) and routes originating at New York (with five US carriers operating transatlantic flights at the time period considered in this paper). But New York has an advantage over Chicago in terms of measuring the effects of airport dominance. Chicago has a virtually symmetric duopoly between American Airlines and United Airlines at O'Hare airport, while metropolitan New York has asymmetries allowing identification of the airport-dominance effect. Finally, the London-New York market is attractive for understanding the future of deregulated international air travel, as we might eventually expect an increase the number of competitors on other routes as entry and other barriers are relaxed.

To disentangle the asymmetric-regulation and airport-dominance effects on fares charged by affected carriers, we employ a difference-in-differences approach, using selected itineraries from the International Data Bank 1A of the US Department of Transportation. A similar difference-in-differences approach was applied to the US airline market by Borenstein (1990, 1991) to measure market power effects of airline mergers and airport dominance on the US market. Yet, Borenstein's application of difference-in-differences to airport dominance involved assessing market share effects of this phenomenon.

Our study yields evidence suggesting that the regulation effect on fares charged by Continental Airlines (the restricted carrier) on the London - New York route is negative. Yet, fare decreases due to the regulation effect are offset by the Continental's large positive airport-dominance effect on the transatlantic routes. Further, the

magnitude of the airport dominance effect we observe (up to 29% of Continental's non-stop transatlantic economy class fares) is greater than that found for the US routes.

The findings of this study have important policy implications for the process of deregulating the international aviation, as follows. First, the airport dominance effect should be taken into account when modeling proposed regulation changes. Second, if the proposed change inevitably results in an asymmetric regulatory regime, fewer freedoms should be given to an airline that has 'umbrella' of airport dominance effect. Third, since currently many airlines are both heavily supported by the governments and have dominant position in airports, which serve as international gateways, partially deregulated environments, which actually favor the carriers with airport dominance, are likely to emerge; this danger should not be neglected in the planning of deregulation of the international aviation.

The paper is organized as follows. Section II briefly describes the current regulation and deregulation efforts on international airline markets, including a description of the entry barriers specific to the London - New York route. Section III analyzes a sample of international itineraries, in order to identify and estimate the effects of airport dominance and asymmetric regulation on fares charged by different carriers on the London - New York market. Section IV offers a discussion of results and policy implications of the analysis, both for London - New York market and for the process of deregulation of international aviation in general. Section V concludes and offers directions for further research.

II. Institutions

1 International Airline Market and Its Deregulation

For decades, countries saw aviation as primarily a matter of national prestige and sovereignty (Economist, 2003). This resulted in excessive protection of countries' airlines from international competition. As a consequence, the international airline industry, the very aim of which is to facilitate connections between countries and make the world more open, has until recently maintained substantial artificial barriers to entry and competition. These barriers allowed the airlines (with assistance from their

governments) to create possibly the largest international cartel in history in terms of its scope. This cartel operated through the International Air Transport Association (IATA), which periodically gathered representatives of almost all airlines operating international services to decide – by unanimous consent – what fares to charge on almost all international routes. According to The Economist (2003), IATA "amounted to an amazing global cartel[3] that made OPEC look amateurish". The entry barriers were specified by a complicated system of bilateral intergovernmental treaties that defined which carriers could perform services between the countries, between which airports, what aircraft they could use, how often they could fly, what fares could be charged (in most cases fares agreed upon at the above mentioned IATA conferences became integral parts of such agreements), etc[4].

Inspired by the successful deregulation of the US airline market, many countries followed suit. At this point, a great number of countries have allowed market forces to govern their domestic airline markets, with mixed outcomes (see Williams (2002) for further details). Some efforts have been implemented towards deregulation of international aviation as well, the most remarkable of which resulted in the gradual creation of the single deregulated airline market within the European Union. Another substantial achievement is the signing of liberal 'open-skies' agreements between the United States and a number of countries[5]. These agreements have recently been ruled unlawful by the European Commission, since they discriminate against carriers from the EU countries, which are not signatories to them. Negotiations between the US and the EU are currently underway to attempt to establish an 'open aviation area' to include Europe, America and the North Atlantic Ocean. At the same time, many routes covering travel to/from Asia, Africa, Eastern Europe and South America, remain governed by the restrictive bilateral agreements. In total, about half of international airline passengers travel on heavily regulated routes.

[3] In fact, IATA had such other features of a cartel as compliance inspectors to enforce the fares set at secret conferences, and substantial financial penalties for non-compliance.

[4] There is a considerable literature describing the details of regulation and deregulation of international air transportation (Doganis, 1991, 2001, de Murias, 1989, Sochor, 1991, Williams, 1993, 2002), and the reader wishing to learn about further details is directed to these sources.

[5] In fact, the history of 'open-skies' agreements offer an excellent illustration of both gradual nature of liberalization of international airline markets and asymmetric regulation that went hand-in-hand with removal of barriers to competition (see Doganis (2001), Chapter 2).

The common feature of all efforts at liberalization of airline markets is their gradual nature. Further, in the process of deregulation some carriers end up being treated better than others. A typical example of an asymmetric partial deregulation in international aviation would be an 'open-skies' agreement between the two countries, granting carriers from the two signatories all possible rights to fly non-stop between any two points in the two countries, and to set schedules and fares as they see fit. Such agreements, while definitely removing a number of constraints present in a typical bilateral air services agreement, discriminate against carriers from other countries, which have to offer one-stop flights if they want to provide service between the countries that signed the 'open-skies' agreement. Further, the fact that political influences in international aviation remain strong may cause deregulation to halt after an institutional structure satisfactory to players with higher political influence has been established. We know that while removal of all distortions and allowing unrestricted competition is welfare-increasing, the welfare effects of removal of only some distortions on the market are not always easy to predict. This means that partial deregulation of international aviation may in fact be welfare-decreasing, discrediting the very idea of bringing market forces into play in the industry. Identifying the factors which can undermine the process of deregulation of the international airline industry is therefore an important issue this paper aims to address.

