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An empirical analysis of Canadian international air policy: effects of dual carrier designation and partial liberalization

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Abstract

This paper assesses the impact on air traffic of Canada's policy of allowing two Canadian flag carriers (dual-designation) to operate in select Canadian international markets. The secondary objective is to assess the effect of Canada's partially liberalized bilateral air services agreements. Using panel data covering Canada's 33 bilateral markets over the 1982–1994 period, we find the following results: (a) dual designation/operation of Canadian carriers in a country-pair market increases total traffic volumes in the market as well as increases the combined passenger volume and market share of Canadian carriers, and (b) Canada's partially liberalized bilateral air services agreements have significantly increased air traffic in those country-pair markets.Two policy implications follow from this research. First, Air Canada's recent merger with Canadian Airlines is expected to have a significant negative impact on total traffic volumes as well as on Canadian carrier traffic volumes and market shares on the country-pair markets both Air Canada and Canadian served previously. Second, not only the US style full liberal bilaterals or open skies, but also partial liberalization of bilateral markets Canada adopted appears to generate consumer welfare benefits. © 2001 Published by Elsevier Science Ltd.

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1. Introduction

For the past two decades, the US has led the effort to increase competition in international air transport. Other countries—such as the Netherlands, the UK, New Zealand, Australia and Canada—have undertaken more moderate liberalization efforts. Canada's partial-liberalization of international markets began in the 1980s and consisted of two specific policies. First, the Canadian government instituted a dual-designation policy that allowed two, instead of one, Canadian carriers to operate in select international country-pair markets.[1] Second, the Canadian government signed a few liberalized bilateral agreements that allowed more carrier-flexibility over the setting of prices and outputs. However, with recent events in the Canadian airline industry, at least one of these policy initiatives—dual designation—is now in jeopardy.

In December of 1999, Air Canada completed its acquisition of rival Canadian Airlines International (CAI); thus, merging the two dominant Canadian carriers under a single management structure. Although there has been much debate over the impact of this merger on the domestic Canadian market, there has been considerably less debate over the impact of the merger on Canadian international air markets, including how the merger might affect Canada's dual-designation policy.[2] It is evident that in most international markets where the two Canadian carriers competed, only a single Canadian flag carrier will now operate.[3]

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[1] The US–Canada bilateral market witnessed multiple Canadian carriers for many years; however, this bilateral market is not analyzed in this paper. The US–Canada bilateral market represents a unique market for Canadian carriers and passengers and is best analyzed as a special case, an approach taken by many researchers. For analyses of the US–Canada market and/or the 1995 'open skies' agreement, see Dresner et al. (1989), Gillen et al. (1991), Oum (1991), Dresner (1992, 1994), Gesser (1992), Kaduck (1997) and Pustay (1997, 1998).

[2] Bill C-26, enacted by the Canadian parliament, effective 5 July 2000, mainly resulted from concern over the potential impact of the Air Canada–Canadian Airlines merger on Canadian domestic air transport markets.

[3] There could also be competition from charter carriers. Due to data limitations, our analysis focuses only on scheduled air transport.

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Our primary objective is to assess the impact of Canada's dual-designation policy on air traffic volumes in Canadian international markets. Using panel data covering the Canadian bilateral markets over the 1982–1994 period, we estimate the effect of the dual-designation policy on total market traffic, Canadian carrier traffic, and foreign carrier traffic. Initially, three separate equations are estimated to factor the effect of dual designation on the three different passenger volumes; however, we also nest these three equations and estimate them as a system of multivariate equations. Our empirical results indicate that total traffic volume, the traffic carried by Canadian carriers (Canadian carrier traffic), and the combined market share of Canadian carriers, all increase under the dual-designation policy. Therefore, the merger between Air Canada and Canadian Airlines is likely to have a negative effect on total international air traffic to and from Canada, Canadian carrier volume, and Canadian carrier market share on international routes.

Our secondary objective is to assess the effect of Canada's partially liberalized bilateral agreements on international air traffic. Previous studies found that the US liberal policy resulted in increasingly competitive market outcomes: lower airfares, increased passenger traffic, and higher consumer surplus (Pustay, 1989; Dresner and Windle, 1992; Dresner and Tretheway, 1992; Maillebiau and Hansen, 1995). However, more modest liberalization efforts have received only limited research attention (Caves and Higgins, 1993; Dresner and Oum, 1998). Our empirical results support the finding that Canada's liberalized bilaterals enhanced international air traffic: total market traffic, Canadian carrier traffic and foreign carrier traffic are all higher in those markets governed by liberalized bilaterals.

The rest of the paper is structured as follows: Section 2 presents a descriptive analysis of Canadian international airline-service markets and the country's limited pro-competitive policies; Section 3 sets the theoretical background for this paper by examining the extensive literature on liberalized international markets; Section 4 presents a model of international air traffic determination to help formulate appropriate regression equations; Section 5 elaborates on our estimation strategy and reviews the empirical tests and results; and finally, Section 6 concludes with a short discussion and policy implications.

2. Canada's partial liberalization policy

Bilateral air transport agreements establish the terms and conditions for air transport between and beyond agreement signatories. Most agreements restrict the competitive practices of airlines, as they contain clauses or attached memoranda of understanding that regulate the number of operating carriers, the capacity of carriers, and the pricing freedom of carriers. Furthermore, governments may enact policies that restrict competition on international routes. The US—with a round of liberal bilateral agreements in the 1970s and 1980s, and a more recent round of 'open-skies' agreements in the 1990s—has most consistently promoted international competition.[4] Liberal and open-skies agreements have allowed airlines to freely set prices and capacity based on market conditions, and to increasingly make market-based entry and exit decisions.

Canada, as with most other nations, has been more cautious than the US in opening its international markets to competition. Since the mid-1980s, however, the Canadian government has taken a more pro-competitive approach to a few international air markets. As stated above, the Canadian government's partial-liberalization efforts have been based on two policy initiatives: (a) allowing two, instead of one, Canadian carriers to compete in select country-pair markets; and (b) signing liberalized bilateral agreements that allow carriers more flexibility over pricing and capacity decisions. These efforts indicate a significant departure from past policy, but are limited by the partial nature of the measures and the limited application of the initiatives to a few bilateral markets.

