The New Price Discrimination and Pricing in Airline
Markets: Implications for Competition and Antitrust*

by

David Gillen
Sauder School of Business
2053 Main Mall
University of British Columbia
Vancouver, BC Canada V6T 1Z2
(604) 822 8352
david.gillen@sauder.ubc.ca

and

Tim Hazledine
Department of Economics
University of Auckland Business School
Commerce A Building
3A, Symonds Street
Auckland, New Zealand
64 9 - 373 7599 Ext: 87435
t.hazledine@auckland.ac.nz

Abstract

The passenger air travel industry has recently been impacted by two major innovations: the rise of Low-Cost Carriers (LCCs) offering cheap, no-frills, one-way fares, and the widespread adoption of Internet-based direct Business-to-Consumer ticket sale systems. This paper explores the implications of these innovations using price data for over 1700 flights on forty Canadian and trans-border routes observed in May 2006.

We find (a) that there is extensive price discrimination based on date of purchase of ticket and other factors; (b) that average prices paid are nevertheless still significantly determined by the number and size distribution of airlines supplying a route; (c) that established 'legacy' carriers can still charge a substantial price premium over LCCs; and (d) that the internet fare systems may have made it easier for legacy carriers to coordinate the typically substantial increases in their fares over the last two weeks before flight date. We note the implications for antitrust policy in these markets

1. Introduction

The passenger air travel market has recently been impacted by two major innovations: first, in the 1990s, the rise of 'Low-cost Carrier' (LCC) airlines offering cheap one-way point to point tickets, and then, in the new millennium, the emergence and enthusiastic adoption by consumers of on-line internet booking systems. It has been suggested that the impact on the established or 'legacy' carriers has been dramatic – even that their business model has been 'broken' (Tretheway, 2004) as a consequence of the spread of these innovations.

Specifically, the transparency of Internet booking systems would result in only the lowest fare offerings being sustainable in the market, and the simplicity and efficiency of LCCs would mean that it would be their fares that would be the lowest. This would seem to have two important implications in practice for the legacy carriers. First, they would not be able to sustain the elaborate price discrimination practices whereby they had been able to extract different prices from different customers and prevent fareclass arbitrage by means of 'fences' placed around their cheapest fares – notably, the advance purchase return ticket with a Saturday night stayover requirement, which was cleverly designed to deter high-value business travellers but not the leisure travel segment of the market. And, second, because the new, flat, fare structure would be determined by the presence of LCCs in a market, the traditional relationship between market structure and price would be broken: it wouldn't matter much whether a route was serviced by three or two or even just one legacy carrier, and indeed the monopoly might even be more attractive because it would be able to reap efficiencies of scale and scope economies.

In this paper we analyse more than 20,000 observations of airfares offered in May 2006 on forty North American routes: twenty two within Canada, and eighteen trans-border routes between Canada and the United States. The impact of the internet and the LCCs is immediately apparent: the old restricted return fare product has completely disappeared from the market – all thirteen of the airlines in our database offer one-way internet fares, which can be purchased either directly off the airline's website, or from a travel agency which collects all the available fares and displays them so as to make it immediately obvious to the consumer where the best deal is coming from.

And yet the outcomes of the new competition do not at all support the 'broken model' predictions. We find that the legacy carriers use the new system to generate substantial inter-temporal price discrimination, with prices offered for a specific flight often being two or three times higher in the week before the flight than the fares available eight weeks before (where our observations begin). We observe this pattern of fare increases even in markets served also by LCCs, whose prices throughout -- and especially in the last week -- are significantly lower than those of the legacy carriers. We find that structural competition still matters: the legacy carriers' fares are lower, on average, if there are more of them operating on a route. And we find evidence that the very transparency of Internet-based fare systems may actually have made it easier for legacy carriers to coordinate their pricing, in particular to take advantage of the generally higher willingness to pay of business travellers making their purchase decision close to the day of the flight.

The paper is set out as follows in section 2 we provide the motivation for and background to our research and section 3 is a summary of previous studies in airline pricing. Section 4 describes our data and defines the variables subsequently used in the econometric modelling Section 5 presents a graphical illustration of prices in a sample of the markets. Section 6 discusses the regression results and their interpretation while section 7 offers a summary and some conclusions.

2. Motivation and Background

The focus of this paper is the link between market structure and the new price discrimination. Standard economic pricing theory is in terms of single-pricing and nearly all econometric tests use average price data, as though only a single price is charged for any particular product or service. Such analyses predict that sellers use their market power to raise price by restricting output, and that the extent a group of sellers can do this depends, among other factors, on their numbers: more sellers means lower price.

Such predictions are the basis of the policy treatment of proposed mergers, which are often turned down by the antitrust authorities if it is deemed, according to the orthodox theory, that the merged firm's market share would be such as to make significant restrictions of output (and consequential allocative inefficiencies) likely. Such in essence was the basis of the decisions of the NZ Commerce Commission and the Australian Competition and Consumer Commission ruling against the 2002 application by Air New Zealand and Qantas to form a 'strategic alliance' (in essence, a cartel) covering all of the markets on which they currently compete.

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A similar type of model was used in assessing the [then] proposed Air France-KLM merger and this was approved, on the basis that the likely price effects would not be significant.

There are some who argue that in such cases that keen competition at the low-price end of the market (induced by the actual or potential presence of the LCCs), coupled with the price discrimination practices of the legacy carriers have basically rendered obsolete the traditional basis of antitrust economics – that is, of price increases from restricting output. Even a dominant firm that could price discriminate effectively would not wish to restrict output, because it would pay them to supply marginal or low-valuation customers so long as this segment of the market could be 'fenced off' from higher value demand. Thus, the formation of a cartel would not necessarily lead to allocative inefficiencies, and possibly not even to increases in the average fares paid in these markets.

Empirical work on domestic NZ and trans-Tasman routes (Hazledine, 2006a) finds evidence that the extent of actual competition on routes (number and size of competing carriers) does still significantly affect the average fare paid, and, perhaps especially, the lowest price at which seats are offered. However, the output restrictions required to affect price increases may indeed be less than is predicted in standard single-price oligopoly models. For the present paper we develop these results and extend the tests to the domestic Canadian market, where an FSA (Air Canada) faces competition from an LCC (WestJet), and to the Canada/US transborder market where differing routes have differing levels of competition in terms of both numbers and types of carriers. We then consider the implications for antitrust as applied to horizontal mergers or alliances between competing airlines. We find this important for two reasons. First, North America has a number of carriers in Chapter 11 protection and it seems only a matter of time before further mergers will be proposed. Second, and pertinent to the Air New Zealand-Qantas proposal, Canada is often described as being similar to the Australian-New Zealand market.

3.   Previous studies of airline pricing

There is an interesting econometric literature on the relationship between airline (average) fares and differences or changes in market structures, mostly using U.S. data. There have been three main focuses of attention: on the link between number of competitors and prices; on the existence of "hub premiums" earned by airlines dominating an airport used as a hub for connecting flights; and on the competitive impact of low-cost carriers or LCCs. Many of these studies are surveyed by Tretheway and Kincaid (2005).

Kim and Singal (1993) examined the impact of the fourteen U.S. airline mergers (national and/or regional carriers) that took place over the 1985-88 period, comparing routes affected by mergers with a control group of unaffected routes. They found that over the period from the initiation of merger talks through merger completion, the merging firms increased fares on average by 9.44% relative to unaffected routes, and any competitors on the affected routes raised their prices by even more -- 12.17%, on average. Hurdle *et al* (1989) compared 850 non-stop city-pair routes in the U.S. and report an average price differential between routes supplied by one carrier and routes supplied by two carriers of about 20%. Borenstein (1990) focused on the 1986 Northwest Airlines/Republic merger and

found average fare increases of 6.7% and 22.5% on routes served pre-merger by both airlines, depending on whether there was or was not at least one other competitor also serving the route. The same author (1991) found average fare differences between monopoly and duopoly, and between duopoly and triopoly, of 8% in each case. Oum, Zhang and Zhang (1993) predict a 17% price increase moving from duopoly to monopoly routes.

