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The Impact of Frequent Flier Programs on Ticket Fares in the Norwegian Domestic Airline Market using a Multiple Linear Regression Model

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Preface

This paper is the final evaluation of the TIØ4905 Managerial Economics and Operations Research, Master's Thesis, a part of the MSc. in Industrial Economics and Technology Management at the Norwegian University of Science and Technology (NTNU). The study has been carried on through the spring and summer of 2018.

The frames of the project was brought up by the Norwegian Competition Authority, but problem specification and research method has been further developed under supervision by Einar Belsom.

I would like to use this opportunity to thank my supervisor Einar Belsom for his crucial guidance and availability for discussion all the way to the finish line.

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Marianne Madsen

Abstract

I investigate how the presence of frequent flyer programs (FFP), in addition to other micro- and macroeconomic variables, influence the ticket fare prices in the Norwegian domestic airline market. The period of investigation, 2007 - 2017, covers a natural experiment with and without a market ban of frequent flyer programs in Norway. The raw data obtained are processed using linear interpolation, arima seasonal adjustments and adjusted for inflation to be useable in a multiple regression analysis. Seven different models are used to test the statistical sensitivity and validity of the multiple linear regression models. The results induce that the introduction of FFP seem to influence prices negatively, in contrast to the findings in most of the existing literature. FFP shows influence with a lower magnitude than the cost indices and the financial crisis dummy variable.

Contents

Chapter 1

Introduction

In 2018, the airport express train from Oslo City to Oslo Airport costs 190NOK one way. I can drive a short 180km drive Oslo-Lillehammer, paying 140NOK *only* in toll fees. An ordinary ticket for the nearly 7-hour train trip Oslo-Trondheim costs 992NOK, or a mini price for 399NOK if one has a good timing. The same distance is easily accessible for about 499NOK on a 55-min long air travel, if buying early or during campaigns, and not flying within national holidays. Based on the average monthly payroll and working hours, the average Norwegian hourly wage rate in 2017 was at 266NOK (SSB, d), demanding two hours of work (before tax) for a ticket flying Oslo-Trondheim. My impression of the Norwegian domestic airline market today is an intense competition on price, maybe as a consequence of the findings that when Norwegians are booking trips, 88% are mostly driven by the price aspect (Travellink, 2016).

The average Norwegian had 5.73 domestic flights in 2016 (data obtained by mail from Avinor), while the same number in the United States was 2.23 (BTS, 2017). Flying directly from South to North of Norway (Oslo-Alta) takes 2 hours, while in the US a trip Miami-Seattle takes no less than 6 hours 40 minutes. Even if the distances domestically are much smaller in Norway than in the US, and could be substituted by other transportation forms, the Norwegians travels domestically more than 2.5 times the average American. A low ticket fare, or inconvenient and expensive transport substitutes can be explanations of the high number of air trips per person in Norway. A high cost level for the companies in the airline business while the ticket prices remain low can indicate that this market is highly competitive.

Since the introduction of the first Frequent Flyer Program (FFP) as we know them by American Airlines in 1981, the popularity of the FFPs has exploded. Already in 1993 an average European traveller had 3.1 memberships in such programs (Dowling and Uncles, 1997). One of the core ideas behind FFPs is the ability to use price discrimination, and from this the airlines can extract more of the surplus by maximizing the individual consumer's willingness to pay. Frequent flyers are also considered by the airlines as the most profitable customers, arguing with the famous Pareto principle: that for many events, roughly 80% of the effects (i.e. share of company's revenues) come from 20% of the causes (i.e. share of company's customers) (Wikipedia, 2018a). By offering rebates on loyal behaviour, the customers get an incentive to choose the same airline frequently.

The Norwegian airline market in late 1990s and early 2000s was dominated by two airlines, the full-service airlines Scandinavian Airlines (SAS) and Braathens, and airline ticket fares were high (Figure 3.1). In 1999 a new rival, Color Air, was pushed completely out of the market after only one year in business. Color Air blamed this partly on the established loyalty program EuroBonus, because it created switching costs for customers, and as a young business it was too expensive for Color Air to introduce a comparable competitive scheme. SAS also bought up Braathens in 2001, giving SAS influence over and access to the whole domestic market.

The Norwegian Competition Authority chose to intervene into the monopoly situation by forbidding SAS and Braathens to give customers FFP points through EuroBonus and Wings on domestic flights in 2002 (Konkurransetilsynet, 2002). This was extended to infer all FFPs in the market in 2007. They reasoned that a ban of FFP domestically would increase the social welfare. The regulation lead to a fall in airline fares (Figure 3.1), and a new competitor, the low-cost-carrier (LCC) Norwegian Air Shuttle (NAS), entered the domestic market right after the regulation in 2002. The entry initiated an intense competition for customers between SAS and NAS pushing down prices. As a result of the highly competitive environment, SAS was forced to streamline their business strategy through Core SAS in 2009 (SAS, 2009), which for example included making 3000 SAS employees redundant and an additional 5600 employees outsourced or divested to reduce costs.

After the re-introduction of FFPs 2013, the situation was a 37%/46% NAS/SAS market share distribution in Norway (Figure 1.1). Widerøe was still a monopolist on the offering processed, less profitable regional market on the West and North coast of Norway. The marked had moved from the monopoly situation, and price level was lowered. The repeal was under the condition that further development of the market should be closely followed up by the Norwegian Competition Authority.

Much of the international research literature and empirical work employ a critical view on loyalty rebates, suggesting that the programs actually induce higher costs for both the customer and the company itself, and that they can work anti-competitively. The survey of Stephenson and Fox (1992) suggests that 70% of both small and large corporations view the FFPs as wasteful and cause higher costs than necessary, even if many of the programs are designed to reach the business segment. Escobari (2011) finds that a 1% increase in FFP programs on average give a 1.16% ticket fare rise and have even more influence, 3.06% rise, on the 20 percentile cheapest tickets. A frequently mentioned and studied problem with FFP is the principal-agent problem: how employees order tickets to themselves using the firm's money, and buy time-wasting and expensive tickets to receive the best benefits possible themselves (Cairns and Galbraith, 1990).

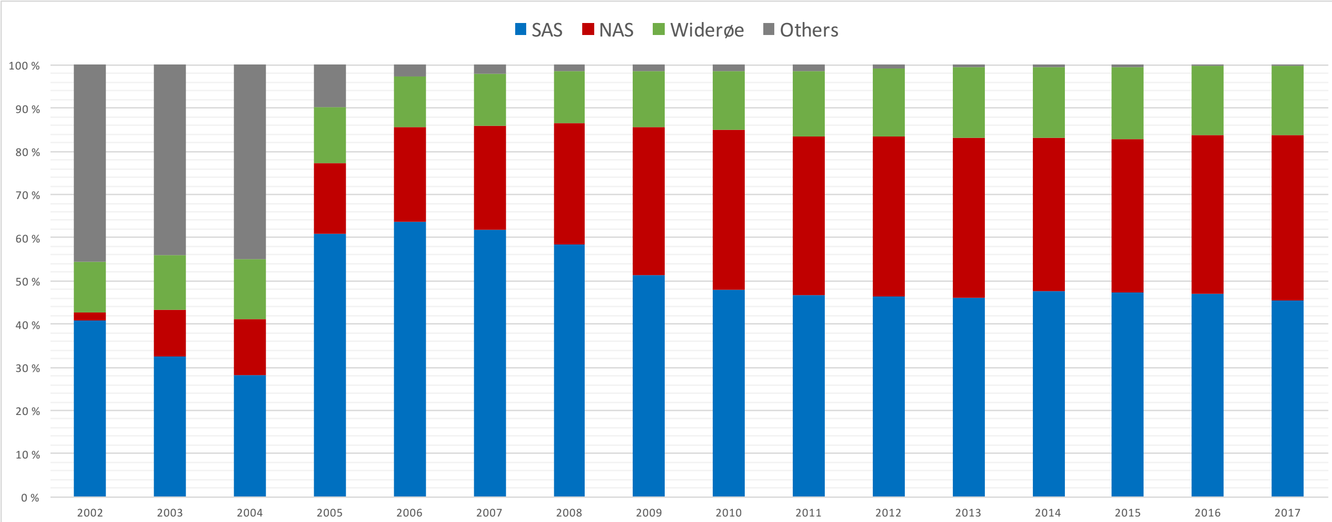


Figure 1.1: Market shares in the Norwegian domestic airline market 2002-2017. Data obtained via mail from Avinor.

Klemperer (1995) shows how switching costs for the customers may work as an entry barrier for new companies, and that this reduces the overall competitiveness of the market. Some goes as far as saying that the presence of FFPs in the market forms a prisoners' dilemma type Nash, where all would be better off without (Cairns and Galbraith, 1990). There are also researches arguing that FFPs makes the customer and market better off, by increasing the competition at the margin (Zenger, 2012).

The literature provides mostly theoretical studies regarding loyalty programs using game theoretic explanation (see e.g. Ackermann (2010); Cairns and Galbraith (1990); Caminal and Claici (2007)), behavioural psychology (see e.g. Dowling and Uncles (1997); Nunes and Drèze (2006a); Nunes and Drèze (2006b)), or a juridical framework (see e.g. Zenger (2012)). The empirical studies are more limited. Surveys (see e.g Stephenson and Fox (1992); Thune-Larsen (2016); Stephenson and Fox (1993)) and econometric models (see e.g. Nako (1992); Escobari (2011)) have been used to explain the influence of FFPs on the competition and prices.

Describing and quantifying the influence of FFPs on the competition and prices is not straightforward, and the literature shows different attempts to separate the variable. Looking to Norway though serves a rare opportunity: the 11-year prohibition of FFP domestically forms a natural experiment. This experiment has the potential to give us empirical information about the influence on the whole market by removing and adding the FFP dummy variable, leaving the rest present for the whole period. Statistics Norway provides the Consumer Price Index (PI) with a separated price index for Passenger Transport by Air (PIPTA) (SSB, a). I have a range of micro- and macroeconomic variables of interest to be able to explain the dependent variable of price changes, *PIPTA*, with a multiple linear regression model (MLR). Cost information from the quarterly reports from SAS and NAS (SAS (a); Norwegian (a)), resulting in microeconomic cost indices. The financial crisis, load factors of the airlines, interest rates, unemployment rates and real wage rates are also included. A dataset including exactly what I want to measure is difficult to obtain, as the data are limited for example by including both international and domestic flights. The aim of the MLR is to show if there are any empirical evidence that *FFP* has any significant influence on prices, and to which extent *PIPTA* depends on this variable. The other variables can hopefully also help to describe the competition intensity in the domestic airline market.

In this thesis I will treat SAS and NAS as the whole domestic market in Norway. Widerøe's operations are partly government funded and doesn't operate in the same competitive environment as SAS and NAS, hence excluded from this analysis. The other airlines with 0.25% market share in total are not considered either.

The following Chapter 2 will build a framework of the topic of loyalty programs, by exemplifying a typical FFP and introducing important theoretical and empirical work. Chapter 3 describes the data used, the transformation of the data series, reasoning behind the model building and a discussion of the MLR results. Chapter 4 covers a conclusion and suggestions for further studies.

Chapter 2

Previous Studies on Loyalty Programs

To be able to understand the use and influence of loyalty programs, one of the main goals in the thesis is to explore the underlying literature. The theoretical and empirical part of this thesis aims to build a foundation for the discussion of the econometric model and results. This chapter will introduce the classic components of a FFP, with SAS' EuroBonus (EB) serving as an example. Thereafter important theory and empirical work in the field of loyalty programs are reviewed.

