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Flight Shame: An Economic, Game-Theoretic Interpretation of Social Values and Aviation Patterns

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Abstract: In this paper, we have given the very recent phenomenon of flight shame an economic interpretation and demonstrated how transforming social values can be an important part of the transition towards a sustainable transportation sector. By developing and simplifying an already existing model, we were able to capture some essential real-world features to reflect the multifaceted notion of human decision-making. We demonstrated how changes in social values and the associated flight shame can affect individual's choices of transportation away from aviation and towards more sustainable modes of travel, and we suggested that societies must engineer social values to preserve the environmental common good.

Keywords: aviation, flight shame, climate anxiety, game theory, model of decency

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1. Introduction

Aviation has become an integrated part of everyday life in large parts of the world. The use of airplanes as a mode of transportation has made the world easily accessible and are nowadays frequently utilized by both business- and leisure travelers. It is a comfortable and, for many, a highly-appreciated form of transportation. Sweden, being a far-stretched country in the outskirt of Europe, has greatly benefited from aviation and today Swedes fly more than the annual European average by a factor of seven (Dunkl, 2018).

Meanwhile, climate change has become one of the most urgent global issues currently facing humanity. The European Union has, among others, described the battle against it as "a key priority" (General Secretariat of the Council, 2019), and all twenty-eight member states are signatories for the United Nations Framework Convention on Climate Change [UNFCCC], the Kyoto Protocol, and the newly signed Paris Climate agreement. Various industries, including the aviation sector, have been at the receiving end of criticism for their pollution damages and extensive greenhouse gas emissions. There is currently work being done to reduce the aviation sector's climate footprint, including sovereign policy tools such as taxation and emission trading systems, as well as the development of biofuel and electric airplanes. However, the impact of these interventions is yet to be observed.

In December 2010, the Swedish newspaper Svenska Dagbladet published an article about what at the time was a brand-new psychiatric phenomenon (Lagerblad, 2010). They called it climate anxiety, anxiety associated with the emerging threat of climate change. The article portrayed a 17-year old boy who two years earlier, in 2008, was taken into custody by the psychiatric department of the Royal Children's Hospital in Melbourne. He feared a global drought, causing millions to die from dehydration, and the anxiety made it nearly impossible for the boy to drink any water himself. The psychiatrists explained to his parents, in lack of any appropriate psychiatric diagnosis, that the boy suffered from "climate change delusion". As time passed by, however, the psychiatrists responsible for the 17-yearold experienced more and more similar cases with psychoses and panic disorders linked to the fear of climate change. Although some authors examined already in 2008 how mental health is associated with climate change[1], this is probably one of the earliest known clinical cases of climate anxiety.

Derived from climate anxiety, the word *flygskam*, flight shame, made its grand appearance into The Dictionary of the Swedish Academy in 2018. The word originates from a shift in public opinion regarding aviation and its climate impact. Nowadays, to an increasing extent in Sweden, aviation is starting to become associated with blameworthiness, and an increasing number of people are inclined to use alternative transportation modes with less environmental impact. With Sweden being one of the first countries ever experiencing this kind of blameworthiness and flight shame, it subsists as an interesting, relevant and contemporary topic to examine with economic measures.

[1] See, for example, the work of Searle and Gow (2010); Fritze, Blashki, Burke and Wiseman (2008).

Due to the flight shame's very recency, however, few contemporary data points are available, making it difficult to measure its impact using an econometric, inductive approach. Till this day, no previous literature has ever been conducted to examine and interpret flight shame using economic methods. This paper seeks to fill this knowledge-gap by giving flight shame an economic, game-theoretic interpretation and demonstrate how shared understandings of societies are associated with blameworthiness.

In this paper, the aviation sector will be limited to only include travels associated with business and leisure. The transport sector's use of aviation, as well as the military's, will hence be excluded from the discussion. As flight shame is a phenomenon associated with personal travel and, to some extent, corporate travel, we argue that this definition of the sector enables a more clearly defined discussion without negatively impacting the conclusions of the paper.

We will start this thesis off by addressing the aviation sector's climate footprint and its history in the Swedish marketplace. We will follow this up by a thorough literature review, focusing on the interchangeability of aviation, time effects, and externalities. Our purpose is to provide the reader with a rigorous background before using our game-theoretic models to explain and illustrate the effects and implications of flight shame and social values.

2. The aviation sector's climate footprint

This section is conducted with the purpose of enhancing the understanding and the wherefores of flight shame. For this reason, a brief overview of the aviation sector's climate footprint will follow.

Sweden emitted a total of 52.7 million tons of greenhouse gas in 2017, a reduction of 0.5% from the previous year (Swedish Environmental Protection Agency, 2018a). In 2017, Sweden passed legislation to become carbon dioxide neutral by 2045 (UNFCCC, 2017), and to reach said goal, an average annual emission reduction of 5-8% would have to be sustained, in other words, a far higher reduction pace than what was experienced in 2017. While Sweden's annual greenhouse gas emission has fallen since 1990, the reduction pace has been steadily decreasing and the transportation sector has fallen behind in the sustainable transition. Focusing on the domestic transportation sector, its total emissions amounted to 17 million tons in 2017, i.e. 32.3% of Sweden's total greenhouse gas emissions. Domestic air travel comprised 553,000 tons of greenhouse gas, constituting a fraction of 3.2% of the transportation sector's total. While the domestic aviation sector's emission only accounts for 1% of Sweden's total, this figure rises to 19% when including international voyages (Swedish Environmental Protection Agency, 2018b). The aviation sector is an industry that, like any other industry, must reduce its emissions for Sweden to become carbon dioxide neutral by 2045. In order to gain some perspective on the environmental impact of aviation, a comparison with trains can be of use. The Swedish railway company SJ, for instance, estimates that the emissions from a flight between Stockholm and Gothenburg are 40,000 times greater than the same trip traveled by train (SJ, n.d.).

One could, of course, argue whether flight shame is based on rational notions and to what extent it effectively reduces Sweden's total greenhouse gas emissions. More efficient interventions can perhaps be undertaken, for the purpose of reducing Sweden's total climate impact, than engineering social values in order to make citizens comply with the interests of the common good. However, the purpose of this thesis is not to make any normative interpretation of flight shame, nor do we wish to address its de facto environmental implications. Instead, we aim to explain flight shame with economic measures, demonstrate the importance of social values in a society where each individual seeks to maximize her own utility, and describe why a shift in social values have, presumably, lead to a decrease in aviation demand.

3. The history of the aviation sector in Sweden

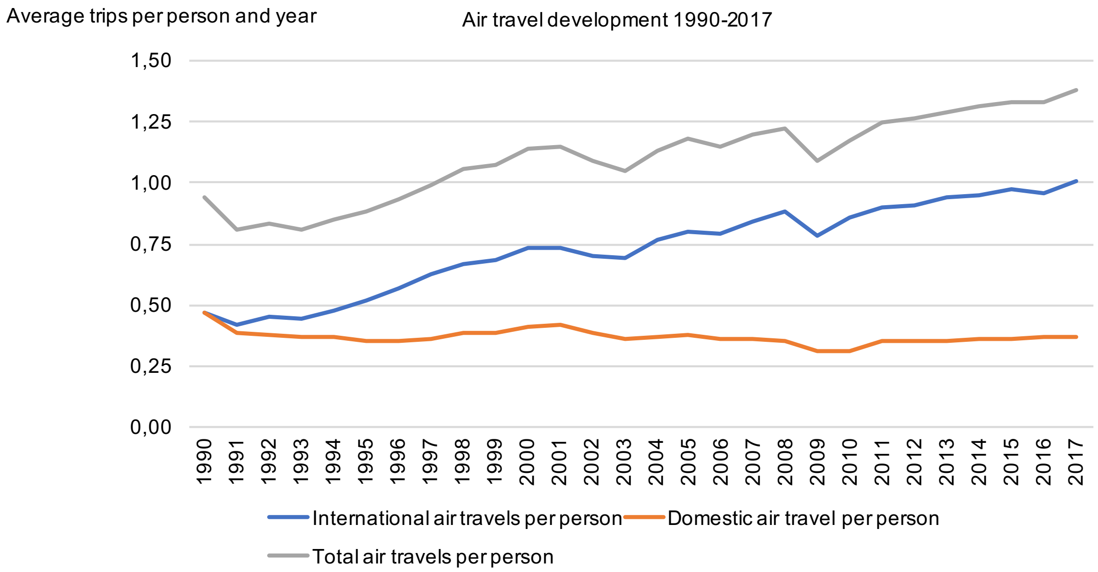
An important part of justifying the topic of flight shame in general, and this thesis in particular, is to note its impact on aggregated aviation demand. As previously explored, due to the very recency of flight shame, few data points on aggregated demand are available when controlling for fare price and changes in convenience, and the airway companies have been reluctant to share any information that could tell tales of declining consumer demand. Therefore, for the purpose of justifying our topic, we will rely on the somewhat anecdotal evidence indicating a growing public reluctance towards the use of aviation. However, as mentioned in the previous section, the purpose of this thesis is not to evaluate any de facto effects on aggregated demand, but to make an economic interpretation of flight shame and show how social values can affect the aggregated aviation demand of societies.

In order to gain some perspective on the presumed recent decline in aviation demand,[2] that to some extent could be caused by flight shame, it is important to first acknowledge how the demand for aviation has developed historically. In this section therefore, we will describe the aviation sector's development since the deregulation in 1992 and onwards. The events prior to the deregulation are not deemed to be of any relevance for the purpose of this thesis.

In the proposed budget put forward by the Swedish government in 1992 (1991/92:100), it was suggested that the Swedish domestic aviation sector should be deregulated in terms of pricing, supply, and capacity. The overarching goal of the proposal was to ensure increased levels of service and lower fares. The Swedish Competition Authority had in 1989 (SOU 1990:58) reviewed how regulated sectors in the Swedish economy, including the transportation sector, could obtain a higher degree of competition, and they believed that the domestic aviation sector was mature enough to be internationally competitive. In addition, the competition associated with the internal market of the European Union and its treaties, in combination with a 250% increase in passengers for domestic aviation travel in Sweden between 1980-1990, further contributed to the proposal. Furthermore, the US deregulation of its aviation sector in 1978 had been positively observed, and as a result, more routes had become available at lower prices following the sector's liberalization. The proposition was enacted on the first of January 1992.

[2] Although anecdotal, see Matsgård, commercial manager at Bromma Airport, (Yttergren, 2019).

Graph 1.



