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LOG950 Logistics

Investigating air transports effect on regional economic development, in a Norwegian context.

André Ree

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Preface

This thesis is written as a final and mandatory part of the Master of Science in Logistics program at Molde University College. The thesis is written in the period January-May 2016, and has been conducted under the supervision of Professor Svein Bråthen from Molde University College.

I would like to express my gratitude to Professor Svein Bråthen for all the help he has provided during the development phase of the thesis, as well as his help with the formation of the questionnaires. I have greatly appreciated the Professors constructive feedback throughout the writing phase, as well as his willingness to provide me with the resources I needed.

In addition, I would like to thank the firms who took their time to answer my questionnaire, and express my deepest Gratitude to Sogn Regionråd, Luster Sparebank, Molde Næringsforum and Ålesund Næringsforening, for their willingness to distribute the survey.

At last, I owe thanks to my wife Åse, who have tried her best not to be effected by my long days of studying and my general lack of mental presence these last six months.

Molde, May 2016.

André Ree

Abstract

The purpose of this thesis is to study the effects air transport have on regional economic development, in a Norwegian context. The thesis consist of three analyzes, all with the intent to determine if, how and why these effects occur, and what relevance they have for economic development in rural and remote locations.

The thesis shows that there is a relationship between air transport and economic development, in addition there are indications that air transport will effect different sized economies in different manners. Furthermore, there are indications that these effects would occur in the long and/or short run for a set of Norwegian airports. In addition, the thesis quantifies the employment effect generated from air transport, these results indicate that with a 10 percent increase in passenger volumes, one could assume that employment would increase by 0,9 and 1,2 percent. Similar results are shown in service sector employment. These types of econometric analyzes have to this authors knowledge not been conducted in a Norwegian context before, and the results should be of great interest for the stakeholders and legislators invested in Norwegian air transport.

The effects shown in this thesis indicate that the supply of air transport in a region will generate employment effects and increased productivity. For a region the increased accessibility air transport creates, serve as a tool to attract qualified people to the local industry, and further develop this industry thru knowledge sharing facilitated by the presence of air transport. In addition, the results of the thesis serve as a confirmation, that the government’s goals of ensuring activity in the peripheral is met.

In addition to the economic effects generated at the aggregated level, the thesis presents results of a survey conducted in the Sogndal region. This survey does not represent the population in a sufficient manner, and is therefore not applicable to determine how air transport effects the Sogndal region. However, the survey provides results which indicate that the airport facilitates increased collaboration, and that it has an importance for the firms market activities.

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PART I

1.0 Introduction

The Norwegian economy have developed from being an agriculture and fishing economy, into a globally competitive technically advanced economy. The country is a world leader within, among other things, deep-sea drilling, fish farming and development of advanced offshore vessels. Many of these prosperous industries have their origin, and is still located in rural locations in the country. A willingness to adapt when factors have changed in these rural regions, combined with policies and a government that ensures equal living conditions, have made some of these regions into global or national centers of expertise. The Norwegian Government have a spoken goal of letting people live were they choose, and to ensure equal living conditions in remote regions as in city regions. To ensure these goals, transport infrastructure plays an important role. However, the topography and the length of the country makes infrastructure expensive to build, in addition the travel times by rail or car are often insufficient. Therefore, the government focused on developing airport infrastructure in the late sixties, this resulted in the development of what is referred to as the STOL[1] network. Today, these airports as well as medium sized airports works as facilitators to ensure activity in the rural regions of the country, and the presence of an airport might have been a key factor for the prosperous industries in the country. In this thesis, I want to shed a light on the importance of air transport in the Norwegian rural and remote regions. The thesis consists of three types of analyzes, two of these are quite unique in a Norwegian context, and have to this authors knowledge never been performed on a Norwegian study.

1.1 Research problem and research questions

Initially this study aimed to see whether industry structure mattered for the catalytic effects of air transport, the idea was to conduct surveys in two regions and apply the results in a discussion on how and why industry structures where affected differently from air transport. However, due to low response rate on these questionnaires the thesis and methodology was changed during the Easter break. When doing the initial literature review, I found it interesting that the works of several authors where based on an assumption that air transport would affect regional economic growth. So when I stumbled upon the study of Baker, Merkert, and Kamruzzaman (2015) I was convinced, I want to

[1] Short take-off and landing airports. 800 – 1100 metere runways.

see whether I could use Norwegian data to show that there is a relationship between air transport and economic growth . In addition, I wanted to see whether this relationship was different for the types of airports, we have in the country.

The general research problem of this thesis is to identify the effects air transport has on regional economic development in Norway, and with a special emphasis on small rural regions. This thesis applies the econometric models from several published authors, on a Norwegian context. In addition, a survey analysis conducted in the Sogndal region is presented. I will seek to answer the research questions presented in this chapter thru the use of these econometric models as well as the survey analysis, which research question that is answered using what method can be seen in Figure 1. In addition, I will try to apply the results in a case study conducted on the Sogndal Region in chapter 7.0.

Mukkala and Tervo (2013), tested a panel of European airports to find possible causal development between airports and economic development. The authors found that there was a bidirectional Granger causality[2] between airports and variables representing economic growth. In addition, the authors found that this causality was heterogeneous, which means that the causality was different between peripheral and central regions. Furthermore, the authors showed that the causal relationship was strongest in the peripheral. In this thesis, I therefore ask the two following questions;

RQ 1 *Is there a relationship between regional air transport and regional economic growth in Norway?*

RQ1.1 *How does the relationship differ among airport types and economic size?*

Baker, Merkert, and Kamruzzaman (2015), found that there exists a bidirectional long and short run Granger causality between air transport and economic growth in Australian Rural and regional airport regions. While Yu et al. (2012) found that the underdeveloped and rural areas of China would not see economic growth from the investment in Air Transport. I therefore ask the following research question;

[2] The concept of Granger causality is presented and discussed in chapter 3.3.1

RQ 2 *Are there indications of Long and Short run Granger causality between air transport and economic growth in Norway?*

Several studies has been conducted using econometric models and surveys to quantify the relationship between air transport and economic growth. Initially I wanted to use a case specific survey to investigate research questions 3-6, however due the limitations and complications with the survey method, I seek answers in both a survey and through econometric modelling.

Several studies have shown that there are links between airports and economic development in Norway (e.g. Halpern and Bråthen 2010, InterVistas 2015, Lian et al. 2005). Moreover, Green (2007) found that passenger boarding's and passenger originations in metropolitan US airports where powerful predictors for economic growth. Similar findings are shown in Brueckner (2003) and Percoco (2010), both these authors found that airport passengers are a strong predictor on employment level, in addition these authors found that service employment where more affected by passenger growth than other employment. I therefore ask the following two questions:

RQ 3 *Do airports create catalytic employment in a region?*

RQ 3.1 *Will service employment be more dependent on air transport?*

Bråthen, Johansen, and Lian (2006) found indications that a regions industry structure will affect the size of the airports catalytic effects. The authors indicated that in a Norwegian case, airports employment effects are smaller when it comes to direct, indirect and induced effects than international studies, while the airports seem to cause a larger catalytic effect. I will test this both econometrically and by a case specific survey, because an econometric analysis can only indicate how certain industries are effected at a generalized level. I ask the following research question:

RQ 4 *Does the industrial structure of a region matter for the airports effects?*

From new economic geography, it is suggested that transport links between regions will encourage investments in the peripheral or the city region. Air transport is a tool that facilitates sufficient transport solution for the peripheral, and which lowers the total transport costs of its users, on long journeys. I wrote that Bråthen, Johansen, and Lian (2006) found indications that industry structure may matter for the airports catalytic effects, while (InterVistas 2015, Lian et al. 2005, Lian, Thune-Larsen, and Rønnevik 2008, Oxford-Economics 2011) all state that the existence of an airport may encourage investments in a region. I therefore ask the following two questions:

RQ 5 *Will the presence of air transport encourage investments in a region?*

RQ 6 *Do air transport facilitate collaboration among firms?*

1.2 Limitations of the study

The study was intended to focus on catalytic effects from air transport on regional industrial structures, much work was put in to creating a well formed questionnaire and study literature related to industry structure. Unfortunately, this approach did not work out, due to a low response rate on the surveys. I therefore had to salvage the thesis by changing methodology and some of the theory applied. Because of this, the models used in the study are to some extent based on models conducted in published articles on similar topics, rather than self-developed. Nevertheless, the models are adapted for a Norwegian context and I am able to find indications that air transport supply matters for regional economic development. Furthermore, the econometric models do not account for air cargo, this surely is a limitation since air cargo might be of great importance for many manufacturers in Norwegian regions, I do address this to some extent in the survey, but the low response rate does not let me apply these numbers in a conclusion. Moreover, I do not include ambulance flights in this study, these might be of great importance for many regions, and investigating their social economic effects would be rewarding and interesting future research. Additional limitations are discussed throughout the thesis, and I have tried to have a critical view through the entire process of working with the thesis.

1.3 Thesis structure

For simplicity, I have structured the thesis into three parts. The first part is where I create the theoretical foundation for the thesis. Here I present and discuss New economic geography in chapter 2.1, the structure of Norwegian air transport in chapter 2.2. Furthermore, the theory on economic effect from air transport is presented in chapter 2.3 and a literature review on relevant previous research on air transport as a facilitator for economic growth is conducted in chapter 2.4. PART I is eventually rounded up with a methodology section in chapter 3.0, where I present the formal structure of my econometric models, in addition to the methodology literature on survey design and case studies.

In PART II of the study, I will present the results of the analyzes conducted and try to answer the relevant research questions for each analysis. Furthermore, I will try to rationalize why we get these results and seek to explain their meaning in the light of new economic geography. In PART III, I will try to apply the results from the analyzes in a case study on Sogndal Airport. In addition to giving a summary of the thesis and recommendations for future research. The structure of the thesis is illustrated in Figure 1.

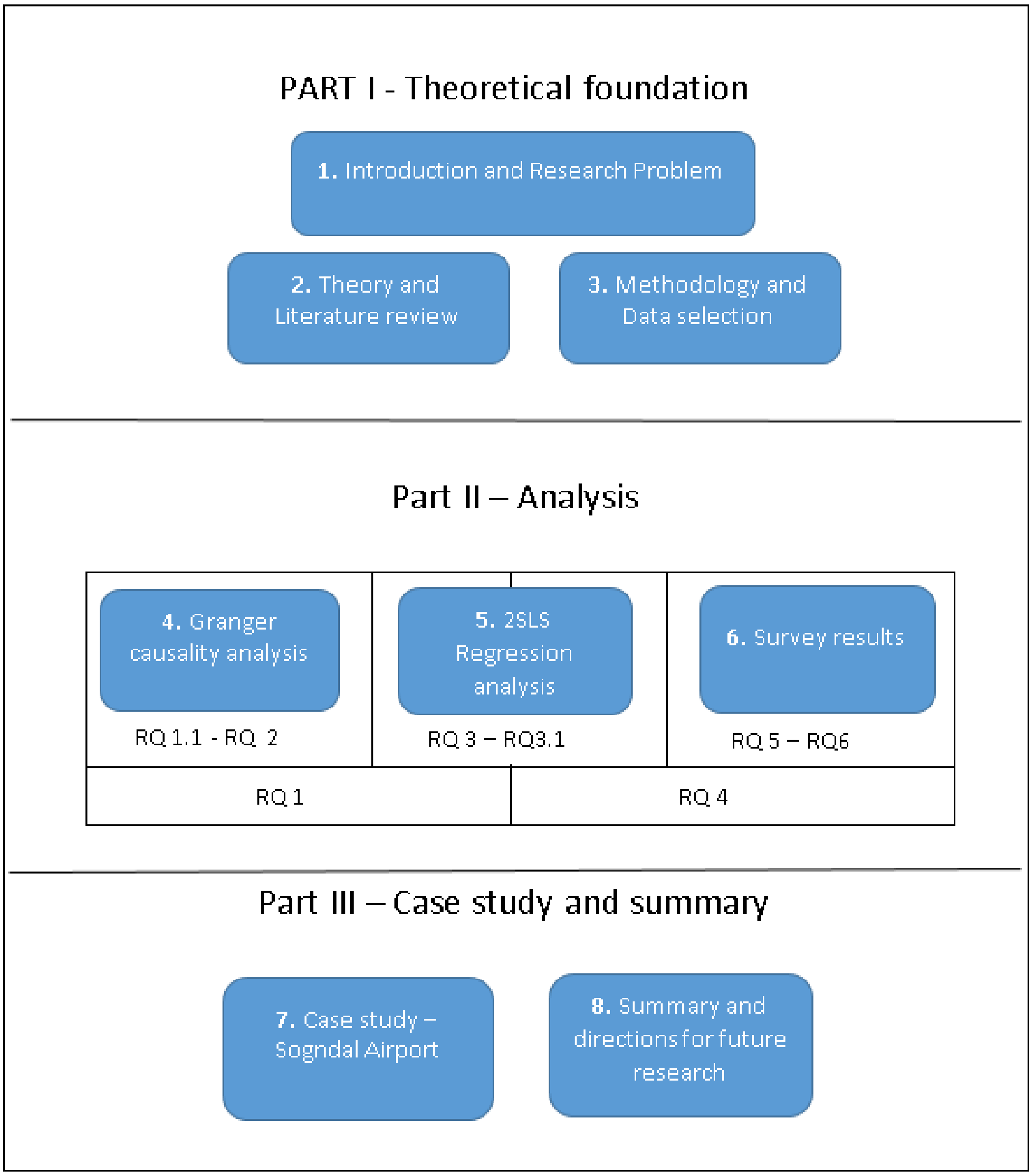

Figure 1,The structure of the thesis. Source: Own work

2.0 Theory and literature review

In this chapter, I will present and discuss theory which are relevant to both answer and understand the research problem and questions. The chapter starts by introducing the new economic geography (NEG) theory, whit which the aim is to understand how and why firms locate where they do, and what role transport in general and especially air transport might play in this location decision. Furthermore, I introduce the Norwegian air transport market, and discuss certain characteristics and aspects effecting demand for air transport as well as the factors affecting airports location to some degree. In addition, I will define the catchment areas of all Norwegian airports. The study continues with theory on airports and economic development, the idea here is that air transport will affect its regional catchment areas economic development in different orders. One example frequently used throughout this thesis, is that airports facilitate employment, these employment effects are split into four orders, direct, indirect, induced and catalytic employment. At the end of the chapter, I will review previous research which is relevant to the development of my analyzes, in addition to providing me with previous findings on the topic.

2.1 New economic geography

New economic geography (NEG) represents a branch of spatial economics, it aims to explain the formation of a large variety of economic agglomeration in geographical space, using a general equilibrium framework (Fujita and Mori 2005). The birth of this new wave of theoretical and empirical work came with Paul Krugman's article "increasing returns and economic geography" in 1990, the author introduced a simple model explaining why and when manufacturing become concentrated in a few regions. Krugman (1991), showed how the balance between production in cities and peripheral would differ at certain levels of transport cost. Fujita and Mori (2005), sums up the four key terms of NEG in a briefly manner. The first is the general equilibrium model, the second is presence of increasing returns, the third is transport costs and the final term is the location movement.

This chapter will continue with a presentation and discussion on the important role of transport on spatial economic development in chapter 2.1.1, furthermore in chapter 2.1.2 I will discuss agglomeration and transport costs effects on vertical linkages between firms. While in chapter 2.1.3 a discussion on the Norwegian economic development in the light of NEG will be presented. However, before we continue I will present and discuss the forces affecting geographical concentration, namely the Centripetal and Centrifugal forces of NEG.

The forces that promote and oppose geographical concentration are listed in Table 1, the centripetal forces are the three Marshallian forces of external economy (Krugman 1998), while the centrifugal forces in the table are the less standard but opposing factor forces presented in Krugman (1998). The idea of these forces is that they work as key factors affecting a firm's location decision, either it is a new or existing firm. In new economic geography these forces are used to explain why a firm would choose to locate in a city or in the peripheral.

Centripetal forces	Centrifugal forces
Market-size effects (linkages)	Immobile factors (sedentary resources)
Thick labor markets (specialized workers)	Land rents (lower in the periphery)
Pure external economies (Knowledge spillover)	Pure external diseconomies (Congestion)

Table 1, Forces effecting geographical concentration. Source: Krugman (1998)

The benefits of cities and large economic regions are shown in the left column of table 1, the market size effects may be crucial for a company faced with economies of scale, or for a producer of intermediate products which may save costs by clustering close to its downstream customer. The presence of thick labor markets might attract technologically advanced production as well as financial services, since there is a better chance of finding the right qualifications here. Then at last, the possibilities of information spillover between the companies in the city, might be important for technically advanced firms, this factor is a pure external spillover. All of these factors creates an employment and employer market, which attracts people and knowledge, this will in time increase the cities real wage as opposed to that in the periphery.

