Essential Air Service in Alaska

Name: Thomas P. Vernède
Student number: 407684
Supervisor: Prof. Dr. H.P.G. Pennings
Erasmus University Rotterdam
Date: 30/08/2016

Abstract: Essential Air Service in Alaska

First, this study investigates the effects of the Essential Air Service (EAS) subsidy on the airfares in Alaska. Second, the study will provide additional insight into the load factors and cost of EAS flights. This is relevant because the program has been criticized due to the underutilized air service and its costs (Grubesic & Wei, 2013). Lawrence et al. (1987) also concludes that the subsidy does not have its intended effect of increasing the quality of the air service, and that it might even deter it. However, the EAS subsidy might decrease airfares, which is beneficial for the public (Lawrence, Cunningham, & Eckard, 1987). Does the EAS subsidy act in favor of the public or of the supplier? The load factor is obtained using descriptive statistics. To obtain the results of the effect of EAS on the airfares, a linear regression model using OLS with robust standard errors, keeping the origin effects fixed was used. The main finding in this study is that the EAS subsidy does not have an effect on airfares. The second finding confirms that the EAS flights are also underutilized in Alaska. However, a surprising result was found: competition increases airfares in the market, which can imply a form of collusion. Based on these findings, it can be concluded that the subsidy can act as a wealth transfer mechanism for airlines, which is not beneficial for the public. On the other hand, if the EAS subsidy is abandoned by the next administration, some routes might not be viable with the same level of air service specified by the US Department of Transport (DOT). Further research should be conducted in comparing routes that function without and with the subsidy, to enable the use of the EAS subsidy in a more efficient manner.

Contents

1. Introduction..4

2. Literature Review..6

2.1. Economic Regulation..7

2.1.1. Effects of Economic Regulation...10

2.2. Essential Air Service...11

2.2.1. Service Level Requirements of EAS...12

2.2.2. Selection of EAS Carriers...12

2.2.3. The Effects of EAS...15

2.3. Airline Prices...16

2.4. Airfares in Alaska..19

2.5. Hypothesis Development...19

3. Data and Methodology...20

3.1. Data Collection..20

3.2. Variable Description..22

3.2.1. Dependent Variable...22

3.2.2. EAS Variable...23

3.2.3. EAS Interaction Variable...25

3.2.4. Control Variables...26

3.3. Methodology..29

3.3.1. Important distinctions between this study and Lawrence et al. (1987)................30

3.3.2. Methodology Hypothesis 1..31

3.3.3 Methodology Hypothesis 2...32

4. Results...34

4.1. Hypothesis 1..35

4.2. Hypothesis 2..37

5. Conclusion and Discussion..40

5.1. Conclusion...40

5.2. Discussion...40

6. References..45

7. Appendix..51

1. Introduction

The EAS (Essential Air Service) subsidy is one of the most questionable policies in the US, and it is heavily criticized and monitored by the federal government (Grubesic T. , Wei, Murral, & Wei, 2016). The aim of the program is to sustain air service to smaller communities after the Aviation Deregulation Act (ADA) in 1978, due to the fear that airline services would move out of less profitable and smaller markets (Tang, 2015).

However, with the upcoming presidential elections of the United States (US) at the end of this year; the current policies and regulations are going to be reassessed. The country will either take a right or left turn, with Donald Trump and Hillary Clinton as the nominated candidates. Both candidates address many of the same problems, but have a completely different agenda and perspective on solving these issues. The Syrian crisis provides a prime example of how these perspectives can differ: one candidate proposes military action, while the other calls for a more diplomatic solution. These are also referred to as right-wing and left-wing solutions. The divisions between right- and left-wing policy makers were also visible during the crisis of 2008. The automobile industry problems made it clear that there is no general agreement on solving these types of crises. Right-wing politicians would refer to the automobile bail out as a waste of money. They would argue that the bailout of General Motors (GM) and Chrysler in 2008 and 2009 cost taxpayers 17 to 20 billion dollars (Sherk, 2013). Conversely, left-wing politicians would refer to the bailout as a success. Politicians who were in favor would advocate that if there had been no bailout, both GM and Chrysler would have failed, which would have made the crisis worse and longer (Goolsbee & Krueger, 2015). Based on this example, it can be stated that more left-wing economists are in favor of a certain type of economic regulation if jobs and businesses can be kept by government intervention, whereas right-wing economists would rather have the market do its work. The automobile bailout was a major decision taken by the Obama administration, and it had to take economic, political, and social factors into account (Goolsbee & Krueger, 2015). These factors also played a role in the establishment of the Essential Air Service (EAS) subsidy, with the aim of delivering a minimum level of air transport to the American national aviation network for remote areas (Grubesic & Matisziw, 2011). This study will analyze the EAS air fares and the load factor in Alaska, because this state is characterized by unique social factors compared to the rest of the country. The next paragraph provides an overview of how essential a well-working EAS subsidy program could be.

Alaska is the largest state in the US, covering an area of 586,412 square miles with a total population of 621,400 (Hudson, 2005). According to the census conducted in 2010, 291,821 people live in Anchorage, the largest city in Alaska (United States Cencus Bureau, 2010). The fact that only 25% of the rural communities have a road connection to a hospital illustrates the level of remoteness in Alaska (Hudson, 2005). This means that transportation relies heavily on alternative transportation modes, such as boats and planes (Hudson, 2005). The so-called "Village Alaska" has no access to marketable natural resources, and accounts for the largest share of poverty in Alaska (Berardi, 1998). According to Berardi (1998), "Income transfers and related economic assistance have heavily supported these villages and have been instrumental in maintaining village residents in these economically nonviable locations." Given its level of remoteness and poverty, Alaska is an ideal example of a region where the EAS subsidy could be of added value.

Although Alaska is a state that could use extra support from the federal government, it is still debatable whether the EAS program contributes to Alaskan society either in a monetary or a non-monetary form. Critics of the program refer to the highs costs and the underutilized airports (Grubesic & Wei, 2013), with costs adding up to 20,523,512.00 dollars for the Alaskan market (U.S. Department of Transportation, 2016). The EAS program will probably be evaluated by the new US administration, taking political, economic, and social factors into account.

If an evaluation process had been determined by Lawrence et al. (1987), the EAS program would already have been abandoned, because the authors conclude that the EAS subsidy does not meet its objectives and might even have deterred the availability of air service. The EAS did not have its intended effect, but it did lead to a minor decrease of airline prices (Lawrence, Cunningham, & Eckard, 1987). Thus, it can be implied that the EAS subsidy acts as a wealth transfer mechanism to people using airlines on the designated EAS routes. This is not in line with the suggestions that the EAS might be used as a corporate welfare system (Grubesic & Matisziw, 2011). A gap is left to investigate whether the EAS subsidy acts more in favor of the public or of the suppliers. This study will analyze the possible airfare reduction versus the cost of the program in order to provide additional insight for the next US administration. The following two questions are of interest to evaluate the EAS program in Alaska:

What effect does the EAS subsidy have on the average airfares for the different routes in the Alaskan market?

What is the load factor and subsidy costs of flights receiving EAS in Alaska?

Different approaches are required to answer these two questions. The first question will be answered by using an econometric model in order to test whether there is a statistically significant difference between airline fares of routes that receive EAS and routes that do not. The second question will be answered by using descriptive statistics. The main results show that airline prices are not lower for routes that receive EAS. Furthermore, the results also confirm that flights receiving EAS are underutilized compared to the average utilization rate in the US.

The rest of this study consists of four main sections. Section 2 discusses the literature concerning the various aspects of airline prices and EAS in Alaska. The literature review contains five subsections. The third main section describes and motivates the data and methodology used to answer the two research questions. The results are described in the fourth main section. This study then finishes with a conclusion and a discussion.

2. Literature Review

The literature review will discuss the important literature which are related to the EAS subsidy in Alaska. The literature review contains five subsections. The first subsection reviews and discusses the literature on economic regulation in general. The second subsection discusses the subsidy received by airlines, by reviewing literature on EAS. Subsequently, theory regarding airline pricing is reviewed. The fourth subsection discusses airfares in more detail for the Alaskan market. Finally the hypothesis are developed in the last subsection by using the literature reviewed in the previous subsections. The next paragraph will give the reader a better understanding of what economic regulation entails.

2.1. Economic Regulation

"The state – the machinery and power of the state – is a potential resource or threat to every industry in the society (Stigler G. J., 1971)."

This statement was made by a pioneer in the literature of economic regulation, and clearly indicates how regulation can have either a desired impact or a disastrous one. The state can intervene in various ways: for example, it can do so by transferring money to prohibit or to compel (Stigler G. J., 1971). By using this power, the state is able to transfer resources from one place to another without companies' or general citizens' agreement (Stigler G. J., 1971). How the state should assert its power is part of the social economic literature. Moreover, the effects of any government intervention in the market are referred to as economic regulation (Posner, 1974). Economic regulation entails taxes and subsidies, legislative and administrative controls over prices and entry, and other factors contributing to economic activity (Posner, 1974). Thus, one can conclude that any form of disturbance of the free market by the state is a form of economic regulation**.** The next paragraph will give an example where the regulator has to take the different stakeholders into account.

Environmental policy is a prime example of an area of economic regulation that is often discussed, because two groups with completely different perspectives need to be taken into account. The industry and the environmentalists both have different agendas when it comes to regulations. On the one hand, the industry focuses on realizing profits, while on the other hand the environmentalists takes the environment into consideration (Hahn, 1990). The regulators' issue here is to balance the economic and political objectives. If the economic objective were the only perspective to be taken into account, the decision-making process would be easy. The choice for the lowest economic cost would prevail. However, Hahn's (1990) model also takes political costs into consideration, which makes the process more complicated for the regulator. Examples of political costs include unemployment, plant closure, and environmental quality (Hahn, 1990). The main issue is that the regulator should find the right balance of economic and political costs. This example is also presented because it can be related to the EAS issues. The industry is represented by the airline carriers, which want to earn a healthy profit. The environmentalists in this case are therefore represented by the rural communities. The rural communities want a high standard of scheduled airline service and a lower cost of living, which could be established by lower airfares. Political factors for the Alaskan society with respect to the EAS subsidy could be the support of the local economy, accessibility to the rural communities, and the overall wellbeing of these communities. Hahn's (1990) model oversimplifies reality, but it provides a useful basic understanding of important actors in a type of economic regulation, and of which factors should be balanced to obtain an ideal outcome.

The previous paragraph presented a brief example to demonstrate that there are different stakeholders that should be taken into consideration when a form of regulation is implemented by an administration. The following paragraph will provide a better understanding of the types of regulation.

Regulations are considered to fall into three categories. The first category refers to qualitative regulations (Joskow & Noll, 1981). The second and third category covers price and entry regulations in competitive and monopolistic industries (Joskow & Noll, 1981). Qualitative regulations can affect environmental, health, occupational safety, and product quality issues (Joskow & Noll, 1981). The EAS subsidy is categorized as a product quality regulation, because this type of regulation attempts to cope with market failure challenges that are not directly linked to prices, profits, or market structure (Joskow & Noll, 1981). The subsequent paragraph will discuss the most important theories of economic regulation.

There are two main theories about economic regulation that prevail in the literature: the public interest theory and the capture theory. The public interest theory comes into play if economic regulation is needed in response to public demand regarding inefficient or unfair market practices (Posner, 1974). This theory suggests that consumers benefit from regulations at the expense of the regulated firms (Schwert, 1981). The capture theory is the second main theory of economic regulation; in this theory, regulations are enacted to respond to interest groups that are struggling to maximize their profits (Posner, 1974). The capture theory has the opposite hypothesis to that of the public interest theory, as it suggests that the regulated firms benefit the most from being regulated, at the expense of the consumer (Schwert, 1981). This theory is divided into different categories and visions. The economic capture theory originated from Stigler (1971), and Posner (1976) proposes that this theory will prevail in the future, even though the capture theories have not been empirically tested. Posner (1976) does make a point with his statement, because when investigating theories about economic regulation, most papers discuss the economic capture theory. The most important facet to be incorporated into the economic capture theory is the combination of political behavior and general economic analysis (Peltzman, Levine, & Noll, 1989). Political behavior is of interest, because the model suggests that politicians are like any other individual, and are thus self-interested maximizers (Peltzman, Levine, & Noll, 1989). It can therefore be derived that interest groups can influence the process of regulation if they offer some kind of benefit to a regulator or politician (Peltzman, Levine, & Noll, 1989). Although there is a vast amount of literature about economic regulation, a great debate is still ongoing regarding whether the suppliers or the public benefit(s) from regulation (Hahn, 1990). This implies that there is no general theory that can be taken as a standard for economic regulation policies.