2 London – New York Market and Asymmetric Entry Barriers

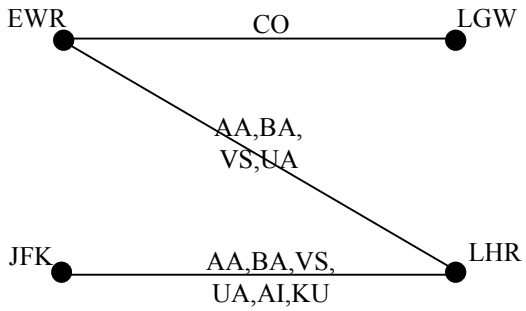
Before we proceed, it is necessary to describe the London – New York market, as well as to outline the nature of asymmetric entry restrictions on the route. Those are related to access to London's Heathrow airport (airport code LHR). Presently, only four incumbent airlines are allowed to offer direct non-stop transatlantic services from Heathrow. These are British Airways (BA), Virgin Atlantic (VS), American Airlines (AA) and United Airlines (UA)[6]. This is the major entry barrier on the US – London market, exacerbated by the fact that LHR is a congested airport and take-off and landing slots there are not readily available.

[6] All four of these airlines are present on the London – New York market, and offer services from Heathrow to both John F. Kennedy and Newark airports.

Direct non-stop services on the London – New York market are offered from two New York City area (John F. Kennedy (JFK) and Newark Liberty (EWR)) and two London area (Heathrow and Gatwick (LGW)) airports. Thus, we end up with four distinct airport-pair markets (APM), of which only three are actually 'functioning': over the time period analyzed there were no non-stop services between JFK and LGW. Access to two (LHR – JFK and LHR – EWR) of these three airport-pair markets is restricted to the incumbent airlines[7], as described above. There is still room for entry on the LGW – EWR market, as well as on the JFK – LGW route[8].

The carrier we will focus our attention on is Continental Airlines, the only airline offering service between Gatwick and Newark. This airline is the restricted carrier on the market. The nature of its disadvantageous position relative to the incumbent carriers is two-fold. First, LHR is more conveniently located than Gatwick and allows picking up more connecting passengers. Second, carriers with access to both London area transatlantic gateways can potentially offer their customers a wider menu of services.

Further, Continental Airlines is the dominant carrier in Newark Liberty airport, which will make us focus at this carrier in determining airport dominance effect on fares. British Airways is a dominant carrier at London Heathrow airport, but available data will not allow us to estimate the airport dominance effect for this carrier. Figure 1 below provides a schematic representation of the market, indicating which carriers are present on which routes.



[7] Air India (AI) and Kuwait Airways (KU) also fly between JFK and Heathrow, but these services are performed in connection to those carriers' flights from Asia, and are governed by bilateral agreements between US/UK on one hand and India/Kuwait on the other.

[8] According to the Air Services Agreement between the US and the UK governments, each country can designate two carriers to perform services on each of those airport-pair markets.

Figure 1. Airlines Operating on London – New York Market

Finally, a couple of words need to be said about potential players on the market. Besides the US and UK carriers mentioned here, Delta Airlines channels a significant portion of its transatlantic traffic through JFK, even though it does not fly to London from New York. In 1999 (the time period covered by our research), TWA was another airline, which flew to many European destinations from JFK airport, but stayed out of the New York–London market. Either of the two (or even both) airlines could have been designated to fly into Gatwick from JFK, according to the Bermuda agreement. On the other side of the Atlantic, British Midland Airlines operates a number of departures from London Heathrow but cannot use this airport as a gateway for its transatlantic services.

III. Disentangling Airport Dominance and Regulation Effects

1 Hypotheses

Whereas airport dominance is clearly expected to have an increasing effect on fares, charged by the dominant airline, hypotheses related to asymmetric regulation appear less evident at first. Yet, simple intuition suggests that less preferential treatment (more entry barriers in case of the London – New York market) will lower fares charged by the affected carrier. The logic is clear in the case of the above-mentioned 'open-skies' agreement: carriers from third countries are restricted to connecting services between the signatories to the agreement (for example, an airline from France cannot offer non-stop services between the US and the Netherlands, and has to channel all its traffic between the two countries through its hub in France), and empirical evidence (e.g., Brueckner, 2003) suggests that adding a stop on the way reduces the fare, as it makes the trip longer. Regarding the situation on the London – New York market, the fares charged by the restricted carrier should be lower either because passengers prefer Heathrow to Gatwick as their arrival airport, or due to the fact that the restricted carrier is allowed to offer fewer services on the market as compared to the unrestricted carriers (unrestricted carriers can potentially fly into both Heathrow and Gatwick, whereas the restricted carrier does not have this much freedom). In the latter case, if an unrestricted carrier raises price for one of its services, some of the passengers will switch to other services of the same

carrier. Since the unrestricted carrier offers more services than does the restricted carrier, the overall profit of the former will be affected less adversely by such a price increase. Thus, the unrestricted carrier will be able to hold prices at a higher level, other things equal[9]. This suggests a testable hypothesis for the effect of asymmetric regulation. Namely, more entry barriers should lead to lower fares charged by the affected carrier.

In testing our hypotheses we will employ the difference-in-differences approach to single out the airport dominance effect for fares charged by Continental Airlines on several transatlantic markets, as well as to determine the impact of differences in regulation on fares charged by Continental Airlines on the London – New York route. The next subsection offers a brief description of the identification strategy, which is then applied to a sub-sample of fares from the International Data Bank 1A (DB1A) of the US Department of Transportation.

2 Identification Strategy

This subsection outlines the methodology used to disentangle the airport dominance and the regulation effects for Continental Airlines, which is both the restricted carrier on the market and likely to be able to take advantage of its dominant position at Newark airport. The 'philosophy' of the difference-in-differences identification strategy is to exploit the similarities across markets and airlines to identify the differences (between markets and carriers) we are interested in. Roughly speaking, the similarities are differenced out in the process, and the differences remain. Once we have identified the effects we are interested in, we can apply the data to the methodology to test for statistical significance of the differences.