Source for underlying data: (Swedish Environmental Protection Agency, 2018b)

Due to the severe Swedish recession of the early 1990s, there were no clear positive changes in the demand for domestic air travel following the deregulation. Instead, there was a decline in the number of passengers between 1990 and 1991, from 8.7 million to 7.2 million, thereby disrupting the historically steady growth path of the industry, and it was not until the second half of the 1990s that the sector recovered to passenger levels in level with those before the crisis (Luftfartsverket, 2001). Following the 2001 terrorist attack in New York City, there was once again a decline in aviation, even in the Swedish market, and it was not until 2003 that the market regained growth. Similarly, there was a decline in the Swedish market following the financial crisis in 2008.

Graph 1 seems to indicate some correlation between economic cycles and passenger volumes, as clear reductions in air traffic are observed around the time of the financial crisis of 1990 and 2008. Furthermore, security concerns do also seem to impact aggregated demand as the Swedish aviation market contracted following the events of 9/11 in the US.

In the graph above, data from 2018 and Q1 2019 are yet to be publicized, hence no apparent tendencies point to any decrease in aviation demand, as suggested in the introduction of this thesis. However, despite this lack of aggregated data, section 4.5 will introduce anecdotal evidence from aviation companies and external observers, which do suggest that there has been a stable decrease in demand since the last quarter of 2018, to some extent caused by flight shame. Yet again, the purpose of this thesis is not to detect any de facto changes in aviation demand, but to make an economic interpretation of flight shame and its possible implications. Hence, our theoretical approach is not hampered by the current lack of coherent data.

Furthermore, as Luftfartsverket (2001) explains, government agencies have deemed the aviation sector to be in a mature phase since the early 1990s and the per capita demand has been quite stable in the past three decades. Any clear sign of a decrease in demand should therefore, given that it cannot be fully explained by economic factors, be explored further.

4. Literature Review

In section 6 and 7, we will demonstrate how social values, blameworthiness, and flight shame, affect individual's choices of transportation. We will do so by comparing individual utilities associated with aviation and train traveling and assume that each individual seeks to maximize her own utility. However, as explained in the foregoing section, economic factors have an obvious and significant impact on the demand for aviation. Therefore, in order to strengthen this argument and further lay the foundation for the discussion that will follow, a concise examination of the previous work regarding price elasticities will follow next. The mathematical expressions covering elasticities can be found in Appendix.

4.1 Own-price elasticities and cross-price elasticities

Jung and Fujii (1976) completed a quasi-experiment using cross-sectional city-pair data from three cities in the south-central regions of the US with distances between 80-800 kilometers. The travel data was collected for the second quarter of 1972 and 1973 where no city pairs were allowed to differ in schedule frequency. The paper concluded that the price elasticity of demand was in the range of -1.77 to -3.15.

Straszheim (1978) explored the potential complications of using data over a long time period to estimate price elasticity. He argued that it is difficult to separate the effects from changes in the service provided (seating-quality, inclusion of food and so on) and the effects of price changes for a particular destination if other, better, routes become available to the consumer. In an effort to reduce this issue, Straszheim used aggregated data for the entire aviation market in the North Atlantic region, thereby capturing all passengers in the data set. The paper concluded that the price elasticity is higher the lower the class of the ticket.

Fridström and Thune-Larsen (1989) found that the fare elasticity in the short- and medium run was -0.82, while the (undefined) long-run price elasticity was -1.63. Brown and Watkins (1968) conducted an analysis of time series in combination with an analysis of cross-section data for city-pair markets and found a price elasticity of -0.85, remarkably similar to the study of Gronau (1970) which concluded a price elasticity for domestic flights in the United States of -0.75. Over longer distances, the Brown and Watkins study concluded that there was an insignificant degree of elasticity which goes in line with the study of Mutti and Murai (1977), that concluded in their study, across the North Atlantic airplane market, that there was a general price inelasticity of -0.89. They further concluded that the price elasticity was lower than 1.0 in all six Western countries included in the sample (the US, the United Kingdom, Netherlands, Italy, Germany and France) but that the income elasticity was significantly higher. The study concluded that the price elasticity appeared to be higher in the US than in the European countries, but this was believed to be caused by the higher degree of (and less price sensitive) business travelers in the European data. Alperovich and Machnes (1994) had similar conclusions and showcased that the demand for air travel in Israel was price-inelastic (-0.27) and income-elastic (between 1.64 and 2.06).

Brons et al. (2002) compared price elasticities between Europe, the US and Australia. The hypothesis was that the price elasticity was higher in Europe due to the greater amounts of substitutes (highly developed train-track network and travel options by boat). The meta-analysis composed 204 previous estimates of price elasticity for air travel demand, but the hypothesis was not supported by the data. The study did however show that the long-run elasticity was higher than the short-run due to the inconvenience of changing short-term behavior patterns.

Gama (2017), when comparing own-price elasticities and cross-price elasticities of U.S. domestic flights and intercity trains, concluded that the own-price elasticity of flights was higher than the own-price elasticity of trains, in absolute terms, by a factor of four. This meant that if the price of plane tickets increased by the same percentage as the price of train tickets, the market share for planes would decrease by more than the market share for trains. In other words, in this particular setting investigated by Gama, the flying sector is more sensitive to changes in fares than are the railroad sector. Furthermore, Gama concluded that because of the positive cross-price elasticities of flights and trains, they are indeed substitutes. Gama estimated that a 1% increase in the price of flight tickets would make people switch to trains and increase their market share by 0.0002%. Similarly, if the train tickets went up by 1%, some people would switch to flying and increase the market share by 0.0008%. Worth noting here is that the cross-price elasticities for flights was higher than for trains. This meant that train travelers were more willing to switch to planes, given the same percentage increase in fares. But although cross-price elasticities are positive, they were not very big. Hence, it might be difficult to make consumers change mode of transportation by merely changing the fares.

Kopsch (2011) conducted an analysis of the demand for air travel on the Swedish marketplace by using aggregated data where no segmentation of fare categories (i.e. leisure and business) was made, though a variable explaining prices in July was used to control for presumed increased leisure demand during the summer holiday. The study showed that the demand for domestic air travel in Sweden was fairly inelastic in the short run (-0.84) and elastic (-1.13) in the long run, where leisure travelers were more sensitive (-0.87) to fare changes than business travelers (-0.67), a result in line with previous studies. The cross-price elasticity between air travel and train travel is found to be 0.44.

Intervistas (2007) conducted a study with data between 1980-2006 and composing 23 different countries. The conclusion was that the price elasticity for domestic leisure air travels was -1.52, compared to -0.7 for business travelers. It was further found that the elasticity for trips within Europe was -1.1 for leisure travelers and -1.15 for business travelers. SIKA (2006) managed a similar study for the Swedish marketplace and found that the price elasticity for domestic air travel was -1.0 among leisure travelers, and -0.2 for business travelers.

Table 1: A summary of selected price-elasticity- and cross-price elasticity studies referred to.

Study:	Price elasticity of demand
Jung and Fujii (1976)	-1.77 to -3.15
Straszheim, M.R. (1978)	-1.92 (summer period)
Fridström and Thune-Larsen (1989)	-0.82 (short- and medium-run) and -1.63 (long-run)
Brown and Watkins (1968)	-0.85
Gronau (1970)	-0.75
Mutti and Murai (1977)	-0.89
Alperovich and Machnes (1994)	-0.27
Brons et al. (2002)	
Kopsch (2011)	-0.84 (short-run) and -1.13 (long-run)
Intervistas (2007)	-1.52 (leisure) and -0.7 (business)
SIKA (2006)	-1.0 (leisure) and -0.2 (business)

Studies focused on price elasticities of demand for aviation, spanning across several decades, show a conclusive picture of a general price elasticity for aviation, although no single representative elasticity measure emerges. Some studies conclude a general price inelasticity while others conclude a general price elasticity.[3] The results vary depending on the time-period, the market observed, and the underlying methodology used in the studies. Furthermore, the research is indicating a higher general price elasticity for the leisure segment. This could be due to the flexibility leisure travelers possess in respect to time and destination, in comparison with business travelers.

Clearly, demand is affected by economic variables, both price and income, as described above. However, the general inconclusiveness regarding the elasticities of aviation seem to indicate that other significant factors are important for the quantity demanded by consumers. These variables will be discussed below.

4.2 The time aspect and its effects on aviation demand

Although the previous segment indicates some price elasticity of demand for aviation, the measure is undeniably quite weak, especially the cross-price elasticity of demand between aviation and railway. There are indeed other factors explaining how people choose between different transportation alternatives. The time savings associated with traveling by plane is another factor that, alongside the standard economic ones, determine the demand for aviation. (Button 2010). Examining these factors are therefore necessary to provide a sufficient base of

[3] For definitions regarding elasticity and inelasticity, see Appendix.

knowledge regarding what has historically been the driving parts of consumer demand. While further factors (such as the political landscape and general safety of a destination) can provide profound explanations to some erratic ripples in the aggregated demand, they are not necessary to further explore given the purpose of this thesis. An explanation of the time aspect and its impact on demand will follow below.

The demand for aviation is partly interlinked to the distance one travels. In the case of shorter distances, for example, aviation is for the most part not considered a transportation alternative, but for longer trips, railway and automobile are the only two reasonable substitutes to aviation. One feature for individuals to consider when making choices regarding transportation modes is the time aspect, equal to some notion of *the travel time budget*. The idea of a travel time budget, derived from the notion of *Marchetti's constant*, is based on the research of Italian physicist Cesare Marchetti (1994). He concludes that people will spend roughly one hour a day traveling, regardless of any improvements in transportation and infrastructure, and that people have done so ever since Neolithic times. As infrastructure and urban planning improves, people will merely adjust their traveling patterns by traveling longer distances.

The ideas of Marchetti is further developed by David Metz (2008), as he points out that "[…] people are choosing to increase the distance they regularly travel, rather than opting for shorter journey times". Following the logic of Marchetti and Metz, the inherently slower pace of which trains and cars operate vis-á-vis airplanes will make consumers, on average, more likely to prefer aviation due to the longer distances one can cover by the same amount of time spent traveling. This has a big impact on transportation habits and helps explain why the cross-price elasticity is small between aviation and railway.

Furthermore, there has been vast amounts of research conducted with the purpose of placing a monetary value on non-work travel time, i.e. the value of time spent traveling that is not part of any paid work. The reason for this is to reveal how travelers value time savings. Intuitively, if an individual is willing to pay SEK X to save Y minutes, then the implicit value of time is equal to SEK (X/Y) per minute.[4] Most studies of non-work travel time are derived from commuting and the result of Waters (1992) is presented below.

[4] Given that individuals value time savings linearly.

Table 2: Values of travel time savings as suggested by Waters (1992).