The theories discussed in the previous paragraph regarding regulative economics do not address subsidies in an explicit manner. This is due to the fact that economists generally accept that industries that effectively gain government support usually opt for a regulation that places restrictions on the output, rather than subsidization (Migué, 1977). The reasoning is that in the long run, the subsidy will be dissipated because of the growing amount of competitors (Migué, 1977). However, this assumption does not hold in the case of the EAS subsidy because of the bidding system that is used. This will be discussed in subsection 2 of this literature review. Stigler (1971), a pioneer in this field, also states that industries that can obtain favors from regulators hardly ever ask this in the form of a monetary transfer. To be clear, these theories do not always hold, even though there are abundant examples in which they do (Migué, 1977).

This paragraph will discuss industries aided by subsidies. Examples of industries that have been aided by subsidies are electricity and public transportation services; these industries have been priced below cost (Migué, 1977). This is also referred to as limit pricing, and it is present in the European agricultural sector as well. For example, "More than 60% of olive-growing farms in Andalusia (Spain) would have negative returns without European agricultural subsidies (Amores & Contreras, 2009)." Again, this is an example of a qualitative regulation, because the objectives are to improve the production quality and the environmental and social values of agriculture (Amores & Contreras, 2009). The objectives of qualitative regulations can hardly be disagreed upon, but the methods applied to meet these goals can be dubious, due to their possible adverse effects. For instance, the limit pricing strategy is also possible for EAS carriers, which means that airlines receiving the subsidy could price below cost to circumvent any threat of new entrants on a specific route. This paragraph briefly discussed some aspects and examples of certain types of subsidies which is part of the economic regulation literature. The following section will now provide an overview of the effects of regulation in general.

2.1.1. Effects of Regulation

The statement made at the beginning of the second paragrah in 2.1 by Stigler (1971) illustrates the importance of economic regulation. This paragraph will give the reader a better understanding of the effects of economic regulation.

First, it is important to mention that the public interest theory is relevant if there are market failures, which refer to a disfunctioning of the price market institution, i.e. if the market is not able to sustain desirable or block undesirable activities (Bator, 1958). Some conditions must be met to achieve efficiency of decentralized price-profit calculations (Bator, 1958). The main theorem behind these conditions is the theory of duality, which refers to a correspondence between pareto efficiency and market performance (Bator, 1958). Thus, the government should intervene using one of its regulatory tools if doing so enhances the economic efficieny in the market (Noll, 1983). The reasoning is that regulation produces red tape in the form of information tranfers to regulatory agencies and vica versa, so that the parties can comply with the rules stated by the regulatory agencies. This efficiency gain or loss is dependent on how the market is restructured. Noll (1983) discusses four further effects of economic regulation; they are presented in the following paragraphs.

The second effect of regulation is on the dynamics of the regulated market. This refers to the ability of the regulated market to adapt to changing conditions (Noll, 1983). Demand, availability of resources, and technological change are aspects where change could occur and affect the dynamics of a regulated market (Noll, 1983). Due to the interference of regulators, adapting to change is slower compared to an unregulated market, because the regulation adds another step in the adaption process to changing circumstances. Slowing down the process of change is usually linked to a loss of economic efficiency. However, this is not always the case, as regulations are also able to reduce uncertainty in a market (Noll, 1983).

Wealth creation or loss is another important effect of regulation that could arise due to efficiency changes (Noll, 1983). However, there are situations where this goes beyond the efficiency aspect of regulation (Noll, 1983). Wealth effects of regulation can be attracted to more specific intrest groups that capture the economic surplus, which means that there could be groups that can handle the regulated environment better than others (Noll, 1983). For instance, one firm's product quality or available production method could be better suited to regulation requirements compared to other firms (Noll, 1983). If the regulation requires products to be of a certain quality, the companies that already focus on quality will clearly benefit from the regulation (Noll, 1983).

The process by which regulations are established and enforced is a fourth effect of regulation that should be taken into account. This is because regulatory agencies are restrained by evidence more than legislatures and other governmental agencies are (Noll, 1983). Because the regulative environment is based on more evidence, decisions made by regulatory agencies seem more like the decision-making procedure used in court (Noll, 1983).

"The fifth and last characteristic of regulation is that the act of creating a regulatory agency and embarking on a new regulatory program does not necessarily require that there be immediate winners and losers in the political struggle (Noll, 1983)."

2.2. Essential Air Service

The previous subsection provided an overview of the literature regarding economic regulation in general. This subsection will give the reader a better understanding of the EAS subsidy and the way it is implemented and enforced.

The deregulation of the commercial aviation market in 1978 meant that airlines had almost all of the freedom to serve any routes and charge any price they wanted (Tang, 2015). The fear was that airline services would move out of less profitable and smaller markets due to this deregulation (Tang, 2015). Therefore, to secure scheduled services for smaller communities, the EAS program was established. The EAS program is a subsidy program administered by the US Department of Transportation (DOT). The program had an initial 10 year expiration date after the Airline Deregulation Act (ADA) (Tang, 2015). However, this later changed to an indefinite period (Tang, 2015). Furthermore, the EAS subsidy has eligibility requirements, but for Alaska and Hawaii exceptions have been made. The only requirement is that the nearest hub airport must have a distance of at least 40 miles from the EAS community being served or more to be eligible for the EAS subsidy (Tang, 2015). This means that Alaska is also exempt to the new EAS policy that was implemented in January 2016, which limits the subsidy cap to 200 dollars per passenger to keep costs down (Tang, 2015). Moreover, there are 743 communities that are eligible for the EAS subsidy, of which 237 are located in Alaska (Tang, 2015). According to Tang (2015), fewer than 300 communities received subsidized aviation services over the period of 1978 to 2015. Although some of these communities were eligible for EAS, some airlines preferred to operate without the subsidy (Tang, 2015). This is also the case for the Alaskan market, where of the 237 communities that are eligible for the subsidy, only 62 communities have airlines receiving EAS (U.S. Department of Transportation, 2016). The fact that the majority of eligible communities do not have an airline receiving EAS could mean that the service requirements set by the US DOT are too high and the subsidies too low for the airlines.

2.2.1. Service Level Requirements of EAS

For eligible EAS communities, the US DOT specifies the service level in four ways for the airline carriers. The first factor evaluated is the current national passenger airline network (Tang, 2015). Secondly, the DOT examines the number of airline seats that need to be provided and the minimum number of round trips to and from a specific community. The third factor that the DOT takes into account is the type of aircraft and the characteristics that are needed. Finally, the maximum amount of stops between the destination and origin is the fourth specification for the minimum required service level for the airlines (Tang, 2015).

2.2.2. Selection of EAS Carriers

After the service requirement levels for a community have been stated, the airline selection procedure can begin. The DOT will ask for proposals to serve an eligible community using a bid system on a “final best offer” basis (Tang, 2015), which starts six to nine months before the expiration date of the current contracts (U.S. Department of Transportation, 2016). The bids of the airline carriers contain service and subsidy proposals for an eligible community (U.S. Department of Transportation, 2016), which will be reviewed using six criteria. The first criterion that the DOT takes into account is the reliability of a carrier. Secondly, the contractual and marketing arrangements with a larger carrier at the hub are of importance. In that same vein, the third important characteristic is the interline arrangements with a larger carrier at the hub (Tang, 2015). The fourth aspect that is taken into account is the community views and opinions (Tang, 2015), while the fifth decisive factor is, "Whether the air carrier has included a plan in its proposal to market its service to the community" (U.S. Department of Transportation, 2016). However, one important criterion is not explicitly mentioned on the official DOT website: the subsidy rates proposed by the airlines. This is specified in the Code of Federal Regulations (CFR): "The amount of compensation that will be required to provide the proposed essential air service" (Office of the Federal Register, 2002). "After all of the above applicable factors have been considered, the Department issues a decision designating the successful air carrier and specifying the specific service pattern (routing, frequency and aircraft type), subsidy rate, and effective period of the rate" (U.S. Department of Transportation, 2016).

How the exact tradeoff is made among the various criteria that are reviewed to obtain the subsidy is not clear. Official websites and government reports do not afford any insight into this matter. However, there is a plausible reason that there is no insight of the tradeoffs made between the various factors to grant the EAS subsidy. This could be due to political factors that can influence public spending. Hall et al. (2015) discuss the EAS subsidy amounts received by various districts. The findings are interesting because the amount of subsidy received is also a matter of politics instead of reflecting purely economically rational choices. The authors state the following: "We find that congressional influences affect the amount of airport subsidies that a congressional district receives through the Essential Air Service (EAS) program (Hall, Ross, & Yencha, 2015)." This implies that airline carriers operating in a district with many congressional influences could obtain higher subsidy rates. Thus, subsidy rates differ from previous contracts due to the different airline proposals received by the DOT, the bid system used, and political influences. After the bidding process when the carrier has been chosen; the contracts can be specified, which will be explained in the next paragraph.

The DOT usually uses periods of two years for its contracts, to give the communities flexibility in their choice (Tang, 2015). Once the EAS contracts have been established and are enforced, the subsidies are transferred from the DOT to the airline carriers at the end of the month, based on the number of flights carried out on the route that is subsidized (Tang, 2015).

This implies that a flight with one passenger on an aircraft received the same subsidy amount as a fully loaded aircraft. The next two paragraphs will discuss the costs of the EAS program.

The total funding for the EAS program in 2015 amounted to 263 million dollars (Tang, 2015). For Alaska, the total amount of EAS subsidy transferred to airlines was 20,523,512.00 dollars (U.S. Department of Transportation, 2016). Conversely, in 2012 the EAS program had an expenditure of 193 million dollars, which means that EAS spending increased by 36% from 2012 to 2015 (Tang, 2015). Furthermore, for the Alaskan market, the subsidy rate increased by 46% from 2012 to 2016 (U.S. Department of Transportation, 2012). A further increase of 7.6% has been forecasted for the total EAS program for the year 2016 (Tang, 2015). As was discussed in the introduction, the rising costs are one of the problems of the EAS program. This issue will be discussed in the next paragraph.

The rising costs are a political issue and various ways are to lower the costs of the EAS program have been examined. Tang (2015) proposes different possibilities for the rising costs of the EAS program. First, a bidding system is used, which has the aim of having airlines compete with each other to serve a subsidized route. However, in most cases only one bid is received to serve a route, which does not give airlines the incentive to minimize their subsidization request (Tang, 2015). Second, the DOT has to take six criteria into account before a bid can be accepted. This means that the financial best offer will not always prevail, because communities being served also have a say in the procedure (Tang, 2015). A third important reason for the rising costs is that planes may be heavily underutilized for certain routes, even though small aircrafts are being used (See: **Table 5**). This means that there are too many weekly departures specified by the DOT on an EAS route. Forty-nine percent of seats are filled on EAS routes, compared to 89% on routes that are not subsidized (Tang, 2015). An overview of the load factors of the Alaskan EAS flights will be discussed in the results section (See: **Table 5**). Once the subsidy rate is set, the airlines are free to set their own prices. This could mean that airlines set higher airfares with lower passenger amounts, thereby decreasing the availability of air service for individuals (Tang, 2015) and leading to a higher subsidy rate per passenger. A table of the subsidy rate per passenger will also be given in the methodology and data section (See: **Table 2**). The next subsection will discuss the effects of the EAS subsidy.