Conditional Mean Fare for Continental Airlines on London-New York Route

To successfully apply this strategy in our case, we assume that fares charged by Continental Airlines on the London–New York route consist of the following effects:

- Regulation effect, arising from the nature of the regulatory constraints that CO faces on the London – New York market ($\delta_{\mathrm{Re}g}^{CO}$).

[9] This result has been formally worked out for logit and nested logit demand structure in an earlier version of this paper. Technical details are available from the author upon request.

- Airport dominance effect, which is the result of the fact that CO has dominant position in the Newark Liberty airport (δ_{Hub}).
- Airline effect (δ_{CO}).
- Non-stop flight effect, which reflects airline customers' willingness to pay premium for travel with fewer stops (δ_{NS}).

Our task is to identify the airport dominance and the regulation effects. For this, we will need to difference out the airline effect and the non-stop flight effect. To be able to do so, we restrict the conditional mean fare function for Continental Airlines in the following way:

$$E\left(P_{LONNYC} \mid Airline = CO, NS\right) = \delta_{CO} + \delta_{NS} + \delta_{\mathrm{Re}g}^{CO} + \delta_{Hub} \qquad (1)$$

Comparison Carrier – Non-Stop London-New York Flights

Whereas for some other carrier on the same city-pair market (the comparison carrier) the conditional mean fare function will be of the form:

$$E\left(P_{LONNYC} \mid Airline, NS\right) = \delta_{Airline} + \delta_{NS} + \delta_{\mathrm{Re}g}^{Airline} \qquad (2)$$

Where $\delta_{Airline}$ is the airline effect, common to all flights by a given carrier, regardless of the number of stops, and δ_{NS} is the non-stop effect, common to all carriers on all airport-pair markets on the route. On the other hand, $\delta_{\mathrm{Re}g}^{Airline}$ varies across carriers.

Getting Rid of the Non-Stop Flight Effect

Given this, using American Airlines as the comparison carrier and taking the difference:

$$\Delta_{NS} = E\left(P_{LONNYC} \mid Airline = CO, NS\right) - E\left(P_{LONNYC} \mid Airline = AA, NS\right) \qquad (3)$$

we will be able to get rid of the non-stop effect. In fact:

$$\Delta_{NS} = \delta_{CO} + \delta_{\mathrm{Re}g}^{CO} + \delta_{Hub} - \delta_{AA} - \delta_{\mathrm{Re}g}^{AA} \quad (4)$$

Getting Rid of the Airline Effects

To difference out the airline effects we can, based on our assumption that it is the same for all flights of a given carrier, use fares for the London – New York segment of what we will call "through itineraries" (e.g., fare for the New York to London segment of the Nashville – New York – London trip). For Continental Airlines, these fares will not include the hub effect, since it is shown to exist only for trips to or from (not through) the hub airport. We will also assume that regulation effects for through trips are the same for all carriers. This assumption might not be reasonable if consumers happen to prefer Heathrow over Gatwick as their departure/ arrival airport, but in this case the resulting estimate of the difference in regulation effects would be biased upward. That is, if a negative value for the difference in regulation effects obtains in the end, we can be rather confident that, even if this estimate is biased in a sense just discussed, correction for this bias would make it even more negative. Thus, possible violation of this assumption will not move us to concluding that negative regulation effect does exist where it does not, but it can lead us to claim that less favorable regulation does not negatively affect fares, when in fact it does. Given our assumptions, the airline effect is the only one we will have in the expected fare function for London – New York segment of one-stop trips. Then, taking the difference:

$$\Delta_{Through} = E\left(P_{LONNYC} \mid Airline = CO, 1S\right) - E\left(P_{LONNYC} \mid Airline = AA, 1S\right) = \delta_{CO} - \delta_{AA} \quad (5)$$

and then differencing:

$$\Delta_{LONNYC} = \Delta_{NS} - \Delta_{Through} = \delta_{Hub} + \delta_{\mathrm{Re}g}^{CO} - \delta_{\mathrm{Re}g}^{AA} \quad (6)$$

gets rid of the airline effects[10]. Thus, the only effects we are left with are hub and (difference in) regulation effects.

Identification of $\Delta_{Through}$ from the Data

But, before proceeding to disentangle the two effects, it is necessary to note that the data on New York to London leg prices for through trips are not available. To be able to identify $\Delta_{Through}$, therefore, we will use the assumption that leg fares for domestic portion of the through international itineraries are the same for both airlines (due to competitive nature of those routes), in which case $\Delta_{Through}$ will be identified by the difference in total fares for through flights.

Identification of the Airport Dominance Effect and the Difference in Regulation Effects

To difference out the hub airport effect and identify the difference in regulation effects we will use transatlantic markets with symmetric regulation. Namely, New York – Frankfurt and New York – Paris routes will be used for this purpose[11]. Then, if we define terms similar to Δ_{NS} and $\Delta_{Through}$ for, for instance, New York – Frankfurt route, and obtain the difference between these terms, denoting it Δ_{FRANYC}, we will be able conclude that:

$$\Delta_{FRANYC} = \delta_{Hub} \tag{7}$$

and finally:

$$\Delta_{LONNYC} - \Delta_{FRANYC} = \delta_{\mathrm{Re}g}^{CO} - \delta_{\mathrm{Re}g}^{AA} \tag{8}$$

[10] This kind of differencing would be necessary even if non-stop trip effect were totally absent.
[11] Travel between Germany and the United States is governed by the "open-skies agreement" between two countries, which basically puts "nationality clause" as the only entry barrier. That is, the only restriction on the market is that airlines offering services between Germany and the United States have to be owned and effectively controlled by nationals of either of the two countries. As of 1999, travel between France and the United States was governed by the bilateral agreement, which is also likely to treat all carriers in the same fashion.

This identifies all the effects we are interested in. Appendix gives a schematic representation of the identification strategy.