However, not all firms locate in the city regions. This may be explained by the Centrifugal forces according to Krugman (1998). First of all, a factor which has been important in the Norwegian economy and is an explaining factor for much of the regional dispersion the country have to this date, the sedentary resources. These are place bound resources, such as natural resources and farm-land. However, they may also represent local knowledge and culture, which is not easily attracted to the more prospers city region. Furthermore, there is the fact that for low-intensive non-specialized production, the land-rents in the city might be higher than the transport cost from the periphery, therefore the company might be better off in the remote region. Finally yet as importantly, the diseconomies of congestion in a city would be off putting on workers, who would put a higher price on the non-congested remote region than the potential real wage increase in the congested city.

2.1.1 Transportation and regional development

We will continue this chapter with presenting some literature on new economic geography related to how transportation effects regional development. However, first let us consider the three underlying conditions for transport investments leading to economic development, proposed by Banister and Berechman (2001).

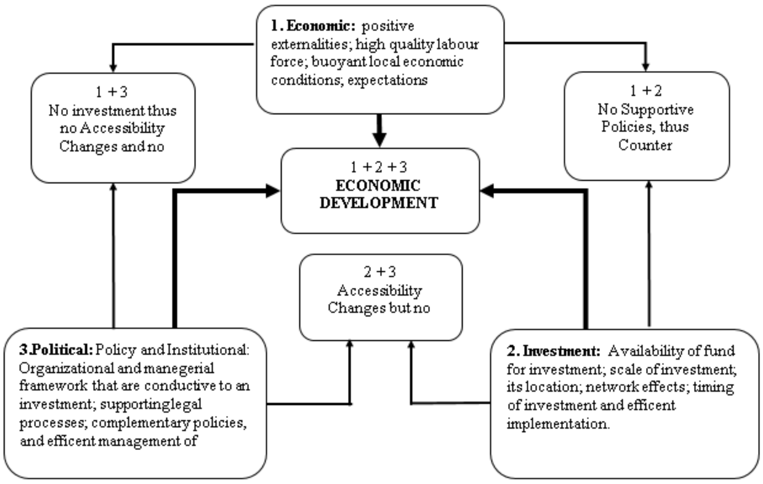

Figure 2, Conditions for transport investments and economic development. Source:Banister and Berechman (2001)

Figure 2, works as an illustration of how transport investment might lead to economic development. If this is to happen, three underlying conditions need to be fulfilled. The first set of conditions are the presence of underlying economic externalities according to Banister and Berechman (2001), such externalities are linked with the agglomeration effects which are considered to a large degree in this subchapter on NEG. These positive externalities may be seen as the centripetal forces, and to some degree the centrifugal forces. Furthermore, the investment conditions are according to Banister and Berechman (2001), linked with the timing of and the location of the investment. These investment conditions are not considered in this thesis, it does however play an important role when considering investment opportunity in a network of already developed infrastructure. The last condition is related to the political factors, these should be considered since they will facilitate the environment in which the investment are done. The political factors are to some degree considered in NEG theory, in addition Fujita and Mori (1996) considered how the location of transport infrastructure might affect agglomeration and regional development.

The mobility of firms and workers plays a crucial role in economic geography, Krugman (1990) showed that in the case of high-transport cost there would be little interregional trade, and workers would be located in their region of origin. However, whit low transport cots, trade from the region would increase wages in the largest regions because of its home market advantage, thereby leading to one of three scenarios (equilibriums). Productions stays the same (unstable equilibrium), some production in one region while more in the other, or the higher real wages and the centripetal forces of the largest region would attract all manufacturers and the second region would become a periphery dominated by agriculture.

Fujita and Mori (1996), investigates the development of port cities using the NEG approach of spatial economic development. Their study aims to explain why many of the important cities of the world economy are at port sites (or linked by waterways), however their study and the developed model may also be used for other transport infrastructure. The study uses a two-region model where one of the regions have a city while the other region is an agricultural periphery, the two regions are divided by water. The authors find that depending on the combination of transport costs and distance from existing city to port site, we may see different results on the development of new cities. If the transport connection is poor (distance from original city to port is large, economic distance between ports are high), then we may never see a development of cities in the peripheral second region. However, if the transport link is good, a gradual development of cities in the peripheral region will take place, at either port site or inland (depending on transport costs). The authors further look at possible transport policies to facilitate such growth, the authors argue that infrastructure investment itself and patience will develop region 2 (this is their policy 1). However, they also propose a policy that increases the transport cost, so that the competition in the goods market in region two will be lower and hence manufacturers will develop here in order to serve this market cheaply. This will lead to the development of a city in the peripheral faster than the first policy.

Fujita and Mori (1997) shows that assuming the existence of a set of cities in the economy, these will have such strong lock in effects in the location space, which prevents the development of new cities and attracts all new manufacturing firms. The authors do however argue that as these cities grow, their hinterland will expand outwards and new cities will develop in the geographical frontiers as a result of increasing transport costs. This process will continue itself to a point where the distance between cities is sufficiently large. Fujita, Krugman, and Mori (1999), further develops this approach to a multiple-industry context, and study the central place hierarchy. The authors present a system where there exist several industries, for modelling purposes all characteristics except price-elasticities are kept equal. They show that when an economy reaches the critical level responding to industry 1's price-elasticity (highest elasticity), this firm will locate in the new city if it is at a critical distance in order to serve this market. The process continues with the second highest price-elastic industry, for all developing cities. In this way the authors show that a nation of different sized cities will develop, a nation will have several small cities with the first industry, some larger cities with the second and first industry and so on. This development of spatial economy is an interesting aspect, and it gives simple theoretical foundation, when addressing development of cities.

The examples above, shows the interplay between centripetal and centrifugal forces, and as we know the transportation costs is a key element in the balance between these forces. We saw that the development of regions and its industries historically might be a result of industries moving outwards in the peripheral to regions with a growing population, in order to serve these markets. This indicates that when transport costs are high, industries with low dependence on the city regions centripetal forces, and industries that is drawn by the centrifugal forces of the peripheral region, will locate closer to this new market. In other words, industries that are not dependent on place bound resources will in cases of high transport cost locate closer to the market. From Fujita and Mori (1996), we were introduced to the aspect that infrastructure (in the form of ports) might be a key element in the development of the peripheral. The authors showed how the infrastructure investment could be beneficial for the development of the peripheral areas. This infrastructure however, may have a two-way effect, where it instead of promoting growth in the peripheral region actually ends up increasing the city region. This is a result of transportation costs being too low, since when the transportation costs are low and the link is built, manufacturers will be drawn by the centripetal forces of the city. These forces will create a benefit, higher than the transportation cost of serving the remote peripheral. Fujita and Mori (1996) further showed how policies which increased transport cost would hinder the industries and promote city growth in the remote peripheral region. Such policies could be related to trade of goods in the form of tolls between countries.

Tabuchi and Thisse (2002), demonstrates the relationship between manufacturing industry share in a city region and transport costs, as a bell-shaped curve (similar to that in Figure 3). The authors write that the manufacturing industry will start as a dispersed industry, however as transport costs fall, the industries will agglomerate in to the city region. The centripetal forces which causes the agglomeration will after a while be lower than the centrifugal forces promoting growth in the peripheral. This combined with decreasing transport costs, will in turn make it favorable for manufacturing firms to locate in the peripheral because for the industry the centrifugal forces of the peripheral are now stronger than the centripetal forces of a city region. In this light the policies introduced in Fujita and Mori (1996) is interesting, we see that the market forces will act the way which is proposed in their first policy. However, there second policy of increasing the cost of transporting manufactured goods between two regions, might make the time-space of the bell shaped curve shorter, and governments will in this way be able to develop the peripheral at an earlier stage.

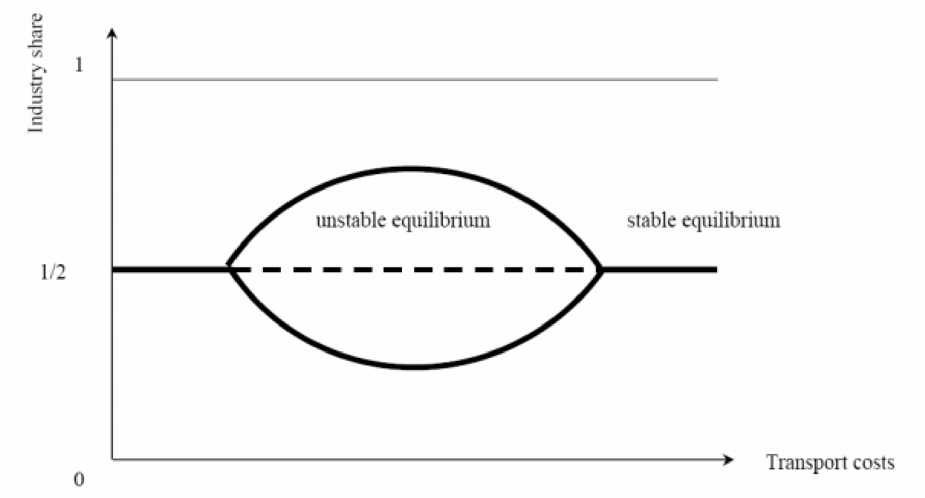

Figure 3, The bell shaped curve of spatial development. Source: (Palma et al. 2011, Chapter 4)

Studies showing the relevance of the NEG theory have been conducted, Fujita, Krugman, and Mori (1999) in addition to creating the model on hierarchical development, showed that the findings where similar to the historic development of the US geography. In addition Combes et al. (2011) find that the historical development of the French manufacturing industry follow the pattern of the bell shaped curve, where falling transport cost initially leads to a concentration of the manufacturing industry, seen in the second column of Figure 4. Then as transport costs continue falling, the manufacturers will find it more profitable to locate in the peripheral again, where the land rents are lower.

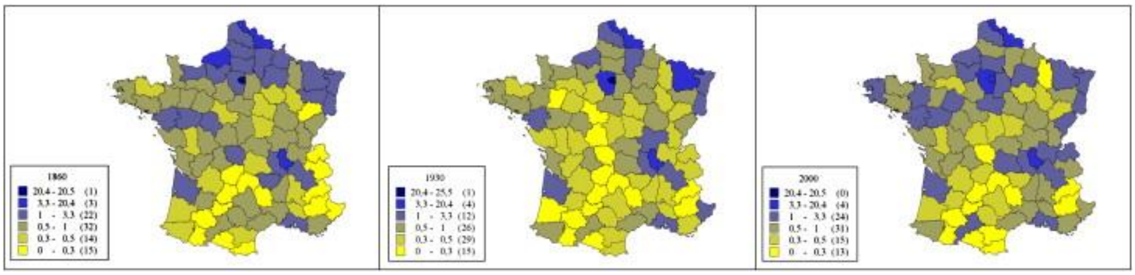

Figure 4, Value creation in the French manufacturing industry per region in France 1860-2000. Source: (Combes et al. 2011)

Furthermore Combes et al. (2011) found that the pattern of service sector and transport cost also followed the bell shaped curve in a similar manner as the manufacturing industry. However, the dispersion of this sectors spatial value adding is not as pronounced as that of the manufacturing industry.

2.1.2 The vertical linkages of firms

Venables (1996) Investigated the effects of agglomeration in a NEG manner on the linkages between firms and their intermediates. The author demonstrates how linkages between firms and their location decisions may be an equally important factor as the mobility of labor and firms (from the former chapter). The author found that giving the characteristics of the industries, those industries that are drawn by the centripetal forces would tend to agglomerate with a change in trade costs. While industries where the benefit of lower transport cost is weaker than the benefits of the centrifugal forces would not. The centripetal forces leading to agglomeration are similar to those we saw in the previous section, upstream suppliers have an incentive to locate where they have the largest market, and the downstream suppliers have an incentive to locate where their suppliers are located. These industries incentives create the agglomeration effects, which eventually may lead to clustering of firms in the same or related industries.

It should be noted that such clustering might be similar to the clusters discussed in literature descending from Michael Porters original cluster approach. In addition, there is no doubt that these vertical linkages give an explanation to why such world-leading industries does gather in geographically small areas. Victor Norman in Bergo et al. (1996), wrote that Michael Porters and his followers approach to clusters in spite of being different from that of Krugman and his descendants, reaches most of the same conclusions. Where Krugman would argue that completion is good, because it lowers the production costs for all domestic producers. Porter would argue that completion is good, because it would create an incentive to constantly innovate (Bergo et al. 1996). I will therefore continue this chapter with a brief review of what makes a cluster, such as those we know so well from Porter and his associates (e.g. Silicon Valley, California wine cluster, Italian leather cluster).

Clusters are local phenomes that often compete globally, a challenge with clusters are that the role of government changes through its lifecycle (Wolfe and Lucas 2005). Porter (2000) defines clusters as geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standard agencies, trade associations) in a particular field that compete but also cooperate. This indicates that, if an industry is able to attract both new companies to their region as well as including industry associated institutions, they will generate such high centripetal forces that a cluster will develop in the region. Venables (1996), demonstrates how companies location decisions are affected by transportation costs and access to market. When transport costs are low and a company can access the market from a single location, depending on the industry we might see clustering effects. Similarly Bergo et al. (1996) writes that the location decision results from a tradeoff between the total costs of the location, against the benefits of being close to the market. Bergo et al. (1996), has an interesting discussion related to the critical mass of a cluster, when transport costs are high the national cluster in a particular industry is protected and financially stable. However, as transport costs fall and international trade cuts in, intimidate companies and qualified people will disappear from the now less productive cluster. Which in turn may not be reversible, and diminishes the whole cluster.

Clusters stimulation and development have received much attention from the Norwegian government the last few years. In a document published by the parliament (Regeringen 2012), it is written that clusters are important for regional development and that the government will contribute financially and with research funds to the development of new industry clusters. From policy perspective, a challenge with clusters is that the role of government changes through its lifecycle (Wolfe and Lucas 2005). While for mature clusters frameworks and policies may be suitable, while in the early development stages there is a need of investing in strategic assets, research and infrastructure for instance, by public or private investment companies or local governments (Wolfe and Lucas 2005). If an industry cluster is determined to be important by the government, Bergo et al. (1996) proposes that investment in infrastructure should be considered as a tool to help strengthening the clusters competitiveness. Investments in infrastructure such as airports, ports or road links, will serve as a tool of attracting more related companies into the cluster region. By increasing the connectedness of the cluster thru infrastructure investments, governments will facilitate lower transport costs that lets the cluster access markets that are more distant. Furthermore such infrastructure as airports, will give international companies access to the cluster and might cause them to fully or partly locate in the region (Bergo et al. 1996).

Lakshmanan (2011), confirms that when transport costs are falling, a firm can reach a larger market from its location, and that this in turn might lead to clustering effect for certain industries. Lakshmanan (2011) links the presence of external economies of scale to clustering effects among firms, and propose that the positive externalities achieved in such clusters might lead to a regional specialization. The term regional specialization is closely linked with clustering, since it implies that an industry in a region is partly specialized, both the workers and the companies possess certain trade specific knowledge. In Norway much of the existing industry is a result of evolving specialization and knowledge in the local industry, however these industries cannot necessary be considered to be clusters. Sasson and Reve (2015) propose that investing in road infrastructure, which links such specialized regions together might cause clustering effects. The authors believe the industries will benefit from knowledge sharing and shared labor markets, which in turn will make both regions industries better off. However, these effects are heavily dependent on the industrial complementarity between the regions (Sasson and Reve 2015). In addition, it should be noted that if transport costs are low, all firms might agglomerate to the region with the largest labor market. Additionally, if transport costs are too high, we might not see any such effects from such infrastructure investments at all.

What we have seen in this sub-chapter is that vertical linkages between firms might also be a reason for agglomeration. From there we took a step into the cluster theory, to investigate how and why firms in certain industries tend to locate close to each other. As with the previous chapters regarding firm and labor mobility, centripetal and centrifugal forces effect linkages between firms and intermediate firms. If an industry sees large gains from the centripetal forces created when clustering together, they will cope with the possible negative effects of higher land rents for instance. These clusters will in turn agglomerate other firms in the same industry, and the clustered firms will gain competitive advantages from the effects created when being located closer together. Furthermore, this will create a higher productivity that leads to higher wages, which in turn attracts additional qualified personnel into the cluster. On the other hand, firms bound to sedentary resources for instance, will benefit from lower land rents outside the cluster.

