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Sustainability-oriented EU Taxes: The Example of a European Carbon-based Flight Ticket Tax

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Abstract

Taxing the aviation sector at the EU level and using the resulting revenues to reduce Member States' contributions to finance the EU budget presents itself as a huge opportunity not only to decrease carbon emissions effectively, but also to reform the EU system of own resources. The aviation sector is a small but fast growing emitter of carbon dioxide. The failed attempts of several EU Member States to introduce a flight ticket tax and the pressure on those EU Member States still levying such a tax clearly demonstrate the limits of national aviation taxation. Assigning any kind of taxes on flight tickets to the EU level would greatly reduce the tax enforcement problems inherent to mobile tax bases and put a stop to harmful tax competition between EU Member States. A double dividend, consisting of a reduction of CO_2 on the one side and a boost for the economy on the other side, is a likely scenario if additional tax revenues are spent in the right way. Therefore, in this paper it is proposed that all revenues from a European carbon-based ticket tax should be used to reduce contributions of Member States to the EU budget. This would allow national governments to reduce taxes more harmful for growth and employment, in particular the high tax burden on labour. Given the current political and legal situation a European carbon-based ticket tax has better chances of implementation compared to a tax on aviation fuel and is therefore a financial instrument which could foster sustainable growth in the very near future. The paper estimates the expected revenue from implementing a carbon-based flight ticket tax at the EU level and revenue distribution across EU Member States. In particular, we propose that every passenger departing from an airport within the EU and every passenger arriving from outside the EU at an EU-based airport is subjected to this new carbon tax which is calculated individually for every route flown. The paper uses a new and very exact data set, which (depending on the country) assigns to approximately 75% to 90% of the respective intra and extra EU routes flown in the year 2014 the corresponding carbon dioxide emissions per passenger (using the ICAO methodology). Based on the demand elasticities provided by IATA (2007), we are thus able to exactly calculate the tax revenues per passenger per route that could have been generated in 2014 by introducing a carbon-based flight ticket tax in the EU.

Keywords: EU system of own resources, flight ticket tax, EU taxes, carbon tax, sustainability-oriented taxation

JEL Classification: H23, H87, Q58

1. Introduction[1]

In the European Union (EU) as well as world-wide, air traffic has been growing considerably in the long run. Between 2008 and 2014, the number of air passengers has increased by almost 10% in the EU. Since 1990, carbon emissions from aviation have doubled. They now account for about 3% of the EU's total greenhouse gas emissions, being to a large part caused by international flights (European Commission 2011a). Recent forecasts predict a considerable expansion of air traffic in the EU also for the future: CO_2 emissions as well as the number of flights are expected to grow by 45% each between 2014 and 2035 (European Commission 2016).

Against this background it is remarkable that the existing under-taxation of the aviation sector has long been neglected in the public finance literature.[2] Only since the beginning of the 2000s, taxes on aviation have attracted some more attention – albeit rather in tax practice than in academic discussions. Hereby the primary motivation was not only the search for effective instruments to curb the ever growing air traffic with its increasing share in carbon and other greenhouse gas emissions. Taxes on aviation have also come into the focus as financing instruments with the positive side effect to display Pigovian characteristics and thus to offer a good justification for their intensified use as innovative instruments to finance development aid introduced globally or by a group of countries within a coordinated move as so-called global taxes.[3]

In 2006 the global health initiative UNITAID[4] was established, which to about 70% is financed by a solidarity levy on airline tickets. The initiative in the meantime is carried by 29 member states, of which nine have introduced a solidarity levy on air tickets. Currently, two European countries contribute to UNITAID's funds via tax-based instruments: France as the only EU Member State applies the solidarity levy on air tickets; Norway contributes a share of its CO_2 tax revenues.

In the EU the potential contribution of an air ticket tax as an innovative financing instrument to increase financial resources for development aid was debated rather intensely in the second half of the 2000s (European Commission 2005a, 2005b, 2010a). Considering the decisive resistance to be expected from several EU Member States, the

[1] We are grateful to Jeroen van den Bergh, Angela Köppl and Ann Mumford for valuable suggestions and comments and to Andrea Sutrich for careful research assistance. The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme 2014-2018, grant agreement No. FairTax 649439.
[2] For one of the rare exceptions see Keen and Strand (2006) and the literature cited therein.
[3] See for early contributions on global taxes to finance development Landau (ed.) (2004), Atkinson (2005), and Kaul and Conceição (eds.) (2006).
[4] UNITAID was launched by the governments of Brazil, Chile, France, Norway and the United Kingdom to provide sustainable funding for the fight against HIV/AIDS, malaria and tuberculosis.

European Commission (2005a) evaluated a voluntary two-level scheme of introduction: in a first step, each Member State should decide about the adoption of an air ticket tax; in a second step, passengers departing from a taxing Member State should opt for paying or not paying the tax. Not surprisingly, the European Commission's evaluation led to the conclusion that such a two-level voluntary scheme would not be expedient, as it would create a considerable administrative burden for airlines while probably generating little revenue only. Consequently France with its solidarity levy on air tickets is still the only EU Member State applying such an air ticket tax as innovative financing instrument for development.

Besides this international debate of flight ticket taxes as innovative financing instruments for development, aviation charges were suggested repeatedly in the relevant EU Commission documents also in the debate about own EU taxes as an option to reform the EU system of own resources serving to finance the EU budget. This discussion strand is the starting point for this paper, which sets out to combine the literature motivating taxes on the aviation sector for environmental reasons with the debate about the reform of the EU system of own resources via the introduction of own EU taxes. We first very briefly sketch the current state of the debate about reform needs of the EU system of own resources and about EU taxes as alternative revenue sources (chapter 2). We then present the theoretical rationale for increasing taxes on the aviation sector and for doing this not unilaterally and in an uncoordinated way at the national level, but to rather introduce such taxes in a coordinated move at the EU level. We also briefly present and discuss the principal options for taxes on the aviation sector and their environmental effectiveness. Moreover the current situation with regard to taxes on air travel in the EU is presented to corroborate the theoretical expectation that the absence of international coordination is likely to lead to under-taxation (chapter 3). Finally the paper estimates the expected revenue from implementing a carbon-based flight ticket tax at the EU level and revenue distribution across EU Member States (chapter 4). In particular, it is proposed that every passenger departing from an airport within the EU and every passenger arriving from outside the EU at an EU-based airport is subjected to this new carbon-based tax which is calculated individually for each route flown. The paper provides a new and very exact data set assigning to approximately 75% to 90% of the intra- and extra-EU routes flown in the year 2014 the corresponding carbon dioxide emissions per passenger (using the ICAO methodology). Based on the demand elasticities provided by IATA (2007), we are thus able to exactly calculate the tax due per passenger per route as well as total tax revenues that could have been generated in 2014. Also overall tax revenues can exactly be assigned to individual EU Member States, demonstrating the potential to reduce their respective contributions to the EU budget. Chapter 5 concludes by formulating several open issues and questions that need to be addressed in more detail should EU Member States seriously consider the introduction of a flight ticket tax to finance part of the EU's expenditures.

2. The debate about reform needs and reform options of the EU system of own resources

For several decades now the EU system of own resources financing the EU's budget has been criticised in a large number of academic and policy-oriented contributions, and the proposal to finance the EU's expenditures at least partially by EU taxes as "genuine own resources" has been put forward repeatedly also by the European Commission (European Commission 1977, 1998, 2004, 2008, 2010b, 2011b, 2011c and Cattoir 2004).

In particular, the following points of criticism are underlined in the literature.[5] First, as in the meantime the bulk of EU revenues stems from direct contributions out of Member States' national budgets, the EU's financial autonomy has been curtailed considerably over the last decades. This revenue structure secondly furthers a juste-retour-position by Member States, which are aiming at maximising their net benefits from (or at least minimising their net contributions to) the EU budget instead of maximising a common EU value added to be achieved by EU expenditures. A third point of criticism is the increasing complexity of the current system of own resources as well as its in-transparency, which threatens political acceptance of Member States' contributions to the EU budget. Fourthly, the distribution of the financial burden among Member States does not adequately account for their respective ability to pay. Finally, the type of current revenue sources does not support central EU policies in general, and in particular it is not connected at all neither to the Europe 2020 strategy aiming at making the EU a "smart, sustainable and inclusive economy" nor to the EU's Sustainability Strategy.

Departing from the last criticism mentioned above – the lack of sustainability-orientation[6] of the current EU system of own resources – we arrive at the conclusion that one of the most relevant potential benefits of EU taxes is that they may help to decrease the existing sustainability gaps in tax systems in the EU. They may serve as instruments to strengthen economic, social and environmental sustainability of taxation[7] in the EU – a potential of

[5] See Schratzenstaller (2013) and Schratzenstaller et al. (2016) and the literature cited therein for a more detailed discussion.
[6] For the concept of sustainability and its dimensions see the literature reviews by Nerudová et al. (2016) and Dimitrova et al. (2013).
[7] For fundamental deliberations on and key features of sustainability-oriented taxation see Schratzenstaller (2016).

EU taxes which has hardly attracted any attention in the debate about reform necessities and options for the current EU system of own resources until now. These sustainability gaps, which are elaborated in detail in Schratzenstaller et al. (2016), include the high and increasing weight of taxes on labour, the decreasing progressivity of tax systems and the diminishing importance of so-called Pigovian taxes (see also section 3.1) aiming at the internalisation of external costs, an intensifying company tax competition and problems of tax compliance and tax fraud.

EU taxes may contribute to strengthening the sustainability of tax systems in the EU via various channels. In the form of Pigovian taxes they may create a double dividend[8]: If introduced within a revenue-neutral tax shift[9] Pigovian EU taxes contribute to environmental sustainability, as a first dividend, while allowing the reduction of national contributions to the EU budget and thus creating leeway for national governments to cut taxes harmful for employment and growth, particularly labour taxes, as a second dividend. In addition, fiscal sustainability of taxation may be improved by assigning those taxes to the EU level for which the enforcement at the national level is increasingly made difficult by tax flight due to high international mobility of tax subjects and/or tax bases – a recommendation which can also be found in the traditional fiscal federalism and tax assignment literature, which suggests assigning taxes levied on highly mobile taxes bases and/or redistributive taxes to the central level (Martinez-Vazquez, McLure and Vaillancourt 2006, Musgrave 1959, Oates 1972, Wildasin 1989). Again, Pigovian taxes are of particular relevance in this context: their erosion through legal tax avoidance or illegal tax evasion would endanger also other sustainability dimensions besides fiscal sustainability – in the case of eroding environmentally motivated Pigovian taxes environmental sustainability would be affected negatively. If tax rates due to spill-overs are fixed at a sub-optimally low level by national governments, the case for assigning these taxes to the EU level would be strengthened further. The revenues from such taxes which are levied on tax bases characterised by international spill-overs cannot easily be assigned to specific individual countries, so that these taxes lend themselves particularly to finance a supranational budget (Keen, Parry and Strand 2012).