2.1 About Frequent Flyer Programs

In their early years, FFPs existed as a non-marketed, exclusive club involving the most frequent travellers, but this soon changed to inclusion of the common traveller. The success of the FFPs in attracting customers can be explained by the innovative reward design, gathering virtual currency ("miles" or "points") from multiple suppliers within an alliance or network, and the currency can only be spent within the airline's business. This creates barriers to exit, also known as switching costs, for the passengers. The aim is to make the customers believe they miss out if *not* spending within the company's limits, both existing and future benefits. Passengers must believe that they receive *more* when using their service. EB will serve as an example of an FFP using well-established approaches reaching the right customers (SAS, b):

1. Bonus points as a virtual currency are used for rewarding the passengers, and has been shown to be very successful. Nunes and Drèze (2006a) propose in their experimental study that *"(...) expenditures recorded as purchases made may focus people on the expense and hence make them think about the dollars they have spent. On the other hand, accumulating points may focus customers on what they have acquired."* Thus the point or mile accumulation of FFPs can be recognized as a brilliant move by the airlines in motivating their passengers to focus on their "goals" (i.e. reaching tier levels or benefits), not the total costs of reaching those.

2. Use of threshold levels; basic – silver – gold and diamond, with increasing benefits like a free extra luggage or entry to the airport lounges. These threshold levels are discussed to evoke a suction effect when close to a new tier level (Steen and Sørgard, 2011). This can result in taking a trip just to get new tier level benefits, known as a *mileage run* in the inner frequent flyer circles. Airlines are then not necessarily chosen because they offer the best service or price. The suction effect, among other things, is discussed to contribute to creation of incremental demand, which can be beneficial for the airlines (Nunes and Drèze, 2006b).

3. The frequent flyer points can be gathered through a diverse selection of channels. Points to a new tier level or a bonus trip can come from car rental, hotels or shopping in addition to flying. There are plenty of examples where people have bought large quantities of goods when points accumulated are especially cheap. An example that raised awareness of this was a 27-year-old Norwegian man, buying 75 bread simultaneously in his local grocery store. He accumulated 10,500 EB points on this trade, equivalent to over half the points needed to reach the silver tier level (Ngo, 2018). Clements et al. (2006) points out how a more extensive route network will give a competitive advantage, with more possibilities of collecting points. This large network of point-giving services can favour the largest loyalty program, and make it tough for a new rival to introduce a competitive one.

4. There is an expiration date of points and threshold levels. The points cannot be used after a certain time period, and a gold membership will not last for more than a year if the customer does not continue to be loyal. Duffy (1998) explains that the redemption of rewards relies on having an expiration date for the program to be able to contribute to incremental sales. He calls it a manipulative, but necessary move to ensure that the loyalty programs build business. Rewarding disloyalty can be very costly, and is a common mistake managers do when designing loyalty programs (Nunes and Drèze, 2006b).

5. Benefits from the threshold levels are designed to contribute to an increasing travel experience. Examples are 'free' access to airport lounge, extra luggage, fast track and seat upgrade – exclusive rewards the passengers wouldn't necessarily pay for with their own money. The rewards are directly tied to the brand, which gives a higher probability of the customers exhibiting brand loyalty, rather than loyalty to the program (Dowling and Uncles, 1997). When experiencing the exclusive rewards mentioned above, this will lead passengers to having pleasant associations with the airline, and this increased travelling experience can be hard to live without in the future, motivating to further point accumulation. In a psychological perspective, rewards can be viewed as *sticky* or *slippery* (Nunes and Drèze, 2006b). Slippery rewards tend to slip from memory, and turn out like everyday rewards. The sticky rewards stick in the recipient's mind, typically enforcing an experi-

ence out of the ordinary, and this in result reinforces the relationship with the program provider. Sticky rewards do not necessarily have to cost the airline amounts of money, but can turn out as simple as the staff honouring the more valuable customers.

6. EB usually offers a “kick-start” when applying to the program, giving introductory points for simply applying, or from a “special offer” from another provider if applying to EB. This enhances *the endowed progress effect*, explained experimentally by Nunes and Drèze (2006a). They suggest that providing a kick-start enhances the sense of momentum for customers, after testing two different programs on a car wash business’ customers. One program offered one free wash after eight purchases (a 0% initial completion), and the other program one free wash after ten purchases, but receiving two initial purchases for free (a 20% initial completion). Both programs required eight purchases to receive a free wash, but the second program gave a sense of advancement toward the goal, and was found to shorten the time to goal completion. This suggests the general behaviour that probability of task fulfilment increases when a task is undertaken and incomplete versus when a task not yet begun – referred to as the endowed progress effect.

The success of an airline’s FFP lies in giving enough incentives for the customers to want more from that airline, without ruining the company’s profits. For a very small part of those customers, the incentives of the rewards can go so far as taking over their lives, and they can be referred to as *bonusjunkies* (Imeland, 2018). Constantly evaluating the possibilities of gathering cheap points within the network of the airline, and how to use the points getting a highest possible dividend. Even though this far from affects all members of the program, this actual effects for some. Whether or not loyal behaviour gives a higher total utility for the customer, or if it limits the competition environment, is a flaming matter of discussion in the literature.

2.2 Theory on Motives and Effects of Loyalty Programs

A wide spectre of general loyalty program literature was produced also before the FFP launch in 1981. Rewarding loyal customers is not a new phenomenon, with the grocery industry as an example. The literature is mostly from the legal, economic and psychological fields. The economic theory on loyalty programs typically uses microeconomics and game theory to describe a theoretical effect of the FFPs on the market. A vast majority of the literature highlights the anticompetitive effects that loyalty programs may induce.

2.2.1 Marketing Tool

The first FFP by American Airlines was introduced as a marketing tool, to induce brand loyalty in the airline industry (Garsson, 1987). But as technology has evolved, so has the available data regarding customers. Monteiro and Macdonald (1996) states how there was an academic and administrative consensus that the 1978 Deregulation Act in the US would lead the airline industry close to a perfectly competitive market. One of the outcomes was an increased strategic use of information gathered from the FFPs and the computer reservation systems, in turn leading to a competitive advantage. This suprised the academic field. To be able to receive a competitive advantage out of the massive amount of information (i.e. big data) available, airlines must be able to *use* information technology (IT) systems efficiently. Porter (1985) proposes that *"technical change is one of the principal drivers of competition"*, suggesting that the increasing strategic use of new technical tools analysing big data enhances the competition, thus suggesting a pro-competitive argument.

In Konkurransetilsynet (2002), SAS argues that the customer data base from EB is crucial for their marketing strategy. SAS claims that the program obtains valuable information about the customers' traveling habits, making it possible to further develop the products towards different customer groups by efficiently using internal data systems. The Norwegian Competition Authority, in contrast, suggests that there may not be a benefit of doing marketing internally, it may as well be cheaper and better using a marketing specialized company. They further argue that the efficient marketing for the market leader may actually lead to a deadweight loss, as new entrants to the market must use more resources per passenger doing marketing for their product. This in turn resulting in higher sunk costs that will be lost in case of bankruptcy.

Some argue the customer related information from FFPs leads to a higher quality of the product, because the airlines can offer service attributes highly rated by the frequent travellers through the programs. Steen and Sørgard (2011) disagrees, in the sense that these services are not limited to be offered through such a program. They state that the only increased quality is the rebate on a future ticket and thus a lower average cost per ticket. The desired products, as for example priority boarding or access to airport lounge, may as well be purchased for an extra fee in addition to the ticket. This has been a normal practice for the LCCs – to pay only for the services desired. Practicing separate buying opportunities of services has also been implemented by SAS in the recent years (SAS, c).

2.2.2 Price Discrimination and Competition at the Margin

Companies have the incentives to maximize their profit and utility. The use of one uniform price for all products are in most cases generating consumer surplus and deadweight loss instead of profit, which is not favourable for the companies to maximize profit. Price discrimination setting the prices equal the consumers' willingness to pay, offering a differential of prices. Ideally, the airlines would want enough information to know the maximum price every passenger want to pay at every single moment in time to achieve this. This can be referred to as *first-degree price discrimination*, or *perfect price discrimination*. It is important to note, however, that for price competition to be possible, two conditions must be satisfied. The first is that the firm must have some sort of market power, because in a perfectly competitive market an entry would take place and force prices down to marginal costs. Second, the market must be divisible into sub-markets with different demand conditions (Lipczynski et al., 2005, p. 358-9). As a consequence of the first condition, the evidence of price discrimination being possible in a market can be used to prove market power of a company. The use of loyalty programs is a kind of price discrimination, sub-grouping the travellers making the frequent customers paying a lower average price per journey than the single-time travellers.

Zenger (2012) shows with a simple rebate model in a microeconomic perspective that under competition with two companies, the use of rebates will lead to aggressive pricing at the margin. He shows that this means lower average prices for the products if the loyalty rebates are allowed than if they are not. Further he explains this counterintuitive result with the observation that because the loyalty rebates allow the firms to extract inframarginal rents (i.e. the profitable units up to the margin) through price discrimination, they therefore *dare* to compete aggressively at the margin. The competition puts pressure on the prices of competitors and leads to a competitive interaction with a mutually more aggressive pricing. Caminal and Claici (2007) uses a two-period Hotelling game theory model to show the same as Zenger did: that the loyalty-rewarding pricing schemes in a highly competitive environment reduce the average prices and increase consumer welfare. They, in contrast to Zenger, base this model on many companies, but conclude with the fact that two conditions must hold simultaneously for a loyalty program to be anti-competitive: a sufficiently small number of firms and design restrictions of the program to involve a low commitment value for consumers. Thus they conclude that being a small amount of firms, like in the Norwegian airline market, doesn't necessarily imply anti-competitive effects of the loyalty programs, so the pro-competitive outcome may hold.

The above literature claims that FFPs can be pro-competitive, increasing consumer surplus and decreasing average prices, but there is empirical work that suggests the opposite – that there are higher prices with FFP present compared to non-present. Escobari (2011) shows in his econometric model how a 1% increase in FFP leads to an average of 1.16% increase in price in average, and a 3.06% increase in the 20 percentile cheapest range of the tickets. The surveys of Stephenson and Fox (1992) finds that as much as 70% of the corporate respondents view the programs as wasteful and inducing higher fares than necessary.

2.2.3 Dampening of Price Competition, Switching Costs and Barriers to Entry

Pike (2016) explains how FFPs potentially can contribute to an anti-competitive effect: a dampening of the price competition between rival airlines. Each of the airlines will benefit from the other airlines having FFPs, because the rival firms can focus on their own loyal customers rather than fighting for new ones. Each of the firms are less willing to cut prices for the rivals' customers, because this will lead to lower revenues from already loyal customers. This is in strong contrast to Zenger (2012) explaining the aggressive competition at the margin. Ackermann (2010) confirms the dampening of price competition with a two-stage Bertrand model for a duopolistic market with two firms. His analysis shows that the two firms have incentives to coordinate on the same first stage price, then the market splits, and each of the firms will act as a monopolist in their own respective markets during the second stage. Theoretically his theory about price coordination can be applied to the Norwegian market today – with two firms serving the competitive domestic market, but empirically we have no evidence of this.

In the airline business there is the artificial kind of switching costs, which the airlines can take advantage of (Klemperer, 1987). These are not *actual* costs, but switching airline will penalize relative to those who remain in one single airline. Doing business with another airline withdraws the opportunity of a later discount, and the average price of the ticket therefore becomes higher. In their report, Konkurransetilsynet (2002) worry about how the FFPs can lead to competition on other parameters than the price. They believe that the programs sufficiently lock the customers into using the same airline by increasing the switching costs, and that this in turn leads to the price as the main competition parameter decreases. The report concludes that the FFPs are contributing to a higher price level, both under monopoly and free competition situations. This was one of the main arguments for implementing the regulation of FFPs in 2002.

