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The economic feasibility of an international air travel adaptation levy

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Contents

1. Introduction	1
2. The core model	2
2.1 The case for a levy	2
2.2 Responsibility.....	2
2.3 Capability	2
2.4 Solidarity with the vulnerable and environmental stewardship.....	3
3. Alternative implementation approaches	4
3.1 The voluntary approach.....	4
3.2 The mandatory approach.....	5
4. Types of levy	7
5. Estimating potential revenue from an IATAL	10
5.1. Main variables	10
5.1.1 Size of levy.....	10
5.1.2 The number of international passengers.....	10
5.1.3 Efficiency of collection	10
5.2. Baseline values of variables.....	11
5.3. Expected baseline revenues.....	12
5.4. Expected revenues with assumption variations.....	13
5.4. Comparing potential revenues with adaptation needs	15
6. Impact analysis	17
6.1. Effect on development through reduced tourism.....	17
6.2. Effect on airline business and competition.....	18
6.3. Effect on passenger welfare	18
7. Conclusions	19
References	20
Sources of data.....	21

1. Introduction

By volume, aviation emissions currently account for about 1.6 per cent of greenhouse gas emissions. Yet, because the majority of these gases are released at high altitude, their impact is believed to be higher than terrestrial emissions (Stern, 2006; van Beukering *et al.*, 2007; Graichen and Guegele, 2006). If the non-carbon dioxide effects of aircraft emissions are included, aviation will contribute about 5 per cent to global warming by 2050 (Stern, 2006).

Air travel has increased by 45 per cent over the last decade (Müller and Hepburn, 2006). In the European Union, emissions from aviation have increased by an annual average of 4.3 per cent (Müller and Hepburn, 2006). The International Air Transport Association (IATA) forecasts that, overall, the air transport industry will handle 620 million more passengers in 2011 than in 2006 (IATA (2007)). The number of international passengers is expected to rise from 760 million in 2006 to 980 million in 2011, an increase of 220 million over the five-year period. This forecast growth in aviation, and the limited options for drastically cutting emissions (Stern, 2007) mean that overall emissions from aviation are likely to increase and will therefore have a greater impact on climate change. Thus, the responsibility for the climate change impacts of the aviation industry in general, and air passengers in particular, will increase significantly, and these impacts will be particularly detrimental to the poorest and most vulnerable countries and communities.

Expansion of a relatively luxury pursuit that will inevitably benefit the richer people in developing countries, stands in stark contrast to the costs that will be felt most by developing countries but significantly by the poorest in those countries. The need to adapt to the impacts of climate change is greatest in poor developing countries which are more vulnerable to climate change and whose adaptive capacity is low. Adaptation has a cost, and estimates to date indicate that these costs will run into tens of billions of dollars per year for developing countries (e.g. Müller, 2008; Goulven, 2008; Oxfam, 2007). Developing country treasuries have a suite of pressing demands on their budgets – health, food, education and so on – and have limited access to additional funds hypothecated for adaptation. Mechanisms to raise and deliver funds hypothecated for adaptation are required urgently. Current international funding for adaptation is well below what is required, so alternative mechanisms are needed to fund adaptation.

The International Air Travel Adaptation Levy (IATAL) proposed by Müller and Hepburn (2006), targeted at international air passengers, is one mechanism that has the potential to raise significant resources to support adaptation. This paper estimates the likely contribution of an international air passenger levy to adaptation funding under various assumptions. Apart from the economic potential of an international air travel adaptation levy, the institutional and practical feasibility will also need to be established before the scheme can be implemented. This paper focuses on the economic potential of an IATAL. The institutional arrangements for the implementation of an IATAL are important, but are not dealt with in this paper. Neither does the paper compare the economic potential of an IATAL against other potential mechanisms for raising funds for adaptation. The paper provides a basis for stronger international engagement with this scheme and provides pointers towards more specific examinations.

2. The core model

2.1 The case for a levy

The case for a passenger levy is made by linking the polluting behaviour of the passenger with the impact of climate change on the poor and the need to address the impact through adaptation. Climate change is a global externality and an adaptation levy is a form of internalising it, as those responsible compensate those who are affected, or enable them to deal with the impacts. This directly connects responsibility with the action required, i.e. adaptation. The willingness to pay for the victims of climate change to enable them to adapt depends on the ability of the polluters to connect their behaviour with the effects, and, of course, their ability to pay.

A study by van Beukering *et al.* (2007) on willingness of international air travel passengers to invest in climate change mitigation showed that 75 per cent of surveyed passengers were willing to pay a carbon travel tax in addition to the price of their air ticket. The two major motivations for willingness to pay are a sense of responsibility and accountability for climate change and an acknowledgement of the detrimental effects of climate change on future generations. Similar reasons (environmental responsibility and general support for development) were also cited in a survey on buyers of carbon offsets on the voluntary carbon market in the United Kingdom (Harris, 2007) and internationally (Hamilton *et al.*, 2007).

2.2 Responsibility

Despite the willingness to pay for something to be done about climate change, respondents have generally only been offered the option of paying to mitigate climate change, not to support adaptation. This has been evident in the emergence of the voluntary carbon market and other activities designed to reduce people's carbon footprint. The international air passenger adaptation levy model focuses on the residual impacts that will ensue even if emissions are mitigated, and consequently on investing in adaptation to reduce these residual impacts. This leads to the assumption that those responsible for climate change through air travel should have a sense of responsibility for the impacts of their emissions, and therefore the responsibility to support adaptation. This is in line with Article 3 of the United Nations Framework Convention on Climate Change (UNFCCC) on the principle of differentiated responsibility and respective capability. In this case, responsibility and capability apply to passengers as specific agents.