[8] For the idea of the two-fold benefits of a revenue-neutral substitution of distorting taxes by environmental taxes see Tullock (1967); Pearce (1991) coined the expression "double dividend". The double dividend hypothesis was elaborated, refined and differentiated further by Fullerton and Metcalf (1997) and Bovenberg and de Mooij (1994); for a critical review, see also Jones, Keen and Strand (2012) and Jaeger (2012).

[9] See for the concept of such tax shifts and their rationale as well as related literature with a perspective on the EU for example Garnier et al. (2014) or Mathé, Nicodème and Ruà (2015).

3. Taxes on the aviation sector – options and current situation in the EU

3.1 Current situation of aviation taxation in the EU

Generally, in economic theory taxes are regarded as important market-based instruments in environmental policy, as they have the potential to contribute to the attainment of environmental goals in a cost-effective way (Kosonen and Nicodème 2009). The principal rationale for aviation taxes is that they are potentially powerful instruments to internalise the external costs of aviation, i.e. costs incurred by the users of air services that they do not have to bear themselves but are imposed to uninvolved third parties (Leicester and O'Dea 2008, Keen and Strand 2006, Jones, Keen and Strand 2012). As Pigovian taxes, aviation taxes aim at the internalisation of externalities, which for the case of aviation range from local (e.g. noise at airports or NOx emissions at the start or landing of aircraft) to global external costs (CO2 emissions and other greenhouse gases). Levying a tax rate corresponding to the marginal external costs of a flight, so as to fully internalise these, is supposed to increase a flight's price which in turn should reduce demand.

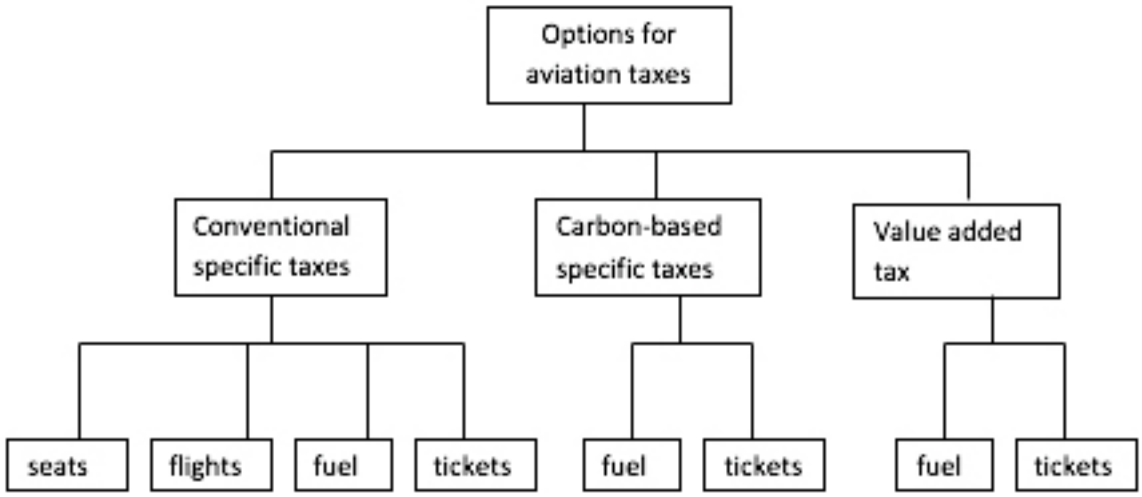
However, attempts to introduce aviation taxes can be expected to encounter a collective action problem. The assignment of aviation taxes to the level of nation states will lead to under-taxation for two reasons (Jones, Keen and Strand 2012). First, due to the existence of cross-border externalities (as the bulk of emissions of aviation is caused by international activities, i.e. international flights) tax rates will be set inefficiently low if they are determined unilaterally without international coordination. Moreover, unilateral action would reduce pressure on other countries to implement own policy measures as they can act as free-riders (Auerswald, Konrad and Thum 2011). Thus countries are stuck in a prisoner's dilemma.[10] Every country would be better off with aviation taxes, in the sense that these would lead to a socially optimal level of air traffic. However, there are incentives for an individual country to defect and to lower or to not introduce aviation taxes in the first place to thus increase its market share in overall air services. Secondly, the mobility of tax subjects (passengers) and tax bases (fuel), respectively, bears the danger of harmful downward tax competition with the consequence of lowering the tax rate (further) below the optimal level. Moreover, tax avoidance measures taken by tax subjects (e.g. travelling to airports in non-taxing neighbour countries or refuelling abroad) may reduce the positive environmental impact of aviation taxes (Leicester and O'Dea 2008). These considerations

[10] In the tax competition literature the prisoner's dilemma framework up to now has been applied to the case of internationally mobile capital only; for a (critical) review of this literature see Dietsch (2015).

speak in favour of introducing aviation taxes within an internationally coordinated move. Of the two options available[11] – international harmonisation of aviation taxes (e.g. within the EU) and revenues going into national budgets, or assignment of aviation taxes to the supranational level (i.e. to the EU) which then keeps the revenues collected to finance its own expenditures – the latter one seems more appropriate, as due to the cross-border nature of the negative externalities caused by air traffic the revenues from their taxation are hardly attributable to a specific country.

There are various possible designs for aviation taxes which differ in their environmental effectiveness (see graph 1).[12] In a narrow definition, aviation taxes are specific (ad quantum) taxes levying a fixed absolute amount on certain tax subjects/tax bases associated with aviation. Graph 1 distinguishes between conventional specific taxes that do not systematically consider the emissions caused by air traffic, and carbon-based specific taxes that take into account the emission-intensity of flying.

Graph 1: Options for Aviation Taxes



Source: own.

Conventionally designed specific taxes may be levied on seats, on flights, on aviation fuel, or on flight tickets. While the latter ones are to be paid by passengers according to the intention of the taxing government, airlines are the designated taxpayers for taxes on seats, flights, and kerosene. It is plausible to assume that – depending on market conditions – these taxes may be at least partially passed on to passengers, so that their "real" incidence will fall both on carriers and passengers.

[11] See Hoel (1992) for a more detailed discussion.
[12] See Keen and Strand (2006), Leicester and O'Dea (2008), European Commission (2005b).

The most common version in tax practice (see table 3) is a *flight ticket tax* (also called air passenger tax) on departures from and/or arrivals at an airport. Many countries levying such flight ticket taxes apply graduated tax rates increasing with distance flown; either with two (short- and long-haul flights) or three (short-, medium- and long-haul flights) tariff zones. A *seat tax* must be paid by the carrier for every seat regardless whether it is occupied or not. Also a *flight tax* is levied on carriers and is due per flight. A *fuel tax* in a conventional design is levied as an absolute amount per litre of aviation fuel not systematically taking into account emission intensity; as a rule existing fuel taxes capture a fraction of the external costs of greenhouse gas emissions only.[13]
Aviation fuel and flight tickets appear as most relevant tax bases for carbon-based specific taxes. A carbon-based design would require that a price would be assigned to the emissions associated with a flight or the use of fuel for a flight to be charged on flight tickets or aviation fuel.

In a broader sense, also VAT on flight tickets and fuel may be regarded as aviation taxes. Although VAT is of course no genuine environmental tax it could influence demand for flight tickets or fuel depending on the price increase it induces (Keen, Parry and Strand 2012). VAT differs from the aforementioned options insofar as it is an ad valorem tax levied as a percentage of fuel or flight ticket prices, not as a fixed absolute amount. Therefore VAT is not affected by the problem of being devalued automatically by inflation, which is inherent to specific taxes in general. While carriers have to pay VAT on behalf of passengers, these are the designated taxpayers; the share of the VAT burden that can be passed on to passengers by airlines depends on market conditions.

To be environmentally effective, taxes on air traffic should provide incentives to reduce fuel use and thus emissions by using more efficient aircraft; to change the fuel mix towards less emission-intensive sources; to maximise aircraft load and thus to minimise fuel use and emissions per passenger as well as to reduce the number of flights; to avoid very short and very long distances as these are particularly fuel and emission intensive (Tol 2007, Keen, Parry and Strand 2012); and to reduce the number of flights demanded by individuals. Environmental effectiveness also depends on the susceptibility of the tax to tax competition and the possibilities of passengers and carriers to avoid it by flying from or by tanking in, respectively, third low- or no-tax countries. The various options for aviation taxes differ in their ability to set these incentives (see table 2).

[13] Normally the rate for fuel taxes does not explicitly refer to emissions, e.g. the carbon content of fuels; exceptions are the carbon tax on kerosene used for national flights levied in Iceland until its abolishment in 2012 due to Iceland's participation in EU ETS (OECD 2014) or the carbon tax introduced in Norway in January 1999 for all flights and abolished in May 1999 for international flights due to non-compatibility with the bilateral Aviation Service Agreements with other countries (OECD 2005).

Generally, the intensity of behavioural incentives of various aviation taxes for airlines and passengers, respectively, depends on their incidence. Here it is important to distinguish between statutory incidence, which refers to the taxable person or entity which is legally obliged to pay the tax, and real or economic incidence, which refers to the person or entity which finally bears the burden of the tax (Fullerton and Metcalf 2002).

Table 2: Environmental Effectiveness of Various Options for Aviation Taxes

Tax instrument	Tax base	Taxable person/ entity	Real incidence	Incentive to reduce fuel use	Incentive to maximise load of aircraft	Incentive to reduce number of flights[1]	Incentive to avoid very short and very long distances	Incentive to change fuel mix	Susceptible to tax competition	Environmental effectiveness
Flight ticket tax	per flight ticket	passenger	passenger	no	no	yes	yes/no	no	yes	weak
Seat tax	per seat	airline	airline/ passenger	no	yes	no	no	no	no	weak
Flight tax	per aircraft	airline	airline/ passenger	no	no	yes	no	no	no	weak
Fuel tax	per litre of fuel	airline	airline/ passenger	yes	yes	yes	no	no	yes	high
Carbon-based flight ticket tax	per carbon emissions per flight ticket	passenger	passenger	no	no	yes	yes	no	yes	medium
Carbon-based fuel tax	per carbon emissions per litre of fuel	airline	airline/ passenger	yes	yes	yes	yes	yes	yes	high
VAT on flight tickets	per flight ticket	airline	airline/ passenger	no	no	yes	no	no	yes	medium
VAT on fuel	per litre of fuel	airline	airline/ passenger	yes	yes	yes	yes	no	yes	medium

Source: own. – [1]) Number of flights demanded by passengers or number of flights supplied by carriers.