Klemperer (1987) uses a two-period model with two firms to show theoretically how the switching costs build up from the first period with no affiliation with the supplier, to the second period where the consumers have built up a supplier relationship. The model confirms that switching costs can contribute to a dampened competition in the market. In the first period, the price competition will be extensive, but with the reason to win a largest possible share of the higher-reservation-price customers. The switching costs in the second period segments the market into submarkets, with the customers in each submarket in extreme cases being monopolized by their firm. In a market this can mean a low price strategy to gain customers in the first period, while increasing the price in the second period (i.e. penetration pricing strategy).

Eight years later, Klemperer (1995) follows up with a new model, upgrading to include a multi-period environment. He highlights how every firm faces a trade-off in every period: investing in market share by charging low price to attract new, valuable customers for the future, or in the other hand, harvest profits by charging high prices to exploit their influence over the loyal customers. The analysis shows that the welfare losses may be substantial, that switching costs generally raise prices and may also discourage new entries. Entry barriers further reduces the competitiveness of the market. In his conclusion he suggests that public policy should regulate the activities that increase the consumer switching costs, in which the Norwegian airline market serves as a real example.

Before the ban of FFP in the Norwegian market, both SAS and Braathens stated how they saw a new entrant in the market as very unlikely, because of the small total market available (Konkurransetilsynet, 2002). The Norwegian Competition Authority disagreed to this argument, and concluded that the loyalty programs are increasing the customer's switching costs, which in turn works as a barrier to entry for new companies, due to the large cost associated with running the FFPs. They believed these costs to be the reason of the lack of new rivals, not the market saturation suggested by SAS and Braathens.

Monteiro and Macdonald (1996) remark the unexpected consequences of the 1978 Deregulation Act: the strategic use of information increased the barriers to entry. One of the reasons to deregulate the market from government intervention, was exactly to reduce the barriers to entry, attempting nearly perfect competition. Before the deregulation, the top eight airlines in the US controlled 80% of the passenger miles, and in 1990 the number was 92%. The same faith crossed the Norwegian market after the 1994 deregulation, with SAS and Braathens controlling nearly 86% of the market in 2002 (Figure 1.1). In contrast to in the US, the Norwegian government chose to intervene into the market in 2002 by forbidding the use of FFPs domestically, attempting to reduce the entry barrier for new rivals.

2.2.4 Network Effects and Hub Premium

The Norwegian Competition Authority argues that the value of a FFP seems to be affected by network externalities (Pike, 2016). A large network is present when there are possibilities to accumulate points through hotel stays, car rentals and other purchases. Another usual way to exploit the network externalities is to join airline alliances, where the passengers can enjoy earning points to their FFP account by using airlines within the same alliance, thus expanding the possibilities of point accumulation excessively. The hub premium is also a topic discussed in the literature, and the presence of FFPs is claimed to contribute to this premium. Hub premium is the fare premium that the dominant firm at a hub airport receives. Lederman (2008) investigates a natural experiment in the US using an empirical approach to estimate a fraction of the hub premium that is due to FFPs. She does this by comparing the mean fares at an airport hub before and after FFP partnerships. The partnership was signed between the dominant and smaller airline at an airport hub, giving the smaller airline the right to give out bonus points on the dominant firms' FFP. Her results imply an increase in the mean fare of between 3.5% and 5% after the partnership was signed, and that the FFP may account for more than 25% of this increase. The suggestion in her conclusion is that a ban of FFP would lower the fare premium of dominant firm, which is in line with what Konkurransetilsynet (2002) suggest. They believe that a ban on accumulation of bonus points on the Norwegian domestic routes will reduce the competitive importance of having a substantial network, because the travellers will to a larger extent evaluate the service and price of each route separately, and not base the decision on the collection of points.

2.2.5 The Suction Effect

An effect described in the loyalty program literature is the so-called "suction-effect". When a customer is close to a threshold level, a small purchase increase will trigger the rebate. This means that the incremental price of the units needed to achieve the threshold may be lower than the listed and discounted price (Faella, 2008). Steen and Sørgard (2011) reviews the size of the suction effect for the silver and gold status in EB by using member data for each level of accumulated points. They don't deny that this effect looks rather insignificant on paper, but mentions that an important lack of the data is that they can hide the actual magnitude of the suction effect: the data do not contain information on what would be the case if the threshold levels were *not* there. An effect of this could be the airline not having as many customers in the upper number of travel range, i.e. the tail of the data being shorter.

2.2.6 The Principal-Agent Problem

The principal-agent problem has frequently been pointed out in the literature because the FFPs traditionally have been directed towards the frequent business travellers. This problem occurs when the person using the service is not paying for it himself. In the business segment of the airline industry it is widespread that the employees (i.e. agent) orders the plane tickets, while the employer (i.e. principal) pays for the trip. ECA (2002) serves the following example of the effect of the FFP: if a traveller (agent) has the private utility u, and the utility is greater with company A than with company B, $u_A > u_B$, then the agent chooses A regardless of the price, given that the agent doesn't consider the principals' costs. The agent doesn't have the budget line, as in a normal microeconomic problem. The extra utility can for example be justified in the accumulation of bonus points, even if the journey in itself is less comfortable. The results of Stephenson and Fox (1992) survey shows that the corporate managers believe the FFPs have increased their travel costs, among other things, in terms of more expensive and unnecessary rental cars, wasted employee time due to inconvenient flight schedules, unnecessary air travel and use of expensive hotel accommodations. All this due to the agents' desire to gain FFP points.

There has though been attempts to overcome this problem. The Norwegian Tax Administration has formed rules towards accumulation of frequent flyer points, saying that the private use of points gained through business trips are taxable. The rules apply to all state employees (Sæbbe, 2016). In the private businesses, it has become a normal procedure for the employers to make guidelines towards employees booking tickets. This has had some result, but the problem is still not eliminated because it is nearly impossible for the employer to follow up whether or not the employee has chosen in accordance with the guidelines (Steen and Sørgard, 2011).

2.2.7 Prisoner's Dilemma – a Zero-Sum Game?

As the last theme in the theory overview, I will mention the prisoner's dilemma, an example in game theory showing that two rational individuals will not cooperate even if this will lead to the best possible outcome (Wikipedia, 2018b). This is because if the other part chooses to not cooperate, you will loose and they will win. There is a probability that the FFPs are caught in a prisoner's dilemma, that the companies are forced to keep running the FFPs as a competitor response, or because termination of the program may result in negative publicity and customer retaliation (Dorotic et al., 2012). Caminal and Claici (2007) provide this message: *"The introduction of a loyalty program is a dominant strategy for each firm (provided these programs involve sufficiently small administrative costs) but in equilibrium all firms lose (prisoner's dilemma)"*. Liu and Yang (2009) questions if the competitive loyalty programs really cancel another's effects out, creating a zero-sum-game, or if some of the firms may enjoy asymmetric advantages. The Bertrand model used by Cairns and Galbraith (1990) expect the use of FFP marketing devices to be a Nash equilibrium, meaning the FFPs will remain if there are no interruptions, although it would benefit all firms to agree to end them simultaneously.

2.3 Empirical Studies on Loyalty programs

There are a loads of theory on how the loyalty programs can influence the competitive environment, but less good evidence in the empirical work. The challenge is to prove how strong the effects of the loyalty programs are alone. In the empirical studies, the frequent methods of quantification are:

1. *Surveys*: These can give valuable information about a group's preferences, but challenging to get a statistically significant group and to measure a representative selection of the total population. Formulating the right questions is challenging, and there is also always a risk that the participants reply dishonestly, or have other perceptions of the question meaning.

2. *Econometric studies*: Usually decomposition of some variable, using existing data to explain the influence of independent variables on the dependent variable. A powerful method, but difficult to obtain data that includes exactly what is wanted, and the researcher must make major assumptions.

2.3.1 Surveys

Many of the surveys in the air loyalty program field use the business market as respondents. Two papers are written to describe the main findings from a 1991 survey sent out to corporate manager members of the National Business Travel Association. Stephenson and Fox (1992) presents the overall results, and Stephenson and Fox (1993) divides the results to explain differences in small and large corporations. The study is a follow-up and is compared to a similar 1986 survey, with an aim to find attitudes towards FFPs in companies. Attitudes toward the FFPs are in general negative, and seem to have changed very little during this period. 56% of the managers believes the programs create higher fares for the company than necessary, and 18% believes they lead to unnecessary air travel. For the largest corporations, 63% thinks the best solution to the principal-agent problem initiated by FFP would be to eliminate the programs fully. The programs are estimated to contribute to an additional cost of 7.9% annually in the travel expenses, and this seems to be nearly the same number for small and larger corporations.

Dolnicar et al. (2011) surveys travellers from a selection of one airlines' flight plan, investigating what are the main drivers of behavioural airline loyalty. They find that the FFPs are strongly associated with behavioural loyalty for business and frequent travellers, but not for the casual and leisure travellers. The decisions of the leisure travellers are strongly influenced by the price parameter.

At last I want to highlight the annual Norwegian travel survey, done by Institute of Transport Economics, as this is one of the most important surveys regarding the Norwegian air transportation market (Thune-Larsen, 2016). The 2015 survey is based on 155000 respondents nationwide, and it aims to supply the pure statistic passenger data with information about preferences and habits of the passengers. It gives interesting data about the Norwegian domestic airline market. For Norway, 2015 was the first year with more leisure than business domestic trips (due to data obtained from Avinor), which also happened in 1989 in the US domestic airline market (Stephenson and Bender, 1996). The reduction in business travel is compensated by the increased leisure travel, keeping the total travel per capita at a constant level. Another noteworthy finding is the stated ticket prices by the respondents: adjusted for inflation the average price has decreased by 21% since 2003, while in contrast the PIPTA has increased by 4% in the same period. The largest price reduction has been enjoyed by the business travellers, with a 26% reduction, and the leisure travellers with a 4% reduction. The validity of these findings can however be doubted, as there only was a 57% response rate on this question.

2.3.2 Econometric Studies

In the econometric field, Nako (1992) is worth mentioning as his model is used as a major empirical argument in Konkurransetilsynet (2002) leading to the FFP ban in Norway. Using data sample of business travellers in three medium sized firms, Nako decomposes an individual's utility for different airline services into independent variables for airline constants, flights offered, time, direct service offered, fare, on-time-performance and FFP. The main findings in this study was that FFPs have a significant effect upon airline choice, and that the advantage of FFP for a larger airline is significantly reduced when the smaller rival has developed a hub. This means that a decreased hub premium results in a reduced FFP advantage. Nakos outcomes are in line with the conclusion of the Lederman (2008) study mentioned above, only that her results suggest an opposite causality – that FFP explains part of the hub premium. Furthermore, the mentioned Escobari (2011) model, which finds a significant FFP premium present, adds that the airport dominance only increases the FFP premium significantly on the cheaper end fares.

Also we have Steen and Sørgard (2011), who tries to improve a simple linear model into a more statistically correct model to find the suction effect of EB at the different threshold levels. They find a presence of the suction effect, but claims that it's not sufficient to tell anything from the analysis when we don't have passenger data for SAS *without* treshold levels.

Chapter 3

Empirical Study

I have collected data from public distributors, companies and tracked the interim reports of the domestic airline services. The combination of micro- and macroeconomic explanatory variables is carefully chosen in order to describe the various factors contributing to price development in the domestic air travel market. The raw data are further processed to meet the basic assumptions of a multiple linear regression model (MLR), and the model is assessed for different combinations of variables.

3.1 Raw Data

3.1.1 Air Ticket Price Index (PIPTA) - The Response Variable

In general, *"a price index is a measure of the proportionate, or percentage, changes in a set of prices over time.* (Young et al., 2004, p.1). The price index typically has a base value of 100 at some point in time, and the index values for the other points in time indicates the percentage change in prices relative to this reference. The overall price index is calculated as weighted averages of the percentage price changes for a pre-specified set of goods or services, and the weights reflect their relative importance in a given time period.

