
Dual Objectives in Taxation Policy

A Study of the Swedish Airline Tax and its Effects

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Abstract

This thesis examines the recently implemented Swedish airline tax. It focuses on two areas surrounding the tax. The first being the dual objectives of increasing efficiency by internalizing the climate externality of aviation and reducing emissions to aid in the completion of Swedish climate goals. The second being the effect of the tax in relation to those objectives. Elasticity estimates for air travel demand are estimated using regression analysis, which are used along with other elasticity estimations to predict the consequence of the tax on demand and emission reduction. The results of the thesis show a clear drop in expected demand and emissions, indicating that the airline tax will be at least partly successful in its objective to reduce emissions. The tax will not be successful in internalizing the climate externality completely due to a low tax rate but will increase efficiency. The dual objectives are concluded to contain some intrinsic conflict since the goals of efficiency and emission reduction does not always coincide. Efficiency appears to have both practical and normative problems as an objective but choosing a target for emission reduction is difficult and prone to similar issues.

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Chapter 1. Introduction

Climate change is becoming an ever-increasing problem for policy makers. Most agree that something must be done about our current climate crisis, the problem is agreeing on what to do. This is true for the aviation industry as well, the externalities resulting from aviation could be solved in several ways. The preferred policy, and the nuances of that policy, depend on the objectives set. Where, generally, two objectives are considered: correct the inefficiency resulting from externalities and reduce emissions to a certain point.

The Swedish government of 2015 appointed a Commission of Inquiry to evaluate the possibility of an airline tax as well as other alternatives to reduce aviation emissions in order to aid in the completion of the environmental quality objective “Reduced climate Impact” (Committee Directive, 2015:106) in accordance with the United Nations Framework Convention on Climate Change (UN, 1992). The Swedish climate policy framework (Government Offices of Sweden, 2017) clarifies these goals, stating the goal of zero net emissions by 2045.

The objectives set up by the committee directive (Dir. 2015:106) are twofold; decreasing emissions in order to aid in the completion of the environmental quality objective; and making aviation carry its own costs. The former is a sub-goal of a larger objective of reaching a specific emission target (the quality objective). Practically, the latter objective means that external costs associated with aviation should be included in the price for aviation, thereby increasing efficiency.

The two objectives stated by the commission of inquiry (emission reduction and efficiency) are similar and often leads to similar consequences. In most cases, there is little distinction between these two objectives since internalizing a climate externality leads to emission reduction and vice versa. The difference lies in the theoretical underpinnings of the objectives and can be consequential when constructing taxation policy. An airline tax with the purpose of reducing emissions to reach a certain target might not be the same as a tax constructed to increase efficiency.

The fundamental assumptions of current economic theory have been discussed and debated at length. Subjects of utility, rationality and normative economics appear frequently in discussions about the discipline. Those abstract concepts are relevant to the construction of policy, why it is important to join such concepts with current policy discussions. The recent implementation of the Swedish airline tax, and the Government Official Report preceding it (SOU, 2016:83), brings these questions to the forefront. The nature of the tax, its appropriateness, adequacy and justification, depend on the theoretical foundations of the two objectives. The relevance of this thesis is therefore to incorporate those theoretical questions to a practical case, to evaluate their effects. Thus, the main purpose of this thesis is to understand the interplay between theory and policy in the case of the airline tax, to do so practically require answering, or attempting to answer, two questions:

1. Is the tax sufficient to reach the objectives?
2. Are the two objectives appropriate?

The first question will be discussed by comparing the expected effect of the tax with the objectives. The objective concerned with emission reduction will be examined using both newly estimated and existing elasticities for commercial air travel and infer expected demand reductions, and the subsequent reduction in emissions. The Pigouvian framework is used to evaluate the objective of efficiency. The second question is difficult to answer conclusively, as appropriateness is fundamentally subjective, but it is possible to discuss by comparing the objectives and examine some of the important assumptions for the models in use.

Chapter 2. Background and Previous Research

2.1 The tax

The tax proposed by the government is a unit tax on tickets for commercial flights departing from Sweden. The tax differs depending on destination, to reflect greater distances, with three different tax rates. The tax implemented as of 1st April 2018 is lower than the tax proposed by the commission of inquiry, because of parliamentary negotiations. The current levels are 60 SEK for

domestic travel and travel within the European Economic Area (EEA), 250 SEK for countries belonging to group 2 (countries within 6 000 km of Stockholm and not in the EEA) and 400 SEK for countries belonging to group 3 (countries further than 6 000 km). Since the tax covers commercial flights, it includes both business and private travel but excludes military, rescue and state flights.

The tax is based on estimated marginal damages in keeping with the Swedish CO₂-tax (which does not include aviation) at a value of 1.15 SEK per kg CO₂. The tax uses short-distance destinations within each group to set the tax rate, so that the tax is not higher than estimated marginal damages for any destination. The effect of the tax is calculated using elasticities from the National Institute for Communications Analysis (2006) (presented in Table 2.1)¹. More recent elasticities were not used since no recent data on passenger categories (private and business) was available.

*Table 2.1 Elasticities used by the
Commission of Inquiry*

	<i>Domestic</i>	<i>Foreign</i>
<i>Private Trips</i>	-0.2	-0.1
<i>Business Trips</i>	-1	-0.7

Sweden has had several different taxes on aviation. In 1978 a tax on charter travel was introduced but was removed in 1993 for a mixture of reasons, including conflicts with EU legislations and concerns about discriminating against certain forms of travels (charter in this case). From 1989 to 1996 there was an environmental taxation on aviation based on emissions from aviation fuels. The tax was deemed to conflict with EU legislation on fuel taxation by the Court of Justice of the European Union (*Braathens Sverige AB v Riksskatteverket*, 1999, C-346/97). A tax was due to be implemented in 2007 but the government proposing it lost the general election before it was implemented.