Real incidence differs the more from legal incidence, the higher the share in the tax burden that can be passed on by the taxable person or entity to third parties.

For the considerations presented here we assume that for the majority of the aviation taxes regarded here, economic incidence only partially overlaps with statutory incidence (see table 2). Accordingly, only taxes on flight tickets will exclusively burden passengers as the taxable persons have no possibility to pass through the tax burden to others. For taxes on aviation fuel, seats and flights, however, it is plausible to assume that they can at least be partially passed on by airlines, as the taxable entity, to air passengers, so that they will induce behavioural reactions both of airlines and passengers.

A conventionally designed flight ticket tax, which is to be charged to passengers via flight ticket prices, is either levied as a uniform amount regardless of the distance of a flight, or it differentiates very roughly only between different (in practice to a maximum of three) distance groups insofar as the tax rate increases with the distance flown. As such it does not systematically account for the carbon content of individual flights; in addition, rates usually cover only a part of external costs caused by overall emissions. Therefore a conventional flight ticket tax bears only negligible incentives to avoid flying at all. Tol (2007) demonstrates that a bad conventional flight ticket tax design can actually have the perverse effect of increasing total carbon emissions due to wrong incentives. A conventional ticket tax will not induce airlines to reduce fuel use (European Commission 2005b), to change the fuel mix or to maximise aircraft load. The environmental effectiveness of a conventional flight ticket tax is very limited due to its aforementioned conceptual characteristics. Environmental effectiveness is improved somewhat by charging economy flights lower than premium flights (business and first class), which are more carbon intensive as seats take up considerably more floor space compared to the economy class (Bofinger and Strand, 2013). Furthermore, a flight ticket tax is susceptible to tax competition, as passengers can avoid it by changing the origin of travel (European Commission 2005b), which is corroborated by the experience of several countries with conventional flight ticket taxes (see section 3.3).

A seat tax, which is levied on carriers, should induce these to maximise aircraft load as the tax is also due on empty seats (OECD 2005), which may result in a reduction of emissions. Apart from this a seat tax is not associated with any environmentally relevant effects. The same is true for a tax levied on flights, the only (in practice weak and rather blunt) incentive of which may be to make carriers reduce the number of flights supplied. A differentiation of rates according to flight distance may bring – albeit very limited – incentives to improve logistics or to reduce flight supply with regard to long distance flights in particular. Altogether tax instruments such as a seat tax or a simple flight tax should be applied with caution as their true effects on emissions cannot be predicted easily.

Among the conventionally designed specific aviation taxes, a tax on aviation fuel presents itself as the environmentally most effective one (European Commission 2005b). It will incentivise airlines to reduce fuel use by installing cleaner technology or optimise flight routes, to maximise aircraft load to minimise costs per passenger, and to decrease the supply of flights, as well as the demand of passengers for aviation under the plausible assumption fuel taxes are partially passed on to passengers via ticket prices (Keen, Parry and Strand 2012). In contrast to taxes on flight tickets and seats, a fuel tax in addition to passenger flights may also impact freight flights (OECD 2005). However, the tax does not encourage airlines to change the fuel mix, or to avoid very short or very long distances. Moreover, it may induce a considerable extent of tax competition, even if, as Keen, Parry and Strand (2012) point out, susceptibility to tax competition may well differ across countries and destinations, respectively; while air ticket and seat taxes do not contain any incentives to tank abroad (OECD 2005). Of course, the extent of tax avoidance through fuel bunkering will crucially depend on the level of tax rates as well as geographical factors (Keen and Strand 2006).

Carbon-based aviation taxes distinguish themselves from conventional ones by their theoretical ability to attach a price to carbon emissions of flights. Thus they are far more effective with regard to environmental aims in general and the objective to reduce carbon emissions in particular than conventionally designed aviation taxes. A carbon-based fuel tax may exert an influence on the fuel mix towards the use of less carbon-intensive fuels; in contrast to conventionally designed kerosene taxes, which impact the amount of fuel used regardless of its composition. Furthermore, it provides an incentive for airlines to reduce emissions for a given amount of fuel used by choosing engines accordingly (Keen and Strand 2006). A carbon-based fuel tax will also reduce the demand for and supply of flights, particularly for very short- and very long-haul flights, and can also be expected to contribute to maximising aircraft load. A carbon-based flight ticket tax contains less environmentally relevant incentives compared to a carbon-based fuel tax, as it does not offer any incentives for carriers to maximise aircraft load and to reduce fuel use. Both carbon-based fuel and flight ticket tax can be expected to cause considerable avoidance reactions by carriers and passengers, respectively, when implemented unilaterally. It needs to be stressed, however, that the ability of a fuel tax to influence demand for air services crucially depends on its effective incidence. If airlines are not able to pass on the fuel tax to passengers, there won't be any impact on flight demand. If airlines pass on the fuel tax to the less price-sensitive premium (i.e. first and business) class flights[14] primarily there won't be much of a demand reaction, while there will be a lack of incentives in the more price-elastic low-cost carrier segment.

3.2 Current situation of aviation taxation in the EU

Based on its nature as well as on its historical development, the aviation sector in the EU is "structurally" undertaxed, as is global aviation in general.[15] In principle, airline charges are

[14] See for a survey of demand elasticities differentiated according to flight classes Gillen, Morrison and Stewart (2003).
[15] See Meijers (2005) for a detailed presentation and discussion of the existing tax exemptions for aviation and their origins.

regulated by the International Civil Aviation Organization (ICAO); as a general rule, charges that cannot be justified by infrastructure costs of the airports are not accepted. This under-taxation of global (as well as EU) air traffic has several components.

First, according to the 6th EU VAT Directive a zero VAT rate has to be applied to international flights; this applies to airlines' inputs (acquisition of aircrafts, fuel) as well as to their outputs (air tickets sold) (Korteland and Faber 2013). In contrast to just exempting international flights from VAT, zero rating implies that airlines can deduct VAT paid for inputs, which could not be reclaimed under a tax exemption regime. VAT may be applied to fuel used for domestic air traffic as well as air tickets, whereby Member States can choose whether to apply the regular or a reduced VAT rate. The overwhelming majority of Member States levy VAT on aviation fuel and air tickets sold for domestic flights, often at reduced rates.

As a second tax privilege the fuel used for international flights is exempted from the mineral oil tax worldwide (Keen, Parry and Strand 2012). This tax exemption dates back to the Chicago Convention on International Civil Aviation concluded in 1944, which aimed at promoting the then emerging civil aviation and which covers about 190 countries under the umbrella of the International Civil Aviation Organization (ICAO).[16] According to Article 24 the fuel carried by an aircraft upon flyover or arrival was tax exempted right from the start, while the tax exemption of refuelling in a given country is based on a recommendation by the ICAO implemented by bilateral treaties (so-called Air Service Agreements) between countries. In the EU, the EU Energy Tax Directive adopted in 2003 obliges Member States to exempt kerosene used for international flights from energy taxation. In accordance with the Chicago Convention, a kerosene tax may be levied on international flights based on bilateral treaties; which, however, is not made use of by any EU country. At the same time the Directive revoked the former ban of mineral oil taxes levied on domestic flights (Article 14(2)); however, only very few Member States levy a mineral oil tax on fuel used for domestic flights.

The considerable under-taxation of the aviation sector in the EU is not adequately compensated by other price-based mechanisms aiming at the internalisation of the external costs of air traffic. The EU Emission Trading System (ETS), which has come into operation in 2005, did not include air traffic in the first years of its existence. Since 2012 air traffic (more precisely: intra-EU flights) is included and airlines are obliged to acquire emission certificates. However, the ETS is still a blunt sword (not only) with regard to emissions from air traffic. Already in 2012 the ETS was suspended for one year for extra-

[16] For details see Keen, Parry and Strand (2013).

EU flights departing from or landing on an EU-based airport to not endanger the efforts started then by the ICAO to establish a world-wide (and not just EU-wide) emission trading system to be developed by 2016 and to be applied by 2020. For the period 2013 to 2016 only emissions from flights within the EEA are covered by the EU ETS, and exemptions for carriers with low emissions have been introduced. Moreover, the price tag attached to kerosene by the EU ETS is rather low, as 85% of carbon certificates were allocated for free in 2012; between 2013 and 2020, 82% of certificates will be given to airlines for free ("Grandfathering").

The under-taxation of the aviation sector first of all is problematic per se, as it implies that policy makers forego the potential benefits of Pigovian taxes as powerful market-based instruments aiming at increasing prices of air services so as to reflect true social costs and thus to reduce excessive demand (Keen, Parry and Strand 2012). Excessive demand also results from tax privileges, concretely from reduced or even zero VAT rates on fuel and air tickets. Pigovian taxes as well as the removal of tax exemptions for purchases of inputs causing negative externalities are also important with regard to the supply side as they create incentives to supply a given good or service at lower social costs. In particular, the non-taxation of fuel used for international air traffic can be seen as one important barrier to develop low-carbon and more efficient air vehicles (McManners 2016). Altogether, aviation taxes could be one instrument to reach the EU's numerous binding environmental targets with regard to transport emissions.[17]

Moreover, the existing under-taxation creates relative price distortions vis-à-vis other transport modes which (particularly rail transport) are associated with considerably lower environmental damage, e.g. CO2 or other greenhouse gas emissions, but are neither exempted from energy taxation nor from VAT (Keen, Parry and Strand 2012).

Not least, the potential revenues foregone are considerable, as various estimations demonstrate. In an older analysis the European Environment Agency estimates the tax revenue losses for the EU25 for the year 2005 due to the exemption of international flights from VAT at € 18 billion and from fuel tax at € 8 billion to € 16 billion, which would amount to a total of € 26 billion to € 34 billion (European Environment Agency 2007). According to Korteland and Faber (2013), subjecting international flights in the EU to VAT and fuel tax would yield tax revenues in a range from € 27.1 billion to € 39.1 billion (€ 7.1 billion from VAT and € 20 billion to € 32 billion from fuel taxes).