Statistics Norway distributes the monthly PIPTA through their website as a subindex of the consumer price index (SSB, a). From August 2007, a new method of calculating PIPTA was implemented. This can be clearly seen in Figure 3.1 The dataset of interest is thus set to start in this period to reduce the number of error sources. In contrast to the the old method, which gathered base prices from the airlines, the new method is designed to catch the dynamic pricing. Pricing is based on the airline revenues, constantly analysed by the internal yield management systems. The ultimate goal for the airlines is to maximize the utilization of consumer surplus at all points in time. Differences in prices for the same service (i.e. ticket of same quality to one flight) therefore depends on current supply and demand, when the ticket is ordered and overall revenues

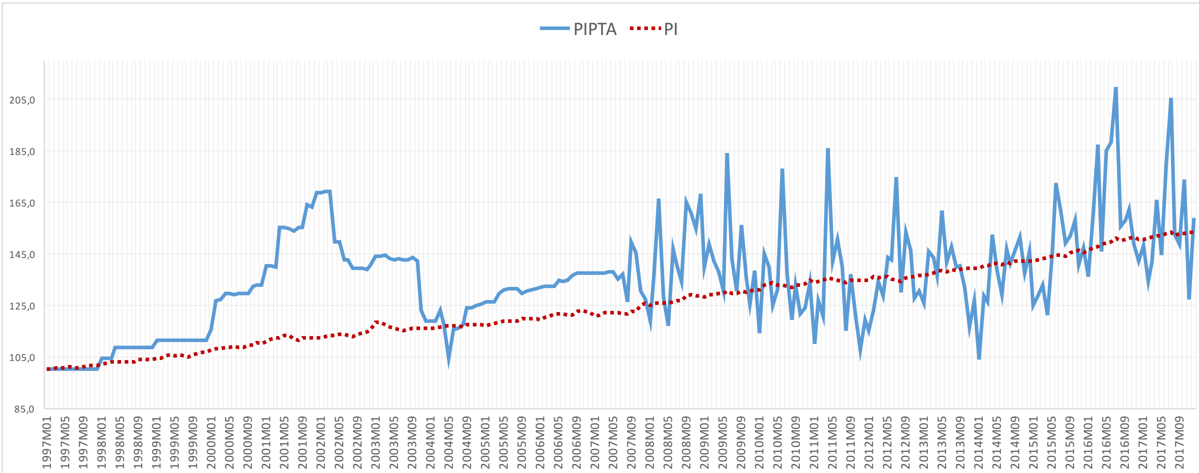


Figure 3.1: *PIPTA* vs *PI* 2007-2017

for company.

For most subindices of the consumer price index, the order and consumption point in time coincides fairly well. This is not the case for airtravel, where the order date may be months ahead of the actual day of consumption (i.e. travel date). To compensate for this, the new measurements of PIPTA are based on price gatherings over a longer period of time (Johansen, 2007). This can be written as the observation $o \in O$ of price. Typically, the first observation is done three and two months ahead, and weekly the last month before domestic departures. If $r \in R$ is the set of stratified routes included in the PIPTA measurement, with flights $f \in F$ operating these routes, then the unweighted geometric mean of the price observation o from different airlines and travel firm operators $a \in A$ on a particular flight f departing at date $d = D$ can be written as $P^D_{rfo} = (\prod_{a \in A} P^D_{rfoa})^{\frac{1}{|A|}}$. The mean price for a particular flight over all observations is then calculated using an unweighted arithmetic mean; $P^D_{rf} = \frac{1}{|O|} \sum_{o \in O} P^D_{rfo}$. Further, the different flights f operating at T over one route are weighted using w^D_f, resulting in the index $I^D_r = \frac{1}{|F|} \sum_{f \in F} w^D_f P^D_{rf}$. At last, the indices for each route I^D_r are weighted together based on passenger data from Avinor to generate the overall index for air ticket price, *PIPTA*. The most accurate way of measuring the ticket prices would obviously be to gather the prices each and every passenger paid for the flight, but this is not obtainable data.

The dataset of *PIPTA* from Aug 2007 to Dec 2017 gives an overview over two important periods, with a sufficient amount of years in each end to see an effect: Aug 2007 – May 2013 with a domestic ban against FFPs, and Jun 2013 - Dec 2017 without the ban. The dataset of $PIPTA_t$ is thus retrieved on a monthly basis, giving a time series with $t = [1, 125]$.

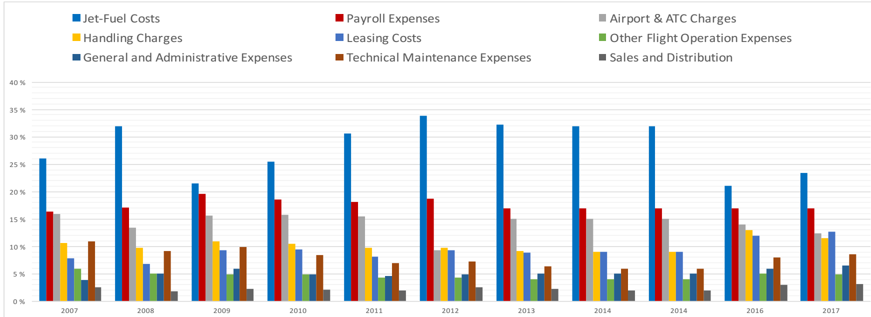
Some harsh assumptions have been made during this project to be able to use price data available for the public. Primarily, I am interested in the domestic market price data exclusively, but *PIPTA* includes weighted price information for both international and domestic selected routes. The weights are not defined; thus it is impossible to clean the time series for international routes. *PIPTA* primarily involves the private market, because the private households, and not the business travellers, are the greatest users of non-flexible tickets. Non-flexible tickets are used to ensure a similar quality of the services in the dataset. Thus, the data provides domestic and international data, focusing on the private market. Ideally, I would want domestic data exclusively, with both business and leisure travellers. At last, the prices are gathered from a representative selection of airlines registered in Norway. Price data from SAS and NAS exclusively would be in my major interest, as these are the airlines chosen in my explanatory variable set.

The Producer Price Index (PPI) for ticket fares from Statistics Norway (SSB, c), which is a quarterly distributed index, has also been evaluated to use as the response variable. PPI is a unit price index, based on turnover per unit sold for a given period, i.e. based on the financial statements and not actual prices seen by the customers. The airlines are themselves reporting unit prices, in contrast to PIPTA where the prices are gathered externally. PPI do not include taxes and fees from the government. I chose the PIPTA on basis of the amount of yearly data points (12 vs 4) contributing to a more reliable econometric analysis, and the aim of the index to catch the dynamic pricing by tracking prices on the internet at several points in time. One significant drawback by this is that validating the prices from PIPTA in retrospect is difficult, as the prices on the web changes continuously, and also the limited amount of observations underlying the index.

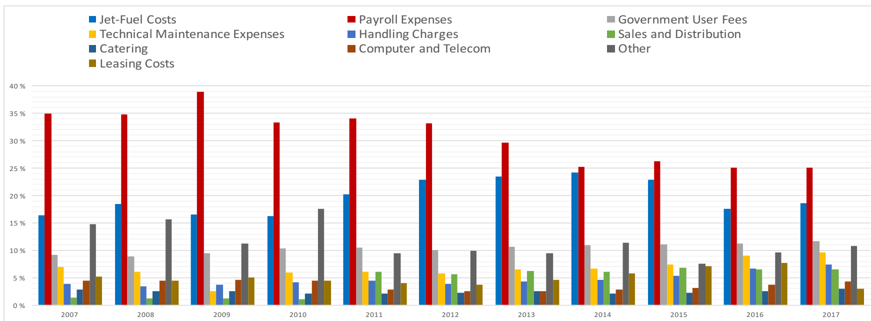
3.1.2 Microeconomic Explanatory Variables

Even though macro- and microeconomic theory are claimed to have merged into inseparable economic theories over the years, I can see a point in dividing these. The microeconomic theory has its foundation in the preferences of the individual and utility maximization, aiming to generate profit maximization for the firm (SNL, 2014). The financial statements for the market of interest, SAS and NAS, are a natural starting point to look for microeconomic explanatory variables for the air ticket price (SAS (a);Norwegian (a)). The quarterly reports 2007Q3-2017Q4 are used for a greater accuracy compared to the annual, giving a total of 42 data points per airline. The macroeconomic variables are provided on a monthly basis. To adjust for the quarterly distributions of the micro viariables, they are upsampled using linear interpolation. This method is a simple and effective way of ensuring the same total area. The upsampling assumes a linear development of the time series between each quarter, and that the middle month in each quarter holds the actual value of that quarter.

The aim of the microeconomic variables included in the model is to catch in which degree the air ticket price (*PIPTA*) responds to underlying fluctuations of key operational factors of the services. Included in this analysis are the factors tied to the operational costs, as well as to the capacity utilization of the airline services, expressed through the load factor (LF). These factors are to some degree controllable for the services. Some operational costs are closely tied to effi-



(a) NAS



(b) SAS

Figure 3.2: Operational cost distributions 2007-2017 (SAS (a);Norwegian (a))

ciency of the firm (e.g. payroll expenses), while others are strictly governed by the overall market (e.g. jet fuel costs). The LF is to some extent driven by the external airline market demand, clearly seen by the natural seasonal fluctuations of both airlines. Nevertheless, LF is commonly evaluated by the internal managers and external investors as a key performance indicator, and a high LF can characterize a well managed airline. Typically, the decisions related to LF includes pricing, capacity and frequency of flights.

As a result of the investigation of the annual operational costs for SAS and NAS, I chose to focus on the payroll and jet fuel expenses. Figure 3.2 show how these clearly have the highest share of the operational costs, and also vary the most. The main assumption for the cost analysis is thus using the development of jet fuel and payroll expenses, holding the other operational costs constant. Both airlines show the same jet fuel cost trend, following the external jet fuel spot price (Figure 3.3). NAS have relative to SAS more of their operational expenses going to jet fuel: while SAS had 39% of their costs going to payroll expenses, NAS spent 20% in 2009. Even though the jet fuel costs can be argued to be defined as a macroeconomic variable, I choose to define them as microeconomic because these are costs directly affecting the companies, and to some degree can be secured by hedging. Because they´ are per passenger indices, they also in part measure efficiency, which is more of a managerial and strategic decision by the airlines.