Although passengers are willing to offset their emissions, their emissions are still responsible for climate change. An adaptation levy enables them to deal with the impacts of climate change, which are unavoidable in the short to medium term because of the current and projected level of emissions.

2.3 Capability

The capability of international air passengers to pay is even more important to a scheme like IATAL than responsibility. The ability of passengers to pay for international travel is an indicator of their ability to pay an adaptation levy. The income status of international passengers also strengthens the case. A survey of passengers arriving at 11 UK airports in 2006 shows that the average income of all passengers (business and leisure, UK and foreign)

is at least £30,000 per year (Civil Aviation Authority, 2006). While it is difficult to classify all passengers with this level of income as being able to pay a levy, it does indicate their ability to make a minimum contribution to offset the impacts of climate change. Data on the income status of international passengers from developing countries (which was not immediately available at the time of writing this paper) is also required before a global generalisation can be made. The ability to pay for air tickets for leisure at these income levels further reinforces the capability argument. However, this assumption requires further examination in light of the rise of budget airlines in developing countries.

2.4 Solidarity with the vulnerable and environmental stewardship

In addition to responsibility and capability, solidarity with the vulnerable forms a good argument for an instrument such as an IATAL. Solidarity, not responsibility, is the major driver behind schemes such as the French solidarity levy. A survey of the voluntary carbon market in the UK by Harris (2007) shows that most buyers of carbon offsets are motivated by the need for 'green' credentials and to support sustainable development among the poor. A 'sense of responsibility and accountability' for climate change was also shown to motivate passengers in the study by van Beukering *et al.* (2007). Solidarity between the rich and poor has also been demonstrated elsewhere, for example between UK consumers and African farmers. According to MacGregor and Vorley (2007), UK consumers are engaged with rural Africa through food consumption choices.

3. Alternative implementation approaches

The two possible approaches for implementing an IATAL are the voluntary and mandatory approach. Both has advantages and disadvantages in terms of the potential revenues they can raise, the cost of implementation including administrative costs, and the impacts on passengers, airlines and other industries such as tourism and travel businesses.

3.1 The voluntary approach

A voluntary approach enables international air passengers to decide individually whether or not to contribute to climate change adaptation. Several schemes could be used to implement this approach, including those suggested by the Commission of the European Communities (2005) and some airlines, although these are designed for mitigation rather than adaptation. The voluntary opt-in scheme enables passengers to voluntarily declare the amount they wish to pay when they buy their tickets. The voluntary opt-out scheme is more stringent, requiring all passengers to pay automatically when they purchase their ticket, and request a refund later if they do not want to contribute (opt-out). Simpler opt-out schemes require passengers who do not want to pay to uncheck pre-checked boxes on a website when buying tickets. Currently, some airlines, such as British Airways, Air Canada, Cathay Pacific, Qantas, Delta and SAS, are implementing different schemes including opt-in and opt-out schemes that enable passengers to offset emissions associated with their air travel. British Airways implements a voluntary scheme that supports projects with social benefits to communities.

3.1.1 Economic issues

The success of a voluntary approach depends on the willingness to pay of international air travellers, but the actual revenue generated depends on how that willingness to pay is translated into actual payment or contribution. Van Beukering *et al.* (2007) found that 75 per cent of passengers were willing to pay a carbon travel tax. In Jetstar's voluntary programme, 10 per cent of Australian passengers who purchased their tickets from the airline chose to offset their carbon. While we can assume that the willingness to pay to offset one's carbon footprint is an indicator of willingness to pay for adaptation, the Jetstar example shows that a much smaller percentage of the total actually commits itself to pay. This is a major downside of a voluntary scheme. On the positive side, there is no resentment towards the scheme by those who may be affected if payment is forced on passengers.

The revenue from a voluntary approach is sensitive to the level of contribution that is charged. If the contribution is low, a higher percentage of passengers will contribute. In the case of the stringent opt-out scheme, few passengers will claim a refund if the cost of doing so is higher than the contribution. In this case, higher revenues can be generated.

The voluntary scheme does not have significant impacts on demand for air travel, and therefore is also unlikely to face resistance from airlines. However, a voluntary opt-out scheme may have a negative impact on demand for air travel if the levy is too high.

3.1.2 Administrative and institutional issues

Apart from the unpredictable revenue from a voluntary scheme, a totally voluntary scheme shifts responsibility away from those who are not willing to pay, to those who are. This is akin to a free rider problem.

The voluntary approach is likely to suffer from administrative complications in its implementation. Unless they are made simple, for example, unchecking a pre-checked box on a website, opt-out schemes may involve the administrative burden of refunding passengers who do not want to contribute. The accounting procedures are also more complex. It is also questionable whether this scheme is really voluntary or just a repackaged mandatory scheme, because people who opt out are nevertheless forced to incur the time and inconvenience involved in getting a refund, which in some instances may be higher than the refund itself. Transparency is also a concern with voluntary approaches. The schemes could be abused by airlines, travel agents or governments wishing to minimise the effects on business or to use the scheme to promote their own businesses. Those who want to minimise business impacts may only give little support to the scheme, or encourage small contributions. Those wishing to use the scheme to enhance their corporate image might claim that they are doing a lot in public while actually collecting little revenue.