2.2.3. The Effects of EAS

The main goal of the EAS program is to keep scheduled flights in service for smaller communities, as according to policy makers this would not otherwise be possible due to the aviation deregulation. The reasoning is that individuals in rural areas are not able to pay for the full cost of the air service, and therefore air service may otherwise fail to exist (Lawrence, Cunningham, & Eckard, 1987). The only study that was found to systematically analyze the effects of the EAS subsidy is that of Lawrence et al. (1987). The authors state that, "The statistical analysis compares air fares and service levels in certain cities before and after the introduction or elimination of subsidies, and compares changes in service and fares during this period between cities whose subsidy status changed and those whose subsidy status remained constant (Lawrence, Cunningham, & Eckard, 1987)." Their results show that the EAS does not impact airline service quality in any way (Lawrence, Cunningham, & Eckard, 1987).

Pressure for the EAS subsidy comes from congressmen who represented states with a large number of rural communities (Lawrence, Cunningham, & Eckard, 1987). This is in line with the capture theory, which states that politicians are self-interested utility maximizers. Rural areas were anxious that there would not be a substitute for the old subsidy after the deregulation, and that this would have an effect on the quality of the service and the scheduled frequency, or even that it would result in the total abandonment of the service on the route (Lawrence, Cunningham, & Eckard, 1987). However, abandonment of routes also took place with formal subsidization that did not have a high profitability (Lawrence, Cunningham, & Eckard, 1987). The fear was that the deregulations would accelerate the abandonment of unprofitable routes, because airlines would be able to enter or leave without any struggle. According to Lawrence et al. (1987), there is a widespread presumption that subsidization programs are needed to sustain certain airline routes, even though no statistical evidence has been found to support this. Even if there were a possible effect on the flight frequency, it would most likely be negative, implying a decrease in the availability of air service (Lawrence, Cunningham, & Eckard, 1987). This paragraph discussed the background of the EAS program. However, there are specific EAS subsidy related effects which will be described in the next paragraph.

There is a positive effect related to the subsidizations for the consumers: airline fares decreased (Lawrence, Cunningham, & Eckard, 1987). According to general economic theory, the expectation was that flight frequency would increase, because subsidy encourages firms to produce more of the product at a lower price (Lawrence, Cunningham, & Eckard, 1987). However, this theory only holds if more than one supplier receives the subsidy, and this is not the case for the EAS program. Due to the structure of the subsidy and how it is implemented, it could also act as a barrier for new entrants (Lawrence, Cunningham, & Eckard, 1987). This is because an airline serving a specific route might adopt a pricing strategy that is below the full cost of new entrants (Lawrence, Cunningham, & Eckard, 1987). This would lead to a reduction in the number of carriers on routes that are served by EAS airlines.

One of the objectives of this study is to analyze the effect of the EAS subsidy on airline fares which was also done by Lawrence et al. (1987), but there are some key differences between both studies; these will be described in the methodology section (3.3). The next paragraph will discuss the air fare characteristics in general.

2.3. Airline Prices

The previous subsection discussed the EAS subsidy and provided an overview of how this regulation is implemented and structured. This subsection will present the most important aspects of airline prices in order to be able to account for the most important facets during the statistical analysis of this study.

First, an airline offer is characterized by its fares, service amenities, and restrictions in a certain market. However, in a time span of 24 hours, the airline offer can be obsolete (Belobaba, 1987). Second, airlines offers are characterized by the speed at which prices change. This is because US airlines are given complete freedom in pricing for the domestic market, which gives them the opportunity to change the origin-destination fares immediately within their own reservations systems (Belobaba, 1987). Due to the freedom that carriers have to change their airline offerings, it is impossible to provide an exact description of how fares are structured for the different airlines and markets. According to Belobaba (1987), it is possible to depict a general structure of price levels in the US domestic market if there is no low cost carrier on the route that would stimulate a price war. Apart from heavy competition due to low-cost carriers, seasonal demand fluctuations could also have an effect on airline prices. In most markets the prices remain stable (Belobaba, 1987), but in the Alaskan market seasonal peaks must be accounted for; these peaks range from mid-June to mid-August (Alaska.org, 2016). However, the differential pricing aspects and market demand practices are two stable factors that make it possible to analyze airline offerings (Belobaba, 1987).

Most of the costs of an airline carrier can be considered fixed in the short run, if the scheduled airlines flights are taken into account one month in advance (Belobaba, 1987). This means that an additional passenger in the aircraft does not contribute to costs in a significant way for an airline carrier. The incremental costs for an extra passenger, which consist of reservations, ticketing, baggage handling, and meal service, would approximately add up to a little less than 25 dollars (Belobaba, 1987). Because of the low variable costs per passenger, it is possible to ask for prices lower than the full fare to attract incremental demand. For example, if the 25-dollar variable cost is taken as a reference, airline carriers would still be making a rational choice by asking for any price above 25 dollars to cover the fixed costs. Airlines have a marginal unit of production with a fixed-seating capacity and a marginal unit sold, which is one seat; this makes it difficult to determine the relevant marginal cost (Belobaba, 1987). Thus, it can be deduced that the operating costs per passenger decrease as the number of passengers increases towards the capacity of the aircraft. Setting prices equal to the variable marginal cost would result in an operating loss due to the fixed costs, which does not make it economically viable. Another way must be found to achieve an efficient allocation of resources in this case (Varian, 1996). Airlines have to earn these fixed costs back, and therefore prices will be above the variable marginal cost. Using the differential pricing strategy, prices per passenger are above the average cost, which will result in a positive operating income. Aspects of differential pricing will be discussed in the next paragraph.

A differential pricing strategy will prevail in industries that show an increase in returns to scale, large fixed costs, and economies of scope (Varian, 1996). Varian (1996) lists three characteristics of these types of industries. First, prices will differ across consumers and types of services. Second, producers will search for ways to differentiate their products in order to ask for different prices. Third, differential pricing arises as a natural act because companies will seek to maximize their revenues under these circumstances; thus, differential pricing will contribute to economic efficiency (Varian, 1996). Due to these characteristics of differential pricing, airlines are able to generate additional revenue, which is required to cover the costs from the passengers who benefit from a reduced airfare (Belobaba, 1987). This results in a more efficient use of the resources with the related sunk and fixed costs by filling the remaining empty seats using differential pricing (Belobaba, 1987). By using a differential pricing strategy airlines can target different market segments. This will be explained in the following paragraph.

Due to the differential pricing strategy, airlines can reduce cyclical variations in demand over time by using time-dependent price reductions (Belobaba, 1987). Using a differential pricing strategy requires the airlines to distinguish between the different segments and the total demand (Belobaba, 1987). The most important determinants of demand with regard to an airline offering are price and service level. By distinguishing between the different market segments, the differential pricing strategy becomes more effective. As previously explained, the airlines differentiate their offerings by purchasing conditions and restrictions, price, and extra services. This makes it possible for airlines to target different segments.

The essence is that a purchase of an airline offering cannot be seen as a commodity, but is specified by its origin, time, and destination (Belobaba, 1987). Belobaba (1987) refers to an airline offering as a package that consists of itinerary limitations, refunding, and extra services.

The previous paragraphs in this subsection are of importance, because it motivates the way in which the data are collected; this will be discussed in the next main section on data and methodology. The next paragraph will now provide a short overview of other determinants of airline offerings.

One explanation for the varying airfares between the different O-D’s is the distance. However, the distance is a non-linear determinant for airline prices, because short-haul flights have a higher cost per kilometer compared to long-haul flights (Abdelghany, 2007). Other determinants that are statistically significant to determining the different air fares between the O-D’s are the number of competitors, number of passengers, and operational systems (Vowles, 2006). Additional factors that also have a significant impact on airline fares are the presence of a budget airline carrier, hub dominance, and the market share of a carrier (Vowles, 2006). The following subsection will describe the Alaskan airfare market.

2.4. Airfares in Alaska

According to Abdelghany (2007), prices to and from Alaska are higher compared to other similar destinations in the US: Anchorage, Juneau, and Fairbanks have higher airfares compared to the rest of the US. This study was conducted by comparing airports in Alaska and the rest of the US by using descriptive statistics. However, the airfares of Fairbanks and Juneau show a greater discrepancy of airfares than Anchorage. Abdelghany (2007) suggests that this might be due to extra airline competition in Anchorage. An explanation for this might further be found in the present study, although that is not its main purpose, which is to analyze the airfare effects and costs regarding the EAS subsidy in Alaska. Another important factor for the Alaskan airline market is the price elasticity of demand, which is the percentage change of demand due to a percentage change in price. This could lead people to use other modes of transportation to access their destination. However, this is likely to be different in Alaska, because it is characterized by longer traveling times and costs for alternative traveling modes (Abdelghany, 2007).

2.5. Hypothesis Development

According to Lawrence et al. (1987), the EAS program has one beneficial effect for the communities receiving the subsidy: it lowers airfares on the subsidized routes. This suggests that Alaskan residents living in a community that is served by an airline receiving EAS would also benefit from the reduced pricing. This leads to the first hypothesis.

H1a: *Airlines that receive the EAS subsidy have a lower airfare compared to airlines that do not receive the subsidy.*

The economic literature states that monopolies generate higher prices than competitive markets do (Schwartzman, 1959). The first hypothesis states that routes with airlines that receive EAS will have lower airfares. However, these effects can be different for origin-destination routes that are served by a monopoly that receives EAS. The expectation is that airlines that receive EAS on monopoly routes will be affected differently compared to those that operate on a route where there is competition. The following sub-hypothesis is thus formulated.

H1b: *The effect of EAS on the price of an airline that receives the subsidy is more negative for a monopoly route than for a competition route.*

The second question of interest in this study concerns the costs of the program. This will be investigated by analyzing the utilization rate and costs of flights receiving EAS, because critics of the program refer to the highs costs and the underutilized airports associated with it (Grubesic & Wei, 2013). Airlines in the US had a load factor of 84.8% (U.S. Department of Transportation, 2016), compared to just 49% for all EAS flights (Tang, 2015). The expectation is that flights that receive EAS in Alaska will have a lower load factor. The next hypothesis is as follows.

H2: *Flights that receive EAS in Alaska are underutilized compared to the airline load factor in the US.*

This literature reviewed discussed the relevant EAS aspects for this study. The two hypothesis are stated using this literature. The next main section will discuss the data and methodology used to obtain the results.

3. Data and Methodology

3.1. Data Collection

This subsection will discuss the data collection method applied and the various data sources used in this study. The data collection method applied is motivated by a large part discussed in subsection 2.3 about airline prices.

To examine the effect of the EAS subsidy on airline prices, data were gathered using various sources. Some parts of the data concerning the Alaskan airline market were not publically available and had to be collected manually. Data regarding the dependent variable, which is the average airfare, were collected using the official websites of the 18 airlines serving the Alaskan market. Direct scheduled flights were taken into account, which means that the prices of air taxis and indirect flights were not collected. This was done to draw a fare comparison between the airlines, because scheduled airlines have large fixed costs (Belobaba, 1987). The next paragraph will explain the data collection principles applied.

The four largest airlines serving the Alaskan market are Alaska Airlines, Ravn Alaska, Grant Aviation, and Penair. One hundred and sixty-eight direct scheduled routes were available for data collection in this sample, of which 31 were not served by the largest four carriers in the Alaskan market. This means that 81.6% were served by the four largest airline carriers. Round trips were used in this sample, with two weeks between the departure and arrival date. For the purposes of creating a larger sample, and to be able to control for differential pricing, prices were taken for three different moments. This means that the data were collected on one day, but for different departure dates. Day 1 refers to the prices of the flights that departed on the same day as the data collection, which was May 21st. However, this was not always possible because some flights were not daily. If there was no departure flight on May 21st, the earliest departure after this day was taken, with a maximum delay of three days. Day 2 refers to departure flights two weeks from the data collection moment. The same principle applies to Day 2 as to Day 1. The departure flight for day 2 was 14 days from the date when the data were collected. Day 2 flights departed on June 5th. Again, some flights were not daily, and therefore the data could be collected within three days of the official collection moment. This means that the actual departure date of Day 2 was the June 5th, but June 8th could also be used. Day 3 refers to the departure flights on June 22nd, with the same principle applied to Days 1 and 2. All return flights were 14 days after the departure date, or the earliest day after. All possible combinations were made between the different departure and arrival times for the three different days. For example, there were five departure times and five return times in one day, and thus 25 different prices were collected. The averages were then taken for the different departure and return dates for Days 1, 2, and 3. Because the averages were taken for the prices, all aspects of an airline price were sought to allow for comparison. This means that the airfare data collected were non-refundable, were valid for coach, and did not include any extra amenities. The succeeding paragraph will give further detail on the other data and how the dataset is compromised.