The first Canadian partial-liberalization initiative, dual designation, signaled replacement of the 'Division of the World' policy by which the Canadian government divided the world regions into two spheres of influence: one for Air Canada and another for Canadian Airlines (Mitchell, 1991). The dual designation policy meant that the government designated two Canadian flag carriers to operate in country-pair markets that were deemed large enough to support additional competition. During the time period of our study, Canada had two flag carriers *operating* in four international country-pair markets: Germany 1988–1994, UK 1990–1994, France 1990–1994, and Japan 1994. Hereafter, we refer to dual operation (the actual operation of two carriers) instead of dual designation in order to be more precise.

The second Canadian partial-liberalization initiative, liberalized bilaterals, involved the signing of a limited number of liberalized bilateral agreements. During the period of our analysis, liberalized agreements with three countries were in effect: Germany 1984–1994, the Netherlands 1990–1994, and the UK 1988–1994. In a study conducted on behalf of the Canadian government, Mitchell (1991) classified none of these bilaterals as fully liberal, instead using the term 'facilitating' agreements—agreements that fall short of full

[4] Features of open skies agreements include (Air Transport Association, 1998):

- Unlimited carrier designations by signatories to the agreement;
- Unrestricted capacity and frequencies by designated carriers; Totally open route possibilities for designated carriers (except for cabotage);
- Unrestricted operational flexibility (for example, allowing carriers to use their own ground-handling personnel);
- Fair & equal opportunity to compete (for example, disallowing differential taxation based on carrier nationality);
- Double disapproval over pricing (no one government may unilaterally disapprove a fare);
- Open cooperative marketing agreements (e.g. code-sharing, block space arrangements) are allowed;
- Liberal charter arrangements.

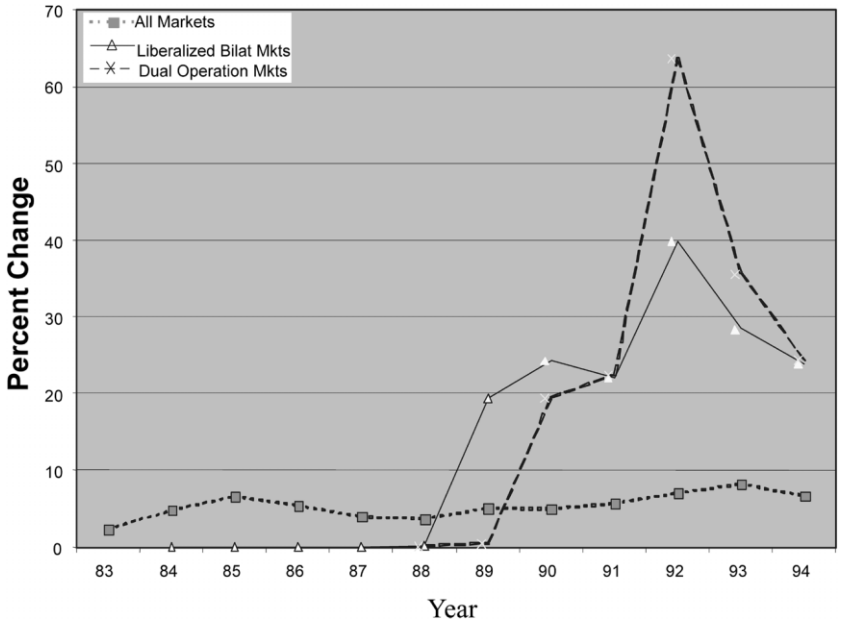

Fig. 1. Annual passenger growth rates in the Canadian international-country pair markets (1983–1994).

liberalization but are more liberal than Canada's other bilateral agreements.[5] Hereafter, we refer to the 'less-than-liberal' facilitating agreements as liberalized bilaterals.

There is some evidence that Canadian partial-liberalization promotes traffic growth. Fig. 1 shows the average annual percentage increase in total traffic for all Canadian country-pair markets (All Markets), the markets governed by liberalized bilaterals (Liberalized Bilateral Markets), and the markets involving two Canadian carriers (Dual Operation Markets). While all Canadian international markets averaged 5.4% annual growth over the 1983–1994 period, the markets governed by liberalized-bilaterals averaged 14.4% annual growth, and the dual operations markets averaged 23.7% annual growth.[6]

3. The literature on the liberalization of international air markets

The extensive literature on US international airline markets and the effects of liberalization indicates that US liberal bilateral agreements lower prices, increase passenger traffic and enhance consumer welfare. Dresner and Tretheway (1992), using data from 1976 to 1981, found US liberal agreements lowered discount fares by 35%. Dresner and Windle (1992), using data from 1976 to 1987, found US liberal agreements increased passenger traffic by 11% annually compared to traditional or partially-liberal agreements.[7] Maillebiau and Hansen (1995) estimated that liberalization of US international routes resulted in consumer benefits of US $5.1 billion or $585 per traveler in 1989.

Non-US international airline markets have received relatively less research attention, and the question remains whether partial-liberalization efforts enhance market competitiveness. Caves and Higgins (1993) assessed the impact of liberalized agreements signed by the UK and found these agreements to have no significant effect on prices and traffic. The results, however, may be due to residual restrictions in UK markets; for example, limitations on slot access into London's Heathrow airport could prevent the benefits of liberalized agreements from being realized.

[5] Canada's facilitating or liberalized-bilaterals contain residual restrictions either on routes, capacity or prices, which render them more-modest than US liberal and 'open-skies' agreements. The Canadian agreement with the UK (in force since 1988) has provisions that restrict carriers from setting prices without the permission of both governments, unless they meet a minimum reference level. Canada's agreement with the Netherlands (in force since 1990) restricts the number of carriers that can be designated to operate routes between the two countries. Finally, the agreement with Germany (in force since 1984) controls price competition by mandating price agreements between Canadian and German carriers.

