1. INTRODUCTION

This paper analyses the flows of passenger air traffic in and out of the five major Canadian airport ‘gateway’ cities: Vancouver, Calgary, Toronto, Montreal and Halifax. The movement of people across space is one of the five great flows of domestic and international commerce: flows of ideas, of capital, of services, of merchandise and of people.

These flows are, of course, interconnected, and indeed in this paper the focus will be on ‘business’ travel -- that is, the people movements which are undertaken not for their own sake but as a complement to the flows of capital, goods and service trade. That is, we will be looking at air travel as an input (to business), not as an ‘output’ as it is for leisure travellers, where the trip itself is the point.

We will be asking a question which has not been answered before for Canada -- indeed, not for any country apart from Germany. The question is this: is there a ‘border effect’ applicable to passenger air travel in and out of the gateways? In one of the most cited and influential trade papers of the past decade or so, John McCallum (1995) reported the discovery of a massive border effect on Canadian merchandise trade. He found that, after controlling for other factors that should influence trade, there was about ten times more of it within Canada -- specifically, between the Canadian provinces -- than there was across the border -- specifically, between Canadian provinces and US states.

The border effect is much too large to be explicable in terms of explicit border restrictions, such as tariffs, as indeed has been explicitly demonstrated in the Canadian case because the effect remains even after the Canada-US free trade agreement virtually eliminated formal trade barriers between the two economies. It is almost certainly much too large too be explained away by more informal barriers, such as the time it takes to actually cross a border and to process the paperwork of international commerce.

That is, the border effect, at least for trade in goods, services and capital, is not about the border itself, but about the territories that the border separates. There is something about Canada/Canadians, on the one hand, and the United States/Americans, on the other that means that the citizens of one country are much more likely to do business with each other than with people from over the border. The precise nature of this ‘something’ is still a mystery, but it appears to be due to what economists call ‘transaction costs’ -- that is, formal and informal
impediments to commerce which may be exacerbated by international differences in culture, language, commercial law and even colonial histories.¹

So what about ‘trade’ in people? First, it is very clear that there is in general nothing like free trade in people, not even between Canada and the United States. With a very few exceptions (citizens of the EU within the EU; citizens of Australia and New Zealand crossing the Tasman Sea) quite onerous, even prohibitory (visa) restrictions limit the movement of people across international borders. Indeed, such restrictions are likely to be a significant contribution to the border effect in goods trade, because they obviously make it more difficult to conduct international business transactions, which may require face-to-face contacts and the redeployment of employees.

In this paper we will look for the existence of a border effect affecting movements of people between Canada and other countries. And we will find it, although its precise form will turn out to differ from the simple border effect uncovered in the trade studies. Next, Section 2 gives some background to the gravity model literature, and Section 3 introduces the application to passenger air travel. Section 4 describes the database assembled for this study, and Section 5 analyses the characteristics of the five gateway airports. Section 6 reports our own estimate of a gravity-based model with border effects, and Section 7 concludes with implications for policy and further research.

### 2. BACKGROUND TO GRAVITY TRADE MODELS

Gravity trade models borrow from physics the formula for the strength of the gravitational attraction between two bodies, being proportional to the products of their mass and inversely proportional to their distance from each other. In trade models, the bodies are, usually, countries, ‘attraction’ is the amount of bilateral trade between two countries, ‘mass’ is proxied by GDP and/or population, and distance is distance.

The gravity model has been remarkably successful at explaining trade flows, and has become the dominant model in empirical trade research over the past twenty or so years. In econometric estimation, it even tends to mimic the strictly proportional effects predicted by the physical gravity equation, although there is no obvious theoretical reason why it should do so.

And that is a bit of a problem. Economists don’t believe something can be true in fact unless they can see how it is true in theory. And we do have a time-honoured theory of international trade: what is called the Heckscher-Ohlin model, which predicts that trade will follow from what are called factor endowments: a country with an abundant supply of capital will specialise in producing, and thus will export capital-intensive goods; a skill-abundant country will export skill-intensive goods, and so on.

The puzzle here is that the gravity model does so well without recourse to these ‘fundamentals’ of trade theory. Even the distance variable, which was thought to have a reasonably fundamental rationale in terms of transport costs, turns out to be not so simply explained away. When you think about it, it really

¹ Of course the presence of a Canada-US border effect is particularly striking given that these two countries do have a relatively open border, that they do already have the largest bilateral trade flows in the world, and that – at least to foreigners – it seems that their cultures have a lot more in common than they have apart.
doesn’t seem likely that increasing distance from, say, 500 kilometres to 1000 kilometres would wipe out the profitability of about one half of the potential trade flows, purely on the basis of the added costs of moving goods the additional kilometres. Grossman (1998) plugged in plausible numbers for transport and other costs, and found that the distance effect thereby predicted is only about one thirtieth of the proportional gravity model effect!