Using the official websites of the 18 airlines that operate in Alaska, the number of competitors and the price of a round trip were obtained. The data were collected manually and transferred into an Excel sheet so that the data from different sources could be merged. Then, the distances between the various origins and destinations were collected using the tool that is available on www.worldatlas.com (Worldatlas, 2016). The number of enplanements of the origins and destinations were also added to the Excel sheet. This refers to the number of passengers boarding at an airport (Federal Aviation Agency, 2016). These data were made publically available on the website of the Federal Aviation Agency (FAA). The data concerning the EAS subsidy were found on the website of the US DOT, which has a report concerning the subsidy rates for the bookkeeping year 2016 (U.S. Department of Transportation, 2016). Furthermore, the determinants of the aircrafts used for EAS routes were also obtained from the US DOT (U.S Department of Transport, 2016).

In summary, this study relies on four sources of the data, which are the airline websites, the world atlas distance tool, the website of the FAA, and the US DOT. The combination of the various sources of data provides a sound base for a statistical analysis of the effect of the EAS subsidy on airline prices. The collected data are also sufficient to analyze the load factor of the EAS carriers using descriptive statistics.

The next subsection will provide further insight into the dependent variables, explanatory variables, and the control variables used for the econometric model to answer the first research question.

3.2. Variable Description

This subsection will describe the variables used in the econometric model. The functional form and the main characteristics will be explained.

3.2.1. Dependent Variable

The dependent variable used in this study is the natural logarithm of the average airfare of direct scheduled flights in Alaska. The direct scheduled routes analyzed are from the primary airports in Alaska, which have airports that have more than 10,000 enplanements per year (Federal Aviation Agency, Airport Categories, 2016). Alaska has 28 primary airports, and there are therefore 28 different origins in this sample. For each of these origins, there are observations of direct scheduled flights to various destinations. This means that there are three departure and return times for one origin-destination. This means that there should be 504 (168 * 3) observations for the 168 scheduled direct flights in this sample, if there are no missing observations. However, there are only 502 observations in this sample: two observations are missing because of the data collection restrictions discussed in section 3.1.

The two observations missing correspond to Day 3 for the route Unalaska-Anchorage, and Day 3 for Anchorage-Dutch Harbor.

3.2.2. EAS Variable

The main variable of interest for the econometric model is the EAS variable. Dummy variables have been created to identify the effect of the EAS subsidy on the average airfare. The dummy will take the value 1 if there is an airline receiving EAS subsidy on a route. As discussed in the literature review (2.2.), there are communities that do not have an airline receiving EAS even though the community is eligible for the subsidy. For example, Bethel is a primary airport in Alaska that is eligible for EAS, but it does not have an airline receiving the subsidy (U.S. Department of Transportation, 2016). The next paragraph will make it clear when a flight is subsidized.

The airline serving the eligible community receives the subsidy if it completes a flight to or from the hub specified by the DOT (U.S. Department of Transportation, 2016).The term hub airport is used differently for the Alaskan case, as it refers to a larger airport in Alaska. Michael F. Martin, an employee of the US DOT, sent an email to the present author to clarify the Alaskan EAS case: “For Alaska, in order for an eligible EAS community to receive federal subsidy, the air service must be to a larger airport which will connect the community to the Alaska air transportation and the larger national air transportation system.” This statement confirms that flights between the specified larger airport and the EAS communities are subsidized.

In this sample there are 84 observations that the EAS dummy variable takes the value 1 for 23 different routes. The reason that there are 23 and not 28 (84 observations divided by three) EAS routes is because the airports of Cordova, Gustavus, Petersburg, Wrangell, and Yakutat are also primary airports. These airports have airlines that receive EAS that fly to the US DOT specified hub airports. This means that these five airports are origins and destinations in this sample, which implies that they have six observations per EAS route. For example, Anchorage-Cordova and Cordova-Anchorage both have three observations. Thus the rest of the 18 (23 routes, five primary EAS airports) EAS routes have three observations, because the EAS airports are destinations in this sample. This means that the EAS dummy variable has the value 1 for 15 (5 EAS airports * 3 observations as origin) observations if an EAS community is an origin, and 69 (23 EAS airports * 3 observations as destinations) where an EAS community is a destination. The next paragraph will give the reader a better understanding of the payment structure of the EAS subsidy.

The airlines receive the subsidy once a month, once the contract has been set up between the airline carriers and the DOT for the various EAS routes. The airlines receive a fixed subsidy rate per flight according to the contract. However, the monthly payments can deviate because of poor weather conditions, flight cancellations, and the use of another aircraft than the one specified in the contract. The total amounts of EAS subsidy spent per community is publically available on the website of the US DOT (See: **Table 1 & 2**).

Table 1:

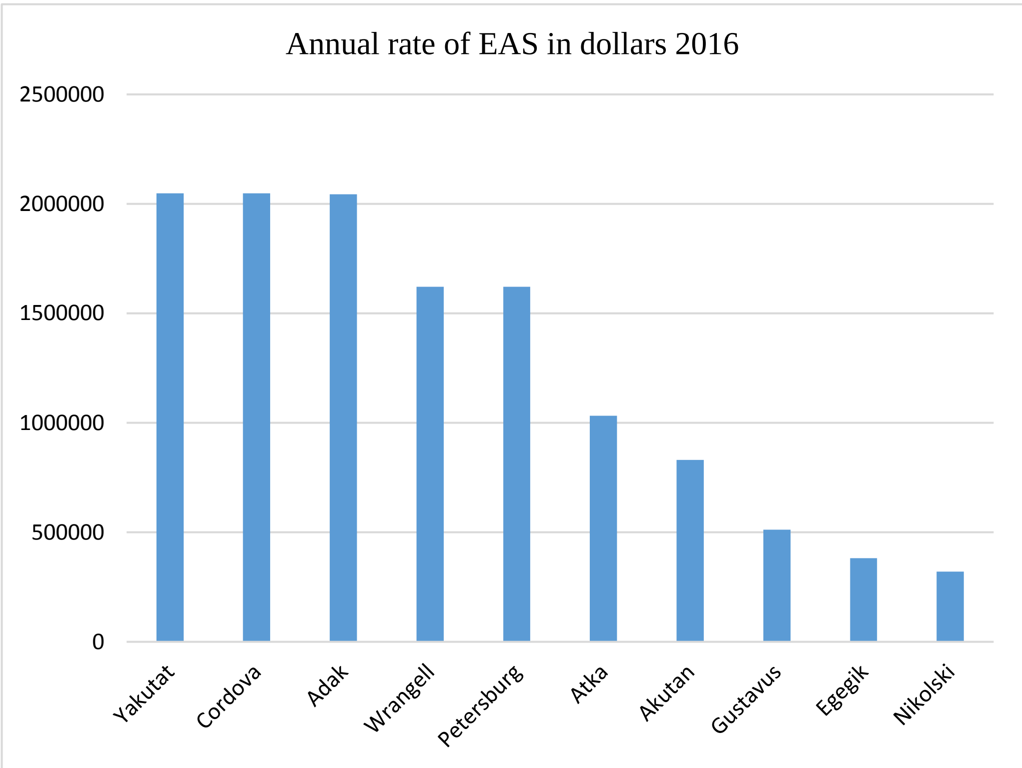
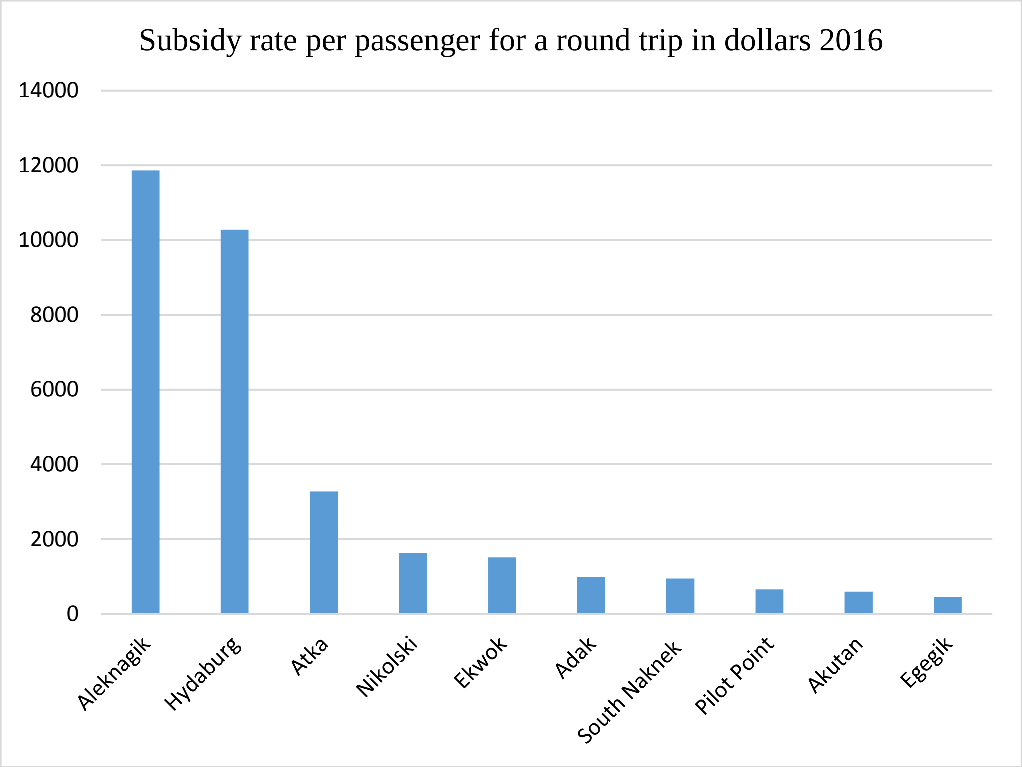


Table 2:



3.2.3. EAS Interaction Variable

The EAS interaction variable is the second variable of interest for hypothesis 1b, which was motivated in section 2.5. The interaction is between the competition and EAS dummy variable. The EAS dummy variable will take the value of 1 if a specific route has an airline receiving Essential Air Service subsidy. The competition variable value will also be 1 if there is competition on the route. There is competition on the route if there are two or more airlines flying. Further explanation of the competition variable will be discussed in the subsection concerning the control variables (3.2.4).

In the collected sample, there was only one route that had a subsidized airline and unsubsidized airline competing with each other. Alaska Airlines receives the subsidy on the route Anchorage-Cordova (U.S. Department of Transportation, 2016) and is in competition with Ravn Alaska. There are six observations for this route, because Cordova is a primary airport.

3.2.4. Control Variables

The previous two subsections provided the variable description, which explained the functional form of the two independent variables and its main characteristics. This subsection will describe and motivate the control variables used. The functional form and the main characteristics of these variables will also be enlightened.

Distance

The natural logarithm of the distance between an origin and a destination is used as a control variable. The flying distance was collected using the tool provided by Worldatlas (2016). The distance between an origin and a destination is expected to increase the average airfare (Vowles, 2000). However, the distance is a non-linear determinant for airline prices, because short-haul flights have a higher cost per kilometer than long-haul flights do (Abdelghany, 2007). To control for non-linearity's, a second control variable is incorporated in the econometric model. The squared distance in the natural logarithmic form is introduced to control for the non-linearity of distance on the average airfare. The expectation is that the average airfare will decrease per passenger after a certain amount of kilometers flown.