[17] For the EU's environmental targets and the regulations and commitments they are based upon, see European Environment Agency (2016).

3.3 Flight ticket taxes in Europe

Table 3 gives an overview over the current situation concerning flight ticket taxes in Europe. It only considers taxes levied on flight tickets upon the departure of air passengers towards an international destination[18]. The flight ticket taxes considered here are applied nation-wide at every airport of the countries regarded.[19] As table 3 shows, several European countries have undertaken to adopt some kind of ticket tax on international flights during the last few decades. Measured against GDP, their revenues have been or are modest; ranging from only 0.003% of GDP in The Netherlands to 0.17% of GDP in the United Kingdom.

Norway was a frontrunner when it introduced its tax on charter traffic as early as in 1978 as one element of its pioneering efforts to “green” its tax system. In subsequent years the Norwegian charter traffic tax was modified several times: into a passenger tax in 1994, into a seat tax in 1998 and back into a passenger tax again in 1999, before it was finally abolished in 2002 together with a broader reform including the formerly VAT-exempt sales of flight tickets into VAT.[20]

[18] This excludes, e.g., the Catalan NOx tax which is levied on all flights departing from or landing at Barcelona airport.
[19] This excludes, e.g., Italy and Spain which both levy some charge on international flights which is, however, differentiated across airports.
[20] For details see OECD (2005).

Table 3: Ticket Taxes in Selected European Countries

Country	**Denomination**	**Rates for short; medium; long haul; economy/business[1)]**	**Tax revenues in Mio. € (in % of GDP)[1)]**	**Introduced in**	**Modifications**
Abolished ticket taxes					
Norway	Passenger Tax	128 NOK (15.90 €)[4)]	173 (0.09)	1978	Introduced as charter traffic tax in 1978, modified to passenger tax in 1994 and decreased, modified to seat tax in 1998 and decreased, modified to passenger tax in 2001 Abolished in 2002
Malta	Departure Tax	12[3)]	6 (0.09)	2001	Abolished in 2008
Denmark	Passagerafgift (Air Passenger Duty)	75/300 DKK (10.07/40.26 €)	45 (0.02)	2005	Halved in 2006 Abolished in 2007
The Netherlands	Vliegbelasting (Air Passenger Duty)	11.25/11.25; 11.25/11.25; 45/45	19 (0.003)	2008	Abolished in 2009
Ireland	Air Travel Tax	3/3; 3/3; 3/3	34 (0.02)	2009	Reduced in 2011 Abolished in 2014
Existing ticket taxes					
United Kingdom	Air Passenger Duty	13/26/78; 73/146/438 (17.91/35.81/107.44; 100.55/201.11/603.32 €)[2)]	4,344 (0.17)[7)]	1994	Increased in 1997, 2007, 2009, 2010, 2012, 2013, 2014; decreased in 2015, increased in 2016
France	Taxe de l'aviation civile (Civil Aviation Tax) Taxe de solidarité sur les billets d'avion (Solidarity Levy)	4.36/7.85[2)] 1.13/11.27; 4.51/45.07; 4.51/45.07	76 (0.004)[7)] 204 (0.01)[7)]	1999 2006	Indexation to CPI since 2011 Increased in 2014 Introduction of a rebate of 50% for transit passengers in 2015 Introduction of a rebate of 100% for transit passengers in 2016[6)]
Austria	Departure Tax (Flugticketabgabe)	7/7 ; 15/15; 35/35	109 (0.03)[8)]	2011	Reduced in 2013
Germany	Departure Tax (Luftverkehrsteuer)	7.50/7.50; 22.43/22.43; 42.18/42.18	988 (0.03)[7)]	2011	Reduced in 2012
Bosnia & Herzegovina	Departure Tax	10.81	n.a.	n.a.	n.a.
Croatia	Civil Aviation Tax	0.68/1.37[5)]	n.a.	n.a.	n.a.

Sources: Deutsche Bundesregierung (2012); Schönpflug, Paterson and Sellner (2014); OECD; own research and compilation. [1]) For abolished taxes: last year of existence. – [2]) Short haul; long haul. UK: Reduced rate for travel in lowest class of travel available/standard rate for travel in any other class of travel/higher rate for travel in aircraft of 20 tonnes or more equipped to carry fewer than 19 passengers. – [3]) Uniform rate regardless of distance. – [4]) Uniform rate for domestic and international flights. – [5]) Domestic flights/international flights. – [6]) This rebate is expected to halve revenues in the future. – 7) 2014. – 8) 2015.

Also the United Kingdom is an early adopter, levying its Air Passenger since 1994; while, as Leicester and O'Dea (2008) point out, not referring to an environmental motive when introducing the tax, but putting forward an environmental justification only with its latest modifications.[21]

Several EU countries – France, Malta, Denmark, The Netherlands, and Ireland – followed between 1999 and 2009. All of them more or less explicitly motivated the ticket tax on environmental grounds. In addition, France has been levying a *Taxe de solidarité sur les billets d'avion* since 2006 within the coordinated efforts of UNITAID mentioned above (see chapter 1) as a surcharge on the already existing *Taxe de l'Aviation Civile* it had introduced in 1999.

Germany and Austria introduced their flight ticket taxes only recently, based however – although also environmental aspects were mentioned in the accompanying documents to the respective tax bills –on a different primary motive: namely as part of the austerity measures in the aftermath of the recent financial and economic crisis.

Table 3 also contains Bosnia & Herzegovina and Croatia, which levy departure taxes on international flights of rather minor size.

The group of European countries which eventually abolished their flight ticket tax is almost as large as the group of countries still having it. While the Norwegian tax survived for almost a quarter of a century, the Maltesian one was eliminated after 7 years only. Denmark and The Netherlands abolished their air ticket taxes almost immediately after introduction, mainly as a consequence of a considerable share of passengers moving to neighbouring airports in Sweden, Belgium and Germany to avoid the tax.[22] Most recently Ireland abolished the Air Travel Tax which had been implemented in 2009 only, after having reduced it already in 2011.

In Austria and Germany, which both adopted flight ticket taxes in 2011 as budget consolidation measure, these are constantly disputed.[23] Both countries reduced the rates shortly after introduction of the taxes to soften the (alleged) negative effects on the competitiveness of the airline and the tourism sector.

In Sweden (2006) and Belgium (2008) governments started initiatives to introduce air ticket taxes, but gave up their plans following fierce resistance by the airline and the tourism industry as well as other stakeholders, e.g. trade unions, all fearing loss of

[21] For details and the historical development see Leicester and O'Dea (2008).
[22] See Gordijn and Kolkman (2011) for The Netherlands.
[23] For Germany see Peter et al. (2012). The German *Luftverkehrsteuer* was even taken to the Constitutional Court which, however, ruled that it is constitutional. For the Austrian discussion see Schönpflug, Paterson and Sellner (2014).

competitiveness and jobs. In Iceland government plans announced in 2011 for a rather moderate tax on air passengers at differentiated rates depending on flight distance were rejected (IMF 2011, OECD 2014). In 2014, the Portuguese government unsuccessfully proposed a moderate air passenger tax of 3 € per air ticket as one element of rather sizeable "green tax reforms".

Only two EU countries are holding on to their flight ticket taxes and have even increased the rates over the years. The United Kingdom does not have to fear any significant competition, neither from airports from surrounding countries nor from other modes of transportation. In France there is no public debate about the *Taxe de solidarité sur les billets d'avion* due to its low rates (at least in the economy class) and its purpose to finance development aid; but also the *Taxe de l'aviation civile* introduced earlier is hardly disputed, probably also because rates and revenues are rather low.

The few empirical analyses of the experiences of European countries with flight ticket taxes are mostly based on descriptive statistics. They suggest a very moderate influence on the number of passengers and on the development of air traffic – and thus only very moderate environmental effectiveness of these taxes. Actually, existing European flight ticket taxes have not resulted in an absolute reduction of air traffic, but have only been able to dampen its dynamics. The most salient effect of flight ticket taxes – in particular for smaller countries surrounded by non-taxing countries offering substitute airports – appears to be a certain extent of rerouting of passenger flows.[24]

European countries' experiences with the introduction of aviation taxes – and particularly those cases where governments unsuccessfully attempted to implement some kind of aviation tax or had to reduce or even abolish them shortly after their introduction – can be taken as anecdotal evidence for a specific type of international tax competition preventing the emergence of significant (in the sense of environmentally effective) taxes in this field. Despite their low level and thus very limited actual effects real life flight ticket taxes generally meet with fierce resistance by various stakeholders, which results in considerable pressure on governments to abolish or reduce existing flight ticket taxes or not to introduce them in the first place. McManners (2016) based on stakeholder interviews comes to the conclusion that no relevant stakeholder group has any interest in any changes in the current situation of under-taxation: neither passengers, because they are content with the existing and ever-expanding supply in air services; nor the aviation industry, because it has no financial incentives for efficiency-saving measures or an expensive switch to low-carbon technologies; and also not politicians, because neither political gains are to be expected by

[24] See, e.g., Gordijn and Kolkman (2011) for The Netherlands and Denmark; Peter et al. (2012) for Germany; and Schönpflug, Paterson and Seller (2014) for Austria.

entering into negotiations on international agreements granting the current tax-free status quo, nor is there any pressure to do so.

Altogether, the (rather limited) experiences of European countries with the flight ticket tax appear to corroborate the theoretical prediction that due to tax competition aviation taxes cannot be implemented effectively on the national level – salient examples are the Dutch and the Danish attempts to introduce flight ticket taxes, which were terminated rather quickly. However, one interesting observation shall be pointed out here: While there is abundant theoretical and empirical work on the mechanisms and the potential outcome of international competition in the realm of direct taxation, and in particular with regard to the taxation of corporations, analyses on international environmental tax competition in general and on competition based on aviation taxes in particular are practically non-existent. This might have to do with the fact that due to intense international competition and because "[A]viation is a prime example of a direct clash between environmental and economic policy…" (McManners 2016: 87), aviation taxes could never gain ground in the first place so that there is little scope for downward competition. So rather than the race-to-the-bottom-like type of tax competition observed in the EU with regard to mobile firms, investment, and particularly corporate profits – which implies the existence of taxes in the first place as well as a significant initial level of taxation – the current status quo regarding flight ticket taxes may be better characterised as "stuck at the bottom" (Weibust 2009: 30).