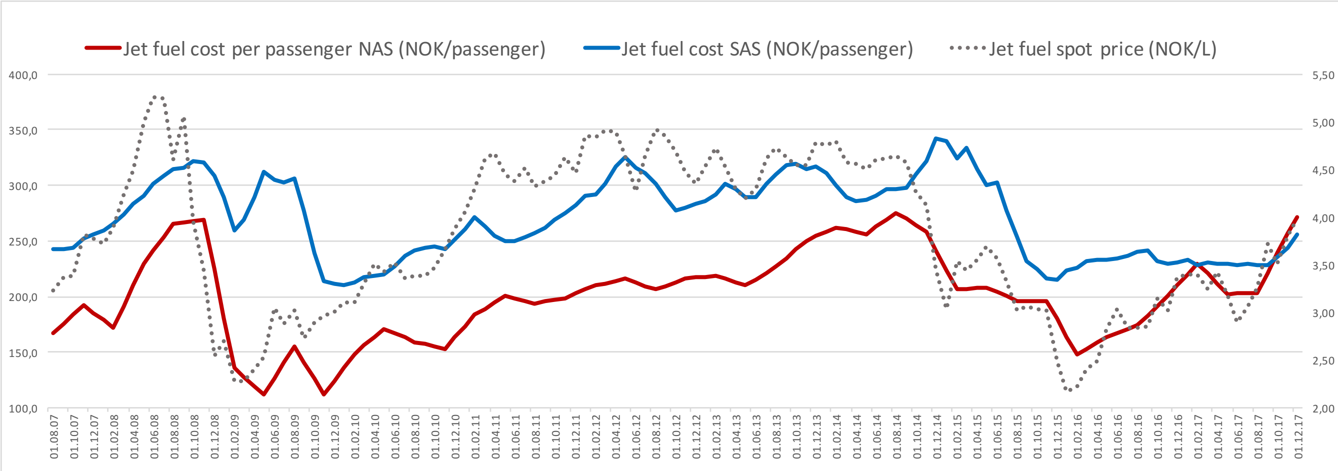


Figure 3.3: Trend jet fuel spot price (eia) vs jet fuel costs per passenger (SAS (a);Norwegian (a)), 2007-2017

Cost Indices (CI)

Even if the analysis is supposed to reflect the domestic market, the total international and domestic passenger numbers, P_{aq}, where $a \in A$ and $A = \{NAS, SAS\}$, are obtained from the quarterly reports $q \subset T$of SAS and NAS. This is due to lack of a consistent availability of the domestic passenger records exclusively during 42 quarters. Only the total operational costs are distributed, and therefore correct to compare to total passenger data. Quarterly costs and the weights (fractional cost/total cost) of these for airline a in quarter q, respectively, are noted as C_{aq}^{OC}, W_{aq}^{OC}, where OC indicates the operational costs of interest: jet fuel (JF) or payroll expense (PE). From this we can obtain the cost parameters:

$$CP_{aq}^{OC} = \frac{C_{aq}^{OC}}{P_{aq}} \tag{3.1}$$

Quarterly jet fuel and payroll expenses per passenger (CP_{aq}^{JF} and CP_{aq}^{PE}) can be considered as parts of the average variable cost (AVC) for the airlines – where each unit equals service of one passenger. Using a per passenger measure is important to be able to compare CI to the PI, as the price indices also measures per person. The per passenger measure in addition induces an efficiency degree. Especially for CP_{aq}^{PE}, a decrease can typically indicate a higher average labour productivity (APL) (Lipczynski et al., 2005, p. 29-30). It can *also* mean a significant wage rate decrease if the number of employees remains constant, but for SAS the reason probably is a higher APL, as they have had several important efficiency strategies. The unions in Norway also have a strong position in the airline industry, with the employees striking frequently in both SAS and NAS. CP_{aq}^{JF} is primarily driven by the external jet fuel cost, but decreases can also be partly explained in technical efficiency. NAS has for example invested in 787 Dreamliner airplanes (Norwegian, b), which they claim reduces the fuel consumption by 20% because of a better aerodynamic design and lighter weight.

The quarterly reports of both SAS and NAS don't contain good information about what the different accounting items include. The items thus may be incomparable between the airlines, but there is a high probability that the jet fuel costs contain the same expenses. Payroll expenses are also specified to include both outsourced and the permanent workforce, which means both of these accounting items include the overall cost of human operation of the companies.

For upsampling the data sets, linear interpolation of $CP_{aq}^{OC}, W_{aq}^{OC}$ is used, expanding from 42 to 125 data points. This implies an upsample of two per point, which certainly creates an autocorrelation of the time series. Nevertheless, I see more value in evaluating over 125 data points, than the downsides of the autocorrelation from linear interpolation. The linearly interpolated, monthly cost parameters and weights are given the notations $CP_{at}^{OC}, W_{at}^{OC}$.

A Cost Index (CI) for both JF and PE was created to better understand the development of costs. The CI starts, as $PIPTA_1$ and PI_1, with a value of 100, which is common practice. Also in the same way as $PIPTA_t$ and PI_t, the CI shows the cost level relative to the starting year $t = 1$. The calculations for CI are:

$$CI_{a1}^{OC} = 100, \quad a \in A \tag{3.2}$$

for the first data point,

$$CI_{at}^{OC} = CI_{a(t-1)}^{OC}\left(1 + W_{at}^{OC}\frac{CP_{at}^{OC} - CP_{a(t-1)}^{OC}}{CP_{a(t-1)}^{OC}}\right), \quad a \in A, t = 2, ..., T \tag{3.3}$$

for the remaining points and

$$CI_t^{OC} = \sum_{a \in A} CI_{at}^{OC} MS_{at}, \quad t \in T \tag{3.4}$$

where $MS_{at}, a \in A, t \in T$ gives the time series of the market share for each airline (from Figure 1.1), interpolated from yearly data. Equation 3.4 provides the CI for each of the chosen operational costs (*CI.JF* and *CI.PE*) for the total Norwegian airline market (SAS and NAS).

Loadfactor (LF)

The *LF* is included to catch up the effect supply and demand in the market (macro), as well as efficiency achieved by the airlines due to internal decisions (micro). It is thus decided to be covered as a microeconomic variable because of the availability in the internal financial reports, and the ability to influence the variable by business decisions. LF_{aq} is also linearly interpolated, upsampling from 42 to 125 points - LF_{at}. As with the CI, the LF is transformed to contain the whole Norwegian airline market;

$$LF_t = \sum_{a \in A} LF_{at} MS_{at}, \quad t \in T \tag{3.5}$$

3.1.3 Macroeconomic Explanatory Variables

The aim of the macroeconomic explanatory variables in the model is to catch up factors describing the cycle of the economy. These are defined as variables the airline businesses themselves cannot affect, and can be viewed as frames defining the competitive environment. The macro variables influence the passengers in how they view their personal economy and further future predictions. They also influence how the airlines must interact with the society, including regulatory aspects and general operational and financial cost level. Investor behaviour are also highly affected if the variables show signs of a market boom or bust, which in turn will influence the airline companies.

Frequent Flyer Programme Dummy Variable (FFP)

The FFP dummy ($FFP \in [0,1]$) is the main explanatory variable of interest in this analysis. It qualitatively indicates the historical natural experiment, where $FFP = 1$ starts in May 2013 ($t = 71$). A dummy variable is used to understand if the FFP significantly shifts the price level outcome from during to after the domestic regulation of FFPs, i.e. making a significant change to the equation changing from 0 to 1. Because of the regulatory nature of the variable, it is defined as a macro variable.

Financial Crisis and Passenger Fee Dummy Variables

The global financial crisis started during the fall of 2008, and affected the number of passengers considerably (Samferdsel, 2008). This stabilized after the fall of 2009. The financial crisis included, among other things, a huge oil price fall from spring to fall of 2008, increasing the capacity and lowering costs of the airlines. It resulted in a recession cycle, including a rise of unemployment rate and a fall of interest rate set by the central bank to stimulate the economy growth. Typically, with a recession in the economy follows reduced consumption and investments. As the 2008 financial crisis has been described as a big contributor to a decrease in passengers, this can work as a dummy variable qualitatively describing the presence of the crisis, and most likely describing part of the price level.

Another potential influencer for significant change in price level is regulatory changes regarding costs. Since PIPTA includes all government taxes and fees to reflect the actual price level, PIPTA is expected to respond to regulatory cost changes. The major aviation tax introduced in the market was the passenger tax June 2016, starting as an 80NOK tax for each passenger, both domestic and international.

Consumer Price Index (PI)

PI, monthly distributed by Statistics Norway (SSB, b), describes the overall development in consumer prices for goods and services, and is a common measurement of inflation. It is built up by subgroups (e.g. PIPTA) of goods, weighted according to the relative importance of the good/service in a household. The monetary policy in Norway is aimed to maintain a low and stable inflation, with a goal of 2% yearly over time (Bank, 2018). The foremost tool of control for maintaining this level is the national key rate. This macro variable is expected to highly influence the price development, and will probably work as an underlying trend for PIPTA and the cost indices. These variables are expected to adjust to the general price level.

Interest (IR), Unemployment (UR) and Real Wage Rate (RW)

IR (monthly, Bank), UR (monthly, SSB (e)) and RW (yearly, SSB (f)) are all macro variables expected to explain part of the domestic competitive frames of the airline services.

The IR of choice is the Norwegian treasury bill level. This is due to a continuous change of the rate, following the market trend responding to boom or recession of the economy, and the general key interest rate set by the central bank. Interest level cannot alone decide the development of an economy. If an interest level is set that deviates from what actual economic conditions implies, we will get temporary imbalances in the economy which will lead to changes and adjustments (Larsen, 2002). Unemployment rates are strongly connected to status of the economic cycle. UR are usually divided into four factors describing the rate: the cyclical, structural, seasonal and frictional unemployment. The cyclical is due to the economic cycle, and are following the general activity of the economy. The structural can be described by adjustment difficulties to e.g. new production methods. Seasonal and frictional unemployment are described by seasonal fluctuations and time in between to jobs, respectively (SNL, 2018).

Real wage is the actual development of wage, adjusted for inflation. The rate of change of RW (ΔRW) is typically negatively correlated with UR, an increase in ΔRW implies a low UR, following the rules of supply and demand. If the unemployment rate is low, the competition for employees are high, allowing for wage rise to keep the working force (Phillips, 1958) This kind of relationship among the explanatory variables can be undesirable in a regression analysis, as this can imply multicollinearity between the variables. Both rates are nevertheless included to test the influence on PIPTA.

3.2 Multiple Regression Analysis (MLR) with Time Series Data

A MLR analysis gives us the ability to isolate, or pull out, the effect of changes in one variable without doing a physical experiment. The response (dependent) variables are allowed to vary in turn, while the others remain fixed. Output coefficients from the analysis create an ordinary least square (OLS) plane ($\widehat{PIPTA_t}$) from the observed values of the response variable ($PIPTA_t$). MLR can be used for a range of data set types, but in this analysis time series regression is performed. A main difference is that the past can affect the future, but not vice versa, which puts requirements on the data being properly ordered. The random sampling of a time series can be viewed as a *random realization* of the many possibilities that could have been realized (the population), unlike with cross-sectional data where the random sampling is more intuitive defined as a significant sample of a population (Woolridge, 2013, Chap. 10)

The first assumption (TS.1) of a MLR is simply that the parameters must follow a model that is linear;

$$y_t = \alpha + \beta_1 x_{t1} + \beta_2 x_{t2} + \ldots + \beta_k x_{tk} + \varepsilon_t, \quad t \in T \tag{3.6}$$

where $t \in T$ is the number of observations and ε_t is the sequence of errors or disturbances. Further the assumptions of no perfect collinearity (TS.2), that none of the explanatory variables are constant nor a perfect linear combination of the others, and the assumption of zero conditional mean (TS.3), must be true to establish unbiasedness of OLS. Assumptions securing homoscedasticity (TS.4), no serial correlation (TS.5) and normality (TS.6) must also hold for a MLR to be valid. Each of these assumptions are to be checked when developing a model for PIPTA. Several common fallacies to note when specifying an econometric model is presented in Table 3.1.

Especially for this analysis, it is important to note number 3 and 10 in Table 3.1. Evaluating these points includes building a solid foundation of economic arguments, to be able to understand whether the significances from the MLR are actually useful or not. Without having the economic arguments, the MLR in itself will be worthless, and can just as well be a result of spurious regression.

3.2.1 Testing and Data Transformations

In this section, testing and transformations of the time series are covered. Due to number 4 and 6 in Table 3.1, this is a critical point in the analysis. The data contains a chain of imperfections worth bearing in mind, starting with the actual measurement methods of the data, and ending in the transformations below. Summary statistics of the variables included in the regressions are placed in figure 3.2, and the time series used in the regressions in Figure B.1 in Appendix B.

Table 3.1: Common MLR fallacies (Hendry, 1980)

1. Using an incomplete set of dependent factors - leading to the problem of *omitted variable bias*.	6. Building models with unobservable variables, estimated from poorly measured data based on index numbers.
2. Misspecifying the dynamic reactions and lag lengths.	7. Being unable to separate the effects of *multicollinearity* in variables.
3. In MLR there are always a risk of *spurious regression* - regressions that look perfectly fine because of a common trend, but using common sense the data sets have no correlation with each other (e.g. explaining the Norwegian PI by the life expectancy in Zimbabwe).	8. Invalidly inferring causality from correlations, known as the common logical fallacy *cum hoc ergo propter hoc*.
4. Incorrect data processing.	9. Predicting inaccurately (non-constant parameters).
5. Assuming linear relationships when there is not.	10. Confusing statistical with economic "significance" of results, and failing to relate economic theory to econometrics.