Morrison and Winston (1990) report that the number of effective airlines in a particular market over the 1982-88 period affected the fare charged with an elasticity of 0.12 -- that is, a route served by two carriers has fares twelve percent lower than a route served by just one airline.

Tretheway, in his 2004 submission to the Australian Competition Tribunal, reports an econometric model of air ticket prices estimated on a panel dataset covering ten years (1990-2000) of data on 1000 U.S. routes.[1] Tretheway's main interest is in the impact of LCC competition on prices, but his results do cover situations in which only 'FSA's (full-service airlines, also known as 'legacy carriers') serve routes, and these imply that a route with just one FSA has fares as much as 33% higher than a duopoly FSA route, which in turn sets prices on average 8% higher than on a route competed for by three FSAs.[2]

However, in later work, not surveyed by Tretheway and Kincaid, Goolsbee and Syverson (2005) find that an increase in the probability of Southwest entering a route[3] has a large (20%+) and significant impact on prices when the existing level of concentration on the route is above average, but not when the route is of below-average concentration. So, there may be some disagreement about the extent to which the 'Southwest effect' is qualified by the extent of existing competition, but there seems little doubt that, overall, Southwest and perhaps some other LCCs have had a substantial impact on US airfares well beyond the tickets they sell on their own flights.

Morrison and Winston (2000) estimated the hub premium using DB1A data from 1996. They compared the average fare at eleven concentrated airports with the average fare across all airports in the US. They found a hub premium estimate of 22%. They next controlled for Southwest by simply by removing airports served by Southwest and found fares at the concentrated airports were found to be 6% lower than the remaining airports; fares at airports served by

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during which Ansett Australia exited and Virgin Blue entered the domestic market. This analysis was subjected to some criticisms from another consultant, Professor Jerry Hausman, which led to the NZ Commerce Commission carrying out its own econometric analysis of the data (2003, Appendix IV). The results of this imply that the presence of Ansett as a competitor to Qantas on a route reduced the latter's fares by about 6.8% on average.

3 The perceived and actual probability of Southwest eventually entering a route increases sharply when it begins operating from both end-point airports on that route.

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1 This paper is reported here as Tretheway and Kincaid (2005)

2 Tretheway's regressions were carried out for him by Steven Morrison and Clifford Winston, who have themselves published a number of studies of U.S. airline pricing. Morrison and Winston also carried out on behalf of Air New Zealand and Qantas an analysis of airfares in Australia over the period 1999-2002,

Southwest were approximately 39% lower than fares at airports not served by Southwest, averaging across al airports.

In another study, Morrison and Winston (1995) found that average fares for travel to and from the 12 concentrated airports were actually 6% *lower* on average than those for trips to and from other domestic airports if those served by Southwest were excluded from the latter group. They noted that if airports served by Southwest were excluded from *both* the concentrated and the remaining unconcentrated hub airports, average fares between the two groups differed by only about 1% after adjusting for differences in passengers' trip lengths and use of frequent-flyer award tickets.

More recently Hofer et al. (2004) examine whether LCCs affect network carriers' ability to benefit from market concentration and power and whether LCCs earn hub premiums. Their conclusion is that airport market power and market concentration are positively correlated with average fares and that the presence of an LCC in a market leads to lower fares.

Overall, the body of econometric air fare analyses, nearly all of it based on the U.S. domestic market and using data generated under the old system of price discrimination based on imposing restrictions on discounted fares, gives strong support to the prediction of oligopoly theory that actual competition should matter to prices in a market.

4. The Database

Sample

The basic unit of observation is the 'flight', which is a particular journey (flight number or pair of numbers) between two cities marketed by a particular airline on a particular date. In most cases the passengers on a flight are travelling in an aircraft operated by the airline or carrier which sold them the ticket, but some flights are code-shares, such that the aircraft carries passengers with boarding cards with differing flight numbers in the name of two or more airlines.

There are 1748 such flights in total, flown on one of four Wednesdays in May 2006, from May 10 through May 31. Thus there are 437 different flight numbers. These flight numbers cover 40 city-pair routes – 18 trans-border (ie between Canada and the United States) and 22 within Canada. Ten of the trans-border routes are only observed ex-Canada, and four are observed flying both ways. In total, thirteen airlines are observed.[4]

The sample does not include all domestic Canadian and trans-border flights. Apart from the exclusion of most 'return' itineraries, the sample was limited by the following choices:

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[4] The airlines that fly these routes are: Air Canada, Alaska, America West, American Airlines, CanJet, Continental, Delta, Harmony, Northwest, Skyservice, United, US Air, and WestJet. Note that in September 2006 CanJet announced its exit from scheduled passenger services.

- The extremely busy (many flights) Ottawa-Toronto-Montreal 'triangle' routes were not included, in the interests of keeping the job manageable
- No itinerary with more than one stop was included, nor any 1-stop itinerary taking more than twice the journey time of a non-stop flight[5]

The sample includes flights to and/or from the ten largest cities in Canada, and two other cities. The trans-border sample is a selection of short- and medium haul flights between four Canadian and ten American cities.

Prices

For each of the 1748 flights we observed[6] the lowest available ticket price, beginning on the Wednesday eight weeks before flight date, and thereafter weekly until the final week before take-off, during which price was observed daily (Thursday, Friday, Saturday, Monday, Tuesday). We thus have up to thirteen observations[7] on the lowest available prices at which tickets for the flight could have been purchased -- a total of 20,494 non-blank data entries. In our econometric work we make use of the eight weekly (Wednesday) observations on prices plus the last price offered, which is usually

that shown on the day before the flight date. We have no information on the quantity of seats sold at each observed price and nor on any other prices that might have been offered before or within our eight week observation period. That is, our pricing data are sampled from the actual distribution of prices purchased.

To get comparability across routes, prices are divided by the non-stop flight distance, in kilometres. The price variables used here are:

Pavk: average price (cents/km) of the eight weekly price observations and the price the day before flight date (ie, this is the unweighted average of nine price numbers).

P8k: price eight weeks from flight date

P0k: price the day before flight date

Pmink: lowest of the nine prices

Pmaxk: highest of the nine prices

Capacity and Concentration

We have no information on numbers of seats sold on each flight. We can ascertain, from the websites, the aircraft type and the number of seats available on the aircraft used on the flight. As a true supply-side variable, untainted by the effects of price charged – unlike the actual number of seats sold – seats available is arguably a

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5 Airline websites are often padded out with large numbers of rather lengthy and inconvenient itineraries, often at higher prices than are on offer for non-stop flights leaving at a similar time (and arriving of course much sooner). 119 of the journeys included had one-stop itineraries.

6 The Expedia.ca website was the source of the price quotes.

7 Fewer than thirteen if the flight was sold out before flight date. The prices included all taxes and 'charges' that the airlines usually do not include in their initial advertised prices.

better measure for use in construction of market structure variables than sales.[8]

However, even on non-stop flights, the total number of seats on the aircraft cannot usually be used as the economic capacity or supply. This is because flights connect with other flights, so that some passengers have an origin and/or destination differing from the take-off or landing point of the particular flight. Also, some flights are operated as codeshares, with seats marketed independently by more than one airline. For these flights we allocated the seats available using what seemed to us to be reasonable rules of thumb. For example for the Air Canada one-stop route from Montreal to Calgary via Toronto, of which the first leg is flown by a 37-seat Dash 8 and the second by an Airbus A320 with 140 seats in total, we assigned just 10 seats to the Montreal-Calgary 'flight', and the remainder to the Calgary-Toronto nonstop. We reasoned that most of the passengers on the first leg would leave the flight at Toronto, either because that was their final destination, or to pick up other onward connections (to Vancouver, or Winnipeg, for example).

Our market structure variables are measured at the route level. For each of the 40 routes we calculated the following:

HHI: Hirschman-Herfindahl Index of seller concentration, defined as the sum of the squared market shares of all the carriers selling seats on the routes, with each airline's market share measured as the sum of all its available seats divided by the total of all airlines'

available seats. So, for example, an airline with two daily flights on a route, flown by 140-seat Airbus A320s, would have a market share equal to 280 divided by the total number of available seats offered on all flights by all airlines supplying this route.