2.1.3 Spatial economics in a Norwegian context

The coordinated-market economic model, which is practiced in Norway, is a model where the government is an important player in the industrial development (Abelsen, Isaksen, and Jakobsen 2013). Norway have developed from being an agriculture, mining and fishing economy, to being a world leader in technological development in several industries, as well as being one of the largest energy exporters in Europe. Despite Norway's dependence on sedentary resources, Fagerberg, Mowery, and Verspagen (2009) writes that also the political system and the ability to change within the industries, have contributed in creating the well-functioning and prosper regional industry the country have today.

As opposed to the centralization of industries during the industrial revolution in Europe, Norway's industry went thru a small-scale decentralized industrialization during the 19th century (Fagerberg, Mowery, and Verspagen 2009). An answer to why this decentralization of industrial activity took place might be found in NEG, as we have seen in the previous chapter, looking at the geographical structure and the topography of the country, one can imagine the high transportation costs between cities and peripheral regions. For this reason the development have continued in the manner shown in Fujita, Krugman, and Mori (1999), where small regional centers in the peripheral have become small cities, due to the transportation cost disadvantage of an agglomerated industry. In addition, maritime transportation has played a key role in the country historically, and might be the reason why most cities today is located at the sea side as proposed by Fujita and Mori (1996). The lack of a central core in the country may as well be a reason for the decentralized industry patterns we see today, in the US for instance central cities have become large industrial centers as transport costs declined (See, Fujita and Mori 1997). Many of the remote regions in the western-part of Norway, have developed their own centers of agglomerated activities (as opposed to the idea of few large cities), from being centers for fishing and agricultural activity in the old days, to being centers for specialized knowledge within boat traditional industries, and with time some of these centers have been internationally competitive.

It is worth noting that large (probably) agglomerated city regions do exist, especially in the southern and eastern parts of the country, where Oslo casts a large shadow in the east, Stavanger, Trondheim and Bergen surely does the same in their respective regions. These large city regions however, have not been able to attract all of the industry from the rural areas. These large cities and a few others surely does act as important national centers of trade and technological development, but the knowledge has been transferred outwards to the districts as well, which has led to a high share of value creating in the rural regions of the country. This indicates that transportation links between these large agglomerated national centers and the smaller agglomerated regional centers, has a positive effect on the distinctive settlement pattern that exists in the country. It is actually a spoken political goal from the Norwegian government to preserve this “distinctive settlement pattern of Norway” as well as offering people “the freedom to live wherever they choose” (Regjeringen 2015a). In addition the government wants to ensure equal living conditions and utilize human and natural resources to its fullest potential (Regjeringen 2015a). In order to ensure these goals, the Norwegian government have had much focus on regional development and stimulating regional growth. Such stimulation measurements are among other things investment in transportation infrastructure to ensure the communication between regions.

The Norwegian industry is dispersed, however it is also internationally competitive. The regional industries have been able to prosper and develop over time, and is often strongly related to the regions traditional industrial origin, and is therefore strongly influenced by local knowledge (Fagerberg, Mowery, and Verspagen 2009). These traditional industries are related to the sedentary resources in the region, such as agriculture, mining, forestry and fishing, in addition we may count local knowledge as a sedentary resource as well. The regional industry has been seen to adapt to changes in the economic environment quite well, some examples of this is the development of a maritime cluster in the north-west, and the technological advanced drilling industry in the south.

We find indications of how dispersed industrial structures are effected by transport links and costs in the NEG literature. Using the bell shaped curve in Figure 3, we may say that as transport costs where initially high, historically the industry developed in a dispersed manner. However, due to the topography and government policies, the large agglomeration effects towards national centers might not have been as strong as those seen in France (Combes et al. 2011) and the US (Fujita, Krugman, and Mori 1999, Fujita and Mori 1997). Because the main reason for the agglomeration activities shown in these studies, are that the centripetal forces of the agglomerated economy outweighs the cost of dispersed close-to-market effects. However, with falling transport costs, the geographical structure of the country prevents us from assuming such effects as those in the international studies. Nevertheless, one cannot state that agglomeration has not taken place, because the bell shaped curve is probably relevant for the regions around those cities, which today are major in the Norwegian industry. Following the pattern, as transport costs have kept falling the industries in the rural regions have prospered into national and internationally competitive producers of goods and services.

Central to the NEG is the centripetal and centrifugal forces from Table 1, it is safe to assume that these forces have interplayed in the Norwegian spatial economy and that they still effect industry structures in the economy. Venables (1996) Showed how agglomeration might be a result of vertical linked industries gaining from locating close to each other (clustering). In this way the centripetal forces of the economy will according to the author lead to a clustering of companies in the same industries and supply chain, because the centripetal forces of such a cluster will be so strong that they will attract all related companies. These centripetal forces are better linkages between firms, larger and more specialized workforce, and the process of knowledge sharing. However, it is worth noting that such clustering will only be seen in some industries, others will be spread out in the economy as we have seen from Fujita, Krugman, and Mori (1999). The reasoning for some industries or companies not to take place within these clusters are the centrifugal forces of sedentary resources, the advantage of lower land rents and the external diseconomies in a city region (e.g. congestion).

These clustered industries as well as those the non-clustered industries in both the rural and city regions, may be sensitive to changes in these forces. In the Norwegian context, an increase in transport costs between a highly specialized industry and its outside market, may in fact lead to a total redistribution of the regions industry to other more “central” locations. A large infrastructure improvement in a city, removing congestion, worsens the centrifugal power and may lead to higher agglomeration in that city. Effects may be seen in the other direction as well, for example building a link between a large city and hereby reducing costs of travel from the hinterland into the city may in fact make some producers take use of the lower land rents in the hinterland, and then workers will follow. This last example is in line with the Norwegian government’s goal of a dispersed industry. Therefore, we may state that funds spent on infrastructure improvements in the rural region and between regions might work as a tool to limit the draw from the centripetal forces of large city regions, on industrial structures in the rural regions of the country.

An example of such investment would be the short take-off and landing (STOL) airport network developed in the late sixties and early seventies, which may have led to an agglomeration of economic activities towards airport regions. In addition, the airports may play an important role in the competitive environments of the existing industries in rural regions. As we discussed previously many of these industries operate in a national and international market, which means that removing the airport may lead to a whole industry and its intermediates move away from the region, in favor of a more central location.

NEG also creates a logic around the idea that transport infrastructure, such as airports may in fact create employment. Because the airports existence will make the rural regions more attractive to new firms and workers according to the theory. These workers and firms will either agglomerate to the region because of higher real wages and productivity in their non-airport region (centripetal forces). Alternatively, they establish because of the attraction of the regions centrifugal forces. In either way, the airport will be a basis of economic activity and will be a tool in the development of regions.

2.2 Air transport in Norway

As we have seen from NEG, transport plays a crucial role in the development of rural areas in a country. Good transport links between cities and rural regions may work as a facilitator for firms locating outside of the city region, in order to take advantage of the centrifugal forces. Norway is a country with many small cities, and only one real metro area (Oslo region). Since the government wants to ensure activity in the rural regions, good transport links might work as a tool to facilitate this. Because of the topography and the length of the country, traditionally the economic development has occurred by the shore. In addition, fjords dominate much of the shore (especially in the western parts), which contributes to high investments costs in transport infrastructure between these regions. The presence of rail transport is low, and because of an undeveloped network travel times between the large cities are high, travelling by train often take as long as travelling by car. According to Hjorthol, Engebretsen, and Uteng (2014), car travel dominates in the country when it comes to long journeys. Next after car use, is air transport usage, which constituted a total of 28 % of all journeys over 100 km and 48 % of all travels over 300 km in 2013.

People who travel by air both domestically and internationally to and from Norwegian airports are according to Hjorthol, Engebretsen, and Uteng (2014) likely to have a high education, work more than 40 hours per week, have an income level over 500k NOK, and they are likely to be employed at a management level. This demonstrates that the usage of air transport is closely linked with employment in some way. Hjorthol, Engebretsen, and Uteng (2014), further shows that as much as 49% of all work related travels are performed using air transport. In addition, Denstadli, Thune-Larsen, and Dybedal (2014) states that as much as 50 % of all air travel done in Norway is done by business passengers. The other half is some sort of leisure passengers, either inwards ore outwards to the region, in addition there is a large part of people travelling to and from Hospitals by air.

From an unpublished dataset obtained from Avinor, we see that the total volume of passengers travelling to and from Norwegian airports was 51 million in 2013. In Figure 5, the share of domestic and international passengers are illustrated, furthermore it is worth noting that approximately 74 % of all passengers in 2013 travelled to or from the four largest airports. To get a comparison, the smallest airport Fagernes only had 4035 passengers in 2013.

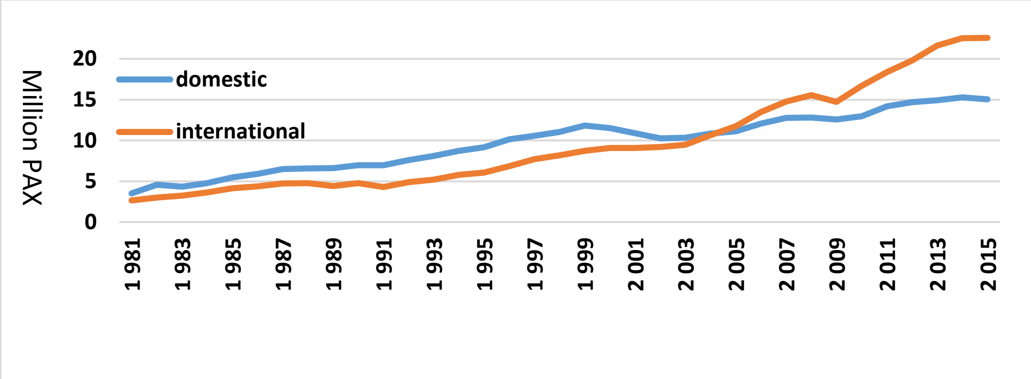

Figure 5, The total share of PAX at Norwegian airports Source: Avinor

2.2.1 Aviation in Norway

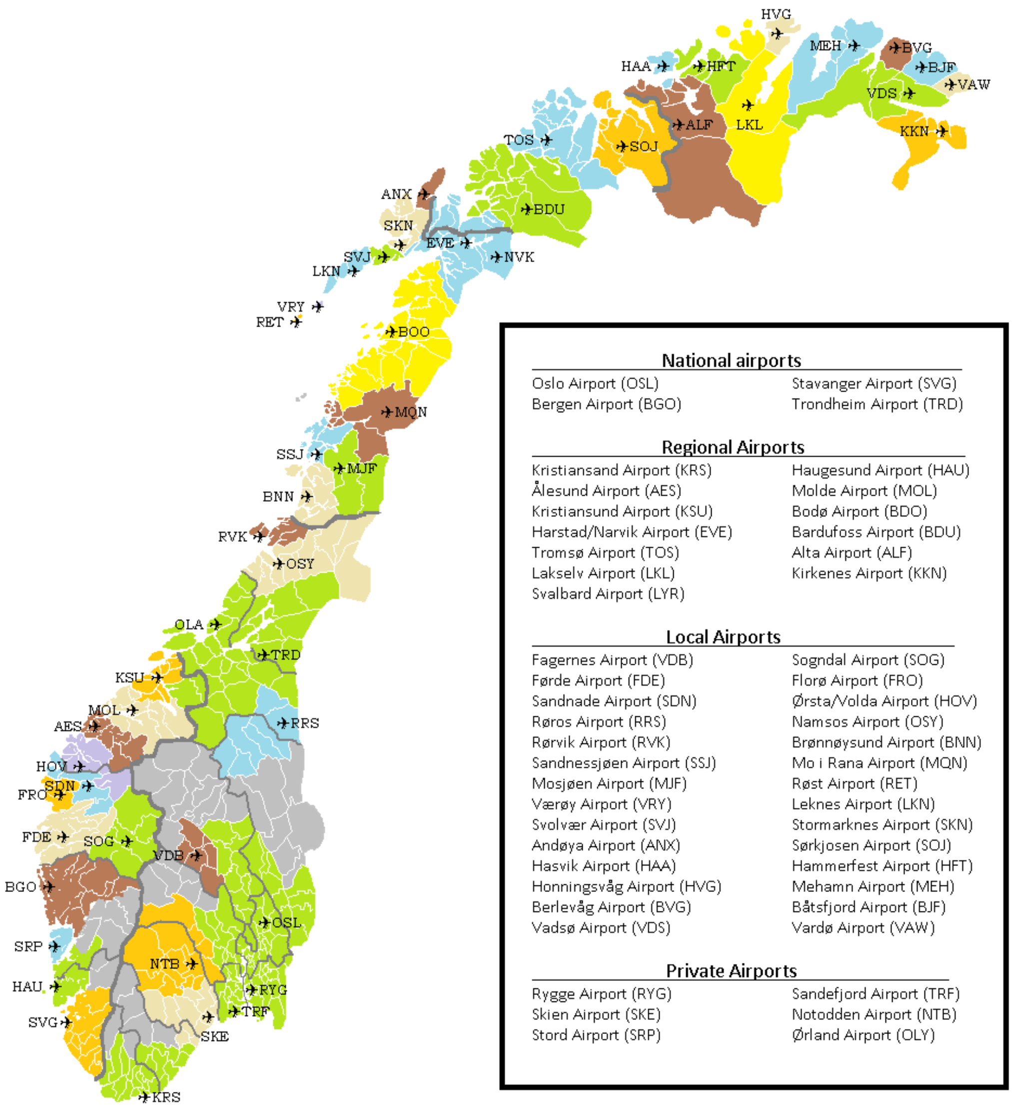

Figure 6, Map of Norwegian airports and catchment areas. Source: Own work

Figure 6 shows the geographical locations of Norwegian airports, with the colors indicating the airports catchment area (catchment areas are presented and discussed in chapter 2.2.2). There is a total of 52 airports with commercial operation in the country (2015), 46 of these are owned and operated by Avinor, while 6 are privately owned. 29 of Avinors airport are defined as local airports (Avinor 2015b) while 13 are Regional airports, and 4 may be classified as National Airports.

The National Airports are large airports with an extensive domestic and international route network. Oslo, Bergen and Trondheim are also important hubs for several Local airports in their respective parts of the country. Oslo is the country's main hub, and it may be seen as a hub for both Local and regional airports. Stavanger and Bergen are both hubs for offshore helicopter traffic. Stavanger does not have any hub function in the Norwegian network, and most of the direct routes of the airport is to international destinations.

The regional airports are often located in regional centers and medium sized cities, these are airports which are served by competing airlines and where the price of flying is influenced by these competitive forces (Avinor 2015b). Of these airports Bodø and Tromsø, as well as Alta and Kirkenes to some extent work as Hubs for the northern parts of the country. These hubs serve the local airports in the three counties of Northern Norway.

The local airports are mainly STOL airports (Short take off and landing), with an 800-1100 meter air strip. They can therefore only be served by small aircrafts (e.g. Bombardier Dash 8 series) with maximum 34-78 seats (Avinor 2015b). Because of this and because they serve relatively small markets, routes to and from 28 of these airports are subsidized (note that per 1.4.16 Fagernes and Narvik will be closed for commercial operations (Regjeringen 2015b)). According to Avinor (2015b), the airline operators serving these airports where payed a total of 675 million NOK. The airports themselves or not financially sustainable either, however because of Avinors ownership the losses from local airports are covered by the profit obtained from larger airports. A map of the typical route structure of subsidized PSO (Public service obligation) routes are presented in Figure 7, note that the route structure is based on Bråthen (2003) with updated information for 2016 obtained from (Regjeringen 2015b).