3.2 The mandatory approach

A mandatory approach would require all international air passengers to pay a set levy to support adaptation, thereby taking responsibility for the impacts of their emissions. The French solidarity levy is an example of such a scheme and is designed to fund HIV/AIDS treatment in developing countries. Under this scheme, on all domestic and intra-European flights departing from French territory economy class passengers pay a levy of €1, and business class passengers pay €10. On international flights, economy class passengers pay €4 while business and first class passengers pay €40. Like IATAL, the French solidarity levy is specifically designed to fund a cause commonly accepted as a global problem affecting poor countries. Such a scheme is also being proposed as a new source of general development finance by the European Community (Commission for European Communities, 2005).

A mandatory levy could be added to the price of the ticket, or collected in the same way as an airport duty or fee. Passenger duties are common in many countries. They are either paid at the airport or they are included in the ticket. In 2003-4, the UK government collected some £791 million in air passenger duty charged on commercial flights from the UK.

3.2.1 Economic issues

The main economic issues are the possible revenues and the effect on air travel demand. The potential revenues from this approach can be projected but the effect on air travel demand depends on price elasticity of demand (InterVISTAS, 2007). Possible revenues and impact on demand are discussed later. They depend largely on the size of the levy, the number of passengers and the efficiency of collection. The higher the levy, the greater the revenue (assuming that there is not a substantial reduction in demand caused by the increased price of flying), but also the greater the impact on passengers, airlines, travel businesses and tourism.

3.2.2 Administrative and institutional issues

Administrative issues pertain to the ease with which this approach can be implemented. The ease of implementation depends on the type of levy/tax used in a unilateral approach (see below). Mandatory approaches may face resistance from airlines or the public if they do not agree with the levy. If implemented at national level, levies have to be backed by national legislation, and the fees may differ from country to country. A uniform international levy would overcome this, but would need to be agreed on by parties (countries) at a global level. Once agreed on, a mandatory levy would be easy to implement and account for because the

same amount is expected from each international passenger without exception. It is also transparent.

3.3. Choice of approach

While the voluntary approach is a way to raise resources for adaptation, it fails to address the principles of both responsibility and capability as it is subject to passengers' willingness to pay. Even with high rates of willingness to pay, the actual contribution may be very low in terms of the number of passengers and the amounts contributed. Even in the voluntary opt-out scheme where the percentage of passengers who eventually pay is likely to be higher than in the opt-in scheme, there are likely to be administrative problems and high costs of implementation. Sustained large-scale awareness campaigns are required, not only at the beginning, but throughout the scheme's implementation period. These would increase the cost of the scheme for revenues that cannot be predicted. The voluntary approach therefore does not raise the maximum possible revenue to support adaptation. We therefore focus attention on the mandatory approach and look at possible implementation instruments.

4. Types of levy

There are three main types of tax that could be levied on aviation: a ticket tax; an excise tax on fuel; and a passenger charge (Keen and Strand, 2006).

Ticket tax

This is a tax levied on the sales of tickets according to their value (*ad valorem*). This can be implemented in the form of a sales tax. A sales tax is a consumption tax charged at the point of purchase for certain goods and services, and is set as a percentage by the authority or government charging it. It can be included in the price or at the point of sale. Value added tax is another form of ticket tax. A conventional or retail sales tax, which charges the tax only to the end user, is simple to calculate and collect. It is fair and has a high compliance rate, and is charged only once on any one item. This avoids the problem of return flights, connections, etc. A ticket tax can therefore be implemented by ticket sales entities like travel agents. These forms of tax are commonly imposed on domestic aviation (Keen and Strand, 2006). International air travel is normally zero-rated, but some developing countries impose sales taxes and VAT on international flights. It would therefore require changes in the legal provisions of countries that do not currently charge such taxes on air travel.

Excise tax on fuel

Excise taxes are generally levied on goods for a number of different reasons including protecting people from harming themselves (e.g. through gambling), their health (through smoking, prostitution) and others, and the environment (through pollution). Excise taxes are also used to raise money to fund publicly provided services such as health and defence and for punishment (as a deterrent). While a fuel tax can eventually be passed on to consumers through increased fares, it is more a cost to the airline than to the passengers, and has a greater impact on improving fuel efficiency than on funding adaptation. A fuel tax may be covered under mitigation e.g. in the EU Emissions Trading Scheme. Moreover, the legal framework for international aviation fuel exempts it from taxation.

Passenger charges

Existing per passenger charges fall into various categories. The most common is an airport charge that accrues to the airport authority. The other is an arrival/departure tax that accrues to the government (Keen and Strand, 2006). In several countries, both of these charges are applied. The tables below give examples of per passenger charges for high-income and low-income countries for international passengers. Passenger charges vary from country to country, and in some cases, are also differentiated by class of travel. In 2005, the highest passenger charge was in the UK where first class passengers travelling to destinations outside the EU paid \$109 (Keen and Strand, 2006).

