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Viewpoint

Making an impact: The influence of policies to reduce emissions from aviation on the business travel patterns of individual corporations ☆

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ABSTRACT

The contribution of aviation to global carbon dioxide (CO_2) emissions is projected to triple by 2050. As nations strive to meet CO_2 reduction targets, policy interventions to manage the growth of emissions arising from air travel are likely. Here, we investigate the potential influence of aviation emissions reduction policies on the business travel patterns of individual corporations. Using travel data from six UK-based companies, we find that increased ticket prices can deliver substantial emissions cuts, particularly on premium class flights, and may provide strong financial incentives to seek modal and/or technological alternatives to flying. We also find that corporations from different business sectors vary in their responsiveness to a range of policy options. Finally, we examine questionnaire data to determine whether companies more broadly are going beyond compliance to mitigate their environmental impact by managing travel-related emissions voluntarily. Although many corporations are measuring and reporting emissions, only a limited number are willing to implement in-house reduction policies prior to regulation.

1. Introduction

Flying currently contributes approximately 3% of global carbon dioxide (CO_2) emissions (IPCC, 2007). Although this appears modest, the civil aviation sector is expanding rapidly. For instance, in the UK, demand for air travel has grown by 130% in the past two decades, whereas GDP has risen to 54% (CCC, 2009). Business travel accounts for 33–40% of total global civil aviation traffic but in some regions, such as China, this proportion can be as high as 80–90% (Vedantham and Oppenheimer, 1998). Again, using the UK as an example, the demand for business air travel has risen from around 30 to 60 million passengers per year since 1990 (CCC, 2009).

Efforts to cut emissions can be broadly classified into those that are regulatory, or voluntary actions that go beyond compliance. To date, the most high profile strategy to curb CO_2 emissions is the EU's Emissions Trading Scheme (EU ETS), which uses a market-based approach to provide economic incentives for achieving reductions. In 2012, the aviation industry will be included into EU ETS (Europa, 2008); the airlines will be responsible for managing their carbon credits, and the associated costs are likely to be passed on to passengers. Although comprehensive analyses have been undertaken to examine the wider economic and environmental impacts of this move (Wit et al., 2005), no research to date has assessed the potential effects of such policy scenarios at the level of an individual company.

In this paper, we use business travel data gathered from a small number of UK-based corporations to assess the responses of those doing the travelling, in terms of passenger demand reduction and how this may vary between different business sectors. Despite the perception that business travel demand is inelastic, the recent recession and unprecedented decline in corporate flights has demonstrated that companies will choose not to fly employees if financially constrained (BTN, 2010). Our analyses are not presented as long-term projections, but rather highlight short-term cost implications of ticket price rises and the incentive they provide for corporations to seek alternatives to air travel. We also go on to consider the extent to which companies are going beyond compliance at a time when corporations are under mounting pressure to take responsibility for mitigating the emissions they generate (MEA, 2005), and the development of proactive environmental management is therefore seen as a source of competitive advantage (López-Gamero et al., 2010). Companies that are prepared for a modal shift from aviation to high speed rail transportation for short-haul routes and/or to use communication technologies as a substitute for long-haul travel are likely to experience economic benefits and

☆2006 average currency conversion rates are used throughout the paper, corresponding to time period when business travel data were collected.

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greater business efficiency when future carbon reduction policies are implemented (CCC, 2009).

2. Economic and environmental impacts of policy scenarios

Here we examine the consequences of five policy scenarios with the aim of curbing CO_2 emissions. The first corresponds with the predicted €9 (US$11) increase on a return ticket within Europe when the aviation industry becomes incorporated into EU ETS (Wit et al., 2005). The remaining scenarios are based on increases in UK Air Passenger Duty (APD) that came into effect in February 2007. The APD is a tax that is levied on all airport passengers, seeing ticket prices rise by £10 (€15/US$18) and £20 (€29/US$37) for economy and premium (business and first) class flights within Europe respectively, £40 (€59/US$74) for economy long-haul flights and £80 (€117/US$147) for premium class long-haul flights.

