IATAL — an outline proposal for an International Air Travel Adaptation Levy

Benito Müller and Cameron Hepburn

Oxford Institute for Energy Studies
EV 36
October 2006

The contents of this paper are the authors' sole responsibility. They do not necessarily represent the views of the Oxford Institute for Energy Studies or any of its Members

ABSTRACT

The world has reached a stage where even a rapid stabilisation and significant reduction of global greenhouse gas emissions could no longer prevent significant climate change. While all countries will experience impacts, the developing world is most vulnerable. Significant financial assistance for adaptation is needed (and would be cost-effective), but current proposals are inadequate. At the same time, aviation emissions are increasing rapidly and are likely to continue to do so in the absence of major policy changes. Solutions to the challenges of adaptation finance and aviation emissions are both urgently required. This paper highlights political advantages and moral reasons to link the problems together (and absence of reasons in economic theory not to). Solving both problems by an International Air Travel Adaptation Levy (IATAL) – or an emissions trading scheme with auction revenues hypothecated for adaptation – is ethically, economically and politically attractive.

JEL classification: H21, H23, H87

Keywords: adaptation, aviation, air travel, transport, adaptation finance, hypothecation, climate change.

ACKNOWLEDGEMENTS

We thank Caroline Lucas MEP, the european capacity building initiative (ecbi) Oxford Fellows, and the participants of the 2006 ecbi Oxford Seminar (www.EuroCapacity.org).

AUTHORS

Dr Benito Müller is Senior Research Fellow at the Oxford Institute for Energy Studies and Director of Oxford Climate Policy. benito.mueller@philosophy.oxford.ac.uk

Dr Cameron Hepburn is Senior Research Fellow at the Oxford Institute for Energy Studies and James Martin Fellow in Climate Policy at the Environmental Change Institute of the University of Oxford. cameron.hepburn@economics.oxford.ac.uk

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

The world has reached a stage where even a rapid stabilisation and significant reduction of global greenhouse gas emissions could no longer prevent significant climate change.

While all countries will experience impacts, the developing world is most vulnerable. Significant financial assistance for adaptation is needed (and would be cost-effective), but current proposals are inadequate.

At the same time, aviation emissions are increasing rapidly and are likely to continue to do so in the absence of major policy changes. Solutions to the challenges of adaptation finance and aviation emissions are both urgently required.

This paper highlights political advantages and moral reasons to link the problems together (and absence of reasons in economic theory not to). Solving both problems by an International Air Travel Adaptation Levy (IATAL) – or an emissions trading scheme with auction revenues hypothecated for adaptation – is ethically, economically and politically attractive.

The Problem of Adequate Adaptation Funding

There are, at present, no accurate estimates on how much it will cost to adapt to climate change, whether for developing or developed countries. However, it is possible to give a reasonable indication at least on the order of magnitude. Based on some recent World Bank estimates and the figures provided in the LDCs' National Adaptation Programme of Action (NAPAs), it can be concluded that the cost of adaptation in the developing world will be in the *tens of billions of Euros annually*.

Current multilateral donor funding is woefully inadequate to meet a demand of anything close to this order of magnitude (see Table). Moreover, judging from the fate of the 0.7% of GDP 'Monterrey commitment', it is clear that it would be politically close to impossible for industrialised countries to try and raise this sort of (additional) money to cover these costs through domestic taxation: the priority of spending any tax money will almost always be domestic (education, health, etc.), no matter how strong the moral case for spending on foreign costs might be.[1] The lesson thus has to be that, in order to help developing countries cope with the expected adaptation cost and to comply with the moral obligations of the principle of 'common but differentiated responsibilities and

[1] Representative governments are, by their very nature, disposed to give priority to the (fiscal) demands of the people they represent. This is why a supra-national regime is essential to redress cross-boundary inequities. However, the fact that such inequities need to be addressed is not 'just' a moral imperative, it is in all nations' (enlightened) self-interest, in the same way in which it is in the citizen's self-interest to be subject to a domestic legal system.

Multilateral Donor Funding

Status in Spring 2006	*Total*	*Pledged*	*Collected*
LDC Fund	$68.3m	$34.3m	$34m
Special Climate Change Fund	$56.5m	$56.5m	
Adaptation Fund Donations	$5.0m	$5.0m	
GEF Special Priority on Adaptation	$50.0m		$50m
Total Donor Funding	**$179.8m**	**$95.8m**	**$84m**

International Private Sector Funding

	Projected
Adaptation Fund CDM levy	$160–950m (total until 2012)
International Air Travel Adaptation Levy (IATAL)	$4,000-10,000m per annum

respective capabilities', money has to be collected from the responsible/capable *individuals* directly, i.e. *outside domestic tax systems*.

Individuals, as independent moral agents, can and have shown to be willing to give money to be spent on helping others hurt by their actions, something which governments, as guardians of their nation's welfare, find very difficult to do. What is needed are revenues with a genuinely *international* character. The proposed IATAL is one way in which such international revenues could be raised equitably.

Addressing the problem of aviation emissions

Not only would an IATAL improve consistency in climate policy by ensuring that the aviation sector faces the carbon prices that are already imposed on other sectors (a precondition for economic efficiency), but it would contribute to reducing aviation emissions in two ways.

- The levy might help stimulate innovation in the air transportation sector, generating new abatement technologies.
- Where price elasticity is high – as in the short-haul leisure market – price increases would reduce the demand for air travel and hence reduce emissions.

Ceteris paribus, higher taxes should —according to Ramsey's (1927) 'inverse elasticity rule'— be imposed on goods with inelastic demand, so an IATAL should be applied as *revenue raising* instrument where, as in long-haul business travel, the price elasticity is low. In short, the proposed IATAL would reduce emissions, where demand is price elastic, and raise revenue for adaptation where demand is not elastic.

The distributional impacts of an IATAL would be progressive, for two reasons. First, air travel is disproportionately consumed by the wealthier segments of society – particularly in the case of the long-haul business travel which would be the primary target for revenue raising purposes. Second, the revenue raised would benefit the most vulnerable, who are often also the poorest.

Raising Revenues or Reducing Emissions or Both?

In its wider sense, this question is obviously rhetorical: given the current state of affairs, there is no doubt that we have to both raise revenues to help developing countries to adapt, and to reduce aviation emissions. However, it is not immediately obviously that we should aim to achieve both objectives with a single instrument.

Could we raise adaptation finance and reduce the aviation emissions with the same instrument? As mentioned earlier, there are good moral and pragmatic reasons why achieving both tasks simultaneously might be easier than achieving them separately. . The IATAL is designed with this in mind when levied as a function of (per capita) flight emissions and ticket price. And the same could be achieved with a (global) aviation emission trading scheme with permit auctioning and revenue hypothecation for adaptation could also achieve both aims.

The main difference between IATAL and the proposed aviation emission trading schemes is that IATAL could also be designed as a pure revenue raising instrument without a (significant) impact on emissions. This would, for example, be the case if it were set as percentage of the (long-haul business) ticket price, similar to the existing French 'solidarity contribution' on air passengers to raise revenue for HIV/AIDS. While we believe that a design based purely around revenue raising would be inferior an IATAL directed at both objectives, there may be political reasons why one might (initially) have to settle for this second-best option.

Politics

The political will among European decision makers to address aviation emissions appears to be at a high, as evidenced by proposals from both the European Commission and the European Parliament to address the problem at the European level by way of cap and trade schemes. These efforts, while extremely valuable, would not be optimal. For one, a global agreement on aviation emissions would be preferable to a (series of piecemeal) regional agreement(s), and it may even be easier to achieve because it would automatically address the thorny competitiveness ('level-playing field') issues.

The main obstacle to 'globalising' either of the proposed European trading schemes is the strong rejection by most developing countries on any mandatory mitigation burdens ('new commitments') rooted in the principle of differentiated responsibilities as operationalised in terms of countries per capita emissions. While this sentiment may be not as strong in the context of sectoral caps, it would still be a considerable obstacle to

introducing a global aviation cap and trade regime. Indeed, it might even extend to objections — in our opinion unjustified — to an emission-related IATAL imposing a cost on individuals in proportion to their individual responsibilities.

While an emission related IATAL would have a good chance of overcoming these objections — given that revenues raised would be for developing countries — it could easily be adapted to accommodate directly both the current EU aviation emission trading lock-in and the developing country rejection of anything resemblig a 'new commitment'. All that needs to be done is to design it as pure (adaptation) revenue raising *solidarity contribution*, based on the UNFCCC principle of 'respective capability.'

As such it would not be aimed at reducing aviation emissions and thus would not be in competition with emissions trading as abatement instrument, and — assuming a very modest average level of €5 per ticket — would still manage to raise €10billion annually, which would at least be in the same order of magnitude as the expected costs for adaptation in developing countries.

2. CHALLENGE I: ADAPTATION FUNDING

2.1 The nature of adaptation

In the climate change context, the term 'adaptation' is used in a variety of ways, ranging from rather narrow interpretations to 'anything other than mitigation'. An appraisal of the funding needs for adaptation thus requires some clarification of what 'adaptation' is meant to refer to, what it is meant to cover, and — equally importantly — what it is *not* meant to address. The following explication of the term 'adaptation' for the present purposes is based on the IPCC WGII TAR definitions,[2] and carried out against the background of a 'climate impact management' taxonomy, introduced in Section 5.2 of Müller (2002).[3]

Working Group II of the IPCC defines 'adaptation' quite succinctly as an "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." It then proceeds to introducing a number of binary classification (dichotomies), namely

- anticipatory (proactive) versus reactive,
- autonomous versus planned, and
- private versus public.