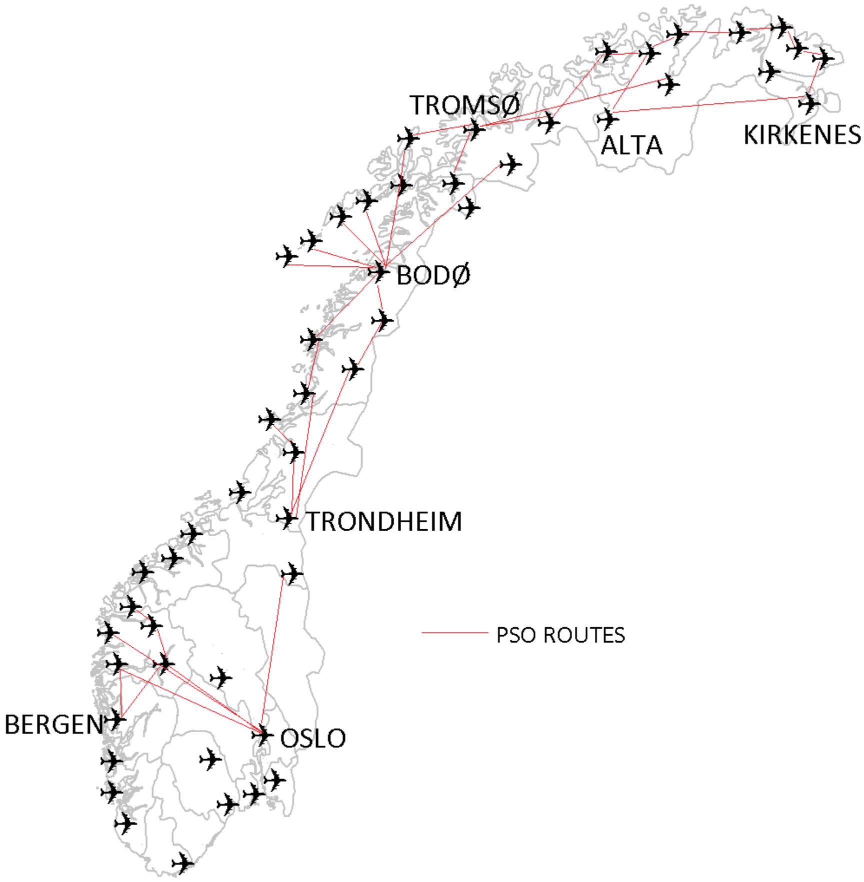

Figure 7, PSO routes in Norway per 1.4.2016. Source: (Regjeringen 2015b)

The privately owned airports are primarily former military airfields under municipality ownership. Of these six airports, Sandefjord and Rygge are large airports (in a Norwegian standard) with more than 1 million PAX in 2015. Both these airports are located within the same catchment area as Oslo Airport, in addition Rygge Airport is a characteristic low-cost driven airport, mainly focused on serving international routes provided by low-cost airlines. In a report created on request from the Norwegian Government, Skien, Notodden and Stord where considered to have an important role in their regions (Mathisen, Solvoll, and Kjærland 2008). The authors show that he route network of Stord has an important role in its catchment area, while at Notodden and Skien other activities (e.g. Training, testing) had a more important role than the actual routes offered for the respective regions. However, they all do to some extent play an important role for their regions, such as the local airports owned by Avinor. The Airport in Ørland seems to have a less important role in its region, and the operations here are strongly affected by the bigger airport in Trondheim. These privately owned airports are largely operated as private companies, and the government do not have the same obligation to ensure activities on routes to and from these. However, the government subsidizes both Stord and Ørland with funds to ensure operations (Regjeringen 2015c).

Three carriers, SAS, Norwegian and Widerøe, dominates the domestic operations within Norway. While SAS and Norwegian are fierce rivals on the routes between regional airports and Oslo and to some extent between other national and regional airports, Widerøe operates all the monopolistic local routes with its fleet of Bombardier Dash 8. In addition to serving the local airports, Widerøe operates many of the thin routes between regional and national airports. As we saw in Figure 5, the market for airline travel have increased significantly. In addition, after the deregulation and with the entrance of the low-cost operator Norwegian into the domestic market, the price of air transport have decreased significantly (Bråthen, Halpern, and Williams 2012).

2.2.2 Airports catchment area

In the analyzes performed later in this thesis, the catchment area of airports plays an important role. The catchment area is the geographical area from which an airport draws most of its passengers (Bråthen 2013, Mathisen, Solvoll, and Kjærland 2008, Svendsen et al. 2015). Halpern and Bråthen (2010) does however write that since the Norwegian airport structure is so dense, many of the catchment areas are likely to overlap, this will need to be considered when applying the structure.

There is no doubt that an airport will affect the municipality or city which it mainly serves, furthermore it is safe to assume this effect goes far beyond the borders of the municipality in which the airport is located in, at least for most airports. This makes the defining of catchment areas difficult, in addition it would not be sufficient doing a visual analysis, since overlapping catchment areas and other infrastructure may affect where people prefer to fly from. The first step towards defining the catchment areas was to find previous research which defined the “regions” in a Norwegian context, Hustoft (1999) defined every municipalities region in Norway based on newspaper subscription, infrastructure, and travel time to regional center. When applying Hustoft (1999) regions the airports impact area increased. However, this definition also creates a large issue, because when I define my regions around culture and newspaper subscriptions as well as transport links, I ended up with several airports in one catchment area, for some of the regions in the northern most area of Norway. If I apply this data some of these passenger would be counted multiple times, since the small airports around Bodø, Alta, Kirkenes for instance actually supply these airports with transfer passengers and should therefore not be in the same catchment area. Therefore, I had to find another way to define my catchment area.

Møreforskning Molde AS provided me with a definition of the catchment areas of airports in the following counties, Finnmark, Troms, Nordland, Nord-Trøndelag, Sør-Trøndelag, Møre og Romsdal and Oppland in an unpublished data sheet. The data can be seen as a part of Appendix A. This leaves me with defining the catchment areas in the south-west as well as the eastern parts of the country. By doing an extensive search in reports (Avinor 2015b, Mathisen, Solvoll, and Kjærland 2008, Svendsen et al. 2015, Bråthen 2013) in addition to examine travel times between counties and airports, I was able to define the catchment area of all the airports except Oslo, Sandefjord and Rygge. These airports catchment areas seem to merge and people are travelling between the regions depending on destinations and purpose of travel. In this thesis, these are therefore summed up into one large region that is referred to as the Oslo area. The lists of each airport and its catchment area are provided in Appendix A. However, the figures below gives a visual overview of the airports catchment area

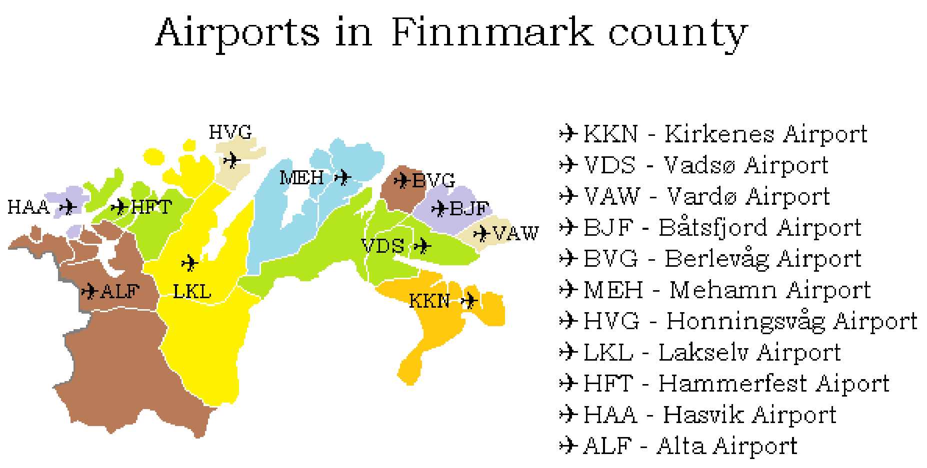

Figure 8, Catchment areas of airports in Finnmark County. Source: Own work

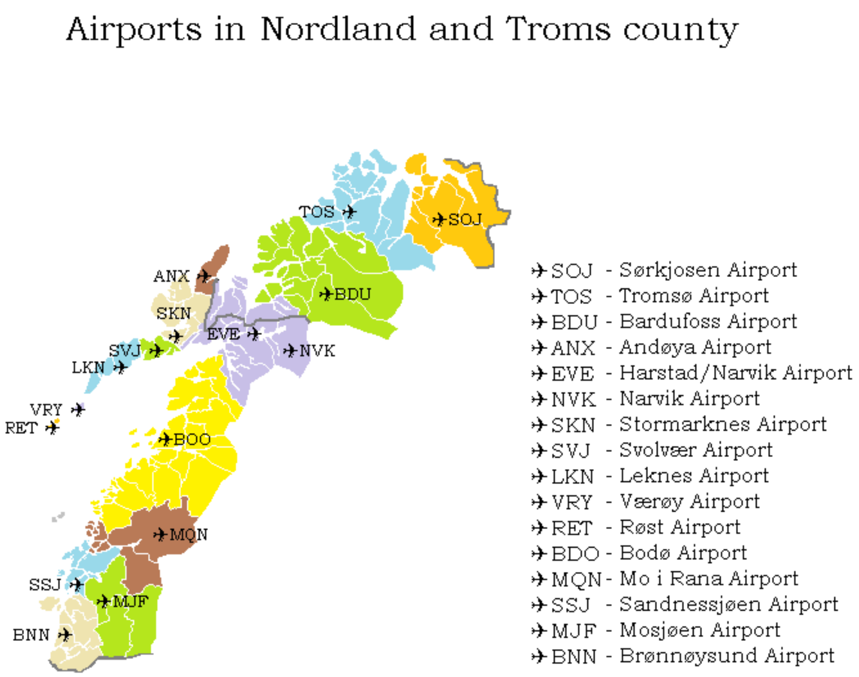

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Figure 9,Catchment areas of airports in Norland and Troms. Source: Own work

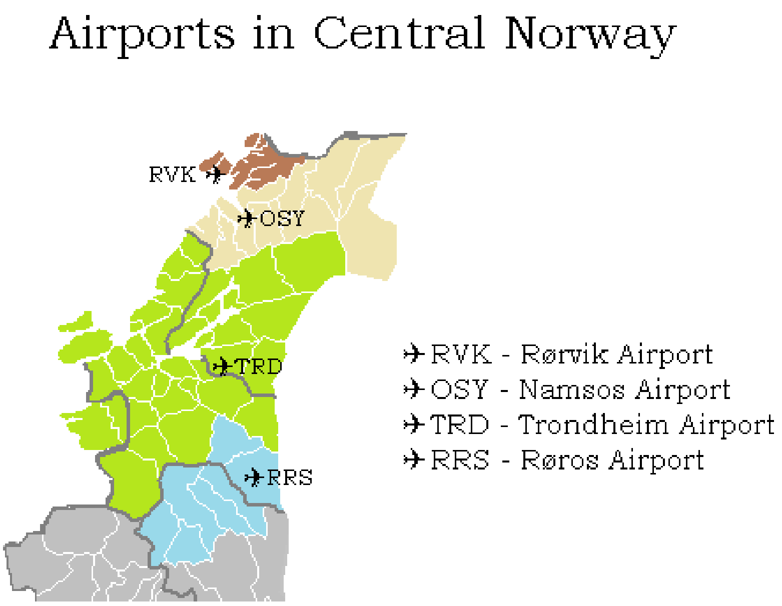

Figure 10, Catchment areas of airports in Central Norway. Note Ørland is not included. Source: Own work

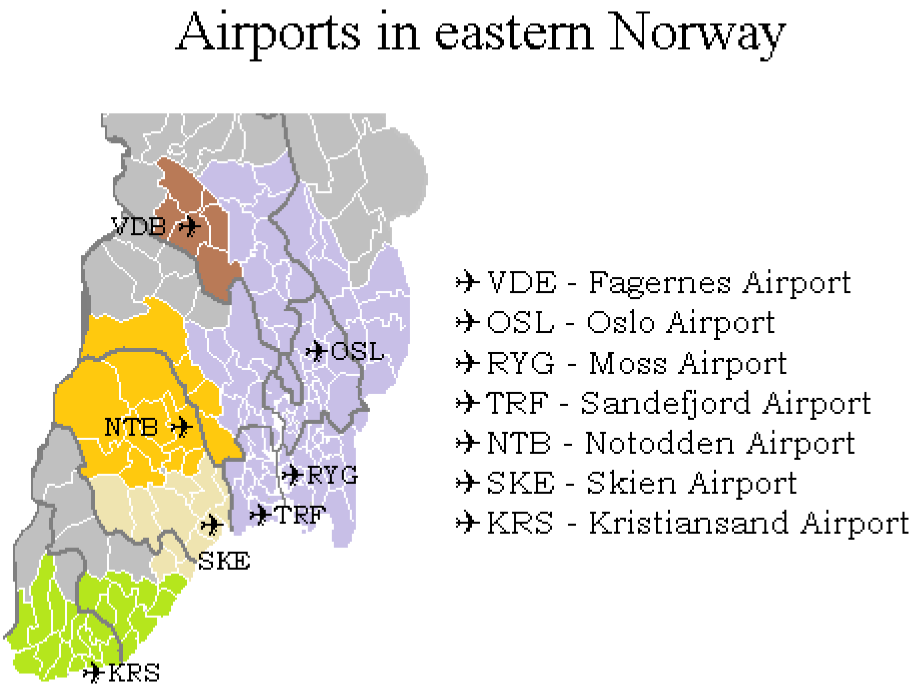

Figure 11, Catchment areas of airports in eastern Norway. Source: Own work

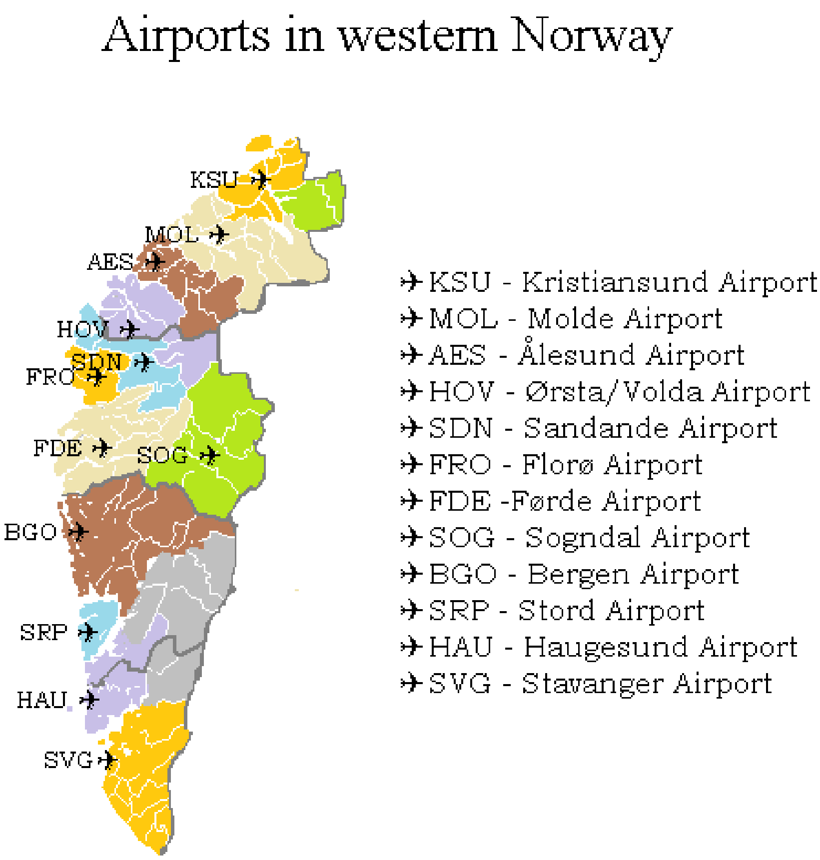

Figure 12, Catchment areas of airports in western Norway. Source: Own work

2.2.3 Air transport and other infrastructure

The STOL network where created to ensure transportation at the remote locations of Norway, since the building of these small airports in the late sixties other infrastructure (mainly road networks) have improved greatly. By investing in fixed links between cities and villages, the catchment areas of airports changes. Because of the competitive environment on regional airports, these airports have started attracting passengers from locations far beyond their original catchment areas, this is especially the case in Lofoten and Ofoten. Here Evenes Airport with its direct routes to Oslo and affordable prices have attracted people from the local airports, and especially from Stormarknes Airport (Avinor 2015b). In addition, new investment in fixed links along the Norwegian western coast should lead to a review of the airports in this region. If the social costs of closing such local airports are lower than the total benefits created from transferring these passengers to other airports, and thereby increasing the catchment area of these airports, politicians should consider closing such airports.

Two examples of such effects are presented in Avinor (2015b), in addition Bråthen (2013) examines the possible effects of an extensive upgrade of the road E39 will have on the airports along its route, which includes many of those seen in Figure 12. One example where an airport is being closed after the building of an improved infrastructure link can be found in Narvik. Where the building of a new bridge, betters the communication to a larger regional airport, which then would attract most of the passengers travelling from Narvik Airport. A similar situation is discussed in the Helgeland Region, where the building of a new tunnel seems to lead to a situation in where two small local airports will be closed, in favor for a new larger airport which will attract competitive routes rather than todays subsidized.

From a financial point of view, local airport operations are not beneficial. However from a social benefit point of view they might be. This is a case specific assumption, and what counts for one region, may not count for the next. One example is when the airport is a factor for the locating decision for a firm, as we saw from NEG a change in the connectivity of this a region might lead to a loss of this local industries competitive advantage. In addition, an industry which is dependent on sedentary resources, and not directly dependent on the airport, might still lose out if the airports existence is an important factor for its employees. Better linkages surely may lead to the closing of some airports, however when increasing the distance from industries to airports these might in fact move together with the airport, and the local region will lose out. There are many considerations to be taken when it comes to the question of airport operations and locations, and as proposed in this chapter an airports catchment area might change when one provide new links such as bridges and tunnels between regions.