4. Revenue potential of a carbon-based flight ticket tax

This chapter is dedicated to the estimation of the revenue potential of a carbon-based flight ticket tax implemented at the EU level to finance part of the EU budget.

4.1 Conceptual considerations – tax rate and design of a carbon-based flight ticket tax

The first problem to be solved when introducing a Pigovian tax is to identify the marginal social external costs connected with the taxed activity, as these need to be known as a prerequisite to be able to fix a tax rate which can bring about the social optimum (Pigou 1954, Baumol 1972). In an optimal world without regulatory frictions or deadweight losses, a carbon tax would have to be determined so as to equal the social cost of carbon; whereas in the real world the carbon tax should be lower compared to the social cost of carbon (Nordhaus 2011): not only due to the additional costs the tax imposes on taxpayers beyond the tax payment, but also (at least in the beginning) to allow firms and households to adjust to increasing prices of fossil fuels.

Since the beginning of the 1990ies, following the seminal contribution by Nordhaus (1982), a large body of empirical estimations of the social cost of carbon has emerged. Several recent meta-analyses show (e.g. Tol 2013, Havranek et al. 2015) that the estimates derived lie within a large range, depending inter alia on the total welfare impact of climate change and the rate of pure time preference.[25] To deal in detail with the problem of fixing the "correct" tax rate to internalise the social cost of emitting one tonne carbon is beyond the scope of this paper. We therefore take recent studies on the social cost of carbon as an orientation for the tax rate we apply in our estimations.

In a study on the potential of a tax on flight tickets to finance development aid, the European Commission (2005a) indicates a price of 20 € to 30 € per tonne carbon emissions. Keen, Parry and Strand (2012) apply prices of US-$ 15, US-$ 25, and US-$ 40 per tonne carbon emissions. Tol (2013) in his meta-analysis of 75 studies on the social cost of carbon, covering 588 estimates, obtains a mean value for the social cost of carbon between US-$ 25 for a discount rate of 3% and US-$ 105 for a discount rate of 1% (expressed in 2010 dollars). Based on the most-cited and -applied economic models to estimate the social cost of carbon, the US-American Interagency Working Group established by US-President Barack Obama arrives at a social cost of carbon estimate of

[25] In his meta-analysis, Tol (2013) presents the determinants of the social cost of carbon in detail.

US-$ 36 for 2015.[26] Most recently, Farid et al. (2016) briefly summarise the various existing estimates regarding the social cost of emitting one tonne of carbon emissions, which under different damage scenarios ranges from US-$ 20 to US-$ 170. Nevertheless, there is a rule of thumb at least for the US that in order to reach specific carbon emission reduction targets the price per tonne should be roughly equal to US-$ 30 (Krupnick et al. 2010).

Considering these studies we can conclude that a price accepted by a majority of researchers concerned with the topic will be within the range of 25 € to 35 € (in € 2014 prices). Accordingly, our proposal for a carbon-based flight ticket tax is based on rather moderate carbon prices remaining within the range of the above-mentioned estimates. We apply three alternative carbon prices: 25 € (low-tax scenario), 30 € (medium-tax scenario) and 35 € (high-tax scenario) per tonne of carbon emissions. Rather than a uniform lump-sum tax independent of carbon emissions connected with the respective flight, an individual tax amount is charged on each flight ticket, reflecting the flight's specific carbon intensity. It may be plausibly assumed that the carbon prices we use for our estimations are under-estimated, as they are based on rather high discount rates and do not adequately reflect risk aversion to extreme climate change.[27] Moreover, the social cost incurred by other emissions caused by air transport, which also reach considerable levels[28], are neglected in our proposal. We therefore expect that the tax rates applied here are too low to bring about a social optimum.

It should be noted here that – in contrast to a conventional flight ticket tax – a carbon-based flight ticket tax in the suggested design in principle is not less accurate a tax instrument than a tax on aviation fuel to internalise the social cost of carbon. The tax charged for a specific flight would account for the individual aircraft's fuel efficiency and its average load factor. As pointed out in section 3.1, even a carbon-based flight ticket tax, in contrast to a tax on aviation fuel, is characterised by medium environmental effectiveness only, as it would not exert any incentives to reduce fuel use, to maximise aircraft load and to change towards a low-carbon fuel mix. However, a tax on kerosene is problematic for two reasons in particular. First, it is highly unlikely that a pure form of kerosene taxation due to severe legal issues (see section 3.2) can be introduced in the near future in the EU. On the other hand, ticket taxes in some European countries have been in place now for many years. Secondly, a tax on kerosene even if implemented for the whole

[26] See https://www3.epa.gov/climatechange/Downloads/EPAactivities/social-cost-carbon.pdf.
[27] See for the calculation of the lower bound for the social cost of carbon, which suggests that currently dominating estimates can be taken as gross under-estimations, van den Bergh and Botzen (2014).
[28] For the carbon footprint of aviation see Southgate (2013); an overview of studies quantifying the external costs of air traffic is provided by Leicester and O'Dea (2008).

EU would face the problem of possible tax avoidance through fuel bunkering and tanking in third no- or low-tax countries. As industry fuel consumption-based estimates could never fully incorporate such possible tax avoidance strategies they cannot serve as a solid empirical basis for policy making.

If taxing the aviation sector is to increase environmental sustainability it is vital that the tax instruments applied are carbon-based. As mentioned above, Tol (2007) demonstrates that with the wrong tax design, aviation taxes could actually have the perverse effect of being responsible for an increase in carbon emissions. This is why we propose a ticket tax individually calculated for every flight ticket according to the expected carbon emissions per person for a given flight and a tax rate able to internalise the associated social cost. There can be no substantial technical obstacles for such a tax, as every offer of a certain route by an airline can easily be connected with the ICAO carbon emissions calculation method, which uses average load factors from previous periods, the type of aircraft etc. As a result, for each individual flight route an individual tax amount can be calculated reflecting its individual carbon intensity.

4.2 Calculation method for potential revenues from a carbon-based flight ticket tax in the EU

The calculation method we apply to obtain potential revenues from a carbon-based flight ticket tax in the EU is straight forward. It is based on the airport-to-airport route data on passenger transports between the main airports of a given country and their main partner airports provided by Eurostat. These data provide us with origin and destination information for roughly 75% to 90% of all passengers carried in a given EU country.[29] 2014 is the most recent year for which these route data are complete and available for each EU Member State in the Eurostat database. In order to capture the whole EU-related air passenger traffic every departure from an airport situated within the borders of the EU, but only arrivals from non-EU countries should be subjected to the tax.

[29] Roughly 75% to 90% of all passengers travel on the most important routes in terms of passenger volumes. Eurostat sets certain thresholds for every individual Member State in order to define whether a route is important or not in terms of passenger volumes. The remaining 10% to 25% of passengers travel on less important routes. According to Eurostat there are definitely no obvious reasons to assume that the average carbon footprint of a passenger travelling on a less important route is significantly different from the one of a passenger travelling on an important route. This is why we assigned to every passenger for whom there is no detailed route data available the respective national average carbon footprint.

In a first step we assign to every route its distinct carbon footprint per passenger, which is calculated with the ICAO methodology.[30] This methodology takes into account aircraft type and load factors in order to obtain the average fuel consumption per passenger. On this basis, the carbon footprint attributable to each economy class passenger for each individual route is calculated.

In a second step the impact of the suggested tax rates (25 €, 30 € or 35 € per tonne carbon emissions) on 2014 flight prices is identified based on two independent sources. The Report of a data mining company (Expedia 2016) analysing 8 billion flight offers from the period October 2014 to October 2015 provides us with an intra-European price average (i.e. an average price for all roundtrips between European destinations), as well as a transatlantic price average and price averages for some representative routes within Europe. In addition, we obtained price data for a small group of selected countries most kindly provided by the national statistical offices of Austria, Slovenia, Cyprus, and Malta for the year 2014.[31] These country-specific price data are comprised of either route-specific prices or national averages. The price data available strongly support our assumption that a carbon-based flight ticket tax between 25 € and 35 € per tonne carbon emissions would increase flight prices for intra-EU flights between 3.5% and 4.9% and for intercontinental trips between 1.7% and 2.4% on average (see table 4).

Table 4: Increase of Flight Prices for Different Carbon-based Flight Ticket Tax Rates

Tax rate per tonne carbon emissions	**25 € (low-tax scenario)**	**30 € (medium-tax scenario)**	**35 € (high-tax scenario)**
Intra-EU	3.46	4.16	4.9
Intercontinental	1.7	2.04	2.38

Source: own

In a third step we apply the pan-national demand elasticities for three different categories of flight routes provided by IATA (2007) to simulate the decrease in demand resulting from a price increase. The elasticity of demand for intra-Europe flights amounts to -0.84, for Europe-North America to -0.72, and for Europe-Asia to -0.54. For our purposes, the

[30] http://www.icao.int/environmental-protection/CarbonOffset/Documents/Methodology%20ICAO%20Carbon%20Calculator_v7-2014.pdf. For a very detailed presentation of the ICAO methodology see ICAO (2011).

[31] We are aware of the fact that average prices for every single route would increase the exactness of our estimations. However, such sensitive information is not easily accessible as is demonstrated by the fact that the policies of most European national statistical offices prohibit the sharing of this kind of information. Trying to obtain representative average prices for many thousand routes from private sources is definitely possible but associated with significant costs.

pan-national price elasticities estimated by IATA (2007) are most adequate, particularly compared to other elasticity estimates on lower levels of aggregation, as surveyed, for example, by Gillen, Morrison and Stewart (2003). One of the most important conclusions from this report in our context is that if air fares are increased roughly to a similar extent for a wide set of flight routes due to the introduction or increase of market-wide taxes, demand tends to be rather price inelastic.

In a last step we simply multiply the reduced (such taking into account the elasticity of demand) number of passengers per route with the distinct carbon footprint per route with the tax rate (i.e. assumed carbon price per tonne carbon emissions) in order to estimate potential total tax revenues per route, as demonstrated for the example of the route Helsinki to Berlin in table 5. In 2014, 206,060 passengers flew from Helsinki to Berlin. According to the ICAO methodology every passenger flying on that route caused average carbon emissions of 97.03 kg. At a tax rate of 30 € per tonne carbon emissions, the average intra-EU route price would have increased by 4.16%. Given the elasticity for intra-Europe flights of -0.84, this price increase would have reduced the number of passengers by 3.49% to 198,859. Accordingly, potential total tax revenues for this route would have amounted to € 578,860. Adding up potential total tax revenues for all intra-Europe routes originating in a particular Member State and for all flights from third countries landing in this Member State yields total potential tax revenues from a carbon-based flight ticket tax for this Member State which are displayed in table 6.