Even as an empirical regularity there was an empirical hole at the centre of the gravity model literature. It used the readily available data on shipments of goods between countries, but actually omitted the much larger internal shipment flows, which are much less conveniently measured. Still, probably very few economists - certainly not those surveyed by John Helliwell (1996) - expected that filling this hole in the data would change the results significantly.

Enter John McCallum (1995), armed with an unusual Statistics Canada database, which tracked shipments of merchandise goods (so no plumbing or retail services included in the data) between Canadian provinces and between provinces and U.S. states in 1988. Estimating the gravity model on these shipments data, McCallum found that he needed an enormous dummy variable to enable it to encompass the two types of shipment flows. Basically, for given values of incomes and distance, trade between the provinces is much more likely than trade across the border. For example, a business in British Columbia was more than twenty times more likely to import goods from Ontario than a business in Washington State, even though both are about the same distance from Ontario. So, there really is `too little trade' -- it is not (just) a matter of distances between agents.

Helliwell (1998) extended the estimation period to 1996, well into the Canada/U.S. free trade era (which began in 1989) and found that 40 per cent of the estimated border effect evaporated in just four years, dropping from about 20 in 1990 to around 12 in 1993 and thereafter - rather more than Helliwell (1996) had predicted. Recent work by Keith Head and John Ries (2001) seems to imply that more than half of the decline is due to the tariff cuts, with the remainder coming from some shrinkage of non-tariff border effects. The latter remain substantial, however, with tariff-equivalent values in 1995 ranging from 27 per cent to 45 per cent, depending on method of estimation.

Wei (1996) added estimates of the distances between people within regions, and came up with much smaller border effects for OECD economies. But his method appears to underestimate true internal distances, and other measures (Nitsch (2000)) result in higher numbers. Even using the Wei procedure, Helliwell (1998) estimates OECD border effects of around 10. Some other studies (eg Frankel and Rose (2000)) find even larger effects, whilst James Anderson and Eric van Wincoop (2001) and Michael Anderson and Stephen Smith (2001) find lower but still large estimates. The problem of a lack of data on internal flows of goods -- the Statistics Canada database used by McCallum and others is just about unique -- can be partially dealt with using micro-level Census data on the location of people within countries, as Helliwell and Verdier (2001) were the first to demonstrate. Applying their method to Australia-New Zealand trade flows, Hazledine and Lipanovic (2004) found another huge border effect between these two countries, even though the economic barriers between them are even lower than they are between Canada and the United States.
It soon became evident that the border effect was not, empirically, an anomaly. Frankel et al. (1995) had already reported the ‘remarkable’ finding that countries with a common linguistic/colonial heritage tend to trade 65% more with each other than they would in the absence of these links. There is the equally remarkable over-sized distance coefficient, noted above. What theory could synthesize and explain these relationships?

The answer came out of the emerging economics of imperfect information, missing from traditional theories such as Heckscher-Ohlin but now increasingly in the centre of how economists understand the world. Trade is a result of people doing business with each other. Doing business is a tricky, risky activity. Information is key, but information is both imperfect and unevenly distributed. Formal and informal institutions, norms and customs serve to mitigate the effects of imperfect information as a deterrence to commerce and trade. And it suddenly seemed highly plausible -- even, obvious -- that such effects would be related to borders and distance. People within a country would share customs and institutions that would make it easier for them to do business with each other than with foreigners. And, both within and across national borders, distance between potential partners might well be linked with ‘unfamiliarity'; with what we call the ‘transaction costs' of doing business.

These considerations will be born in mind when we now move on to the enterprise of testing the gravity model on data on ‘trade in people’ -- passenger air travel.

### 3. APPLYING THE GRAVITY MODEL TO PASSENGER AIR TRAFFIC

It would seem a natural fit to apply the gravity model to ‘trade’ in people; specifically to air passenger travel movements between cities or regions, and I have found several studies that do this. Interestingly, there is no link between the trade economists and the transportation economists on this matter. The empirical trade studies never, to my knowledge, mention trade in air travel; and the papers modelling air travel and using a gravity model approach don't even call it by this name, with the exception of Klodt (2004).

The reason for the lack of interest on the part of transportation economists in the gravity model per se may be that their primary concern is with prices, not quantities. For example, Dresner et al. (1996) are interested -- as are many U.S. aviation specialists -- in the impacts on market prices of the entry of Low-Cost Carriers (LCCs), such as Southwest Airlines. For this, they estimate an equation to explain price. But this equation has demand -- number of passengers -- in it, and demand is itself a function of price, so the appropriate thing from an econometric point of view is to also estimate a demand function, allowing for the simultaneity between price charged and quantity demanded.