DOMINATED: This is a dummy variable set equal to 1 for a route on which the largest airline offers more than 50% of the available seats, with no other carrier offering more than 25% of the seats. On twenty of the forty routes, one carrier was deemed to be dominant by this criterion.

Costs

In most airline pricing studies route distance is used as a proxy for costs. This is clearly an important determinant of flying costs, and is always a highly successful variable in econometric models, but it does suppress any variation in costs due to other factors, such as aircraft type, wage costs and overall operating efficiency. Therefore, in this study we built up our cost variable directly. This is not a simple matter. Apart from the data requirements, important conceptual and economic issues are raised. In particular, the appropriate measure of costs depends on the time horizon -- what contribution to 'fixed' costs is expected when airlines set fares – and also the extent that airlines expect each flight to pay its way, or, instead, price on a broader basis, such as the average costs for the route, or even for their entire networks. We do not bring firm priors to these issues, and our approach will be to let the data reveal the dimensions of costs that enter airlines' pricing and yield management decisions.

We have three different ways of building up a costs variable. Two of these apply formulations developed in a recent article by Swan and

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8 With the qualification that a seat in business class is not really the same as a seat in economy. Here we just add the total number of economy and business class seats, with no weighting of the latter.

Adler (2006). The third is a 'block hour' measure based on Form 41 costs collected by the USDoT/FAA and reported in *Aviation Daily*.

Swan and Adler report two methods for constructing costs. First is what they term a 'planar-form cost function' based on engineering data ,which specifies that aircraft trip costs are determined by seat numbers (S) and route distance (D). For single-aisle operations from 1000-5000 km, the relationship is:

$$C = (D+722)*(S+104)*\$0.019$$

And for longer haul twin-aisle operations:

$$C = (D+2200)*(S+211)*\$0.0115$$

The latter function has more application to long haul trans-ocean flying, whereas our data covers markets which are essentially domestic flying; our longest route is 5335 km and the average non-stop flight length is 1683 km. These formulae are designed to incorporate only aircraft trip costs, which Swan and Adler state are around 50-60% of total costs, with general administrative costs around 30% and commissions and sales expenses the remainder. Note that the constants added in these expressions to both D and S ensure that there will be increasing returns to both these factors: doubling distance for a given number of seats, or doubling aircraft seat capacity for a given distance, will in both cases less than double the total costs of making the trip, so the costs per seat kilometre will fall.

The other cost formula provided by Swan and Adler is a Cobb-Douglas cost function estimated as a log-linear regression on the same information as they used in constructing the planer cost functions. The two specifications estimated for narrow body and wide body operations, respectively, with cost per seat kilometre as the dependent variable, are:

$$c = 2.44S^{-0.40} D^{-0.25}$$

and

$$c = 0.64S^{-0.345}D^{-0.088}$$

Note that in these equations the impact of distance on costs is captured through a distance elasticity, and varies between -.09 to -.25. This 'cost taper' results from lower fuel burn at higher altitudes and spreading the costs of getting to altitude over more km.

Our third method builds up flight costs from available measures of 'block hour' operating costs. The cost associated with operating aircraft on a route; referred to as flying operations cost (FOC) can be measured by the cost per block hour multiplied by the number of block hours required for the route:

$$FOC_s = B_s \bullet H_s \bullet f(Y_s)$$

where B_s is cost per block hour for the aircraft used, H_s are the block hours required for segment S, and $f(Y_s)$ is flight frequency which depends on number of passengers on segment, Y_s. a route can have one or more segments and we examine a flight so frequency is 1. Obviously, the cost per block hour for a given aircraft and given segment will depend upon the labour prices of the carrier as well as other input prices.[9] However, the other input

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9. The aircraft cost can be measured by adding the cost per block hour multiplied by the number of block hours required for the flight segment and a portion of the indirect airline costs which are attributable to flight frequency. Note that the

prices such as fuel, maintenance and capital costs will not vary significantly across carriers for that segment.

We constructed this cost measure using information submitted by carriers to the USDOT and assembled as 'Form 41' data. These data are available by aircraft type by carrier by activity -- for example, costs per block hour are available for United, Southwest, American and USAir flying a Boeing 737-400 series. The data are also available on a cost per available seat mile (CASM) basis broken out for crew cost, fuel/oil, aircraft cost, insurance, taxes and maintenance burden. The cost of operating an aircraft type by carriers using that aircraft were reported by carrier, and an average across carriers for an aircraft type is also reported. We had available all costs for all aircraft types used in our data set.

The cost variable was measured as the block hour operating costs for the aircraft used times the block hours for a flight (available when collecting price data). These were divided by the seat km of the flight and expressed as 'cost per seat km'. These represented flight costs.

These costs can differ for the same airline flying the same route if it uses different aircraft type. Accordingly, we also calculated a route-based operating cost measure for each airline and route, which was a

capacity-weighted average of the individual flight costs. We will let the econometrics tell us which measure is the more appropriate.

There are additional non-operating costs attached to a flight. These include marketing and transaction costs, passenger and baggage ground-handling costs, and airport fees. We have little direct information on these costs, but we do know that they are incurred on a per passenger basis, so that excluding them from our costs measure would bias upwards the relative costs of longer flights. Therefore, we proceeded on a "top down" basis, as follows. We calculated the total of operating costs for each airline, based on the block hour-based per flight costs we had already computed aggregated over all the flights observed, applied the Swan and Adler rule of thumb that these costs are around 20% of flight operating costs, divided by the total number of seats offered on all flights by the airline, to get marketing etc costs per seat, and then for each flight divided this number by flight distance and added to our flight operating cost measure to arrive at our total costs per seat kilometre measure.

We thus have twelve possible measures of the cost per seat kilometre for a specific flight by a specific airline. There are the three different methods for constructing the operating cost variable, each of which can be measured at the flight or route level, and to which can be added or not the top-down estimate of marketing and ground costs.

We found that neither of the Swan/Adler measures performed well econometrically. This may be because our routes are clustered near

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block-hour costs need to be adjusted upward by the amount of interest cost on the capital tied up in aircraft. It appears that the cost per block hour available in Form 41 data includes only the aircraft rentals paid for leased aircraft, and does not appear to include the interest cost on the owned aircraft. This however may not be a significant problem given that most airlines lease aircraft.

or below the bottom end of the flight distance range specified by Swan and Adler -- 1000-5000 kilometres.[10] The nonlinearity built in to the Swan/Adler formulas could overestimate flight costs for these shorter flights. Also we observe both single and double aisle aircraft flying transcontinental routes, but the shorter distance Swan/Adler formula is designed just for single-aisle aircraft.

We therefore used the measure that we developed ourselves from the block hour data as the basis of our cost variable. Perhaps surprisingly, we found that adding our, admittedly quite crude estimate of marketing etc costs to the operating cost data improved the explanatory power of the variable, and we also found that prices were better explained by operating costs measured at the route, not the flight level.

Other variables

SOLDOUT: This is a dummy variable set equal to 1 if the flight appeared to have sold-out at any time in the last week before the flight date, as evidenced by its disappearance from the website offerings

LEISURE: This is an informed 'quesstimate' of the percentage of passengers on a route who are 'leisure' as opposed to 'business' travellers. Leisure travel includes tourism and the 'VFR' (visiting friends and relatives) category. This was constructed using as a basis the industry rule of thumb that, overall, about 70% of passengers are leisure travellers, and then modifying this up or down depending on the known characteristics of the route. For example, the value of

LEISURE for the Toronto-Tampa route is set at 90, and for the Toronto-New York route at 40.

PEAKDUM: This is a dummy variable assigned the value 1 for some early morning short-haul flights between large cities. It did not show any significance in the econometric analysis.

LCC: The airlines America West, CanJet, Harmony and Skyservice are all 'Low Cost Carriers' and the dummy LCC is set at 1 for them. We will also show results with WestJet categorised as an LCC

STOPS: set equal to 1 for one-stop flights.