¹ *These are the elasticities later used in the thesis, combined with new estimates.*

2.2 The EU Emissions Trading System

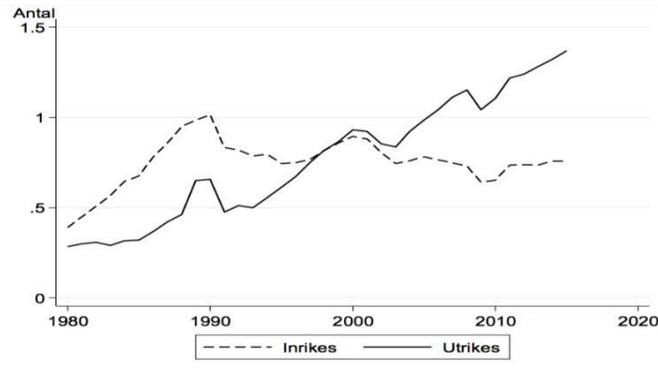
The ETS is a central part in the efforts to handle climate change and is established in the ETS directive (Council Directive 2003/87/EC). The directive was later changed to also include aviation activities in the trading scheme (Council Directive 2008/101/EC). The ETS is currently operating under its latest amendment (EU Regulation No 421/2014) which is applicable for the years 2013 to 2020. The ETS covers the EEA, meaning domestic and intra-EEA travel is covered by the ETS and their emissions are priced to some extent. Not all climate costs are included, certain emissions and high-altitude related emission impacts are not priced (Swedish Transport Agency, 2016).

2.3 Aviation in Sweden

The total CO₂-emissions from Swedish aviation was 3 million² tonnes in 2016 (Swedish Statistics, 2016). The number of departures from Swedish airports are increasing, mainly due to a steady increase in international travel (see Figure 1). The increase in demand has led to increased emissions, the climate impact from Swedes international flying has increased at a rate of 2 % per year since 1990 and is predicted to continue increasing in the future (SOU, 2016:83; Swedish Transport Agency, 2018). Most of the international aviation is private, while most of the domestic travel is business travel, albeit the distinction is small for domestic travel (see Table 1). The total number of departing flights from Swedish airports was roughly 23 million, 8 million domestically and 15 million for international travel.

² *This is only counting departing flights, if total flights are covered the numbers are higher. Since the tax is only applied to departing flights, this is the statistic of most concern.*

Figure 1. Flights per capita
from Swedish Airports.



Source: Swedish Government Official Reports, 2016

The filled line represents international flights while the dashed line is national flights.

Table 1 Passengers divided
by purpose for travel in percent

	Domestic	International
Business trip	46.5 %	31.1 %
Private trip	53.5 %	68.9 %

Source: Swedish Government Official Reports, 2016

2.4 Limitations

The subjects of taxation, evaluation of public policy and economic philosophy are far too broad to be discussed in detail in one thesis and thus necessary limitations must be made. Firstly, the policy implemented by the Swedish government is an airline tax, meaning no other forms of environmental policy will be discussed at length. Nor will other policies in place in other countries or internationally, unless they interact with the Swedish airline tax. Potential policies and policies that do not yet exist will not be discussed. This is a thesis focusing on public

economics and not climate science, meaning that the intricacies of climate change will not be delved into deeply, and will only be discussed in relation to their economic effects. The Government Official Report (SOU 2016:83) specifies climate impact as a chief concern. As such, this thesis will not focus on other damages caused by aviation and they will only be mentioned briefly. Lastly, appropriate use of the money collected from the tax will not be discussed.

2.5 Previous Research

There has been much debate over the fundamental assumptions of economics, much of which is relevant to this thesis since it attempts to discuss such matters in a policy context. Arguably the most famous critique of rationality, utility and the way economics generally deal with preferences is Amartya Sen's *Rational Fools* (1977). In the journal Sen argues that the way preferences and revealed preferences are defined does not adequately reflect people's actual wants. One might prefer to have other preferences for instance, such might be the case with addicts or someone who would like to consume more ethically yet cannot bring themselves to change their pattern of consumption. Furthermore, he argues that economics, specifically the assumption of utility maximization, views humans too narrowly as egoistic and self-serving. He points out that people can act against their own self-interest in commitments to other purposes. This does not only apply to altruistic acts which yields some utility because of the sense of goodness it can bring, but also in doing acts one anticipates will lower one's own welfare.

Charles Manski (2014) argues that many of the terms we use to describe and analyze tax are mere examples of negative rhetoric that abstracts from the actual rationales for taxation, advocating a minimal use of unnecessary normative concepts, such as distortions and inefficiency. He points out that Mirrlees (1971) required no other normative concepts other than the social welfare function³. Manski's points relate to the potential issue of overusing normative concepts in otherwise objective evaluation on policy. Such overreliance, in his view, gives a skewed perception of the true effect of a policy, both rhetorical and actual.

There is much research on elasticity in the aviation sector and the transport sector in large. The *Journal of Air Transport Management* and the *Journal Transport Economics and Policy* being significant sources of research for such topics. In a meta-analysis Brons and others concluded that long-run elasticity gives better estimates of the actual elasticity because of a lag between price

³ *Also a contentious concept, see (Sen, 1977 pp. 339)*

changes and demand changes (Brons et al. 2002). They also concluded that European price sensitivity is not greater than American or Australian, which is surprising given the number of substitutes available in Europe. The International Air Transport Association (IATA) finds the opposite to be true, estimating the European aviation market to be considerably higher than all other comparable markets (IATA, 2007). In their report, IATA discusses the relevance of substitute modes of transportation for the elasticity of air travel, where regions with higher ease of access tends to have more elastic demand. IATA also discussed appropriate regression techniques for elasticity estimations in the aviation sector, opting for an Ordinary Least Squares (OLS) model. Other models were discussed and tested, Two-Stage Least Squares (2SLS) had benefits but was practically difficult to use and lagged models (such as the Autoregressive Distributed Lag) were shown to have benefits in specific circumstances where lagged values were reasonable to assume. (IATA, 2007)

The climate impact of aviation has also been discussed at length, especially in recent years. Lee Chapman (2007) in an article regarding the climate impact of transportation and Anger (2010) in her discussion surrounding the ETS and aviation warns about the increasing climate impact of aviation. Stating that while aviation may appear to have a minor climate impact now, the aviation sector grows rapidly, something supported Swedish Transport Agency's forecast (2018). The Intergovernmental Panel on Climate Change's (IPCC) fifth assessment report on climate mitigation (2014) discusses the declining rate of technological advancements in aviation fuel efficiency, which is a potential hindrance to emission reduction. The report states that findings suggest that demand management and technological development may both be necessary to reduce aviation emissions (IPCC, 2014).