Table 5: Example Calculation for Potential Revenues from a Carbon-Based Flight Ticket Tax for Flight Route Helsinki to Berlin at a Carbon Price (Tax Rate) of 30 € per Tonne Carbon Emissions (2014)

Route	**Number of passen-gers**	**Carbon emissions per passenger one way in kg**	**Expected average price increase for intra-Europe flights in %**	**Intra-Europe price elas-ticity**	**Reduced number of passen-gers**	**Reduction of number of passen-gers in %**	**Total tax revenues per route in €**
Helsinki - Berlin	206,060	97.03	4.16	-0.84	198,859	3.49	578,860

Source: own

4.3 Estimated revenues from a carbon-based flight ticket tax in the EU

Table 6 contains the estimated revenues from a carbon-based flight ticket tax in the EU Member States for a tax rate of 25 €, 30 €, and 35 € per tonne carbon emissions. Altogether, potential revenues range from € 3.884 billion (low-tax scenario) to € 5.392 billion (high-tax scenario) for the total EU (0.03% to 0.04% of overall EU GDP). The United Kingdom would collect the highest revenues in absolute terms – between € 899 million and € 1,250 million; followed by Germany, France, Spain, and Italy. The island states Malta and Cyprus would realise extraordinarily high revenues of 0.1 percent of GDP, followed by the tourist destinations Greece, Spain and Portugal with revenues between 0.06% and 0.07% of GDP. Revenues in most of the other EU Member States lie between 0.02% and 0.04% of GDP. Luxembourg (as very small country), Slovenia and Slovakia even in the high-tax scenario would obtain revenues of 0.01% of GDP only.

In total terms our estimate comes close to that of the European Commission (2005b), who arrives at potential tax revenues of € 6 billion p.a. for an EU-wide departure tax (10 € on intra-community flights, 30 € on international flights). It should be noted, however, that revenues originating from taxing the arrivals from non-EU countries make up 32% of our total estimated revenues.

In a recent study Chancel and Piketty (2015) estimate world-wide revenues of € 150 billion for a flight ticket tax levied at 20 € in the economy class and 180 € in the business class. Keen, Parry and Strand (2013) estimate world-wide revenues from a flight ticket tax based on a tax rate of US-$ 25 per tonne carbon emissions at US-$ 12 billion. Here it needs to be pointed out that our estimate represents a lower bound because the carbon footprints we use are representative for economy class flights only. Therefore our estimations do not account for the higher carbon emission intensity of premium classes. Considering that about 15% of all air traffic originating in Europe and about 10% of all flights originating in North and Latin America and in Asia and Pacific are premium flights (Keen, Parry and Strand 2013), a carbon-based flight ticket differentiating for flight classes would yield somewhat higher revenues and would improve the tax' environmental effectiveness.

Table 6: Estimated Revenues from a Carbon-based Flight Ticket Tax in the EU28 (2014)

EU Member State	25 €[1] (low-tax scenario)		30 €[1] (medium-tax scenario)		35 €[1] (high-tax scenario)	
	In mio. €	In % of GDP	In mio. €	In % of GDP	In mio. €	In % of GDP
Belgium	78	0.02	92	0.02	107	0.03
Denmark	69	0.03	82	0.03	96	0.04
Germany	659	0.02	788	0.03	916	0.03
Ireland	58	0.03	70	0.04	81	0.04
Greece	82	0.05	98	0.05	114	0.06
Spain	454	0.04	542	0.05	630	0.06
France	556	0.03	664	0.03	772	0.04
Italy	285	0.02	340	0.02	395	0.02
Luxembourg	4	0.01	4	0.01	5	0.01
Netherlands	277	0.04	331	0.05	385	0.06
Austria	60	0.02	72	0.02	84	0.03
Portugal	90	0.05	108	0.06	125	0.07
Finland	55	0.03	65	0.03	76	0.04
Sweden	70	0.02	84	0.02	97	0.02
United Kingdom	894	0.04	1,068	0.05	1,242	0.06
Bulgaria	16	0.04	19	0.04	22	0.05
Czech Republic[2]	26	0.02	32	0.02	37	0.02
Estonia	3	0.02	4	0.02	5	0.03
Cyprus	21	0.1	25	0.1	29	0.2
Latvia	8	0.03	10	0.04	11	0.05
Lithuania	7	0.02	8	0.02	9	0.03
Hungary	16	0.02	19	0.02	22	0.02
Malta	8	0.1	10	0.1	11	0.1
Poland	54	0.01	64	0.02	75	0.02
Romania	19	0.01	22	0.01	26	0.02
Slovenia	2	0.01	3	0.01	3	0.01
Slovakia	4	0.01	5	0.01	6	0.01
Croatia	10	0.02	11	0.03	13	0.03
Total EU28	**3,884**	**0.03**	**4,642**	**0.03**	**5,392**	**0.04**

Source: own calculations. – 1) Tax rate per tonne carbon emissions. – 2) As the Czech Republic specifies the country of destination only, but not the specific destination airport, we assume as destination airports the capitals of the respective countries of destination

Also a comparison of potential and actual revenues for those countries currently levying some kind of flight ticket or passenger tax is interesting. Current revenues from the United Kingdom's Air Passenger Duty are several times higher compared to the revenue potential of the proposed carbon-based flight ticket tax, and also Austria's and Germany's current flight ticket taxes yield more than potential revenues in our high-tax scenario. France's air passenger tax, in contrast, tax renders only a small fraction of potential revenues; and also the Irish, the Maltese, the Danish and the Dutch flight ticket tax are (partially considerably) less abundant compared to potential revenues according to our estimations.

Table 7: Number of Passengers with and without Carbon-based Flight Ticket Tax of 35 € per Tonne Carbon Emissions in the EU28 (2013/2014)

EU Member State	**Number of departing passengers 2013**	**Number of departing passengers 2014**		**Growth rate 2013/2014 in %**	
		Without tax	**High-tax scenario**	**Without tax**	**High-tax scenario**
Belgium	13,207,712	14,406,511	13,851,628	9.08	4.88
Denmark	14,524,640	15,307,528	14,707,785	5.39	1.26
Germany	101,444,666	104,307,285	100,409,969	2.82	-1.02
Ireland	12,331,336	13,188,072	12,685,258	6.95	2.87
Greece	19,340,728	22,798,239	21,871,325	17.88	13.08
Spain	93,253,848	97,383,909	93,511,105	4.43	0.28
France	83,036,467	81,835,963	78,908,387	-1.45	-4.97
Italy	71,879,745	75,109,263	72,130,921	4.49	0.35
Luxembourg	1,090,528	1,224,145	1,174,646	12.25	7.71
Netherlands	29,054,785	30,503,583	29,451,919	4.99	1.37
Austria	13,224,990	13,526,480	12,996,969	2.28	-1.72
Portugal	16,203,634	17,586,144	16,903,326	8.53	4.32
Finland	9,518,384	9.853.445	9,478,767	3,52	-0,42
Sweden	19,017,005	19.810.370	19,012,573	4,17	-0,02
United Kingdom	113,762,680	118.708.803	114,443,741	4,35	0,60
Bulgaria	3,647,568	3,868,955	3,709,709	6.07	1.70
Czech Republic	5,948,808	6,050,752	5,807,798	1.71	-2.37
Estonia	993,359	1,020,367	977,869	2.72	-1.56
Cyprus	3,519,545	3,665,889	3,516,313	4.16	-0.09
Latvia	2,393,496	2,398,244	2,299,532	0.20	-3.93
Lithuania	1,746,751	1,900,752	1,822,517	8.82	4.34
Hungary	4,254,777	4,559,437	4,373,375	7.16	2.79
Malta	2,015,771	2,145,833	2,058,645	6.45	2.13
Poland	12,306,566	13,634,359	13,084,551	10.79	6.32
Romania	5,269,157	5,704,162	5,470,682	8.26	3.82
Slovenia	631,360	654,522	627,582	3.67	-0.60
Slovakia	792,778	850,360	815,359	7.26	2.85
Croatia	3,098,272	3,304,186	3,168,963	6.65	2.28
EU28	657,509,356	685,307,558	659,271,214	4.23	0.27

Source: Eurostat; own calculations.

As a first indication for the environmental effectiveness of the suggested carbon-based flight ticket tax, table 7 shows passenger numbers for all 28 EU Member States for 2014 in comparison to a scenario with a carbon-based flight ticket tax of 35 € per tonne carbon emissions (high-tax scenario), based on the demand elasticities applied for our revenue estimations. In the majority of EU Member States, a flight ticket tax at a tax rate of 35 € – due to the rather dynamic increase of the number of passengers in 2014 compared to the preceding year – would have dampened growth of passenger volumes only. In one third of Member States (Germany, Austria, Finland, Sweden, the Czech Republic, Estonia, Cyprus, Latvia, Slovenia), however, the flight ticket tax would have turned low growth rates of passenger numbers into stagnating or even negative ones. In France it would even have exacerbated an already negative growth rate. For the whole EU28, the flight ticket tax would have dampened a growth rate of passenger volumes of more than 4% before taxation to a de facto stagnation after taxation.

Most certainly this snapshot allows limited conclusions about the long-term impact of a flight ticket tax in the suggested design only. However, with all due caution two tentative conclusions impose themselves: First, an overall significant reduction of passenger volumes would require higher tax rates than suggested here. Secondly, this implies that the tax rates applied in our estimations of potential revenues of a carbon-based flight ticket tax would ceteris paribus guarantee stable revenues for the EU budget as they would only dampen the growth of passenger numbers but not reduce them in absolute terms.

5. Conclusions

A carbon-based flight ticket tax may be seen as an effective instrument to internalise external costs of aviation. Compared to existing flight ticket taxes levying mostly rather moderate lump sum tax rates which are differentiating very roughly only for flight distances and thus carbon emission intensity of individual flights, a carbon-based flight ticket tax is more efficient: it is able to directly and rather exactly internalise the actual external costs of flying and thus to exert an effective incentive for passengers to reduce the number of flights and to avoid very short- and long-haul flights as it captures the over-proportional high carbon intensity of very short flights and the proportional high carbon intensity of very long haul flights.