2.3 Economic impacts of Air Transport

Air transport is important for nations, businesses, people and regions. The presence of air transport has led to a more globalized economy, where high value products and services are traded over large geographical areas in a short time frame. From (IATA 2015) we can see that air cargo, while only accounting for a modest volume of trade, actually accounts for as much as 35 % of the total value of global trade in merchandise. In addition, air transport eases the travelling to such a level, that producers of services or technicians can be located in one specific region and still serve the global market with their products. Air transport surely have played an important role in what we know to be the globalized economy.

The airport is both a company offering a service, a location for commercial activity and an infrastructure, as a company it employees people and buys services from other companies, in addition it often competes with other airports to attract as many users as possible. As an infrastructure, it may have the effect such as a bridge between two cities. Which in the light of new economic geography might lead to economic development in the airports region.

The economic effects from air transport have received much attention during the last ten years. Researchers tried to categorize these effects and measure them, so that an understanding of its importance and a framework for investing in such infrastructure may be developed. Bråthen and Strand (2000), splits between direct and indirect effects, and further present three categories of indirect effects, called second, third and fourth order effects. York-Aviation (2004) and Lian et al. (2005) proposes similar categories for economic effects from air transport, it is the methodology from Lian et al. (2005) I will apply in this thesis, since this is the methodology applied in most Norwegian air transport studies. A short description of the effects is presented in Table 2.

Type of impact	Description
1 Direct	Operation of airlines and airports (technical support and handling, catering, fuel, security, cleaning), commercial activities (shopping, restaurants, car rental, parking), land transport and air cargo.
2 Indirect	sub supplies (goods and services) to direct activities (covered in the region)
3 Induced	Spending by employees in activity 1 and 2
4 Catalytic	a- Location impacts (firms and labour) b- Tourism and trade (demand side) c- Productivity and investment (supply side)

Table 2, The economic impacts of air transport. Source: Lian et al. (2005)

As we can see from Table 2, the catalytic effects are divided into three subgroups, this was initially proposed in Cooper and Smith (2005) and adopted by Lian et al. (2005). The direct, indirect and induced impacts have been measured in many studies related to airport importance for regions and airport investments, there exists a solid framework of how to measure these effects. The catalytic effects on the other hand are related to more uncertain measurements and have only been a hot topic the last decade.

2.3.1 Direct effects

York-Aviation (2004), defines the direct impacts to be the employment at or immediately around the airport, these effects stem from airlines, administration and commercial services. Bråthen, Johansen, and Lian (2006), builds on this definition and includes services directly linked to air transport which are often placed outside the airports immediate area, such as Airline offices and Air traffic control. However, the common denominator for all direct impacts is that they are fully dependent on the existence of Air Transport in the region on order to deliver their goods and services. Bråthen, Johansen, and Lian (2006) measured these direct effects by surveying the airports of scope in their study on employment, by using the employment figures together with rates collected on the national account they were able to calculate production values and wage payments for direct effects of air transport as a whole. The results showed that the average of the surveyed Norwegian airports had approximately 600 employees per million passengers. A similar study on the European level, showed that the average number of employees per million workload unit (WLU) in Europe where 925 (York-Aviation 2004). These two results are hard to compare since the airports used in the European example are mainly large international airports, which can only be compared with four airports in Norway. In addition, the two studies use different measurements, the Norwegian study only accounts for passengers while the WLU measurement used by York Aviation also accounts for freight handling.

2.3.2 Indirect and Induced effects

Bråthen, Johansen, and Lian (2006) and York-Aviation (2004), defines the indirect effects as economic and employment effects generated by the sub-suppliers of the airport in the surrounding region. The sub-suppliers are those supplying goods and services to the businesses that are directly impacted by the airport. The induced effects are defined as the economic and employment effects generated regionally from the spending of wages generated by the direct and indirect activities (York-Aviation 2004). Both the indirect and induced effects can be measured using a Panda model (Lian et al. 2005) or weighted average (York-Aviation 2004). The panda model is a single-region input-output model, which by Lian et al. (2005) and Bråthen, Johansen, and Lian (2006) is used to analyze industry, value creation and employment. The model is used in a regional perspective, therefore Bråthen, Johansen, and Lian (2006) emphasis that it is important to define a relevant region before using the model. For Norwegian airports these multipliers where found to be between 1,3 and 1,7 (Dybedal (2005) cited in Lian et al. 2005), which indicates that if 100 people are employed at a direct activity on the airport, there will be between 130 and 170 people employed as a result of the indirect and induced effects.

2.3.3 Catalytic effects

York-Aviation (2004) writes that the catalytic effects of air transport are income and employment generated in the regional economy from air transports improvement in productivity of businesses and as an attractor of inward investment and tourism. In their report, the authors consider only the inwards effect to the region, excluding all possible negative outwards effects one might see from air transport to a region. Cooper and Smith (2005) on the other hand, presents a more concrete framework, and introduces the idea of splitting the effects into supply side, demand side, firm and labor effects. Which is further developed in Lian et al. (2005) and widely used in Norwegian studies on the matter. Both these studies also stress that one might see positive effects from for example a larger market as well as negative effects from this increased competitiveness. Cooper and Smith (2005) extinguish the catalytic impacts from airports in the following subgroups, change in consumer surplus, environmental and social impacts, negative and positive economic spillovers. Lian et al. (2005) recognizes these subgroups, but presents a different terminology. The authors split the catalytic impacts into the following three subgroups; Location impacts, tourism and trade impacts, Productivity and investment impacts.

2.3.3.1 Location impacts

Air transport accessibility is one of the factors affecting certain firms location decisions (Lian et al. 2005). From NEG theory, we saw how firms and labor would agglomerate into a city or village, depending on the strength of the centripetal and centrifugal forces. What Lian et al. (2005) proposes, in the light of NEG theory, is that firms might agglomerate to the more connected airport region, rather than staying in the peripheral.

New economic geography and cluster theory may serve as tools to explain why certain firms or industries locate in the airport region, however the location impacts are hard to measure in an economic sense and is therefore best studied using qualitative research methods such as surveys (Lian et al. 2005). Furthermore, the authors write that location impacts should be interpreted and measured on a regional level, since they on the aggregated national level are considered to be redistribution effects.

Bråthen et al. (2006), did a case study on the region surrounding Molde Airport. In their case study, the authors found indication that the airport might play a particular important role for the large exporters in the region, which are also large employers. The airport might not have been the reason for these firms' location decision, however its existence may be an important factor for why these internationally oriented firms' are still present in the region, and why they are able to compete globally. Lian, Thune-Larsen, and Rønnevik (2008) did a case study on the potential for Hammerfest Airport, and found that if one invested in a new run-way at the airport. The region might see inbound investment effects from the oil and gas industry, in addition they expected firms to locate in the region.

2.3.3.2 Tourism and trade impacts

Tourism and trade impacts, also referred to as demand-side impacts, are effects of air transport on the net demand for goods and services in a region/country (Cooper and Smith 2005). Tourism impacts are considered to some degree in previous studies (e.g. Lian, Thune-Larsen, and Rønnevik (2008), Oxford-Economics (2011)), these impacts are seen as economic and employment effects in a region generated from the air service inbound to the region. Oxford-Economics (2011), discussed how low-cost operators have contributed to economic growth with the creation of new tourism. However, tourism may also have a negative effect, such as when the inhabitants of a region uses the air service to travel and spend income in other regions or countries.

As 35 % of the total value of international goods are transported by air (IATA 2015), there is no doubt that air transport plays an important role in the globalized trade patterns. In a regional sense one could state that a company with good air transport links would more easily be able to access the global market then in the case of no air service in the region. Lian et al. (2005) writes that air transport facilitates more productive face-to-face meetings between buyer and seller, which is an important tool in the service industry. Furthermore, Oxford-Economics (2011) showed how ash cloud following volcano activity in Iceland in 2010, negatively affected the trade pattern and production for just-in-time manufacturers in Germany. This example showed how dependent these manufacturers where on international trade facilitated by air transport.

2.3.3.3 Productivity and investment impacts

Impacts on productivity and investment are seen as the supply-side effects of air transport. This is because change in a regions productivity for instance, will lead to a change in air service supply to the region. Cooper and Smith (2005) Writes that either such impacts on the productivity may come from the quantity of resources deployed, or via the efficiency those resources are employed. The authors stress the importance that one have to consider both the potential adverse as well as beneficial spillover effects generated by air transport in the economy. Seen in the light of NEG theory, supply side impacts will lead to location impacts and location impacts might lead to these supply side impacts. The productivity and trade impacts does not only occur as a result of air transports existence, the impacts also facilitate demand for air transport., One example of this might be that when a particular industry invest in a region, its presence might lead to more complementary industries agglomerating to the region. However, one should note that the transport links provided by air transport, might also lead to outbound investment as well. In that case, the centripetal forces of a connected region is strong, in addition the transportation costs of serving the region of origin are lower than the gain of moving to the more prosperous region.

2.4 Literature review

In this section previous I will present and discuss literature related to analytical part of this thesis, the literature consists of previous studies that have applied the methods I will apply in this thesis successfully, and a presentation of these results. The section consists of two sub chapters, in chapter 2.4.1 literature and research related to the causality between airports and economic development is discussed. While I provide an overview of literature seeking to identify or quantify the economic effects from air transport both in a Norwegian and international context in chapter 2.4.2.

2.4.1 The casual relationship between air transport and economic growth

While researchers clearly state that there is a relationship between air transport and economic growth, little evidence of the direction of the relationship exists. In this section, I will discuss the few articles produced on this topic, the reader should note that when discussing causal relationships in this thesis I often refer to Granger causality. I use the term Granger causality to avoid stating that there is an actual relationship present, since these econometric analyzes only identifies a statistical relationship. The concept of Granger causality is discussed in chapter 3.3.1. However, the main idea of Granger causality is to find indications of the directional relationship between two or more variables (X ←→ Y).

Button et al. (1999) did a Granger causality test to investigate the relationship between high technological employment and airport-hubs. The author found that there where a potential one way effect between the variables, where a growth in passenger numbers would almost certainly effect the employment levels in the region. This standard Granger causality test performed by Button et al. (1999), even though giving expected results does have some limitations. It is performed on time series data, using only one airport. This gives very case specific results, since one cannot assume that all airports in a country are homogeneous.

According to Mukkala and Tervo (2013), Grange causality is increasingly being performed on panel data. The panel Granger test, are more effective, since these let me test if there is a heterogeneous relationship between a set of airports. Mukkala and Tervo (2013) did a study testing whether their existed Granger causality between different sub sets of airports. The authors performed a three step approach, proposed by Hurlin and Venet (2001 and

2005), which first tested for homogeneous non-causality for the whole panel data set. Then they tested for a homogeneous causality relationship. While in the third test, the authors split their set of airports into three sub-sets, peripheral regions, middle regions and core regions. What is interesting with this study is that they found reasons to believe that Air traffic heterogeneously Granger causes GDP in the peripheral regions and that for the same regions GDP heterogeneously Granger causes Air traffic. Furthermore, they found a directional homogeneous causality moving from air traffic to GDP for the middle regions. And interestingly, no heterogeneous causality was found in either direction for core regions. One should note that, this study was performed on a European level, where the peripheral where the geographical distance from a core in Germany. This means that the authors assumed that two of the biggest airports in Norway were in the peripheral.

Yu et al. (2012), performed a panel Granger causality tests similar to the in Mukkala and Tervo (2013). The authors wanted to test whether causal links between infrastructure investment and economic growth existed at national and regional levels in China. The regional panel series, where tested in order to investigate whether the casual relationship varied across sub-national areas. The author found indications that on a national level, there existed a long-run equilibrium relationship between economic growth and transport infrastructure, however they found no indications that transport infrastructure Granger causes economic growth on the national level. Furthermore, at the regional level they found indications that transport infrastructure investment would not be an important factor for growth in the less developed western parts and the low-income central parts of China. A reason for this lack of causality between transportation infrastructure and economic growth may be a underdevelopment in complementary resources in the spatial economy (Yu et al. 2012). The authors therefore suggested that the government should invest in education, science, and technology development in these rural regions, in order to better realize economic growth. When the region have overcome these barriers for economic growth, they may see positive effects of transport infrastructure investments (Yu et al. 2012).

Baker, Merkert, and Kamruzzaman (2015), set out to find indications of a causal relationship between airports and economic growth in remote rural regions of Australia, in both the long-run and the short run. The authors applied a panel granger causality test, and assumed a heterogeneous relationship between regions. The authors use the aggregated real taxable income to represent regional growth, and their findings are impressive. They find that there is a strong granger causality running in both directions between airports and economic growth for both regional and remote airports, furthermore they show that Granger causality exists in both the short-run and long run, when applying four lagged variables in their analysis.

2.4.2 Air transports effect on regional development

During the last decade, there has been a surge towards understanding more about the catalytic impacts of air transport. It is widely assumed that air transport facilitates growth in the wider regional economy, and we shall use this chapter to go thru some of the research that has been conducted with the goal to quantify and identify these catalytic effects. There exist two general methods of quantifying we shall discuss these in the methodology section in chapter 6, however these methods are econometric studies and qualitative case studies. In this literature review, we will look at results from both methods, the reader should note that in the Norwegian framework case studies are most often used, while internationally there is a wide range of econometric studies.

Cooper and Smith (2005) discussed whether air transport might facilitate outbound and inbound effects in a region, in terms of business development and tourism. The authors found indications that on an aggregated European level, the supply side effects and location effects where the most notable catalytic effects. Their study is extensive and they find evidence showing that catalytic effects from air transport have contributed to an increase in European GDP of four percent. They further state that the most important factor of this growth is that the airport has effected business investment in the region, in addition some of the effects might be a result of the airport contributing to growth in trade and tourism. The authors also found that a 10 percent increase in air transport usage seems to increase the industries investment by 1,6 percent. These results seems fair when comparing to Brueckner (2003), where the author tested how air transport in 91 US metropolitan areas effected employment. Brueckner (2003), found that an increase in airport traffic (PAX) of 10 percent, will lead to a 1,1 percent growth in employment for service-related industries the same year. Additionally the author found fairly significant results showing an increase in total employment in the metro area of about 0,9 percent after a 10 percent increase in air traffic.

Green (2007) did a study on metropolitan US airports, similar to the approach of Brueckner (2003). The author sought to find indications of a relationship between airport activity and economic growth, and did find evidence showing that large airports contributed to both employment and population growth. The author further suggested that airports effected by capacity constraints might generate positive effects in the metropolitan areas employment and population if an investment to increase capacity was conducted. These results are similar to those shown in Brueckner (2003), and therefore strengthened his findings. Furthermore Green (2007) investigated whether airport cargo and freight activities had similar effects on the metro areas economy, however the author did not find conclusive and statistically significant results to prove this assumption.

While Brueckner (2003) and Green (2007) focused their studies around large metropolitan airports in the US, Percoco (2010) performed a similar econometric study on the Italian airport network, which consists of several small and regional airports. The author includes regions without airports in his study, to create more robust results, and eliminate the selection bias induced by airport location choice (Percoco 2010) and finds elasticities showing that a 10 percent increase in passengers will lead to a 0,56 percent increase in a regions service employment. In addition the author introduce a spatial spillover method, which lowers the elasticity to 0,45 percent in the airport region, and a spillover of 0,17 percent employment in the neighboring region. These results are interesting since the author is the first to introduce the potential spillover effects from a region with an airport, to neighboring regions. While Percoco (2010) show that airports create employment effects also in smaller regions, Allroggen and Malina (2013) examines the elasticities of airport movements on economic growth and find that for large and medium sized German airport this elasticity is positive, while for smaller airports it is surprisingly negative. Which would mean that an increase of movements at the airport would have negative effects on the local economy. The results in Allroggen and Malina (2013) are interesting in a spatial economic view, as they might show that the airport provides a link towards further agglomeration into larger economic centers.

Whereas the studies above use econometric models to predict the economic effects from air transport on population or employment, most Norwegian studies related to such catalytic affects are focused around case studies, consistent of surveys. The reason for this may be that there seem to be a general understanding among Norwegian researchers that airports effect their respective catchment areas differently, that the airports are heterogeneous and therefore one should be careful when generalizing the results. We shall now go through the results from Norwegian studies on catalytic effects, common for them all is that they are performed as case studies on one or several regions.