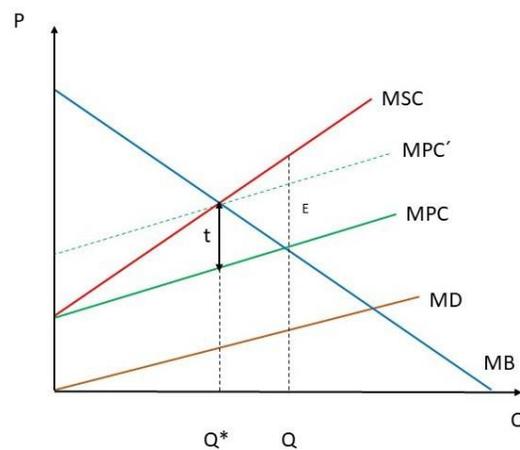
Chapter 3. Theoretical Framework

In this chapter, each objective will be explained separately by presenting their components, theoretical backgrounds and assumption. The theories and concepts presented in this chapter will be applied in the "discussion" chapter (chapter 6). This thesis has no dedicated methods chapter, it instead uses both empirical findings (from chapter 5) and theoretical frameworks from this chapter in the analysis. Both theory and empirical findings serve important methodological purposes and the combination is often required. Both this chapter and chapter 4 functions to explain the methodology of this thesis.

3.1 The Objective of Efficiency.

There are several ways to internalize externalities and thereby fulfil the efficiency objective. The proposed solution to the externality in the aviation sector is a tax levied on output. Ideally, this would shift the external costs back to the producers. This sort of taxation is a Pigouvian tax and was first introduced by Arthur C. Pigou (1920). The idea is to levy a tax on output equal to the marginal damage at the efficient level of production, that is the output level when the social marginal cost equals the private marginal cost (and they both equal the marginal benefits).

Graph 3.1 Pigouvian Tax



Where $MSC = \text{Social Marginal Cost}$, $MPC = \text{Marginal Private Costs}$
 $MD = \text{Marginal Damage}$, $MB = \text{Marginal Benefit}$, $t = \text{Tax}$

Graph 3.1 illustrates the basic principle of Pigouvian taxation⁴. The initial equilibrium (Q) is inefficient since the social costs (the cost of the externality in addition to the private costs) is greater than the price, in this case resulting in overproduction. A Pigouvian tax can be set so that it is equal to the marginal cost of the externality (difference between social marginal costs and the private marginal costs) at the efficient level of output (Q^*). Thus, increasing private costs to the same level as social costs, increasing efficiency.

3.1.1 Criticisms of Efficiency

Pigouvian taxation is not uncontroversial and there are criticisms against the theory and discussions regarding its proper implementation. It requires knowledge of marginal damage and

⁴The graph illustrates Pigouvian taxation generally and is not to be seen as a graph over the Swedish airline tax, even if the same principles apply.

elasticities to compute the size of the tax and there are practical issues with both and for the former some potential theoretical objections. The adequacy of the efficiency goal depends on the Pigouvian framework being theoretically sound and practically useful.

The Pigouvian model requires some assumptions regarding efficiency, rationality, preferences and utility. The terms will be defined briefly before discussing them more in-depth. The concept of efficiency, or economic efficiency, has several meanings. It can refer to productive efficiency, Pareto or allocative efficiency, which represents the maximization of consumer preferences (practically efficiency is gained when marginal benefit equals marginal costs). The efficiency of concern here is allocative efficiency, since the purpose of Pigouvian taxation is to increase allocative efficiency. In this thesis, the term “efficiency” refers to allocative efficiency unless stated otherwise. Utility is not simple to define, in essence economists use it to describe the satisfaction gained from consumption of a good. Rationality can be defined differently but generally it means people being rational in the sense that they act in a way to increase utility and have rational preferences.

The point of contention concerning efficiency regards its normative value. Essentially, the normative weight of Pigouvian taxation, of efficiency, rests on the normative value of preferences, or to be more precise, the normative value of acting on one’s preferences. While few contends that efficiency increases wellbeing in some sense, the extent of which is a topic of disagreement, more on this in chapter 6.

3.1.2 Market structure

The first fundamental theorem of welfare economics states that an efficient allocation of resources emerges if there exists perfect competition and a market exists for all commodities. The Pigouvian framework is a way of rectifying the market failure resulting from the lack of market for certain goods. However, the lack of perfect competition can potentially influence the usage of the Pigouvian framework as well.

The assumption of perfect competition not holding potentially influences the size of the tax. James M. Buchanan (1969) argues that the Pigouvian tradition focuses too heavily on competitive market and that adjustments needs to be made for it to fit non-competitive markets. A. H. Barnett (1980) adds that there are appropriate departures to be made from basing the tax

solely on marginal damage since monopolies already tend to underproduce and a tax equal to the marginal damage at the efficient level risks increasing existing distortions. While the aviation market is far from being monopolistic, it certainly does not have perfect competition, as such the market structure and existing distortions is a relevant factor in deciding the size of the tax.

3.1.3 Marginal Damage as a Basis for Taxation

When evaluating markets with emissions we need to evaluate the damage caused by such emissions in monetary terms to fit it into an economic model. The damage is translated to marginal damage, the damage caused by each additional unit of emissions.

The arguments concerning monetizing the environment can be roughly categorized in two;

- (1) Imbuing nature with monetary value is difficult and yields uncertain results and;
- (2) Doing so is wrong since it diminishes other values the environment might have.

The first argument deals with estimation and computational issues, something that poses great impediments to constructing policy. There is no consensus on how to measure marginal damage and the estimates vary considerably. A substantial problem lies in isolating variables. Ecosystems are complex and interconnected and predicting all the effects of damage done to them accurately is difficult, any necessary limitations imposed will invariably lead to some miscalculations.

Measurements is not the only issue with reaching an appropriate cost. A present value must be put on future costs, since considerable part of the costs associated with aviation will not occur for a long time. The choice of a discount rate, sometimes called the social discount rate⁵, is therefore essential. Much of the differences between marginal damage estimates are due to the choice of discount rate and there is no consensus on which to use.

The essential question for discount rates is how to value the cost inferred on future generations, making the marginal damage computations inherently normative in nature and fundamentally tied to concerns of intergenerational equity. Not all agree however and argue that the question is descriptive rather than normative, and a “true” discount rate can be found empirically. People in favour of using this prescriptive approach to discount rates often argue for the use of market

⁵ A distinction is sometimes drawn between a normative discount rate and market interest rate, in which case the former is being referred to as a social discount rate.

interest rates (Goulder et al., 2012). While arguing for the use of something can still be considered normative, the difference is whether ethical considerations should serve as a basis for constructing the discount rate or if empirical research of people's behaviour should. The American Environmental Protection Agency (2010) uses rates between 2.5 % and 5 % in their policy recommendations, while Hepburn and others (2006; see also: Stern, 2006; Nordhaus, 2010) considers discount rates well below 2 %. The difference can be immense when estimating long-term damages.