Identification Strategy in Regression Context

It is relatively easy to put this approach in the regression context – as we will in fact do in the next section. The effects we are interested in will be defined by interactions of indicator variables and/or their differences. Suppose, we want to identify the hub dominance effect for CO versus AA from the regression:

$$P_i = X_i\beta + \gamma_1(CO * NonStop)_i + \gamma_2(AA * NonStop)_i + \gamma_3(AA * Through)_i + error_i \quad (9)$$

here *CO*Through* variable serves as the baseline category and *X* is the vector of controls. In this case, the hub dominance effect will be defined as:

$$\delta_{Hub} = \gamma_1 - (\gamma_2 - \gamma_3) \quad (10)$$

if we add the three variable interaction *CO*NonStop*LONNYC* to this regression, the coefficient on this variable will identify the difference in regulation effects on the London-New York market[12]. These results can be easily verified by constructing the appropriate conditional means and taking their differences.

We can term the identification strategy outlined above either difference-in-differences-in-differences or difference-in-differences-and-difference (since one of the effects is obtained with a difference-in-differences and we need to take another difference to arrive at the other effect we are interested in). Angrist and Krueger (1998) contains a nice general description the difference-in-differences approach. The method has been applied to analyze effects of a wide variety of policies (see Athey and Imbens (2003) for a review of applications of the method). It should also be noted that our application of the difference-in-differences approach is different from most other cases, since we do not have a panel data set. Yet, there is nothing to preclude us from using this approach;

[12] The coefficient on *AA*NonStop*LONNYC* variable (if added to regression (9)) should not be statistically significantly different from zero, following our assumptions.

further, the above-cited application of difference-in-differences to the airline industry (Borenstein, 1991) also uses cross-sectional data.

3 Estimation

The data necessary for implementation of the above-described identification strategy was obtained from the Data Bank 1A (DB1A) International for the third quarter of 1999, collected by the US Department of Transportation (US DOT). DB1A, collected quarterly, provides a 10% sample of all tickets sold for travel on US airlines. We will use restricted economy class roundtrip fares, since the number of itineraries for other fare types on the markets of our interest is very small. Yet, the dataset we use has one serious limitation: it only permits us to obtain roundtrip fares for US carriers (whereas itineraries involving segments operated by foreign carriers do appear in DB1A, as long as at least one segment is flown on a US carrier, itineraries operated solely by foreign carriers are not included into the dataset). This limits the set of comparison carriers for identification of both effects to American Airlines and United Airlines. Further, since United Airlines does not channel much traffic to London through New York[13], we can only use AA to difference away all the effects we pointed out. In addition to that, we can use Trans World Airlines[14] as a comparison carrier on the New York – Paris market for an additional estimate of Continental's airport dominance effect.

Before proceeding with the more careful analysis to control for airline and market-specific heterogeneities, we will present results of a simple 'raw' data analysis. The purpose of this is twofold. First, we want to see whether the raw data points us towards existence of the effects just discussed. Second, this analysis both provides a clear first application of the identification strategy just discussed to data, and helps us define the relevant variables to be included into regressions reported later in this subsection. The summary statistic we will be interested in is the average restricted economy class fare on selected routes. In accordance with the previous subsection, we use roundtrip fares for both non-stop flights between New York and London, Frankfurt

[13] United Airlines' channels its transatlantic traffic through either Washington or Chicago, thus leaving us with very few one-stop itineraries to London through New York for this carrier.

[14] In 2001 TW was absorbed by AA; even though TW did channel its transatlantic traffic through New York, it was not present on London – New York and Frankfurt – New York markets.

and Paris; as well as roundtrip fares for travel to each of the three European endpoints through New York from other US airports (what we referred to as through-fares in the previous subsection). The following selection criteria have been applied. First, in order to prevent contamination of our results by the unreasonable fares, we discarded roundtrip fares below $100 and above $4000, as well as any other fares, flagged as 'questionable' in the dataset. Second, only single-airline roundtrip itineraries were included[15]. Third, for through itineraries, only those US end-points were selected, for which both Continental Airlines and the comparison carriers channeled traffic from a given US endpoint to a specified European endpoint through a New York City area airport[16]. For example, if Continental Airlines were actively present on the Rochester – New York – London market, but not on the Rochester – New York – Frankfurt route; whereas American Airlines channeled its traffic from Rochester to both London and Frankfurt through New York; in this case, we would exclude AA's Rochester – New York – Frankfurt itineraries from the sample, since the two carriers do not actually compete on this route. Results of the raw data analysis are presented in Table 1 below.

[15] American Airlines and American Eagle were considered to be the same carrier.
[16] We considered this to be the case, if the dataset contained at least five such through-itineraries for each of the carriers involved.

Table 1 Estimates of Hub Dominance and Difference in Regulation Effects for Continental Airlines on New York – London, New York – Frankfurt, and New York – Paris Routes (Differences in Means Approach)

	New York – London	New York - Frankfurt	New York – Paris	
Fares and Differences	AA as Comparison Carrier	AA as Comparison Carrier	AA as Comparison Carrier	TW as Comparison Carrier
CO – Non-Stop Fares (1)	696.81 (39.44)	724.26 (43.04)	824.26 (36.44)	
CO – Through Fares (2)	605.69 (22.26)	611.59 (22.98)	698.96 (44.77)	
Comparison Carrier – Non-Stop Fares (3)	597.25 (11.57)	571.75 (24.13)	735.14 (29.89)	867.76 (45.59)
Comparison Carrier – Through Fares (4)	648.02 (12.99)	668.87 (17.85)	844.19 (37.73)	966.68 (77.37)
Δ_{NS}=(1) – (3)	99.56** (32.02)	152.51** (49.34)	89.19* (47.14)	-43.50 (56.06)
$\Delta_{Through}$=(2) – (4)	-42.32* (25.77)	-57.27** (29.11)	-145.23** (58.55)	-267.72** (89.39)
$\Delta_{LONNYC} = \Delta_{NS}^{LONNYC} - \Delta_{Through}^{LONNYC}$	141.88** (41.10)	Not Applicable		
$\delta_{Hub} = \Delta_{NS} - \Delta_{Through}$		**209.78** (57.28)**	**234.35** (75.17)**	**224.21** (105.52)**
$\Delta_{LONNYC} - \delta_{Hub} = \delta_{Reg}^{CO} - \delta_{Reg}^{AA}$		**-67.90 (70.51)**	**-92.47 (87.33)**	**Not Applicable**

Non-stop fares are average restricted economy class fares across itineraries between the indicated European airport and New York City area airports, for non-stop return trips operated by a single carrier. Through fares are average restricted economy class fares for one-stop return trips operated by a single carrier from US airport to a European end-point through a New York City area airport. Obtained from DB1A for third quarter of 1999. Values in parentheses are standard errors. All numbers are in US Dollars.