[6] The first liberalized-bilateral came in to effect in 1984 and the first dual-operation markets in 1988. Readers familiar with the airline economics literature realize that city-pair markets are the favored level of analysis. However, we aggregate the Traffic by Flight Stage city-pair data into country-pair markets for this illustrative figure and the later empirical tests, because dual-operation and liberalized-bilaterals are determined on a country-pair basis, rather than on a city-pair basis. Dual-operation does not necessarily imply that there will be two Canadian and two UK carriers on each route between the two countries. The agreement might stipulate for any given route (e.g. Toronto–Manchester) that only one Canadian carrier and one UK carrier can operate. Therefore, dual-operation might not affect individual city pairs, even though it is likely to influence total traffic in the UK–Canada market.

[7] The insignificant results for the partially-liberal agreements may owe to the choice set faced by US international passengers. These passengers may choose from markets governed by fully-liberal agreements, as well as partially-liberal and non-liberal agreements. Conversely, passengers on non-US international routes may only choose from markets regulated by partially liberal and non-liberal agreements. Therefore, markets regulated by partially-liberal agreements may be less appealing to US international passengers than to passengers on other international routes.

Gillen et al. (1999) constructed a simulation model to examine the impact of bilateral air-service liberalization, and then applied the model to measure the welfare effects of a counter-factual liberalization between Canada and Japan. In a study most relevant to this paper, Dresner and Oum (1998) examined the impact of both US liberal and Canadian liberalized agreements on the diversion of visitor traffic (non-residents of Canada) from Canadian to US international air routes. They drew two major conclusions that support Canadian liberalization increasing international passenger traffic: First, US liberal agreements divert visitors from Canadian to US international routes; second, and more importantly, Canadian liberalized bilaterals reduce that diversion. However, due to data limitations, Dresner and Oum could not determine the differential impacts of the liberalized agreements on Canadian and foreign carriers, nor could they generalize their findings to all Canadian international passenger traffic.

In summary, the literature supports US liberalization efforts leading to increased traffic, lower prices, and, overall, consumer benefits. However, the literature on non-US liberalization efforts is less conclusive.

4. A model of international passenger traffic volume

We start with a simple model that illustrates the primary determinants of international air traffic between nations. Passenger demand in an international country-pair market (e.g. Canada–UK) can be represented as follows:

$$\text{Demand} = f(\text{Price, Demographics, Consumer Tastes, Service Characteristics}) \quad (1)$$

where:

- Price is the average fare paid by passengers in the market,
- Demographics include characteristics such as the population and income of the two countries,
- Consumer tastes reflect variation in consumer preferences across markets and over time,
- Service characteristics comprise flight frequencies and other service quality attributes.

Unfortunately, consistent and reliable price information is not publicly available for international air routes; hence, a reduced form model must be estimated. It is assumed that price can be represented as follows:

$$\text{Price} = g(\text{Market Competition, Carrier Costs}) \quad (2)$$

where:

- Market Competition reflects the competitive forces in a market.
- Carrier Costs are those costs related to providing service in a specific country-pair market.

A reduced form traffic volume model can then be constructed by substituting Eq. (2) for Price into Eq. (1):

$$\text{Country} - \text{Pair Traffic Volume} = f(\text{Market Competition, Carrier Costs, Demographics, Consumer Tastes, Service Characteristics}). \quad (3)$$

Next, we can build on this model of passenger traffic determination (Eq. (3)) to form appropriate regression models. A description of the actual data used to measure these broader variables follows:

- Country-Pair Traffic Volume: The number of passengers flown in a specific country-pair market. Note that there are three different international air traffic measures. Total traffic—**Total Market Traffic**—carried in a particular country-pair market, is composed of the traffic carried by Canadian carriers—**Canadian Carrier Traffic**—and the traffic carried by foreign carriers—**Foreign Carrier Traffic**. ICAO's *Traffic by Flight Stage* series (1982–1994) records the number of annual passengers carried by airline on different international routes and allows the creation of the three dependent variables. When a country-pair market involves multiple routes, the data is aggregated to form the country-pair air traffic volumes.
- Market Competition: First, the number of competing airlines in a country-pair market—**Market Competitors**—clearly affects the extent of market competition. Additionally, international aviation policy (i.e. dual operation and liberalized bilaterals) can affect the strategic interaction between airlines and the resulting market competitiveness. Two dummy variables—**Canadian Dual Operation & Foreign Dual Operation**—reflect whether two Canadian carriers and/or two foreign carriers operate on a route. A dummy variable—**Liberalized Bilateral**—reflects whether the Canadian government signed a liberalized agreement reducing restrictions on frequency, capacity and/or pricing.[8]
- Carrier Costs: Consistent and comprehensive unit cost data, comparable across all airlines and the time-periods of this study, are lacking.[9] Accordingly, we use an efficiency index—**Canadian Efficiency**—and an input price index—**Canadian Input Prices**—as proxies for the unit cost of Canadian carriers. Oum and Yu (1998a) computed both indexes. The input price measure is an aggregation of labor, fuel, aircraft, and other material and service input prices using the multilateral Tornqvist index procedure developed by Caves et al. (1982). The efficiency measure is residual total-factor-productivity

[8] The bilateral classification is based on Mitchell (1991).

[9] Even if an airline's system-wide unit cost per passenger mile can be compiled, it is difficult, if not impossible, to compute its unit costs applicable to each country-pair because each firm has unique network characteristics that influence system-wide unit costs. See Oum and Yu (1998b) for details on this issue.

Table 1
Descriptive statistics (the measure of traffic is the number of passengers)

Variable	Mean	SD	Minimum	Maximum
Market Competitors	1.37	0.62	1	4
Canadian Efficiency	0.87	0.043	0.785	0.949
Canadian Input Prices	0.90	0.078	0.749	0.997
Canadian Carrier Traffic	116,213	177,632	1418	1,133,108
Foreign Carrier Traffic	140,881	152,101	5946	847,244
Total Market Traffic	165,080	276,764	1418	1,980,352
(Sub-Sample Statistics for the Total-Market-Traffic Variable)				
Relevant Sub-Sample	Mean	SD	Minimum	Maximum
Liberalized Bilat Markets	805,789	551,324	279,495	1,979,874
Non-Liberalized Bilat Markets	119,151	172,292	1418	958,177
Cnd Dual-Operation Markets	863,494	560,139	345,007	1,979,874
Cnd Single-Operation Markets	122,977	179,103	1418	1,001,516

and reflects overall airline efficiency after removing factors often beyond managerial control (stage length, output mix, etc.).[10]