Stationary and Weakly Dependence of Time Series

Stationary behaviour and weakly dependence in time series must be evaluated to prevent the phenomenon of spurious regression, which can produce meaningless results. Failing to identify this behaviour can cause a false belief of a relationship between variables. Stationary behaviour of a data set is achieved when the statistical properties like mean, variance and autocorrelation are all constant over time. This means that a time series (i.e. stochastic process) is stationary if for every collection of time indices $1 \leq t_1 < t_2 < \ldots < t_m$, the joint distribution of $(x_{t_1}, x_{t_2}, \ldots, x_{t_m})$ is the same as the joint distribution of $(x_{t_1+h}, x_{t_2+h}, \ldots, x_{t_m+h})$ for all integers $h \geq 1$. Weakly dependence implies that $Corr(x_t, x_{t+h}) \to 0$ as $h \to \infty$. Thus, we use the stationary and weakly dependence assumptions in order for the law of large numbers and the central limit theorem to hold.

Many officially provided economic time series suffer from non-stationary behaviour or are highly persistent, and should be further adjusted to give validity to econometric models. Typical reasons for these behaviours are the presence of seasonality, trends (linear, logarithmic, exponential, polynomial) or random walks, which are quite common characteristics of economic time series. There are, fortunately, methods to clean the data sets for the non-stationary features.

Some of the data sets obviously contain seasonal patterns, due to the natural variations in

Table 3.2: Descriptibe statistics selected variables

Descriptive Statistics					
Variable	Obs	Mean	Std.Dev.	Min	Max
X12.PIPTA.DEFL	125	93.32	9.30	76.90	128.61
X12.CI.PE.DEFL	125*	96.58	5.57	88.24	112.28
CI.JF.DEFL	125*	96.50	4.75	87.36	104.88
X12.LF	125*	0.77	0.03	0.70	0.82
FFP	125	0.44	0.50	0	1
FINCRIS	125	0.10	0.30	0	1
PASSFEE	125	0.15	0.36	0	1
IR	125	0.02	0.02	0.00	0.06
UR	125	0.04	0.01	0.02	0.05
RW	125**	110.20	5.08	100.00	115.51

(*) 42 before linear interpolation.

(**) 11 before linear interpolation

supply, demand and pricing in the market during the year. PI and *UR* are officially distributed as seasonally adjusted. Because the data sets provided by Statistics Norway use X-12-ARIMA (X12) as a more advanced tool for seasonal adjustments, I also use X12 for the remaining variables. The aim is to decrease sources of imperfections of the model, assuring that similar and more accurate methods are used. In their description, Findley et al. (1998) states that compared to the previous X-11-ARIMA, X12 provides improved filter options for seasonal, holiday and trading effects, in addition to in general being a more comprehensive method than the trivial use of seasonal indices. By the Kruskal-Wallis test in X12 software (NumXL), PIPTA, *CI.PE* and *LF* are found to have seasonality present at the 1% significance level. This can be explained by their strong relation to the seasonal fluctuating demand in the airline business.

Underlying trends, both in the response and explanatory variables, can lead to false conclusions in a regression analysis. Two different time series can appear to correlate, only because they are both trending over time (e.g. number 3, Table 3.1). There are, however, easy methods to transform the time series. Granger (1974) suggest that differencing of n orders (first order: $y'_t = y_t - y_{t-1}$) *almost* always works as a good solution, without being a universal rule. Differencing can also be used to transform highly persistent random walks to weakly dependent time series. Log, polynomial or exponential transformation of the realizations in the time series should be done before the regression to assure the linearity assumption to hold (TS.1). Woolridge (2013, Chap. 10) suggests adding an underlying time trend of up to nth order to the regression ($y_t = \beta_0 + \beta_1 x_{t1} + \beta_2 x_{t2} + \beta_3 t + \ldots + \beta_{n+3} t^n + \varepsilon_t$). This is meant to catch up the trends. In my analysis, I see the PI as the underlying time trend, affecting the indices PIPTA, *CI.JF* and *CI.PE*. The intuition behind this statement lies in the fact that they are all indices measuring *changes* in price or costs, and that the magnitude of these changes certainly will be affected by the PI. Because the PI is not explaining the trend for all the independent variables, I chose to divide PIPTA, *CI.JF* and *CI.PE* (Figure B.1) by *PI* in order to adjust the variables for inflation.

Inflation and seasonal adjustments are done to achieve stationarity of the time series. The impacts of autocorrelation due to linear interpolation are considered to disturb the Agumented Dickey Fuller test enough to give false test results. Therefore I suggest the previous transformations to be satisfactory.

3.3 Model Building

This section provides the development of a general regression model, built on economic arguments for which variables are most likely to significantly describe PIPTA. Thereafter I will include several regressions varying the independent variables to look for improvement of the model, as well as functioning as a sensitivity analysis of the general model. It is of importance that the extensions also have economic arguments. Whether the assumptions (TS.1-TS.6) hold for the models, implying a statistical significance of the regression (not to be confused with economic significance), will be discussed as the results are represented.

Table 3.5 provides an overview over the models investigated. The starting point, the general model, is labelled *model 1*. The intuition behind this model is based on my evaluations of the time series data, and which variables are most likely to explain the response variable.

Table 3.3: Overview contents of regression models

	Equations	
Model	Response	Explanatory
1	*X12.PIPTA.DEFL*	FFP FINCRIS CI.JF.DEFL X12.CI.PE.DEFL
2	*X12.PIPTA.DEFL*	FFP FINCRIS *DIFF.CI.JF* X12.CI.PE.DEFL
3	*X12.PIPTA.DEFL*	FFP FINCRIS CI.JF.DEFL X12.CI.PE.DEFL *X12.LF*
4	*X12.PIPTA.DEFL*	FFP FINCRIS CI.JF.DEFL X12.CI.PE.DEFL *RW IR UR*
5	*X12.PIPTA.DEFL*	FFP FINCRIS CI.JF.DEFL *CI.PE.DEFL*
6	*X12.PIPTA.DEFL*	FFP FINCRIS CI.JF.DEFL X12.CI.PE.DEFL *PASSFEE*
7	*X12.PIPTA.DEFL*	FINCRIS CI.JF.DEFL X12.CI.PE.DEFL

First, *X12.PIPTA.DEFL* (seasonally and inflation adjusted) by *PI* is used. The seasonal patterns are expected (and validated by Kruskal-Wallis test) to be present, because of price variations for example due to holiday seasons. *PIPTA* is also expected to follow the trend of *PI*. A slightly decreasing trend after being inflation adjusted can indicate a general decrease in prices compared to actual purchasing power, and may also suggest an increasing competition at the margin. It can also be due to increased efficiency of the airlines, meaning lower costs per output, but the reason for increased efficiency probably lies in a highly competitive market. Pulling *LF* into the regression would be interesting, because this primarily can be seen as an efficiency performance measure of the market (model 3).

The *FFP* is the variable most interesting to see the impact of in this analysis, as the aim of the thesis is to investigate whether the frequent flyer programs actually have any significant influence on the price development in the domestic airline market. Other independent variables are included to measure other aspects likely to drive the price competition. It is interesting to see how the coefficient of the *FFP* performs, but also doing one model *without FFP*, to see the effect of *not* including the variable (model 7).

FINCRIS is included due to descriptions of its major impact on passenger numbers, leading to expensive operation of the airlines with a lower demand. This dummy variable is expected to be an explanation of changes in the *IR*, *UR* and *RW* variables, which means I only include *FINCRIS* in the general model. This is a classical question of causality, and intuition would suggest that *FINCRIS* leads to changes in *IR*, *UR* and *RW*. Nevertheless, including these variables in a sensitivity analysis is desirable (model 4).

The inflation adjusted jet fuel cost index *CI.JF.DEFL* is included, and as expected not significantly influenced by season because the time series is mainly following the underlying fluctuations of the global oil price. It is questionable whether this variable follows the underlying Norwegian inflation, so instead of being inflation adjusted, *CI.JF* is differentiated in model 2.

X12.CI.PE.DEFL is included using the X12 version partly because of the significance of the seasonality, but mainly because the short term fluctuations of passengers do not actually measure the overall development of costs. As the wage costs increase with inflation, the cost index for payroll expense is expected to be more accurate in a inflation adjusted version. This cost index is also influenced by efficiency, and a negative trend of this variable after inflation adjustments can indicate either lower wages (low probability), or a higher share of work per employee in the airline business (high probability). It is also important to note that it is a per passenger cost index, meaning that a decrease can also be a result of higher demand. The non-deseasonalized *CI.PE.DEFL* is also used in the sensitivity analysis (model 5).

The inclusion of *PASSFEE* in the market in June 2016 was of such a high magnitude (80NOK), that it is expected to have a significant effect. It is included in the sensitivity analysis in model 6.

Because the price data for *PIPTA* is based on a time period of three months before departure, intuition could suggest using a distributed lag model. The cost indices would then be included with different lags. This can end in results difficult to interpret due to the nature of the cost indices. They are originally quarterly collected data, linearly interpolated to achieve monthly data. Thus, there is autocorrelation of the nearest points. Based on the limitations of the time series, I choose not to include distributed lag models in this analysis. An argument could also be that a cost index data point is based on the nearest points, but similarly the *PIPTA* is also calculated over a longer time period. Therefore, it may not be any more correct using lagged variables.

Durbin-Watson test is used to test for autocorrelation of the residuals (TS.3 and TS.5). The errors of the residuals should be white noise. The homoscedasticity assumption (TS.4), is checked using the Breusch-Pagan test, where H_0 = *constant variance*. It tests whether the variance of the regression errors are dependent on the values of the explanatory variables. Further, the variation inflation factors are used to test for multicollinearity (TS.2). Finally, the Ramsey Regression Equation Specification Error Test (RESET) is used to test for omitted variable bias, where H_0 = *no omitted variables*. Normality (TS.6) is evaluated using the distribution of residuals (Kernel density estimate). The linearity assumption (TS.1) is the core of being able to use linear regression. Because of the predicted influence of the dummy variables, it is difficult to graphically obtain something from scatter plots without dividing the series. The linear relationship is the cornerstone of actually analysing with MLR, TS.1-3 is necessary to establish unbiasedness, and the other assumptions are needed to be able to trust estimations of the statistic values (P, t).

Table 3.4: Overview model 1-7 regression results and tests

	1	2	3	4	5	6	7
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.251	0.220	0.270	0.325	0.246	0.262	0.190
Adj R^2	0.227	0.193	0.239	0.284	0.221	0.231	0.170
$\sqrt{MSE}$	8.182	8.374	8.114	7.872	8.211	8.161	8.475
DW	1.714	1.668	1.731	1.899	1.705	1.743	1.594
BP	0.990	0.421	0.727	0.873	0.751	0.884	0.541
RESET	0.122	0.754	0.028	0.150	0.461	0.001	0.027
VIF	2.090	1.980	3.140	11.260	1.910	2.590	1.420

DW: Durbin-Watson. Correlation of residuals. 0 = positive, 4 = negative AC.
BP: Breusch-Pagan. Test heteroscedasticity. H_0 = constant variance.
RESET: Test for omitted variables bias. H_0 = no omitted variables.
VIF: Mean variation inflation factor. Multicollinearity. Should be <5.