Study:	Country	Value of time as % of the wage rate	Trip purpose	Mode
Beesley (1965)	UK	33-50	Commuting	Auto
Quarmby (1976)	UK	20-25	Commuting	Auto, transit
Stopher (1968)	UK	21-32	Commuting	Auto, transit
Oort (1969)	USA	33	Commuting	Auto
Thomas and Thompson (1970)	USA	86	Interurban	Auto
Lee and Dalvi (1971)	UK	30-40	Commuting	Bus, Auto
Wabe (1971)	UK	43	Commuting	Auto, Subway
Talvitte (1972)	USA	12-14	Commuting	Auto, transit
Hensher and Hotchkiss (1974)	Australia	2.70	Commuting	Auto, transit, Hydrofoil. Ferry
Kraft and Kraft (1974)	USA	38	Interurban	Bus
McDonald (1975)	USA	45-78	Commuting	Auto, transit
Ghosh et al. (1975)	UK	73	Interurban	Auto
Guttman (1975)	USA	63	Leisure	Auto
Hensher (1977)	Australia	35–39	Leisure, commuting	Auto
Nelson (1977)	USA	33	Commuting	Auto
Hauer and Greenough (1982)	Canada	67-101	Commuting	Subway
Edmonds (1983)	Japan	42-49	Commuting	Auto, bus, rail
Deacon and Sonstelie (1985)	USA	52-254	Leisure	Auto
Hensher and Truong (1985)	Australia	105	Commuting	Auto, transit
Guttman and Menashe (1986)	Israel	59	Commuting	Auto, bus
Fowkes (1986)	UK	27-59	Commuting	Rail, bus
Hau (1986)	USA	46	Commuting	Auto, bus
Chui and McFarland (1987)	USA	82	Interurban	Auto
Mohring et al. (1987)	Singapore	60-129	Commuting	Bus
Cole Sherman (1990)	Canada	116-165	Leisure	Auto

Source: Waters (1992).

As can be observed in the table above, individuals do value non-work travel time savings to a varying degree, however, the implicit value is, in most studies, below the wage rate. Although the above-mentioned studies have mostly researched urban commuters, parallels can be drawn to longer business- and leisure trips in the aviation sector. Even though the values are highly dependent on the methodology used and the assumptions made in the studies, they all clearly demonstrate that individuals value time savings and are willing to pay some amount to reduce the time spent traveling. This revelation helps explain why the aviation sector has grown in the past 50 years and why the price elasticities presented in section 4.1 are not higher.

The reduction in travel time derived from the usage of aviation is clearly something people value. Individuals will by this reasoning try to maximize the distance traveled whilst minimizing the travel time. However, using aviation as a mean to maximize the travel time budget has further consequences – negative externalities. A theoretical explanation to the externalities associated with aviation will follow in the next section.

4.3 The tragedy of the commons

Before discussing externalities and social values, an introduction to the concept of the tragedy of the commons will be presented. By doing this, we want to provide a theoretical background to the sections that follow. As we will see, extensive use of fossil fuel and the associated greenhouse gas emissions is a classical tragedy of the commons problem, and a literature review of this topic is an absolute necessity in order for us to understand the aviation patterns of today. Of particular interest in this section is how some authors describe the problem as a "no technical solution"-kind, as well as the emergence of bottom-up public solutions. Flight shame, and climate activism in general, share traits with these bottom-up solutions.

The well-known theories of the Scotsman Adam Smith, as put forward in his work The Wealth of Nations (1776, Book IV, chapter 2, p. 445), argues that an individual who "intends only his own gain [is] led by an invisible hand to promote […] the public interest". Although Smith never argued that this was an unconditional case, a simple game theoretic setting can easily show why Smith got it wrong, or at least how he got misunderstood. Two players playing a game of the prisoner's dilemma will, under the assumption of common rationality, fail to maximize the common utility because of their own self-serving deeds.

Self-serving interests are an important component of the tragedy of the commons, and the extensive greenhouse gas emissions associated with aviation is a classic example of this common tragedy. It was firstly introduced by William Forster Lloyd in his soon to be two-hundred years old essay *Two Lectures on the Checks of Population,* published at the University of Oxford in 1833. The concept became widely known when the American ecologist and philosopher Garrett Hardin introduced his well-cited article *The Tragedy of the Commons*, published in Science in 1968. Although not being the first author to construct this theory[5], Hardin explains how individuals acting in their own self-interest will cause an over-exploitation of common resources and hence not generate the socially optimal outcome, thus in somewhat contrast to the ideas of Adam Smith. Although this, in the short-run, would lead to higher personal profit and utility, it would eventually cause the destruction of the common resource.

[5] See, besides the work of William Forster Lloyd, the work of Gordon (1954); Scott (1955).

When explaining the feature of the tragedy of the commons, Hardin (1968) demonstrates an example with cattle and herdsmen. We will modify his example to fit our context, and for this reason include aviation, travelers, and greenhouse gas emissions.
Consider the case of several individuals in a society with a need for transportation. Each individual can afford to buy fares for aviation, and together with all other individuals they share a common environment. In the case of just a few aviation trips per individual, the common environment will be resilient enough to cope with everyone's generated emission. However, when each rational individual tries to maximize his own gain, any individual will add an extra trip to his travel scheme and thereby gain some utility. What is the cost of adding one additional trip? The individual needs to pay some fare but would not do so if the utility associated with the trip was less than the disutility associated with funding the ticket, in other words, the individual earns some net utility. However, adding one additional trip affects the common environment. The costs of negative externalities, in this case the higher levels of greenhouse gas in the atmosphere, will be paid for by all other individuals as well, not only the one individual adding the additional trip to his utility fortune. By this reasoning, the additional cost for any individual adding one additional trip is only a fraction of what the total cost is to the common society. Hence, every rational individual will continue increasing his number of trips and eventually ruin the common for everyone.

"Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons."
Hardin (1968, p.3).

There are other problems associated with this fallacy as well. Say, for example, that we can solve the tragedy of the commons by appealing to each player's conscience of what is to be considered a fair number of trips. In that case, self-serving bias runs the risk of making everyone's assessment of what a fair number of trips are biased in a narcissistic way, even if players share the same information.[6]

Hardin (1968) goes on by addressing pollution as a phenomenon.

"The rational man finds that his share of the cost of the wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them. […] The owner of a factory […] has difficulty seeing why it is not his natural right to muddy the waters flowing past his door."
Hardin (1968, p.4*)*.

The last sentence in the quotation above highlights the problem with self-serving bias.

Furthermore, Hardin argues that to some problems, there are "no technical solutions", and he goes on by defining a technical solution as "[…] one that requires a change only in the techniques of the natural sciences, demanding little or nothing in the way of change in human values or ideas of morality." (p.1). Although Hardin made his argument regarding the context

[6] For a deeper understanding of the role of self-serving biases, see for example the work of Babcock and Loewenstein (1997), and section 8.3.

of overpopulation, his observations do have wider implications as well. In fact, Hardin discusses morality and the role of conscience. He argues that the laws of society are often ill-suited to address complex problems, especially in a changing environment. And although enacting laws may be a simple task, enforcement and governance are typically more difficult. He states that "It is a mistake to think that we can control the breeding of mankind in the long run by an appeal to conscience." (1968, p.5). Indeed, to put the existential threat of climate change in the hands of the human conscience is arguably a great risk to take. However, he argues, societies must find ways to make citizens comply with what is considered to be in the public interest. In the model we develop in section 6 and 7, individuals not complying with the social norm will be blameworthy and suffer feelings of shame.

Hardin proposes several alternatives to deal with the tragedy of the commons problem, for example to sell the common as private property or to keep the common as a public property but allocate usage rights. What is of most importance, he argues, is that we choose among the alternatives, or otherwise the commons will be destroyed. However, to sell the atmosphere as private property is a difficult task.

Elinor Ostrom, the first woman laureate of the Nobel Memorial Prize in Economic Sciences, argues, in contrast to Hardin's dystopian view of human conscience, that individuals often create solutions to the common problem themselves. In her research, Ostrom (American Enterprise Institute, 2012) points to several real-world examples where bottom-up approaches from the community have resulted in a sustainable, shared management of resources. The shifting values associated with flight shame is one of these bottom-up movements. Following the ideas of Ostrom, changing social values, in contrast to allocating atmospheric property rights, might be a more pragmatic way of coping with the tragedy of the commons fallacy.

4.4 Valuation of externalities

By the work of previous sections, it should now be clear that the demand for aviation is interconnected with economic features such as the ticket price and the price of substitutes, as well as the value individuals associate with time savings. In section 4.5, when addressing the presumed transformation in social values regarding aviation, we will argue that changes in public opinion are derived from individuals considering the negative long-term externalities associated with aviation, i.e. greenhouse gas emission, and that such externalities have a direct impact on people's utility.

In this section however, following Hardin's (1968) view of externalities ruining common goods, evidence will be put forth to demonstrate that individuals have put a monetary value on aviation externalities historically as well, but only in the context of short-term externalities with a direct effect on an individual's utility.

In a meta-analysis conducted by John Nelson (2004), the negative relationship between noise levels, due to close proximity to airports, and property values was evaluated. The study included 33 estimates from 23 different airports across the United States and Canada, from a total of 20 different studies. Despite some differences between countries, the weighted-mean noise discount, i.e. the decrease in property value, was 0.58% per increased decibel. The takeaway for the context of this thesis is that short-run externalities can, and have by individuals, been measured in monetary terms and impacted individuals purchasing behavior.

Table 3: The relationship between noise level and property value, as suggested by Johnson and Button (1997).

Study:	% in house price	Country
Abelson (1979)	0.45	Australia
Collins and Evans (1994)	0.45	UK
De Vany (1976)	0.80	US
Dygert (1973)	0.60	US
Emerson (1969)	0.57	US
Gautin (1975)	0.35	UK
Levesqus (1994)	1.30	Canada
Maser (1977)	0.62	US
McMillan (1978)	0.50	Canada
McMillan (1980)	0.87	Canada
Mieszkowski (1978)	0.40	Canada
Nelson (1979)	1.10	US
O'Byrne et al. (1985)	0.52	US
O'Byrne et al. (1985)	0.57	US
Paik (1972)	0.65	US
Pennington et al. (1990)	0.60	UK
Price (1974)	0.83	US
Uyeno et al. (1993)	1.13	Canada

Source: Johnson and Button (1997)

In contrast to the study of Nelson (2004), pollution and greenhouse gas emissions associated with aviation can only be observed in the long-run and are thus not immediately obvious to the individual actor. Therefore, compared to the studies cited above where one single noise source (in this case airplanes) contributed to these short-term externalities, it is difficult to blame climate change on any sole airplane. This is yet again analogous to the ideas of Hardin (1968), more specifically his view of long-term externalities being paid for by all individuals in society, not only the individuals using the airplane, and that the additional cost for the individuals traveling by airplane is only an insignificant fraction of the total long-term cost to society. Instead, emissions are usually only seen when aggregated on a global scale.