Differential Pricing

To incorporate time-specific effects in this model, two dummy variables have been created: one each for Day 2 and Day 3. This means that Day 1 is used as a base category. These dummies have been created because an airline offering cannot be seen as a commodity, but is specified by its origin, time, and destination (Belobaba, 1987). Belobaba (1987) refers to the airline offering as a package that consists of itinerary limitations, refunding, and extra services. As discussed earlier, the data collection method used aimed to keep all of these factors constant. However, the time-specific effects still need to be controlled for by using three dummy variables for Days 1, 2 (departure within two weeks), and 3 (departure within a month). The dummy variable will take the value 1 if the price relates to the day of departure. Using a differential pricing strategy requires the airlines to distinguish between the different segments and the total demand (Belobaba, 1987). Business travelers generally value time more than leisure travelers do (Brons, Pels, & Rietveld, 2002). This means that business travelers substitute a greater amount of time for money. Using this reasoning, the expectation is that the average airfares will decrease from Day 1 to Day 3.

Airline Code Sharing

A code sharing dummy variable has been created for routes that have airlines cooperating with each other. The dummy variable will take the value 1 if there is cooperation between airlines on the route. The Alaskan market only has one agreement among Alaska airlines, Ravn Alaska, Penair, Delta Airlines, and American Airlines (Alaska Airlines, 2016). Routes that have a cooperation agreement have lower airfares (Brueckner, Lee, & Singer, 2011; Brueckner & Whalen, 2000).

Demand

To control for the demand on specific routes, the natural logarithm has been taken for the number on enplanements for a destination. According to Castelli et al. (2003), there is significant variability of the elasticity of passenger demand with respect to the different airfares paid among the different routes in their study. The results differ per origin-destination, but they all have a negative price elasticity of passenger demand. Therefore, the expectation is that an increase in the number of enplanements for a destination will decrease the average airfare that is paid. The model used in this study does not include the demand factors of the origin because origin effects are kept fixed; this will be discussed in the methodology section.

Competition

A dummy variable has been used to control for competition. This variable will take the value 1 if there are two or more airline carriers on a route. There are 184 observations for routes with competition. This variable has been included because the economic literature states that competition decreases prices. Various studies have confirmed that even the threat of a potential competitor decreases the price of incumbent firms (Kwokaw & Shumilkinaz, 2010).

Flying Outside of Alaska

A control variable is constructed for flights outside of Alaska. A dummy variable will take the value of 1 if a destination is located outside of Alaska. During the introduction, an illustration was given of the rural nature of Alaska. Anchorage is the most populated area, with approximately half of the Alaskan population, leaving the rest of the people spread over the largest state in the US. Anchorage has a population of 291,826, while Alaska's total population is 710,230 (United States Cencus Bureau, 2010). In addition, the Alaskan people rely heavily on air transport (Hudson, 2005), which suggest that traveling within Alaska could be more expensive compared to flights outside of Alaska. This is possible because the prices are more elastic for people visiting than for people traveling out of necessity.

Airlines in Alaska

As described in the data collection section, the four largest airlines in Alaska account for 80% of the airfares in this sample. Dummy variables have been created for Alaska Airlines, Ravn Alaska, Penair, and Grant Aviation. The dummy variables are 1 if one of the airlines is present on the origin-destination. These control variables control for specific airline effects, which could refer to the operational systems used by the airlines (Vowles, 2006).

Table 3: Continuous variable list and description

Variable	Obs	Source	Mean	Std. Dev.	Min	Max
Average prices O-D	502	Airline websites	368.61	205.07	110.00	1324.00
Ln average prices O-D	502	Airline websites	5.79	0.47	4.71	7.19
Air distance in km	502	Worldatlas	494.42	840.37	5.00	4592.00
Ln air distance in km	502	Worldatlas	5.42	1.22	1.79	8.43
Number of enplanements destination	502	FAA	1564653	5023498	19	33800000
Ln number of enplanements destination	502	FAA	9.72	3.31	3.00	1.73

The previous subsections described the variables which are used in the econometric model in this study. The summary statistics of the continuous variables are also present (See: **Table 3**). The next subsection will describe the methodology used to answer the research questions.

3.3. Methodology

The former subsections presented the summary statistics of the continuous variables (See: **Table 3**) and described the independent, dependent, and control variables that are used in the econometric model. The first goal of this study is to analyze the effects of the EAS subsidy on airfares. Secondly, the load factors of EAS flights will be obtained.

To begin, this section will discuss the key differences between this study and that of Lawrence et al. (1987). The key differences are described to give the reader a better understanding why the research done in this study is not redundant, because Lawrence et al. (1987) also analyzed the effect of the EAS subsidy on the air fares. The largest differences between the two studies are due to the methodology used. Once the differences have been described, the two different methodologies used in this study will be motivated.

3.3.1. Important distinctions between this study and Lawrence et al. (1987)

The first hypothesis, which states that the EAS subsidy decreases the average airline prices, is deducted from the work of Lawrence et al. (1987). However, there are some major differences between these two studies. First, the statistical approaches differ: while Lawrence et al. (1987) use comparative statistics, the present study obtains results using ordinary least squares (OLS) with robust standard errors, absorbing the origin effects. The two other major differences concern the data used and the year during which the studies were conducted. Regarding the data, a drawback of using comparative statistics for the situation before and after the introduction of the EAS subsidy is that it is difficult to control for changing circumstances over time, which could have an effect on the airline prices. Even though Lawrence et al. (1987) try to control for exogenous effects such as fuel prices and cyclical demand variation over time, it is still possible that there were specific regional demand changes over time. However, Lawrence et al. (1987) argue that their study was conducted during a time of economic stability, implying that the airline demand levels were also stable. Regarding the year, Lawrence et al.’s (1987) study was conducted nine years after the Airline Deregulation Act (ADA), using data from 1978 to 1984. Conversely, the present study was conducted 38 years after the ADA, which means that the market for the airlines receiving EAS has reached a stable equilibrium. This is most likely less stable for data from 1984, which was only six years after the ADA. The reasoning is that regulation can lead to wealth creation or loss due to efficiency changes (Noll, 1983). Furthermore, some interest groups are more capable of capturing the economic surplus created, which means that some groups handle the regulated environment better than others do (Noll, 1983). Thus is can be deduced that airlines left and entered the market after the ADA, and that the market was therefore most likely not in a stable equilibrium for a few years thereafter. The third main difference is that this study takes Alaskan airfares into account, whereas Lawrence et al. (1987) consider air fares from 41 states. Specific origin effects are not controlled for in the early study, whereas they are controlled for in the present one. This could mean that the heterogeneity between airport costs could influence airfares. The following statement will enlighten the different costs of various airports: “Aeronautical revenues include aircraft landing fees, aircraft parking and hangar fees, passenger terminal fees and air traffic control charges (if the service is provided by the airport authority), with landing and passenger terminal charges being most important” (Zhang & Zhang, 2002). To give an example: passenger terminal charges will be absorbed in this study, whereas they could bias the results of Lawrence et al. (1987).

This paragraph provided the reader with a better understanding of the differences between this study and that of Lawrence et al. (1987); this is important because both analyze the effects of the EAS subsidy on airfares. The following paragraph will motivate the econometric model used in the present study.

3.3.2. Methodology Hypothesis 1

A multiple regression model was used using OLS with robust standard errors to test the first hypothesis, keeping the origin effects fixed. Three factors played a key role in choosing this model. First, the airfares for the Alaskan market were not publically available, which means that the data had to be collected manually for the different airline routes. The data collected are referred to as cross-sectional data. Biørn (2013) clarifies what cross-sectional data are: "These are data from units observed at the same time or in the same time period. The data may be single observations from a sample survey or from all units in a population." Due to the fact that the sample has one time period, one dependent variable and more than one explanatory variable, using a multiple regression model suites the best manner. This is due to the fact that this model can keep the control variables factors fixed. This implies that the effect of the EAS variable can be analyzed.

The previous paragraph motivated the multiple regression model using OLS. The next two paragraphs will explain why the robust standard errors have been used and why the origin effects are absorbed.

The second important factor is that the collected data are clustered. This is also referred to as correlated data (Institute for Digital Research and Education, 2016). The data are clustered because there are three different departure and return dates for an origin-destination, which in turn means that there are three different observations. The correlated nature is fairly clear in this sample, because an origin-destination has similar characteristics for the three departure and return dates. Clustered data need to be taken into account, as this leads to incorrect standard error estimates, which would have an effect on the significance level (Institute for Digital Research and Education, 2016). This means that robust standard errors should be used because this allows for cluster correlation (Wooldridge, 2009).

The third important factor that was considered when choosing the model was to keep the origin effects fixed. An example of an origin effect that is absorbed in the model is the passenger terminal costs, which can deviate per origin and could thus bias the result (Zhang & Zhang, 2002). The “areg” command used in STATA absorbs the origin effects. By using this command, the dummy effects are not shown in the results output.

In summary, the model used is motivated by three factors: the cross-sectional and the clustered nature of the data, as well as the possibility of origin effects influencing the results. Using OLS with robust standard errors while keeping origin effects fixed yields a sound statistical estimation of the effects of the EAS subsidy on the average airfares. The next paragraph will describe how the load factor of EAS flights in Alaska is obtained, because these statistics are not publically available per flight.

3.3.3. Methodology Hypothesis 2

This subsection will discuss the methodology used to obtain the combined EAS load factor for Alaska and separate EAS flights. The first paragraph will explain how the load factor is calculated. This will give the reader a better understanding of the subsequent paragraphs, which will motivate the strategy used to answer the second research question.

“Load factor represents the proportion of airline output that is actually consumed” (Massachusetts Institute of Technology, 2016). To obtain the load factor of a single EAS flight in Alaska, two essential statistics are needed. The number of passengers and available passenger seats on a route. The load factor for a single flight is calculated by dividing the number of passengers by the available seats on the flight (Massachusetts Institute of Technology, 2016). However, calculating the load factor for more than one flight, the distance is also needed between an O-D. The US DOT then uses the passenger-miles as a proportion of available seat-miles expressed in percentages (U.S. Department of Transportation, 2016). Revenue passenger miles is the basic measure used for airline passenger traffic (Massachusetts Institute of Technology, 2016). An example of revenue passenger miles (RPMs) will give the reader a better understanding: “For example, if 200 passengers fly 500 miles on a flight, this generates 100,000 RPMs” (Massachusetts Institute of Technology, 2016). Available seat miles (ASMs) is the second facet to calculate the load factor of more than one O-D flight. The ASM measure entails the airline output which is a common tool in the industry. Again, an example will be given to clarify: “An aircraft with 100 passenger seats, flown a distance of 100 miles, generates 10,000 available seat miles” (Massachusetts Institute of Technology, 2016). To obtain the load factor of more than one flight the sum of RPM’s are divided by the ASM’s.

The previous paragraph discussed the load factor statistic. The next paragraphs will explain the assumptions which are going to be made and data used to obtain the answers for the second research question.

First, it is important to mention that the load factors are not publically available for the different EAS O-D’s. However, it is nice to have these statistics in an overview to give the reader a better understanding of the various EAS O-D’s in Alaska (see: **Table 5**). Second, the number of passengers on an EAS route is not publically available. As discussed in the previous paragraph, the number of passengers on a route is important to calculate the load factors of various flights. The next paragraphs will explain the assumptions and data needed to obtain the load factor of the Alaskan (AK) EAS market and the independent EAS O-D’s.

Assumptions are needed to be able to proxy the load factor for the different EAS O-D’s and the Alaskan market, using publically available data. The number of enplanements in an airport is publically available on the Federal Aviation Administration website (Federal Aviation Agency, 2016), which does not include air taxis (DWU Consulting, 2015). Weekly flights constituted the second statistic that was needed; this was obtained by using the official websites of the airlines serving Alaska. The Load factors of all the EAS communities were also available on the US DOT website. The last statistic needed was the aircraft size; this was obtained using the EAS determinants document made publically available on the US DOT website (U.S. Department of Transportation, 2016). With these data it is possible to approximate the load factor, which will be enlightened in the following paragraph.