What causes? 'Adaptation' thus, first of all, refers to a change in a system (be it human or natural), and more precisely a change *in response* to certain causes, namely "climatic stimuli or their effects". The notion of climatic stimuli seems to be reasonably clear, but what precisely is meant to be covered by 'their effects'? There have been attempts to include rather indirect consequences – such as the impacts of measures taken to combat climate change on certain fossil fuel dependent economies – in this category of causes for adaptation, but for the present purposes, only climate impacts in the narrow sense will be taken into account as causes. 'Adaptation,' as used here, only refers to activities triggered in direct response to climate impacts, and thus explicitly excludes measures reacting to 'impacts of response measures.'

Impact reduction versus impact response. Another dichotomy which must be addressed to achieve the required conceptual clarity is between 'impact *reduction*' and 'impact *response*,' borrowed from the conceptual 'continuum' used in the field of disaster management (see Box 1). Why? Given that the IPCC does use the term *reactive* adaptation, one might easily be led to believe that 'adaptation', as used by the IPCC, is meant to cover not just impact reduction, but also impact response measures. In other words, that it is meant to cover impact damage as well as reducing impact risks. Yet

---

[2] http://www.grida.no/climate/ipcc_tar/wg2/689.htm

[3] Benito Müller, *Equity in Climate Change: The Great Divide*, EV31, Oxford: Oxford Institute for Energy Studies, September 2002

while there is no explicit ruling in the IPCC definitions on this possibility, there is indirect evidence against this wider conception. In the classification of *climate impacts* – themselves defined as: "consequences of climate change on natural and human systems" – the IPCC distinguishes between potential impacts and residual impacts, as follows:

- Potential impacts are all impacts that may occur given a projected change in climate, without considering adaptation.
- Residual impacts are impacts of climate change that would occur after adaptation.

Box 1: The 'Disaster Management Continuum'

Disaster A serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of affected society to cope using only its own resources.

The Pre-disaster Phase (Disaster Reduction)

- **Prevention:** Encompasses activities designed to provide permanent protection from disasters. It includes engineering and other physical protective measures, and also legislative measures controlling land use and urban planning.

- **Mitigation:** Measures taken in advance of a disaster aimed at decreasing or eliminating its impact on society and environment.

- **Preparedness:** Activities designed to minimize loss of life and damage, to organise the temporary removal of people and property from a threatened location and facilitate timely and effective rescue, relief and rehabilitation.

The Post-disaster Phase (Disaster Response)

Relief: Assistance and/or intervention during or after disaster to meet the life preservation and basic subsistence needs. It can be of emergency or protracted duration.

Rehabilitation: The operations and decisions taken after a disaster with a view to restoring a stricken community to its former living conditions, whilst encouraging and facilitating the necessary adjustments to the changes caused by the disaster.

Reconstruction (recovery): Actions taken to re-establish a community after a period of rehabilitation subsequent to a disaster. Actions would include construction of permanent housing, full restoration of all services, and complete resumption of the pre-disaster state.

Source: Internationally Agreed Glossary of Basic Terms related to Disaster Management, IDNDR/DHA 1992

This indicates that 'adaptation', as used by the IPCC, does not refer to impact response — dealing with the damage caused by climate impacts — but impact reduction. Adaptation is directed at reducing potential impacts from climate change, including

actions aimed at reducing related parameters such as risk, vulnerability and so on.[4] *Reactive* adaptation, in particular, is adaptation which comes about in reaction to actual unavoided ('residual') impacts *in order to adjust* to potential future impacts, and does not cover the activities aimed at dealing with these unavoided impacts themselves.

In sum, 'adaptation,' as used by the IPCC, is concerned with impact reduction, i.e. with reducing potential harmful climate impacts. It is, in particular, *not* meant to cover damages from unavoided climate impacts (dealt with in activities such as relief, rehabilitation and reconstruction, and closely associated with the issue of compensation, and liability in general). Nor is it meant to cover indirect effects such as the so-called 'impacts of response measures' on fossil fuel exporting economies. Adaptation, in this "narrow" sense, is – like its "cousin", mitigation – a tool to reduce the potential severity of the climate change problem. Both of them have become necessary, as neither of them is severally sufficient to solve that problem. Moreover, it is not clear whether they are jointly sufficient, i.e. sufficient to avoid all dangerous climate impacts as envisaged in the over-all objective of the UNFCCC.

2.2 Scale and nature of the funding challenge

2.2.1 Scale of the challenge

Neither the costs for adaptation nor for unavoided damages are well understood. At the time of writing, the two main sources of relevant information for developing countries were the recent World Bank Report on 'Clean Energy And Development: Towards An Investment Framework,'[5] and the 'National Adaptation Programmes of Action' (NAPAs) which are currently being put together by the members of the group of Least Developed Countries (LDCs).

(a) *The World Bank Estimates*

The World Bank estimates of adaptation costs are based on a top-down 'ball-park figure' methodology, based on estimates of annual investments in developing countries. More precisely, the WB report is based on estimates of percentages for different investment flows, meant to capture the costs of "climate proofing" these investment flows. Based on this, the report suggests a total figure of between $9bn and $41bn annually, highlighting the fact that this does *not* cover the cost for climate proofing *existing* investments.

---

[4] To be sure, 'adaptation' — as conceived by the IPCC — is not synonymous with 'climate impact reduction,' if only because the former, unlike the latter, deals both with potential climate change benefits and damages.

[5] World Bank Environmentally & Socially Sustainable Development and Infrastructure Vice Presidencies, 'Clean Energy And Development: Towards An Investment Framework' Development Committee (Joint Ministerial Committee of the Boards of Governors of the World Bank and the International Monetary Fund on the Transfer of Real Resources to Developing Countries), Washington D.C./USA: 5 April 2006

Table 1. Preliminary Estimates of Annual Adaptation Costs in Developing Countries.[1]

Investment type	*Amount*	*Climate sensitive*	*Adaptation costs (%)*	**Costs (2000 US$)]**
ODA & Concessional Finance	$100bn	40%	10 – 20%	$4bn – $8bn
Foreign Direct Investment	$160bn	10%	10 – 20%	$2bn – $3bn
Total international costs				**$6bn – $11bn**
Gross Domestic Investment	$1500bn	2 – 10%	10 – 20%	$3bn – $30bn
Total adaptation costs				**$9bn – $41bn**

Source: Table K.1, WBIF (2006)

(b) *NAP-based estimates*

The LDC National Adaptation Programmes of Action (NAPAs) are to identify *urgent and immediate adaptation actions* in each country and to provide a prioritized list of adaptation projects. Of the 50 members of the LDC group[6], five[7] (referred to here as the 'NAPA-Group') have submitted their NAPAs at the time of writing. The cost for the listed urgent and immediate projects of this group adds up to a total of $131.5million, [8] averaging $26.3m. This average is within the range of between $20-50million which experts expect as project cost total that the remaining countries will individually ask for in their NAPAs. Using this per country average to extrapolate the costs of urgent and immediate adaptation needs to the larger grouping(s) leads to a figure of $1.3bn for the 50 member LDC group, and $3.4bn for the G77+China (132 members).

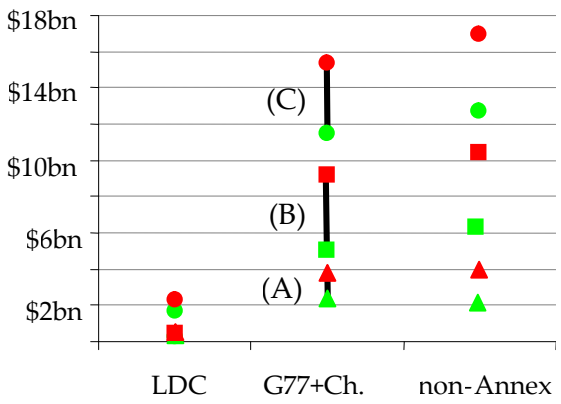
Yet, it stands to reason that an extrapolation of adaptation costs for larger groupings by reference to country numbers alone is somewhat over-simplistic, and that one ought at least take into account some additional parameters such as size of the economy, size of population, or land area impacted by human activity, as listed in Box 2. Given the per capita NAPA cost of the NAPA group, namely $131.5m/163m = $0.81, the population-based extrapolation of urgent adaptation cost for G77+China is $3.8bn, while the GDP-based extrapolation leads to an estimate of $9.2bn, and the land-based one to the figure of $15.4bn (Box 2, upper limit of ranges A, B and C respectively), significantly more than the initial country-number based estimate of $3.4bn.

[6] http://www.un.org/special-rep/ohrlls/ldc/list.htm

[7] Samoa $7.8m, Bangladesh, $73.7m, Bhutan $7.5m, Mauritania $20.1m, Malawi $22.4m.

[8] Taking into account that some of these projects have a 2-3 year duration, and that some of the projects listed may not genuinely qualify as climate change adaptation, the range of figures thus extrapolated may be slightly exaggerated as to the actual needs.

Box 2: NAPA-based extrapolations of urgent (annual) adaptation costs



The depicted extrapolations of adaptation costs are based on the figures of NAPA costs (A) per inhabitant, (B) per GDP, and (C) per land area impacted by human activity. The two estimates for each parameter are based on the minimum figures among the NAPA Group members (represented in green), as well as the figures for the Group as a whole (red). Multiplying the minimum (Bangladeshi) figure and the Group figure of NAPA cost per GDP with the G77+Ch GDP thus results in extrapolated estimates of $5.4bn and $9.2bn, respectively.