In the next section, changes in social values regarding environmental concern and aviation will be introduced, and evidence will be put forth to show that individuals are starting to alter their behavior due to the negative environmental impact associated with the use of aviation. In other words, individuals are starting to consider the aviation's long-term negative externalities.

4.5 Fluctuations in social values

As previously explained, no aggregated data points on aviation consumption is yet publicly available for 2018 and 2019. And since the phenomenon of flight shame made its breakthrough in 2018, data from 2017 and before will not showcase any recent decline in aviation demand. There are, however, surveys and data from individual aviation companies and airport operators in Sweden that provide such information. Some of these surveys and data points will be presented below.

Vagabond's annual survey on Swedish aviation habits concluded that a fourth of the participants will be reducing their flying during 2019, and when being asked for what reason, 64% answered that it was due to the aviation sector's environmental impact. According to the responses of the survey, 2018 was the first year where a decrease in aviation was detected that could partly be explained by other factors than economic ones, political risk or war. In comparison to the survey of 2016 where 0% answered that they withstood aviation traveling because of environmental concerns, it seems to have been a recent shift in the perception of aviation (Andersson, 2019).

A similar survey, produced by Royal Dutch Airlines (KLM) in cooperation with Ipsos (2018), concluded that 69% of the participants believed aviation had a negative impact on the climate (10 percentage points higher than 2017) and about half of the respondents stated that they had a bad conscience following the purchase of an airplane ticket. In other words – they felt flight shame. Simultaneously, 8% stated that they were planning to eliminate aviation as a form of personal transportation, and 36% of the respondents stated that they climate compensated their travels. Unfortunately, it is somewhat difficult to provide an understanding of the long-term changes in public opinion by the use of these surveys, as KLM and Ipsos only been conducting surveys on Swedes' view on aviation and its climate impact since 2016. However, the very fact that this type of surveys has come into existence should perhaps be viewed as the biggest sign of a shift in social values among the Swedish citizens (Bergqvist, 2019).

WWF's assessment of Swedish consumers for 2019 drew similar conclusions, where a fourth (23%) of the respondents answered that they had neglected trips by airplane due to its environmental impact (compared to 19% in 2018). Furthermore, two fifths of the respondents also answered that they had chosen to travel by train instead of airplane in the past 12 months (WWF, 2019).

According to Swedavia that operates 10 airports in Sweden including Arlanda, Bromma and Malmö Airport, these suggested changes in behavior and opinions seems to have had an actual impact on the aviation demand. The number of passengers has been decreasing year-on-year for the past seven months (October 2018 – March 2019). Swedavia themselves explain this reduction as partly the effect of changes in public opinions regarding climate and aviation, but also due to currency fluctuations and the unnaturally warm Swedish summer of 2018. Furthermore, the Swedish Transportation Administration reported a decline for the domestic aviation industry of 3.7% in 2018, and 5% during the first quarter of 2019 (Axelsson, 2019).

Similarly, the aviation company BRA, with over 1,000 employees, 30% market share and 17 out of their 21 destinations being located within the Swedish border, recently announced that they will lay-off 363 employees. The company quotes the decreasing demand for domestic aviation, currency fluctuations, increasing price of jet fuel and flight shame as reasons behind this layoff. Additionally, BRA announced that they will phase out their older airplanes and instead focus on smaller and more environmentally friendly ones (BRA, 2019).

The Swedish railway company, SJ, are also experiencing the effects of the, seemingly, new trend in Swedish transportation. 2018 was a record year for the company with a total 31.8 million passengers, despite the warm weather affecting many passengers' ability and desire to travel at all (SJ annual report, 2019).

Following the surveys and reports explained above, there seems to have been a significant shift in values and opinions regarding aviation, but while the aviation sector has been experiencing a decreasing demand in the past months, it is still unclear to what extent flight shame is a factor of causation. However, worth highlighting is that both BRA and Swedavia mention flight shame as one of the main factors behind this declining demand. Furthermore, as SJ has presented record figures in terms of passengers, we argue that the aviation sector's decline cannot completely be explained by economic factors as such would have influenced the demand for train fares as well (Larsson, 2018).

As previously described, economic variables and economic cycles have a substantial impact on the demand for aviation. The Swedish National Institute of Economic Research (2018) provide historic and future estimates of GDP, and their research clearly shows that Sweden currently experiences an economic boom with a decreasing GDP growth first expected in 2020. Therefore, while it is true that currency fluctuations can have impacted the recent demand for aviation, the strong economic GDP development and the fact that we do not expect people to value their time substantially different today than from just two years ago, indicates that other factors than economic ones must explain the recent drop in aviation demand. Flight shame could be one such explanation.

5. The selection of an appropriate model

Given the purpose of this thesis – to provide an economic, game-theoretic interpretation of flight shame and the potential effects of changes in social values on aviation habits – we develop a model customized to capture some central features of the real world. For example, the model we introduce in section 6, and very briefly in this section, will allow for separating both social values, social norms and individuals' different propensities to feel shameful.

There is an inevitable tradeoff between developing an overly complex model for the purpose of scientific rigorousness and capturing a complex reality, or to develop a simplistic, elementary model for the purpose of intuitiveness and straightforwardness. The British economist Alfred Marshall, one of the pioneers in the field of neoclassical economics, once wrote in a letter to Professor A.L. Bowley, January 27, 1906, that:

> "[…] I had a growing feeling in the later years of my work at the subject that a good mathematical theorem dealing with economic hypotheses was very unlikely to be good economics[…]"
> (Whitaker & Wood, 1983, p. 281-82.)

By the reasoning of Marshall, there is no point in setting up a model too mathematically complex for the reader to work through with ease, not even for the purpose of capturing what can only be understood as a complex reality. With this being said, the model we introduce in section 6, derived from the work of Ellingsen and Mohlin (2019), will be both simplified and customized in order to fit our environmental context.

At the same time, however, we recognize that models from other scientific fields can help us explain the behavior of individuals, as well as provide a more nuanced explanation to the inquiries we address. In this section, therefore, we will be briefly introducing other thoughts of interest in order to broaden our horizons, and thereafter provide a solid argument for the model we have chosen.

The attitude behavior approach, developed by McKenzie-Mohr (2011), describes how to change individuals' behavior by increasing public knowledge. In this case, behavioral patterns are derived from engineered shifts in individual attitudes. This is much in line with the ideas of the formerly mentioned Garret Hardin (1968), as he argues that societies must find ways to make citizens comply with what are considered to be in the public interest. In the case of aviation and flight shame, this theoretic approach describes the perceived behavioral change of Swedish citizens regarding declining aviation usage, potentially derived from the media's attention and concern regarding climate issues and the environmental impact of aviation. In other words, the news coverage of recent years and the emergence of flight shame as a vocabulary has potentially led to a transition in the public opinion away from aviation and towards less harmful modes of transportation.

However, as concluded by Geller (1981), the impact on behavior from information-based programs do often have an insignificant effect. Similarly, the study completed by Federico et al. (2011) on the Healthy Eating campaigns drew the same conclusion, stating that while public information campaigns do have an impact on awareness and intentions, it rarely changes health outcomes and consumption patterns. The attitude behavior approach, with the contributions of Geller's and Federico et al., can thus only help explain why survey respondents to a high degree admitted avoiding, or limiting, their aviation travels. However, the approach cannot explain why a domestic decrease in aviation demand has been somewhat observed and will thus not be used in this paper.

Conventional models of self-interest, often associated with the school and authors of classical economics, that describe the behavior or the expected behavior of individuals, typically base their assumptions on individuals acting in their own economic self-interest.[7] These models, however, have limited applicability in the case of behavioral changes in relation to climate change and aviation. As McKenzie-Mohr (2011) argues, the classical economics approach fails to examine the underlying reasons for change. Because humans are not completely rational in their decision-making, the self-interest approach has limited usage in describing behavioral changes, particularly in situations where individuals are, seemingly, acting against their own best interest.

The model we develop to describe flight shame and its implications must thus be based on a broader foundation, taking into account the multifaceted decision-making process of human beings, although not being too mathematically advanced and within reasonable bracketing. Therefore, we present and build on the model developed by Ellingsen and Mohlin (2019), although we make our own simplifications and adjustments to fit our explicit topic. There are several benefits with this model and the way we use it, as will be understood in section 6 and 7. However, for the purpose of very briefly mentioning some of the main strengths of the model, we will introduce three main concepts at this point.

First of all, we assume that any rational individual seeks to maximize individual utility. More specifically, as done by Huck, Kübler and Weibull (2012), we assume that individuals maximize some combination of personal utility and social value, and that individuals' utility is the accumulated utility of personal benefit derived from a particular action, less the blameworthiness associated, i.e. the flight shame. Flight shame originates from an individual failing to maximize social value, given the social values of one particular society.[8]

Secondly, we use delta, δ_i , as a variable to measure individuals' different propensities to feel shameful, and we make the assumption that delta follows a Normal probability distribution. Different people have different propensities to feel shameful, and by making this assumption, we allow for variation between individuals' propensities. We argue that this is a reasonable assumption to make. Some people do not feel shameful, regardless of any despicable behavior, and considering delta as drawn from a Normal probability distribution allows for this variation in human conscience. This will be further emphasized by Assumption (4) in section 6.4.

[7] For example, see the previous discussion on the work of Adam Smith.
[8] We define social values in section 6.1.

Thirdly, we use alpha, α, as a variable to measure social values over time and between different societies. Alpha is hence a longitudinal- and cross-sectional measure. As different societies have different concerns about environmental hazards, we expect flight shame to differ quite substantially between countries as well. And indeed, although anecdotal, the German tabloid Die Welt is not too impressed by the *schwedishe Flugscham*, as shame, they argue, is not something that should affect and direct the public debate.[9] The fact that Germans and Germany, an otherwise very similar country to Sweden, notably in terms of economic standards and cultural inheritance, are not at ease with the phenomenon of flight shame, suggests that Sweden potentially is the patient zero. Differences in social values between countries, such as Sweden and Germany, are captured by different measures of alpha. This will be demonstrated by equations (4) and (5) below and emphasized by Definition 1. Since flight shame is such a recent phenomenon, and indeed only observed in a limited number of countries, including alpha allows us to explain why societies bear different concerns regarding environmental hazards.

[9] Von Herold, L. (2019, 2 April). Schweden – das Land des Schämens. See References.