That is, the demand equation, which is a gravity model in trade economics terms, is not the prime focus of attention - it is just there to clean up the estimation of the pricing model. This is something of a pity, since these air travel gravity models\(^2\) are actually more advanced than the standard trade models,

\(^2\) Another such study is Reiss and Spiller (1989). Dresner et al. (1996, footnote 3, p310) give references to other studies of the determinants of air traffic and/or prices.
because they do include an important price variable -- the actual average price, or ‘yield’, achieved on a route.

News of the border effect does not appear to have reached aviation economists, with one exception. My keyword search of the standard economics bibliographic database, *EconLit*, revealed just one, very interesting article, by Henning Klodt (2004). Klodt examines passenger trips from the three largest German airports, Frankfurt, Hamburg and Munich, to 14 within-Germany destinations (including each other) and 101 international destinations, this number excluding all ‘tourist’ destinations (eg, all flights to Greece), because Klodt is ‘interested in flight activities as complements of trade and investment activities’ -- that is, he is interested only in business travel.

Compared to the data available for the present paper, Klodt’s are better in two respects and more limited in one. He has numbers on actual passengers, whereas I have to proxy passengers with seats flown. And his passenger data are on an ‘origin-destination’ (O/D) basis, whereas ours will be for single sectors (takeoff/landing), even though some journeys have more than one stop, before or after the segment departing from one of our gateway airports. On the other hand, we do have data on individual flights, whereas Klodt’s are supplied to him aggregated to the route level, and so do not allow analysis of the ‘thickness’ of routes (number of flights daily on the same route) and of differences in type of airplane used to service routes.

Klodt’s estimated gravity model reveals striking border effects. With factors such as distance and GDP held constant, passenger air travel activity on international routes is just 22% of the activity on domestic German routes. Klodt also finds that German-speaking destinations get more travellers from Germany, *ceteris paribus*. Klodt presents his results as being ‘intended to add a further piece of evidence to the still unsolved puzzle [of the large size of border effects]’ (2004, p520). Now, we will offer a second piece of evidence from analysis of the Canadian data.

4. DATA

Conceptually, we are interested in the flows of travellers in and out of Canadian “gateway” cities. In general, trips or “travel” can be within the city, within the province, between provinces, across the Canada-US border and between Canada and third countries. Since we will be focusing on air travel we will be limiting ourselves to trips long enough that air rather than automobile or bus is the preferred means of transport. We then face two big data problems: getting information on the number of air travellers and distinguishing between business and ‘leisure’ travel, which itself is often divided into ‘tourism’ and ‘visiting friends and relatives’ as the prime reason for a trip.

Number of seats

Statistics Canada does publish data on trans-border passenger numbers, but, since 1999, it has not published data on air passenger movements (by origin and destination airport) within Canada. So, we proxy passenger numbers by the number of seats flown on each route. This will be a good proxy for actual
passengers to the extent that airplane load factors do not vary a lot across different city-pair routes.

The website www.flightstats.com lists scheduled departures, including aircraft type, for each airport. For the five gateway airports we recorded all scheduled passenger flight departures for one twenty four hour period, being Wednesday, March 21, 2007. This is a normal ‘business’ day, and outside of the usual vacation periods. We used various websites, including some airline websites, to get figures for the number of available seats on each flight. These figures will not always be exactly correct because they depend on seating configurations which can differ for the same type of aircraft between and sometimes even within individual carriers. We do make sure that single-class carriers, such as WestJet, have the correct number of seats assigned to their flights.

**Business travellers**

We are primarily interested in business travel. Unfortunately, there are no data at the route or flight level distinguishing between different purposes of travel. There are more aggregated data, however, produced from customs and immigration arrival and departure cards filled in by international travellers. Statistics Canada’s publication 66-2-1-XIE *International Travel* reports these data in the following aggregations:

- US residents entering Canada for one or more nights, by plane, by purpose of trip
- Residents of other countries (i.e. not US) entering Canada for one or more nights, by purpose of trip
- Canadian residents returning from the US after a stay of one or more nights, by transportation other than automobile, by purpose of trip
- Canadian residents by province of residence returning from other countries after a stay of one or more nights, by purpose of trip and by area of destination
- Residents of other countries entering Canada for one or more nights, by purpose of trip, with some detail on area of residence (China, Hong Kong, etc)

These data can be used to construct direct estimates of the number of business travellers (or rather the proportion of seats to be assigned in our database to business travellers) for some long-haul international routes. For example, the proportion of residents of Germany visiting Canada who give the purpose of their trip as ‘business, convention or employment’ in 2005 was 18%. We don’t have the equivalent number for Canadians visiting Germany, but we do know that for all Canada-Europe trips the proportion of business travellers was actually the same in both directions, at 14%. So, rounding off the 18% number, we will assume that all Canada-Frankfurt flights have 20% business travellers.