Table 1: Airport and trip charges for international travel from selected high-income economies (US\$ per traveller as of April 2005)

Country	Airport charges	Trip charges	Total passenger charges
Australia	11-19	30	41-49
Austria	16	16-17	32
Belgium	0	12-25	12-25
Canada	22-36	0	22-26
Denmark	20	12	32

Finland	3	6-12	9-15
France	9-16	0	9-16
Germany	11-19	0	11-19
Greece	44	0	44
Hong Kong	0	15	15
Ireland	4-6	10	14-16
Israel	12	8-55	20-26
Italy	6	7-11	13-19
Japan	11-28	0	11-28
Netherlands	40-42	0	40-42
New Zealand	11	14-18	25-29
Norway	17	0	17
Singapore	0	10-13	10-13
Spain	1	5-8	6-9
Sweden	12-25	0	12-25
Switzerland	0	6-28	6-28
United Kingdom	18-36	9-73	27-109
USA	3	31	34

Source: IATA (2005) in Keen and Strand (2006)

Table 2: Airport and trip charges for international travel from selected emerging and developing economies

Country	Airport charges	Trip charges	Total passenger charges
Argentina	12	18	30
Brazil	0	12-36	12-36
Chile	8	20/50	8
China	11	0	11
Colombia	0	60-66	60-66
Costa Rica	7	26	33
India	5.5	3-12	5.5
Indonesia	5-10	10	15-20
Korea	23-27	0	23-27
Malaysia	0	5-12	5-12
Mexico	10	39	49
Nigeria	35	0	35
Pakistan	12-25	27	39-52
Peru	0	43	43
Philippines	10	23-32	33-42
Poland	10-16	0	10-16
Russia	6-14.5	15	21-29.5
Saudi Arabia	0	9	9
South Africa	19-21	10	29-31
Taiwan	0	10	10
Thailand	0	12	12
Turkey	7-18	0	7-18
Ukraine	1-5	10-15	11-16
Venezuela	0	30-37	30-37

Source: IATA (2005) in Keen and Strand (2006)

Taxes such as the French solidarity levy fall under the category of passenger charges (although they are not included in the figures above).

Passenger charges can either be included in a ticket or paid by passengers at the port of exit or entry. They can be collected at ticketing by airlines/travel agents, by airport authorities or

government revenue departments. Systems for collecting passenger levies already exist in many countries. Revenue projections are easy to make and audits are no more complex than for the ticket taxes discussed above. This levy leans more towards capability than responsibility, as it does not take into account the length of journey. In the French solidarity levy and other passenger charges, differentiated capability is factored into the charges by differentiating the levy by class of travel.

Although adaptation is a response to a global externality (human-induced climate change), it is difficult to attribute specific responsibility for the impacts, and therefore for the adaptation required, to a specific entity. This is even more complex in aviation, where both travellers and airlines have joint responsibility. An airline may have the responsibility to improve fuel efficiency, thereby cutting the amount of GHG emissions. On the other hand, a passenger's responsibility on a particular flight depends on factors outside their control, such as the efficiency of the aircraft, how full a flight is, and so on. Therefore, responsibility is better treated crudely as the decision to fly, and therefore an adaptation levy is designed to compensate for the impacts of emissions from air travel.

Therefore, in estimating the impact of the IATAL, we focus on a mandatory passenger levy. Using the example of the French solidarity levy, and other levies being proposed to fund development, the trip/passenger duty will be used to assess the potential of the IATAL. A solidarity levy per passenger has the minimum administrative and legal complexities for international air travel, and is not subject to the restrictions imposed by existing national laws.

Taking into account the different approaches (mandatory and voluntary) and levy options discussed above, and the goal of generating resources to support adaptation in less developed countries, the most appropriate approach would be one that generates the maximum possible revenues with the least impact on passengers, airlines and development. The approach should also be simple and transparent, likely to achieve consensus at international level, and require as little legal manipulation as possible. It is therefore proposed to use a mandatory approach that levies individual international air passengers a specified sum of money. This approach focuses on responding to adaptation needs in poor countries through the ability of international air travellers to pay. It does not apply the principles of responsibility. In this sense, the IATAL can be considered a solidarity levy by the international air travel community.

5. Estimating potential revenue from an IATAL

The main factors determining the amount of revenue that could be generated from an IATAL are the size of the levy, the number of passengers involved in international travel, the level of international participation by countries/airlines and the efficiency of collection. In the long term, trends in international air travel demand will affect the revenues generated.

5.1. Main variables

5.1.1 Size of levy

The amount of revenue that can be generated is a function of the size of the levy. As the levy increases, *ceteris parabis*, the amount of revenue also increases. However, the levy also increases the cost of travel, which reduces demand for flights and also affects demand for related products and services such as tourism. These impacts may eventually affect development in poor countries. The impacts are discussed in a later section.

A useful starting point is looking at existing passenger levies. IATA data from selected high income and emerging economies shows that international passengers are levied between \$21 and \$29 in total passenger taxes (airport and departure/arrival taxes) (Keen and Strand, 2006). The average and median figures are \$21 and \$21.5 respectively. Some charges are differentiated by class of travel. An IATAL would be levied in addition to these charges. The French solidarity programme levies international passengers (outside the EU) about \$6 for economy class and \$62 for business and first classes (Klosek and Nguyen, 2006). Chile plans to impose a solidarity levy of \$2 per passenger on all international flights. This analysis suggests a levy in the region of the French solidarity levy as a starting point.