Table 1 provides the summary statistics for each variable used in the regression analysis.

Table 1

	Pavk	Pmink	P8k	Pmaxk	P0k	ROCOSTB	HHI	DOMINATED
Mean	0.1992	0.1466	0.1559	0.3339	0.3275	0.1315	5,171	0.2943
Standard deviation	0.1274	0.0865	0.0933	0.2664	0.2662	0.0855	1,891	0.4558
Maximum	0.8772	0.5427	0.8400	1.5138	1.5138	0.6318	10,000	1
Minimum	0.0338	0.0167	0.0167	0.0406	0.0292	0.0418	2,176	0
	SOLDOUT	LEISURE	WEEK1	WEEK2	WEEK3	LCC	STOPS	PeakDum
Mean	0.2012	65.11	0.25	0.25	0.25	0.1819	0.2189	0.1125
Standard deviation	0.4010	14.39	0.4331	0.4331	0.4331	0.3858	0.4136	0.3160
Maximum	1	90	1	1	1	1	1	1
Minimum	0	35	0	0	0	0	0	0

5.   Pricing Behaviour

Asymmetric information is an intrinsic and inescapable fact in nearly all pricing situations: customers know more about their maximum willingness to pay [WTP] for a given good or service than does the seller. This is still true of course in air travel markets, but

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10 Fifteen of our 40 flights are actually less than 1000kms in distance.

what distinguishes the passenger airline industry from just about all others is the extent to which the sellers -- the airlines -- have been able to devise methods of separating potential travellers by their WTP, and charging them accordingly.

In this section we use our price data to illustrate what is now the most important tool used for sorting passengers by their willingness to pay, which is simply the practice, using what the airlines call 'yield management', of increasing the lowest fare offered for a particular flight as the day of that flight approaches. This exploits the different WTP of leisure and business travellers. Generally leisure passengers will be more price sensitive (lower WTP) and are willing to plan and book well ahead of the departure date. Business passengers on the other hand tend to face continuously changing schedules requiring flexibility and so are unwilling to commit to an itinerary well in advance, but are willing to pay a high price when they do choose to travel

Figure 1 shows the YVR-YEG (Vancouver-Edmonton) route, which has a somewhat higher than average proportion of business travellers. The route is served by two airlines, the legacy carrier Air Canada (AC) and a LCC, WestJet (WJ). We can see both carriers start to increase prices five weeks out, at P5, and that the average price increases steadily, but with AC at a higher level throughout than WJ. So, both carriers are using intertemporal price discrimination, but the legacy carrier more so than the LCC.

Figure 1

Average Fare by Carrier YVR-YEG May 2006
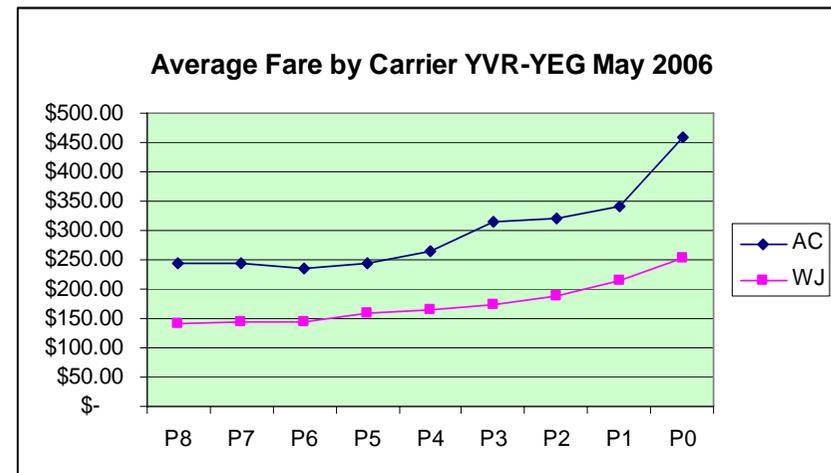
In contrast, on Figure 2 showing the Vancouver-Halifax (YVR-YHZ) route, we had three carriers -- two LCCs (WJ and Canjet) and Air Canada. This is a relatively long haul route, at approximately 4600 km. The carriers behave in strikingly different ways. WJ gradually increases prices by a small amount, Canjet keeps prices relatively constant and AC increases prices very little in the first 6 weeks but two weeks before the flight increases prices significantly. So we have one LCC which does not price discriminate at all, one which does to a small degree and a legacy carrier which discriminates to some degree over 6 weeks and significantly in the last two weeks.

Figure 2

Average Fare by Carrier YYC-YHZ May 2006

Average Fare by Carrier YYZ-LGA May 2006
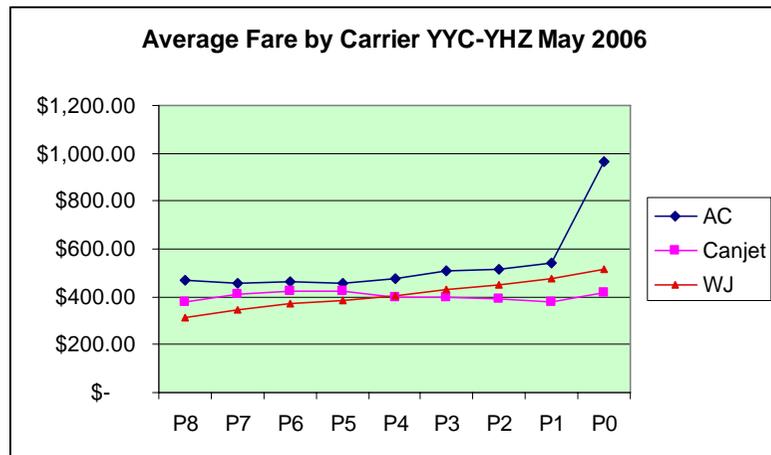
Compare this behaviour with Figure 3 which illustrates prices in a transborder market – a market in which the route joins a city in Canada with a city in the US. The route shown is Toronto-New York (YYZ-LGA), as served by 4 legacy carriers -- AC, AA (American airlines), Delta and UA (United Airlines) -- and one LCC, Canjet. This can be regarded as a predominately business market. Prices are relatively constant until 2 weeks prior to the flight with the LCC is charging the lowest price. At 2 weeks before the flight every carrier except Canjet raises prices significantly, as then does Canjet one week out. The prices rise significantly and in an apparently coordinated way.

Figure 3
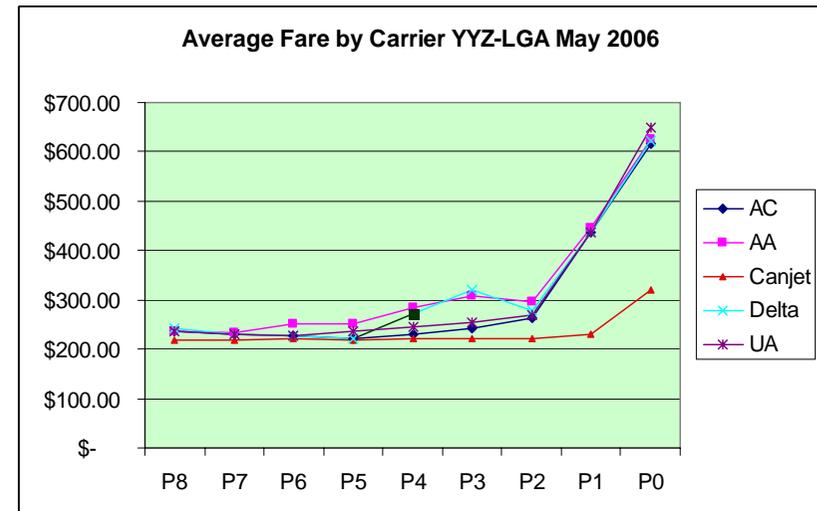
In Figure 4 we show the high volume domestic route Toronto-Vancouver, which is fairly typical route with respect to the relative proportions of business and leisure passengers. There are four carriers: a legacy carrier, AC, a low cost carrier, WJ and two scheduled charter operators which would also be low cost.[11] The legacy carrier sets prices 60 percent or more higher than other carriers. All carriers increase their prices by a small amount over weeks eight through two before flight date, but only the legacy carrier increases prices significantly within two weeks of take-off.