While it may be less environmentally effective than a fuel tax, a carbon-based flight ticket tax has one crucial advantage: it is not outlawed by international agreements such as the Chicago Convention, which refers to the taxation of fuel but not to the taxation of carbon emissions.[32] Moreover, given the grandfathering of the large majority of certificates which implies that 85% of emissions from commercial aviation are not covered by the ETS, there is room for an aviation tax without incurring substantial double taxation also for the medium-term future (Keen, Parry and Strand, 2012).[33]

In the EU the failed attempts of several Member States to introduce a flight ticket tax and the pressure on those Member States still levying one show that such a tax cannot be implemented effectively at the national level: expected or factual avoidance reactions of passengers, who are migrating to non-taxed airports, induce national governments not only – as expected by the "race to the bottom" hypothesis – to introduce the tax at rather low rates only or to abolish it outright; but in many cases rather not to introduce it at all in the first place – i.e. to remain "trapped" in a "stuck to the bottom". Implementing the flight ticket tax at the EU level would avoid these forms of tax competition leading to under-taxation of air traffic. Assigning a flight ticket tax to the EU as own revenue source appears justified also due to the cross-border nature of emissions from international flights. National implementation would result in inefficiently low tax rates. Also non-attributability of externalities and thus of revenues from their taxation justifies implementation as an EU tax and collection of revenues by the EU.

[32] Of course, the bilateral Air Service Agreements could be renegotiated to remove the most important current legal obstacle to introducing a fuel tax on international flights; however, considering the several thousands of existing Air Service Agreements, this would be a rather lengthy and tedious process (Keen and Strand, 2006).
[33] It would go beyond the scope of this paper to discuss the optimal instrument choice with regard to tax- versus quantity-based instruments; for an overview of the relevant aspects see Jones, Keen and Strand (2012).

Certainly world-wide introduction of a flight ticket tax would be preferable not only to avoid competitiveness issues, but also to prevent tax avoidance. Moreover, as with environmental taxes in general (Braathen 2012), carbon leakage will be the smaller the larger the group of adopting countries and thus the smaller the number of "pollution havens" (Thalmann 2012: 459). However, as tax subjects are imperfectly mobile and EU airports and extra-EU airports are imperfect substitutes, neither the relocation of significant numbers of departing passengers to non-EU airports nor the diversion of large numbers of extra-EU passengers landing at EU airports, respectively, appears very likely. Therefore for a flight ticket tax a substantial impact with respect to climate mitigation may be expected also from a coordinated move by a group of countries only (Keen, Parry and Strand 2012): although of course the benefits of non-cooperation may increase for the non-cooperating countries with introduction by a group of countries (e.g. the EU) only (Keen and Strand 2006). In any case, the uneven distribution of emissions across countries, which is one important reason for their differing interest in taking policy action (Jones, Keen and Strand 2012, Thalmann 2012), is less pronounced in the EU compared to the global scale, so that here chances should be higher to reach agreement about coordinated measures.

Replacing a part of the EU's current own resources by the revenues from a flight ticket tax may improve – besides environmental sustainability – also the economic dimension of sustainability: it would allow Member States to decrease their contributions to the EU budget paid out of national budgets, so that they can cut other taxes harming employment and growth, in particular taxes on labour. Thus a double dividend – in the sense of a synergy between environmental and economic sustainability – may be realised.

A flight ticket tax can be assessed favourably also from the perspective of cultural sustainability. As it is levied on a sector which is substantially under-taxed and perceived to not contribute its fair share to overall tax revenues, public acceptance can be expected to be high (European Commission 2010a; Keen, Parry and Strand 2012). Political acceptance should be high – and indeed higher compared to other environmental or carbon taxes in other sectors – also because a flight ticket tax probably has less unfavourable distributional effects. The few existing analyses of the distributional impact of aviation taxes suggest that they are not (particularly) regressive (Leicester and O'Dea 2008) or even progressive (Kosonen 2012). A progressive design of a carbon-based flight ticket tax as proposed by Chancel and Piketty (2015), with tax rates for premium flights considerably higher than for economy flights, could mitigate potential negative distributional implications and enhance environmental effectiveness at the same time: considering the higher carbon footprint of premium flights which probably to an overwhelming share are bought by higher incomes.

In any case, the distributional impact of a flight ticket should be explored in more detail, as it is an important aspect from the perspective of comprehensive sustainability which includes also the social dimension.

As with taxation issues in an EU context in general, several issues and open questions remain. First of all there is the question how to overcome resistance to be expected from EU Member States levying some kind of flight ticket tax already; although the problem appears manageable due to the small number of Member States having flight ticket taxes and the very limited amount of tax revenues they yield. If the required unanimity of Member States to introduce a flight ticket tax as an EU tax cannot be reached, there is still the option to introduce it in a group of at least nine countries based on so-called "enhanced cooperation"; although this of course will considerably decrease the effectiveness of the tax. It is an open question whether countries are really caught within a prisoner's dilemma, or whether some countries rather prefer short-run gains (by attracting additional tax base or tax subjects by offering low or even no tax rates) over long-run benefits from taxation (i.e. a decrease of emissions) and thus are against tax harmonisation or the introduction of EU taxes.

Moreover, there is still the need – from an environmental policy point of view – to decrease excessive demand for air services by removing VAT exemptions in addition to the introduction of a flight ticket tax; also with a view to eliminate distortions vis-à-vis other modes of transport which are subject to VAT. In this context it should be noted that the carbon prices applied in our estimations against the background of actual flight prices are rather moderate only and accordingly will lead to moderate price increases and thus demand reductions. Considering current projections of the long-term future growth trends in air traffic, a carbon-based flight ticket at the levels proposed here will only slightly dampen the projected growth of the number of passengers, but won't reduce the absolute number of passengers. To reduce passenger numbers significantly, the tax rate would have to be considerably higher. In addition, as with all environmental taxes, the potential trade-off between environmental effectiveness of a flight ticket tax (which will reduce the tax base and thus tax revenues) on the one hand and revenue potential on the other hand needs to be highlighted particularly when considering the flight ticket tax as alternative revenue source for the EU budget: as the EU budget requires own resources yielding stable revenues in the long run, due to the ban of EU debt and the increase of tasks and thus expenditures of the EU to be expected in the future.

Finally our estimations demonstrate that expected revenues from a flight ticket tax will be rather limited, so that they won't be able to replace a substantial share of current EU revenues (at least for the rather moderate tax rates applied in our estimations[34]). Nevertheless, a European flight ticket tax may serve as an illustrative example to demonstrate the chances and challenges associated with international taxes in particular regarding their potential contribution to sustainable development.

[34] Even revenues according to our high-tax scenario would cover less than 5% of annual EU expenditures.

References

Atkinson, Anthony B. 2005. *New Sources of Development Finance*. Oxford: Oxford University Press.

Auerswald, Heike, Konrad, Kai and Thum, Marcel. 2011. *Adaptation, Mitigation and Risk-Taking in Climate Policy*. CESifo Working Paper 3320.

Baumol, William J. 1972. On Taxation and the Control of Externalities. *The American Economic Review* 62(3): 307-322.

Bofinger, Heinrich, and Strand, Jon. 2013. *Calculating the Carbon Footprint From Different Classes of Air Travel*. World Bank Policy Research Working Paper 6471.

Bovenberg, A. Lans and de Mooij, Ruud A. 1994. Environmental Levies and Distortionary Taxation. *The American Economic Review* 94 (4): 1085–89.

Braathen, Nils Axel. 2012. The Political Economy of Environmental Taxation. In Milne, Janet E., and Andersen, Mikael, S. (eds.). *Handbook of Research on Environmental Taxation*. Cheltenham/Northampton: Edward Elgar, 230-245.

Cattoir, Philippe. 2004. *Tax-based EU Own Resources: An Assessment*. European Commission Directorate-General Taxation & Customs Union Working Paper 1/2004.

Chancel, Lucas, and Piketty, Thomas. 2015. Carbon and Inequality: From Kyoto to Paris. Paris: Paris School of Economics.

Deutsche Bundesregierung. 2012. *Bericht an den Deutschen Bundestag über die Auswirkungen der Einführung des Luftverkehrsteuergesetzes auf den Luftverkehrssektor und die Entwicklung der Steuereinnahmen aus der Luftverkehrsteuer*. Berlin.

Dietsch, Peter. 2015. *Catching Capital. The Ethics of Tax Competition*. Oxford: Oxford University Press.

Dimitrova, Anna, Hollan, Katarina, Laster, Daphne, Schratzenstaller, Margit, Walterskirchen, Ewald and Weiss, Teresa. 2013. *Literature Review on Fundamental Concepts and Definitions, Objectives and Policy Goals as well as Instruments Relevant for Socio-Ecological Transition*. WWWforEurope Working Paper 2013/40.

European Commission. 1977. *The MacDougall Report – Volume I. Study Group on the Role of Public Finance in European Integration*. Brussels: Commission of the European Communities.

European Commission. 1998. *Agenda 2000 - Financing the European Union*. Commission Report on the Operation of the Own Resources System. Brussels: European Commission.

European Commission. 2004. *Financing the European Union*. Commission Report on the Operation of the Own Resources System. COM(2004)505. Brussels: European Commission.

European Commission. 2005a. *An Analysis of a Possible Contribution on Airline Tickets as a New Source for Financing Development*. Commission Staff Working Paper SEC(2005)733.

European Commission. 2005b. *New Sources of Financing for Development: A Review of Options*. Commission Staff Working Paper SEC(2005)467.

European Commission. 2008. *European Union Public Finance*. 4th edition. Luxembourg: Office for Official Publications of the European Communities.

European Commission. 2010a. *Innovative Financing at a Global Level*. European Commission Taxation Papers Working Paper 23.

European Commission. 2010b. *Communication from the European Commission on the EU Budget Review* COM(2010)700.

European Commission. 2011a. Questions and Answers on Historic Aviation Emissions and the Inclusion of Aviation in the EU's Emission Trading System (EU ETS). Memo/11/139.

European Commission. 2011b. *Financing the EU Budget: Report on the Operation of the Own Resources System*. Accompanying the Document Proposal for a Council Decision on the System of Own Resources of the European Union. Commission Staff Working Paper SEC(2011)876 final/2.

European Commission. 2011c. *A Budget for the European Union 2020*. Commission Staff Working Paper SEC(2011) 868 final.

European Commission. 2014. *Taxation Trends in the European Union*. 2014 ed. Luxembourg: Publications Office of the European Union.