The second point is more of a philosophical point and not one that is going to be discussed at length in this thesis. It should however be pointed out that the attempt to put a monetary value on nature to construct policy need not necessarily retract from any other value nature might have, such as artistic or spiritual value, or perhaps some intrinsic value that is not measurable in monetary terms. That being said, a discussion regarding the risk of under-valuating nature due to a neglect of nature's more unquantifiable properties might be fruitful. Furthermore, economists do not make policy alone and any political debate on the issue is sure to consider other aspects of environmental protection as well.

3.1.4 Composition of Marginal Damage

Marginal damage is not uniform and includes all sorts of damages aviation might infer, such as climate impacts, health hazards and noise pollution. Though most of the external damage of aviation is related to climate. According to a report on climate impact of transportation (Lee et al., 2010)⁶, commissioned by the EU, the main types of climate impacts from aviation are the long-term CO₂ impacts and the more short-term water vapour, nitrogen oxides, sulphate particles and soot⁷. The differentiation of long-term and short-term is important to economists as well as climate scientists. When damage is computed the long-term will have to be discounted to a present value, both current effects with lasting impacts and future effects will have to be discounted. The effects vary depending on a variety of factors including distance, landing-and-

⁶ *The report was written as an update on the previous IPCC assessment report, since then another assessment report (2014) has been published, though the assessment report contains no changes to the composition of aviation emissions and damages, only changes to numbers. Since the actual numbers of emissions and damages are not used in this section the source is still relevant.*

⁷ *The long-term vs short-term distinction is a simplification but holds true in general, for more information see *Transport impacts on atmosphere and climate: Aviation* (Lee et al., 2010).*

take-off (LTO) procedures and emissions on high altitudes (Swedish Transport Agency, 2016). Many of the health hazards are also caused by emissions, especially during LTO (Yim et al. 2013) and depend on type of fuel used. So-called “small particles” emitted are especially hazardous (Morita et al., 2014). Ideally, everything should be comprised in a marginal damage estimate.

The health impacts and climate impacts, as well as any other source of damage, are combined to make marginal damages. This may strike some as a simplification, but the damage measurements are not meant to give information on their effect, they are used for the purposes of informing economic policy. To increase economic efficiency all damages must be computed together to correct the market failure. The objective stated by the commission of inquiry (SOU 2016:83) states that the aviation industry should carry “its own climate costs”, turning this objective into economic policy requires a cohesive and inclusive concept of marginal damage.

3.2 The Objective of Emission Targeting

Emission reduction differs considerably from Pigouvian taxation as an objective. The purpose of a Pigouvian tax is to correct an externality and thereby increase economic efficiency, not necessarily reduce emissions (even if this is a consequence of reduced output). In other words, a Pigouvian tax is not concerned with reaching a specific emission target, but the government might be.

The objective of emission reduction is difficult to define, since its only stated as an objective to aid in the completion of another, larger goal. It is not stated by which metric such an objective can be considered fulfilled, or indeed to what extent the emission reduction objective should aid in the larger Swedish climate goals completion, making the process of choosing an emission target for the policy difficult.

Emission reduction is rife with both theoretical and practical difficulties. The theoretical problems stem mainly from what target to choose. Regarding the larger quality objective of net zero emissions by 2045, there are several other factors to consider. The tax together with potential technological improvements, changes in preferences and other policies aimed at reducing emissions are all part of achieving this goal. The question is how large a part the airline tax needs to play to be considered adequate. A clear answer cannot be given but an evaluation of

the effect of the tax on emission reduction as well as mention of other potential sources of reduction might give a clearer picture of its adequacy⁸, more on this in chapter 6. To predict emission reductions, we require knowledge of elasticities to predict to what extent output will reduce.

Chapter 4. Estimating Elasticities

This chapter explains the process behind the new elasticity estimates. The elasticities in question are price elasticities of demand for airport level, domestic and international air travel. Estimating new elasticities serves two purposes. The first is that estimates vary, and more estimates gives a broader picture of a possible outcome of the tax. Secondly, the elasticities used by the Commission of Inquiry are old, from 2006, and in the presence of a rapidly evolving market like the aviation industry, recent estimates can be useful.

4.1 Model

The model used for the elasticity calculations is Ordinary Least Squares (OLS), using STATA. Doing so relates aviation demand with prices, GDP and population while minimizing variance. GDP and population are used as control variables while the effect of price on demand is isolated. A log-log model is implemented, where variables are transformed by the natural logarithm. Since log-logs measure percentage change, the estimations we receive can be seen as elasticities. Lastly, monthly dummies are used to correct for seasonality and yearly dummies to capture the overall trend while controlling for other sources of variation over time⁹. The specifications are as follows:

$$D_{t,i} = \beta_0 + \beta_1 P_t + \beta_2 G_t + \beta_3 P_o_t + Z_{i,t} + \varepsilon_{i,t}$$

Where D is demand (dependent variable), P is the price variable, G is GDP, P_o is Population, Z is any dummy or fixed effect used and ε is the error term. Subscript t refers to time (monthly) and i refer to airports if any is used in the regression.

⁸ The assumption being that aviation has the same need to reduce emissions as all other industries do. In practice, potential reductions that are costly or an inability to reduce emissions for some other reason can be covered by reduction in other industries.

⁹ Given the comparatively small sample size, only one at a time is used.

This model was used to estimate price elasticities of demand for domestic aviation (both nationally and at the route level using a selection of airports) as well as elasticities for international aviation.

4.2 Data and variables

Accurate pricing data for aviation is difficult to come by since prices change rapidly and depend on factors which are difficult to measure, such as website or agency used for the booking and when the booking occurs. Swedish Statistics provided pricing data for aviation since the year 2000, categorized by domestic and international travel which is used in this thesis. While Swedish Statistics is reputable and tends to have reliable information, the difficulties in finding pricing data applies to them as well, meaning the data is less reliable than would be ideal.

Demand numbers comes from the Swedish Transport Agency (2018), except from the route-level airport demand numbers which comes from Swedavia¹⁰, the governmental organization owning most Swedish airports (Swedavia, 2018). The demand is monthly, each observation being the aggregate numbers of departing passengers each month for each category (domestic and international). In the case of the airport specific data, it is the aggregate number of departing flights domestically each month. Only domestic data is used at the airport level, this is because many airports only have domestic travel and international travel is, therefore, better captured with a national aggregate.