6. Model Specification

This section is entirely dedicated to reviewing, altering and simplifying the work of Ellingsen and Mohlin (2019), in order to apply their models and frameworks to our explicit context.

6.1 Background

Social scientists have long been devoted to the task of explaining the behavior of individuals. Individual agents can sometimes be seen to act as expected by the observer, and at other times act completely irrational. To what degree individuals internalize social norms, and under what circumstances they act in accordance with them, are important features of the model we are now introducing, and indeed necessary to predict and explain the unique behavior of individuals. To start off, we will make the distinction between *empathetic* behavior and *decent* behavior. Individuals may act in a certain way, either because they want to by true altruistic measures, or because they ought to by the prevailing social norms. The distinction between the two is important to make. As highlighted previously, Hardin (1968, p.5) argues that it is naïve to think that solutions of common tragedies can be found by "appeal[ing] to [people's] conscience". More specific, encouraging people to act empathetically will likely be insufficient if the goal is to reduce greenhouse gas emissions in the atmosphere. By the reasoning of Hardin therefore, focusing on empathetic behavior might lack the potentiality of wider implications and further explanatory value, however, focusing on decent behavior might just be what the literature on the topic is missing.

Ellingsen and Mohlin (2019) are merely focused on decent behavior, and following the argument made above, this is what we will focus on in this paper as well. For one more reason, and as indeed stated by Ellingsen and Mohlin, a model of decency is constraining. Social obligations prohibit individuals in acting as they would have done in a completely anarchistic, shameless society. This is of particular interest to us. In the case where the emission of greenhouse gases is of little cost to the individual, and that we have a tragedy of the commons problem as described previously, it is indeed important to constrain individual behavior and to limit the damages caused by excessive greenhouse gas emissions.

As stated by Ellingsen and Mohlin (2019), values of decency are shaped by the prevailing cultural forces in a society.[10] This implies that there could be large differences between societies and countries when it comes to the level of decency, or as in our case, level of environmental concern. There could also be differences in what individuals consider to be decent behavior. By this reasoning, instilling values of decency is an important task of every society for the purpose of constraining potential damage caused by unconstrained individual liberty. There are indeed several ways to do so without targeting the explicit values of a society. Governmental efforts usually take the form of taxation, emission reduction schemes, emission trading systems, quotas, etc. However, governments are yet to impose a political intervention powerful enough

[10] For another interesting perspective on this, analogous to our paper although addressing a completely different topic, see the work of Adamczyk and Pitt (2009).

to enforce any significant impact on greenhouse gas emission reduction. No policy has singlehandedly turned the global emission curve,[11] and societies continue emitting greenhouse gases at levels violating the Paris agreement. Instilling and engineering social values is therefore an important part of creating a sustainable society. Values permeate behavior in every aspect and have thereby the potential to greatly leverage every other policy intervention, as well as magnifying the impact.

> **Definition 1:** Social Values.
>
> Social values are defined as the level of environmental concern in a given society and will be interpreted as a measure of how the citizens value the tradeoff between individual benefit and environmental damage. In our model, this will be captured by alpha.

The model presented by Ellingsen and Mohlin (2019) is built on three different assumptions, as we describe below.

Assumption 1.
Social values are established at a level external to each individual. The individual actor is part of some distinctive group, e.g. a country or a society, and within that group there exist some shared values and beliefs which steer the actions of its members. In other words, any individual takes social values as given.

Assumption 2.
Individuals internalize the values of the group and make them their own.

To illustrate this by an example, consider an individual with some old, used-up batteries, ready to be disposed of. Instead of going to her local recycling center and thereby take the associated personal loss of time, energy, utility, etc., she could easily, without anyone noticing, throw her old batteries into some grassland on her way to work or just throw them out with the household garbage. However, as we believe is usually the case, people will under ordinary circumstances recycle their used-up batteries instead of disposing them in nature, although going to the recycling center means taking some personal loss, albeit for the benefit of society at large. This is because social values, consciously or unconsciously, have been internalized by the individual. If the group share some understanding about what environmental damage careless battery disposal could lead to, and values the common good of the environment, any individual with internalized social values will comply with the shared understandings of the group, regardless of any external observers.

[11] However, this is not to say that governmental regulations are not important or that regulations cannot have a serious impact on common problems. Governmental regulations can in fact be both powerful and sufficient problem solvers. The restrictions imposed on the usage of toxic Freon gases by the Montreal Protocol in 1987 successfully limited the ongoing ozone depletion.

Why will any individual accept a personal loss in this case? If an individual can choose between getting a personal payoff of -10 or ± 0, arbitrarily associated with going to the recycling station or disposing the batteries in some convenient nearby nature, she will surely choose the least negative alternative in terms payoff, i.e. not recycle. However, when social values are internalized, not complying with the social norm will lead to feelings of guilt and shame. Therefore, even though different payoffs may look as proposed to any external observer, the true utilities might instead be -10 or -15, because people dislike feeling shameful and carless battery disposal is associated with an, on average, -15 utility. We will develop this reasoning further when addressing blameworthiness in a subsequent section.

Internalization, however, is an individual process and, as argued by Ellingsen and Mohlin (2019), internalization can be partial as well as differ between individuals. By this reasoning, we will think individuals' propensity to feel shame as drawn from a Normal probability distribution in order to allow for variations in internalization and decency.[12] Therefore, when speaking of peoples' utility in general terms, we use the denotation "on average". Following the example above, any individual's disutility, associated with her propensity to feel shame, is drawn from a Normal probability distribution, which in this arbitrarily case renders an average disutility of -15. As described earlier, allowing for individual propensities of blameworthiness and internalization is one of the many strengths of the model we develop.

Assumption 3.
Social understandings and conventions are never completely exhaustive, and we need to bracket situations narrowly in order to make the possible actions subject to moral judgements.

The model presented by Ellingsen and Mohlin (2019), as we will simplify in the next section, will subsequently provide a link between social values, social norms, and individual behavior. As noted by Ellingsen and Mohlin (2019), some situations are social by their very nature, while other situations are considered non-social. This distinction is also one important to clarify. In a social situation, individuals will take the prevailing social norms into account when choosing between different actions. If, for instance, an individual defies prevailing norms in a social situation, she will suffer feelings of guilt and shame. On the other hand, if the situation is of a non-social kind, she will not feel shameful regardless of what action she chooses to pursue. Why is this important? Looking back at the previous example of battery disposal, if an individual is on a holiday trip in a country with poor waste disposal, she might behave differently because she no longer considers the situation a social one. When addressing our main topic in this essay, namely flight shame and aviation patterns, we assume that people consider the situation a social one. However, we understand that this is not to be taken for granted, and we will further discuss its implications in a subsequent section.[13] Indeed, Ellingsen and Mohlin (2019) are aware of this and argue that individuals in unfamiliar situations might not regard an otherwise social situation as a social one.

As we will see below, and as can be illustrated by an even simpler game of prisoners' dilemma, individually rational behavior does not necessarily promote socially efficient outcomes. This is

[12] See "Assumption 4".
[13] See "Discussion".

indeed the core feature of the tragedy of the common's fallacy, which was further explored in section 4.3. However, the, perhaps reasonable, assumption made when arguing for suboptimal outcomes in the prisoners' dilemma, is that people will pursue the action that is of most individual benefit and that the matrix payoffs are stated in von Neumann-Morgenstern (VNM) utilities.[14] But if the actors instead cared about each other in the prisoners' dilemma, the outcome would be different from what is usually the case. In other words, in a situation where actors instead maximize some social value function, there will always be an equilibrium that maximizes social welfare.

6.2 Denotations, situations and games

In this section, we continue following the path of Ellingsen and Mohlin (2019). However, we will simplify their work and make small alterations for the model to fit our environmental context.

A situation, as intuitively addressed and explained by Assumption 3, is a tuple of the kind $F = \langle N, S, Z, x \rangle$ where N is a set of n players, $S = S_i$ is a finite set of pure strategy profiles[15], Z is a set of possible outcomes, and x is an outcome function associated with strategy profiles rendering outcomes, $x : S \to Z$. Following the logic of Ellingsen and Mohlin (2019), we only consider material outcomes, $Z \subset \mathbb{R}$. Furthermore, consider σ to be an element of a strategy profile.

A situation is defined as a game with complete information, following the definition above, but associated with a VNM-utility function, $U_i : Z \to \mathbb{R}$ where $u_i(\sigma) = E_\sigma\left[U_i\big(x(s)\big)\right]$ and s is a particular action. A complete information game is hence a tuple of the kind $G = \langle F, u \rangle$.

Following Ellingsen and Mohlin (2019), we will consider Nash equilibrium and undominated Nash equilibrium as solution concepts. We use Nash equilibrium for the purpose of demonstrating that individuals will maximize their expected utility, conditional on what the other player is doing.

Definition 2. A strategy profile σ^* is a Nash equilibrium of a game G if, for all $i \in N$,

$$\sigma_i^* \in \arg\max_{\sigma_i \in \Sigma_i} u_i(\sigma_i, \sigma_{-i}^*).$$

[14] The von Neumann-Morgenstern utility theorem states that any individual actor will, under the assumption of mutually rational expectations, maximize the *expected* utility. The utility is expected with regards to what the other actor does.

[15] A pure strategy profile is a strategy profile that determine one player's complete moves during a game. In other words, a pure strategy profile has specified one player's moves for all possible moves of the other player. In the way we are applying the model however, we do not pay any particular interest to "the other player".

Definition 3. A Nash equilibrium σ^* is undominated if there is no player i and strategy $\sigma_i \neq \sigma_i^*$ such that $u_i(\sigma_i, \sigma_{-i}) \geq u_i(\sigma_i^*, \sigma_{-i})$ for all σ_{-i}. In other words, a Nash equilibrium is undominated if there are no gains from deviating from the prescribed strategy σ_i^*.

These solution concepts are necessary for predicting individuals' behavior. As previously mentioned, individuals will strive to maximize their expected utility by choosing their optimal strategy profile, given what the other player is doing. For the purpose of this thesis, we will simply think of the other player as one individual in the society that always plays in accordance with the social norm. This will be further explored in the following section.

6.3 A model of social values

Suppose social values are associated with a particular outcome function x, and an action s, and defined as follows:

$$v(\sigma) := E_\sigma\big[V\big(x(s)\big)\big] \tag{1}$$

Ellingsen and Mohlin (2019) emphasize the concept of social norms, however, we will not address this topic in much detail, although some notations are important to make. Ellingsen and Mohlin (2019) make a distinction between prescriptive norms, i.e. how people ought to behave, and descriptive norms, i.e. how people tend to behave. We, however, will not make this distinction since it is beyond the scope of this thesis, and any such distinction would not affect the result of our research. We will simply think of norms as doing the best action for the common good, given what other actors are doing in society. In other words, the social norm will always be to choose the optimal action s_i^* to maximize social value V, given the other player's action, s_{-i}^*. As before, we think of the other player as someone always obeying the social norm, i.e. maximizing social value. Therefore, any individual will always face a social norm that encourages the maximization of social value. We define a social norm in accordance with Ellingsen and Mohlin (2019).