Parameters for Extrapolating Costs of Urgent and Immediate Adaptation Needs

	NAPA cost ($m)	*Population 2002 ('000)*	*GDP 2002 ($m PPP)*	*Land Area Impacted by Human Activity (km²)*
NAPA-Group		(A)	(B)	(C)
Bangladesh	73.7	144,437	221,298	97,328
Bhutan	7.5	2,211	n/a	2,707
Malawi	22.4	13,166	6,042	27,368
Mauritania	20.1	3,158	4,193	2,192
Samoa	7.8	186	929	670
NAPA-G Total	***131.5***	***163,158***	***232,462***	***130,265***
LDC	n/a	678,279	710,326	2,262,910
G77+China	n/a	4,668,387	16,223,763	15,178,410
non-Annex I	n/a	4,885,051	18,333,628	16,807,592

Sources: UNFCCC Website (NAPAs), Climate Analysis Indicators Tool (CAIT) Version 3.0. (Washington, DC: World Resources Institute, 2006).

2.2.2 Nature of the challenge

In light of the fact that the above NAPA-based figures and the World Bank estimates are at least partially complementary costs — if only because the former include 'climate proofing' of some existing investments, which the latter do not — it can reasonably be concluded that current adaptation funding needs of the developing world are likely to be in the tens of billions of dollars annually. Given the present Official Development Assistance (ODA[9]) levels of $80bn (0.26% of GNI), and the apparently insurmountable

[9] "Official Development Assistance (ODA) is defined as those flows to developing countries and multilateral institutions provided by official agencies, including state and local governments, or by their executive agencies, each transaction of which meets the following tests: i) it is administered with the promotion of the economic development and welfare of developing countries as its main objective; and ii) it is concessional in character and conveys a grant element of at least 25 per cent."[http://stats.oecd.org]

problems in reaching the Agenda 21 ODA target level of 0.7% GNI, it is thus unlikely that public sector funding will ever be able to provide adequate adaptation (let alone impact response) funding for the most vulnerable constituencies in the world. Sovereign bi- or multilateral funding inevitably involves money raised through domestic taxation, and as such will always be seen as competing with domestic funding needs (hospitals, education, etc.). Transfers abroad of substantial amounts of money are and will remain politically highly controversial, even if legally and morally justified.

In short, it will not be possible to raise the sort of funding that appears to be required to cover the urgent adaptation needs of developing countries through ODA-type bilateral payments. Other fund-raising mechanisms have to be devised. It is this realisation that provided the main motivation for the proposal put forward in this study.

2.3 Current adaptation funding

The variety and complexity of possible adaptation actions not only contribute to problems in estimating the scale of required adaptation funding, but also in trying to put a figure on how much is actually being spent on adaptation. This is true for current figures, and even more for projections. Current adaptation spending is by far the most transparent in the case of multilateral funding, i.e. funding through the multilateral funds, such as the ones established under the United Nations Framework Convention on Climate Change (UNFCCC) or the Trust Fund of the Global Environment Facility (GEF).

2.3.1 Multilateral funding

Two UNFCCC funds were established in decision 7 of COP7, the seventh session of the UNFCCC Conference of Parties (COP) in 2001: the Special Climate Change Fund (SCCF) and the Least Developed Country Fund (LDCF), both operated by the GEF under the guidance of the COP, and replenished through voluntary sovereign contributions by industrialised countries from their domestic tax revenues. Of the two, only the LDCF has thus far funded adaptation-related activities, primarily the development of the LDC NAPAs.

In addition, there is a Kyoto Protocol *Adaptation Fund*, targeted at "concrete adaptation" activities and (primarily) to be funded through a 2% levy on the credits generated in developing countries by projects under the Clean Development Mechanism (CDM). This levy is expected to generate an income of €325m (within a range of between €125m and €750m),[10] chiefly from the private sector of both industrialised and developing

[10] UNFCCC Secretariat, Background paper on Share of Proceeds to assist in meeting the costs of adaptation, UNFCCC WORKSHOP ON THE ADAPTATION FUND, Edmonton, Alberta, Canada, 3 – 5 May 2006: Table 1. Possible levels of funding for the Adaptation Fund trustee account to 2012

countries ("unilateral CDM"). At the time of writing, the Adaptation Fund was not yet operational because of prevailing differences of opinion as to who should be the fund's operating entity/entities. Further adaptation funding has recently been set aside under the GEF Trust Fund for its newly established *Strategic Priority on Adaptation* (SPA). According to Huq (2006),[11] current multilateral funds for adaptation are in the region of $180million (see Table 2), with more than half thus far only pledged. Funding currently available for adaptation (related) activities in LDCs is accordingly $34.5m, or $690k each.

Notwithstanding the 2001 COP commitment in decision 7/CP.7[12] to make available "predictable and adequate levels of funding" for developing (non-Annex I) countries – specifically through the SCCF, the LDCF and increased GEF replenishments –, current donation-based multilateral funding is clearly not adequate to cover the expected adaptation costs for the most vulnerable countries. And, for political reasons, it is highly unlikely that they could be sufficiently increased. The only current multilateral mechanism that could even come close to contribute significantly toward adequate funding is the private sector levy on the Clean Development Mechanism used to replenish the Kyoto Protocol Adaptation Fund. The proposed levy on air travel is meant to provide another genuine alternative.

Table 2: Current Multilateral Funding for Adaptation ($m)

	Fund Total	*Pledged/projected*	*Actual*
LDCF	68.3	34.3	34
SCCF	56.5	56.5	
AF Donations	5	5	
SPA (SPA LDC)	50 (<0.5)		50 (<0.5)
Total Donation-based	**179.8**	**95.8**	**84**
AF CDM levy	**160–950**	**160–950**	

Sources: Huq (2006), UNFCCC (2006)

2.3.2 Other Funding: The UK case

Figures on actual current spending on adaptation activities other than the contributions to the aforementioned multilateral funds are very difficult to come by. Just to give an idea, we have collected some information on the case of the UK, one of the undisputed leaders in the field.

---

http://unfccc.int/files/cooperation_and_support/financial_mechanism/financial_mechanism_gef/application/pdf/adaptation_sop.pdf

[11] Saleemul Huq,1 March 2006, 'Adaptation funding after Montréal', *Tiempo Climate Newswatch* www.tiempocyberclimate.org/newswatch/report060401.htm

[12] http://unfccc.int/resource/docs/cop7/13a01.pdf#page=43

Bilateral funding. In addition to establishing the two Convention funds, and to deciding on the provision of predictable and adequate levels of funding for developing countries, decision 7/CP.7, in its preamble, also welcomed "the joint political declaration [the 'Bonn Declaration'] made by the European Community and its member States, together with Canada, Iceland, New Zealand, Norway and Switzerland, on their preparedness to contribute collectively €450 million/US$410 million annually by 2005". The Bonn Declaration covers all activities that enable developing countries to respond to climate change, including mitigation/low carbon development, adaptation, capacity building and research. Expenditure (disbursements not pledges) is meant to be accountable from 2005 and should be additional to expenditure levels in 2001. Signatories to the Bonn Declaration have agreed to report how they are meeting their commitment through National Communications.

For this purpose it has been proposed to apply the OECD DAC[13] marker weights to bilateral development assistance, according to which funding for projects which directly and explicitly address climate change are fully counted, while the climate change costs of those which address it only indirectly are set at 40% of the total budget. Funding for adaptation related activities such as disaster risk reduction, water management, food security and agricultural management, environmental management, environmental health, climate change research is envisaged to be covered by this proposal. It is not self-evident as to why the climate component of 'mainstream' projects has been set at 40% of the total costs. As concerns adaptation, this seems to be somewhat inflated, at least when compared to the World Bank estimate of between 10 to 20% (see Table 1).

As concerns explicit adaptation funding, the UK Department for International Development (DfID) has allocated £25 million over 5 years to adaptation research and £5 million over 5 years to the GCOS[14] ClimDev project. DFID China and DEFRA[15] are collaborating on a £550k *Integrated Assessment of Impacts of Climate Change on Chinese Agriculture and options for adaptation*. Among the projects indirectly addressing adaptation, DfID Bangladesh is providing £6 million over 5 years to support UNDP and the government of Bangladesh in establishing a *Comprehensive Disaster Management Programme*.

Domestic Funding It is difficult to find any information about current domestic adaptation expenditures, even in affluent countries such as the UK. Indeed, according to Chris West of the UK Climate Impacts Programme (UKCIP)[16], the only explicit adaptation funding at the national level is roughly £1million *per annum* for some research projects, and chiefly for UKCIP. While there are a number of regional

[13] Development Co-operation Directorate

[14] Global Climate Observing System, http://www.wmo.ch/web/gcos/gcoshome.html

[15] UK Department for Environment Food and Rural Affairs.

[16] www.ukcip.org.uk, personal communication, 26 July 2006.

authorities that have employed some staff with the remit of looking at implications of climate change for local planning, there are no figures indicating how much, if anything, these local authorities are spending on measures to adapt to climate change. If climate change is taken into account at all, it will usually not be separately accounted for. To get an idea of the amount of money spent on measures to tackle current climate variability, one only needs to point out that current annual cost for the up-keep of UK flood defences is in the region of £800million, itself dwarfed by the annual flood damages which are in the region of £1.4billion (see Table 3)[17]

Table 3: UK. Current Annual Flood Management and Damage Costs

	Damages (millions)	*Flood management costs (millions)*
River/coastal flooding	£1088	£464
Intra-urban flooding	£270	£320
Total	**£1400**	**£800**

Source: Evans *et al.* 2004.