- Demographics: The size and wealth of a population constitute crucial demographics with regard to air travel demand.[11] Foreign nation per-capita GDP—**Foreign GDP**—reflects average income by the foreign nation, and is normalized to 1990 US dollars for all nations. Foreign nation population—**Foreign Population**—reflects the potential scale of the market. Population and GDP data were gathered from the International Monetary Fund's International Financial Statistics (1982–1994).
- Consumer Tastes: Measuring the changing tastes of consumers is difficult; however, by combining the time trend and country-pair dummy variables we attempt to account for consumer taste variations. The time trend variable—**Time-trend**—accounts for changes in consumer tastes over time. The country-pair dummy variables account for consumer taste differences across country-pair markets.[12]
- Service Characteristics: It was not possible to obtain consistent service attribute variables over and above what can be indirectly reflected by the number of competitors in the market and the regulatory environment variables.

Tables 1 and 2 provide some details on the variables used to operationalize our model of country-pair air traffic determination. Table 1 illustrates key descriptive statistics on the three dependent variables (Total Market Traffic, Canadian Carrier Traffic and Foreign Carrier Traffic), as well as on the continuous explanatory variables (Market Competitors, Canadian Efficiency, Canadian Input Prices). Table 2 provides information on the characteristics of the Canadian international country-pair markets, and on the non-continuous (dummy) explanatory variables.

5. Empirical issues and results

Since total traffic for each country-pair market is the sum of the traffic carried by Canadian and foreign carriers in that market, for econometric efficiency it is desirable to jointly estimate the three traffic equations as a system of equations. Estimating a system of equations allows making use of the cross-equation error covariance matrix, but also requires matching observations for all three traffic equations. Since neither Canadian carriers nor foreign carriers serve all the country-pair markets for all the years of our sample, we would lose valuable observations by relying strictly on joint-equation estimation. Therefore, we adopt the following estimation strategy:

1. Separately estimate the three single equations using all available observations;
2. Jointly estimate the three traffic equations using the limited matching observations;
3. Then, observe the compatibility of the three single-equation and joint-estimation results.

A panel data set was constructed covering Canada's 33 international country-pair markets over the 1982–1994 period.[13] Since our sample includes 33 country-pairs and 13 years (82–94), the maximum number of panel observations (annual country-pairs) is 429. Of these 429 observations, 299 observations had traffic carried by either Canadian or foreign carriers: 227 cases had Canadian carrier traffic and 167 cases had foreign carrier traffic. Only 45 observations exist where

[10] Note that in the single equation estimation we omit foreign carrier efficiency and input price variables due to the limited coverage of foreign airlines in our data source (Oum and Yu, 1998a). Also, note that in the case of two national airlines operating in a market, the indexes reflect a weighted-average of the two airlines' measures.

[11] Only the size and wealth of the foreign nation are analyzed. Although the demand in a market would also depend on the population and income of Canada, there would be no variation in these factors across different Canadian country-pair markets—Canada's population and income remains constant across panels but varies over time.

[12] Although transport demand models typically include distance in order to reflect time and/or impedance factors, we exclude distance because it is reflected by the country-pair dummy variables.

[13] The names of the 33 countries are listed in Table 2.

both Canadian and foreign carriers compete; thus, the joint-estimation involves 45 observations. Since researchers frequently use both log–linear and linear functional forms, we conducted a statistical test by estimating the Box–Cox models.[14] Our test results reject a log–linear functional form, but could not reject a linear functional form at the 1% significance level. Therefore, a linear functional form is used throughout the regressions.

5.1. Formulation, estimation and empirical results—single equation models

Based on the previous discussion of relevant variables, we estimate the following three single-equation regressions using the OLS procedure:

- Regression #1: The Total-Market-Traffic Equation

$$\begin{aligned}\text{Total Market Traffic}_{it} &= \beta_0 + \beta_1\ \text{Cnd Dual Operation}_{it} \\ &+ \beta_2\ \text{Liberalized Bilat}_{it} + \beta_3\ \text{Market Competitors}_{it} \\ &+ \beta_4\ \text{Cnd Efficiency}_{it} + \beta_5\ \text{Cnd Input Prices}_{it} \\ &+ \beta 6\ \text{GDP}_{it} + \beta_7\ \text{Population}_{it} + \beta_8\ \text{Timetrend}_t \\ &+ \Sigma_{i=1}^{k-1}\beta_{i+8}\text{Country Pair}_i + \epsilon_{it} \qquad (4)\end{aligned}$$

- Regression #2: The Canadian-Carrier-Traffic Equation

$$\begin{aligned}\text{Canadian Carrier Traffic}_{it} &= \beta_0 + \beta_1\ \text{Cnd Dual Operation}_{it} \\ &+ \beta_2\ \text{Liberalized Bilat}_{it} + \beta_3\ \text{Market Competitors}_{it} \\ &+ \beta_4\ \text{Cnd Efficiency}_{it} + \beta_5\ \text{Cnd Input Prices}_{it} \\ &+ \beta_6\text{GDP}_{it} + \beta_7\ \text{Population}_{it} + \beta_8\ \text{Timetrend}_t \\ &+ \Sigma_{i=1}^{k-1}\beta_{i+8}\ \text{Country Pair}_i + \epsilon_{it} \qquad (5)\end{aligned}$$

- Regression #3: The Foreign-Carrier-Traffic Equation

$$\begin{aligned}\text{Foreign Carrier Traffic}_{it} &= \beta_0 + \beta_1\ \text{Foreign Dual Operation}_{it} \\ &+ \beta_2\ \text{Liberalized Bilat}_{it} + \beta_3\ \text{Market Competitors}_{it} \\ &+ \beta_4\ \text{Cnd Efficiency}_{it} + \beta_5\ \text{Cnd Input Prices}_{it} \\ &+ \beta_6\ \text{GDP}_{it} + \beta_7\ \text{Population}_{it} + \beta_8\ \text{Timetrend}_t \\ &+ \Sigma_{i=1}^{k-1}\beta_{i+8}\ \text{Country Pair}_i + \epsilon_{it} \qquad (6)\end{aligned}$$

[14] For Box–Cox model, we transformed all the continuous explanatory variables used in the regression models into the following form: $(1 - X^8)/8$ where lim $(1 - X^8)/8$ approaches a linear form as 8 approaches 1, and where lim $(1 - {}^8)/8$ approaches natural log of X as 8 approaches 0.

where i indexes the country-pair, t indexes time (annual data from 1982 to 1994), and k represents the number of country pairs (i.e. 33). Table 3 reports results for the three single equation regressions—Total Market Traffic, Canadian Carrier Traffic, and Foreign Carrier Traffic—and the results for each equation are discussed below.