Past analyses of the impacts of these policies either focus on air travel as a whole (Wit et al., 2005) or aggregate all business travel (Lu, 2009). In contrast, we concentrate on the impact of these scenarios on the travel patterns of individual companies using travel data provided by Hogg Robinson Group Corporate Travel, one of the largest global business travel providers. The 2006 travel profiles for six UK-based companies were used for the analysis, two being selected from each of three business sectors: food manufacturing, pharmaceutical and financial. The corporations were chosen to be representative of each of the sectors in terms of the number of flights taken, the relevant proportion of different ticket types purchased (economy short-haul, premium short-haul, economy long-haul and premium long-haul), and their annual spend. Each travel profile detailed all flights taken that calendar year, listing the ticket price, distance flown, the number of individual flight segments constituting each trip, ticket class, and the arrival and departure destinations. Due to the sensitive nature of these data, we are precluded from presenting results for the individual corporations. We therefore provide our findings as either an average or combined measure across the two companies for each sector.

Given that corporations fly to specific destinations (e.g., based on the location of offices, operations or customers), increased ticket prices are most likely to modify the frequency of business travel. In order to examine the consequences of the five policy scenarios, we constructed simple curves for each sector, relating the cost per ticket to the cumulative number of flights taken (Fig. 1). Curves were produced for the four different types of ticket, rather than for particular city pairs, due to the high heterogeneity in routings (Table 1). The marginal impact of each policy was assessed by interpolating the reduction in travel from the curve, based on the average cost of the 2% of flights around the median priced ticket before and after the relevant tax is added (Table 2). The associated decrease in kilometres travelled was calculated by multiplying the number of flights that are no longer taken by the average distance flown for the 2% of flights detailed above. The allied cut in CO_2 emissions was determined using a regression model; the freely accessible online International Civil Aviation Organization (ICAO) emissions calculator was used to relate the distance flown between 60 city pairs and CO_2 emitted, for both economy ($R^2=0.96$) and premium ($R^2=0.97$) classes. This method does not account for the emissions associated with the ground operation at airports and will therefore underestimate the potential reduction in CO_2, particularly for short-haul flights.