5.1.2 The number of international passengers

The number of paying passengers determines the revenue base for a given levy size. If the levies are differentiated by class (economy or premium), the proportion of passengers in each class becomes important. If premium class passengers are subject to higher levies than economy passengers, then total revenue will increase with the proportion of passengers in premium classes. In 2006, the airline industry handled 760 million international passengers (IATA, 2007b). IATA (2007) forecasts that international air passenger numbers will grow at an annual average rate of 5.1 per cent between 2007 and 2011. Liberalisation of markets and emergence of new routes and services will drive this growth while slower global economic growth accounts for a growth forecast lower than the 7.4 per cent annual average attained between 2002 and 2006. Recent shocks such as oil price increases and the corresponding increases in the costs of travel may also affect the projected growth in passenger numbers. The share of first class and business class passengers on flights between London and New York in 1998 was 9 per cent of all passengers (Keen and Strand, 2006). If the levy is going to be differentiated by class, this provides a basis for forecasting potential revenues. It also helps to assess the potential for increasing revenues because of the capability of premium class passengers to pay more.

5.1.3 Efficiency of collection

Efficiency of collection here refers to the share of potential revenue that is actually collected and submitted to the authority running the programme. Passenger duties collected through air tickets have a very high rate of efficiency. Under the UK system, in 2005 only £0.6 million of £791 million (about 0.07 per cent) of passenger duties was not channelled to the government

(Commission of European Communities, 2005). Thus close to 100 per cent efficiency can be attained.

5.1.4 Level of international participation by countries/airlines

This refers to the degree to which the concept of an IATAL will be accepted and implemented by all players. Some countries or airlines may not fully back the initiative, and will therefore not commit themselves to collect the levy, unless the legal and institutional mechanisms for its implementation require all countries/airlines to participate. The level of participation by countries in implementing the IATAL can be assessed by looking at the participation of countries in a global climate change agreement like the UNFCCC's Kyoto Protocol. As of April 2008, 180 countries had deposited instruments of ratification, accession, approval or acceptance of the Kyoto Protocol (UNFCCC, 2008). Given that there are 195 countries in the world (including the Vatican and Kosovo, who are independent but not members of the United Nations), this represents about 92 per cent participation or agreement to address climate change. Also related is participation in the International Civil Aviation Organization (ICAO), which is a UN agency. Potential participation by airlines can be estimated from their membership of a trade association like the International Air Transport Association (IATA). IATA represents about 240 airlines, comprising 94 per cent of scheduled international air traffic (IATA, 2007b). These figures are indicative of participation in the implementation of a global scheme like IATA either through countries or airlines. The practical aspects of implementing an IATAL through these or other mechanisms are discussed elsewhere.

Given this information, we can establish baseline assumptions that enable us to compute the possible revenues in a base year, and project expected revenues in the future. The baseline assumptions will be varied to assess the possible maximum and minimum revenue that can be generated by an IATAL. This can be compared with a situation where the scheme is voluntary.

5.2. Baseline values of variables

Baseline assumptions provide a starting point for calculating the possible revenues from IATAL. To make the estimations tractable, we use a minimum number of assumptions. Variation of assumptions provides for errors in the input data and possible departures from expected trends.

Table 3: Values of variables (assumptions)

Assumption/variable	Baseline	Varied assumption
Uniformity of levy	Differentiated by class	Varied between uniform and differentiated levy
Economy levy	\$6 (equal to French solidarity levy)	\$2 (feasible in developing countries e.g. used in Chile) \$1 (minimum impact on passengers and airlines, and may yield 100% compliance even by frequent travellers) \$20 optimistic scenario
Business levy	\$62 (equal to French solidarity levy)	\$31 (half of French levy) \$5 (minimum impact on passengers and airlines and may yield 100% voluntary compliance even by frequent travellers)

		\$100 optimistic scenario
Passenger numbers	760 million in first year (IATA estimate)	Vary by assumption on demand growth
Passenger demand growth	5.1% per year (IATAL forecast)	Lower growth – 3%, 2%, 1% No growth – 0%
Collection efficiency	99% (based on UK passenger charge rates)	Assume reduced efficiency due to large numbers involved and burden on enforcing compliance (80%, 50% worst scenario)
Participation/compliance by countries/airlines	94% if implemented through UNFCCC 93% if implemented through IATA	Protest by some airlines/ countries citing effects on demand and other sectors (90%, 80%, 50% worst case scenario)