The Total-Market-Traffic equation (Regression #1) generally conforms to expectation. The R-square of 0.94 indicates a reasonably good model fit and all the explanatory variables have the expected sign. The three principal explanatory variables—Liberalized Bilateral, Dual Operation and Market Competitors—are all significant at the 1%-level. The coefficient estimate for Liberalized Bilateral (232,161) suggests that markets governed by liberalized bilaterals comprise an additional 230,000 annual passengers. The coefficient estimates for Canadian Dual Operation (158,241) and Market Competitors (123,608) must be combined to factor the effect of an additional Canadian carrier, since adding a Canadian carrier also increases the number of competitors in a market. The two coefficient estimates suggest that markets characterized by Canadian dual operation comprise an additional 281,849 ($= 158{,}241 + 123{,}608$) annual passengers.

The Canadian-Carrier-Traffic equation (Regression #2) also conforms to expectation with an R-square of 0.94 and all the explanatory variables—except for the insignificant Population variable—having the expected sign. The three principal explanatory variables are all significant at the 1%-level. The coefficient estimate for Liberalized Bilateral (196,697) suggests that markets governed by liberalized bilaterals comprise an additional 197,000 annual passengers for Canadian carriers. The coefficient estimates for Canadian Dual Operation (85,399) and Market Competitors (38,841) suggest that markets characterized by Canadian dual operation comprise an additional 124,240 ($= 85{,}399 + 38{,}841$) annual passengers for Canadian carriers.

The Foreign-Carrier-Traffic equation (Regression #3) conforms to expectation with an R-square of 0.92 and all the explanatory variables—except for the insignificant Canadian Efficiency and Canadian Input Price variables—having the expected sign. Both the Liberalized Bilateral and Foreign Dual Operation variables are significant at the 1%-level. The coefficient estimate for Liberalized Bilateral (177,811) suggests that markets governed by liberalized bilaterals comprise an additional 178,000 annual passengers for foreign carriers. The coefficient estimate for Foreign Dual Operation (266,355) suggests that markets characterized by foreign dual operation comprise an additional 266,000 annual passengers for foreign carriers. Note that the Market Competitors variable is not statistically significant.

5.2. Formulation, estimation and empirical results—multi equation model

As discussed in the Estimation Strategy section, joint estimation of the system of Total Market Traffic, Canadian

Carrier Traffic and Foreign Carrier Traffic equations is desirable for econometric efficiency reasons. In order to estimate the three volume regressions jointly, we formulate the following system of equations with cross-equation parameter constraints:

- Regression #4: Joint Estimation of a System of Three Equations

Equation 1:

$$\text{Total Market Traffic}_{it} = \beta_0 + \beta_1 \text{ Cnd Dual Operation}_{it} + \beta_2 \text{ Liberalized Bilat}_{it} + \beta_3 \text{ Market Competitors}_{it} + \beta_4 \text{ Market Efficiency}_{it} + \beta_5 \text{ Market Input Prices}_{it} + \beta_6 \text{ GDP}_{it} + \beta_7 \text{ Population}_{it} + \beta_8 \text{ Timetrend}_{it} + \Sigma_{i=1}^{k-1}\beta_{i+8} \text{ Country Pair}_i$$

Equation 2:

$$\text{Canadian Carrier Traffic}_{it} = \{\text{Canadian Market Share}_{it} * \text{Total Market Traffic}_{it}\} = (a_0 + a_1 \text{ Cnd Dual Operation}_{it} + a_2 \text{ Foreign Dual Operation}_{it} + a_3 \text{ Relative Efficiency}_{it} + a_4 * \text{Relative Input Prices}_{it}) * [\beta_0 + \beta_1 \text{ Cnd Dual Operation}_{it} + \beta_2 \text{ Liberalized Bilat}_{it} + \beta_3 \text{ Market Competitors}_{it} + \beta_4 \text{ Market Efficiency}_{it} + \beta_5 \text{ Market Input Prices}_{it} + \beta_6 \text{ GDP}_{it} + \beta_7 \text{ Population}_{it} + \beta_8 \text{ Timetrend}_{it} + \Sigma_{i=1}^{k-1}\beta_{i+8} \text{ Country Pair}_i]$$

Equation 3:

$$\text{Foreign Carrier Traffic}_{it} = \{(1 - \text{Canadian Market Share}_{it}) * \text{Total Market Traffic}_{it}\} = (1 - a_0 - a_1 \text{ Cnd Dual Operation}_{it} - a_2 \text{ Foreign Dual Operation}_{it} - a_3 \text{ Relative Efficiency}_{it} - a_4 \text{ Relative Input Prices}_{it}) * [\beta_0 + \beta_1 \text{ Cnd Dual Operation}_{it} + \beta_2 \text{ Liberalized Bilat}_{it} + \beta_3 \text{ Market Competitors}_{it} + \beta_4 \text{ Market Efficiency}_{it} + \beta_5 \text{ Market Input Prices}_{it} + \beta_6 \text{ GDP}_{it} + \beta_7 \text{ Population}_{it} + \beta_8 \text{ Timetrend}_{it} + \Sigma_{i=1}^{k-1}\beta_{i+8} \text{ Country Pair}_i]$$

The three equations make use of the adding up property (Canadian Carrier Traffic + Foreign Carrier Traffic = Total Market Traffic) and the tangential fact that foreign market-share is equivalent to one minus Canadian market-share. *Equation 1* is the familiar Total-Market-Traffic equation; though, this equation slightly departs from the set-up for the single equations by taking advantage of the data for foreign carrier efficiency and foreign carrier input prices. The efficiency measure—**Market Efficiency**—is now captured by summing Canadian carrier efficiency and foreign carrier efficiency. The input price measure—**Market Input-Prices**—is now captured by summing Canadian carrier input-prices and foreign carrier input-prices.