Definition 4. A social norm is a strategy profile σ_i such that, for all $i \in N$,

$$\sigma_i^* \in \arg\max_{\sigma_i} \mathrm{v}\,(\sigma_i, \sigma_{-i}^*).$$

Following this argument, every player i in the population N will be requested to play the strategy profile σ_i that maximizes social value.[16]

6.4 Utility, social benefit, and blameworthiness

[16] By population, we refer to all individuals, i, in the society in focus.

As stated above, the norm is to maximize social value. If an individual neglect maximizing social value for the sake of personal gain, she will suffer feelings of guilt and shame. We define a player i's blameworthiness $b_i : S \rightarrow \mathbb{R}$, in accordance with Ellingsen and Mohlin (2019), as the social value neglected by her choice of action.

$$b_i(s_{i,}s_{-i}) := \max_{s_i^*} V\big(x(s_i^*, s_{-i})\big) - V\big(x(s_i, s_{-i})\big). \tag{2}$$

As following by this definition of blameworthiness, blame is partly dependent on the other player's action s_{-i}. As previously noted, we think of the other player as some role model individual in the population that always maximize social value. We will not elaborate on this any further.

Utility is the defined as $U_i^{dec}(s) = U_i\big(x(s)\big) - \delta_i\, U_i\big(b_i(s)\big)$. Intuitively, utility is a function of the strategy chosen and are increasing with the outcome function of that strategy x, and decreasing with the blameworthiness associated. Guilt and shame are hence the disutility associated with blameworthiness.

The simplified model we introduce below, derived from the work of Ellingsen and Mohlin (2019), uses the denotation social benefit. By social benefit, we refer to the aggregated benefit of all individuals in the society, associated with one individual's particular action s_i.[17]

Every possible transportation alternative is associated with some individual- and social benefit. One man that chooses to fly between Stockholm and Gothenburg will experience some utility from saving time, compared to if he instead had taken the train. If this action is of no benefit to any other individual in society, the total social benefit is composed of the benefit of that sole individual. However, actions are also associated with some environmental harm. For example, traveling by plane is associated with higher greenhouse gas emissions per traveled mile than going by train. In other words, the increased individual utility associated with traveling by plane comes at an environmental cost. As previously addressed, there is an inevitable tradeoff between social benefit, composed by aggregated individual benefit as well as potential synergies, and environmental damage. By this reasoning, we will also refer to social benefit net environmental harm. This is simply the social benefit created by an individual's action, s_i, less the environmental damage imposed by that action.

We will go on by simplifying the definition of utility stated above. To highlight some simplifications vis-á-vis the definitions stated above, we will use $\tilde{s}_i$ instead of s_i^*. Consider,

$$U_i^{dec}(x) = x_i - \delta_i \left[\max_{\tilde{s}_i} V\left(x(\tilde{s}_i)\right) - V\big(x(s_i)\big)\right] \tag{3}$$

where

[17] Please note that we use the terms *social benefit* and *social value* interchangeably. Social value is not to be confused with *social values* (see Definition 1.), with the latter referring to the moral ideas of a society regarding environmental concern and the tradeoff between individual benefit and environmental damage.

x_i is player i's benefit as before,
δ_i is player i's propensity to feel shame,
s_i is player i's action,
$\tilde{s_i}$ is player i's action that would have maximized social benefit net environmental harm,
$V(x(\tilde{s}_i))$ is the maximum potential net social benefit,
$V(x(s_i))$ is the actual net social benefit created by is player i's action.

The difference between potential social net benefit and actual social net benefit, i.e.

$$V(x(\tilde{s}_i)) - V(x(s_i)), \tag{4}$$

is the social net benefit neglected by player i's chosen action, in other words, the additional environmental damage imposed by player i for the sake of personal gain.

What follows from the model is that people feel shameful when damaging the common good, i.e. neglecting social net benefit. In our model, this is expressed by personal utility decreasing with $potential\ social\ net\ benefit - actual\ social\ net\ benefit$, i.e. decreasing with the blameworthiness and the feelings of shame associated. More intuitively, when individuals sacrifice the common good for the sake of personal utility, they are considered blameworthy and will suffer feelings of shame. Considering aviation, when people travel by plane for the sake of their own interests (e.g. because of time gains, comfortability, status, etc.), instead of any other less energy-consuming alternative, they will be blameworthy and feel ashamed – this is the flight shame of our model.

Previously, we made the argument that individuals internalize social norms to different extents as well as have different propensities to feel shameful. Looking back at equation (3), we can conclude that the parameter δ_i is individual. Depending on the value of the parameter, people feel different levels of shame. More specifically, if $\delta_i = 0$, the person does not care about social values and conventions at all. If $\delta_i < 0$, the individual will take antisocial actions, i.e. take pleasure in destroying social welfare and the environment. Normally, however, $\delta_i > 0$. This means that people indeed feel some level of shame when neglecting social benefit/value and when damaging the common environment. Because delta is an individual parameter, we cannot say very much about any sole individual's degree of shame. However, we will make the assumption that delta follows a Normal probability distribution with some mean μ and variance ν.[18]

[18] We deviate from the common conception of using σ^2 as the denotation of the Normal probability distribution variance. We do this for the purpose of not confusing variance with the sign of a strategy profile, as defined in section 6.2.

Assumption 4.

Delta δ_i follows a Normal probability distribution with mean 1 and variance ν, $\delta_i \sim N(1, \nu)$.

This assumption allows us to make inferences at an aggregated level. We will continue this reasoning in section 7.

6.5 A linear model

Following the work of Ellingsen and Mohlin (2019), we consider a linear model to be our social value function, in accordance with the definition of social values made above. Consider,

$$V(x) = x^+ - \alpha x^-, \tag{5}$$

where

$$x^- = individual's\ payoff^* - society's\ payoff^*,$$

$$x^+ = \sum_{i=1}^{n} x_i$$

We will provide some intuition behind these expressions. x^+ is the sum of all individual benefits, i.e. the total aggregated benefit of society, net environmental damage. x^- is the difference between the payoff received by the individual actor directly from the payoff matrix (i.e. the benefit of the individual gross the disutility associated with flight shame), and the immediate payoff imposed on society (i.e. the negative externality created by the individual).

Alpha, α, is some measure of how a society values the tradeoff between individual benefit and environmental damage, in other words, a measure a society's environmental concern. For this reason, we can expect alpha to be small in a society where, for instance, environmental awareness and educational standards are low. If people do not care about the environmental damage others cause by their selfish actions, we cannot expect the tradeoff between individual benefit and environmental harm to be of any significant concern in that particular society. Furthermore, and perhaps more importantly, we also expect alpha to be small in poor countries where every individual benefit is of great importance, perhaps even a necessity of life. In poor countries, individuals will cherish their individual benefit (i.e. personal wage, food, the convenience of taking a car, etc.) to a larger extent than people in rich countries, and hence not value the tradeoff especially high. We can think of rich countries as experiencing diminishing marginal utility of benefit. If prosperous, individuals can afford to neglect some personal utility.

[*] Note that these are payoffs directly derived from the payoff matrix. This is not to be confused with social value V.

By the same reasoning, we also expect alpha to be small in countries suffering from diseases and plagues, corruption, war, famine, civil riots, etc.

On the other hand, alpha is expected to be large in countries aware of environmental issues, for example in prosperous and well-educated Scandinavian countries. In Sweden, for instance, it is not uncommon for people to neglect individual benefit for the purpose of environmental sustainability.[19] As WWF notes, there is an increasing number of people neglecting aviation and meat consumption for the purpose of sustainability, although this on average implies less individual benefit in terms of timesaving and convenience.[20] In other words, by the features of our model, people do value this tradeoff previously explained. These values can change, however, as will be addressed next. Initially, we assume that $\alpha > 0$ and we will elaborate on this in section 7.

To summarize this last section, the social value model consists of the following: Values are increasing with the sum of total social net benefit x^+, and decreasing with the social net benefit neglected by pursuing a socially suboptimal action for the sake of individual gain αx^-, where α is a measure of how the society values the tradeoff between individual benefit and environmental damage, i.e. the society's environmental concern, in accordance with Definition 1.

[19] One can of course raise objections to the fact that neglecting individual benefit for the sake of the environment is in fact an individual action that brings another type of benefit, perhaps feelings of responsibility and elation.
[20] It is of course not obvious that, for instance, neglecting meat consumption is of any inconvenience to a particular individual. However, if individuals value the opportunity to choose between various alternatives, adding alternatives is indeed of value to the individual since she now has another alternative to choose from. This implies that a total disregard of one alternative makes individuals, on average, worse off.

7. Results, examples and interpretations

So far, we have presented an extensive background information, discussed different theories of interest, and outlined an explicit model to answer our inquiries. This section will go on by using these tools to explain flight shame from a game theoretic perspective, merely by applying the model outlined in section 6 and show how changing social values can affect flight shame and aviation patterns.

7.1 The general case

Consider the following example where an agent, the row player, can choose to travel by plane, thereby emitting greenhouse gases into the atmosphere for the sake of personal benefit, or to travel by a climate-neutral train and thus not emit any greenhouse gases, albeit getting a personal disutility. These payoffs are summarized in the table below. More intuitively, traveling by plane yields a personal benefit of $+1$ vis-á-vis traveling by train, for instance caused by the time gains associated. However, traveling by plane also yields a negative social benefit of -2 caused by increased greenhouse gas emissions. Traveling by train is associated with a personal benefit of -1, however causing no environmental damage, ± 0. The negative payoff originated from train travel is associated with the relative inconvenience vis-á-vis aviation, e.g. time loss.

In order to highlight the tragedy of the commons problem even further, as discussed in section 4.3, once again note that air traveling yields a payoff of -2 to the society as a whole, i.e. the common good in this case. Since numerous agents share the common good however, in this case the atmosphere, the individual player will only bear an insignificant fraction of this cost. By this reasoning, any player basically chooses between an individual payoff of $+1$ or -1.