5.3. Expected baseline revenues

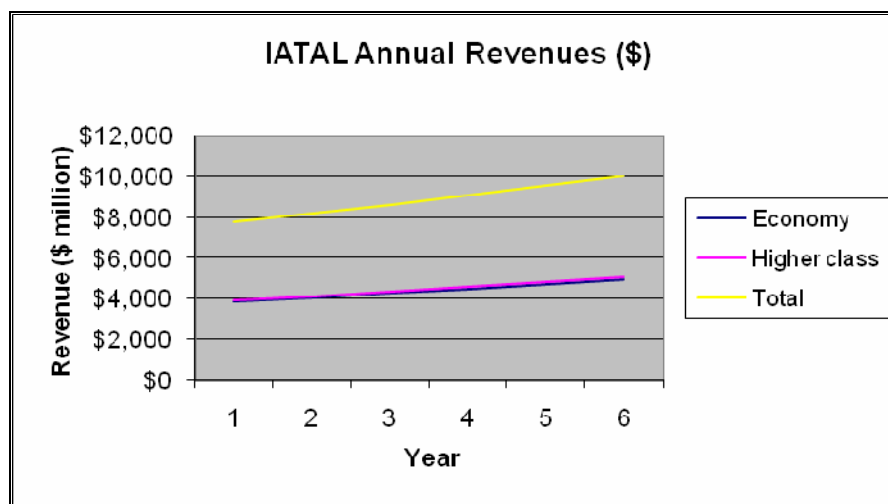
Taking a five-year forecast of passenger numbers from 2009 to 2013, the following annual revenues are expected under the baseline assumptions. Note that we are making the somewhat unrealistic assumption that there is no reduction in demand given the increase in cost of travel. At one extreme, this is likely to be a good assumption for long-haul international business flights where demand elasticities are less than -0.5, but is less realistic for short-haul leisure flights where demand elasticities appear to be around 1.5 (Müller and Hepburn, 2006). Nevertheless, this merely implies that if a \$6 economy levy increased the cost of travel by 10 per cent, there would be a 15 per cent reduction in passenger numbers, hence reducing total revenues from the levy by 15 per cent. So the order of magnitude of the estimates in Table 4 is invariant to demand response effects. We discuss these impacts further in section 6.

Table 4: Expected revenue under the baseline assumptions

Year	Revenue (Million US\$)		
	Economy class	Premium classes	Total
1	3,862	3,946	7,808
2	4,059	4,148	8,206
3	4,266	4,359	8,625
4	4,483	4,582	9,065
5	4,712	4,815	9,527
6	4,952	5,061	10,013

In the baseline scenario IAPAL has the potential to generate a total of \$7.8 billion in the first year, increasing annually to about \$10 billion in the sixth year as a result of growth in the number of international passengers. In this scenario, total revenues for economy and premium class passengers are almost equal although premium class passengers are assumed to account for only 9 per cent of all international passengers. This is largely because of the high levy charged on premium class passengers. The baseline scenario is also depicted in the graph below.

Figure 1: Baseline scenario



5.4. Expected revenues with assumption variations

A key variable in this analysis is the size of levy that can be charged to passengers. Assuming a minimum levy (one that has minimum impact on passengers), the potential revenue from the IATAL drops significantly. A minimum impact levy of \$1 per economy passenger and \$5 per premium class passenger will generate revenues shown in the table below. This table also shows revenues generated when a \$2 levy is charged on all passengers (economy and premium classes) as used in one of the developing countries (Chile) that levies international passengers.

Table 5: Possible revenues with variable levy sizes

Year	Revenue (Million US\$)					
	Minimum impact levy (\$1 in economy and \$5 in premium classes)			\$2 levy for all classes (as in Chile)		
	Economy	Premium class	Total	Economy	Premium class	Total
1	644	318	962	1,287	127	1,415
2	676	334	1,011	1,353	134	1,487
3	711	352	1,062	1,422	141	1,562
4	747	369	1,117	1,494	148	1,642
5	785	388	1,174	1,571	155	1,726
6	825	408	1,233	1,651	163	1,814

A minimum impact levy has the potential to raise around a billion dollars per year, with the levy on premium class passengers generating about a third of the total revenue. If a flat levy of \$2 is charged on all passengers, irrespective of class, potential revenue increases significantly from the assumption when a minimum levy is used, by about \$400 million at least in the first year of implementation. In this case the percentage contribution of premium class passengers to total revenues falls significantly to 9 per cent of total revenues.

The annual revenue increases noted in the results above depend on the assumption of a 5.1 per cent annual average growth rate forecast by IATA. If this is not attained as projected, the

revenue projections made under the baseline scenario will not be attained. If a zero growth in demand is assumed, then under each policy, revenues will remain stationary at the first year level. While no negative growth in demand may eventually lead to stabilisation or reduction in emissions due to stable or reduced demand, this may not be significant if it is not matched by aircraft fuel efficiency and other emission reduction measures.

The efficiency with which revenue is collected, together with the level of compliance or participation in the scheme by countries/airlines are also critical factors in the success of IATAL generating significant revenues. It is possible that the baseline values of these factors may not be attained, especially in the early years of the scheme. Because this analysis focuses on the first six years, the impact of these variables is even more significant. The table below shows the potential revenues from IATAL with different assumptions about collection efficiency and participation. All other variables are kept at baseline values as each of these two are varied separately.

Table 6: Possible revenues with varying levels of efficiency and participation

Year	Total Revenue (Million US\$)			
	Collection efficiency		Participation/compliance	
	Worst-case scenario (50%)	Medium-case scenario (80%)	Worst-case scenario (30%)	Medium-case scenario (80%)
1	2,643	4,229	1,670	4,454
2	2,778	4,445	1,756	4,681
3	2,920	4,672	1,845	4,920
4	3,069	4,910	1,939	5,171
5	3,225	5,160	2,038	5,543
6	3,390	5,423	2,142	5,712

The departure of variable values from baseline assumptions often happens simultaneously, with different variables departing from assumed values by different degrees. To get a picture of the possible revenues from an IATAL as assumptions are varied simultaneously, we give all variables altered values and estimate the possible annual revenues that can be generated. We estimate possible revenues if all variables assume conservative and worst-case values. The optimistic scenario assumes the IATAL can be implemented under all other baseline conditions but with high levies (\$20 for economy and \$100 for premium class passengers). The following values were given to the key variables under conservative, worst-case and optimistic (best-case) scenarios.