Table 3.5: Regression results model 1-7

	1 X12.PIPTA. DEFL	2 X12.PIPTA. DEFL	3 X12.PIPTA. DEFL	4 X12.PIPTA. DEFL	5 X12.PIPTA. DEFL	6 X12.PIPTA. DEFL	7 X12.PIPTA. DEFL
FFP	-7.382*** (2.354)	-5.359** (2.265)	-6.328*** (2.412)	-4.007 (2.876)	-6.752*** (2.266)	-7.935*** (2.388)	
FINCRIS	17.252*** (3.086)	16.596*** (3.151)	14.864*** (3.356)	15.581*** (3.161)	16.444*** (2.987)	18.627*** (3.262)	15.118*** (3.118)
PASSFEE						-4.103 (3.222)	
CI.JF. DEFL	-0.485*** (0.183)		-0.792*** (0.253)	-0.685 (0.430)	-0.499*** (0.184)	-0.676*** (0.236)	-0.255 (0.173)
DIFF. CI.JF		-1.002 (0.861)					
X12.CI. PE.DEFL	-0.602*** (0.224)	-0.646*** (0.236)	-0.728*** (0.234)	-0.153 (0.352)		-0.758*** (0.255)	-0.140 (0.174)
CI.PE. DEFL					-0.471** (0.187)		
X12.LF			-114.218* (65.860)				
IR				412.007* (217.723)			
UR				388.481 (321.883)			
RW				0.329 (0.730)			
CONST	199.847*** (29.174)	156.525*** (23.363)	329.001*** (79.895)	116.641 (88.404)	190.134*** (27.446)	234.079*** (39.612)	129.928*** (19.489)
Obs	125	124	125	125	125	125	125
R^2	0.252	0.219	0.270	0.325	0.246	0.262	0.190

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

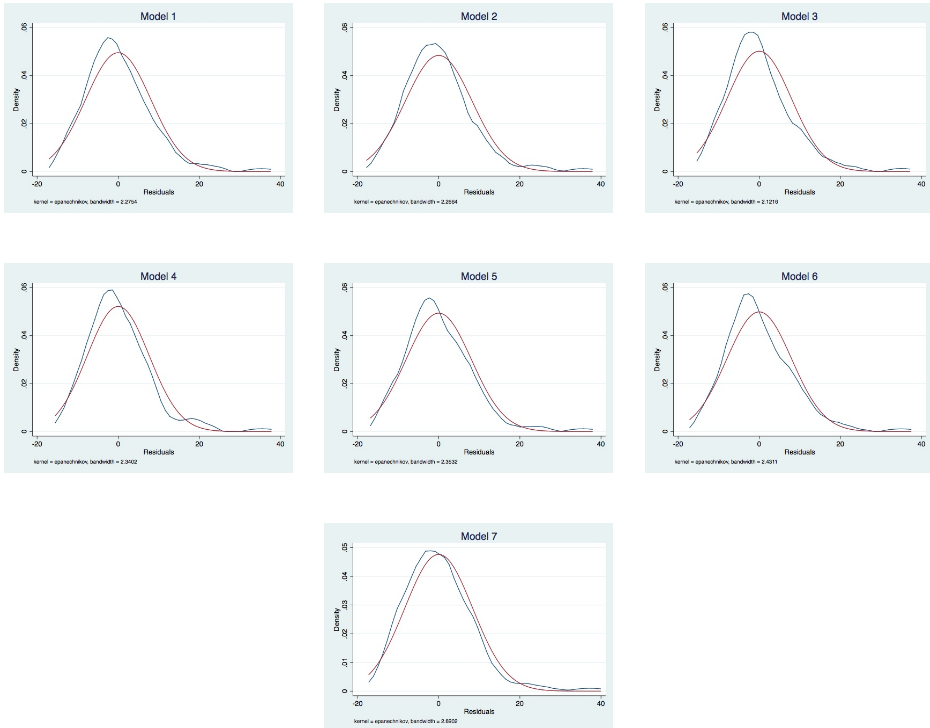


Figure 3.4: Distribution of residuals vs normal distribution (Kernel density estimate)

3.4 Results and Discussion

A general preparation of the results and tests of regression 1-7 is provided in Table 3.4, a more detailed analysis containing each variable is placed in Table 3.5, and a distribution plot of the residuals is located in Figure 3.4. This following section will provide a discussion of the attained results.

3.4.1 Evaluation of the Models

The general model (model 1), displays a decent R^2 of 0.252, and a DW close to 2, which is a good sign considering the spurious regression problem. This indication though applies to all the models evaluated. All variables included in model 1 are within the 1% significant area, and have coefficients ($\hat{\beta}$) suggesting a negative *FFP* and *CI*s, and a positive *FINCRIS*. A decrease in prices even when FFP is introduced in the market is part of my hypothesis, but the negative signs of the *CI*s may at first glance look counterintuitive. They indicate that an decrease in costs results in a increase in prices, which can be interpreted as a competition closer to the margin. But they do also show the opposite, that an increase in costs leads to decrease in prices, which actually suggest far from a competition at the margin. On the other hand, these results may in fact be intuitive according to basic microeconomic theory. Remembering the nature of the cost indices - these represents a per passenger index. An increase of the cost index can therefore be a result of three cases:

1. An increase of actual costs, but number of passengers remaining constant.

2. An increase of costs and a decrease of the passenger numbers.

3. A passenger decrease, while costs remain constant.

According to the law of supply and demand: if the supply remains constant, and the total demand shifts negatively (the cost indices increase), the price level will decrease (*PIPTA*). Similarly – a price increase can be linked to a higher demand, and a higher demand implies lower costs per passenger (*CI*).

FINCRIS influences the prices remarkably in model 1, with a high $\hat{\beta}$. The global financial crisis occured right after a huge oil price fall during spring and summer of 2008. For the airlines, this reduced costs considerably, which gave an opportunity to increase the capacity (Samferdsel, 2008). When the crisis occurred, the capacity of the services exceeded the demand considerably. The decrease of demand would suggest, as with the cost indices, lower prices. However, this *can* be a sign of cooperative pricing between the airlines – with the cooperation agreement done implicitly. Knowing that the decreased demand, due to macroeconomic factors, affected both SAS and NAS, may have been an incentive to use this strategy. The airlines had difficulties inducing an increase in the total demand, and for the firms to get through the crisis without a major loss, keeping the existing customers over fighting for new may have been the strategy.

It is worth noticing that the results in 3.5 must be evaluated with caution because of the different magnitudes of the variables. The cost indices ranges from 100 +/- and the dummies $\in [0,1]$, and to be able to compare we should divide the dummies by 100. This gives the coefficients $\hat{\beta}_{FFP} = -0.073$ and $\hat{\beta}_{FINCRIS} = 0.173$, and with fairly small standard deviations. This means that the cost indices in fact influences *PIPTA* the most, followed by *FINCRIS* and *FFP*, respectively.

The included variable *DIFF.CI.JF* in model 2 is not significant, and has a higher standard error. R^2 is smaller, and the *FFP* variable is less significant. The model after all passes all tests, but intlation adjustment *CI.JF* seems to be more suitable in the model, suggesting that the inflation rate is an underlying trend both for price (*PIPTA*) and costs.

Including *X12.LF* in model 2 gives a high R^2 of 0.270, and the other coefficients remain at about the same level. *X12.LF* is only within the 10% significance range, and seems to influence the response variable at about the same level as the cost indices. The negative coefficient of the *LF* looks reasonable: we would expect higher utilization and lower prices to be correlated. The causality of the price and utilization is however not clear. This result can also be understood as a *consequence* for the airlines, that higher competition on price makes it necessary to utilize the resources fully. Nevertheless, *LF* has a slightly higher standard deviation of $\hat{\beta}_{LF}$ than the other variables, suggesting that there is uncertainty regarding this variable. The RESET test is rejected in this model, suggesting omitted variable bias, and the distribution of the residuals is somewhat further from the normal distribution than the general model. The rejection of RESET can suggest that the value of $\hat{\beta}_{LF}$ is somewhat overstated, and that this variable also accounts for another underlying variable. A longer distance from the normal distribution suggests that the errors of the model is not consistent over the full range of the response variable *PIPTA*. *LF* is, similarly as the cost indices, based on passenger data. It is likely that this could be an underlying common factor of these variables.

Model 4 includes the macrovariables *IR*, *UR* and *RW*, and shows the highest R^2 of all the models included (0.325). This doesn't automatically mean a good model, as the VIF test shows very clear signs of multicollinearity – intercorrelations between the variables. The high R^2 can be explained a result of overfitting the model by adding more variables. *IR* is within the 10% significance level, but also a high standard deviation. *FFP* and the cost indices are all evaluated as statistically insignificant in this model. The hypothesis of the relation between *IR*, *UR*, *RW* and *FINCRIS* seems to have reliability. A general suggestion in MLR is to avoid using more indicators of same type. These variables are all describing the economic cycle, and the dummy *FINCRIS* may be covering them all.

The non de-seasonalized *CI.PE.DEFL* in model 5 obtains a lower $\hat{\beta}$, but with a lower standard deviation than the general model, and is within p<0.05. The model generates a marginally smaller R^2 than the model 1 (0.246), but in return most of the variables shows a lower standard deviation. This model shows that the seasonality of *CI.PE* doesn't influence the model much, but including *X12.CI.PE.DEFL* results in a slightly better statistically fitted model than *CI.PE.DEFL*.

Model 6 includes the dummy variable *PASSFEE*, and there doesn't seem to be a significant shift of prices in *PIPTA* after the introduction of this fee. This is a surprise, because a 80NOK fee should intuitively affect the price level remarkably. The variable shows a very small and negative $\hat{\beta}_{PASSFEE}$ (lower than $\hat{\beta}_{FFP}$), and with a high relative standard deviation. Surprisingly, the negative $\hat{\beta}_{PASSFEE}$ indicates a *lower PIPTA* after the introduction of the fee. R^2 is also here higher than the general model (0.262), but the RESET test is clearly rejected within p<0.01. As model 3, the residual plot for model 6 shows more deviation from the normal plot than the other models. Intuition would clearly suggest that this variable should have had a positive and clearly significant $\hat{\beta}_{PASSFEE}$ – resulting in a rise of *PIPTA* after the introduction. However, there may be many factors overseen in this analysis. Politics is often a question of where and from whom to extract the money from, and which signals to send by doing this. While introducing the passenger fee, aiming and signalling to reach the pockets of the passengers, there could have been other taxes or fees reduced for the airlines – in total resulting in no cost changes, or even a reduction. If not initiated by the government, the airlines themselves could have begun reducing their costs to adjust for the *PASSFEE*. There are many ways of achieving this; taking charge for previous free goods or services, overbooking of flights or automation of tasks that previously required manual labour.

The rejection of RESET in model 7 (removal of *FFP*) can in fact seem very intuitive. Also, a great change of $\hat{\beta}$'s for the cost indices may show that these account for the omission of *FFP* in model 7. R^2 is quite lower than the general model (0.190), suggesting a poorer fit. In contrast to model 3 and 6, model 7 has the best fit in the residual plot, inducing that the *FFP* is contributing to some deviation.

Through this sensitivity analysis we can see that the models change pulling in and pushing out variables, but the signs and magnitude of the coefficients seems surprisingly stable, with the core variable coefficients from model 1 staying very consistent through all the regressions. I found that the general model was the best prediction, very equalized with model 5. The other models have some limitations, braking some of the basic assumptions to be able to interpret results from a regression analysis statistically.

3.4.2 Statistic and Economic Significance of the Models

Now that each model is evaluated statistically, then the real question appears – what the economic significance of the models are.