Equation 2 is the Canadian-Carrier-Traffic equation, where Canadian Carrier Traffic is a function of the country-pair market share held by Canadian carriers—**Canadian Market Share**—multiplied by Total Market Traffic. A simple linear function is used to explain Canadian Market Share, where Canadian Market Share is a function of Canadian Dual Operation, Foreign Dual Operation, Relative Efficiency, and Relative Input-Prices.[15] A measure of Canadian carrier efficiency relative to foreign carrier efficiency—**Relative Efficiency**—was constructed by dividing the Canadian carrier efficiency index by the foreign carrier efficiency index. Similarly, a measure of Canadian input prices relative to foreign input prices—**Relative Input-Prices**—was constructed by dividing the Canadian carrier input price index by the foreign carrier input price index. In *Equation 3*, Foreign Carrier Traffic is a function of foreign market share (1 − Canadian Market Share) multiplied by the familiar Total Market Traffic.

Due to the presence of market share equations and the imposition of parameter constraints for the adding-up property of traffic volumes and market shares, the multi-equation system is non-linear in its parameters with cross-equation parameter constraints. Therefore, we estimate this system using the FIML (full information maximum likelihood) procedure available in SAS. Table 4 reports the parameter estimates and asymptotic *t*-ratios for the multi-equation model. The *R*-squares for the three equations—Equation 1 Total-Market-Traffic (0.98), Equation 2 Canadian-Carrier-Traffic (0.91), and Equation 3 Foreign-Carrier-Traffic (0.89)—support an overall goodness of fit.

The parameter estimates for the variables determining Total Market Traffic—all of have the expected sign. In addition, all the coefficient estimates are significant at the 1%-level, with the exception of the Population variable's 10% significance, and the GDP variable's 5% significance. The coefficients for Canadian Dual Operation (−356,549) and Market Competitors (464,844) must again be combined to factor the effect of an additional Canadian carrier. The coefficients suggest that markets served by two Canadian carriers are expected to have an

[15] Ideally, a measure of relative fare levels should be used as a market-share predictor, as airlines with low fares are expected to garner greater traffic. However, no systematic average yield or fare data was available; thus, we use the Relative Efficiency and Input Price variables as a proxy for average fares.

Table 2
Pair-Country Market characteristics

Pair-Country Market	Liberalized Bilateral	Cnd/For Dual-Oper.	AC/CAI Operation	Mean Pop (mlns)	Mean GDP (per capita)
Antigua	No	No/No	92–94/No	0.06	4291
Argentina	No	No/No	No/88–92	32.53	4636
Australia	No	No/No	No/92–94	17.66	17593
Austria	No	No/No	1994/No	8.03	21412
Bahamas	No	No/No	82–94/No	0.25	10565
Barbados	No	No/No	82–94/No	0.26	6206
Belgium	No	No/No	No/No	9.92	17971
Brazil	No	No/No	No/87–94	150.33	1152
Chile	No	No/No	No/88–92	13.13	2137
China	No	No/No	No/86–94[a]	1132.16	325
Denmark	No	No/No	No/90–91	5.15	25264
Dominican Repb.	No	No/No	87–90/No	6.94	1036
Finland	No	No/No	No/No	4.96	24226
France	No	90–94/No	82–94/90–94	56.15	19779
Germany	84–94	88–94/No	82–94/88–94	67.46	22464
Greece	No	No/No	89–90/No	10.09	7862
Haiti	No	No/No	82–94/No	6.26	431
Hong Kong	No	No/No	No/85–91	5.65	12139
Italy	No	No/No	No/84–94	57.21	17846
Jamaica	No	No/No	82–94/No	2.35	1652
Japan	No	94/No	1994/84–94	122.27	21712
Mexico	No	No/No	No/88–94	84.54	2873
Netherlands	90–94	No/No	No/84–90	14.79	17818
Peru	No	No/No	No/84–91	20.48	1829
Portugal	No	No/No	88–90/84–88	9.91	6204
Repb. of Korea	No	No/No	1994/No	43.09	6146
Saint Lucia	No	No/No	86–94/No	0.14	2813
Spain	No	No/No	No/No	38.65	11548
Switzerland	No	No/No	82–94/No[b]	6.64	31568
Taiwan	No	No/No	No/91–94	20.85	8986
Trinidad	No	No/No	82–94/No	1.20	4578
UK	88–94	90–94/92–93	82–94/90–94	57.25	15863
Venezuela	No	No/No	89–92/No	19.56	2603

[a] AC did not compete in the Switzerland market in 1985–88 and 1992.
[b] CAI did not compete in the China market from 1990 to 1993.

additional 108,295 (= 464,844–356,549) annual passengers. The coefficient estimate for Liberalized Bilateral (242,611) suggests that markets governed by liberalized bilaterals can be expected to have an additional 242,000 annual passengers.

The parameter estimates for the variables determining Canadian-Market-Share must also be analyzed. The coefficient for Canadian Dual Operation (0.07) has the expected sign and is statistically significant at 5% level—suggesting that the market share of Canadian carriers increases by seven percentage points when two Canadian carriers operate in a country-pair market. The coefficient for Foreign Dual Operation is virtually zero and not statistically significant—suggesting little impact from dual operation by foreign carriers on Canadian carrier traffic. This surprising result may owe to the fact that the data include only two observations (UK 1992–1993) where two foreign carriers operate. The coefficient for Relative Efficiency has the expected positive sign and is significant at the 10% level—suggesting that the market share of Canadian carriers increases when Canadian carriers are relatively more efficient than foreign carriers. The coefficient for Relative Input-Prices has the expected negative sign, but is not statistically significant.