Table 7: Values of variables used under conservative and worst-case scenarios

Variable	Conservative value	Worst case value	Optimistic scenario
Variation of levy by capability (flight class)	Same for all passengers	Same for all passengers	Varied by class
Levy size	\$2/ passenger	\$2/passenger	\$20 economy \$100 premium
Passenger demand growth rate	2%	0%	5.1%
Collection efficiency	80%	50%	99%
Participation/compliance rate	80%	30%	94%

The resulting total revenue streams from these assumptions are shown below.

Table 8: Total possible revenues under conservative and worst-case assumptions

Year	Conservative total revenue (US\$ million)	Worst case total revenue (US\$ million)	Optimistic total revenue (US\$ million)
1	973	228	19,237
2	992	228	20,218
3	1,012	228	21,250
4	1,032	228	22,333
5	1,053	228	23,472
6	1,074	228	24,669

5.4. Comparing potential revenues with adaptation needs

There are wide ranging estimates of the cost of adaptation in developing countries but it is expected that the cost will run into tens of billions of dollars per year. Oxfam (2007) estimates that at least \$50 billion will be needed to support adaptation in developing countries each year, and the figure will be even higher if GHG emissions are not cut rapidly. An IATAL under the baseline scenario (raising a total of \$7.81 billion in the first year) would generate about 16 per cent of this requirement for developing countries each year, assuming no growth in air travel demand. The percentages of the developing country adaptation requirement raised by the IATAL in the first year under the different scenarios discussed above are presented below.

Table 9: Percentage of adaptation requirement raised by IATAL in the first year of the scheme under different scenarios

Scenario	Revenue (\$ million)	% of the \$50 billion adaptation requirement in developing countries
Baseline scenario	7,808	16%
Variable levy by class (\$1 economy and \$5 business)	962	2%
Uniform levy of \$2/passenger	1,415	3%
Worst-case scenario with a uniform \$2 levy (50% efficiency, 30% participation/compliance)	228	0.5%
Conservative scenario with uniform \$2 levy (80% efficiency, 80% participation/compliance)	973	2%
Optimistic scenario (higher levies of \$20 in economy and \$100 in premium classes with all baseline conditions)	19,237	38%

Assuming international consensus is reached among countries and business, and an appropriate implementation mechanism is in place, IATAL has the potential to significantly contribute to adaptation funding. In the baseline scenario, IATAL can meet about 16 per cent of the \$50 billion total adaptation resources estimated by Oxfam (2007) to support adaptation in developing countries. In the worst-case scenario, IATAL could generate revenue almost equal to the \$232 million pledged to all international adaptation funds by 2007, and more

than the \$139 million received (Oxfam, 2007). It may take time to set up a fully operational IATAL, but once in place, resources will be predictable and will not be subject to the periodic budgetary reviews characterising development assistance funds from individual countries.

6. Impact analysis

Applying a passenger levy has the same effect as increasing the airfare or the cost of travelling. The likely response of passengers to such a levy and how this eventually affects the entire air travel industry and related industries are key factors to consider in schemes like IATAL. Of particular concern is how such a scheme will affect the development of sectors such as tourism in developing countries. In this paper, we look at the impact of an IATAL with respect to tourism, airline business and passenger welfare (Klosek and Nguyen, 2006; Commission of European Communities, 2005).

The price elasticity of demand determines the extent to which demand changes in response to price. In this case, own price elasticity of demand is the relevant indicator. For normal goods, demand decreases with price increases. For a commodity with a price elasticity of -1 or -0.1 , a 10 per cent increase in price results in demand declining by 10 per cent and 1 per cent respectively. InterVistas (2007) estimate that the price elasticities for flights where fare increases are imposed at a pan-national level (more than one country e.g. at the EU level) vary from -0.36 to -0.92 , which is relatively inelastic. Short-haul and long-haul price elasticities at the pan-national level range from -0.4 to -0.92 and -0.36 to -0.84 respectively i.e. demand for long-haul flights is less elastic than demand for short-haul flights. This compares well with elasticity figures of -0.7 to -2.1 in Tol (2006). When fare increases are imposed at a pan-national level, for example within the EU, there are few options for avoiding such increases and therefore elasticities are lower. The relatively higher elasticities for short-haul pan-national flights are a result of possible inter-modal substitutions with other modes of transport such as rail and road. Business travellers are less sensitive to fare changes than leisure travellers and therefore have lower absolute elasticity values (InterVistas, 2007; Tol, 2006).

6.1. Effect on development through reduced tourism

An increase in fares due to an IATAL has the potential to affect the tourism industry through reduced air travel demand and destination switching. This can have ripple effects through loss of employment in the tourism, travel and supporting sectors. The impact on tourism will be felt most by some developing countries for whom tourism is a significant source of income, employment and foreign exchange earnings. Impact on demand can be assessed by looking at the expected response to specific levies. For example, a \$6 levy for a trip costing \$500 represents a price increase of 0.8 per cent. With an average price elasticity of demand of -0.65 and -0.6 (short-haul and long-haul respectively) this would result in a drop in demand of 0.52 per cent and 0.47 per cent respectively for short-haul and long-haul flights. This is much less than the expected growth in air travel demand of 5.1 per cent per year. Tol (2006) suggests that a carbon tax equivalent to up to €9 per round trip is unlikely to deter many passengers from travelling.