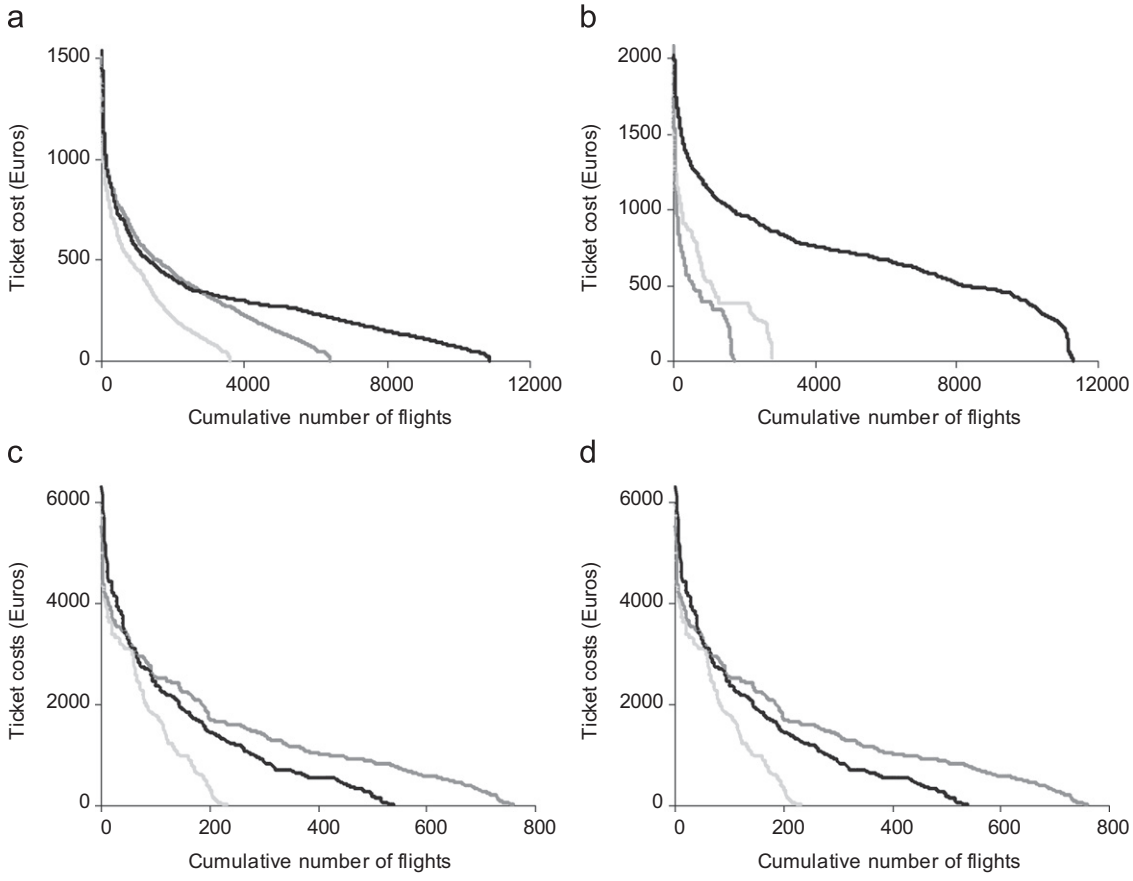

Fig. 1. Frequency of business air travel for (a) economy short-haul, (b) premium short-haul, (c) economy long-haul and (d) premium long-haul flights in the food manufacturing (light grey line), pharmaceutical (dark grey line) and financial (black line) business sectors. The *y* axes have been truncated for graphical representation.

Table 1
Descriptive summary of the 2006 business air travel profiles from three business sectors, each comprising of two representative companies.

Ticket type	Travel profile variable	Food manufacturing	Pharmaceutical	Finance
Economy short-haul	Contribution to travel profile (%)	44	56	38
	Greatest proportion of trips between same city pair (%)	4.3	5.0	15.4
	Number of different city pairs	541	840	752
	Median ticket price (Euros)	252.30	300.70	259.63
	Maximum ticket price (Euros)	13,318.86	5214.07	3966.32
Premium short-haul	Contribution to travel profile (%)	34	15	40
	Greatest proportion of trips between same city pair (%)	21.5	16.9	5.1
	Number of different city pairs	372	325	1142
	Median ticket price (Euros)	376.98	394.58	685.32
	Maximum ticket price (Euros)	2796.39	2085.84	2749.88
Economy long-haul	Contribution to travel profile (%)	3	7	2
	Greatest proportion of trips between same city pair (%)	9.1	10.9	7.4
	Number of different city pairs	81	179	163
	Median ticket price (Euros)	1529.91	1069.32	1061.99
	Maximum ticket price (Euros)	5934.88	5516.77	6309.82
Premium long-haul	Contribution to travel profile (%)	19	22	20
	Greatest proportion of trips between same city pair (%)	12.3	17.4	16.0
	Number of different city pairs	389	475	885
	Median ticket price (Euros)	3994.19	3530.67	3615.75
	Maximum ticket price (Euros)	12,735.91	9284.11	14,027.34

Table 2
The potential impact of policy scenarios on the annual business travel profile of a UK-based company in one of three business sectors. *Cost increase* indicates the additional annual cost implication to travel within each ticket class before a reduction in travel; *travel reduction* is the predicted decrease in the number of flights taken and therefore kilometres flown; *CO_2 reduction* estimates the associated cut in emissions in both absolute (tonnes) and relative terms (%). For premium class, the figures in parentheses denote the most conservative reduction if flights were still taken but downgraded to economy class.

Policy scenario	Policy impact	Food manufacturing	Pharmaceutical	Finance
Economy short-haul EU ETS	Cost increase (%)	2.7	2.5	3.1
	Travel reduction (no. of flights)	23	43	146
	Travel reduction (1000 km)	35	62	115
	CO_2 reduction (tonnes)	2.7	4.8	9.0
	CO_2 reduction (%)	1.8	1.4	2.4
Economy short-haul APD	Cost increase (%)	4.4	4.1	5.1
	Travel reduction (no. of flights)	34	85	372
	Travel reduction (1000 km)	47	113	268
	CO_2 reduction (tonnes)	3.7	8.8	21.0
	CO_2 reduction (%)	2.4	2.6	5.6
Premium short-haul EU ETS	Cost increase (%)	1.7	1.9	1.3
	Travel reduction (no. of flights)	403	132	65
	Travel reduction (1000 km)	433	140	91
	CO_2 reduction (tonnes)	66.8 (32.9)	21.7 (10.6)	14.1 (6.9)
	CO_2 reduction (%)	11.6	14.4	0.5
Premium short-haul APD	Cost increase (%)	5.5	6.1	4.1
	Travel reduction (no. of flights)	414	138	316
	Travel reduction (1000 km)	442	146	508
	CO_2 reduction (tonnes)	68.3 (33.6)	22.6 (11.1)	78.4 (38.6)
	CO_2 reduction (%)	11.9	15.0	3.0
Economy long-haul APD	Cost increase (%)	3.3	4.2	4.0
	Travel reduction (no. of flights)	1	4	5
	Travel reduction (1000 km)	19	42	30
	CO_2 reduction (tonnes)	1.5	3.3	2.4
	CO_2 reduction (%)	1.5	1.2	1.0
Premium long-haul APD	Cost increase (%)	3.0	3.3	3.2
	Travel reduction (no. of flights)	26	92	123
	Travel reduction (1000 km)	392	1117	1493
	CO_2 reduction (tonnes)	60.6 (29.8)	172.5 (84.8)	230.6 (113.4)
	CO_2 reduction (%)	2.1	6.9	2.2