Causality is an important topic when coming to the interpretation of correlational studies. How can one be sure that the independent variables describe the dependent variable, and not the other way around? When it comes to the macroeconomic variables, this is unquestionable. The domestic air ticket prices do not have the power (at least not a noticeable one) to influence the overall inflation of a country, the resurrection of a global financial crisis or the overall interest rates, real wage rate or unemployment rates. In the case of *FFP*, the general ticket price level *can* have lead to the decision of a re-introduction of FFPs in the market, but after this point, the causality must be explained the other way around – that the presence of *FFP* influence the prices. Considering *CI.JF*, this variable is also mostly influenced by macroeconomic factors, suggesting that the causality goes one way from the jet fuel costs to the ticket prices. But – nothing without an exception. In times of low ticket prices, the airlines may reduce their jet fuel costs, either by utilizing the capacity on their flights by selling more tickets, or reduce the overall capacity. *CI.PE* may show the same story. The price level cannot influence wage rates for the personnel, as this is more influenced by general wage rates and unions. But the price level can influence the efficiency of each employee. This analysis suggests that most variables possibly has a one-way causality, while we can't exclude the hypothesis that the cost indices have a more dynamic relationship with causality both ways.

Another question to ask is the whether there is a misspecification of the model, typically an over- or under specification. The problem in this regression would rather be under specification, as the dynamic price setting of ticket prices undoubtedly has many other factors contributing.

The model provided in this analysis brings factors I mean possibly contribute the most to *PIPTA*, but chances are high that they only serve a small picture – seen clearly by R^2. It could also be misspecification in terms of including variables that are not relevant, but through the sensitivity analysis I've concluded that the variables in model 1 seems like significant indicators for the price level.

The time series used for the regressions do also contain a lot of imperfections, to a high degree influencing the validity of the final results. First, *PIPTA* has a limitation already in the scope of the variable. It focuses on a sample of selected domestic and international flights, and it is impossible to clean the set to consider only domestic prices. The points in time of data gathering is not continuous, leading to a lack of important information to the index. A larger market than desired is also covered by the cost indices. The financial statements provide information regarding the whole operation of the airlines, and are not differencing in the international and domestic segment. Also to mention, the jet fuel and payroll expenses included are only a fraction of the costs experienced by the company, estimated in this analysis to be the costs of most variation and influence. The calculation of the indices contains many sources to imperfections: the linear interpolation of quarterly data, use of interpolated (from yearly to monthly) market shares, calculation methods to transform the costs to indices and further transformation of the series leads to more imperfection sources. The dummy variables, formed as binary variables, have few sources of imperfections. The question here is rather if they should have been defined quantitatively as opposed to qualitatively. Imperfections in the time series can lead to regression results difficult to interpret, but the general signs and relations between the variables may be somewhat right. Thus, the magnitude of the coefficients, standard deviations and the R^2 contains errors due to imperfections, so the actual numbers should not be interpreted literally.

The models show statistical significance, that the independent variables included may describe about 25% of changes in *PIPTA*. In a MLR, this could be completely due to spurious regression if not having good arguments for the variables to be connected. I see a high chance of the variables being connected, that the selected explanatory variables must explain part of the price fluctuations. The matter of discussion is how much to trust the magnitude and signs of the coefficients, due to a long chain of imperfections in the data sets. The sensitivity analysis showed that the signs of $\hat{\beta}$ and their relative magnitude were incredibly constant through model 1-7, with small variations. This suggests some sort of robustness in the variable selection, and their relative performances on *PIPTA*. From this I suggest that, their relative influence and signs on the response variable can in the best case *indicate* how the variables interact in a price setting process.

3.4.3 The Interpretation of the Models on the Norwegian Domestic Airline Market

Here I want to use the regression models as a starting point to evaluate how they can *indicate* the state of the competition environment in the Norwegian domestic airline market. The first idea to notice is that the financial crisis seems to have influenced the ticket prices to increase fairly significant through all models. This is a macroeconomic variable, not in the power of the airlines. Macroeconomic tendencies in this model seems to influence the competition environment significantly. It doesn't hit like a surprise that the economy and future outlooks have the power to influence the demand. The airline business may be one of the first markets to be hit, as flying for many passengers are seen as an extra and unnecessary bonus, only to pursue in times of good economy. Including the business travel as well, when the economy moves into a recession, companies must re-prioritize their budgets, and excessive business travelling may be restricted. Restrictive behaviour by both leisure and business travellers resulting in lower demand, and especially right after an economic peak where the outlooks were bright and the airlines enlarged their capacity, instinctively must influence the prices set by the airlines. Following the law of supply and demand, the coefficient of *FINCRIS* should have been negative to secure passenger income. But, as previously mentioned, this can be a result of a cooperative strategy. Knowing that the whole market suffer the same decline in passengers, all the airlines may have chosen to increase prices. I want to emphasize again that the MLR only in best case can show indicators of how the market works, and that there are no other evidence of cooperative pricing than this model.

The general negative indication of the cost indices seems counterintuitive to interpret, but when adding that these are per passenger indices, the law of supply and demand is interpretable. If the total demand shifts negatively (increase of *CI*), the price level will decrease (*PIPTA*), while a price increase can be linked to a higher demand and lower costs per passenger (*CI*). If the increase of the cost indices are due to rise of actual costs while the demand remains constant, then a theory behind this could be a strategy including that, under periods of high costs, the airlines are better off trying to *sell out their tickets*, compared to keeping the prices high and lowering the demand. The alternative cost of empty seats is much more expensive. Then, when the costs are yet again decreasing, the airlines have the possibility to fill in the loss gap, increasing the prices.

The presence of FFPs do not, in this analysis, appear to indicate a dampening on the price competition in the Norwegian airline market, but rather the opposite. A negative and significant $\hat{\beta}_{FFP}$ of a quite small magnitude is the trend through all the regression models. This can be understood as an increased price competition, shifting the general price level down after the re-introduction of FFPs in 2013. It is not said, however, that the increased price competition is *due to* the FFPs. The only indication to retreive from this, is that after 2013, *PIPTA* has shifted negatively, obtaining a lower general price level. This indicates a harder competition towards the margins in the airline market. The shift has happened after the re-introduction of the FFPs, but the programs do not necessarily contribute to this shift. From the MLR we can only conclude the following: after the re-introduction of the frequent flyer programs, the price competition has tightened, so the price competition in the market has *not* dampened after 2013.

Chapter 4

Conclusion

There is a general agreement regarding the anti-competitive consequences of loyalty programs in the theoretical and empirical studies, with a few studies implying a pro-competitive effect. The anti-competitive consequences are described to be a dampening of the price competition, locking the customers into one company. Typical pro-competitive arguments are the improvement of customer data and targeted marketing, and an increase of price competition. In this thesis, I have not been able to investigate the magnitude of each of the problems suggested, but I view the price level as a good indicator of the competitive environment in the Norwegian domestic airline market.

Due to the MLR, the competition in the Norwegian domestic market doesn't show any indicators of being dampened after the inclusion of FFPs in 2013. Instead, it suggests that FFP has lead to a decrease in price level after the re-introduction in 2013. The regression analysis indicates that there are several factors contributing more to the price level than FFP, like jet fuel and payroll expenses of the airlines and the financial crisis. The changes in demand do also seem to have a significant effect, following the law of supply and demand.

There are several factors that may cause implications interpreting the results from the analysis. A major limitation is skewed data sets. One example of this is the *PIPTA*, which covers a broader market than desired. Another potential limitation is the lack of data sets, non-published material. The airlines are holding price data to themselves, which would be useful in this analysis. There may be unknown variables influencing PIPTA that I am unaware of. An additional implication is the inaccuracies from the data processing (e.g. trend adjustments and the creation of cost indices). The MLR method is limited, assuming linear relationships between the variables. Finally, the interpretation of the results could be afflicted by cognitive biases.

For further study I would firstly suggest improving the quantitative method that I´ve used. This can include obtaining more correct data, to validate if the results obtained in this analysis can be confirmed. Secondly, designing a qualitative study, aiming for the preferences of the consumer, may improve the results. The qualitative study could outline more specific behavioural outcomes from frequent flyer programs.

Appendix A

Acronyms

APL Average Productivity per Labour

AVC Average Variable Cost

CI Cost Index

DEFL Inflation Adjusted Time Series

DIFF Differenciated Time Series

EB SAS EuroBonus

FFP Frequent Flyer Programme

IR Interest Rate

JF Jet Fuel

LCC Low-Cost Carrier

LF Load Factor (Revenue Passenger Kilometers / Available Seat Kilometers)

MLR Multiple Linear Regression

NAS Norwegian Air Shuttle

OLS Ordinary Least Squares

PE Payroll Expense

PI Consumer Price Index

PIPTA Consumer Price Index for Passenger Transport by Air

RW Real Wage Rate

SAS Scandinavian Airlines

UR Unemployment Rate

X12 X-12-ARIMA Seasonal Adjustment

Appendix B

Time Series Plots

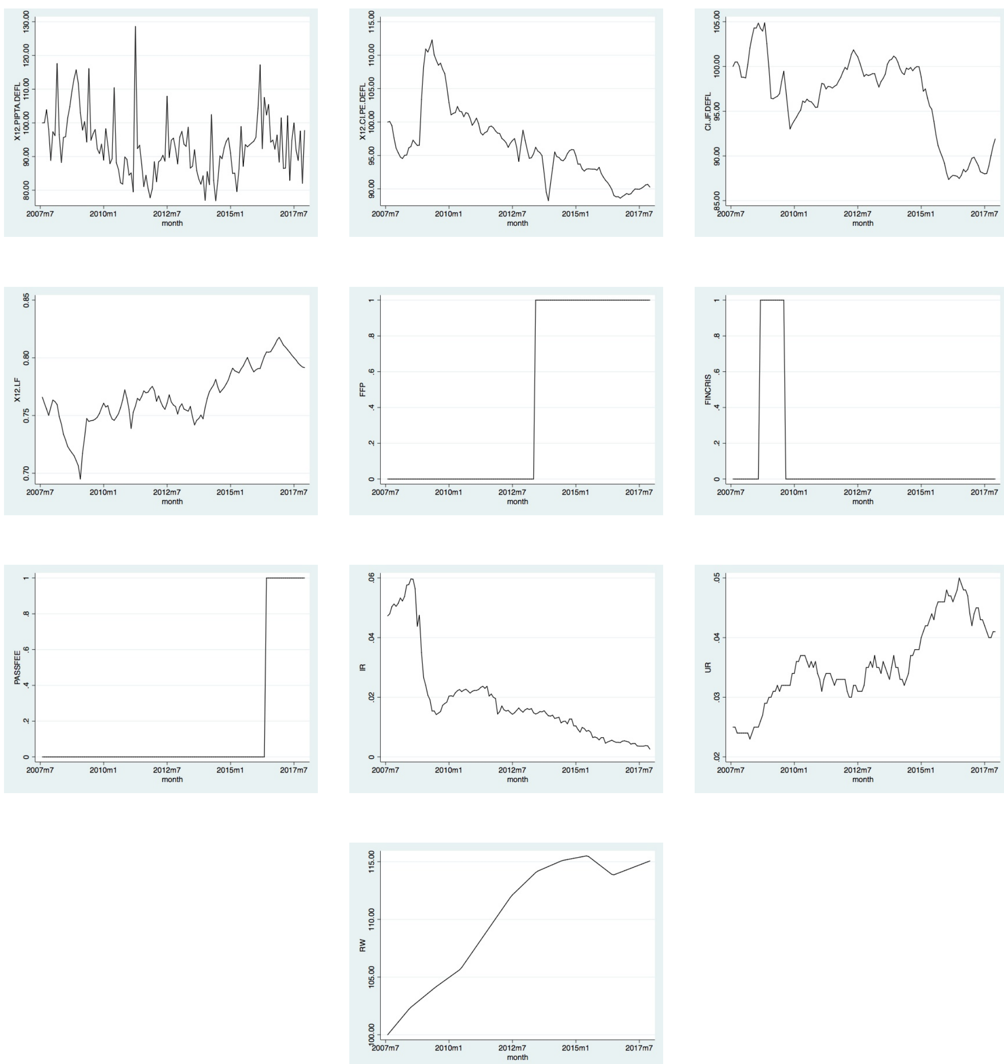


Figure B.1: Plots of selected time series

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