Lian et al. (2005) in addition to his contribution on the terminology of economic effect in air transport, indicated that some industries are more dependent on air transport. The authors focus especially on the oil and gas industry, which is spread out along the Norwegian coast from Stavanger in the south to Hammerfest in the most northern parts of the country. The offshore activities are largely dependent on several onshore supply bases and activities, which due to travel times are spread out on several offshore hubs along the coast. The authors state that the development of the industry as we know it today, would not have been possible had there not existed good air transport connections. Bråthen, Johansen, and Lian (2006) does an explorative survey of the catalytic effects in the Molde region in central Norway. The authors find indications that the local airport affects both the economy in general as well as the industrial structure of the airports catchment area, thru location decisions. They show how the centrifugal forces of local knowledge and skills might be the reason for some industries locating in the region, and since these industries are competing in a global market, they are dependent on air transport for both personnel and equipment. The authors write that because of this dependence on air transport, a negative change in the regions connectivity might force these companies to relocate and move the employment to a new region. This study gives an indication of how an airport creates a link which lets an industry locate in a remote region, in addition it is a good example of how airports influence the location decisions of firms.

Lian (2007) presented two case studies addressing the catalytic effects of air transport, both case studies where performed in regions dependent on oil activities. The first case study was performed thru interviews with six internationally oriented firms in the Stavanger region, which is the region in Norway with the largest cluster of oil related firms operating on the Norwegian continental shelf. The author found that these companies where heavily dependent on good air transport linkages abroad, and especially to international hubs, which is understandable when operating in a global industry. The author additionally found that these international links was important when recruiting qualified personnel to the industry, because the presence of these international links made the foreign personnel feel more close to home (Lian 2007). The second case study in Lian (2007) was performed in the small region of Hammerfest. This region has a developing oil and gas industry after the government gave their consent to search for oil in the Barents Sea, in addition the city is the location of the Snøhvit plant for processing LNG. The county of Finnmark where Hammerfest is located, is known for its harsh environment and tough living conditions, the author found that the presence of an airport here helped attract highly educated people to the region from more southern parts of the country. Simply because the presence of an airport made them feel closer to home and let their friends and family visit them. In addition, the author found indications that the airport was important to bring equipment to the local fishing industry. Hammerfest airport is a STOL airport meaning that only small aircrafts operate at it, Lian, Thune-Larsen, and Rønnevik (2008) therefore studied how an investment in a longer runway would affect the regions industry structure and attractiveness. Such an investment would mean direct flights to Oslo instead of having to go through Tromsø. The authors write that such an investment might lead to inbound investment in the region, especially from companies in the oil industry. They write that if the oil companies locate in the region as a result from the investment, a further development of the economy related to R&D, health and education is expected. This is an example of how increased accessibility leads to more inbound investment in the peripheral as we saw from NEG theory.

Rønnevik, Lian, and Gjerdåker (2010) studies the potential of Florø Airport, which is another airport highly dependent on the Oil and Gas industry, they surveyed a set of companies and found that they were all satisfied with the route network offered at the airport, especially because the direct routes ease the contact with the respective firms' main offices in Bergen, Stavanger or Oslo. Since the airport is located in a hub for oil related activities, the airport was shown to have an importance for logistical activities and ensuring fast deliveries of critical components to the platforms connected to the hub. InterVistas (2015) did a similar study interviewing twelve companies located in the Kristiansand region, the respondents told that the local airport where crucial for their business and their customers, both internationally and domestically. In addition the respondents stated that the airport was important when transferring internal business and business partners in their global supply chain to Kristiansand (InterVistas 2015). Furthermore, this case study, which was conducted on request by ACI Europe, showed that

75 percent of the surveyed businesses saw the airport as an important factor in their future growth.

3.0 Methodology

The idea that there exist a relationship between transport infrastructure and economic growth have been presented by using theory from the new economic geography field in chapter 2.1, combined with theory related to economic impacts of air transport in chapter 2.3 and a relevant literature review conducted in chapter 2.4. We have seen that transport costs play an important role in a firms location decision, in addition we have seen how the historical drop in transport costs have changed the geographical location of firms and industries as a whole. In chapter 2.2.1 I stated that the direct cost of using air transport have decreased significantly after the deregulation of the market, this combined with the time savings of the transport mode is likely to have contributed in the location decisions of firms and labor. The idea in air transport economics is that the reduction created by the total time cost savings, make the region which is served more productive. In addition, an airport region might see external economic benefits from the presence of air transport. In this chapter I shall present the methods used to measure and indicated this relationship between air transport and regional economy development.

In the conceptual model presented in Figure 13, the effects from air transport on a firms environment are presented. The reader should notice that the model does not include population effects directly, but follows the approach of new economic geography and assumes that population will grow as jobs are created.

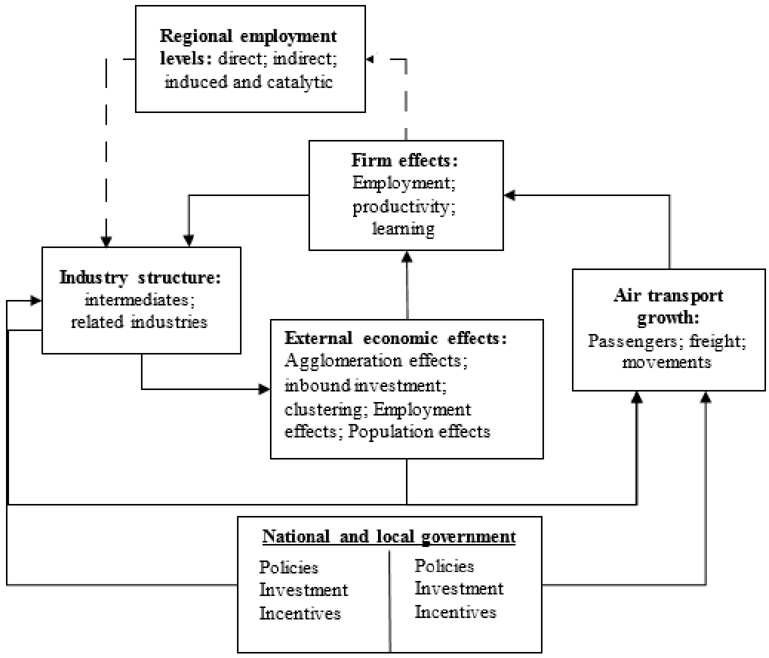

Figure 13, Conceptual model, air transport and economic effects. Source: Own work

3.1 Research design

The original purpose of this thesis was to conduct two case studies and examine the catalytic effects of air transport on employment and industry structure thru questionnaires. However, this approach was not as successful, since I did not obtain a sufficient amount of response to represent the population in the surveyed regions. In addition, I only obtained enough response to present in one region, however the response frequency was low, in addition it the respondents does not represent the industry structure of the region in a sufficient manner. Therefore, the survey results will be applied carefully in the thesis, the survey results are presented in chapter 6.0.

Because of these issues, the study has changed a great deal, and the emphasis of the study is now on econometric analyzes. Two new aspects are included in the thesis. The first is a test of possible bidirectional causality between air transport and regional development. This method will be presented in chapter 3.3 and the results are presented in chapter 4.0. The other method included, tests the effects air transport have on regional employment by regressing airport passenger levels and regional employment levels, this method is described in chapter 3.2, and the results are presented in chapter 5.0. The results from the analyzes are all presented in PART II of the thesis. While I in PART III I conduct a case study as a measure of testing the econometric results in a regional context, in addition the third part provides a summary of the thesis and recommendations for future research. The case study methodology is discussed in chapter 3.2, it is followed by the formal presentation of the models conducted to indicate the directional relationship between air transport and economic activity in chapter 3.3. While I in chapter 3.4, present the formal model used to measure the effect air transport has on regional employment. In chapter 3.5 I discuss survey design, which is relevant for the third analysis in the thesis, this section also includes methodology on questionnaire design.

3.2 Case study

Lian et al. (2005), recommended case studies, when addressing catalytic impacts from air transport. Furthermore, (York Consulting 2000 cited in Halpern and Bråthen 2010) states that catalytic impacts are best described in qualitative terms, citing surveys on attitudes as the most appropriate method.

In Grønmo (2004) the case study is described as a study of a single unit of unique and scientific interest in a limited universe. According to Yin (2009) the case study should be seen as a research strategy, rather than an approach for data collection and data analysis. The case study method lets me use both the quantitative and qualitative approach, and triangulate the results (Gerring 2007, Grønmo 2004). Yin (2009) confirms this and states that the possibility of collecting data from several sources is the strength of a case study. Additionally Frankfort-Nachmias and Nachmias (2008) writes that, collecting data with the use of two or more methods, to reduce the specificity or dependence on one method which might limit the scope, is the essence of triangulation. In addition, triangulation of data sources may help strengthening the results of any study in social science (Frankfort-Nachmias and Nachmias 2008).

As stated previously, the main idea of the thesis was to identify the catalytic effects of air transport on regional economic development, such as employment and investment impacts. However, because of limited response from the surveyed businesses I was only able to get results in one region, these results however do not represent the “population” in the region sufficiently, and are therefore only applied carefully in the case study. I will therefore base most of the case study on quantitative econometric models conducted on Norwegian sample data. I conduct this Norwegian analysis because if I were to use results from previous studies conducted on US or European air transport, I might produce biased results, since these econometric results might not be applicable in a Norwegian context.

My results are then applied in a case study conducted on the Sogndal region. The reason for still conducting a case study is to show how these econometric results may be applied in a Norwegian context. However, applying such generalized elasticities may not be sufficient, since airports are assumed heterogeneous. I therefore apply these results carefully as well and seek to find their relevance in a regional context. The case study performed in chapter 7.0.

3.3 Granger causality tests

In this study I want to see if we can find indications that such a directional relationship does exist between airports and regional development in Norway. However, due to the complex nature of the field I need to follow the approach of previous and similar studies, I am then left with two choices. The first, is to follow Baker, Merkert, and Kamruzzaman (2015) and simply assume that the airports are heterogeneous, in order to test whether there exists a long and short run Granger causality among the airports, and simply test all the subgroups of airports. The other and more safe choice is to apply the method proposed in Mukkala and Tervo (2013) and test whether the causality actually is heterogeneous for the different subgroups of airports, and then as a second step apply the method shown in (Baker, Merkert, and Kamruzzaman 2015) for those sub-groups which show to be heterogeneous. In order to do this, I will have to apply both methods, these are presented in the following subsections, however first I will go thru the concept and definition of Granger causality for this thesis.

3.3.1 The concept of Granger causality

In his book Basic Econometrics Gujarati (2003) warns that granger causality is a highly philosophical and is a debated topic, at one extreme people believe “everything causes everything”, while on the other extreme people deny the existence of causation whatsoever (Gujarati 2003). Granger (1980), writes that this lack of positive statements surrounding the causality test in many text books, may come from the fact that the concept lacks a universal approved definition. And that one cannot provide a definition which would satisfy both the philosophers and the statisticians. Granger (1980) defines “Granger causality” in the following manner:

"X_{n-1} will consist of a part that can be explained by some proper information set, excluding $Y_{n-1}(j \geq 0)$, plus an unexplained part. If the Y_{n-j} can be used to partly forecast the unexplained part of X_{n+1}, then Y is said to be a prima facie cause of X"
– (Granger 1980)

Granger (1980) further writes that this definition is heavily dependent on the axiom, that the past and presence may cause the future, but the future cannot cause the past. In addition the authors definition depends on there not being two similar variables explaining the same information set. Furthermore, Granger (1980) deems a third axiom that all causal relationship remain constant in direction throughout time, important.

In this thesis, the definition above is what is meant discussing Granger causality. In addition, when I state that a variable X Granger causes variable Y for instance, this implies that X contains useful information that seems to explain Y. I therefore have a responsibility to apply variables that explains the situation in the correct manner. The data selection is discussed in chapter 3.3.4 and chapter 4.1.

The Granger causality analysis lets me determine the directional relationship between two variables X and Y (Gujarati 2003). The method is commonly used on time series, but a methodology testing for Granger causality using panel data have been developed the last decade. Using Panel data lets the researcher distinguish between homogeneous and heterogeneous causality, that is I may assume that my dependent Y or X variables are heterogeneous. A good example of this is when Granger tests are performed on different nations, then it would not be appropriate to assume that all nations are equal. Mercan and Göçer (2013) showed such a study's relevance when assessing economic growth on the BRIC countries. Even though Granger causality is commonly used we will tread carefully when addressing the results. Therefore, the results obtained in this study should not be interpreted to be conclusive, however it lets me determine whether my variables obtain useful information to explain each other.

3.3.2 Testing for heterogeneous causality

In order to investigate the causality between air transport and regional growth we follow the Venet and Hurlin (2001) method, which is also used in Mukkala and Tervo (2013). By applying these three steps, we are able to test for homogeneous non-causality, homogeneous causality and heterogeneous non-causality respectively, each step consist of a hypothesis, these are shown in Figure 14.

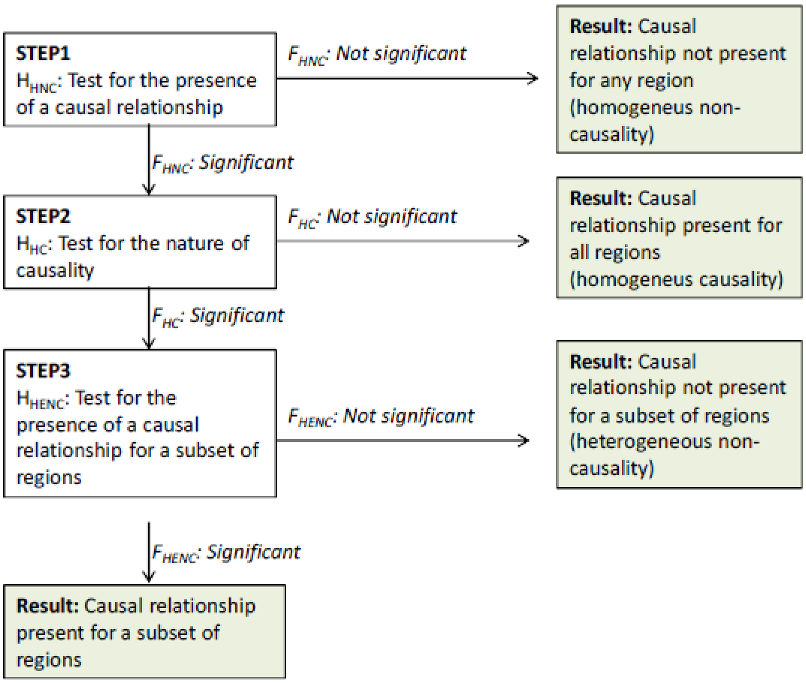

Figure 14, Testing procedure HNC, HC, HENC. Source: Mukkala and Tervo (2013)

After the testing procedure, depending on the results I will test for a long-run and short-run causality on the sub-set groups which have shown indications of heterogeneous causality with an appropriate statistical significance, these tests are similar to those done in Mercan and Göçer (2013), Baker, Merkert, and Kamruzzaman (2015) and Yu et al. (2012).

Gujarati (2003), writes that the majority of economic series and financial data are effected by Unit-roots, to avoid this issue we will use the natural logarithm of the variables, and then difference them, this approach follows the work in Mukkala and Tervo (2013).

To test for heterogeneous causality I apply the technique of vector auto regression (VAR), which is adapted for panel data with time series as proposed in Mukkala and Tervo (2013). The model tests the transformation of a set of endogenous variables which are denoted k, over a sample period of t (t=1,…,T), for each region i (i=1,…,N). The general model is a panel data model with fixed coefficients and is presented in equation (1)

$$(1)\ y_{i,t} = \sum_{k=1}^{p} y^{(k)}\, y_{i,t} - k + \sum_{k=1}^{p} \beta^{(k)}\, x_{i,t} - k + v_{i,t},$$

where $v_{i,t}$ = a_i + $\varepsilon_{i,t}$ are i,i,d. (0, σ_ε^2) and p represents the number of lags. The autoregressive coefficient $y^{(k)}$ and the slope coefficent $\beta^{(k)}$ are assumed to be constant for all lag orders of $k \in [1, p]$. In addition, the autoregressive coefficient is equal for all regions, while the slope coefficient varies across regions.