Data on quarterly GDP and quarterly population numbers (used as control variables) also comes from Swedish Statistics (SCB, 2018). The population variable excludes children under the age of two since they often pay either nothing or little for air travel. For more precision an exclusion of people over a certain age could be possible, since people over certain ages can be expected to travel less. The problem would be to find an appropriate age threshold, which would ultimately be an arbitrary choice. The number of people above the ages where such a threshold would be reasonable is minor compared to larger ages groups such as children under the age of two, meaning such an omission would not be particularly important.

¹⁰ *Approximately 90 % of Swedish passengers depart from Swedavia airports. Since Swedavia owns a wide variety of airports, the demand should be generalizable.*

No recent data is available on categories of passengers, a reasonable split would be between private and business travel since they likely respond differently to price changes. For this reason, the Government Official Report (SOU 2016:83) uses old estimates from 2006 where such categories were used. While no such distinction is made in the regression, the passenger category data can still be used to give some indication of the purpose for people's travels. Swedish Statistic had no pricing data on European travel prices either, only for the totality of international travel, which is why the elasticity estimates are divided domestic/foreign as opposed to domestic/European/other. The Commission of Inquiry does not include European elasticities either (SOU 2016:83).

The regressions include only what is deemed to be the most relevant variables and fixed effects as to not run the risk of overfitting the model, given the scarce available data. The number of observation ranges from 216 (for national and international demand) to 1080 for airport specific data. The larger numbers for the airport specific data is divided by airport, the numbers of observations for each individual airport being 132.

Since not everything can be control for, not all the results will be useful. The role of seasonality for international aviation can be assumed to be high since seasonality is known to effect tourism and nearly 70 % of international travel is private (SOU 2016:83), and thus likely to be related to tourism. The year fixed effects regression on international aviation is misleading for this reason, since it does not correct for seasonality. The airport level data gives useful insights on the effect of price changes on the local level, which varies widely across the country. The airports differ from each other however, while it might be a good idea to correct for year fixed effects generally, for airports such as Arlanda it might be misleading since a majority of its travel is international (Swedavia, 2018) and subject to great variation depending on season. Both cannot be corrected for without running the risk of overfitting the data.

4.3 Heteroscedastic and Autocorrelation

Tests have been made to check for problems within the dataset. The Durbin-Watson test was used to check for autocorrelation and the Breusch-Pagan test for heteroscedasticity. The data seems to have some problems with both, autocorrelation being mainly a problem for the airport specific data. To rectify this, STATA's clustering command is used to adjust for autocorrelation (while not

correcting it), allowing arbitrary autocorrelation of random terms within the airport variable. Some heteroscedasticity in the data is less severe, it does mean however that the estimator is not BLUE (best linear unbiased estimator) according to the Gauss-Markov theorem, and therefore less efficient.

4.4 Applying the results on demand and emissions

When calculating expected emission reductions in figure 5.2 both the elasticities from the Government Official Report and the newly estimated elasticities will be used. The emissions data comes from Transport Analysis (2016), where the monetary costs of emissions are recalculated to obtain the CO₂-equivalents (CDEs). CDEs are used to sum up the different types of emissions from aviation into a cohesive measurement. One kg CDE has the same environmental effect as one kg CO₂, which is why they are called equivalents. Out of necessity representatives are used as proxies for domestic, intra-EEA and non-EEA international travel. For domestic travel the route Arlanda- Landvetter is used (444 km) and Boeing 737-600 (CFM56-7B20/3 motor) with capacity of 60 %. For intra-EEA travel the route Arlanda-Madrid is used (2 679 km), Airbus A-320 and capacity 70 %. For non-EEA international travel the route Arlanda-Bangkok is used (8 415 km), Boeing 777-300 with a capacity of 80 %. These are the same assumptions used by the Swedish Transport Agency.

The estimates assume that the economic incidence falls entirely on the consumers, an assumption supported by the Commission of Inquiry (SOU 2016:83) and Severin Bornstein (2010). The Commission of Inquiry does include calculations for a 75 % increase of price as well. It is probably safe to assume that consumers do not bear the entirety of the costs long-term, though to what extent is unknown, the resulting demand reduction should therefore be slightly less.

Chapter 5. Estimated Elasticities

In this chapter the results of the regression are presented. The results themselves will mainly be discussed in the next chapter “discussion” however. This is because this thesis relies heavily on theoretical concepts as well as empirical, making it useful to apply theory and empirical results in the same chapter.

Figure 5.1 displays the results of the regression. The different regressions are shown in the same table, where they differ between year fixed effects and month fixed effects as well as domestic, foreign and airport level regressions.

For reasons mentioned in previous chapter, the elasticities used from figure 5.1 to calculate expected drops in demand are -0.39 for domestic and -0.14 for international. This is because year fixed effects are deemed more important to correct for domestically, while seasonality is more important for international aviation. This seems to be supported by the division of private and business travels as used by the Government Official Report (SOU 2016:83), where private travels make up a large majority of international travel while the split is more even domestically, suggesting that tourism is more important for international travel (and thus more sensitive to seasonality).

Figure 5.2 uses the elasticities of 5.1 as well as those used by the Government Official Report (2016) to compute expected drops in demand and expected emission reduction, everything else being equal¹¹.

¹¹ *Total missions are still increasing, the emission reduction of concern here is the reduction as compared to an expected increase without the tax.*

Table 5.1 Price Elasticity of Demand for Aviation

	<i>Coef.</i>	<i>Std. Err.</i>	<i>t.</i>	<i>P>t</i>	<i>95 % conf.</i>
<i>Panel A: Elasticity for Domestic Air Travel</i>					
<i>Year Fixed Effect</i>	-0.39	0.1	-3.9	0.000	(-0.58) – (-0.19)
<i>Month Fixed Effect</i>	-0.21	0.028	-6.8	0.000	(-0.25) – (-0.14)
<i>Panel B: Elasticity for International Air Travel</i>					
<i>Year Fixed Effect</i>	0.73	0.1	6.5	0.000	(0.51) – (0.95)
<i>Month Fixed Effect</i>	-0.14	0.08	18.8	0.000	(-0.3) – (0.0)
<i>Panel C: Airport Specific Elasticities</i>					
<i>Sum of Selected Airports</i>	-0.3	0.12	-2.5	0.034	(-0.56) – (-0.29)
<i>Airport</i>	<i>Coef.</i>	<i>Airport</i>	<i>Coef.</i>	<i>Airport</i>	<i>Coef.</i>
<i>Göteborg-Landvetter</i>	-0.82	<i>Kiruna</i>	-2.2	<i>Luleå Airport</i>	-1
<i>Malmö</i>	-0.59	<i>Ronneby</i>	-2.6	<i>Stockholm Arlanda</i>	0.85
<i>Umeå</i>	-1.1	<i>Visby</i>	-1.8	<i>Åre Östersund</i>	-2