2.4 Adaptation Funding: Summary

There are, at present, no reliable estimates on how much the cost arising from adaptation to climate change is or will be, whether for developing or developed countries. However, it is possible to give some reasonable indication on at least of the order of magnitude. Based on some recent World Bank estimates and the figures provided in the LDCs' National Adaptation Programme of Action (NAPAs), it can be concluded that the cost of adaptation in the developing world will be in the *tens of billions of Euros annually*. Whatever the exact figure might be, it is clear that it would be politically close to impossible for industrialised countries to try and raise this sort of money to cover these costs through domestic taxation: the priority of spending any tax money will almost always be domestic (education, health, etc.), no matter how strong the moral case for spending on foreign costs might be. The lesson thus has to be that, in order to help developing countries cope with the expected adaptation cost – whatever the exact figure might turn out to be – and to comply with the moral obligations of the principle of 'common but differentiated responsibilities and respective

[17] Evans, E., Ashley, R., Hall, J., Penning-Rowsell, E., Saul, A., Sayers, P., Thorne, C. and Watkinson, A. (2004), *Foresight. Future Flooding. Scientific Summary: Volume I Future risks and their drivers.* Office of Science and Technology, London.
http://www.foresight.gov.uk/Previous_Projects/Flood_and_Coastal_Defence/Reports_and_Publications/Volume1/Contents.htm

capabilities', money has to be collected directly from the responsible/capable *individuals* outside domestic tax systems. Individuals, as moral agents, can and will be willing to give money to be spent on helping others hurt by their actions, something which governments, as guardians of their nations welfare, find very difficult to do. What is needed are revenues with a genuinely international character. The proposed IATAL is one way in which such international revenues could be raised.

3. CHALLENGE II: AVIATION EMISSIONS

Bunker fuel emissions fall roughly into two categories, namely emissions from marine bunker fuels (primarily for goods transport), and aviation bunker fuels (primarily passenger air travel). There are plausible economic reasons for imposing levies on both categories of emissions. However, the focus in this paper is on air travel, for environmental, economic and ethical reasons.

Environmental Reason. Emissions from aviation are greater, and are growing more rapidly, than emissions from goods transport. In 1990, marine emissions were 366 $MtCO_2$ while aviation emissions were 544 $MtCO_2$, and average growth has been 0.8% for marine emissions and 3.3% for aviation emissions over the last 25 years (Olivier and Peters, 1999).

Economic Reason. Allowing levies on goods transport creates an excuse for protectionist policies that, although expressed as climate change levies, are actually intended to reduce trade flows from developing world producers to industrialised consumers. For many developing countries, restricting trade is thus understandably a more sensitive issue than potential restrictions in international passenger numbers.

Ethical Reason. Export emissions for many developing countries are – to use a distinction often made by Southern stakeholders – 'survival emissions' rather than 'luxury emissions' (Agarwal, Narain and Sharma, 1999). By contrast, it is more difficult to argue that air travel emissions are 'survival emissions', and indeed a larger proportion would probably be legitimately classified as luxury emissions. Müller (2006) argues, on ethical principles, that it is therefore fair to ask all nations to address emissions from air travel in accordance with the principles of Art. 3.1 of the UNFCCC.

3.1 Scale and nature of the challenge

The growth in air travel has been extraordinary since commercial aviation took off after the Second World War. Passenger numbers have increased by 45% over the last decade alone, and in 2004 airlines carried 1.9 billion scheduled passengers (Air Transport Action Group, 2005). The recent growth in air travel has been driven by globalisation (producing changes in preferences), increasing incomes, and reduced costs arising from increases in efficiency and competition (coupled with relatively price-elastic demand in the short-haul leisure sector, as discussed in Section 5 below). This astonishing growth is likely to continue over the next few decades.

A direct consequence of the growth in air travel has been a dramatic increase in emissions from aviation. In the European Union, emissions from aviation fuel use increased by 73% (or 47 $MtCO_2e$) between 1990 and 2003, reflecting an average compound annual growth rate of 4.3% (European Commission, 2005). Furthermore, by 2012, it is forecast that aviation emissions will have increased by 150% on 1990 levels.

Although emissions from aviation currently represent only 3% of total greenhouse gas emissions, this rapid growth implies that tackling emissions from aviation is critical if greenhouse gas emissions are to be brought under control. Left unchecked, aviation emissions may increase to 15% of global emissions by 2050 (Intergovernmental Panel on Climate Change, 1999). It should be relatively obvious that significant action is required.

Nevertheless, the Kyoto Protocol to the UNFCCC did not include aviation emissions, partly on account of the legal niceties presented by dealing with emissions over the oceans, and in the territory of sovereign states who are simply allowing aircraft to pass overhead. Instead, greenhouse gas emissions from aviation were to be addressed through the International Civil Aviation Organisation (ICAO). To date, however, policy appears to have had a very limited, if any, impact on aviation emissions.

3.2 Current aviation taxes and charges

Policy makers rarely make policy with a clean slate. Generally, policy instruments must be designed and implemented in the presence of pre-existing policies. This problem is particularly common in climate policy, because of the complex and international nature of the issues.

Climate policy addressing aviation emissions will inevitably be layered on top of various different national policies. For instance, domestic air passenger transport is currently subject to VAT in some EU Member States, but it is not in the United Kingdom (House of Lords, 2006). International flights avoid VAT in all Member States. And although the UK does not levy VAT, it does impose an air passenger duty ('APD'), but this has been frozen at the same level since April 2001 (yielding declining revenues), and remains frozen in the most recent Budget, HM Treasury (2006, ¶7.84).

Many view the APD freeze to be 'incoherent and unconvincing' (House of Commons Treasury Committee, 2006) and the budget report stated that "the Government is aware that economic instruments, including APD, may provide a route through which improved environmental performance in the aviation sector can be incentivised."

In contrast, excise duty on aviation fuel is internationally harmonised as a result of the 1944 Chicago *Convention on International Civil Aviation* — article 24 exempts aviation fuel from customs duty. Furthermore, most bilateral Air Service Agreements between nations contain an explicit clause to the effect that aviation fuel will not be taxed. However, these impediments might also give way — European Council Directive 2003/96/EC now allows Member States to tax aviation fuel for domestic flights, and also intra-Community flights through the bilateral agreements.

The aviation sector, therefore, has escaped any serious climate policy. While the International Air Travel Association (2005) unsurprisingly argues that the sector is already heavily taxed, it is clear that there is very little reason to whinge about the implicit carbon tax faced by the industry. In the absence of a compelling international

proposal on aviation emissions, there have been several more successful European-led proposals, which we now examine.

3.3 New proposals

Given the obvious need to limit the projected increases in aviation emissions, a variety of proposals have been advanced. We examine three in more detail. First, the European Parliament (2006) has recently adopted a resolution proposing the introduction of a separate, dedicated emissions trading scheme for aviation emissions. Second, European Commission has proposed to integrate (European) airline emissions into the existing EU Emission Trading Scheme (EU-ETS). Finally, the French Government has begun collecting an 'international solidarity contribution', primarily intended to fund health development, particularly HIV/AIDs. Although this scheme is not currently aimed at reducing emissions, it could potentially be adjusted and extended to have that impact. We then examine the impacts if these policy instruments functioned simultaneously.

3.3.1 European Parliament: separate emissions trading for aviation

In June 2006, the European Parliament published the final version of an important report on reducing climate change emissions from aviation. The report included a motion for a resolution of the European Parliament, which would create an emissions trading scheme for aviation. The key features of the proposal are that:

- it would be a separate dedicated scheme for aviation emissions.
- Because of the Under Kyoto, the aviation sector would be unable to sell into the EU ETS, and any buying from the EU ETS would be "carefully limited".
- the initial allocation of allowances, set at the EU level rather than Member State level, would be fully auctioned. No statement is made about the use of the resulting revenues, but it is noted that there may be "further environmental benefits if the revenues are appropriately hypothecated";
- the allocation would not allow for growth in emissions above the base year;
- it would be part of a "package" of other measures.

This scheme has significant merits. Obviously, the key advantage is that it would place a price on aviation emissions, and would do by auctioning the initial allocations, with all of the concomitant advantages discussed by Hepburn et al. (2006), not least in focussing managerial incentives on reducing emissions and providing a spur to research and development in the sector.

Moreover, the scheme could be potentially designed along the lines proposed in this paper (see Section 4 below), whereby the revenues from the auctioning the allowances are hypothecated for adaptation finance. However, as the auction would be carried out by the EU, it may be politically difficult to send the money South. This problem would, of course, be magnified if the auctions were done by the member states themselves.

However, there are certain problems with the proposal. As Hepburn (2006) points out, price instruments (e.g. levies) may be preferable to quantity instruments (e.g. trading schemes) for short-term climate policy on efficiency grounds. For sectors covered by the Kyoto Protocol, the institutional switching costs of moving from negotiations over quantities to prices probably exceed the benefits. However, aviation is a (relatively) clean slate, and offers an opportunity for a price-based policy to be implemented.

Second, there are difficulties in attempting to integrate aviation into the current emissions trading framework, as was discovered at Kyoto. Because of the resulting limitations, it is difficult for the aviation sector to sell allowances into the EU ETS (European Parliament, 2006).