Figure 4

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11 A schedule-charter operator flies some scheduled routes at low frequency and also flies charters to leisure destinations.

Average Fare by Carrier YYZ-YVR May 2006
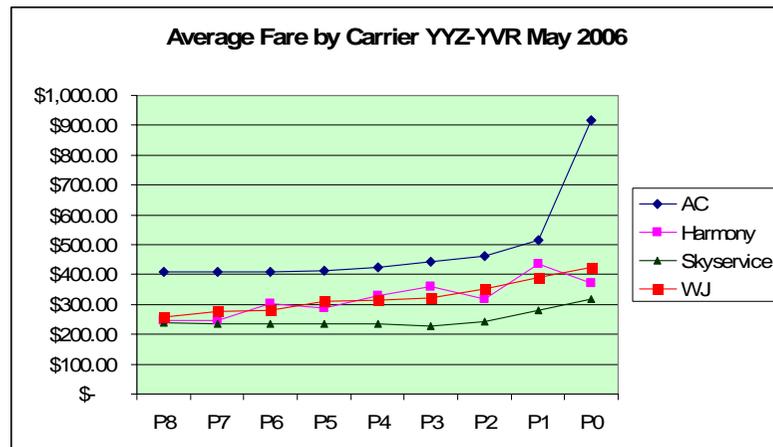
Our final illustration is Figure 5, showing another transborder route (Los Angeles-Vancouver), which is served by five legacy carriers plus the US based LCC, America West. Here the pricing behaviour is quite different. Each carrier appears to set its own, different, price level -- eight weeks out from the flight date prices range from $180 to $300. The price distributions are relatively flat in some cases and volatile in others: on average there is very little price discrimination before the last two weeks before the flight. The LCC is not even the low price supplier. Some prices go up two weeks out but others fall and the increases are not nearly as marked in other markets.

Figure 5

Fare by Carrier LAX-YVR May 2006
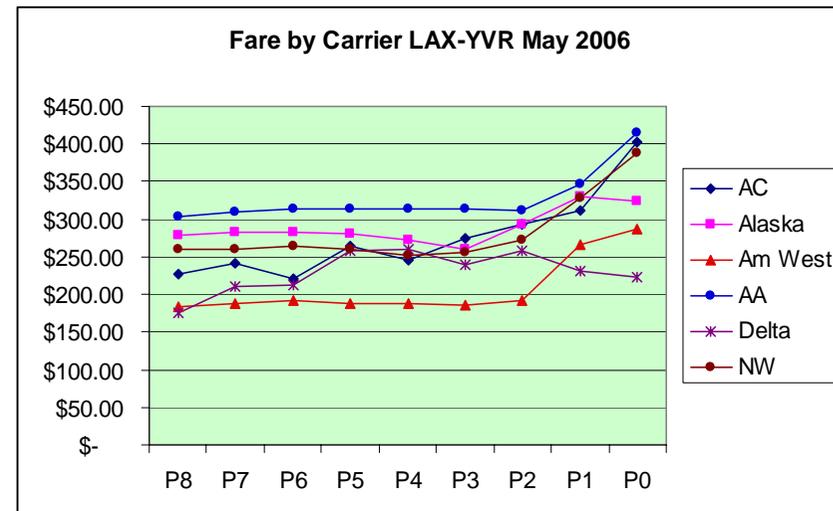
Figure 1 through 5 illustrate pricing activity in markets with differing numbers of carriers, as well as differences in route length, market type, domestic versus transborder and mix of carriers. These data show quite marked differences in prices charged for flights on the same route and the same day – differences both across carriers and over time on each carrier. The data also reveal some striking apparent coordination of price increases as the flight date approaches. The next section explores these pricing patterns systematically.

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6.   Econometric Results

The graphics shown in the previous section reveal substantial and differing patterns of intertemporal price discrimination across the Canadian and trans-border routes. In this section we seek to explain these patterns in terms of supply, demand and market structure factors. We are particularly interested in whether the prediction of standard (one-price) oligopoly theory that price is affected by the extent of structural competition in a market, as evidenced by the number and relative size of sellers, holds true when 'price' is demonstrably an average of prices paid which can differ, for the same flight, by a factor of two or three depending on when the ticket was purchased. We are also interested in the competitive impact of Low-Cost Carriers, and on whether we can explain the pattern of price discrimination; in particular, whether this is affected by market structure, as predicted by theory.

We have a panel of data, with 437 itineraries or flights each observed four times on consecutive Wednesdays in May 2006, giving a total of 1748 observations. To estimate our models we use EViews 5.1 Panel EGLS with cross sectional random effects, with the flight as the cross sectional identifier.

Results are shown on Table 2. Here we have two sets of six regression outputs. The two sets differ only in their treatment of the Canadian airline WestJet. The upper group of six has WestJet classified as a Low Cost Carrier, as indeed it claims to be. The lower six regressions all have WestJet not classified as an LCC.[12]

Average price regressions

The first two regression models in each group have the log of the average lowest price per kilometre as the dependent variable. We are testing the proposition that average price (in essence, the first order summary statistic of the price distribution) is a meaningful number even in the context of the very substantial intertemporal price discrimination revealed by our data. Hazledine (2006) finds in the context of the linear homogeneous Cournot-Nash model that average price charged is actually unaffected in theory by the extent of price discrimination (number of different prices offered) -- here we can test this prediction.

These regressions introduce the set of explanatory variables that we use throughout. Looking first at the first column of results, we note the following:

- Our cost measure is a highly significant determinant of the average level of prices
- The HHI market concentration index is a moderately significant determinant of average prices, as predicted by oligopoly theory

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12 The new term for business model followed now by Westjet is 'Value Focused Carrier' (VFC), meaning a carrier which follows the LCC strategy with respect to costing but has added services for additional price.

- Flights which are sold out before the flight date have higher average prices, suggesting that selling-out is a demand-shift phenomenon, not a movement down demand curves induced by lower prices
- Flights with a higher proportion of leisure (non-business) passengers may have lower prices, although this finding is not robust to the classification of WestJet
- There was a monotonic ramping up of prices as the month of May proceeded towards the summer holiday travel season, with flights on the last day of the month tending to be more than 9% more expensive than flights just twenty one days earlier
- One-stop flights yielded fares at least 15% lower than non-stops. This is a striking result, because the costs of flying one-stops must in general be higher than a non-stop routing, so that supply-side factors would push for a higher, not lower price.[13] It seems likely that what we have found is a manifestation of a price discrimination practice, with highly time-insensitive travellers taking up these cheap itineraries whose inconvenience[14] deters the high-value time-sensitive business customer.
- It is clear, as it was in the graphs of section 5, that LCCs charge lower prices than legacy carriers: but it seems that WestJet is a more expensive LCC than CanJet, America West and the others. Without WestJet, the coefficient on the LCC dummy variable is about -0.3; with WestJet also classified as an LCC, the coefficient rises to just -0.08
- The classification of WestJet also affects the significance of the HHI, which is greater when WestJet is assigned to be an LCC. The reason for this is probably that most of the relatively highly concentrated duopoly routes are those inside Canada on which Air Canada and WestJet compete, and on which WestJet does systematically charge lower prices than Air Canada, especially in the last week before travel. Treating WestJet as an LCC allows some of this price differential to be absorbed into the LCC dummy coefficient, leaving more effect to be accounted for by the HHI structural measure.

In the second column we allow the coefficient of HHI to differ according to whether the route is deemed to have a 'dominant' carrier, as defined (without any experimentation but not unreasonably) as an airline offering more than half of the seats on a route on which no other airline offers more than one quarter. Statistically, this is a highly successful specification, but its economic implication was a surprise. Bearing in mind the literature on 'hub premia' and 'city presence' effects, we had expected prices to be higher for a dominant carrier, ceteris paribus, and indeed first specified the dummy variable 'DOMINANT', taking the value 1 for the airline, not for the route. When the coefficient came out as negative we investigated further, and found that the characteristic being picked up is more likely a route, not an airline characteristic – a model with the dummy variable DOMINATED fit the data better.