* - indicates that difference is statistically significantly different from zero for two-tail test at 10% significance level

** - indicates that difference is statistically significantly different from zero for two-tail test at 5% significance level

The following results are evident from Table 1. First, the three estimated airport dominance effects are rather close to each other, represent 27 to 29 percent of average CO non-stop fare on a respective route, and are highly significant. Second, estimates of the difference in regulation effects are negative as expected, but not statistically significant. One should however keep in mind that the identification strategy employed might end up underestimating the difference in regulation effects. As noted above, one of the reasons such an effect may exist on the market in question is due to consumers' preference of Heathrow over Gatwick. In such a case, $\Delta_{Through}^{LONNYC}$ will include these effects.

Thus, $\Delta_{Through}^{LONNYC}$ will be underestimated; hence, Δ_{LONNYC} will be overestimated, and the difference in regulation effects will be biased towards zero. In the most extreme case where regulation effects are completely included into the through fares, $\Delta_{Through}^{LONNYC}$ will completely difference out the regulation effects and Δ_{LONNYC} will only identify the airport dominance effect. Also, in obtaining the raw estimates reported above we do not control for a number of important factors, such as distance, market size and competition. This is the primary goal of the regression analysis that follows.

In the estimations, results of which are reported in Tables 2 and 3, we control for distance by using the natural logarithm of fare per mile as the dependent variable. The market size is controlled for by using the geometric averages of endpoints' population (a rather standard measure). Finally, two measures of competition are used: the number of online and interline competitors. The number of on-line competitors is simply the number of carriers offering non-stop service in case of London – New York, Paris – New York and Frankfurt – New York routes, or the number of airlines offering one-stop services through New York, for all other markets. The number of interline competitors was calculated for through itineraries as the number of airlines offering services between the spoke airport and New York, times the number of carriers, offering non-stop services between New York and a European end-point. For non-stop itineraries, the number of interline competitors is equal to zero. While we understand that the use of measures of competition is potentially dangerous due to their possible endogeneity, two things should be noted. First, these variables have been used in the literature, when estimating reduced-form price equations for airline markets. Second, it can be argued that, unlike setting of fares, entry decisions by airlines are not taken overnight (especially so on international routes). Given that our data only spans one quarter, we can suggest that the possible endogeneity problem is mitigated.

Table 2 below includes results for all the itineraries, markets and carriers employed previously. Table 3 reports results with Trans World Airlines itineraries excluded (as this carrier is not used in identification of the difference in regulation effects).

Table 2 Estimation Results – All Itineraries

	Specification 1	Specification 2	Specification 3	Specification 4
Independent Variable	Coefficient (st. error)	Coefficient (st. error)	Coefficient (st. error)	Coefficient (st. error)
Constant	-2.7846** (0.0229)	-2.7995** (0.0253)	-2.7652** (0.0645)	-2.7648** (0.0651)
Interline Competition	---	---	-0.0046 (0.0074)	-0.0041 (0.0079)
Online Competition	---	---	0.0065 (0.0133)	0.0028 (0.0433)
Market Size	---	0.17E-08 (0.88E-08)	---	0.17E–08 (0.88E-08)
US Origin	0.1179** (0.0161)	0.1183** (0.0161)	0.1189** (0.0161)	0.1189** (0.0161)
London Itineraries	---	0.0498 (0.0329)	0.0556** (0.0185)	0.0508 (0.0367)
TW*Non-Stop Itineraries	0.4484** (0.0482)	0.4550** (0.0572)	0.3953** (0.1636)	0.4061** (0.1776)
TW*Through Itineraries	0.2590** (0.0573)	0.2683** (0.0606)	0.2767** (0.0588)	0.2683** (0.0629)
CO*Non-Stop Itineraries	0.3265** (0.0383)	0.3334** (0.0488)	0.2739* (0.1603)	0.2847* (0.1648)
AA*Non-Stop Itineraries	0.2330** (0.0250)	0.1960** (0.0408)	0.1369 (0.1533)	0.1470 (0.1656)
AA*Through Itineraries	0.1189** (0.0277)	0.1065** (0.0278)	0.1051** (0.0281)	0.1062** (0.0277)
CO*London*Non-Stop Itineraries (Regulation)	**-0.0858** (0.0398)**	**-0.1254** (0.0418)**	**-0.1243** (0.0436)**	**-0.1251** (0.0442)**
Adjusted R-squared	0.06199	0.06345	0.06330	0.06306
Values Derived from the Regression Coefficients				
Airport Dominance (CO-AA)	**0.2124** (0.0423)**	**0.2440** (0.0438)**	**0.2421** (0.0435)**	**0.2440** (0.0443)**
Airport Dominance (CO-TW)	**0.1373* (0.0755)**	**0.1468* (0.0779)**	**0.1553** (0.0767)**	**0.1527* (0.0798)**

Notes:

1. Dependent variable is natural logarithm of fare per mile
2. Number of observations = 3986
3. See previous paragraph for description of market size and competition measures
4. Data comes from DB1A for the third quarter of 1999
5. Results corrected for heteroscedasticity using White robust variance-covariance matrix
6. Hub dominance effect is identified as follows:
   a. For CO versus TW – by the difference: CO*Non-Stop-(TW*Non-Stop-TW*Through)
   b. For CO versus AA – by the difference: CO*Non-Stop-(AA*Non-Stop-AA*Through)
7. Regulation effect is identified by the coefficient on CO*London*Non-Stop Itineraries dummy

* significant at 10% level

** significant at 5% level

Table 3 Estimation Results – TW Itineraries Excluded

	Specification 1	Specification 2	Specification 3
Independent Variable	Coefficient (st. error)	Coefficient (st. error)	Coefficient (st. error)
Constant	-2.8159** (0.0251)	-2.8157** (0.0676)	-2.8110** (0.0702)
Interline Competition	---	-0.0022 (0.0073)	-0.0012 (0.0078)
Online Competition	---	0.0140 (0.0338)	0.0040 (0.0442)
Market Size	0.48E–08 (0.87E–08)	---	0.42E–08 (0.11E–07)
US Origin	0.1579** (0.0155)	0.1579** (0.0156)	0.1580** (0.0156)
London Itineraries	0.0392 (0.0326)	0.0524** (0.0186)	0.0405 (0.0365)
CO*Non-Stop Itineraries	0.3175** (0.0487)	0.2686* (0.1583)	0.2951* (0.1733)
AA*Non-Stop Itineraries	0.1792** (0.0406)	0.1333 (0.1512)	0.1577 (0.1638)
AA*Through Itineraries	0.1008** (0.0277)	0.0976** (0.0280)	0.1004** (0.0273)
CO*London*Non-Stop Itineraries (Regulation)	**-0.1236** (0.0416)**	**-0.1198** (0.0436)**	**-0.1222** (0.0442)**
Adjusted R-squared	0.06556	0.06528	0.06505
Values Derived from Regression Coefficients			
Airport Dominance (CO-AA)	**0.2391** (0.0437)**	**0.2330** (0.0434)**	**0.2379** (0.0441)**

Notes:

1. Dependent variable is natural logarithm of fare per mile
2. Number of observations = 3628
3. Data comes from DB1A for the third quarter of 1999
4. Results corrected for heteroscedasticity using White robust variance-covariance matrix
5. Hub dominance effect is identified by the difference in coefficients on the following variables: CO*Non-Stop-(AA*Non-Stop-AA*Through) (See also (10))
6. Regulation effect is identified by the coefficient on CO*London*Non-Stop Itineraries dummy

* significant at 10% level

** significant at 5% level

As we can see from the tables above, both the airport dominance and the differential asymmetric regulation effects are confirmed. Further, estimates of the airport dominance effect using American Airlines as a comparison carrier is rather stable across specifications and sub-samples. The same can be said (even though to a lesser extent) about the estimates of the difference in regulation effects. Note also the different estimates of the airport dominance effects across comparison carriers (21-24% using American Airlines as a comparison carrier versus 13-15% when TWA is used as a comparison carrier). These values are, however, not inconsistent with results from Table 1. To realize this, observe that while estimates of the airport dominance effects are the same across comparison carriers, TWA's fares are substantially higher than those charged by American Airlines.

Generally, results in Tables 2 and 3 are in accordance with our stated hypotheses regarding airport dominance and unfavorable regulation effects. In the next section, we will present arguments as to whether those results can be applied to the process of deregulation of international aviation in general, as well as suggest what they imply for this process.

IV. Discussion and Policy Implications

1 Generality of Results

The analysis performed in the previous section showed two things. First, the airport dominance effect, shown to exist for the US domestic market, applies to international routes as well. Second, facing more regulatory restrictions on a market causes the affected carrier to charge lower fares. We have also found some evidence for robustness of our results across routes. It can be further conjectured that these two reasons contribute to the fact that, unlike American Airlines and United Airlines, US carriers currently flying to London (Delta, Northwest, US Airways) perform their services only from the airports, at which they have dominant position. In this way carriers, not allowed to fly into London's Heathrow airport, can exploit the airport dominance effects to mitigate the negative effect of asymmetric regulation. This section will discuss potentially weak points in the analysis presented above, as well as suggest implications of

our analysis for deregulation of the international airline markets in general and the London – New York route in particular.

The first issue is the generality of our analysis and results. If we want to derive general policy implications for deregulation of international airline markets, we must be as confident as possible that our analysis will be likely to yield similar results when applied to other markets and carriers. Indeed, regulatory environments in international aviation are to a certain extent route-specific, and airlines are regarded in economics as heterogeneous agents. This may suggest that our identification strategy may in itself be market- or route-specific. A point in defense of the generality of our results is that markets analyzed here represent different regulatory regimes. In 1999 travel on Paris – New York market was regulated by the US – France bilateral, making it look more similar to the London – New York route; whereas Frankfurt – New York route has been more liberalized, due to the 'open-skies' agreement between the US and Germany. As noted above, extensive analysis over various routes is difficult due to data availability and market structure limitations. In most cases, price data only on a single US carrier will be available, making meaningful comparisons infeasible. Markets originating at Chicago are a notable exception. O'Hare airport is divided by American Airlines and United Airlines, and both carriers face the same restrictions on international routes. In fact, application of our identification methodology to the Chicago – London and Chicago – Frankfurt routes operated by AA and UA did not yield any significant airport dominance effects, as expected. Also, if the goal is to learn about the airlines' behavior on deregulated markets, the London – New York route is the market of choice, due to substantial passenger traffic and number of competitors present. Experience shows that after deregulation the number of both passengers and competitors on the route increases. So, studying a market with substantial traffic, where more than two airlines are present, we can better address the questions we want to address.