When price rises are relatively small in comparison to the cost of a ticket (generally 2–9%), one might anticipate that the demand for business flights would be unresponsive. However, this ignores the booking procedures followed by most companies. Typically, a business travel management team will not respond to a policy at the level of an individual ticket but will, instead, have a fixed budget to spend per quarter. When the additional cost implication of such modest price increases is summed across all flights purchased by the organisation within that period, it can become quite significant (Table 2). The overall annual cost implication varied from €7664 (US$9628) for EU ETS on premium class short-haul flights made by a pharmaceutical company, through to €324,871 (US$408,116) for APD on premium class long-haul trips made by a financial corporation.

Unsurprisingly, for all three business sectors, the larger price rises associated with the APD scenarios result in greater decreases in the frequency of short-haul travel than the less aggressive cost increase associated with EU ETS. However, the reduction in corporate air travel across the sectors is a non-linear function of the rise in ticket prices, because of the shape of the different curves. APD on premium class long-haul flights provided the greatest absolute reduction in emissions when totalled across the sectors, whereas APD for short-haul premium class tickets supplied the largest percentage decreases in CO_2 emitted relative to that before policy intervention. For each scenario, comparing the additional cost implication with the relative cut in travel reveals how the impact of the different policies may vary between sectors. For instance, the food manufacturing and pharmaceutical companies examined here respond dramatically to the APD price rises associated with the premium short-haul flights, while the financial sector corporations are comparatively insensitive to all of the policy scenarios. The sector that would realise the greatest overall emissions reduction is therefore dependent on which scenario is considered, and the additional cost implication that will be incurred by individual companies relative to the suitability of substitutes for air travel.

Business air travel is undergoing a strong recovery after the economic downturn, with demand already approaching pre-recession levels (BTN, 2010). Although our analyses are a snap-shot from just 1 year, the heterogeneous responses of companies and relative impact across business sectors that we have illustrated here are likely to be robust as the aviation industry continues to grow in the future (CCC, 2009).

3. Voluntary actions to go beyond compliance and reduce emissions

Current regulations to cut emissions are patchy in coverage, with only some corporations having to account for the CO_2 emitted from selected parts of their operation (i.e., energy consumption by companies under EU ETS). As such, more comprehensive emissions reductions are dependent on the voluntary actions of corporations willing to go beyond compliance at this time. Here we examine two sets of self-reported questionnaire data to ascertain whether companies are taking a proactive approach, both measuring and developing internal policies to reduce the emissions arising from their business, in anticipation of possible future regulation.

The Carbon Disclosure Project (CDP) is the biggest global repository of corporate emissions data (for further details see www.cdproject.net/). Each year, the CDP asks major corporations to voluntarily complete a standardised questionnaire, which reports on emissions accounting, management and governance. We collated and summarised the findings of the 2007 CDP5 survey for 500 of the world's largest companies (commonly referred to as the FT500); 316 of these organisations agreed to their questionnaire responses being made publicly accessible. Despite only 28% of the 316 corporations having a regulatory requirement to quantify their emissions, 86% state that they measure the CO_2 they are responsible for emitting (Table 3). However, accounting practices are inconsistent; 42% do not follow standardised greenhouse gas protocol methodology and 39% do not have any kind of independent third party verification of their emission reporting standards. Less than half of the companies replying to the questionnaire currently have an emissions reduction policy in place. If we assume that corporations choosing to publicly respond to this questionnaire include some of the "best in class" for environmental performance, this suggests that approximately one third of FT500 companies are likely to have a strategy in place for decreasing the emissions they generate. This implies that, without a regulatory push, only a limited subset of companies may be willing to take the next step on from simply measuring CO_2 emitted from operations to actively implementing emissions reduction policies.

Business travel is widely believed to be the second largest contributor to a corporation's emissions after estate and site operations, yet transparent and reliable estimates are difficult to find in the scientific literature or popular media. Where sufficiently resolved data were available from the CDP survey to make such an approximation ($n=53$), business travel accounted for, on average, 15% of overall emissions (ranging from 0.007% to 65%). This suggests that the total emissions estimates reported by the remaining 60% of companies that do not consider travel-related emissions are likely to be substantial underestimates.