Are these numbers reasonable? Indeed, they are arbitrarily chosen. Imagine an agent that can either go by plane or by train from Stockholm to Malmö. Taking the plane takes ca. 50 minutes, and taking the train takes ca. 4 hours 30 minutes. Clearly, taking the plane is more convenient for the individual in terms of time gains. However, taking the plane does also mean emitting greenhouse gases into the atmosphere, undoubtedly to a larger extent than what traveling by train does. Hence, there is a tradeoff between individual benefit and environmental damage. The arbitrarily chosen numbers in the game matrix below try to illustrate this tradeoff. Whether or not they are entirely accurate proxies is not of any particular interest for the point of this thesis.

Air traveling	**+1, -2**
Train traveling	**-1, 0**

NB: These numbers are arbitrarily chosen and merely for the purpose of illustrating our example. Furthermore, this payoff matrix differs from conventional ones in the sense that the column player cannot make chose between actions. The payoffs associated with the column player, i.e. the society at large, are imposed by the actions of the row player.

Let us follow the previous assumption that the norm is to maximize social value and that values follow equation (5). In that case:

$$V(x) = x^+ - \alpha x^-. \tag{5}$$

$$V(air\ traveling) = (+1-2) - \alpha\big(+1-(-2)\big) = -1-3\alpha$$

$$V(train\ traveling) = (-1) - \alpha(-1) = -1+\alpha$$

As the calculations above demonstrate, the social benefit/value associated with traveling by train is clearly greater than the social value of traveling by plane when alpha is larger than 0, in other words, $V(train\ traveling) > V(air\ traveling)$ when $\alpha > 0$.[21] We previously stated the assumption that $\alpha > 0$, and we will demonstrate the implications of altering alpha in section 7.2.

In Definition 4, stated in section 6.3, we argued for the reasonable assumption that the norm is to maximize social value. In accordance with the calculations above therefore, we can conclude that the social norm is to not emit greenhouse gases in the atmosphere for the sake of the personal utility, associated with aviation vis-á-vis train traveling. But under what conditions will the individual actor comply? Remember that individuals have a utility-function of decency defined by equation (3).[22]

$$U_i^{dec}(x) = x_i - \delta_i \left[\max_{\tilde{s}_i} V\left(x(\tilde{s}_i)\right) - V\big(x(s_i)\big)\right] \tag{3}$$

We make the calculations assuming that if $\alpha > 0$, i.e. that the social norm is to travel by train, and not doing so will make any individual blameworthy.

$$U_i^{dec}(air\ traveling) = +1 - \delta_i[(-1+\alpha)-(-1-3\alpha)] = 1-\delta_i(4\alpha).$$

$$U_i^{dec}(train\ traveling) = -1 - \delta_i[(-1-\alpha)-(-1-\alpha)] = -1.$$

The calculations demonstrate that any individual agent will comply with the social norm of traveling by train when $U_i^{dec}(train\ traveling) = -1 \geq U_i^{dec}(air\ traveling) = 1 - \delta_i(4\alpha)$, in other words, when $\delta_i\alpha > 0.5$. Indeed, air traveling is associated with an immediate personal utility of $+1$, whilst traveling by train is associated with an immediate personal utility of -1, as previously discussed, originating from the relative inconvenience of traveling by train vis-á-vis traveling by plane. However, and this is the important part, because the use of aviation neglects social value and defies the social norm, indeed for the purpose of individual benefit, any individual who travels by plane will be blameworthy and suffer feelings of shame. This is

[21] To be more accurate, the social value created by train travel is higher than the social value created by plane travel if $\alpha > -\frac{1}{3}$.

[22] For an intuitive distinction between decent and empathetic utility-functions, please revisit section 6.1.

the flight shame of our model, derived from the factor of δ_i and 4α. Flight shame is hence the feeling of blame associated with neglecting social value for the purpose of individual gain.

7.2 Interpretation

The results above show that, following our arbitrary example, any agent will comply with the social norm of choosing the environmental-friendly traveling alternative when the product of alpha and delta is larger than 0.5, i.e. $\delta_i \alpha > 0.5$. The purpose of this section is to bring some intuition to this result and discuss what flight shame implies in terms of our model, as well as to illustrate the role of social values.

As previously stated, delta is an individual parameter. Therefore, we cannot say very much about the flight shame at an individual level. However, as we previously concluded that delta can be thought of as drawn from a Normal probability distribution with some mean μ and variance ν, we can indeed make inferences on a general level. For simplicity, we made the assumption that delta follows a Normal probability distribution with mean 1 and variance ν, i.e. $\delta_i \sim N(1, \nu)$.

Let us assume that a society is characterized by little environmental concern, more specifically, that $\alpha = 0.25$. What does this imply for the behavior of individuals? We illustrate this by the methodology from before. The value equations and the utility equations remain unchanged.

$$V(air\ traveling) = (+1 - 2) - \alpha\big(+1 - (-2)\big) = -1 - 3\alpha$$

$$V(train\ traveling) = (-1) - \alpha(-1) = -1 + \alpha$$

$$U_i^{dec}(air\ traveling) = \ +1 - \delta_i[(-1 + \alpha) - (-1 - 3\alpha)] = 1 - \delta_i(4\alpha)$$

$$U_i^{dec}(train\ traveling) = \ -1 - \delta_i[(-1 - \alpha) - (-1 - \alpha)] = -1.$$

If $\delta_i = 1$, as expected on average, and $\alpha = 0.25$, this implies that

$$U_i^{dec}(train\ traveling) = -1 < \ U_i^{dec}(air\ traveling) = \ 1 - \delta_i(4\alpha) = 0.$$

In other words, the individual utility of traveling by plane is larger than traveling by train, and any individual with a delta of 1 will violate the (quite weak) social norm of traveling by train.[23] The flight shame, derived from $-\delta_i(4\alpha) = -\big(1 * 4(0.25)\big) = -1$, is not large enough for people to comply with the social norm. This is what we would expect from a society with low levels of environmental concern, i.e. low levels of alpha, and therefore low levels of flight shame.

[23] Recall that the social norm, i.e. the transportation alternative that maximizes net social benefit, is to travel by train in any society where $\alpha > -\frac{1}{3}$.

Let us consider another example. If a society instead has some environmental concern associated with $\alpha = 0.75$, this means that,

$$U_i^{dec}(train\ traveling) = -1 > U_i^{dec}(air\ traveling) = 1 - \delta_i(4\alpha) = -2.$$

Intuitively, societies characterized by high levels of concern regarding the tradeoff between social benefit and environmental damage will have a stronger social norm encouraging individuals to choose other means of transportation compared to societies with low levels of concern. The norm is still to travel by train, as in the previous case, but the norm is stronger, expressed by a higher value of alpha. In this case, given $\delta_i = 1$ as before, any individual will comply with the social norm. The flight shame associated with deviation, i.e. $-\delta_i(4\alpha) = -\big(1 * 4(0.75)\big) = -3$ is sufficiently large for individuals to comply. In other words, how a particular society values the environmental tradeoff, i.e. their environmental concern, affects the individual behavior of actors via blameworthiness of deviation.

Why is this interesting outside our specific example and our arbitrarily constructed payoff matrix? Flight shame is indeed an individual feeling, δ_i, and different people will feel different levels of shame given the same social values (i.e. the same measure of alpha). Some people will not feel shameful at all, regardless of the activities they pursue and the prevailing norms in society. We mentioned earlier that people with levels of delta close to zero will not care about any social conventions, e.g. people with sociopathic personality traits. However, these outliers are not of any particular interest to us. Instead, we assume that people all around the world have their propensity to feel shameful drawn from the same Normal probability distribution with a mean of 1. By this assumption, we can make inferences at a general level. To what extent individuals do feel shameful depends on the social norms of their society, as well as their individual propensity to feel shameful. In the medieval old town of Stockholm, for example, people did not feel shameful when disposing household garbage in the street. If this is done today, however, people are arguably more likely to feel shameful, not because people are more decent today, but because societal norms have changed throughout history.

In conclusion, we have described flight shame by economic measures and associated it with disutility, shown that blameworthiness will be higher in societies characterized by high environmental concern, and that blameworthiness and social values will result in more environmental-friendly transportation choices. This is perhaps not very surprising. However, we have, for the first time, applied a game-theoretic framework to the concept of flight shame, and explained it with an economic model. Our results do therefore have implications for policymakers as we have shown, mathematically, that awareness and concern affect how people choose to travel. Yet again referring to the arguments of Hardin (1968), for societies to premier environmental-friendly behavior, they must engineer social values where environmental issues are in focus.

8. Discussion

In this section, we will bring a variety of interesting topics to discussion. We will also address the limitations of our model, as well as provide guidelines for future research.

8.1 Engineering social values skewing the probability distribution of delta

When discussing social value engineering in terms of our model, we mostly consider this as changing the value of alpha. This is indeed the main point of value engineering, and where engineered social values will have the largest impact since alpha is the de facto measure of social values in a society. However, value engineering can perhaps change delta as well, i.e. peoples' propensity to feel shameful. We previously assumed that delta is Normally distributed across all societies with a mean of 1. Social value engineering, whatever that is, can perhaps shift the mean of the Normal probability distribution as well, or make the distribution negatively skewed with a long, left tail. (Of course, skewness implies that delta no longer follows a Normal probability distribution since the definition of a Normal probability distribution is symmetry around the mean.) In other words, if value engineering alters individuals' propensity to feel shameful, neglecting social value (i.e. harming the common environment for the purpose of individual benefit) will be considered even more shameful by the individual and associated with even more "negative utility". Individuals are thus more probable to feel shameful, given a fixed level of blameworthiness, defined by equation (2).

8.2 Differences in flight shame and social values between countries

Another interesting topic to discuss is to what extent social values and environmental concern differs between countries at present. In section 5, we briefly discussed the case of Germany and one particularly interesting article in Die Welt, arguing against the very phenomenon of Swedish flight shame. Ellingsen and Mohlin (2019, p.3) argue that "In comparison with innate moral passions, decency is […] more immediately tied to cultural variation in moral behavior". In terms of our model, what Ellingsen and Mohlin refers to in the quotation above is that decency, i.e. to what degree individuals comply with the social norm, is more linked to the cultural values of society, α, than people's propensity to feel shameful, δ_i. Building on the argument of cultural variety, social values are not the same in every country, and environmental awareness is not equally widespread. Values and understandings can differ across countries and societies, as do the degree of internalization, and this is perhaps the reason why some countries adapt faster to new guidelines and policies, as well as experience different levels of flight shame.