The next issue is possible other explanations for results obtained in the previous section. Among the suspects we could name cost difference across airlines on the same route and perceived quality differences (i.e., airline heterogeneity). To begin with, our identification strategy (conditional on the assumptions being correct) differences out any airline–specific heterogeneities, provided they apply to all markets served by a given

carrier. Any violation of our assumptions due to airline heterogeneity that could bias our results, would have to involve airline-route heterogeneities. For example, if in reality there were no hub effect, but consumers regarded Continental's non-stop transatlantic flights as superior to the airline's through-flights (whereas for the comparison carrier the situation were the opposite), we would falsely detect positive airport dominance effect. This scenario is unlikely for the following reasons. First, the fleet of the US carriers does not differ much in terms of safety and comfort, and services offered in the economy class cabin are pretty much uniform across carriers (level of service is rarely a factor in choosing a carrier, when it comes to the economy class travel). Second, we cannot expect connections for transatlantic flights at EWR to be systematically less convenient than at JFK, especially for flights continuing on the same airline (whereby the passenger does not have to change the terminal).

Also, Continental is unlikely to incur higher costs on the transatlantic flights than American for the following reasons. First, Newark is a 'cheaper' airport in terms of take-off and landing fees as compared to JFK. Second, JFK, unlike Newark, is a slot-controlled airport, which also adds to cost of airlines operating from JFK. Finally, the cost of flying a passenger across the ocean does not appear to vary much across different types of aircraft, which is to be expected.

Somewhat puzzling is the large magnitude of he observed airport dominance effect. In fact, Borenstein (1989) suggested that, other things equal, the magnitude of the airport dominance effect on fares on routes between airports, in both of which a carrier has dominant position, is not likely to exceed 12 percent of the fare. Evans and Kessides (1993) do provide estimates implying higher magnitude of such an effect, but applying their estimated parameter values to our markets would suggest the most optimistic estimates of about 20 percent of the average fare[17], which is still lower than what we find[18]. It is possible that such high magnitude of the airport dominance effect could be

[17] Taking Evans and Kessides estimate of 0.538 for the coefficient on the carrier's average market share in the endpoint airports (Evan and Kessides, 1993, Table 2), for the regression with logarithm of fare as the dependent variable. Holding other things constant and suggesting that for Continental Airlines the average share in Newark and Frankfurt airports is equal to about 30 percent, while for American Airlines such is equal to only about 5-6 percent.

[18] Considering that Berry et al. find that airport dominance effect is restricted to business travelers and in our data we have fares for both leisure and business travel, these premiums could be underestimated by our analysis (as well as by Borenstein and Evans and Kessides).

explained by the remaining entry restrictions on transatlantic routes. Also interesting is that airport dominance effect is the same on more regulated Paris – New York and the less regulated Frankfurt – New York routes. This suggests that regulatory regime may not affect the magnitude of the airport dominance effects, but more extensive research is necessary to come to a more definite conclusion.

2 Policy Implications

Let us now consider the policy implications for both further deregulation of international aviation in general and removal of entry barriers on the London – New York market in particular. First, it is clear that, since airport dominance effect applies to international routes as well, it should be taken into account when removal of another barrier to competition is considered.

Second, if it appears that removal of a barrier will lead to asymmetric rules of the game, it seems pro-competitive to put the carrier, which can take advantage of its airport dominance, into a relatively disadvantaged position. This conclusion is actually in line with results for telecommunications markets[19].

We can actually foresee the following difficulty in the deregulation process, which stems from the above considerations. Players on many of the regulated international markets are both supported by their governments and have dominant position in respective airports in their countries. It can therefore be suspected that governments, unwilling to open their airlines to full-scale competition overnight and possessing substantial bargaining power in the deregulation process, will try to negotiate preferential treatment for their carriers. This can prevent relatively disadvantaged carriers, who do not have such umbrella of airport dominance, from entering such a partially deregulated market. For example, this might have been the reason why Delta and TWA decided to stay away from London – New York market, while offering services from New York to many other European destinations. Also, less efficient carriers can continue operating under protection of the remaining regulatory barriers.

[19] de Bijl and Peitz (2002) claim that it is pro-competitive in the long-run to restrict incumbent firm's freedoms just after the new entry has taken place to allow the entrant to establish a solid position on the market. The structure of the telecommunications markets appears to be such that an incumbent is in a more

This may compromise the very idea of deregulation. Partial deregulation, if conducted in a way, which gives more freedoms to a less efficient carrier with a dominant position in a country's international gateway, may fail to bring the expected welfare gains, as it can effectively deter carriers from entering the market.

Regarding further deregulation of the London – New York market, the following policy implication can be suggested. Suppose that the UK government decided to somewhat relax restrictions on access to Heathrow airport, by only allowing a single additional US carrier to enter the gateway with a non-stop service from New York. We restrict our attention to two US carriers currently offering transatlantic services from New York: Delta Airlines and Continental Airlines. Our conclusions from the above paragraph imply that, since CO, unlike DL, can take advantage of the airport dominance effect, Delta should be chosen to enter Heathrow.

Finally, our results bring a new consideration to the debate of deregulation of the London – New York (and US – UK in more general terms) market. If currently disadvantaged carriers are allowed more freedom on the market, the direction of changes in their fares for travel between London and their hub airports is not hard to predict. Thus, the total welfare impact of complete deregulation is not so obvious. On one hand, we can obtain higher fares charged by airlines that can take advantage of the airport dominance effect. On the other hand, carriers currently in more advantageous position can decrease their fares due to increased competition, or exit the market altogether. Also, new entry can occur by those carriers, which previously chose to stay away from the market. Additionally, we can suspect that the impact on business and leisure travelers can be different, if we believe conclusions of Berry et al. (1996). Obviously, assessing impact of removal of the regulatory constraints on London – New York (US – UK) market is an interesting topic for future research, from which we can both draw conclusions about generality of our findings and learn lessons regarding bringing market forces into play on the markets in other parts of the Earth.

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advantageous position relative to the new entrant. Therefore, regulation restricting the otherwise better positioned agent in the short-run appears welfare-increasing in the long-term.