5.3. Comparing estimation results between the single-equation and the multi-equation models

In keeping with our estimation strategy, we now compare the empirical results of the single-equation estimations with those of the multi-equation estimation. Recall that we are interested in the effect of Canadian dual-operation, foreign dual-operation, and liberalized bilaterals on international air traffic. The single-equation estimations suggest that annual total market traffic increases by 281,849 passengers under Canadian dual-operation, while the joint estimation suggests an increase of only 108,295 passengers. The single-equation results also suggest that Canadian carriers' annual traffic increases by 124,240 passengers due to Canadian dual-operation, while the joint estimation

Table 3
Estimation of three single equations (dummy for Switzerland omitted from models to serve as base intercept. Significance: * = 1%; ** = 5%; *** = 10%)

Regression	#1		#2		#3	
Dependent variables:	Total Market Traffic (Passengers)		Canadian Carrier Traffic (Passengers)		Foreign Carrier Traffic (Passengers)	
Explanatory variables	Coefficient estimate	'T' ratio	Coefficient estimate	'T' ratio	Coefficient estimate	'T' ratio
Intercept	−369980**	−2.36	−342209*	−2.64	−95643	−0.63
Liberalized Bilateral	232161*	7.51	196697*	7.39	177811*	9.4
Cnd. Dual Operation	158241*	4.74	85399*	3.40		
For. Dual Operation					266355*	6.37
Market Competitors	123608*	7.06	38841*	2.80	7971	0.59
Canadian Efficiency	71865	0.89	78384	1.20	32772	0.45
Canadian Input Prices	−73795	−0.88	−129087***	−1.73	−31588	−0.42
For. GDP (per capita)	8.65***	1.66	9.26**	2.21	3.77	0.73
For. Population (mlns)	750	1.00	−171	−0.33	7232*	4.45
Timetrend	3403	1.46	8787*	3.42	1419	0.70
Argentina	172729	1.17	253663**	2.13		
Antigua	190850	1.23	226012***	1.85		
Australia	70821	0.77	115007	1.62		
Austria	33748	0.35	60414	0.86		
Bahamas	183280	1.62	226795**	2.50		
Barbados	232813***	1.72	279003**	2.57		
Belgium	122448	1.60			100	0.001
Brazil	83238	0.43	299516***	1.96	−961195*	−3.21
Chile	208331	1.30	272930**	2.13		
China	−622749	−0.73	475390	0.79		
Denmark	7371	0.11	50293	1.02		
Dominican Republic	235680	1.43	301533**	2.28		
Finland	49810	1.03			−8815	−0.21
France	149117***	1.85	245682*	3.91	−264368**	−2.36
Germany	−51517	−0.64	−6885	−0.11	−400510*	−3.35
Greece	155204	1.21	189404***	1.76	4414	0.04
Haiti	235915	1.44	291166**	2.20		
Hong Kong	224078**	2.08	274608*	3.19		
Italy	87136	1.01	145576**	2.15	−308074**	−2.55
Jamaica	321880**	2.03	378293*	2.98	112381	0.71
Japan	158361	1.51	261767*	3.39	−749738*	−3.65
Mexico	150746	0.93	280038**	2.11	−489981**	−2.36
Netherlands	434010*	5.41	347873*	5.37	214884*	2.75
Peru	227263	1.44	298567**	2.35		
Portugal	156257	1.15	225598**	2.05	22079	0.17
Republic of Korea	161832	1.13	170861	1.44	−210825	−1.32
Saint Lucia	210612	1.36	261535**	2.10		
Spain	178326	1.62			−160647	−1.27
Taiwan	171403	1.32	226910**	2.21		
Trinidad	215444	1.50	263504**	2.29		
UK	826582*	8.25	642349*	8.16	−79395	−0.62
Venezuela	88378	0.55	222545	1.74	−61875	−0.38
R-Squared	0.94		0.94		0.92	
Observations	299		227		167	

suggests an increase of 114,592 passengers.[16] Both estimation approaches support Canadian Dual Operation enhancing Total Market Traffic and Canadian Carrier Traffic; although, the joint estimation provides more conservative results. Conversely, Foreign dual-operation generates conflicting results: the single-equation estimations support a large and positive effect on foreign carriers' traffic (+266,355 passengers), while the joint estimation approach finds statistically insignificant effect. Lastly, the two estimation techniques virtually converge on the effect of Liberalized Bilaterals: the single-equation estimation finds Liberalized Bilaterals to increase annual Total Market Traffic by 232,161 passengers; while the joint estimation finds Liberalized Bilaterals to increase annual Total Market Traffic by 242,611 passengers.

In sum, Canadian Dual Operation and Liberalized Bilaterals appear to have a positive impact on total traffic volumes in Canada's country-pair markets. In addition,

[16] The annual passenger increase of 115,675 is calculated from the joint estimation results as follows: the average passenger volumes of the markets with dual operations by Canadian carriers is 863,494 (see Table 1). Since Canadian carrier dual operation has increased the total traffic by 108,295 passengers, the total traffic would be 755,199 passengers in the absence of dual operation. Canadian carrier market share is expected to be 57% and 50% with and without the dual operation, respectively. Therefore, Canadian carriers would carry 492,192 passengers (57% of 863,494) and 377,600 passengers (50% of 755,199), with and without the dual operation, respectively. The difference is 114,592 passengers.

Table 4
Joint estimation of a system of three equations (dummy for Switzerland omitted from model to serve as base intercept. Significance: * = 1%; ** = 5%; *** = 10%)

Regression Number	#4	
	Coefficient estimate	'T' ratio
Total-Market-Traffic Regressors		
Intercept	−2646370*	−4.45
Canadian Dual Operation	−356549*	−5.28
Liberalized Bilateral	242611*	4.59
Market Competitors	464844*	8.37
Market Efficiency	761527*	3.19
Market Input-Prices	−468953*	−3.30
Foreign GDP (per capita)	34.17**	2.14
Foreign Population (mlns)	4916***	1.69
Timetrend	44384*	4.76
France	268847	1.03
Germany	−32534	−0.12
Japan	−120429	−0.29
Netherlands	801514*	3.98
UK	1031233*	3.29
Canadian-Market-Share Regressors		
Intercept	0.51*	20.65
Canadian Dual Operation	0.07**	2.17
Foreign Dual Operation	0.007	0.24
Relative Efficiency	0.42***	1.84
Relative Input-Prices	0.07	0.48
Observations: 45		
R-Squared for Total-Market-Traffic Equation: 0.98		
R-Squared for Canadian-Carrier-Traffic Equation: 0.91		
R-Squared for Foreign-Carrier-Traffic Equation: 0.89		
Log-Likelihood: −191.56		

Canadian Dual Operation also enhances Canadian carrier traffic; i.e. the presence of two Canadian carriers in a market shifts traffic (and market share) to Canadian carriers from foreign carriers.