If a tax is applied regionally rather than globally, then the taxed region may lose market share to the non-taxed region (Tol, 2006), if the decrease in demand is significant. An IATAL is proposed for all regions such that there will not be disproportionate impacts on tourism by region. The impact of the possible decline in demand can also be assessed by looking at the strong growth of tourism demand (European Commission, 2005). The levy used in this illustration (\$2) per passenger has been compared with the price of an air ticket rather than the total tour package, which is often higher than that. According to Tol (2006), air travel represents about 25 per cent of the total costs associated with leisure travel. The French

government, in response to IATA on the impact of the French solidarity tax, argues that small surcharges will not deter people from flying (Klosek and Nguyen, 2006).

An issue that has not been quantitatively analysed here is the cost of the IATAL through reduced travel demand of the proportions discussed above against the expected benefit through the potential adaptation revenues that IATAL can raise. Given that the IATAL collects revenues internationally to support adaptation in developing countries, the net benefit to developing countries is positive.

6.2. Effect on airline business and competition

A levy on passengers is borne directly by passengers, with no additional operational costs to the airlines. The main impact on business will be in the form of reduced business if there is a significant drop in demand. However, as discussed above, the decline in demand will be less than the percentage increase in the cost of travelling. However, a selective instrument may affect airlines differently. For example, if a levy is imposed in selected countries, airlines or routes, airlines operating in the countries/routes concerned may lose business. The IATAL, however, is for all international passengers irrespective of destination/origin or the airline they use. Thus, the impact expected on airline business is that related to aggregate decline in demand. Differential impact arises if passengers from some regions or countries are more sensitive to price changes than others. For example, leisure passengers from poor countries may respond to a levy more strongly than those from high-income countries.

6.3. Effect on passenger welfare

IATAL, like any levy of its type, can also affect the welfare of passengers by increasing the cost of travel, thereby affecting their ability to undertake leisure, family or other activities that depend on air travel. Willingness to pay is a possible indicator of the impact that a levy has on a passenger's welfare. The size of the levy should also be compared against their total income or expenditure to assess how significantly it affects passenger income or expenditure. Willingness to pay surveys at Schiphol International Airport in the Netherlands show that willingness to pay for emissions (though this is different from willingness to pay for adaptation) goes up to about €92 per passenger for an inter-continental round trip (van Beukering *et al.*, 2007). An analysis of data from a UK Civil Aviation Authority (2006) survey shows that the average income of international business and leisure passengers arriving at 11 UK airports in 2006 was about £61,000 and £50,000 respectively. A levy of \$62 and \$6 per passenger represents about 0.6 per cent and 0.07 per cent of monthly incomes of these groups of passengers respectively. This is only to illustrate the likely impact of a levy on the welfare of passengers. The levy has to be analysed with respect to other variables like total expenditure, total travel expenditure, and so on. It should also be noted that the income figures shown above could be very different in other regions and countries. For example, incomes of international travellers between neighbouring countries in Asia or Africa will be different. However, the share of the levy will be much smaller.

7. Conclusions

Overall, the impact of an international air travel adaptation levy is likely to be minimal on developing countries and passengers. The suggested levies are only a small proportion of total incomes and the travel expenditures of most passengers. Passengers who travel an average of once a year on international leisure trips will be affected least with a minimal levy while an average levy is unlikely to deter premium class passengers from travelling. The impact on airline business is highly dependent on the response from passengers. As an international instrument, the IATAL does not discriminate against countries or regions by making some routes more expensive than others. This means that airlines will not gain or lose competitive advantage. The net benefit for poor countries will be higher than the possible costs.

An IATAL enables poor nations to adapt to climate change by tapping resources contributed by international air passengers, who, on average, are wealthier than the victims of climate change. This redistributes resources from those who are contributing to climate change to those who contribute least to it. This corresponds well with the principle of responsibility (Müller and Hepburn, 2007). The mandatory approach provides for the participation of all international air passengers, with revenues that are easy to project. The IATAL proposed is simple and takes the form of a solidarity levy by imposing a flat levy on passengers instead of a percentage of ticket values. In full operation, at the suggested levies of \$6 and \$62 for economy and premium passengers respectively, an IATAL can generate about 16 per cent of the total estimated resources required to support the most urgent adaptation in developing countries. The figures suggested do not fall outside the range of passenger charges that are already applied in various countries. Even at worst an IATAL could generate in one year more than the total amount contributed to international adaptation funds to date. The impacts of the IATAL are more than offset by the benefits - especially to poor countries.

While this analysis provides the basis for the process of building international consensus on IATAL knowing the order of magnitude of its potential revenue, final detailed analyses should be carried out with regard to:

- the cost of implementing IATAL for different options of the scheme's set up
- the specific cost benefit analysis for specific poor countries whose tourism industries will be most affected by IATAL
- new international travel demand forecasts with the expected reduction in demand due to an IATAL.

These analyses should be done in consultation with other parties such as developing countries, international air travel organisations such as IATA, ICAO, the UNFCCC Adaptation Fund Board etc.

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