Table 5.2 Expected Changes in Demand and Emissions

<i>Level</i>	<i>Domestic</i>	<i>Europe</i>	<i>International</i>	<i>Total</i>
<i>Panel A: Expected changes using elasticities from the Commission of Inquiry.</i>				
<i>Demand Private</i>	-254 253	-199 313	-26 764	-480330
<i>Demand Business</i>	-44 198	-12 852	-1 725	-58 775
<i>Total Demand</i>	-298 451	-212 165	-28 489	-539 105
<i>Tonnes of CDE reduction</i>	50 557 (19 004)	104 619 (51 265)	79 818	233 994 (150 087)
<i>Panel B: Excepted changes using elasticities from table 5.1</i>				
<i>Demand</i>	-185 343	-57 856	-8 390	251 589
<i>Tonnes of CDE reduction</i>	31 397 (11 802)	28 529 (13 980)	23 507	83 433 (76 187)
<i>Panel C: Expected changes using airport specific elasticities from table 5.1</i>				
<i>Demand</i>	-142 572			
<i>Tonnes of CDE reduction</i>	24 152 (9 178)			*76 188 (46 665)

The elasticities used from figure 5.1 to calculate expected drops in demand are -0.39 for domestic and -0.14 for international. Bracketed numbers are the emissions if normal CO₂-emissions is assumed to be completely internalized by the ETS.

*Since only domestic elasticities are available on the airport level, the total in Panel C uses the results for European and International changes from Panel B.

Chapter 6. Discussion

This discussion will focus on the evaluation of the airline tax in relation to the two objectives, as well as the appropriateness of those objectives. The sufficiency of the tax is subjective but can still be discussed by comparing it with the two objectives.

6.1 Evaluating the Objectives

Besides evaluating the tax, the objectives themselves can be questioned. In this section the two objectives will be discussed in some detail, and later compared briefly.

6.1.1 Objective of Efficiency

6.1.1.1 Marginal Damage

The wide range of marginal damage estimates (and their dependents on ethical concerns) makes accuracy difficult to obtain. Since the Pigouvian model is based on a correct level of taxation being equal to the marginal damage, the precision of those measurements is essential.

Basing the airline tax on a comparatively low damage estimate risks continuing existing efficiencies due to externalities as well as resulting in lower emission reduction than would have been the case. Having a relatively high damage estimates will lead to greater emission reduction but increased tax-related distortions. This is especially true when existing market distortions (other than externalities) exists, such as non-competitive market distortions. The low marginal damage estimates could serve an efficiency enhancing purpose as well, as both Buchanan and Barnett (1980; 1969) discusses, there might already exist market failures of other kinds that needs to be taken into consideration. The degree to which the aviation market is non-competitive certainly effects current distortions given an already artificially high price that tends to be inherent in such market structures. If efficiency is one's goal, then a balance between not increasing existing distortions and decreasing the inefficiency of the externality should be maintained.

The problem ultimately is that marginal damage is a blunt instrument. Given the wide range of estimates, that differ for both practical and ethical reasons, and a great deal of uncertainty,

marginal damage makes a meagre basis on which to construct a tax upon. The objective to make the aviation industry “carry its own cost” might carry some ethical meaning, but unless that cost can be specified with some accuracy the objective risks being more symbolic than practical.

6.1.1.2 The Concept of Efficiency

Efficiency carry normative implications, albeit not necessarily intrinsically¹². Economists are quick to point out that the normative aspect of decision making is best left to other disciplines, economics is concerned with the “how” rather than the “ought”. If policy makers want efficiency, economists simply provide a way to obtaining it. This saves economics from having to deal with the difficulty of merging objective approaches to theory and empiricism with the normative aspects of policy. The potential issue comes when a large part of our economic theory and out economic tools are based on highly normative assumptions, as efficiency is. Central to the concept of efficiency is the idea of utility being revealed through consumption choices, utility being what gives ethical weight to efficiency. Utility cannot be separated from ethics easily, as it describes some sort of satisfaction or wellbeing. To reject the pursuit of it is, by definition, to reject wellbeing and satisfaction¹³.

Doubting the bond between utility, preferences and consumption, is often referred to as “paternalism”, implying that such a view is tantamount to believing that the government knows what people want more than people themselves do. This view, however, is not paternalistic because it does not mistrust people’s ability to know what they want, it simply mistrusts the connection between people’s consumption choices and their wants. The leap that is made by the rationality assumption is not necessarily assigning rational preference to consumers, it is assigning utility to those preferences. To uses an obvious example, it might be true that someone prefers a pack of cigarettes to the monetary value of those cigarettes but that does not imply that cigarettes increases that persons utility¹⁴, or as Sen (1977) points out, revealed preferences might not reflect our true wants.

¹² *The normative value of economic efficiency need not be intrinsic to the concept, it could just be interpreted in such a way. It does not make much of a difference in this case.*

¹³ *Utility is commonly defined by the satisfaction and usefulness derived from consumption.*

¹⁴ *Unless utility is defined in a circular manner as Joan Robins argue (1962 cited in Ackerman et al.,1997, pp. 72), in which case cigarettes do increase utility by definition.*

This is not a new critique, but it is relevant here. In the case of environmental taxation and policy, others, perhaps more easily accepted assumptions, are available. The assumption that we need to reduce emissions to a certain level require no additional assumptions regarding utility, and it is an assumption widely subscribed to. The goal of reducing emissions has problems of its own however (see next section).

6.1.2 The Objective of Emission Targets

The other part of the motivation for the implementation of the Swedish airline tax was the desire to reduce emissions, specifically to aid in the completion of the environmental quality objective “Reduced climate Impact” (SOU 2016:83; Dir. 2015:106).