Third, a related problem is that the proposal is, inevitably, limited geographically to the EU, yet there are compelling reasons to address the problem globally. It is true that an EU aviation emissions trading scheme might provide the stimulus for the development of a truly international scheme. However, given the relatively uncertain future of climate policy post 2012, it may prove difficult to globalise the control of aviation emissions through emissions trading (even if trading under the Kyoto Protocol were extended to cover the whole globe, which appears unlikely).

Additionally, any revenues derived from the EU scheme are likely to be claimed by Member States, if not the EU, and directed to domestic priorities. Expanding the EU arrangement globally will probably leave countries collecting and disbursing their own revenues on domestic priorities. While there is nothing necessarily inappropriate with such a situation, it does forego the opportunity to direct revenues to poorer countries for the finance of climate adaptation, for which air travel users are partly responsible (see Section 4.1 below).

In sum, the European Parliament (2006) proposals represent a useful advance in policy on aviation emissions. In their current form, the EU proposals are not inconsistent with the proposals of this paper, in so far as the revenue raised from auctioning the allowances could be hypothecated and applied to adaptation finance. However, we believe it could be improved from its current form.

3.3.2 European Commission: including aviation in the EU ETS

The European Commission (2005) also endorses emissions trading for aviation, noting that this is consistent with the view of the International Civil Aviation Organization (ICAO), which was charged with pursuing aviation emissions reduction by the Parties negotiating the Kyoto Protocol. Unlike the European Parliament, the European Commission considers the inclusion of aviation in the EU ETS as the "most promising way forward". Aircraft operators would be made responsible for compliance, and both CO_2 and non-CO_2 impacts be addressed (in its present form, the EU ETS only covers CO_2 impacts). The Commission notes that its preferred model should be able to be

"extended or replicated worldwide", which is indeed sensible. Finally, the Commission suggests that "a harmonised allocation methodology should be agreed". This is sensible. Furthermore, we would argue (consistent with our proposals below) that the allocation of emission allowances should occur be through (at least) partial auctions, and the revenues could be hypothecated and applied to adaptation finance.

3.3.3 French 'solidarity contribution': aviation and HIV/AIDS finance

On 1 July 2006, France began collecting an 'international solidarity contribution' of €1 on all European economy class flights (€10 in business) and €4 on international economy flights (€40 in business). This is expected to generate revenue of €200 million per annum, which will be devoted to fight pandemics, including access to anti-retroviral treatments for HIV/AIDS (Landau, 2004; French Government, 2006). An international drug purchase facility (see http://www.unitaid.eu/sommaire.php3?lang=en) has been created to disburse the revenues collected from the scheme.

A declaration signed by 79 countries (including the UK, excluding the USA and Australia) in September 2005 encouraged further work on such solidarity contributions, and the UK has stated that it will allocate a proportion of the revenue from the existing air passenger duty (APD) for health development projects including HIV/AIDS, tuberculosis and malaria.

The stated objective of the initiative is to raise funds "in addition to traditional ODA" to provide stable and predictable resources for health development. The benefits of the contribution are that:

- it is easy to implement with low collection costs (0.1% in the experience of the UK);
- it does not diminish national tax sovereignty;
- the economic impact is limited;
- the distribution of the burden is equitable.

An additional benefit of the approach is that it appears to be politically feasible. France has already begun collecting the contribution, and according to Unitaid (2006), 14 countries have expressed their intention to implement "the same type of levy".[18]

The proponents of the scheme do not claim that the levy is addressed at reducing emissions. Indeed, as the contribution is not a function of emissions, it provides little, if any, incentive for abatement. As such, the only channel through which the contribution might have an impact on emissions is through demand reduction. However, the level of the contribution is too low to have much impact on demand. Indeed, the fact that the

[18] These countries are Brazil, Chile, Cyprus, Congo, Gabon, Ivory Coast, France, Jordan, Luxembourg, Madagascar, Mauritius, Nicaragua, Norway and the United Kingdom.

tax would not lead to behavioural change appears to be one of the selling points of the scheme (French Government, 2006).

3.4 Summary

All these proposals make important and useful contributions. The EU proposals proposal are helpful first conceptual steps towards addressing aviation emissions. The French scheme is an appealing mechanism to collect funds for development objectives. Both proposals have some very appealing points.

However, there is an opportunity for dialogue between the two types of policy. For one thing, as discussed above, policies are rarely applied in a policy vacuum, and their interactions with other policies can be important for success. The international solidarity contribution (a price instrument at the national level) will obviously interact with the EU aviation emissions scheme (a quantity instrument at the supranational level). It is not impossible for a solidarity contribution to exist alongside the emissions trading scheme. However, the arrangement is highly unlikely to be economically efficient unless the policy interactions are properly understood and harmonised.

Why not harmonise the two objectives — reducing aviation emissions and raising development finance — by a tax that is explicitly aimed, at least partially, at reducing greenhouse impacts? The Landau (2004) report considered this idea, noting the possibility of a tax on kerosene (which is limited by bilateral agreements discussed in Section 3.2 above), or a tax on the use of air corridors, either of which might generate US $10 billion.

More generally, the report considered the potential for carbon taxes to contribute to development. It concluded that because of the current focus on emissions trading, it was unlikely for carbon taxes to generate development funding in the short term. They noted that "even if such a tax were to be implemented, proceeds may be needed to finance actions more directly linked to the reduction of the greenhouse effect." This is largely what we will argue in the following section.

4. SOLUTION: THE INTERNATIONAL AIR TRAVEL ADAPTATION LEVY

Section 2 made the case that new sources of adaptation finance are needed. It should be evident from Section 3 that there is a pressing need to address aviation emissions. Of course, the mere fact that both policy problems need to be addressed does not necessarily imply that they should be linked. Indeed, it generally makes good economic sense to address individual policy issues with appropriately tailored instruments. Nevertheless, in the following section we argue that solving both problems with one instrument is ethically and politically appealing, and adheres to the logic of responsibility set out in Art. 3.1 of the UNFCCC.

4.1 Why link aviation emissions and adaptation finance?

It is essential for any money transfer proposal that requires consent – particularly if crossing national borders – that it is seen to be equitable. More specifically, the parties whose consent is required must not feel that the result is inequitable.[19] The general guidance on both moral and legal grounds with regard to climate change funding is provided in Article 3.1 of the UN Framework Convention on Climate Change, in particular the 'principle of common but differentiated responsibilities and respective capabilities'.[20] It is not always self-evident how these two parameters – 'responsibility' and 'capability' – should be operationalized, although it may be easier if one talks about the responsibility/capability of individual agents rather than that of countries (or, for that matter, that of airlines).

Unfortunately, the 2% Adaptation Fund levy on permits (CERs) generated by CDM projects, neither reflects responsibility, nor ability to pay (particularly if the ownership of the CERs is with the host institution). All it does is to provide a *dis*incentive for an activity which is meant to be encouraged!

What sort of activities and characteristics reflect responsibility/capability in the context of climate change? Consider 'responsibility': given that the problem in question is *anthropogenic* climate change, the relevant activities are all forms of man-made (net[21])

[19] Issues of equity are often portrayed as irrelevant in face of hard-nosed economic self-interest, particularly in so-called '(neo-) realist' conceptions of the world. However, it would be wrong to underestimate the power of equity, or rather the power of (perceived) inequitable treatment which can scupper any 'regime' – particularly international ones which rely on the consent of the parties involved – even if the regime would have strictly speaking been in the (national) self interest. It is for this reason that we believe it to be essential to try and incorporate equity from the outset into the design of the proposed regime.

[20] 'The Parties should protect the climate system for the benefit of present and future generations of humankind, *on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities.* Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.'[UNFCCC Art 3.1.,emphasis added]

[21] Including anthropogenic reductions of existing greenhouse gas sinks.

greenhouse gas emissions. And while it may be possible to determine a 'formal degree' of responsibility – as envisaged by the so-called 'Brazilian proposal', which aims to provide a percentage share of climate change responsibility for each country – it may not only be more practical, but also more useful, to create a direct link with the offending activities, i.e. with emitting of greenhouse gases, in order also to create direct mitigation incentives (always keeping in mind the primary function of providing an equitable method of collecting funds for adaptation activities for the most vulnerable communities). In short, for practical reasons 'responsibility' is probably best measured in terms of emissions themselves.

For reasons of equity and justice, the most appropriate method of raising adaptation finance is through national 'adaptation responsibility levies' — essentially carbon taxes that are hypothecated for adaptation.[22] Unfortunately, however, international fund transfers struggle for political acceptability (see Section 2.2.2) when the tax base can be interpreted as being 'domestic', and even more so when the levy is collected by the relevant national governments. To circumvent this problem, we need 'international emissions' — emissions which do not obviously fall within the jurisdiction of specific nation states. There are, of course, emissions which have thus far been excluded from the multilateral mitigation regime embodied in the Kyoto Protocol precisely because they could not readily be assigned to countries, namely the so-called bunker fuel emissions of international transport and travel.

Introducing a levy on international air passengers has the added equity benefit of focusing purely on (individual) responsibility and capability, without consideration of any other demographic criteria such as geographic origin of the responsible individuals. Furthermore, provided the levy were global in application, it would not create differential competitiveness impacts, and hence be more likely to be acceptable to industry.[23]

However, imposing a world-wide levy on the activities of every individual *purely as a mitigation tool*, is unlikely to be politically acceptable, particularly in developing countries. Given international disparities in per capita emission figures, developing countries have justifiably insisted that the developed world shows leadership. However, if the revenues from the levy are hypothecated and returned for adaptation finance in developing countries, the proposal is bound to be more politically appealing to them. In other words, linking aviation emissions with adaptation finance increases the odds of the scheme being implemented globally.