V. Concluding Comments

This paper addresses two issues related to deregulation of international airline markets. One issue is the price effects of existing entry barriers on different carriers, in an environment where airlines are treated asymmetrically under the current regulatory regime. The second issue is measuring the airport dominance effect on international airline markets. These topics are currently important, and are likely to remain such in the future, as we observe further tendencies towards deregulation of international aviation. Experience shows that the deregulation process is likely to be gradual and prolonged, with existing constraints relaxed one at a time; it is therefore important to understand how players on the international markets will react to gradual changes in the regulatory environment. To address the issues outlined above, this study considers London – New York market as an example of a partially deregulated route with asymmetric regulatory constraints.

Data analysis conducted in this paper provides evidence that asymmetric regulatory constraints lead to lower fares charged by the relatively disadvantaged carriers. On the other hand, there is also evidence of positive effect of hub airport dominance on fares on international markets. On the market considered in this study, Continental Airlines both faces relatively more restrictions and is a dominant carrier in one of the airports. Effect of relatively more restrictions on fares charged by CO is determined to be negative. We also find evidence of rather substantial airport dominance effect.

Research presented here sheds some light on behavior of airlines in partially deregulated international markets, and can be used to at least qualitatively predict the impact of proposed changes in regulation, given the current market structure and the way different players in the market will be treated as a result of such changes. Applying our findings to London – New York market, we conclude from existence of the negative regulation effects for the restricted carriers on the market that further deregulation may cause Continental Airlines to increase fares. While study of welfare impact of further deregulation on this market is beyond the scope of this paper, we can indicate several points, which could be important for such an analysis. First, airport dominance does play

a role. Second, it appears some carriers can actually increase fares once the existing restraints imposed on them are lifted. Third, some carriers currently not present on the market can enter once the rules of the game are made equal for all players. Forth, we should not neglect the possibility of the incumbent airlines exiting the market.

Also, the study has broad policy implications for determining the structure of asymmetric regulatory barriers, where such appear inevitable. The main idea is that where it is not feasible to relax regulatory barriers in a symmetric fashion, the airline(s) having an advantage due to airport dominance or other factors should be considered a candidate for the less preferential treatment. Yet, given the current structure of the international airline markets, this might appear infeasible in a number of cases. Many airlines in the regulated industry are both heavily supported by the respective governments and have dominant position in airports, which serve as international gateways. This can lead to anti-competitive partially deregulated environments, which actually favor the carriers with airport dominance. Thus, our research helps identify a problem, which can pose substantial threat to successful deregulation of the international airline markets.

Topics for further research can include governments' incentives to deregulate air travel between countries; and predicting welfare impacts of changes in regulatory regimes. Another line of research could focus on comparing airport dominance effects on fares on deregulated domestic and partially or completely regulated international markets. Contingent on data availability, the simple methodology employed here can be applied to other markets and/or to obtain more precise predictions. It should be noted that lack of data is a serious obstacle in producing much needed quality research on international airline markets, and development of techniques, which would allow the efficient use of the limited available data will be appreciated.

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Appendix Identification Strategy – Schematic Representation

London – New York				Frankfurt – New York			
Non-stop fares		Through fares		Non-stop fares		Through fares	
Airline	Conditional mean fare	Airline	Conditional mean fare	Airline	Conditional mean fare	Airline	Conditional mean fare
CO	$\delta_{CO} + \delta_{NS} + \delta_{\mathrm{Re}g}^{CO} + \delta_{Hub}$	CO	δ_{CO}	CO	$\delta_{CO} + \delta_{NS} + \delta_{Hub}$	CO	δ_{CO}
AA	$\delta_{AA} + \delta_{NS} + \delta_{\mathrm{Re}g}^{AA}$	AA	δ_{AA}	AA	$\delta_{AA} + \delta_{NS}$	AA	δ_{AA}
Δ_{NS} =CO – AA	$\delta_{CO} - \delta_{AA} + \delta_{\mathrm{Re}g}^{CO} - \delta_{\mathrm{Re}g}^{AA} + \delta_{Hub}$	$\Delta_{Through}$ =CO – AA	$\delta_{CO} - \delta_{AA}$	Δ_{NS} =CO – AA	$\delta_{CO} - \delta_{AA} + \delta_{Hub}$	$\Delta_{Through}$ =CO – AA	$\delta_{CO} - \delta_{AA}$
$\Delta_{\mathrm{LONNYC}} = \Delta_{\mathrm{NS}} - \Delta_{Through}$	$\delta_{\mathrm{Re}g}^{CO} - \delta_{\mathrm{Re}g}^{AA} + \delta_{Hub}$			$\Delta_{\mathrm{FRANYC}} = \Delta_{\mathrm{NS}} - \Delta_{Through}$	δ_{Hub}		
$\Delta_{\mathrm{LONNYC}} - \Delta_{\mathrm{FRANYC}} = \delta_{\mathrm{Re}g}^{CO} - \delta_{\mathrm{Re}g}^{AA}$							

Note: Frankfurt – New York route is used as an example. Identification using Paris – New York route uses the same methodology

Explanation of Terms:

δ_{CO}, δ_{AA} airline specific effects, assumed the same for all flights of the same carrier

δ_{NS} non-stop flight effect, assumed the same for all non-stop flights, regardless of the operating airline

δ_{Hub} hub airport effect, or airport dominance effect, assumed to exist and supposed positive for non-stop flights, operated by Continental Airlines to/from Newark airport

$\delta_{AA}^{\mathrm{Re}g}$ regulation effect for American Airlines, assumed to exist only on London – New York Route; technically, this effect can be assumed equal to zero

$\delta_{CO}^{\mathrm{Re}g}$ regulation effect for Continental Airlines, assumed to exist only on London – New York Route; supposed to be less than the regulation effect for American Airlines (or negative, if $\delta_{AA}^{\mathrm{Re}g}$ is assumed to equal zero)

Δ_{NS} difference between non-stop fares for travel between New York and a European endpoint, charged by Continental Airlines and American Airlines

$\Delta_{Through}$ difference between 'through' fares of Continental Airlines and American Airlines ('through' fares are defined as fares for one-stop trips between a US airport and a European destination through a New York City area airport)