6.1.2.1 Choosing a target for the specific policy

The benefits of the emission reduction approach stem largely from the fact that it seemingly requires less axioms and normative judgements. This too could be a problem however, the Pigouvian framework provides a framework that informs policy makers on what they “ought” to do, given that efficiency is desirable to us. The aim to reduce emissions generally provides no such normative guidelines for decisions. Rather it removes the normative question from economics and puts it elsewhere, such as in the realm of political science or climate science. This could be preferable, depending on one’s view on the ability of economics to handle normative questions of this kind. However, any choice of an appropriate level of emission reduction is bound to face some difficulties, given its normative nature. A target could be chosen in the same manner as the tax level is chosen in the Pigouvian framework, that is by using efficiency as a standard. If a target is set in such a way, then there is no difference between the two objectives.

6.1.2.2 Reaching the target

The problem is that the stated objective is incredibly difficult to evaluate. While the desire is to reduce emissions, it is not specified by how much, only that it needs to aid in the completion of the quality objective.

Seen as a subset of the larger quality objective, emission reductions resulting from the tax can be evaluated as a part of a larger set of policies meant to reach that goal. This would require an

assessment of how much emission reduction needs to result from active policy and how much can be left to market forces. It is certainly the case that consumer power, technological advancements and other such factors will make up a considerable part of the required reductions, though the extent of which is unknown. The result of the tax depends on how much potential emission reduction one ascribes to other factors.

Arguably the largest source of hope for reducing emission is technological advancements. The IPCC's fifth assessment report on climate mitigation (2014) states that there is a lack of policies attempting to increase the usage of low-carbon biofuels in aviation, despite biofuel usage being a major factor in emission reduction forecasts (IPCC, 2014). The rate of technological advancement in the aviation sector has slowed down in recent years in regard to the rate of fuel consumption. The annual rate of fuel consumption reduction was approximately 3 – 6 % in the 1950s, to approximately 1 – 2 % in the beginning of this century (IPCC, 2014). If energy efficiency is not combined with price increases, then output prices are sure to fall, offsetting the climate effect somewhat. Policy could complement this in some fashion but implementing policy that incentivises technological advancements is difficult on a national level since fuel taxation is virtually illegal under the Chicago convention (ICAO, 1944) and EU legislation (Council Directive 2003/96/EC, 2003).¹⁵

A change in preferences could also yield decreasing emissions, such changes are difficult to predict but it should, nevertheless, be mentioned. An increase in awareness of climate change and its urgency might lead to some shifts in demand. It appears, however, that no preference shift great enough to halt the demand increase has occurred yet (Swedish Transport Agency, 2018)

6.1.3 Comparison

The relevance of this discussion is largely illustrated by the differences between these two objectives. It may seem a strange distinction to draw as they often lead in a similar direction, but

¹⁰This prohibition is often blamed on the Chicago Convention on International Civil Aviation (1944), but as Akerman (2013) explains, the wording of the convention only prohibits taxation of fuel already on board an aircraft on arrival in another state. However, most bilateral air service agreements that regulate international air traffic, including the EU/US Open skies agreement, prohibit fuel taxation, as does the EU energy taxation directive 2003/96/EC.

the difference can have substantial policy implication, both in terms of what policy action to take but also the magnitude of any policy. They are fundamentally at odds, if emissions are to reduce to a point of net zero emissions by 2045 then that reduction might go beyond the efficient level. This is only true for the Swedish quality objective, if the emission targets are set using an efficiency standard, or if marginal damages are sufficiently high, there is no distinction between the objectives at all. The central question is which target is more valid, one set by economics or one set by some other metric? The answer is not obvious.

6.2 Evaluating the Airline Tax in Relation to the Efficiency Objective

The evaluation a Pigouvian policy is rather straightforward in principle, compare the tax level with the marginal damage at the efficient level of output. The difficulty comes in what marginal damage estimation to choose. In this section it is assumed that the marginal damage chosen by the Commission of Inquiry is appropriate, for a discussion on the difficulties of choosing an appropriate level of marginal damage see the chapter 3 section 3.1. Those estimations are 1.15 SEK per kg CO₂-equivalent.

Since efficiency is the concern of this objective, rather than emission reduction generally (even if this is a consequence of efficiency), the current pricing of emissions is most relevant. Taxing aviation too much, at a level higher than its marginal damage, would be inefficient. In their calculations for the monetary costs of emissions the Government Agency for Transport Analysis (2016) discusses the rate of internalization for certain types of emissions, that is the rate at which external damages are internalized by some sort of fee, tax or any system of regulation for emissions. The health and infrastructure damages are mostly internalized by Swedish fees and taxes (Swedavia 2018; Transport Analysis, 2016) while emissions are not. The ETS internalizes some or all the CO₂ emissions, the uncertainty stems from the price of emission rights and whether it is enough to completely internalize the CO₂ emissions. The increased impact of emissions on high altitudes, which is the dominant form of climate damage on long-haul flights, is not covered by the ETS nor is certain emissions (Transport Analysis, 2016).

For short-haul domestic flights the standard CO₂ emissions are dominant, making the question of correct pricing important. If we assume CO₂ to be completely internalized, the marginal damage for domestic travel decreases by nearly two thirds (Transport Analysis, 2016). This is the assumption made by the Government Official Report (SOU 2016:83) and the tax is modelled

with that assumption.

To accept complete internalization risks setting the tax level too low however as many researchers and agencies have pointed out the prices of emission right being too low to properly internalize CO₂ emissions (see Transport & Environment, 2016; more). While knowing the extent of internalization is difficult, it would be prudent to put the tax level above the current level, since it is probably safe to assume the internalization of CO₂ is not 100 %.

As to the climate impacts not covered by the ETS, high-altitude related effects, certain types of emissions and flights outside the EEA, the tax needs to cover all of these costs entirely for an efficient outcome. For domestic travel, it does on short-haul flights if the emission data from Transport Analysis (the numbers used by the Government Official Report) are to be believed, but not on longer flights. This is a larger problem with the tax decrease resulting from parliamentary negotiation. For intra-EEA and other international travel however, the tax is far lower than what would be required, on average, to internalize the costs. For example, the external climate costs for a trip from Stockholm to Bangkok is nearly 2 600¹⁶ SEK (Transport Analysis, 2016) while the airline tax is only 400 SEK and is only applicable for one trip. Resulting in the price being 2 200 SEK below the efficient level, or 4 800 SEK if return-trips should be included (but that is a discussion for another time).