This VAR model is applied to test the three hypothesizes, presented in Figure 14. I will start of by testing for homogeneous non-causality (HNC). I then continue with a test of homogeneous causality (HC) for those variables that we could reject the first hypothesis, and further test for heterogeneous non-causality (HENC) on those variables which we are able to reject the homogeneous causality. The hypothesis for homogeneous non-causality proposed by Mukkala and Tervo (2013) is shown in equation 2, I will reject the null-hypothesis if one or more of the lagged orders of k in the VAR model in equation 1 is significant. The null-hypothesis propose that the slope coefficient is zero, for all (∀) lagged variables in all regions. If this is not true, we can reject the hypothesis.

$$(2)\ H_0: \beta_i^{(k)} = 0 \forall i \in [1, N], \forall k \in [1, p]$$
$$H_1: \exists_{(i,k)} / \beta_i^{(k)} \neq 0$$

Following Mukkala and Tervo (2013), we test the null hypothesis in equation (2) using a Wald test on a set of residuals, to obtain the F-statistic and its significance. This test is formally presented in equation (3),

$$(3)\ F_{HNC} = \frac{(RSS_2 - RSS_1)/N_p}{RSS_1/(NT - N(1+p) - p)},$$

Where RSS_2 represents the restricted sum of squared residuals obtained in H_0 and RSS_1 corresponds to the residual sum of squares in the VAR model in equation (1) (Mukkala and Tervo 2013). The sum of squares is obtained from a maximum likelihood estimation and are assumed to have fixed effects, which follows the approach of the Mukkala and Tervo (2013).

If the null hypothesis in equation (2) is rejected, I continue my testing procedure with the hypothesis proposed in equation (4). In order to perform this test, I will have to regress a set of residuals (RSS_3) obtained in a restricted model, where the slope terms are kept equal. And then test this on my obtained residuals in the first test (RSS_1). The hypothesis for the Homogeneous causality test (HC) is:

$$(4)\ H_0: \forall_k \in [1,p]/\beta_i^{(k)} = \beta^{(k)} \forall_i \in [N-1]$$
$$H_1: \exists_k \in [1,p], \exists_{(i,j)} \in [1,N]/\beta_i^{(k)} \neq \beta_j^{(k)}$$

With the following test statistics,

$$(5)\ F_{HC} = \frac{(RSS_3 - RSS_1)/p(N-1)}{RSS_1/(NT - N(1+p) - p)}$$

For this method as well, I follow the Mukkala and Tervos approach and assume fixed effects, these are provided by the maximum likelihood estimation.

If the null hypothesis in (4) is rejected for any number of the lagged variables, I will continue with a test for heterogeneous non-causality (HENC). For the HENC test, the test statistsics is presented in equation (6), for this model I need to define a set of subgroups, in my approach I have used Avinors airport classification to develop three subgroups, Local airports (peripheral), Regional Airports (Medium sized regions) and National Airports (Large regions). For each subgroup I need to compute the residuals while constraining the slope coefficient of the panel members to zero (RSS_4) (Mukkala and Tervo 2013).

$$(6)\ F_{HENC} = \frac{(RSS_4 - RSS_1)/(n_{nc}p)}{RSS_1/(NT - N(1+p) - n_c p)}$$

If the statistics I obtain from the Wald test applying equation (6) are significant, it indicates that I can reject that there is a heterogeneous non-causality relationship running between my variables.

The results are computed and presented in chapter 4.2. I will now continue the methodology with the presentation of a vector error correction (VEC) model which is used to test for long-run, short-run and strong Granger causality. This test is performed only on those subgroups and in the direction where I have found a heterogeneous causality using the testing procedure proposed in this chapter.

3.3.3 Vector error correction method

I applied the vector error correction (VEC) model in order to include the error correction term in my model, as opposed to the alternative vector auto regression (VAR) model that I applied in the example above. The error correction term, represents the time that the error corrects itself, I use this to determine whether there is a long run causality. I will apply the same values as I did in the previous testing procedure, with logarithmic values in first difference I (1) to avoid unit-roots effecting my results.

The formal notation of the vector error correction model for variables Y and X is as follows:

(1) $\Delta Y_{it} = \propto_{1j} + \eta_{1i}\alpha_{it-1} + \sum_{k=1}^{p}\beta_{ik}\,\Delta Y_{it-k} + \sum_{k=1}^{p}\lambda_{ik}\,\Delta X_{it-k} + \varepsilon_{1it}$

(2) $\Delta X_{it} = \propto_{1j} + \eta_{2i}\alpha_{it-1} + \sum_{k=1}^{p}\beta_{ik}\,\Delta X_{it-k} + \sum_{k=1}^{p}\lambda_{ik}\,\Delta Y_{it-k} + \varepsilon_{2it}$

Where ΔY and ΔX denotes the I(d) (order of difference) for the variables, and where i=1,2,…,N cross section units and t=1,2,…,T periods. The ε (error terms) should be serially uncorrelated, the α_{it-1} coefficient represents the error correction term which is the result of a long-run cointegration (Baker, Merkert, and Kamruzzaman 2015), while the η coefficient represent the dependent variables deviation from the long run run equilibrium. The p term represents the number of lags used.

Following Baker, Merkert, and Kamruzzaman (2015) I will seek to measure the long and short run causality. From the VEC model we will obtain the value of the α_{it} coefficient, this value should be a number between 1 and 0, and it has to be a negative number. This coefficient will indicate how much of the disequilibrium will be corrected over one year, so if it turns out to be positive it would not make any sense, since the future cannot predict the past. The short run causality will be estimated by conducting a standard Wald test on all lagged variables, this test will check the combined significance of the dependent variables lagged terms λ_{ik}. If the test turns out to be statistically significant I can conclude that Y granger causes X in the short-run. In addition, I will test for a strong granger causality applying a similar Wald testing procedure, where λ_{ik}.=0 and $\eta_{1i} = 0$.

3.3.3.1 Approach and assumptions

In order for the VEC model to produce correct results, I need to do some assumptions on the co-integrative relationship between the two variables. The approach to VEC models is first to test for stationary, in level and differences. In this approach, I assume to have eliminated the stationary problem by applying logged variables in first difference, which follows the approach of Mukkala and Tervo (2013) when dealing with the unit-roots. Then the second step before preforming a VEC model, is to test for co-integration in the first difference I(1). If there is a co-integration relationship between the two variables, I can assume that there is a relationship between them and safely apply a VEC model.

When testing the co-integration in first difference I will use a test based on Johansen (1995) for panel data provide by Eviews software 9.5. The Johansen test is based on maximum likelihood of a matrix (r-1) under the assumption that the error variables are normally distributed (Startz 2015). To continue I need to make some additional assumptions about the co-integration relationship, I follow Startz (2015) tip and apply the most commonly used co-integration assumption from Johansen (1995). I will assume that the level data Y_t have linear trends but the co-integrating equations have only intercepts (Startz 2015),the formal presentation of this Johansen co-integration test is as follows (Startz 2015):

$$H_1(r): \Pi y_{t-1} + Bx_t = \alpha(\beta' y_{t-1} + p_0) + \alpha_{\perp} y_0$$

Where the co-integration relations $\beta' y_t$ are regressed on a constant, in order to identify whether the error correction term has a sample mean of zero (Startz 2015). Johansen (1995) writes the following about the H_1(r) model;

> "*... It still has a linear trend given by the trend coefficient ... but this can be eliminated by the cointegrating relations β, and the process contains no trend stationary components.* ***Thus the model allows for linear trend in each variable but not in the cointegrating relations****." - (Johansen 1995)*

The reader should note that this Johansen model is chosen because it was stated by (Startz 2015) that it is the most commonly used Johnsen test, in addition this model was the one which produced the most significant results when applied in the Eviews software 9.5 on the variables. This is a limitation of the study, since the choice of cointegration test is not based on an understanding of the concept. The bold text in the cited text above represents the assumption taken regarding this model, and if this is found not be true in future research the results from chapter 4.3 should be discarded.

3.3.4 Data collection

The data used in this test had to represent economic development and airport activity. The ideal data to represent economic development would be GDP, however since I'm applying the tests on a regional level this data is not applicable. The initial idea was to let employment represent regional economic growth, however this data was only available for 15 years, and for this model to be robust I need to apply data for a longer period if possible. Therefore I followed Baker, Merkert, and Kamruzzaman (2015), and calculated aggregated real taxable income (ARTI). The data for real taxable income where found at Norwegian Statistics (SSB) websites, this data were available from 1993 to 2014, which gave me a time series of 22 years. The real taxable income where found at a municipality level, and aggregated into their respective regions. Then I adjusted the data to represent 1998 NOK using the consumer price index provided by Norwegian Statistics SSB (2015).

To represent airport activity, I will use passenger data. This data was available per request from Avinor for all Norwegian airports in the timeframe 1983-2015. Another possibility could be to use aircraft movements, however do to the use of small aircrafts on many routes as discussed in chapter 2.2.1, aircraft movements in some regions would be artificially high compared with the passenger numbers. Furthermore, freight data would be interesting to test, however this data is not easily available. The datasets and descriptive statistics are further discussed and presented in chapter 4.1.

3.4 2SLS Regression model specifications

In order to quantify air transports effect on regional development, I computed a regression model. This approach is recognized thru previous studies (e.g. Brueckner 2003, Percoco 2010) and has shown to produce good results. My model is based on these previous studies, however the formal model follows the general model from Gujarati (2003). First let us assume that the function of regional employment (Y_i) is as follows;

(1) $Y_i = \propto_{10} + \beta_{11}T_i + \beta_{12}X_{2i} + \beta_{13}X_{3i} + ... + \beta_{1k}X_{ki} + u_i$

Where Y_i denotes regional employment, T_i denotes passengers from regional airport and X_{ki} is a set of exogenous variables influencing the level of employment in addition to the proposed T_i. Furthermore, let us assume that airline traffic is decided by the function in equation (2), where Y_i is one of the variables influencing the volume of airline passenger, and that there exists a set of exogenous Z_{ki} variables also affecting T_i.

(2) $T_i = \propto_{20} + \beta_{21}Y_i + \beta_{22}Z_{2i} + \beta_{23}Z_{3i} + ... + \beta_{2k}Z_{ki} + v_i$

Since I want to estimate the effect from regional airports (T_i) on regional economic growth (Y_i), one would normally compute the regression model with equation (1). However, since T_i is a linear function of u_i (and thereby correlated with u_i) I would violate the assumptions for the general model and the standard appraisal method ordinary least squares (OLS) results would be biased. In the case of endogeneity Gujarati (2003) proposes the use of the two stage least square method (2SLS), to cope with the endogeneity problem. This is also the approach of (Brueckner 2003, Green 2007, Percoco 2010).

To get rid of the correlation between T_i and Y_i's disturbance term u_i, I need to find a proxy for T_i that will not correlate with u_i. Let us call the proxy $\hat{T}_i$. The first stage of the 2SLS model will be to generate the proxy, and the second stage will be to estimate equation (1) where T_1 is replaced with $\hat{T}_i$. To generate such a proxy we need at least one Z_{ki} value that determines T_i but does not influence Y_1, this is formally explained in the following way:

$$COV(Z, u) = 0$$
$$COV(Z, T) \neq 0$$

Such instrumental variables (IV) or in this case Z_i values are often hard to find, however assuming I am able to find at least one, the next approach may be formally explained in the following two steps presented in (Gujarati 2003). The first step is to regress T_i on all the predetermined variables of Y_i, this means regressing T_i on all the X_{ki} variables from equation (1) as follows:

(3) $T_i = \propto_{30} + \beta_{31}Z_i + \beta_{32}X_{2i} + \beta_{33}X_{3i} + \ldots + \beta_{3k}X_{ki} + v_i$

In equation (3) I will include all of the exogenous variables from equation (1) on the right hand side and add my instrumental variable (IV) Z into the equation. This process generates a new set of values for the proxy variable $\hat{T}_i$:

(4) $\hat{T}_i = \propto_{30} + \hat{\beta}_{31}Z_i + \hat{\beta}_{32}X_{2i} + \hat{\beta}_{33}X_{3i} + \ldots + \hat{\beta}_{3k}X_{ki}$

(5) $T_i = \hat{T}_i + \hat{v}_i$

Then I can substitute T_i in equation (1) with the new values of $\hat{T}_i$:

$$
\begin{aligned}
(6) \qquad Y_i &= \propto_{10} + \beta_{11}(\hat{T}_i + \hat{v}_i) + \beta_{12}X_{2i} + \beta_{13}X_{3i} + \ldots + \beta_{1k}X_{ki} + u_i \\
&= \propto_{10} + \beta_{11}\hat{T}_i + \beta_{12}X_{2i} + \beta_{13}X_{3i} + \ldots + \beta_{1k}X_{ki} + (u_i + \beta_{11}\hat{v}_i) \\
&= \propto_{10} + \beta_{11}\hat{T}_i + \beta_{12}X_{2i} + \beta_{13}X_{3i} + \ldots + \beta_{1k}X_{ki} + u_i^*
\end{aligned}
$$

Where $u_i^* = u_i + \beta_{11}\hat{v}_i$

The advantage of this method is that although T_i is likely correlated with the disturbance term of Y_i in equation (1), by using a proxy variable $\hat{T}_i$ and appropriate instrumental variables Z I can calculate an adapted version of equation (1) (presented in equation 6) as an ordinary least square regression without violating any of the assumption of the general model.

The reader should note that all the calculations will be done applying a 2SLS model directly in the software Eviews 9.5, in addition a Durbin-Wu-Hausman test will be estimated to test the endogeneity of all the appropriate regressors. The instrumental variables are also tested using the Durbin-Wu-Hausman test, in addition these variables are tested using a residuals test provided by the Eviews 9.5 software, which we will not go into detail on. The reader should also note that to my knowledge such tests are not performed in the previous studies, in this thesis they only work as an additional assurance of the model. Therefore, the results of these tests will not be reviewed in the main frame of the thesis, however the “Hausman test” results will be noted in the regression results and the output from Eviews related to this test can be found in Appendix C, where the formal explanation of the model is also provided.

3.4.1 Data collection

The data used in this model will be collected from Norwegian Statistics and Avinor. I will use passenger data to represent airport activity, and employment data to represent regional growth. In addition, I will have to find data which exogenously affect employment level. To find this I will follow the approach of previous studies and see which fits the best, meaning those variables that shows to have a statistical significant effect. Such data could be population, age, education, centrality, regional characteristics etc. Furthermore, when applying a 2SLS model, it is important to choose the correct instrumental variables. Therefore allot of focus will be put into testing a set of instrumental variables, such instruments will probably have to be computed as binary variables, which is done in previous studies (e.g. Brueckner 2003, Percoco 2010), however this is not a necessity of the model. The data used in this model are further presented and discussed in chapter 5.1.

3.5 Survey design

The most common approach when doing a survey is preparing a questionnaire (Frankfort-Nachmias and Nachmias 2008). The authors further express that when creating such a questionnaire the creator must make sure that the questionnaire translate the research objectives into specific questions. Survey questions may be concerned with facts, opinions, attitudes, respondents motivation, and their familiarity with a certain object (Frankfort-Nachmias and Nachmias 2008). Furthermore, the authors argue that most questions may be classified in two general categories, factual or subjective experience questions. Where the factual questions would be used for mapping and classifying the surveyed objective, while the questions regarding subjective experience would be used to find their attitude or opinion towards something.

There are off course some disadvantages with using a questionnaire, it requires “simple” questions and the researcher will have no opportunity probing the answers (Frankfort-Nachmias and Nachmias 2008). In addition, the authors state that there will be a low response rate and the distributor will have little control over who actually fills out the form. Furthermore Frankfort-Nachmias and Nachmias (2008) writes that the respondents should be determined by nature of the study and by the characteristics of the population. From the case study literature, the population should be within a limited space (Yin 2009), the space may be time and/or geographical boundaries.

The foundation of any questionnaire is the questions (Frankfort-Nachmias and Nachmias 2008), as I wrote previously the authors split questions into two categories; factual questions and questions about subjective experience. In this research, most questions will be factual, these are questions that tells the respondent to answer questions based on facts which he/her should have access to or knowledge off. The factual questions may be used to group the respondents, in addition these are questions related to financial performance, number of air travels and so on. These questions need to be formulated properly in order for the respondent understand the question, in addition the researcher must make sure that the respondents know the information, and that they are not reluctant to answer. Furthermore, there will be some questions related to the respondent’s subjective experience, these are often referred to as questions related to attitude. Examples of such questions might be questions about the respondents (businesses) feelings about existing air transport network, their prediction of future dependency and so on.

Furthermore Frankfort-Nachmias and Nachmias (2008) identifies two types of questions, open ended and close ended. The close ended are questions where the respondent picks between pre-defined answers, while in open ended questions the respondent may answer in his/her own words. In this research some of the questions are open ended, while many are a mixture between open and close ended. Frankfort-Nachmias and Nachmias (2008) writes of the special case of close ended questions called contingency questions, these are questions that applies only to a subgroup of the respondents. In the electronic questionnaire developed for this thesis there will be a at least one contingency question, since some answers needs follow up questions. There are also a set of panel questions, these are designed so that the respondent can answer a statement, with the grading in a scale. Questions that address the opinions or importance related to air transport are formed this way, for the scale I follow the recommendations given in Fink (2003) and provide five levels in the scale, this scale is fairly similar to the Likert scale which is often used in questionnaires.