---

[22] In the context of a cap and trade regime, it might be argued that all emissions below the cap, should be exempt from such a levy, as they are permitted by the system. However, the fact that they are permitted by a cap and trade regime does not automatically make them causally harmless.

[23] To maximise shareholder profits, (ignoring good public policy), industry should be expected to lobby for subsidies first, then freely allocated permits, before accepting a levy (Hepburn, 2006).

Some people may wonder whether both objectives — raising adaptation finance and internalizing a climate externality — can be achieved simultaneously? We think so. As discussed above, there are political and pragmatic synergies in combining the objectives. As discussed below, internalizing the appropriate carbon price (whether through auctions or a levy) would raise roughly the right order of magnitude of adaptation funds that are needed.

4.2 Institutional and operational details

The previous section outlined some basic reasons why an IATAL appears to be worth considering in principle. However, the devil is often in the details. In order to fully assess the merits or otherwise of the IATAL, we must specify how it would be operationalised, specifically with respect to questions such as: (i) who would collect and disburse the levy; and (ii) who would be charged.

4.2.1 Collection and disbursement

A primary reason for creating a levy on *international* air travel is to ensure the levy is, and is seen to be, independent of national budgets. As such, it would be counterproductive to collect the levy through the domestic revenue systems. Instead, the levy would be collected through an international instrument, such as an international fund, preferably with some expertise in collecting private sector contributions. Given the proliferation of such funds, particularly in the climate change context, our preferred solution would be to make use of suitable existing instruments. In particular we believe that the Kyoto Protocol's Adaptation Fund – with its existing private sector replenishment through a 2% levy on the transactions of the Clean Development Mechanism – could be suitable to administer the proposed IATAL, provided its operational structure – which at the time of writing is yet to be decided – will indeed suitable for the job.

Adaptation and, more generally, the management of climate (change) impacts involves an extremely diverse set of issues, ranging from, say, capacity building and technology transfer, to disaster relief and damage liabilities. Many of them will have relevance outside the confines of adaptation, indeed outside climate change. Disaster relief, or one, is clearly not just concerned with weather related disasters, let alone with their climate change components; nor is technology transfer something that only occurs in the context of adaptation.

There are a number of well-established as well as newly created institutions and instruments that deal with these areas. For one, there is the Global Environment Facility (GEF), with its implementing[24] and executing agencies[25] carrying "the lead responsibility

[24] UNDP, UNEP and the World Bank

[25] African Development Bank, the Asian Development Bank, the Inter- American Development Bank, the European Bank for Reconstruction and Development, the Food and Agriculture Organization of the United

for designing, implementing and executing projects"[26] Although the GEF has climate change as one of its focal areas, it is only one among many.[27] Then there is World Bank's recently proposed *Clean Energy and Development Investment Framework*.[28] While most of its climate change activities are concerned with greenhouse gas mitigation through clean energy investments, it stands to reason that if this framework proves to be efficient in transferring mitigation technology, then it might do this equally well for the transfer of technologies related to adaptation. Accordingly it would be at best wasteful to set up an independent instrument dealing just with adaptation transfer technologies. Probably the best example as to why one has to be very careful not to 're-invent the wheel' in attempts to spend adaptation related moneys is funding for disaster relief. Given that the UN Office for the Coordination of Humanitarian Affairs (OCHA) has recently re-organised Central Emergency Response Fund (CERF), it would be nonsense to create a separate instrument for disbursing exclusively climate change related disaster relief funding.

In sum, we envisage that the international instrument that is to govern the proposed international air travel adaptation levy should contend itself with the raising of revenues, and not get involved in the operational aspects of spending it. These should be delegated to the greatest possible degree to separate implementing agencies. The only spending decision of the governing body of the levy should be how much funding is to be disbursed to each of these implementing agencies, based on independent audits and other expert input. It stands to reason that the 'natural' governing body for such a levy is the UNFCCC Conference of Parties (possibly serving as Meeting of the Kyoto Protocol Parties). Whether the Kyoto Protocol Adaptation Fund could be used for this purpose thus depends very much on the character of its operating entity.

Having decided that the operation of the levy should be restricted an international fund concerned only with revenue raising, the most immediate open question is: who should be made to pay?

Nations, the International Fund for Agriculture Development and the United Nations Industrial Development Organization.

[26] UNFCCC (2006):8

[27] GEF focal areas: biodiversity, climate change, international waters, ozonedepletion, land degradation, and persistent organic pollutants.

[28] 2005] World Bank Environmentally & Socially Sustainable Development and Infrastructure Vice Presidencies, 'Clean Energy And Development: Towards An Investment Framework'
Development Committee (Joint Ministerial Committee of the Boards of Governors of the World Bank and the International Monetary Fund on the Transfer of Real Resources to Developing Countries), Washington D.C./USA: 5 April 2006

4.2.2 Who is to be charged?

Even with the guidance of Art. 3.1, a number of fundamental decisions have to be taken to fully operationalise the idea of an adaptation levy on international air travel. First of all, the 'level of agency' as concerns responsibility and/or capability has to be fixed: are we talking about the responsibility/capability of individuals (passengers), or of other involved agents, such as airlines? The latter would arguably open similar sort of problems as the attribution of responsibility/capability of countries (as concerns responsibility, one might, for example, have to consider emissions per passenger instead of overall emissions). However, if one chooses individual passengers as responsible/capable agents, then strictly speaking one would have to refer to the wealth of the individual as indicator of capability, and, presumably, to the total of greenhouse gases emitted during the flight, divided by the actual number of people carried. Neither option seems to be practicable, and some justifiable compromise needs to be found.

One option is to consider the ticket price as a proxy for capability, and emissions per 'notional passenger' (i.e. per available seat) as the measure of individual responsibility. To simplify things further, one might introduce a carbon coefficient for each type of aircraft, reflecting the average emissions per kilometre per (notional) passenger. There are a large number of other options concerning that choice as to who should be made to pay. However, an acceptable approach, from a political, moral and practical point of view, would appear to involve charging individual passengers on the basis of these two parameters – ticket price (capability) and emissions (responsibility). We therefore define the proposed adaptation levy, a, for a journey according to:

$$a = \alpha \cdot p + \beta \cdot e \cdot l \qquad (1)$$

where p is the ticket price, e the passenger emissions coefficient of the type of plane used, l the length of the journey, and α and β are parameters in the appropriate units. The parameters α and β might be chosen anywhere on the spectrum. For instance, $\alpha = 0$, the levy is entirely a function of responsibility for emissions, and would be similar to an aviation emissions trading scheme, in so far as those responsible for emissions must pay. This would find a theoretical justification in the standard Pigouvian logic of internalising externalities. Alternatively, we might set $\beta = 0$, thereby making the levy a pure function of capability to pay. Such a scheme would be closer to the French international solidarity contribution, with theoretical support to be found in Ramsey taxation arguments (see below). The particular choice of parameters, and therefore the emphasis of the scheme, would be dictated by the perceived political constraints.

5. POTENTIAL IMPACTS OF IATAL

This section analyses the economics of the proposal encapsulated in equation (1). The proposal allows a mixture between the revenue raising objectives of the French proposal (captured by $\alpha \cdot p$) and the objectives of the EU proposal to reduce aviation emissions (capture by $\beta \cdot e \cdot l$). As such, the IATAL would combine the 'solidarity levy' with a carbon tax on aviation emissions. The precise combination of the two components is reflected by the relative sizes of α and β. Finally, under the IATAL proposal, the revenues (or at least a part thereof) would be hypothecated for adaptation finance.

5.1 Potential revenues

What would an IATAL deliver? This obviously depends upon the particular parameters adopted in equation (1). There are two extremes — purely Pigouvian ($\alpha = 0$) and purely revenue raising ($\beta = 0$).

5.1.1 Pigou

First, suppose the IATAL is purely Pigouvian, which is to say that it focuses entirely upon 'responsibility' (ignoring 'capability') and simply internalises the external cost of carbon emissions. This is equivalent to setting $\alpha = 0$ and $\beta = 1$ à la Pigou (1920) in equation (1). We consider two estimates, which provide roughly consistent results.

First, the IPCC (1999) estimated that aviation was responsible for 3.5% of radiative forcing by greenhouse gas emissions.[29] If global emissions are approximately 25 $GtCO_2e$, and the marginal social cost of emissions is about €30/tCO_2 (about £70/tC),[30] then the social cost of aviation emissions is approximately €25 billion,[31] and a purely Pigouvian IATAL would therefore raise **€25 billion**. According to calculations by Monarch Airlines reported by the House of Lords (2006), this would equate to a surcharge of roughly €4-5 on a typical European route.

Second, and similarly, Landau (2004) estimates that the revenues raised from an aviation levy (whether on kerosene or the use of air corridors) set at one third of the Pigouvian tax rate would raise around **€10 billion**. Although it isn't entirely clear, the calculation is presumably based on a social cost of carbon of $100/tC (about €20-25/$tCO_2e$), which is referred to earlier in the paper.

---

[29] Aviation is responsible for 2% of CO_2 emissions. The full total is higher because of the impact of non-CO_2 emissions, including Ozone and the effect of contrails. Note, however, that the science in this area is still uncertain.