The first assumption: it is assumed that all of the enplanements from an origin fly to the hub airport as destination, because most of the EAS airports have one route scheduled. To give an example of this assumption: Hydaburg is an EAS community with Ketchikan as a hub airport. Hydaburg had 19 enplanements in 2015, thus with the previous stated assumption, all the passengers fly to Ketchikan. In addition, the weekly departures were the same for the off-peak and peak seasons. The reasoning is that, according to the US DOT's Alaskan EAS determination document, the EAS determinations for the peak and off-peak departures are the same for most of the airports (U.S. Department of Transportation, 2016).

With these assumptions the combined load factor is obtained for the 23 EAS communities in this sample for a year, by dividing the sum of the RPM's by the APM's (See: **Table 5**). The load factor for the independent communities is obtained from the US DOT website, because an assumption was made that all the flights from an EAS community fly to a hub specified by the DOT (See: 2.2.1.). To make sure that the combined EAS load factor approximation will be as precise possible, the load factors were also calculated manually for the independent EAS flights with the available data and assumptions, which were then compared to the official statistic. This was done by using the number of enplanements of an EAS airport and the number of seats available per flight. The manually calculated EAS load factors were compared to the official statistic provided by the US DOT. If the load factor from the EAS community differs 10 percent from the official statistic, this community will not be taken into account for the combined load factor. This discrepancy is due to the assumptions made. To give an example: The number of scheduled flights can differ compared to the reality, thus effecting the ASM's. The combined EAS statistic in Alaska will answer the second research question.

The data and methodology section motivated the data and strategy used to obtain the answer of the two research questions. The two research questions are obtained using a different approach. The first question is answered using an econometric model. The second research question is obtained by using descriptive statistics. The next mains section will describe the results.

4. Results

The previous section described the strategy used to test the developed hypotheses. This section will discuss the results of the econometric model and descriptive statistics used (See: **table 4 & 5**). Results regarding the first hypothesis will be discussed first; these were obtained with a linear regression model using OLS with robust standard errors, keeping the origin effects fixed. Subsequently, the results for the second hypothesis will be presented.

4.1 Hypothesis 1

To ensure that the results are not biased due to multicollinearity, variance inflation factor (VIF) and correlation statistics were obtained. Multicollinearity occurs when two or more variables are moderately or highly correlated (Pennstate Eberly College of Science, 2016). High correlation among regressors can lead to large standard errors for the OLS estimates (Wooldridge, 2009). Regression analysts often rely on variance inflation factors to be able to detect multicollinearity (Pennstate Eberly College of Science, 2016). The results of the correlation statistics indicate that there is no multicollinearity among the independent variables (See: **Appendix A & B**). The highest correlation value is 0.6290. Moreover, the highest value for the VIF statistic is 2.75. The rule of thumb is that VIF statistics above 4 need further attention, and VIF statistics above 10 indicate serious multicollinearity (Pennstate Eberly College of Science, 2016). Hence, it can be concluded that none of the independent variables are affected by multicollinearity.

The multiple regression model shows five different results, with the natural logarithm average price as the dependent variable (See: **Table 4**). The first model includes all control variables that apply for airfares in general. The second model includes a variable to control for the effects of flights outside of Alaska, such as Anchorage-Seattle. After controlling for the effect of these flights, specific Alaskan control variables are added. The fourth and fifth models include the two independent variables that are of interest for the first hypothesis. All of the models absorb the origin fixed effects, such as passenger terminal cost. It should be noted that the EAS subsidy effects are not absorbed, because an airline may receive a subsidy for flying from one origin to a certain destination, while another airline flying from the same origin to the same or another destination may not receive a subsidy.

The first model includes the general control variables for airfares. The results are statistically significant and show the right sign, except for the competition variable. Competition is not significant and has a positive sign. The expectation was that competition would decrease the average airfare. Secondly, the variable of number of enplanements, which proxies demand, is negative and significant, as was as expected. The variables concerning the air distance between an origin and destination should be interpreted jointly. The results show the expected sign, which means that the average airfare increases per kilometer, but then decreases again at a certain point. This in line with the literature, which suggests that the distance is a non-linear determinant of average airfares (Abdelghany, 2007). The variables of Days 1, 2, and 3 are all significant and have the expected sign. Flights on Day 2 have a lower average airfare compared to Day 1. Conversely, Day 3 has a larger negative effect on average prices than Day 2 does, which is also in line with the literature.

The second model includes the control variable for flights outside of Alaska, which has a negative and significant effect on the average airfare on a route. This means that model 1 suffers from an omitted variable bias. All of the variables from model 1 still have the expected sign, except for the variable of competition, which is still insignificant and has a positive sign. Model 3 builds upon the second model by adding the Alaskan control variables. The four largest airlines and a code sharing agreement are controlled for. The results indicate that all of the airlines have a significant effect on the airfares except for Ravn Alaska. The code sharing agreement variable is significant and decreases the average airfare on a route. The inclusion of these variables also affects the control variables of competition and number of enplanements in an important manner. Competition becomes significant at a 1% level in the third model, increasing the average airfare if there is competition on a route. The effect of the number of enplanements is still significant in model 3, but an extra enplanement at the destination does not reduce the airfares as much as in model 2. Model 3 is specified in the best manner, and reveals that the other models suffer from an omitted variable bias.

H1a: *Airlines that receive the EAS subsidy have a lower airfare compared to airlines that do not receive the subsidy*.

The fourth model includes all of the control variables including the EAS variable. The EAS variable has no effect on the average airfare, as the variable is insignificant (See: **Table 3**). This implies that hypothesis H1a is rejected

H1b: *The effect of EAS on the price of an airline that receives the subsidy is more negative for a monopoly route than for a competition route.*

The interaction term with competition and EAS is not significant either. This means that routes that have an airline that receive EAS and is in competition with another airline have no effect on the average airfare paid in Alaska (See: **Table 3**). This indicates that hypothesis H1b is rejected.

4.2 Hypothesis 2

The hypothesis is answered using the methodology described in section 3.3.3. The combined load factor is obtained for the EAS communities in this sample. Seven communities were dropped from this statistic: Yakutat, Pelican, Petersburg, Angoon, Cordova, Kake and South Naknek. These communities were dropped because the manually obtained load factor differs more than 10 percent from the US DOT statistic. The manually obtained statistics are needed to obtain the combined load factor (RPM'S/APM's). The revenue/available passenger miles in this sample are 133814.4/597264

H2: *Flights that receive EAS in Alaska are underutilized compared to the average airline load factor in the US.*

Hypothesis 2 is confirmed using descriptive statistics (See: **Table 5**). The load factor of EAS flights in Alaska is 24.4%. Petersburg has the highest load factor at 64.0 %, which is still below the US load factor of 84.8% (U.S. Department of Transportation, 2016). The lowest passenger load factor is in Hydaburg at 1.5%, which is much lower than the total US EAS load factor of 49% (Tang, 2015). In addition, it can be concluded that there are many empty planes flying without any passengers. Hydaburg is a prime example: it has only 19 enplanements per year, but has three weekly scheduled flights with a small aircraft.

This main section reviewed the results obtained for the hypotheses. The subsequent two pages contain the statistics obtained for the results. The next main section will conclude the study and discuss the findings.

Table 4: Hypothesis 1a & 1b

VARIABLES	(1)	(2)	(3)	(4)	(5)
1. Ln air distance km	8.865***	10.16***	10.41***	10.40***	10.39***
	(0.834)	(0.877)	(1.014)	(1.006)	(1.009)
2. Ln air distance squared	-4.206***	-4.837***	-4.964***	-4.959***	-4.955***
	(0.406)	(0.427)	(0.494)	(0.489)	(0.491)
3. Ln number of enplanements destination	-0.0495***	-0.0453***	-0.0290***	-0.0272***	-0.0271***
	(0.00753)	(0.00756)	(0.00705)	(0.00678)	(0.00679)
4. Competition	0.0201	0.0407	0.0949***	0.0981***	0.0990***
	(0.0337)	(0.0348)	(0.0331)	(0.0335)	(0.0340)
5. Day2	-0.0787***	-0.0786***	-0.0735***	-0.0735***	-0.0734***
	(0.0271)	(0.0267)	(0.0240)	(0.0240)	(0.0240)
6. Day3	-0.107***	-0.106***	-0.104***	-0.104***	-0.104***
	(0.0276)	(0.0272)	(0.0245)	(0.0245)	(0.0245)
7. Flights outside Alaska		-0.234***	-0.246***	-0.254***	-0.254***
		(0.0878)	(0.0894)	(0.0899)	(0.0899)
8. Alaska Airlines			-0.180***	-0.184***	-0.184***
			(0.0451)	(0.0453)	(0.0454)
9. Ravn			0.0399	0.0413	0.0419
			(0.0409)	(0.0410)	(0.0413)
10. Penair			0.294***	0.298***	0.299***
			(0.0684)	(0.0685)	(0.0686)
11. Grant Aviation			-0.152**	-0.154**	-0.154**
			(0.0655)	(0.0659)	(0.0661)
12. Code sharing			-0.192***	-0.200***	-0.199***
			(0.0726)	(0.0742)	(0.0755)
13. Essential Air service subsidies				0.0293	0.0318
				(0.0413)	(0.0437)
14. Interaction EAS & competition					-0.0185
					(0.0672)
Constant	3.791***	3.559***	3.462***	3.440***	3.440***
	(0.115)	(0.138)	(0.153)	(0.161)	(0.161)
Observations	502	502	502	502	502
R-squared	0.730	0.738	0.796	0.796	0.796
Origin FE	Yes	Yes	Yes	Yes	Yes

Dependent variable: Ln Average airfares

Robust standard error in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Hypothesis 2

Community	Subsidy rate ($) 2016	Airline	Number of enplanements in 2015	Subsidy rate ($) for a round trip per passenger	Weekly departures	Passenger seats	Load factor 2015
1. Adak	2043620	Alaska Airlines	2084	980	3	66	0.198
2. Akutan	831115	Grant Aviation	1399	594	12	8	0.280
3. Aleknagik	118667	Grant Aviation	10	11866	3	8	0.047
4. Angoon	253430	Alaska Seaplanes	1809	140	21	8	0.390
5. Atka	1031793	Grant Aviation	315	3275	3	8	0.242
6. Circle	162863	Warbelow's	406	401	5	8	0.167
7. Cordova	2048749	Alaska Airlines	16997	121	20	60	0.410
8. Egegik	381249	Grant Aviation	855	446	6	8	0.283
9. Ekwok	212044	Grant Aviation	140	1515	6	8	0.152
10. Excursion Inlet	29827	Alaska Seaplanes	149	200	3	8	0.059
11. Gustavus	512187	Alaska Airlines	10893	47	30	45	0.403
12. Hydaburg	195319	Taquan Airlines	19	10280	3	8	0.024
13. Igiugig	198840	Grant Aviation	547	364	3	8	0.317
14. Kake	194302	Alaska Seaplanes	2273	85	7	8	0.395
15. Minchumina	102300	Wright	225	455	2	8	0.270
16. Manley	47361	Warbelow's	241	197	1	8	0.093
17. Nikolski	320491	Grant Aviation	196	1635	2	8	0.256
18. Pelican	308790	Alaska Seaplanes	1164	265	20	8	0.369
19. Petersburg	1621730	Alaska Airlines	20477	79	14	66	0.640
20. Pilot Point	205813	Grant Aviation	315	653	3	8	0.233
21. South Naknek	133435	Grant Aviation	141	946	14	8	0.323
22. Wrangell	1621730	Alaska Airlines	12588	129	7	66	0.500
23. Yakutat	2048749	Alaska Airlines	10230	200	19	66	0.336
Load factor AK							**0.244**

5. Conclusion and Discussion

5.1. Conclusion

The gap of research which this study sought to enlighten is if the EAS subsidy acts in favor of the public or the suppliers. This study confirms that the EAS subsidy does not decrease airfares. The results also show that EAS flights are underutilized. The load factor for EAS flights in Alaska is 24.4%, compared to 49% for all of the EAS flights in the US. With the obtained results hypothesis 1 is rejected and 2 is accepted, and it cannot be stated that the public or the suppliers are the net beneficiaries of the subsidy. Moreover, a surprising result of this study is that competition increases the average airfare in the Alaskan airline market. The next paragraph will interpret the results of this study with reference to the literature that was discussed.