5.4. Counter-factual scenario analysis: Canada–UK bilateral case

In order to illustrate the magnitudes of the effects of Dual Operation of Canadian carriers and the Liberalized Bilateral Air Services Agreement (ASA) more clearly, it is useful to analyze what would have happened in the Canada–UK bilateral markets in 1993 in the absence of (a) the dual operation of Canadian carriers (Air Canada and Canadian Airlines International), (b) the liberalized Canada–UK Bilateral ASA, and (c) in the absence of both. Using the results of our single equation estimation and those of the multivariate system estimation, the effects on total traffic volume and the traffic volume carried by Canadian carriers in the Canada–UK bilateral markets are computed and reported in Table 5.

Although both of the models give the same direction of changes, the magnitudes are different between them. As discussed earlier, both models have advantages and disadvantages. While the single equation models use a larger number of observations in estimation than the multivariate system, the former does not take into account the adding-up properties of Canadian carrier traffic and foreign carrier traffic volumes while the latter does. Therefore, the true results may lie somewhere between these two results. Therefore, the results in Table 5 may be summarized as follows:

1. The 1993 total traffic volume in the Canada–UK bilateral markets may have been reduced from 1,980,352 passengers to 1,689,000–1,872,000 (a reduction of 108,000–282,000 passengers) if only a single Canadian carrier had operated in that market. Furthermore, the traffic volume carried by Canadian carriers would have gone down from 1,133,108 one-way passengers to 936,000–1,009,000 passengers). The multivariate system estimation shows that Canadian carrier market share would have gone down by seven percentage points.
2. In the absence of the Liberalized Bilateral ASA, the total traffic volume would have been reduced by 232,000–243,000. Canadian carriers' combined traffic volume would have been reduced by 143,000–197,000 passengers from the 1,133,000 passengers actually carried by the two Canadian scheduled service carriers.

Table 5
Counter factual scenario analysis: Canada–UK Market (What would have happened in the absence of Canadian Carrier Dual Operations; (b) Liberalized Bilateral; and (c) Absence of Both ?) (Notes: 1. Based on coefficients of the single equation and multivariate equation models. 2. 1993 Canada–UK market as the base case market.)

	1993 Base case with dual operation and liberalized bilateral	(a) Without dual operation	(b) Without liberalized bilateral	(c) Without both dual operation or liberalized bilateral
Single Equation Results				
Total Market Traffic	1,980,352 1993 actual	1,698,503 (−281,849)	1,748,191 (−232,161)	1,446,342 (−514,010)
Canadian Carriers' Traffic	1,133,108 1993 actual	1,008,868 (−124,240)	936,411 (−196,697)	812,171 (−320,937)
Multiple Equation Results				
Total Market Traffic	1,980,352 1993 actual	1,872,057 (−108,295)	1,737,741 (−242,611)	1,629,446 (−350,906)
Combined Canadian Carriers Market Share	57% 1993 actual	50%	57%	50%
Canadian Carrier Traffic	1,133,108 1993 actual	936,028 (−197,080)	990,512 (−142,596)	814,723 (−318,385)

3. In the absence of the both Dual Operations of Canadian carriers and the Liberalized Bilateral, the total market size would have been reduced from 1,980,000 to 1,446,000–1,629,000 passengers, a reduction of between 351,000 and 514,000 passengers (18–26% reduction). The traffic volume carried by Canadian carriers would have been reduced from 1,133,000 to 812,000–814,000 passengers, a 28% reduction.

6. Discussion and conclusion

In 1999, Air Canada acquired its rival, Canadian Airlines, thereby effectively reducing the number of scheduled Canadian flag carriers from two to one while signaling an end to (or at least a lull in) Canada's dual designation policy. The major purpose of this paper was to investigate the impact of dual designation on Canada's international air traffic. Our analysis indicates that the dual designation policy served to both increase total traffic in Canada's international air markets, as well as increases the combined traffic volume carried by Canadian carriers. The empirical result of the multivariate system estimation indicates that the share of traffic carried by Canadian flagged airlines also increases by 7 points in the presence of Dual Operation of Canadian carriers in a country-pair (bilateral) market. Since the merger of Air Canada and Canadian implies an automatic reduction of the number of scheduled Canadian carriers (from 2 to 1) in current and future dual designation markets, the acquisition is likely to have a substantial negative impact on total traffic volume, Canadian carrier traffic volume and Canadian carrier market shares.

The second purpose of this paper was to examine the effect of liberalized bilaterals on Canada's international air traffic. The results indicate that these partially liberal agreements have significantly raised both Canadian and foreign carrier traffic—and thus total market traffic—in the Canadian bilateral country-pair markets. In addition, the empirical evidence supports liberalized Canadian bilaterals improving the combined market share of Canadian carriers. These results indicate that even the moderate (partial) liberalization efforts adopted in some Canadian bilateral air services agreements has been beneficial to all parties by increasing the total market traffic, Canadian carrier traffic and foreign carrier traffic volumes

Previous research produced conflicting or inconclusive results concerning the effect of partial liberalization initiatives on airline traffic. We find that both elements of Canada's partial-liberalization policy—dual designation and liberalized bilaterals—has increased international passenger traffic levels. Due to the lack of meaningful average fare data, we were unable to measure the effect of Canada's bilateral liberalization on airfares or consumer welfare; nevertheless, the evidence presented here is consistent with partial-liberalization efforts improving consumer welfare. Simply put, the Canadian country-pair markets subject to partial liberalization have witnessed increases in both total market traffic and Canadian carrier traffic.

In the future, this research can be expanded in two ways. First, when average air fare (average yield per passenger) data become available, it would be valuable to estimate the effects of partial liberalization on average airfare and consumer welfare. Second, since we focus on Canada's bilateral markets, it would be useful to examine the partial-liberalization efforts of other nations for similar results.

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