[30] The £70/tC is the unofficial UK government estimate from 2000, without the recommended increase of £1/tC per annum, or any adjustment for inflation (Clarkson and Deyes, 2002).

[31] Note that using a *marginal* social cost for a source of 3.5% of global emissions is conceptually inappropriate, but is probably an adequate approximation for our purposes.

5.1.2 Ramsey, Diamond and Mirrlees

The second extreme case is a tax aimed purely at revenue raising ($\beta = 0$). This roughly corresponds to the French 'solidarity contribution', which is not a function of emissions, but is rather a function of the class of travel (and thus the price). Here the optimal levy is a function of several considerations. First, the levy should be greater for goods that are less responsive to price changes, according to the 'inverse-elasticity rule' of Ramsey (1927). [32] Second, under reasonable social welfare functions, optimal taxes tend to involve higher tax rates on goods consumed predominantly by the rich (Diamond, 1975). This consideration supports the notion of higher levies on business class flights, and indeed also argues for higher taxation of aviation more generally. Finally, under fairly general conditions, taxes on factors of production should be avoided Diamond and Mirrlees (1971), and if aviation is viewed as one of the factors of production, tax rates should be reduced.[33] Teasing out these different considerations, and applying them to aviation taxes is a complicated and difficult task which we do not endeavour to perform here. Instead, we examine three rough estimates of revenue raising potential of aviation taxes that are not directed at reducing emissions.

First, the French scheme is expected to raise €200 million per annum based on a levy of €1 on all European economy class flights (€10 in business) and €4 on international economy flights (€40 in business). France has approximately 5% of the global aviation industry. If France is roughly representative of the mix of different classes of travel, then extrapolation implies that applying the French scheme worldwide would raise **$4 billion**.

Second, in 2004 airlines carried almost 2 billion scheduled passengers. Suppose a levy is imposed as a function of the price of the ticket. If the average levy per flight is €5, then the scheme would obviously raise **€10 billion**.

Third, Landau (2004) reports an estimate that a 5% tax on first and business class tickets would yield approximately $8 billion, or at current exchange rates, roughly **€6 billion**.

5.1.3 Combining the approaches

The proposed IATAL would reflect a combination of the two extremes discussed above, where the mixture is reflected by the choice of the capability (α) and responsibility (β) parameters in equation (1). Given the estimates above, it would seem that a global IATAL of the form proposed would be likely to raise in the order of $10 billion. Compare this to the various estimates and calculations from Section 2.2.1 concerning development and adaptation finance:

---

[32] This rule is derived using the relatively strong assumptions that demand for goods does not depend upon the price of other goods, and that the supply of all goods is perfectly elastic.

[33] Other factors are likely to further complicate optimal tax results. For instance, the analysis by Frank (1985) is relevant to optimal aviation taxes if aviation is regarded as a positional goods.

- Present Official Development Assistance is $80bn (0.26% of GNI);
- The Agenda 21 ODA target is 0.7% GNI (around $220bn);
- Adaptation funding needs are at least $10bn annually.

If these estimates are accurate, a reasonable conclusion is that the funds raised by an IATAL would lie at the lower end of the funds needed for adaptation finance, but is nevertheless reasonably close.

5.2 Efficiency

Efficient policy on aviation emissions would (i) determine a risk-adjusted social cost of carbon, and (ii) ensure that the aviation sector faced, at the margins, this same price of carbon. Of course, such a policy is impossible in reality, because

(i) the social cost of carbon is extremely difficult to estimate (because of scientific and socioeconomic uncertainties and ethical issues in the valuation of climate impacts in the distant future); and

(ii) the collective action problem, and the necessity for international agreement, make carbon price harmonisation difficult.

Nevertheless, if a truly international scheme like IATAL is shown to be politically feasible, it would also have the benefit of increasing efficiency. If a IATAL were agreed (and a single carbon price for aviation emissions established globally), then it follows that carbon policy within the aviation sector would be efficient. If the IATAL were layered on top of an EU aviation emissions trading scheme, efficiency is more difficult to asses (and less likely to be achieved.) Also, unless the aviation carbon price matched implicit carbon prices in other sectors, overall climate policy would not be efficient.

Alternatives to international schemes, such as the European aviation emissions trading scheme in its current form, are likely to be less efficient than an IATAL, because the carbon price between European and non-European aviation would differ. Furthermore, in addition to being inefficient, these price differentials might lead to (probably minor) competitiveness impacts, by way of reducing the appeal of European destinations.

5.3 Distributional impacts

The most significant distributional impact of the IATAL is that it would shift income from aviation consumers (who are contributing to climate change) to people who are likely to suffer from climate change. Aviation consumers, irrespective of nationality, tend to be wealthier than average, and citizens in need of adaptation finance will tend to be poorer than average. As such, the distributional impacts of the policy are progressive. Moreover, they concord, as discussed above, with notions of responsibility.

Ultimately, the precise distributional effects will be a function of the relative size of the capability (α) and responsibility (β) parameters in equation (1). The scheme will not generate windfall profits (as a trading scheme with free allocation is likely to).

5.4 Emission mitigation incentives

Ensuring that the aviation industry faces an appropriate carbon price is a precondition for appropriate abatement incentives to emerge. The EU aviation emissions trading scheme might achieve this, especially if the allowances are auctioned.[34] Obviously, the French proposal will not achieve much abatement, if any, because the levy is not a function of aviation emissions.

Providing abatement incentives involves (in part) ensuring the industry faces a long-term, credible carbon price. This allows the industry to plan ahead and to make a financial return from research into low-carbon technologies (Hepburn, 2006). But creating a long-term, credible carbon price signal is notoriously difficult. The EU emissions trading scheme is unlikely to succeed because of uncertainty in the regime post 2012. It is unlikely that an IATAL fares any better — levy rates can always be adjusted, or the levy removed altogether. However, just as the current bilateral agreements limiting tax on aviation fuel appear to have achieved a degree of policy lock-in, so an international agreement on an IATAL may also become relatively difficult to renege upon. In this area, international bureaucracy and inertia may actually provide a valuable economic benefit — credibility that the policy is not going to change in the short term.

Provided a credible, long-term IATAL were implemented, we might expect increased abatement from the aviation industry in two of the three possible categories: engine design, fuel choice, and operational decisions.

5.4.1 Engines

IPCC (1999) note that over the 40 years to 1999, aircraft fuel efficiency per passenger-km improved by 70%, largely due to engine and airframe design improvements. Another 20% improvement is projected to 2015, and a 40-50% improvement by 2050 (relative to 1999). Strong economic incentives may well increase the speed at which such technological improvements are generated.

Several interesting and important considerations need to be balanced in future engine design, between different greenhouse emissions at different altitudes (IPCC, 1999). Although research is proceeding in these areas, one suspects that economic incentives might operate to bring more minds to the problem.

---

[34] Hepburn et al, (2006) discuss the relevance of the marginal and the inframarginal incentives, including managerial attention.

5.4.2 Fuel

The opportunities for abatement by aviation fuel switching appear to be extremely limited. The IPCC (1999) formed the view that although hydrogen might eventually be viable as an aircraft fuel, this would require new aircraft designs and infrastructure that will not be forthcoming in the short to medium term. Seven years later, submissions to the House of Lords (2006) indicate that this remains the appropriate conclusion, because 'unlike many other industry sectors, aviation does not have feasible alternatives to fossil fuels in the short to medium term'. However, a study carried out at the London-based Imperial College Centre for Energy Policy and Technology concludes that "hydrogen, Fischer Trops kerosene and biodiesel, […], all have the potential to bring savings in the sector's use of non-renewable energy and emissions of greenhouse gases. These benefits are greatest for H2, FT kerosene then biodiesel, respectively. All three options would be significantly more expensive to produce compared to the cost of kerosene today. In the long-term, however, the costs of producing H2 and FT kerosene may drop sufficiently for them to become viable options. Hydrogen aircraft would require new engines and airframes and are unlikely to be seen for at least several decades. In general, renewable fuels are likely to be used for uses such as road transport or electricity generation in preference to aviation."[Saynor 2003:p.6]

5.4.3 Operational decisions

In submissions to the House of Lords (2006) it was suggested that air traffic control efficiencies, along with improved aircraft design, could deliver 50% of fuel savings by 2020. The IPCC (1999) had estimated that air traffic management would yield reductions of 6-12% over the next 20 years. Without a carbon incentive, monopolist airport operators do not have the appropriate incentive to extract these savings.

Finally, research and development, by its very nature, often produces previously unexpected results. While financial incentives are not an especially important driver of more fundamental research, they do have some power to shape the allocation of intellectual resources. Once the aviation industry faces a pseudo-carbon price, like the IATAL, it will be expected to apply more intellectual capital to the challenges of aviation emissions. As ever, we should expect the unexpected.

5.5 Potential behavioural changes

Imposing the IATAL will increase prices paid by consumers and therefore reduce demand. The extent to which demand is reduced by increased prices is captured by the (own) price elasticity of demand.