What about the many domestic Canada and Canada-US flights? For our joint research into airline pricing, my co-author David Gillen has come up with “educated guesses” of the proportion of business travellers on a number of these routes, rounded to ten percent intervals. I have then used these guesstimates as a guide to infill numbers for all the other routes. Then I have carried out the one check we can
make against the Statistics Canada data, which is to calculate the implied number of business travellers (or seats) on each route and then aggregate these.

Statistics Canada reported that 36% of the 3.915 million US residents flying into Canada in 2005 were on business, and that 27% of the 6.266 million Canadians flying the other way were business travellers. Business travellers were therefore in aggregate 30% of all trans-border air travellers. The number we get by aggregating all our guesstimates is also 30%. So it seems that at the least our guesstimates are not biased.

Distances

Gravity models of international trade flows need a figure for the 'distance' between each pair of trading entities. Usually, these studies simply choose a city as being the 'centre' of the trading entity and measure the distance between all city-pairs. This is uncontroversial in the case of compact countries like, say, Singapore, less so in the case of Canada or the United States. However, for the present study we are dealing with routes connecting specific cities, so there is no problem in principle with what distance we should measure. There are a number of programs on the Web which calculate the as-the-crow-flies distance between any two points on the globe -- we used www.indo.com/distance/index.html.

Populations

Gravity trade models use national populations as one of the 'attractor' variables for trade between nations. In our disaggregated situation the measurement of the relevant population is rather more problematic. We basically need for each airport a figure for the number of people who, if they did travel, would likely depart from that airport. For all the Canadian and U.S. airports we used the population (in 2006) of the relevant 'Metropolitan Area' -- eg, for Vancouver the Greater Vancouver Regional District -- with data obtained, mostly, from Wikipedia.com. 'New York' was taken to be the NewYork/Newark area, and the Bay Area was specified for San Francisco and San Jose.

For the longer haul international destinations it is not so simple. These routes are generally much 'thinner' than North American routes. For example, there is no scheduled passenger air service from Canada to any French city other than Paris. So, a Canadian with business in, say, Lyons, would most likely travel via Paris. Such considerations suggest using as the population attractor not the airport city, but the population of the entire country or region.

On the other hand, precisely because of the lack of direct air service, doing business in Lyons will be less attractive to Canadians, and in farther flung corners of France less attractive still. Therefore, we will experiment with three measures of the relevant population in overseas countries. One is, as for North America, the metropolitan area population. The second uses the population of the country or the larger region (e.g. Scotland, in the case of Glasgow flights). The third simply doubles the metropolitan area population.

Using the population of the airport city or metropolitan area as the attractor would be highly problematic in a U.S.-focussed study, because of the prevalence of
hub-and-spoke systems in that country, meaning that a large number of point-to-point flights do not involve journeys to one of the 'points', when that is a hub city. However, in geographical terms, Canada is a rather one dimensional country, with its major population centres more or less strung out along a very long line not far from the 49th parallel. As a result, although larger city airports act as local hubs, there is not an American-style hub-and-spoke system in operation. Nevertheless, many journeys within Canada do involve a stopover, and these will not be picked up in our database. We can note, however, that stopover flights will be less attractive to time-sensitive business travellers.

**Incomes**

Trade is attracted by not just the number of people, but also by how much business they do, which is quite literally measured by per capita incomes. We source per capita GDP from the CIA 'World Factbook'. We use national figures for the Canadian provinces and for the US states, even though there are regional differences in incomes.

**Dummy variables**

It is customary in gravity trade models to use dummy variables or shifters to account for factors which are expected to affect the costs and likelihood of trading relationships between economies or regions, but which cannot be measured directly. Dummy variables used or tried out in this study will include:

CAPITAL = 1 if destination is a capital city
RESORT = 1 if a specialised tourism destination
PROVINCE = 1 if flight is intra-provincial
CANADA = 1 if flight is within Canada
USA = 1 if flight destination is in the US
ROW = 1 if destination is elsewhere in the world
LANGUAGE = 1 if main language of destination differs from origin city

We will be excluding all specialised tourist resort destinations (such as Cancun, Mexico) from the estimated model. A gravity-based model cannot be expected to explain tourist flows to resort destinations: in particular, the population variable will not in general be an attractor (and indeed lack of local population may well be part of the attraction of some tourist destinations).

**5. SCOPING THE GATEWAYS**

Table 1 gives data for the five gateway airports. In total, the metropolitan areas served by these airports contain 12.3 million people, which is about 37% of the population of Canada. There were a total of 1276 scheduled departures from the five airports that day, offering around 128,000 total seats, so the average flight offers one hundred seats. About 58% of these flights were within Canada (this figure is not shown on Table 1).