European Commission. 2016. *European Aviation Environmental Report 2016*. Brussels: European Commission.

European Environment Agency. 2007. *Size, Structure and Distribution of Transport Subsidies in Europe*. Copenhagen: European Environmental Agency.

European Environment Agency. 2016. *Market-based Instruments and EU Environmental Policies*. Copenhagen: European Environmental Agency (forthcoming).

Expedia. 2016. Preparing for Take Off. Air Travel Outlook for 2016. https://viewfinder.expedia.com/img/HLG-ARC-Booklet.pdf.

Farid, Mai, Keen, Michael, Papaioannou, Michael G., Parry, Ian W.H., Pattillo, Catherine A., and Ter-Martirosyan, Anna. 2016. *After Paris: Fiscal, Macroeconomic and Financial Implications of Global Climate Change*. IMF Staff Discussion Note 16/1.

Fullerton, Don and Metcalf, Gilbert E. 1997. *Environmental Taxes and the Double-Dividend Hypothesis: Did You Really Expect Something for Nothing?* NBER Working Paper 6199.

Fullerton, Don and Metcalf, Gilbert. 2002. Tax Incidence. In Auerbach, Alan J. and Feldstein, Martin (eds.). *Handbook of Public Economics*. Volume 4. Amsterdam: Elsevier, 1787-1872.

Garnier, Gaëlle, György, Endre, Heineken, Kees, Mathé, Milena, Puglisi, Laura, Ruà, Savino, Skonieczna, Agnieszka and Van Mierlo, Astrid. 2014. *A Wind of Change? Reforms of Tax Systems Since the Launch of Europe 2020*. European Commission Taxation Paper 49.

Gillen, David W., William G. Morrison, Christopher Stewart. 2003. *Air Travel Demand Elasticities: Concepts, Issues and Measurement*. Ottawa: Department of Finance.

Gordijn, Hugo, and Kolkman, Joost. 2011. *Effects of the Air Passenger Tax. Behavioral Responses of Passengers, Airlines and Airports*. Den Haag: Ministry of Infrastructure and the Environment.

Havranek, Tomas, Irsova, Zuzana, Janda, Karel, and Zilverman, David. 2015. Selective Reporting and the Social Cost of Carbon. CERGE-EI Working Paper Series 533.

Hoel, Michael. 1992. Carbon Taxes: An International Tax or Harmonized Domestic Taxes? European Economic Review 36(2-3), 400-406.

IATA. 2007. Estimating Air Travel Demand Elasticities. https://www.iata.org/whatwedo/Documents/economics/Intervistas_Elasticity_Study_2007.pdf.

ICAO. 2011. *ICAO Carbon Emissions Calculator*. Montreal: International Civil Aviation Organization.

IMF. 2011. *Iceland: Advancing Tax Reform and the Taxation of Natural Resources*. Washington D.C.: IMF.

Jaeger, William K. 2012. The Double Dividend Debate. In Milne, Janet E., and Andersen, Mikael, S. (eds.). *Handbook of Research on Environmental Taxation*. Cheltenham/Northampton: Edward Elgar, 211-229.

Jones, Benjamin, Keen, Michael, and Strand, Jon. 2012. *Fiscal Implications of Climate Change*. World Bank Policy Research Working Paper WPS5956.

Kaul Inge, and Conceição, Pedro (eds.). 2006. *The New Public Finance. Responding to Global Challenges*. Oxford: Oxford University Press.

Keen, Michael, Parry, Ian, and Strand, Jon. 2012. *Market-Based Instruments for International Aviation and Shipping as a Source of Climate Finance*. World Bank Policy Research Working Paper WPS5950.

Keen, Michael, Parry, Ian, and Strand, Jon. 2013. Planes, Ships and Taxes: Charging for International Aviation and Maritime Emissions. *Economic Policy* 28(76): 701-749.

Keen, Michael, and Strand, Jon. 2006. *Indirect Taxes on International Aviation*. IMF Working Paper WP/06/124.

Korteland, Marisa, and Faber, Jasper. 2013. *Estimated Revenues of VAT and Fuel Tax on Aviation*. Delft: CE Delft.

Kosonen, Katri. 2012. Regressivity of Environmental Taxation – Myth or Reality? In Milne, Janet E., and Andersen, Mikael, S. (eds.). *Handbook of Research on Environmental Taxation*. Cheltenham/Northampton: Edward Elgar, 161-174.

Kosonen, Katri, and Nicodème, Gaëtan. 2009. *The Role of Fiscal Instruments in Environmental Policy*. European Commission Taxation Papers Working Paper 19.

Krupnick, Alan J., Parry, Ian W.H., Walls, Margaret, Knowles, Tony, Hayes, Kristin. 2010. *Towards a New National Energy Policy: Assessing the Options*. Washington D.C.: Resources for theFuture.

Landau, Jean-Pierre (ed.). 2004. *Les Nouvelles Contributions Financières Internationales: Financement et Développement et Taxation Internationale*. Paris.

Leicester, Andrew and O'Dea, Cormac. 2008. Aviation Taxes. In Chote, Robert, Emmerson, Carl, Miles, David and Shaw, Jonathan (eds.). *The IFS Green Budget 2008*. London: IFS, 187-211.

Martinez-Vazquez, Jorge, McLure, Charles and Vaillancourt, Francois. 2006. Revenues and Expenditures in an Intergovernmental Framework. In Bird, Richard M. and Vaillancourt, Francois (eds.). *Perspectives on Fiscal Federalism*. Washington D.C.: Worldbank, 15-34.

Mathé, Milena, Nicodème, Gaëtan and Ruà, Savino. 2015. *Tax Shifts*. European Commission Taxation Papers Working Paper 59.

McManners, Peter John. 2016. Developing Policy Integrating Sustainability: A Case study Into Aviation. *Environmental Science and Policy* 57(3): 86-92.

Meijers, Daniël. 2005. *Tax Flight. An Investigation into the Origins and Developments of the Exemption from Various Kinds of Taxation of International Aviation*. University of Maastricht Working Paper I05-E001.

Musgrave, Richard A. 1959. *The Theory of Public Finance: A Study in Public Economy*. New York: McGraw-Hill.

Nerudová, Danuše, Rozmahel, Petr, Dobranschi, Marian, Litzman, Marek, Hampel, David, Janova, Jitka and Brogger, Benedicte. 2016. *Sustainability of the Taxation System*. Mimeo.

Nordhaus, William D. 1982. How Fast Should We Graze the Global Commons? *American Economic Review* 72(2): 242-246.

Nordhaus, William D. 2011. *Estimates of the Social Cost of Carbon: Background and Results from the RICE-2011 Model*. NBER Working Paper 17540.

Oates, Wallace E. 1972. *Fiscal Federalism*. New York: Harcourt Brace Jovanovich.

OECD. 2005. *The Political Economy of the Norwegian Aviation Fuel Tax*. Paper Prepared for the Joint Meeting of Environmental and Tax Experts. COM/ENV/EPOC/CTPA/CFA(2005)18/FINAL. Paris.

OECD. 2014. *OECD Environmental Performance Reviews: Iceland*. Paris: OECD.

Pearce, David. 1991. The Role of Carbon Taxes in Adjusting to Global Warming. *The Economic Journal* 101(407): 938–948.

Peter, Martin, Bertschmann-Aeppli, Damaris, Zandonella, Remo, Maibach, Markus. 2012. *Auswirkungen der Einführung der Luftverkehrsteuer auf die Unternehmen des Luftverkehrssektors in Deutschland*. Zürich: Infras.

Pigou, Arthur C. 1954. Some Aspects of the Welfare State. *Diogenes* 7(6): 1-11.

Schönpflug, Karin, Paterson, Iain, Sellner, Richard. 2014. *Evaluierung der Flugticketabgabe. Update zur IHS Studie 2012*. Vienna: Institute for Advanced Studies.

Schratzenstaller, Margit. 2016. Sustainable Tax Policy Beyond the Tax Ratio for the EU as Core Element of a "Fiscal Union". In Oesterreichische Nationalbank (ed.). Toward a Genuine Economic and Monetary Union. Vienna: Oesterreichische Nationalbank, 141-157.

Schratzenstaller, Margit. 2013. The EU Own Resources System – Reform Needs and Options. *Intereconomics* 48(5): 303-313.

Schratzenstaller, Margit, Krenek, Alexander, Nerudová, Danuše, and Dobranschi, Marian. 2016. EU Taxes as Genuine Own Resource to Finance the EU Budget – Pros, Cons and Sustainability-oriented Criteria to Evaluate Potential Tax Candidates. FairTax Working Paper (forthcoming).

Southgate, Dave. 2013. *Aviation Carbon Footprint*. Canberra.

Thalmann, Philippe. 2012. Global Environmental Taxes. In Milne, Janet E., and Andersen, Mikael, S. (eds.). *Handbook of Research on Environmental Taxation*. Cheltenham/Northampton: Edward Elgar, 456-476.

Tol, Richard S.J. 2007. The Impact of a Carbon Tax on International Tourism. *Transportation Research Part D* 12(2): 129-142.

Tol, R. S. J. 2013. Targets for Global Climate Policy: An Overview. *Journal of Economic Dynamics and Control* 37(5): 911-928.

Tullock, Gordon. 1967. Excess Benefit. *Water Resources Research* 3: 643–44.

Van Den Bergh, Jeroen C. J. M., and Botzen, Wouter J. W. 2014. A Lower Bound to the Social Cost of CO2 Emissions. *Nature Climate Change* 4(4): 253-258.

Weibust, Inger. 2009. *Green Leviathan: The Case for a Federal Role in Environmental Policy*. Surrey/Burlington: Ashgate.

Wildasin, David. 1989. Interjurisdictional Capital Mobility: Fiscal Externality and a Corrective Subsidy. *Journal of Urban Economics* 25(2): 193–212.

Project information

FairTax

FairTax is a cross-disciplinary four year H2020 EU project aiming to produce recommendations on how fair and sustainable taxation and social policy reforms can increase the economic stability of EU member states, promoting economic equality and security, enhancing coordination and harmonisation of tax, social inclusion, environmental, legitimacy, and compliance measures, support deepening of the European Monetary Union, and expanding the EU's own resource revenue bases. Under the coordination of Umeå University (Sweden), comparative and international policy fiscal experts from eleven universities in six EU countries and three non-EU countries (Brazil, Canada and Norway) contribute to FairTax research.

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