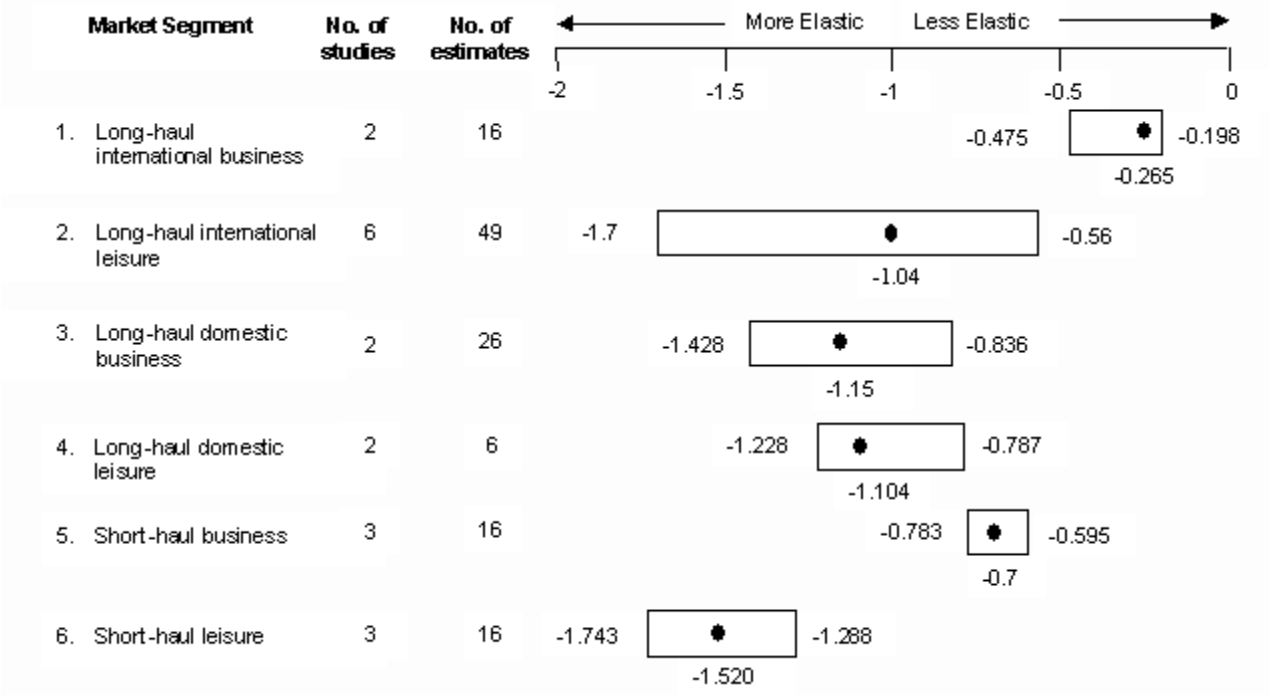
Curiously, politicians appear to believe that the price elasticity of demand is extremely low. For instance, according to the BBC in February 2006, 'Tony Blair says it is unrealistic to think the tax system can be used to reduce air travel in the UK. The prime

minister said it would take a "fairly hefty whack" for people to cut back on flights in the UK and abroad.'

However, as transport economists have recognised for at least the past 20-30 years, considering air travel as a single market is misguided.[35] Intuitively, one expects the Prime Minister to be correct for business travel — the price elasticity is probably low, especially in long-haul, because close substitutes are often unavailable. In contrast, he is probably incorrect for the leisure market, which one would expect to be strongly price sensitive. Indeed, the fact that the emergence of low-cost airlines in Europe has dramatically increased demand for air transport surely suggests that air travel for leisure is rather elastic.

A recent Canadian meta-analysis by Gillen, Morrison and Stewart (2002), who collect 254 demand elasticity estimates from 21 studies, supports this view. Figure 1 shows that long-haul business travel is highly inelastic, while short-haul leisure travel is quite price sensitive.

Figure X: Price elasticity of demand for different air travel sectors



Source: Gillen, Morrison and Stewart (2002)

[35] See, eg, Verleger (1972), Taplin (1980), Anderson and Kraus (1981).

Clearly, then, the segment most effected by an aviation levy would be the low-cost leisure flights around Europe,[36] which is arguably a more politically charged area of policy. This is clearly understood by the industry lobby group, the European Low Fares Airline Association, who stated in a 2005 press release that 'The discrimination against air travel in Europe has to stop and we will fight any further taxes…' In contrast, an aviation levy would not have much impact on business travel, which is a more inelastic good.

Finally, even if politicians are correct that all air travel exhibits a low price elasticity of demand, this simply provides a further argument for higher aviation taxation according to optimal tax theory developed by Ramsey (1927), by the 'inverse elasticity rule' (higher taxes should be imposed on goods with inelastic demand).

[36] It is likely that the availability of cheap flights has led to the purchase of second homes, near the airports offering cheap flights. Once individuals have purchased property abroad, their price elasticity of short-haul leisure flights is likely to be reduced. It is unclear, however, whether this factor has had a significant effect on overall price elasticities in the short-haul leisure market.

REFERENCES

Air Transport Action Group, 2005. *The economic & social benefits of air transport*, September.

Anderson, J. E. and Kraus, M., 1981. Quality of Service and the Demand for Air Travel. *Review of Economics and Statistics*, **63**:4, 533-540.

Agarwal, A. Narain, S. and Sharma, A. 1999. *Global Environmental Negotiations 1: Green Politics*, New Delhi: Centre for Science and Environment.

BBC, 2006. *Cutting air travel 'unrealistic'*, 7 February 2006. Accessed at http://news.bbc.co.uk/1/hi/uk_politics/4688452.stm on 10 May 2006.

Clarkson R and Deyes K, 2002, Estimating the social cost of carbon emissions, *Government Economic Service Working Paper 140*, HM Treasury and Defra, January.

Collaborative forum of air transport stakeholders, 2003. *Fast facts*, February. Accessed at http://www.atag.org/files/FAST%20FACTS-120341A.pdf.

Diamond, P. A. and Mirrlees, J. A. 1971. Optimal taxation and public production I: Production efficiency and II: Tax rules, *American Economic Review*, **61**, 8-27 and 261-78.

ELFAA, 2005. ELFAA to fight any State imposing taxation on aviation to fund development aid. Press Release, 8 June. Accessed at www.elfaa.com/documents/ELFAA-8June2005-ELFAAtofightanyStateimposingtaxationonaviaitontofunddevelopmentaid_003.pdf.

European Commission, 2005. *Reducing the Climate Change Impact of Aviation*, COM(2005) 459 final.

European Parliament, 2006. *Motion for a European Parliament resolution on reducing the climate change impact of aviation*, Report A6-0201/2006.

Federal Aviation Administration, 2005. *Aviation & Emissions: A Primer*, January. Accessed at http://www.faa.gov/regulations_policies/policy_guidance/envir_policy/media/AEPRIMER.pdf.

Frank, R. H. 1985. The demand for unobservable and other nonpositional goods, **75**:1, *American Economic Review*, 101-116.

French Government, 2006. Conference Report: Solidarity and globalization: innovative financing for development and combating pandemics. Accessed at http://www.diplomatie.gouv.fr/en/IMG/pdf/argumentaires-eng.pdf.

Gillen, D. W., Morrison W.G. and Stewart, C., 2002. Air travel demand elasticities: Concepts, issues and measurement. Department of Finance, Canada, 2002. Available at http://www.fin.gc.ca/activty/consult/airtrav_e.html.

Hepburn, C., 2006. 'Regulating by prices, quantities or both: an update and an overview', **22**:2 *Oxford Review of Economic Policy*, 226-247.

Hepburn, C., Neuhoff, K., Grubb, M., Matthes, F. and Tse, M., 2006. 'Auctioning of EU ETS Phase II allowances: why and how?', **6**:1 *Climate Policy*, 137-160.

House of Commons Treasury Committee, 2006. *The 2006 Budget: Fourth Report of Session 2005-6*. 24 April. London, UK: The Stationary Office Limited.

House of Lords European Union Committee, 2006. *Including the Aviation Sector in the European Union Emissions Trading Scheme*. 9 February. London, UK: The Stationary Office Limited.

HM Treasury, 2006. *Budget 2006 — A strong and strengthening economic: investing in Britain's future*. 22 March. London, UK: The Stationary Office Limited.

International Air Travel Association, 2005. *Aviation taxes and charges*. IATA Economics Briefing No. 2, November.

Intergovernmental Panel on Climate Change, 1999. *Aviation and the global atmosphere*, IPCC Special Report.

Landau, J.-P., 2004. Rapport à Monsieur Jacques Chirac, Président de la Republique, *Group de travail sur les nouvelles contributions financières internationales*, December. Accessed at http://www.diplomatie.gouv.fr/en/IMG/pdf/LandauENG1.pdf.

Müller, B., 2006. *Montreal 2005: What happened and what it means*, Oxford: Oxford Institute for Energy Studies, February.

Olivier, J. and Peters, J., 1999. 'International marine and aviation bunker fuel: trends, ranking of countries and comparison with national CO2 emissions', *Netherlands National Institute of Public Health and the Environment*, RIVM report 773301 002.

Ramsey, F.P. 1927. A contribution to the theory of taxation. *Economic Journal*, **37**, 47-61.

Saynor, B., A. Bauen, and M. Leach 2003. The Potential for Renewable Energy Sources in Aviation" London: Imperial College Centre for Energy Policy and Technology http://www.iccept.ic.ac.uk/pdfs/PRESAV%20final%20report%2003Sep03.pdf

Taplin, J. H. E., 1980. A coherence approach to estimates of price elasticities in the vacation travel market. *Journal of Transport Economics and Policy*, **14**:1, 19-35.

Verleger, P. K., 1972. Models of the Demand for Air Transportation. *Bell Journal of Economics and Management Science*, **3**:2, 437-457.