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13 The RCOSTB unit cost variable does not account for additional costs of operating a one-stop itinerary. It has the same value for all the flights on a particular route of a particular airline.

14 As well as taking longer, many one-stop itineraries operate in non-peak hours.

The implications of the result can be seen as follows. Suppose we have two routes. One is supplied by two equal-sized airlines, and so has a HHI value of 0.5. The other has a 'dominant' carrier offering 2/3 thirds of the total seats, competing with two smaller carriers, each supplying 1/6 of the market. The HHI for the second route is also 0.5, but according to our regression model, prices would be about thirteen percent higher on the symmetrical duopoly route.[15] That is, on these routes, there is more effective price competition between three firms than between two, even if in the triopoly case two of the three suppliers are much smaller than the leading firm. A possible explanation is that two similar-sized duopolists find it easier to tacitly collude to avoid over-enthusiastic price competition. This may help explain why WestJet -- which operates mostly in duopoly situations with Air Canada – has prices systematically higher than the other LCCs.

Low price regressions

The third and fourth of the six columns of results on Table 2 explore the determinants of the lowest prices charged by the airlines.[16] We use two measures of low price: Pmink, which is the lowest of the nine prices observed over the eight weeks before flight date, and P8k, which is the first price observed, eight weeks before flight date. In 57% of cases (998 out of 1748) these numbers are the same, but in the other instances the lowest fare was observed less than eight weeks before flight date.

Which is the most appropriate low-price measure? Sudden (and usually temporary) breaks in the pattern of monotonically increasing prices over time seem likely to be mostly due to unforeseen shifts in the demand curve (eg because of a cancellation of a tour group booking), not to price discrimination, which is about movements along the demand curve. If then, our focus is on the characteristics of (inter-temporal) price discrimination, then we might wish to focus on the P8k variable, being the price at the low-price end of the intertemporal distribution. On the other hand, Pmink is indeed an actual price offered in the market, and as the lowest such price is of some interest in itself, whether or not price discrimination is involved.

In the event, the two different price measures do not produce radically different regression models. It appears that market structure is an important determinant of fares even at the low-end of the demand curve, and that the legacy carrier price premium over LCCs is also observed at this end of the distribution.

We will compare these results with those in the fifth and sixth columns, which model the highest observed price (Pmaxk) and the last observed price, the day before flight (P0k). In 92% of cases these two numbers are the same, and so it is not surprising that we get quite similar regression models. These show interesting differences from the low-price models, and we focus

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15 Exp(0.5*0.25) = 1.133
16 These are the 'lowest of the low' -- all our price observations are the lowest price offered for a flight on the day the flight is observed.

on the comparisons between these, and with the average price (Pavk) results. We can note that:

- The market structure variables HHI and HHI*DOMINATED play a significant role throughout the yield management process, with possibly little difference in the proportional impact of structure on high and low prices.
- The generally higher yields from SOLDOUT flights appear to be garnered in the middle of the price distribution, since although average prices are around 3% higher on sold-out flights, there is no discernible positive effect on either lowest or highest prices
- If LEISURE does have an effect on yields (it only consistently appears to do so in the regression model with WestJet classified as an LCC) this is apparent throughout the price distribution, not – as one might expect -- just at the high price end, which is when we expect most business travellers to purchase their tickets. Eight weeks out from flight date we believe that nearly all purchasers of tickets will be 'leisure' travellers, whatever the eventual composition of the passenger load when the plane takes off. Our results suggest that the airlines price their 'leisure' tickets higher if they know the flight will eventually have a higher business traveller composition, probably to ensure that seats for the latter will still be available in the last one or two weeks.
- The seasonal effect on prices, which went up on average through the month of May, seems to be largely worked through prices nearer the beginning of the distribution, presumably because it is the demand from leisure travellers (not business) that is increasing as the summer approaches
- However WestJet is categorised, the LCC price effect is much larger the day before the flight than eight weeks before. After inspecting the graphs shown in section 5 we can see that it could hardly be otherwise, since it is in the last week or perhaps two before flight date that the legacy carriers' prices increase sharply, with this being not generally matched by the LCCs, from whom a relatively inexpensive ticket can often be purchased as late as the day before the flight
- The price discount charged on one-stop flights also widens markedly in the last week, consistent with our interpretation that these flights do not generally appeal to high-value business travellers from whom a price premium can be extracted on last-minute ticket sales.

Analysis of the link between concentration and price discrimination

We have found that the overall position of the intertemporal distribution of prices, as measured by the mean value of prices observed, is related to the size distribution of sellers. Is the shape -- in particular, the slope -- of the distribution also a market structure-related variable? Hazledine (2006b) predicts that it will be, at least under Cournot-Nash assumptions: in his model the high/low dispersion of prices is larger the smaller the number of competitors. That is, a monopolist is able to extract the most surplus out of a

market by means of price discrimination, and, at the other structural extreme, a near-competitive industry with many firms will have very little discriminatory power, simply because its firms lack the power to raise any of their prices much above marginal costs.

There have been two previous studies of airfare price dispersion, both using U.S. data of samples of fares actually paid during the pre-internet era, when legacy carriers partitioned their markets using the Saturday Night Stayover advance purchase restriction on their cheaper fares. Borenstein and Rose (1994), and Stavins (2001) both find that the dispersion of fares paid on particular flights was increasing in the number of airlines flying the route. Borenstein and Rose explain this by distinguishing conceptually between "competitive-type" and "monopoly-type" price discrimination. The latter is based on differences between customers in their elasticities of demand at the total market level, and the extent of such discrimination would be expected to be greater under monopoly conditions. However, if within-market cross elasticities of demand are larger at the lower willingness-to-pay end of the demand curve -- that is, such customers are also keener comparison shoppers – then introducing more competition onto a route could result in larger falls of price at the lower than at the upper end of the fare distribution.