To develop a more detailed understanding of the extent to which corporations voluntarily participate in initiatives to mitigate the environmental impact of their business travel, we undertook a survey of members of the Association of Corporate Travel Executives (ACTE). ACTE is a not-for-profit organisation that represents the global business travel industry and has a broad membership, primarily consisting of senior travel industry executives from across a diverse range of business sectors (for more information go to www.acte.org). In 2007, we asked ACTE members to complete a web-based questionnaire that examined company policies regarding emissions, the business profile of the organisation and the personal perspectives of the recipient with regard to climate change and travel (Appendix 1 Supplementary Information). We restricted our survey to travel buyers and an invitation to participate was sent by email to approximately 850 individuals. A modified Dillman methodology (Dillman, 1978) was used to maximise response rates; 2 weeks after the initial invitation a second email was sent to non-respondents. The results of the survey were anonymous and could not be related back to the responding company, although each corporation was given a unique identification number to ensure

Table 3
The proportion of companies taking proactive action to assess and reduce their emissions, recorded as part of the Carbon Disclosure Project's "CDP5 Questionnaire" and the Association for Corporate Travel Executives "Corporate Travel and Climate Change" survey.

Action	% CDP corporations (no. respondents)	% ACTE corporations (no. respondents)
Measure emissions	86 (316)	49 (171)
Measure emissions arising specifically from business travel	43 (271)	60 (80)
Use the GHG protocol to calculate emissions	58 (271)	
Externally verify or audit emissions calculations	61 (271)	
EU ETS regulated	28 (316)	11 (170)
Have an emission reduction policy	47 (316)	33 (163)
Have an emission reduction policy specifically for business travel		40 (53)
Offset business travel		13 (152)

that it was only represented once within the final dataset. The survey was completed in full by 137 companies and partially by a further 34. A smaller proportion of the ACTE corporations (49%) were found to measure their emissions, and fewer had a regulatory requirement to do so (11%) than in the FT500 sample (Table 3). This is likely to reflect the diverse range of organisations that are members of ACTE, which includes small and medium-sized businesses in addition to large, multinational corporations. Of those companies that did record their emissions, a larger proportion (60%) measured CO_2 emitted as a direct result of business travel. However, just one in ten respondents rated emissions as the key consideration when purchasing business flights; in general, environmental impacts were ranked as the fourth most important factor behind ticket price, flexibility in the ticket and duration of travel, and only ahead of choice of carrier. Although only 11% of corporations are EU ETS regulated, one third of companies had an emissions reduction policy in place. Nonetheless, only half of these strategies explicitly include employee travel and only three companies invest in offsets in order to mitigate travel-related emissions; the remaining 16 corporations offsetting business travel are doing so independently of any company emissions reduction policy. When examining the personal perspectives of respondents, 81% believe that more could be done to make their corporation's emissions policies proactive and comprehensive.

4. Conclusion

Our paper is the first to investigate the influence of aviation emissions reduction policies on the business travel patterns of individual corporations. This perspective is critical to understand possible policy impacts and companies' responses to them. Across the three business sectors examined, over 70% of corporate flights were short-haul. We find that ticket price increases on short-haul premium class trips produced the greatest relative reductions in CO_2 emissions compared to those prior to policy intervention. In addition, the high cost implication of APD on short-haul flights may also prove to be a strong incentive for businesses to find alternatives to air travel, especially as this is where the greatest scope exists for a modal shift to high-speed rail transportation. In fact, in many parts of Europe, short-haul flights can no longer rival train links between major cities. Similarly, in the US, Amtrak now competes with the airlines on its Boston–New York–Washington express rail service. Increasing ticket prices for premium long-haul flights has the largest environmental impact in absolute terms, highlighting where companies voluntarily wishing to reduce emissions at this time can make the largest cuts using technological substitutions to long-haul air travel such as videoconferencing. Indeed, we have shown that many corporations are already going beyond compliance by voluntarily measuring and reporting emissions across their operations, although few account for emissions specifically arising from business travel. However, the usefulness of such voluntary action is currently limited because of the heterogeneous reporting methods and standards adopted by companies. In addition, without a regulatory push, a limited subset of corporations are going beyond merely measuring the CO_2 they generate to implementing emissions reduction policies, despite employees believing that the companies they represent could take more proactive action.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.enpol.2010.09.007.

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