The Commission of Inquiry (SOU 2016:83) reasons that with a low tax level, there is no risk of any route being taxed above its marginal damage. Putting aside the possibility of differentiating the tax based on distance (which might be practically difficult to implement), using the lowest estimate for an entire market misses out on large potential efficiency gains since the tax is going to be far below the efficient level for most routes. Had the tax instead used an average distance or a representative proxy route, efficiency would increase.

To conclude this section, the tax appears to be at a reasonable but slightly too low level for efficient taxation at the domestic level, assuming the same marginal damages and degree of internalization as the Commission of Inquiry. The tax international travel (including the tax on intra-EEA travel which is the same as domestic) appear far too low compared to the efficient level.

¹⁶ *Adjusted for current price levels.*

6.3 Evaluating the Airline tax in Relation to the Emission Targeting Objective.

Using the results from figure 5.1 and 5.2 there are four different estimations of emission reductions (as measured by CDEs). These are 233 994, 150 087, 83 433 and 76 187 Tonne/CDEs. According to Statistics Sweden (2016) the total amount of emissions from Swedish aviation (both national and international) is 3 112 700 Tonne/CDEs¹⁷. The change in emissions is, at the most, 7.5 % and at the lowest estimate around 2.5 % (1.45 % if airport specific elasticities are used)¹⁸.

Compared to the emissions¹⁹ from the probable change in demand of 650 000 during 2018 and 670 000 during 2019, which is an increase of 2.8 % per year (Swedish Transport Agency, 2018), the effect of the tax is certainly noticeable, albeit minor. The expected increase is calculated with the tax in mind, meaning the expected demand would be higher without it. Most of the demand increase is expected to occur for international travel, resulting in higher emissions. The change in international travel is expected to increase around 4 % yearly, as opposed to domestic travel which is expected to increase around 0.5 % in the coming years.

A reduction in demand is certainly not the only way of reducing emissions. It is, however, the only concern for an output tax which does not incentivise (nor disincentivise) technological advancement. The only measurement of success for the airline tax (in regard to the emission reduction objective) is reduced demand.

The ETS is discussed more in the previous section yet it relates to this objective in some sense as well. While the extent and effectiveness of the ETS going forward is unknown, there are a few things that seem likely, if not certain. The ETS will not cover all the costs concerned with aviation nor cover non-EEA international travel. Meaning the type of travel that emits the most will most likely not be part of the ETS. Subsequently, the reduced demand for non-EEA air travel

¹⁷ This is the latest statistic available and it is from 2016. Since emissions change constantly as demand changes, we can expect this number to be slightly higher given the increase in demand over the last two years. This change is slight enough to not make a significant difference for this analysis, it is however worth keeping in mind. The total amount of emissions depends on how they are counted, the actual numbers are less important for this thesis than the relative change of emissions however. It is nonetheless important to note that different results can be reached based on the measurements of emission used. For higher emission estimates see (Swedish Environmental Protection Agency, 2018)

¹⁸ Given that the airport level elasticities only exist at the domestic level and the substantial variance between airports existing, they are less useful here and more useful to give a picture of the differences at the local level.

¹⁹ No estimations for the expected emissions exist, only expected increases in demand. It is reasonable to assume however that emissions will increase more than demand, since most of the expected demand concerns international travel.

becomes vital for the effectiveness of the airline tax. A lasting effect most likely requires the reduction of such travels to be more substantial than it is. Of course, it needs to be noted that the ETS need not constrain national policy. From the perspective of the emission reduction objective, efficiency and internalization are not chief concerns, only emissions are. Meaning any reduction will aid in such a goal, whether efficient or not.

In relations to the overarching quality objective of net zero emissions by 2045, the effect of the tax appears minor but not insignificant. While it is, as discussed previously, difficult to tell where reductions should come from and how large a part any single policy should play, it seems clear that more and more aggressive policies are required to reach such an objective. Should the rate of technological advancement increase, or the next period for the ETS become better at reducing emissions, that changes. In conclusion, the tax does aid in achieving the quality objective, becoming successful by definition. Its contributions can hardly be considered significant however.

Chapter 7. Conclusion

The initial intuition seems correct, the sufficiency of the airline tax depend on which objective is deemed to be more important. The policy will not correct the climate externality fully since the tax rate is set at a low enough level as to never be too high for any destination, on top of the tax being lowered in parliamentary negotiations. It will, however, increase efficiency by internalising some of the externalities from aviation emissions. On a domestic level, the tax manages to correct for most of the climate externality. For international travel however, especially long-haul flights, the tax is generally too low to internalize a significant part of the external damages. The low tax rate implies that overtaxing and increasing existing distortions to such an extent that it lowers overall efficiency seems improbable, unless other marginal damage estimates are used which are much lower than those used in this thesis.

As for the second objective of reducing emissions to aid in the completion of the quality objective, the success of the tax is more ambiguous. The results of applying the different elasticities to predict changes to demand and emissions indicate a noticeable drop in both (compared to what would have been the case without the airline tax). The demand and emissions are still increasing however, and the sufficiency of the airline tax depend on the ability of other

factors to reduce emissions further. If the airline tax was meant to be a significant addition to the quality objective, its success is doubtful. As a complement however, it serves a purpose and thus aids in the completion of the Swedish quality objective.

The efficiency objective is fraught with many issues. Most notably, it is difficult to estimate what the efficient level of taxation is. There is no objective answer when it comes to the climate, since monetary evaluation of the climate is subjective to some extent. This is most notable when choosing a discount rate. Estimating the monetary effects of emissions on a complex climate is difficult to do with any accuracy, as is evident by the wide range of marginal damage estimates. Efficiency can still be increased to some extent without knowing what the most efficient level of taxation is however. Efficiency's ethical value is potentially limited, or at least uncertain. For those reasons, efficiency is questionable as a primary objective for environmental taxation, yet it can still be a useful tool when constructing policy.

The emission reduction objective requires less normative assumptions and the process of reaching the objective is more straightforward, making it more predictable in principle. The problem is deciding a target for reducing emissions and knowing how much emission reduction is necessary for each individual policy that is working toward that target. If the emission target is set generally instead of a per-policy basis, as is the case with the airline tax, knowing when the objective is reached becomes difficult. The emission reduction objective is prone to several of the same problems that hinders the efficiency objective, since deciding on an appropriate level of emission reduction also requires normative judgements.

To conclude, to better reach both objectives, a higher tax rate would be advisable. The emission reduction objective is appropriate for the airline tax if an appropriate target can be agreed upon. Efficiency appears less sound as an objective yet is still important to consider when constructing policy.

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