Table 2: Regression Results

<table>
<tr><td colspan="13">with WestJet classified as an LCC</td></tr>
<tr><td>dependent</td><td colspan="2">log(Pavk)</td><td colspan="2">log(Pavk)</td><td colspan="2">log(Pmink)</td><td colspan="2">log(P8k)</td><td colspan="2">log(Pmaxk)</td><td colspan="2">log(P0k)</td></tr>
<tr><td></td><td></td><td>t-stat</td><td></td><td>t-stat</td><td></td><td>t-stat</td><td></td><td>t-stat</td><td></td><td>t-stat</td><td></td><td>t-stat</td></tr>
<tr><td>C</td><td>0.873</td><td>8.2</td><td>0.865</td><td>8.4</td><td>0.412</td><td>4.2</td><td>0.576</td><td>6.0</td><td>1.688</td><td>11.8</td><td>1.713</td><td>11.9</td></tr>
<tr><td>log(RCOSTB)</td><td>1.026</td><td>24.9</td><td>1.051</td><td>26.1</td><td>0.969</td><td>25.3</td><td>1.009</td><td>26.7</td><td>1.215</td><td>21.7</td><td>1.219</td><td>21.6</td></tr>
<tr><td>HHI</td><td>0.279</td><td>3.4</td><td>0.568</td><td>5.8</td><td>0.612</td><td>6.5</td><td>0.424</td><td>4.6</td><td>0.597</td><td>4.4</td><td>0.633</td><td>4.6</td></tr>
<tr><td>HHI*DOMINATED</td><td></td><td></td><td>-0.259</td><td>-4.9</td><td>-0.284</td><td>-5.7</td><td>-0.223</td><td>-4.5</td><td>-0.312</td><td>-4.3</td><td>-0.315</td><td>-4.3</td></tr>
<tr><td>SOLDOUT</td><td>0.031</td><td>3.2</td><td>0.029</td><td>2.9</td><td>-0.002</td><td>-0.3</td><td>-0.020</td><td>-2.1</td><td>-0.002</td><td>-0.1</td><td>0.011</td><td>0.5</td></tr>
<tr><td>LEISURE</td><td>-0.004</td><td>-3.9</td><td>-0.005</td><td>-4.0</td><td>-0.006</td><td>-5.3</td><td>-0.005</td><td>-4.6</td><td>-0.004</td><td>-2.5</td><td>-0.005</td><td>-3.1</td></tr>
<tr><td>WEEK1</td><td>-0.094</td><td>-12.0</td><td>-0.094</td><td>-12.0</td><td>-0.023</td><td>-4.6</td><td>0.007</td><td>1.0</td><td>-0.015</td><td>-0.9</td><td>-0.013</td><td>-0.7</td></tr>
<tr><td>WEEK2</td><td>-0.052</td><td>-6.6</td><td>-0.052</td><td>-6.6</td><td>-0.011</td><td>-2.2</td><td>-0.025</td><td>-3.3</td><td>0.002</td><td>0.1</td><td>0.007</td><td>0.4</td></tr>
<tr><td>WEEK3</td><td>-0.042</td><td>-5.3</td><td>-0.042</td><td>-5.3</td><td>-0.005</td><td>-1.0</td><td>-0.021</td><td>-2.7</td><td>-0.040</td><td>-2.4</td><td>-0.039</td><td>-2.2</td></tr>
<tr><td>LCC</td><td>-0.083</td><td>-2.6</td><td>-0.110</td><td>-3.5</td><td>-0.122</td><td>-4.1</td><td>-0.102</td><td>-3.4</td><td>-0.273</td><td>-6.2</td><td>-0.268</td><td>-6.0</td></tr>
<tr><td>STOPS</td><td>-0.149</td><td>-5.0</td><td>-0.160</td><td>-5.5</td><td>-0.105</td><td>-3.8</td><td>-0.094</td><td>-3.4</td><td>-0.283</td><td>-7.0</td><td>-0.279</td><td>-6.8</td></tr>
<tr><td>weighted R2</td><td colspan="2">0.489</td><td colspan="2">0.505</td><td colspan="2">0.481</td><td colspan="2">0.492</td><td colspan="2">0.440</td><td colspan="2">0.439</td></tr>
<tr><td>unweighted R2</td><td colspan="2">0.751</td><td colspan="2">0.763</td><td colspan="2">0.774</td><td colspan="2">0.765</td><td colspan="2">0.691</td><td colspan="2">0.685</td></tr>
<tr><td colspan="13"></td></tr>
<tr><td colspan="13">with WestJet not classified as an LCC</td></tr>
<tr><td>dependent</td><td colspan="2">log(Pavk)</td><td colspan="2">log(Pavk)</td><td colspan="2">log(Pmink)</td><td colspan="2">log(P8k)</td><td colspan="2">log(Pmaxk)</td><td colspan="2">log(P0k)</td></tr>
<tr><td></td><td></td><td>t-stat</td><td></td><td>t-stat</td><td></td><td>t-stat</td><td></td><td>t-stat</td><td></td><td>t-stat</td><td></td><td>t-stat</td></tr>
<tr><td>C</td><td>0.856</td><td>8.6</td><td>0.885</td><td>9.0</td><td>0.502</td><td>5.3</td><td>0.651</td><td>7.0</td><td>1.772</td><td>13.0</td><td>1.763</td><td>13.1</td></tr>
<tr><td>log(RCOSTB)</td><td>1.115</td><td>30.2</td><td>1.145</td><td>30.9</td><td>1.052</td><td>29.4</td><td>1.079</td><td>30.5</td><td>1.437</td><td>28.1</td><td>1.447</td><td>28.5</td></tr>
<tr><td>HHI</td><td>0.235</td><td>2.9</td><td>0.461</td><td>4.7</td><td>0.522</td><td>5.6</td><td>0.349</td><td>3.8</td><td>0.344</td><td>2.6</td><td>0.370</td><td>2.8</td></tr>
<tr><td>HHI*DOMINATED</td><td></td><td></td><td>-0.205</td><td>-4.0</td><td>-0.237</td><td>-4.7</td><td>-0.184</td><td>-3.7</td><td>-0.184</td><td>-2.6</td><td>-0.184</td><td>-2.6</td></tr>
<tr><td>SOLDOUT</td><td>0.032</td><td>3.2</td><td>0.031</td><td>3.1</td><td>-0.001</td><td>-0.1</td><td>-0.018</td><td>-1.9</td><td>0.010</td><td>0.5</td><td>0.022</td><td>1.1</td></tr>
<tr><td>LEISURE</td><td>-0.001</td><td>-0.6</td><td>-0.001</td><td>-0.9</td><td>-0.004</td><td>-3.1</td><td>-0.003</td><td>-2.7</td><td>0.003</td><td>1.8</td><td>0.003</td><td>1.8</td></tr>
<tr><td>WEEK1</td><td>-0.094</td><td>-12.0</td><td>-0.094</td><td>-12.0</td><td>-0.023</td><td>-4.6</td><td>0.007</td><td>1.0</td><td>-0.014</td><td>-0.9</td><td>-0.013</td><td>-0.7</td></tr>
<tr><td>WEEK2</td><td>-0.052</td><td>-6.6</td><td>-0.052</td><td>-6.6</td><td>-0.011</td><td>-2.2</td><td>-0.025</td><td>-3.3</td><td>0.002</td><td>0.1</td><td>0.007</td><td>0.4</td></tr>
<tr><td>WEEK3</td><td>-0.042</td><td>-5.3</td><td>-0.042</td><td>-5.3</td><td>-0.005</td><td>-0.9</td><td>-0.021</td><td>-2.7</td><td>-0.040</td><td>-2.4</td><td>-0.039</td><td>-2.2</td></tr>
<tr><td>LCC</td><td>-0.311</td><td>-4.9</td><td>-0.289</td><td>-4.6</td><td>-0.147</td><td>-2.4</td><td>-0.123</td><td>-2.1</td><td>-0.626</td><td>-7.2</td><td>-0.698</td><td>-8.1</td></tr>
<tr><td>STOPS</td><td>-0.159</td><td>-5.4</td><td>-0.167</td><td>-5.8</td><td>-0.108</td><td>-3.9</td><td>-0.097</td><td>-3.5</td><td>-0.302</td><td>-7.5</td><td>-0.299</td><td>-7.5</td></tr>
<tr><td>weighted R2</td><td colspan="2">0.500</td><td colspan="2">0.510</td><td colspan="2">0.473</td><td colspan="2">0.486</td><td colspan="2">0.447</td><td colspan="2">0.457</td></tr>
<tr><td>unweighted R2</td><td colspan="2">0.76</td><td colspan="2">0.767</td><td colspan="2">0.769</td><td colspan="2">0.762</td><td colspan="2">0.697</td><td colspan="2">0.698</td></tr>
</table>

So, for example, if all business travellers are keen members of a preferred Frequent Flier Program, whereas leisure travellers are not (or cheap fares don't carry FFP points), then the willingness of business travellers to fly with other airlines, even at a lower price, might be less than the willingness of leisure travellers to take their business to the cheapest provider on the day. The data displayed in the previous section do reveal striking differentials in the lowest prices generally available on a particular route on a given day of flight, especially between LCCs and legacy carriers and especially over the last week or so before the flight date.

However, whilst these differentials are consistent with significant differentiation across the broad product types -- ie LCC versus network legacy carriers -- especially in the minds of travellers making their purchase decision soon before the flight, this does not necessarily imply that high-value customers (who may be valuing, say, convenience as well as other features of the legacy carriers' service) will not generally be sensitive to price differentials within the legacy carrier segment. Looking at it from the airlines' perspective: high value travellers are extremely profitable, and the temptation to undercut competitors to gain their custom must be considerable, and therefore more likely to be acted on the more competitors there are in the market.

We note too that our data are generated by the new regime of internet-available one-way tickets, which may break down some of the old demarcation between 'leisure' and 'business' markets, as well as making consumer price comparisons easier. Our price data are always the lowest available fare available on a flight, and this mostly is below other fares available on the same flight. Sales made at a higher fare than the lowest available on the same flight (which

would have been included in the samples used by Borenstein/Rose and Stavins) obviously indicate a low level of price sensitivity on the part of the customer, who may indeed be influenced by frequent flier loyalty programs and related considerations, such as access to airline lounges and the possibility of using upgrade certificates to business class, which often cannot be applied to the lowest priced tickets.