5.2. Discussion

The literature review discussed two dominant theories concerning economic regulation: the public interest theory and the capture theory. Both theories are relevant if two extremes cases are analyzed. The first extreme case refers to the Anchorage-Cordova EAS route, which is operated by two airlines. Alaska Airlines is the only airline to receive EAS on this route, and it is in competition with Ravn Alaska. This study confirms that EAS does not decrease airfares; therefore, it can be stated that this route most likely acts as a corporate welfare system for Alaska Airlines (Grubesic & Matisziw, 2011). The reason for this is that Ravn Alaska is able to operate without any subsidy, which implies that the subsidy received by Alaska Airlines is not a necessity to serve the route. This argument alone is not enough, because it is also possible that the subsidies could decrease the airfares on the EAS routes, which would be beneficial for the public using the airlines. However, this is not the case. Taking the previous route into account, it is highly likely that Alaska Airlines benefits from the EAS subsidy at the expense of the public. This is in line the economic capture theory. A deregulation might be desirable, because this could save tax payers money. The next paragraph will discuss this standpoint by taking left- and right-wing orientated economist views into account.

The interpretation that the regulation acts in favor of the airline needs to be done in a cautious way. This is because it is difficult to predict the effects of a deregulation, and thereby the abandonment of the EAS subsidy in Alaska. For instance, left-wing economist could argue that the aircrafts used could change and the amount of scheduled flights could drastically decrease after a deregulation, leading to a lower quality of air service. In the case of a deregulation, the airlines would not be required to follow the conditions set by the DOT (See: 2.2.2.). This is plausible, but right-wing economists could argue differently. They could refer to the limit pricing strategy, which can be used if there is a potential threat of a new entrant (Lawrence, Cunningham, & Eckard, 1987). This is possible because the subsidy is granted to one airline on an EAS route. It is also highly likely that the limit pricing strategy is one of the reasons why there was only one route with competition and an airline receiving EAS in this sample. Using the argumentation of right wing economists, it is plausible that competition and thus the availability of an airline service deters under the EAS regulation (Lawrence, Cunningham, & Eckard, 1987). Dropping the subsidized Cordova route would save taxpayers over 2,000,000 dollars of EAS subsidy on a yearly basis, because it would be viable without a subsidy (U.S. Department of Transportation, 2016). The next paragraph will discuss the other extreme case where the public interest theory is more applicable.

The second extreme case refers to the Ketchikan-Hydaburg route with a load factor of 2.4 percent. This route is given as an example because it is clear that the “passenger” air service market alone cannot sustain a desirable level of air service, which is also referred to as a market failure (Bator, 1958): if there were no subsidy or other stream of income for the airlines, the scheduled flights would fail to exist. There were 19 enplanements in 2015 at the Hydaburg airport, which has three weekly one-way direct scheduled flights for an average price of 135 dollars to the hub of Ketchikan (Taquan Air, 2016). With 156 flights and a subsidy rate of 195,319 dollars a year, it is probable that the airline needs a small alternative revenue stream per flight. This is because the 40 minute flight with a Havilland-Bombardier (8 seater) on the Hydaburg-Ketchikan route is subsidized with 626 dollars per one-way flight (U.S. Department of Transportation, 2016), which might not cover the cost. Chartering a De Havilland-Bombardier Beaver with eight seats for an hour costs 800 dollars plus additional expenses (Alaska Fly Out, 2016). The previous reasoning is confirmed with respect to the alternative revenue stream, because Taquan air has a freight service which also manages the US mail (Taquan Air, 2016). With the previous facts it is very unlikely that the scheduled service stated by the DOT will maintain the same level of air service without the subsidy. Using an assumption stating that Taquan air has a very limited second revenue stream per flight, it can be stated that the public benefits at the expense of the airline. The reasoning is that the airline can just cover its full costs with the subsidy and the alternate revenue stream, and that the passengers receive scheduled air service without paying a significantly higher price compared to other routes. This would be in line with the public interest theory. Again, the interpretation needs to be done with care, because Taquan air also has a freight department that generates revenue. This revenue stream can be large enough to sustain the Hydaburg-Ketchikan route without the EAS subsidy. The next paragraph will discuss if the EAS is actually necessary to keep a scheduled flight, taking left- and right-wing views into account.

The similar discussion arises as with the Anchorage-Cordova route. It is likely that the three weekly one-way direct scheduled flights Hydaburg-Ketchikan will not be viable after a deregulation. However, it must be noted that Taquan air, the airline serving Hydaburg does not generate its income solely through passenger air service. Right-wing economists could argue that the market will be able to sustain a scheduled service on the Hydaburg-Ketchikan route with the revenues generated by the transportation of cargo. The dependency of air cargo is illustrated by the US code "41901", which has a separate subsection concerning the Alaskan mail services (Office of the Law Revision Counsel, 2016). This code states that the DOT is required to set fair and reasonable rates for the US postal services to be able to transport mail within Alaska (U.S. Department of Transportation, 2016). Thus, a deregulation would imply that airlines could set its own prices and outputs for the passenger and freight business. A deregulation could imply that Taquan air could remain scheduled service without the EAS subsidy. On the other hand, left economists could argue that the regulations which apply to the Alaskan airline market benefit the communities, due to the lower prices for freight transportation and a high level of weekly passenger service. This would be necessary because the so-called "Village Alaska" has no access to marketable natural resources, and accounts for the largest share of poverty in Alaska (Berardi, 1998), and that air transportation can play a vital role in developing these remote areas (Mukkala & Tervo, 2013). With a subsidy cost of 10,279 dollars per enplaned passenger, it is up to the next administration if the political factors, such as the accessibility of the communities justify this EAS expense of this route. The next paragraph will discuss the surprising result found in this study.

The most surprising result of this study is that competition increases the average airfare by 9.9%. This is not in line with the theory that competition decreases prices: "Nearly all writings agree that price under monopoly is higher than under competition, and the usual condemnation of monopoly rests on this conclusion" (Schwartzman, 1959). It can be deduced that some kind of collusion is required to obtain higher prices on routes with competition.

Uniform costs, product homogeneity, foresight, market concentration, and a lack of greed are the key ingredients for collusion (Schwartzman, 1959; Asch & Seneca, 1975). If these ingredients are present, collusion becomes attractive, because the combined profits of an industry are higher if it acts as a monopoly (Stigler G. J., 1964). The joint determination of output and prices by presumably independent firms is plausible in the Alaskan airline market, because the ingredients for collusion are present. Product homogeneity, foresight, and market concentration are factors that could increase the probability of airlines colluding in this market; this can be substantiated by logical reasoning. Firstly, the Alaskan airline market analyzed in this sample is fairly homogenous. This is because all of the airfares in this sample are for coach seats, are non-refundable, and include no amenities. Secondly, 81.6% of the Alaskan airline market is served by the four largest carriers; thus, the market is relatively concentrated. The last argument for the possibility of collusion in the Alaskan market regards its foresight: Alaska heavily depends on air transportation and the peak and off-peak seasons never differ due to the weather circumstances.

The previous paragraphs interpreted the results of this study. Now the limitations must also be discussed. Firstly, it is highly likely that the model is missing an essential variable, which means that there is an omitted variable bias. This is because the competition variable is positive, which means that it increases the average airfare on a route. Controlling for routes that have presumably independent airlines determining joint outputs and prices would be ideal in the econometric model, but this information is obviously not available due to the fact that this type of collusion is not allowed according to the US antitrust law. The second limitation of this study is the sample selection bias: only direct scheduled flights were collected in this data set, which means that the flights that had one or more stops for an origin-destination were not considered. Therefore, the sample only included 23 EAS communities of a total of 62 in the Alaskan market, which is a major drawback in this study.

To conclude, this study indicates that the EAS subsidy does not have an effect on airfares and that EAS flights are underutilized. The aim was to investigate whether the subsidy acts more in favor of the public or the suppliers. In general it cannot be stated that either the public or the regulated firms benefit more from the EAS subsidy, as was illustrated by the origin-destination examples. However, it is clear that some scheduled routes would cease to exist in in the form specified by the DOT (See: 2.2.2.) if the EAS program was abandoned. Other routes might even prosper with a deregulation, due to the possible present limit pricing strategies by airlines. The left- and right-wing discussion arises, because left-wing economists could argue that the nonviable locations benefit from a scheduled service through the increased accessibility. Conversely, right-wing economists could refer to the inefficient use of the aircrafts and the total costs. Moreover, the first example presented proved that routes would be able to continue without the EAS program. The fact that there are routes that are viable without EAS but that still make use of the subsidy is questionable with the provided analysis. The next paragraph will give a short description of the relevance of this study.

This study has provided additional insight into the EAS program for the upcoming US administration, which will evaluate the program. The EAS does not have an effect on airfares, and these flights are also underutilized. However, a complete abandonment of the program would not be wise: Alaskans depend on air travel, and some routes would cease to exist in its current form specified by the DOT if the program were to end. The subsequent paragraph will suggest some interesting areas of research that would also enhance this research.

Further research should be done in comparing routes to investigate whether there are more routes that would be viable without the EAS subsidy. This is plausible because only 62 out of 237 eligible EAS communities (Tang, 2015) have an airline receiving this subsidy, which means that the majority of eligible communities do not have an airline receiving EAS service. Furthermore, it would also be useful to investigate whether there is collusion among the independent airlines in the Alaskan market, as this would have a negative impact on the public due to higher prices.

6. References

Abdelghany, A. (2007). Methodology for Comparative Analysis to Evaluate Air Travel Service in Alaska. *Transportation Research Record: Journal of the Transportation Research Board*, 83-91. doi:10.3141/1996-11

Alaska Airlines. (2016). *Alaska Airlines*. Retrieved 7 22, 2016, from Codeshare Travel Information: https://www.alaskaair.com/content/travel-info/before-your-trip/codeshare-information.aspx

Alaska Fly Out. (2016). *Air Taxi Directory*. Retrieved 8 21, 2016, from Alaska Fly Out: http://www.alaskaflyout.com/air-taxi/k2-aviation

Alaska.org. (2016). *Best Time to Visit Alaska*. Retrieved 7 19, 2016, from Alaska.org: http://www.alaska.org/advice/best-time-to-visit-alaska

Amores, A. F., & Contreras, I. (2009, March 16). New approach for the assignment of new European agricultural subsidies using scores from data envelopment analysis: Application to olive-growing farms in Andalusia (Spain). *European Journal of Operational Research, 193*(3), 718-729. doi:10.1016/j.ejor.2007.06.059

Asch, P., & Seneca, J. J. (1975). Characteristics of Collusive Firms. *The Journal of Industrial Economics*, 223-237.

Bator, F. M. (1958, August). THE ANATOMOY OF MARKET FAILURE. *The Quarterly Journal of Economics, 72*(3), 351-379.

Belobaba, P. P. (1987). *Air Travel Demand and Airline Seat Inventory Management.* REPORT R87-7, Massachusetts Institute of Technology, Flight Transportation Laboratory.

Berardi, G. (1998). Natural Resource Policy, Unforgiving Geographies, and Persistent Poverty in Alaska Native Villages. *Natural Resources Journal*, 85-108.

Biørn, E. (2013). *ECON3150/4150 INTRODUCTORY ECONOMETRICS.* Lecture note no. 1, Department of Economics.

Brons, M., Pels, E., & Rietveld, P. (2002). Price elasticities of demand for passenger air travel: a meta-analysis. *Journal of Air Transport Mangement, 8*, 165–175.