8.3 Self-serving bias

Previously, we introduced the concept of self-serving bias as adding to the tragedy of the commons problem. If we assume that we can solve the tragedy of the commons by appealing to each player's conscience of what is to be considered a fair number of aviation trips, self-serving bias will likely make everyone's assessment of what is a fair number of trips biased in a narcissistic way. Babcock and Loewenstein (1997) demonstrate that self-serving bias will be present even when individuals share identical information. They go on by concluding that "[…] self-serving bias affects not only individuals' evaluations of themselves, but also of groups they are affiliated with." (p. 111). This implies that an individual who is part of some social subgroup, e.g. international businessmen, may consider his own right to use aviation as more righteous than other people's right, because of his group affiliation. Businessmen must travel, one can argue. In this thesis, we do not make any distinction between different groups of travelers. However, it is not that hard to imagine how different subgroups in a society share different social values. One of the many strengths of the model we develop is the flexibility in defining the boundaries of a society. If our analysis is troubled by great differences between subgroups, we can easily solve this by simply defining smaller subgroups and apply the same methodology as used before, thereby controlling for greater variation in social values, i.e. controlling for different alpha between subgroups.

8.4 Limitations of the model

Following the reasoning of Alfred Marshall, we previously addressed the tradeoff between complexity and usefulness of economic models. In this section, we will further consider the limitations of our model.

As formerly mentioned, and noted by Ellingsen and Mohlin (2019), some situations are social by their very nature, while other situations are non-social. In a social situation, individuals will take the prevailing social norms into account when choosing between different actions, and if an individual fails to comply with the social norm, she will suffer feelings of guilt and shame. On the other hand, if the situation is of a non-social kind, she will not feel shameful regardless of her behavior. Previously, we assumed that people choosing between transportation alternatives consider the situation a social one. However, we understand that this is not always a realistic assumption. Indeed, Ellingsen and Mohlin (2019) are aware of this and argue that individuals in unfamiliar situations might not regard an otherwise social situation a social one. It is not obvious that individuals consider the situation to be social, and therefore not obvious that they will feel shameful if not complying with the social norms. However, social norms are only relevant as a concept where there is a social situation to consider. In a non-social situation, there are no social norms to consider. In other words, if there is a social norm that tells individuals what the desirable behavior is, and the individuals are aware of that, the situation will be considered a social one. If the social norm is to use environmental-friendly alternatives of transportation, and the individuals of the society are aware of the social norm, they will consider the situation as a social one. As mentioned earlier, there might be differences between business travelers and leisure travelers. For example, business travelers might have the same propensity to feel shameful as leisure travelers, but do not consider the situation of choosing transportation to be a social one. This would imply that business travelers use aviation to a larger extent than leisure travelers, without feeling blameworthy, albeit being just as probable to feel shameful. Again, because we do not make any distinction between traveler groups, this goes beyond the scope of this thesis.

Individuals can also make choices about what situations to engage in. A situation is usually narrowly bracketed. In our case, a situation is simply the choice of transportation. There are a lot of societal "occurrences" that are not considered to be situations at all. Following our example, an individual can, besides deciding in the actual situation of transportation alternatives, also decide whether to travel or not at all. Indeed, the latter mentioned situation is also a situation, a sort of "meta"-situation, that needs to be considered as well for us to better understand why people engage in different situations. Another interesting inquiry to highlight is that individuals can, by neglecting individual payoff, do so by pure self-interest. This might seem like a contradiction. However, if an individual instead gets utility from feeling responsible and abiding, abstaining payoff might be utility-maximizing.[24] However, this is also beyond the scope of this thesis, albeit an interesting topic to address in future literature.

A possible fallacy of our model is then the risk of bracketing situations too narrow. If we define a social situation as a one-time decision between taking the plane or taking the train, as we do in our examples, people may take the train just occasionally in order to not be blameworthy and keep a "clean sheet". We could think of blameworthiness as lagging behind, for it is reasonable to assume that the actions of one day are not forgotten the next day. Hence, blameworthiness is something that can stick with individuals. However, if we instead assume that preferences were defined on broader outcomes, e.g. lifetime usage of trains or planes, we might see other results. When making many choices, a person can broadly bracket them by assessing the consequences of them all taken together, or narrowly bracket them by making each choice in isolation. The opportunity cost of acting unselfish is not that large in the case of narrow bracketing (e.g. it is not particularly terrible to lose SEK 100 occasionally). But if we instead consider broader bracketing, there is no reason to not act selfishly in such circumstances, except for the disutility of feeling ashamed. The opportunity cost of broadly bracketed situations is much greater than for narrowly bracketed situations (e.g. it is indeed terrible to lose SEK 100 every day for the rest of one's life). In our model, we do not expect people to behave altruistically in any way. Our model is a model of decency, and we made the distinction between decent preferences and empathetic preferences early in section 6.1. As argued by Ellingsen and Mohlin (2019), decency is part of a society's culture and subject to policy and change. If greenhouse gases associated with aviation is a "no technical solution" problem, Hardin (1968) might be right when arguing for the insufficiency of appealing to people's empathy. The distinction between empathetic- and decent preferences is thereby justified, and it becomes a necessity for each society to engineer social values that do not require empathetic behavior to be expected for preserving common goods.

[24] Please note the difference between payoff and utility.

8.5 “No technical solutions”-problem

As we mentioned earlier, Garret Hardin (1968) argues that to some problems, there are “no technical solutions”. Academics and elected politicians will then of course, following the reasoning of Hardin, debate whether this is true in the case of aviation and extensive greenhouse gas emissions, and subsequently ask the question whether it is economically and environmentally defensible to, for example, construct high-speed railroads (as are frequently discussed in the Swedish environmental debate) given the ambition to reduce pollution and carbon emissions in the atmosphere. Given the substitutability of trains and aviation, and the price-elasticities- and cross-price elasticities of demand displayed in section 4.1, and as somewhat addressed by Gama (2017), if railroad investments cause higher ticket prices whilst not altering the quality experienced by the customers, this might instead lead to customers shifting transportation away from train and towards aviation, thereby causing worse environmental outcomes than what would have been the case if the railroad investments were to be put somewhere else. Furthermore, any railroad investment will likely have an environmental impact as well, and it will surely take some time for any new construction to become environmentally net neutral, considering the vast amounts of energy it takes to construct a new railway. In other words, any new railway construction that affects the pricing of train fares will have a reversed effect as well, inducing people to shift from the now relatively more expensive train to aviation. If this is true, and that the tragedy of the commons problem regarding aviation is of the “no technical solution”-kind, societies must engineer the values of its custodians to protect the commons, as Hardin (1968) argues. How this should be done is beyond the scope of this thesis, however, by the outlined game-theoretic model, developed from the work of Ellingsen and Mohlin (2019), we have shown what such engineering could imply in terms of behavior at an aggregated level.

8.6 Engineering social values via media and education

We do not seek to address the psychological prerequisites and mechanisms of changing attitudes – it would be far beyond the scope of this paper.[25] Instead, we merely illustrate what flight shame and shifting social values can imply in terms of economic measures. However, this does not mean that we cannot ask the question; how can societies engineer social values to fit the societal desires? Indeed, Hardin (1968) explains how a key priority for any society is to make its citizens comply with the prevailing social norms. In that case, media has arguably an important role to play in order to raise awareness and make people understand the importance of sustainability, as well as the role played by each individual. Neither should the educational aspect be neglected, and it could be beneficial to further highlight environmental concerns in the public schooling. As Ellingsen and Mohlin (2019, p.2) argues, “Parents, teachers, politicians, authors, and managers foist social understandings and values on their children, pupils, voters, readers, and organization members”. Ohlander and Ohlander (2016) further concludes, in their study on Swedish secondary school students, that the students respond with

[25] For such work however, see Massaro, Petty, and Cacioppo (1988); Kelman (1958); Vogel (2016).

general or societal perspectives to the causes of climate change, rather than an individual perspective. Ohlander and Ohlander (2016, p. 349) continues by arguing that "The ability to connect general/societal issues with individual issues relating to climate change could prompt students to reflect on the contributions of individuals towards climate change mitigation[…]". If individuals neglect their own responsibility in mitigating climate impact, perhaps due to carelessness (i.e. low levels of delta), lack of understanding, or the role of self-serving bias, the risk of a tragedy of the commons increases.

9. Concluding remarks

Flight shame has emerged as a smoking-hot topic during the last twelve months, and the Swedish word *flygskam* made its royal appearance in The Dictionary of the Swedish Academy in late 2018. Due to its very recency, no economic literature has endeavored to explain the phenomenon, and too few data points are available to make any inductive approach scientifically reliable.

In this paper, we have further developed and simplified the work of Ellingsen and Mohlin (2019) for the purpose of giving flight shame an economic, game-theoretic interpretation, as well as addressing the potential effects of changes in social values on aviation habits. By doing so, we developed a model customized to capture some central features of the real world. For instance, we made distinctions between social values, social norms, and individuals' different propensities to feel shameful, to reflect the multifaceted notion of human decision-making. More specifically, by the features of our model, we demonstrated how changes in social values and the associated flight shame can affect individual's choices of transportation away from aviation and towards more sustainable modes of travel.

Our findings suggest that any individual who neglects to comply with the social norm of using an environmental-friendly traveling alternative will be blameworthy and suffer feelings of shame – flight shame. Individuals will maximize their own personal utility, but since shamefulness is associated with some negative utility, people will take the prevailing social norms into concern when choosing between traveling alternatives. Presumed recent shift in social values has led to an increasing number of individuals associating aviation with blameworthiness.

Considering this, we suggested that societies must engineer social values to preserve the environmental common good. We did not explore any course of action; however, we highlighted the role of media and the importance of a profound educational system. Social value engineering, as well as the role of self-serving bias and differences in environmental concern between societies, are indeed intriguing topics, and promising avenues for future research.

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11. Appendix

Own-price elasticity of demand.
Elasticity of demand is calculated as the percentage change in demanded quantity divided by the percentage change in price.

$$E_D = \frac{\%\Delta Q_{Demanded}}{\%\Delta P_{rice}}$$

If elasticity of demand is less than 1, in absolute terms, the demand curve is inelastic. Similarly, if the calculated elasticity is more than 1, the demand curve is elastic, and if the elasticity is equal to one, i.e. a borderline case, the demand curve is unit elastic.

There is also sometimes a change in base of which we're calculating elasticity and percentage change. This inconsistency can create misunderstandings. Therefore, the Midpoint Formula is often used, given by:

$$E_D = \frac{\%\Delta Q_{Demanded}}{\%\Delta P_{rice}} = \frac{\frac{\Delta Q}{\text{Avg. }Q}}{\frac{\Delta P}{\text{Avg. }P}}$$

Cross-price elasticity of demand.
How a price change in one good affects the quantity demanded in another good.

$$E_D = \frac{\%\Delta Q_X}{\%\Delta P_Y} = \frac{\%\text{ Change in Quantity Demand X}}{\%\text{ Change in Price Y}}$$