In any case, our econometric results do not give strong support to predictions of differences in price discrimination between less and more concentrated markets. If we focus on the P8k and P0k regressions, which tell us about the pattern of inter-temporal price discrimination, then we find that the HHI has a larger proportional effect on last-minute prices (P0K) than it does on prices available eight weeks out (P8k), but only for the model in which WestJet is classified as an LCC. We can however say that the dollar difference in ticket prices between early and late-purchased fares tends to be larger in more concentrated markets, because the whole fare structure is higher in these markets.

In summary, orthodox oligopoly theory appears to be alive and well in these air travel markets, despite the striking violation evident in the data of the standard single-price assumption of oligopoly models (and of price theory in general). We have found that the entire distribution of prices, which is largely but not entirely monotonically increasing over time, as flight date approaches, is higher in more concentrated industries than in structurally more competitive markets. But there are some surprises. Prices tend to be lower, for a given HHI value, if a market has a single 'dominant' carrier competing with a number of much smaller operators (more precisely, operators offering a much smaller number of seats on the

particular route) rather than if the seats are spread more equally between a smaller number of competitors. And the coexistence of legacy carriers and LCCs is marked by striking differences in their pricing behaviour, most of all in the last week or perhaps two weeks before flight date, when the legacy carriers are able to increase their fares dramatically even though these are not matched by any LCCs in the market.

7.   Conclusions

We have collected and analysed data on the 'new airline price discrimination' – the Low Cost Carrier-inspired innovation of one way fares offered across airline and travel agency websites. These fares differ substantially across routes, across airlines, across flights offered on the same route by the same airline, and within individual flights, such that on any given day, travellers who when they purchased a ticket for a particular journey had paid the lowest fare available at that time may differ by a factor of two or more in what they did pay for their ticket.

Beneath this remarkable diversity of prices we are able to discern a pattern, and this is a pattern familiar from oligopoly theory and from empirical analysis of pricing in other industries as well as previous studies of airline markets. The mean value of prices offered on a particular flight turns out to be a meaningful variable, of which we are able to explain a reasonably large proportion of the variance across flights in terms of plausible cost, demand and market structure factors. In particular, we find that average fares tend significantly to be lower on routes on which there is more competition, and that average fares offered by LCCs are

significantly below those charged by network or 'legacy' carriers competing with them.

Thus, it does not appear that the new price discrimination regime requires a new oligopoly model to explain the overall levels of prices, so long as it is assumed that there is product differentiation between legacy carriers and LCCs. But can we go further and explain the discrimination itself, in particular the strong tendency for the lowest available price for a ticket on a particular flight to increase as the day of travel approaches? Descriptive analysis of the data reveals two striking patterns: fares on legacy carriers increase sharply over the last two or even just one week before the flight; and fares offered by LCCs mostly do not increase much over time, so that the price differential between LCCs and legacy carriers widens substantially as the flight date approaches.

Our econometric modelling reveals that both high- and low-price ends of the intertemporal price distribution are influenced by the extent of competition on routes, but we were not able to find evidence to strongly support sharper theoretical predictions about the link between market structure and the range of prices observed.

As for the policy implications of our results: if the new airfare price discrimination does not require a new oligopoly model to make sense of it, then nor does it require a new anti-trust to regulate it -- or exemption from the old anti-trust. Mergers or horizontal alliances between airlines currently competing independently can be expected to result in higher prices, and so must still raise competition policy concerns, whether or not a Low Cost Carrier is or could be present in the market. Further, we find evidence that when small numbers of legacy carriers compete on a route, they appear to be able to tacitly

coordinate the substantial prices increases that occur in the last two weeks before flight date, with this coordination possibly facilitated by the transparency of fares on the new internet booking systems. This finding may be of particular policy relevance to Canada, where there may be a risk of a 'cosy duopoly' forming between Air Canada and WestJet, as the latter airline departs further from its LCC roots. Since the domestic Canadian market does not seem to be able to support additional home-grown airlines (witness the recent departure of CanJet), there may be a case for opening the market to entry by established carriers through extended 5th Freedoms; allowing a foreign carrier to fly between domestic points having started its journey in its home market.

References

Borenstein, Severin, "Airline Mergers, Airport Dominance, and Market Power," *American Economic Review*, 1990, 80, 400-418.

Borenstein, Severin, "The Dominant Firm Advantage in Multi-product Industries: Evidence from the U.S. Airlines," November 1991, *Quarterly Journal of Economics*, 106, 1237-1266.

Borenstein, Severin and Nancy L. Rose (1994), "Competition and Price Dispersion in the U.S. Airline Industry," *Journal of Political Economy* 102 (August), 653-683.

Goolsbee, Austan and Chad Syverson (2005), 'How do incumbents respond to the threat of entry? Evidence from major airlines', NBER working paper 11072, January.

Hazledine, Tim (2006a), 'Pricing and Competition in Australasian Air Travel Markets', downloadable from
www.transport.govt.nz/assets/NewPDFs/3-August-06-paper-from-Prof-Hazledine-re-pricing.pdf

Hazledine, Tim (2006b), 'Price Discrimination in Cournot-Nash Oligopoly', forthcoming in *Economics Letters*

Hofer, Christian, Martin Dresner, & Robert Windle, *Hub Premiums in an Era of Low-Cost Carriers and Financial Distress*, Address at the 2004 Air Transport Research Society World Conference in Istanbul, Turkey (July 2, 2004)

Hurdle Gloria J. , Richard L. Johnson, Andrew S. Joskow, Gregory J. Werden, Michael A. Williams, ' Concentration, potential entry, and performance in the airline industry', *The Journal of Industrial Economics*, Vol. 38, No. 2. (Dec., 1989), pp. 119-139

Kim, E., and V. Singal (1993) 'Mergers and Market Power: Evidence from the Airline Industry', *American Economic Review*, **83**, 549–569.

Morrison, Steven and Clifford Winston (2000), the remaining Role for Government Policy in the Deregulated Airline Industry", in Sam Peltzman and Clifford Winston (eds), *Deregulation of Network Industries: What's Next*, AEI-Brookings Joint Centre for Regulatory Studies, Washington

Morrison, Steven and Clifford Winston (1990), "Dynamics of Airline Pricing and Competition", American Economic Review, 80, 2 (May) 389-393

Morrison, Steven and Clifford Winston, *The Evolution of the Airline Industry*, Washington, D.C., The Brookings Institution, 1995

Oum, T.H., A. Zhang, and Y. Zhang, "Inter-Firm Rivalry and Firm-Specific Price Elasticities in Deregulated Airline Markets," J*ournal of. Transport Economics and Policy* **27,** 171–192 (1993).

Reiss, Peter, and Pablo T. Spiller, "Competition and Entry in Small Airline Markets," October 1989, *Journal of Law and Economics*, 32.

Strassman, D. "Potential Competition in the Deregulated Airlines," *Review of Economics and Statistics,* 1990, 72, 696-702

Stavins, Joanna (2001), "Price Discrimination in the Airline Market: The Effect of Market Concentration," *Review of Economics and Statistics*, 83(1), February, 200-202

Swan, William and Nicole Adler (2006), Aircraft Trip Cost Parameters: A Function of Stage Length and Seat Capacity, *Transportation Research E*, 42, pp. 105-115

Tretheway, Michael E. (2004), 'Distortions of Airline Revenues: why the network airline business model is broken', *Journal of Air Transport Management*, Vol 10, pp 3-14

Tretheway, Michael and Ian Kincaid (2005), The Effect of Market Structure onAirline Prices: A Review of Empirical Results, *Journal of air Law and Commerce*, Vol. 70, No 3 (Summer)

www.transport.govt.nz/assets/NewPDFs/3-August-06-paper-from-Prof-Hazledine-re-pricing.pdf