Brueckner, J. K., & Whalen, T. W. (2000, October). The Price Effects of International Airline Alliances. *The Journal of Law & Economics, 43*(2), 503-546. Retrieved from http://www.jstor.org/stable/10.1086/467464

Brueckner, J. K., Lee, D. N., & Singer, E. S. (2011). ALLIANCES, CODESHARING, ANTITRUST, IMMUNITY, AND INTERNATIONAL AIRFARES: DO PREVIOUS PATTERNS PERSIST? *Journal of Competition Law & Economics,* 1-30. doi:10.1093/joclec/nhr005

Castelli, L., Ukovich, W., & Pesenti, R. (2003). *An airline-based multilevel analysis of airfare elasticity for passenger demand.*

DWU Consulting. (2015, March 7). *Enplaned Passengers.* Retrieved 8 10, 2016, from DWU Consulting: https://dwuconsulting.com/images/Articles/150310%20Enplaned%20Passengers.pdf

Federal Aviation Agency. (2016). *Airport Categories*. Retrieved 8 7, 2016, from Federal Aviation Agency: http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/categories/

Federal Aviation Agency. (2016). *Passenger Boarding (Enplanement) and All-Cargo Data for U.S. Airports.* Retrieved 7 19, 2016, from Federal Aviation Agency: http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/preliminary-cy15-all-enplanements.pdf

Goolsbee, A. D., & Krueger, A. B. (2015). A Retrospective Look at Rescuing and Restructuring General Motors and Chrysler. *The Journal of Economic Perspectives, 29*(2), 3-23.

Grubesic, T. H., & Matisziw, T. C. (2011). A spatial analysis of air transport access and the essential air service program in the United States. *Journal of Transport Geography, 19*, 93-105.

Grubesic, T., & Wei, F. (2013, June). Essential Air Service: a local, geographic market perspective. *Journal of Transport Geography, 30*, 17-25. doi:10.1016/j.jtrangeo.2013.02.008

Grubesic, T., Wei, R., Murral, A., & Wei, F. (2016). Essential Air Service in the United States: Exploring Strategies to Enhance Spatial and Operational Efficiencies. *International Regional Science Review, 39*(1), 108-130.

Hahn, R. W. (1990). The Political Economy of Environmental Regulation: Towards a Unifying Framework. *Public Choice*, *65*(1), 21-47.

Hall, J., Ross, A., & Yencha, C. (2015, October). The political economy of the Essential Air Service program. *Public Choice, 165*(1), 147-164. doi:10.1007/s11127-015-0298-z

Hudson, H. E. (2005). Rural Telemedicine: Lessons from Alaska for Developing Regions. *TELEMEDICINE AND e-HEALTH, 11*(4), 460-467.

Institute for Digital Research and Education. (2016). *Analyzing Correlated (Clustered) Data*. Retrieved 8 10, 2016, from Institute for Digital Research and Education: http://www.ats.ucla.edu/stat/stata/library/cpsu.htm

Joskow, P. L., & Noll, R. G. (1981). Regulation in Theory and Practice: An Overview. In G. Fromm, *Studies in Public Regulation* (pp. 1-78). The MIT Press.

Kwokaw, J., & Shumilkinaz, E. (2010, December 767-793). THE PRICE EFFECT OF ELIMINATING POTENTIAL COMPETITION: EVIDENCE FROM AN AIRLINE MERGER. *THE JOURNAL OF INDUSTRIAL ECONOMICS*, *LVIII*(4).

Lawrence, Cunningham, F., & Eckard, W. (1987, September). U.S. Small Community Air Service Subsidies: Essential or Superfluous? *Journal of Transport Economics and Policy*, *21*(3), 255-277.

Massachusetts Institute of Technology. (2016). *Airline Data Projects*. Retrieved 8 20, 2016, from Global Airline Industry Program: http://web.mit.edu/airlinedata/www/Res_Glossary.html

Migué, J.-L. (1977). CONTROLS VERSUS SUBSIDIES IN THE ECONOMIC THEORY OF REGULATION. *The Journal of Law & Economics*, *20*(1), 213-221.

Mukkala, K., & Tervo, H. (2013). Air transportation and regional growth: which way does the causality run? *Environment and Planning A, 45*, 1508 – 1520. doi:10.1068/a45298

Noll, R. (1983, October). The Political Foundations of Regulatory Policy. *Journal of Institutional and Theoretical Economics, 139*(3), 377-404.

Office of the Federal Register. (2002). *The Code of Federal Regulations of the United States of America.* Washington: Office of the Federal Register National Archives and Records Administration. Retrieved from https://play.google.com/store/books/details?id=Cdw5AAAAIAAJ&rdid=book-Cdw5AAAAIAAJ&rdot=1

Office of the Law Revision Counsel. (2016, 7 29). *49 USC 41901: General authority*. Retrieved from http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title49-section41901&num=0&edition=prelim

Peltzman, S., Levine, M. E., & Noll, R. G. (1989). The Economic Theory of Regulation after a Decade of Deregulation. *Brookings Papers on Economic Activity*, 1-59.

Pennstate Eberly College of Science. (2016). *Lesson 12: Multicollinearity & Other Regression Pitfalls*. Retrieved 7 23, 2016, from Pennstate Eberly College of Science: https://onlinecourses.science.psu.edu/stat501/node/343

Posner, A. R. (1974). THEORIES OF ECONOMIC REGULATION. *Bell Journal of Economics, 5*(2), 335-358. doi:10.3386/w0041

Schwartzman, D. (1959, August). The Effect of Monopoly on Price. *Journal of Political Economy, 67*(4), 352-362.

Schwert, W. G. (1981, April). Using Financial Data to Measure Effects of Regulation. *The Journal of Law & Economics, 24*(1), 121-158.

Sherk, J. (2013). *Auto Bailout or UAW Bailout? Taxpayer Losses Came from Subsidizing Union Compensation.* Testimony before Committee on Oversight and Government Reform United States House, The Heritage Foundation, Washington DC.

Stigler, G. J. (1964, February). A Theory of Oligopoly. *Journal of Political Economy, 72*(1), 44-61.

Stigler, G. J. (1971). The Theory of Economic Regulation. *The Bell Journal of Economics and Management Science, 2*(1), 3-21.

Tang, R. Y. (2015). *Essential Air Service (EAS).* CRS Report, Congressional Research Service, Transportation and Industry.

Taquan Air. (2016). *Online Bookings - Search Results*. Retrieved 7 29, 2016, from Taquan Air: https://apps6.tflite.com/takeflitepublictaq/PgSearchResults.aspx

U.S Department of Transport. (2016). *Alaskan Essential Air Service Determination.* Retrieved 7 24, 2016, from U.S Department of Transport: https://cms.dot.gov/sites/dot.gov/files/docs/AK_Determination_2012.pdf

U.S. Department of Transportation. (2012, 1). *Current and Historical Status Reports.* Retrieved 7 18, 2016, from U.S. Department of Transportation: https://www.transportation.gov/sites/dot.gov/files/docs/Alaskan%20Subsidized%20EAS%20Report%20May%202012.pdf

U.S. Department of Transportation. (2016). *Alaskan Mail Rates*. Retrieved 7 29, 2016, from U.S. Department of Transportation: https://www.transportation.gov/policy/aviation-policy/small-community-rural-air-service/alaskan-mail-rates

U.S. Department of Transportation. (2016). *Bureau of Transportation Statistics*. Retrieved 7 19, 2016, from U.S. Department of Transportation: http://www.transtats.bts.gov/

U.S. Department of Transportation. (2016, 4). *Current and Historical Status Reports.* Retrieved 7 18, 2016, from U.S. Department of Transportation: https://www.transportation.gov/sites/dot.gov/files/docs/Subsidized%20EAS%20report%20for%20communities%20in%20Alaska-Apr%202016%20%28VP%29.pdf

U.S. Department of Transportation. (2016). *Essential Air Service*. Retrieved 7 28, 2016, from U.S. Department of Transportation: https://www.transportation.gov/policy/aviation-policy/small-community-rural-air-service/essential-air-service

United States Cencus Bureau. (2010). *Profile of General Population and Housing Characteristics.* Retrieved 7 19, 2016, from United States Cencus Bureau: http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF

Varian, H. R. (1996, August 5). Differential Pricing and Efficiency. *First Monday : Peer-reviewed Journal on the Internet Source:Zeitschriften (kostenlos), 1*(2), 1-10.

Vowles, T. M. (2000). The effect of low fare air carriers on airfares in the US. *Journal of Transport Geography, 8*, 121-128.

Vowles, T. M. (2006). Airfare pricing determinants in hub-to-hub markets. *Journal of Transport Geography, 14*, 15-22.

Wooldridge, J. M. (2009). *Introductory Econometrics: A Modern Approach* (Vol. 4). (L. Bofinger, Ed.) Canada: Macmillan Publishing Solutions.

Worldatlas. (2016). *Flight Distance Mileage Calculator.* Retrieved 7 20, 2016, from Worldatlas: http://www.worldatlas.com/travelaids/flight_distance.htm

Yamaguchi, K. (2007). Inter-regional air transport accessibility and macro-economic performance in Japan. *Transportation Research Part E, 43*, 247–258. doi:10.1016/j.tre.2006.10.004

Zhang, A., & Zhang, Y. (2002). Airport charges and capacity expansion: effects of concessions and privatization. *Journal of Urban Economics, 53*, 54-75. doi:10.1016/S0094-1190(02)00500-4

7. Appendix

A: Variance Inflation Factor

Variable	VIF	SQRT VIF	Tolerance	R-Squared
1. Competition	1.62	1.27	0.6187	0.3813
2. Day2	1.34	1.16	0.7487	0.2513
3. Day3	1.34	1.16	0.7486	0.2514
4. Flights outside Alaska	2.05	1.43	0.4886	0.5114
5. Alaska Airlines	2.31	1.52	0.4337	0.5663
6. Ravn	2.25	1.50	0.4446	0.5554
7. Penair	1.33	1.15	0.7535	0.2465
8. Grant Aviation	1.20	1.10	0.8334	0.1666
9. Code sharing	1.44	1.20	0.6956	0.3044
10. Ln air distance in km	2.24	1.50	0.4456	0.5544
11.Ln number of enplanements destination	2.75	1.66	0.3639	0.6361
12.EAS	1.75	1.32	0.5713	0.4287
13.EAS interaction competition	1.22	1.11	0.8178	0.1822
Mean VIF	1.76			

B: Correlation table

	1	2	3	4	5	6	7	8	9	10	11	12	13
LN average air fares													
1. Competition	1.000												
2. Day2	0.0033	1.000											
3. Day3	0.0043	-0.5007	1.000										
4. Flights outside Alaska	0.1379	0.0093	-0.0041	1.000									
5. Alaska Airlines	0.0150	0.0142	-0.0151	0.3198	1.000								
6. Ravn	0.4829	-0.0061	0.0049	-0.2342	-0.3377	1.000							
7. Penair	-0.1900	-0.0138	-0.0107	-0.0667	-0.1382	-0.1979	1.000						
8. Grant Aviation	-0.1037	0.0024	0.0066	-0.0896	-0.2109	-0.1413	-0.0824	1.000					
9. Code share agreement	0.3406	0.0036	-0.0095	-0.0738	0.2068	0.2992	-0.0343	-0.0911	1.000				
10. Ln air distance in km	-0.0027	0.0121	-0.0098	0.5663	0.4575	-0.2794	0.1916	-0.1919	0.1184	1.000			
11.Ln number of enplanements destination	0.1480	0.0089	-0.0072	0.5667	0.5902	-0.1008	0.0340	-0.2506	0.2351	0.6290	1.000		
12.EAS	-0.2892	-0.0034	0.0027	-0.1311	0.1284	-0.3612	-0.1204	0.2442	-0.0536	-0.2080	-0.2546	1.000	
13.EAS interaction competition	0.1659	0.0103	0.0120	-0.0343	0.1303	0.0822	-0.0315	-0.0423	0.2150	-0.0062	0.0483	0.2617	1.000