The survey design and approach follows the guideline provided in Fink (2003) for self-administrated questionnaires. And I have used this book to identify how to ask certain question. In addition I follow the framework provided in Bråthen et al. (2006) and their recommendations when considering catalytic effects in a survey approach. Some of the questions are also similar to those questions provided in Bråthen et al. (2006), in addition the catalytic study of Halpern and Bråthen (2010) provided some inspiration with regards to the questions in the questionnaire.

The questionnaire was developed for three regions, first I wanted to survey Molde and Sogndal. However, the distributor of the survey in Molde gave some information indicating that the timing of the survey might not be optimal. Therefore, this questionnaire was not distributed after all and I tried my luck in Ålesund instead. However, here there was little response to the survey so I had to discard this one as well. Sogndal on the other hand provided a few answers, the results from this survey will be presented in chapter 6.0, in addition a paper copy of the questionnaire is provided in Appendix D.

Since this survey is conducted in only one airport region, the results cannot be generalized in any way, which is a weakness with this method in general as well as of this thesis.

PART II

4.0 Analysis 1 – Test of heterogeneous causality

4.1 Data and descriptive statistics

As discussed in chapter 3.3.4, the data used in the analysis to represent regional economic growth and airport activity is aggregated real taxable income (ARTI) and airport passengers (PAX). All the data was grouped into a panel data sheet, with time series. And the data was logged using their natural logarithms by Eviews 9.5 software for econometric analysis.

A critical factor when considering which data to use was the availability over several periods, in addition since I use financial data I had to account for the inflation. ARTI is computed using the mean taxable salary of each municipality per year, these are aggregated into regional levels and adjusted to represent into 1998 NOK using the consumer price index from Norwegian Statistics (SSB 2015). The time period for the analysis is 1993-2014. The descriptive statistics for all sub groups and the total are presented in Figure 15.

Passenger numbers, denoted PAX, where selected to represent airport activity. The data was available for the time period 1993-2014 per request from Avinor. After some testing and addressing other studies, total scheduled passengers from the airport was used, this is similar to the data used in Baker, Merkert, and Kamruzzaman (2015). The data includes transfer passengers to some extent, which may lead to double counting at some airports. Furthermore, addressing the catchment areas discussed in chapter 2.2.2, one can see that some airports are located in the same "region". For these airports I had to sum up the passenger numbers. This was the case at three airport regions, Trondheim, Oslo and Harstad/Narvik. Trondheim was merged with Ørland, Oslo Gardermoen was merged with Rygge and Sandefjord, and Harstad/Narvik Evenes was merged with the smaller Narvik Airport. In addition to Avinors airports, this study includes privately owned airports such as Skien, Stord and Notodden, which are all included in the Local sub-group. The descriptives for PAX in total and the sub groups is presented in Figure 15. Note that the descriptives are not in logarithmic forms.

	All airports				National Airports			
	Mean	SD	Obs.		Mean	SD	Obs.	
			Min =	6,5E+07			Min =	3,2E+10
ARTI	2,54E+10	9,2E+10	Max =	1,1E+12	2,11E+11	2,46E+11	Max =	1,1E+12
			N =	1034			N =	88
			Min =	0			Min =	1771361
PAX	750972,8	2708076	Max =	2,8E+07	6842488	6699822	Max =	2,8E+07
			N =	1034			N =	88

	Regional Airports				Local Airports			
	Mean	SD	Obs.		Mean	SD	Obs.	
			Min =	9,3E+08			Min =	6,5E+07
ARTI	1,66E+10	1,83E+10	Max =	1,2E+11	4,86E+09	7,27E+09	Max =	6E+10
			N =	264			N =	682
			Min =	42155			Min =	0
PAX	550613,3	441828,1	Max =	1910680	42529,44	35518,2	Max =	161437
			N =	264			N =	682

Figure 15, Descriptive statistics ARTI and PAX. Data source: Avinor, SSB, Own work

From the descriptive statistics in Figure 15 we can see that the standard deviation of ARTI for all airports and local airports are quite high compared with the standard deviation for regional and national airports. This high standard deviation shows us that we have a large spread in the data series, in the case of local airports the reason for this spread might be that we include both regions with a high employment rate and remote northern region with a low employment rate.

The all airports data is used in the test for homogeneous non-causality (HNC) and homogeneous causality. While the sub-groups are used to test for heterogeneous data, the subgroups where computed using Eviews 9.5 based on Avinors airport classification. Furthermore, only the sub-groups Regional and Local airports where tested for short and long run causality, since these where the only sub-groups that seemed to be heterogeneous.

4.2 *Three step approach of determining heterogeneity*

In this chapter, I will test whether the causal relationship between ARTI and PAX is in fact different among the airport types, or catchment areas. A heterogeneous causality means that airports effect their respective catchment areas differently. If one or more of the sub-groups are shown to have a heterogeneous causality in one or both directions, one can state that the airport type does in fact matter for the causal relationship, and that not all airports effect its catchment area equally.

The next steps are performed using a standard VAR model in Eviews 9.5 (explained in chapter 3.3.2) to produce the residuals series, and a Wald test which computes the F-statistics for each lagged variable, in addition the Wald test provides the statistics probability (p-value) which is used to confirm or reject the null-hypothesis for each step. The number of lags determined by Eviews 9.5 when applying the Schwarz Info Criteria, According to Startz (2015) applying the Schwarz Info Criteria in Eviews will give correct number of lags with respects to the number of years included in the time series. In this thesis, the number of lags applied is four.

4.2.1 Step 1 - Testing for Homogeneous non-causality

This first test assumes homogeneous non-causality between the variables, in Table 3 the F-statistics from the Wald-test are presented. The number of stars behind each F-statistic indicates the probability. The null hypothesis is formally presented in equation (2) in chapter 3.3.2. Generally speaking, the null hypothesis states that there does not exist a homogeneous bidirectional causality running between ARTI and PAX. If any of the F-statistics produced in the Wald test are significant for any number of lags, one can reject the null hypothesis that there is no homogeneous causality between the variables.

Test for homogeneous non-causality (HNC) F-statistics		
Lags	PAX on ARTI	ARTI on PAX
LAG 1	5,022**	1,128
LAG 2	2,428	1,823
LAG 3	0,790	0,046
LAG 4	11,25***	9,732**
The significance level (p-value). *0,1 **0,05 ***0,001		

Table 3, Homogeneous non-causality (HNC) results. Source: Own work

Column 1 in Table 3, presented statistically significant F-statistics for LAG 1 and LAG 2, which lets me reject the null hypothesis of homogeneous non-causality running from PAX to ARTI. Column two tests the homogeneous non-causality running from ARTI to PAX, here one can see a statistically significant F-statistic in LAG 4, which lets me reject the null hypothesis also for this directional relationship.

I can therefore move on to Step 2, which test for homogeneous causality, for both the directional relationships.

4.2.2 Step 2 - Testing for Homogeneous causality

Step 2 tests whether there is a homogeneous causality running from one variable to the other. This tests formal null hypothesis was introduced in equation (4) in chapter 3.3.2. The null hypothesis state that there is a homogeneous relationship, as with the previous step, I apply a Wald test to compute F-statistics for the residual series in equation (5) from chapter 3.3.2, if these F-statistics have significant p-values I can reject the null hypothesis that there is a homogeneous causality. If I am not able to reject the null hypothesis, I will stop the test for that direction and assume that the causal direction of the relationship is homogeneous.

Test for homogeneous causality (HC) F-statistics		
Lags	PAX on ARTI	ARTI on PAX
LAG 1	11,04***	0,401
LAG 2	22,98***	0,525
LAG 3	1,339	0,204
LAG 4	0,353	1,156
The significance level (p-value). *0,1 **0,05 ***0,001		

Table 4, Homogeneous causality (HC) results. Source: Own work

From Table 4, one can see that the F-statistics when assuming equality in the slope coefficients are indeed significant for LAG 1 and LAG 2 in PAX causing ARTI. This means that different levels of PAX will cause ARTI in different manners. Which lets me continue the testing, by splitting the all airport group into sub groups to determine whether different airport types actually effect regional economic growth differently. I will therefore continue testing for a heterogeneous non-causality running from PAX to ARTI, in chapter 4.2.3.

I am however not able to reject the null hypothesis in the causality running from ARTI to PAX, which may be an indication that ARTI Homogeneously Granger cause PAX. In other words, the aggregated real taxable income, which in this case represents regional economic development, seems to effect passenger numbers equally in all regions. This lets me assume that ARTI causes PAX in "the same way" for all airport regions. I will therefore not include ARTI on PAX in the heterogeneous relationship test performed in the next section. Moreover, I will not test for a long-run and short-run Granger causality for this relationship either.

4.2.3 Step 3 - Testing for Heterogeneous non-causality

In step 3, I will examine whether the causal relationship between PAX and ARTI is heterogeneous, this is done in the same manner as the previous steps, by producing residual series (equation 6 in chapter 3.3.2) and testing them using a Wald test. Mukkala and Tervo (2013) used the subgroups Peripheral regions, middle regions and Core regions. I will follow their approach to some degree, however instead of focusing on the regions specifications I will let the subgroups be defined by the airport type in the specific regions. These are National Airports (Large cities), Regional Airports (Often regional centers and medium sized cities), and Local Airports (Which are airports in remote peripheral areas of Norway).

The null hypothesis is that there is a heterogeneous non-causality between PAX and ARTI, if the F-statistics produced by the Wald test is statistically significant in one of the four LAGS, I can reject the null hypothesis. From Table 5 one can see the test results for each sub group.

Test for heterogeneous causality (HENC)	
Lags	PAX on ARTI
Local airports region	
LAG 1	4,456**
LAG 2	11,55***
LAG 3	1,790
LAG 4	0,398
Regional airports region	
LAG 1	1,268
LAG 2	0,516
LAG 3	3,674*
LAG 4	0,764
National Airports region	
LAG 1	0,011
LAG 2	2,043
LAG 3	0,156
LAG 4	0,002
*0,1 **0,05 ***0,001	

Table 5, Heterogeneous non-causality (HENC) results. Source: Own work

As one can see from the results, only for the local and regional airport regions are there F-statistics that have a statistical significance which lets me reject the null hypothesis. This tells us that for these two subgroups PAX seems to Granger cause ARTI. The results are most evident for the Local airports, where I obtain quite significant F-statistics for the lagged periods 1 and 2, this indicates that passenger numbers have a significant effect on aggregated real taxable income for these smaller regions.

The results for regional airport regions are not as clear-cut, however there is an indication that also here there exists a relationship running from airport passengers to aggregated real taxable income. The p-value for LAG 3 at Regional airports, has the value 0,0572 from the Wald test. I therefore assume that this is statistically significant at a fair level, which lets me test the presence of long and short run Granger causality in this region as well as Local airport regions. The reason for this low significance might be that as the region gets larger and better connected, the marginal utility of air transport falls. This assumption is further strengthened when addressing the National Airports. For these airports I am able to reject heterogeneous causality all together, and a possible reason might be that for these large economies, with lots of alternative transportation, the airport is not as strong of a force affecting aggregated real taxable income.

To identify possible long run, and short run causality, and to compute strong-granger causality I will continue the testing procedure in chapter 4.3. For this test, I will only consider granger causality from PAX to ARTI for local and regional airport regions, since these are the groups where I was able to detect possible heterogeneous causality.

4.3 Determining the existence of Granger causality

By examining the subgroups from chapter 4.2.3 I am able to determine the coefficients for the long and short run statistics as well as strong granger causality. The reason for the interest in long and short run causality is that it may be helpful when addressing investment and development of such smaller airports and smaller regions (Baker, Merkert, and Kamruzzaman 2015). If one can find long run causality, it indicates that the investment to increase airports efficiency (PAX) may in fact create a higher productivity in the region (ARTI) in the long run. The short run causality, gives indications that one may see effects on ARTI from growth in PAX the same year. In addition, I will compute strong granger causality statistics, in order to determine whether the combined causalities are significant within a five percent level, if they are I can say that PAX Granger causes ARTI.

The test is performed using a vector error correction (VEC) model in Eviews 9.5 (the VEC model is explained in chapter 3.3.3), for the Local airports I only include two lags since there were indications that this is where the significant causality is from the previous HENC test. For Regional airports I include four lags since it was first in the third lag there was a possible heterogeneous causality. The reason for using a VEC model is that it produces a correction term, which is used to indicates long-run causality (Baker, Merkert, and Kamruzzaman 2015).

Explanatory factors	Model 1: ΔARTI (LOCAL)		Model 2: ΔARTI (REGIONAL)	
	Coefficient	t-value	Coefficient	t-value
Constant	0,088021***	19,59		
1-year lag of ΔARTI	-0,224429***	-5,48	-0.280341	-4.19
2-year lag of ΔARTI	-0,110087**	-2,71	0.008710	0.13
3-year lag of ΔARTI			0.124004	1.84
4-year lag of ΔARTI			-0.217110	-3.48
1-year lag of ΔPAX	**0,006019**	0,99	**0.067475****	2.84
2-year lag of ΔPAX	**0,012624****	2,34	**0.066615****	2.73
3-year lag of ΔPAX			**0.025620**	1.05
4-year lag of ΔPAX			**0.089442*****	3.67
Long-run causality	-0,000758	-1,45	-0,001396**	2,73
Adj. R-squared	0,056		0,338	
LOG likelihood	1039,71		481,82	
F-statistic	7,98		10,99	
Pro (F-statistic)	0,000		0,000	
Notice that all variables are computed using their natural logarithmic form.				
Significance, *0,1 **0,05 ***0,001				

Table 6, VEC results ΔPAX on ΔARTI for local and regional airports. Source: Own work

The way to read the results in Table 6, is to look at the bold numbers, these represent the effect of PAX on ARTI for each lag (year). The number of stars indicates the significance of the lagged variables. As we can see from model 1, only the second year lag is significant. From Model 2 we can see that of the four years, only the third does not produce a significant effect on ARTI from PAX. The variables presented, are all in their natural logarithmic form. The reader should notice the low R-squared value of Local airports, which indicates that much of the growth in ARTI for these regions are not explained by PAX. On the other hand, at a Regional level the R-square value is high, indicating that we may have a sufficient model. However, the reader should remember that Regional airports barley made it out of the HENC test, and this may influence the results.

The Long run-causality coefficient is the speed of adjustment parameter of the model, this coefficient indicates the speed of which the error is corrected. This value should be negative and between 0 and 1. If the value were 1, the error would be corrected in one lag. We can see that the coefficients are quite low, especially for Model 1, however this coefficient is not statistically significant. For Model 2 on the other hand the significance of the long run causality is strong, with it being a logarithmic variable it is hard to find literature on how to interpret its meaning, therefore I choose not to in this thesis. I rather state that there is an indication that there exists a long-run causality from PAX at regional airports to ARTI in the respective regions.

Null hypoteses	Short-run χ^2-statistics (p-value)	Long-run - error correction coefficient (t-stat)	Strong granger causality χ^2-statistics (p-value)
Model 1: ΔPAX (LOCAL) does not granger cause ΔARTI (LOCAL)	5,675 (0,0586)	-0,0008 (-1,445)	8,829 (0,0317)
Model 2: ΔPAX (REGIONAL) does not granger cause ΔPAX (REGIONAL)	33,182 (0,0000)	-0,0014 (-2,729)	46,836 (0,0000)

Table 7, A summary of the causality coefficients obtained in the VEC. Source: Own work

In Table 7 the summary of the three different Granger causalities composed are presented, notice that the non-causality hypothesis in the short run for Model 1 is only significant within the 10 percent level. However, I am not able to reject the no long-run causality hypothesis for this model. Furthermore, there is a significant chi-square value on the strong granger causality, which indicates that there is an indication that Local PAX Granger cause Local ARTI.

Furthermore, for the second model (regional airports) all of the non-causalities are rejected. This lets me assume that Regional PAX does strongly Granger cause Regional ARTI, in addition to Granger causing ARTI both in the long and short run.

These results give an indication that there is a Granger causality between the variables, which represents air transport supply and regional economic development. We have seen from these results that with statistically significance, I was able to reject the null-hypothesis of no Granger causality between Local air transport supply (PAX) and their respective catchment areas economic development (ARTI), in addition there are indications that this causality has a short run effect. Which lets me assume that an Investment to increase air transport supply (PAX) at Local Airport may affect the economic development (ARTI) positively, in the short-run. However, there should be a demand in the market for such investment as well, otherwise the investment would have no effect.

For the regional airport regions, I am able to prove the existence of Granger causality running from airport efficiency (PAX), to economic growth (ARTI). In addition, there were indications that this causality had long and short run effects. Which lets me assume with statistical significance, that an investment to increase a regional airports efficiency may lead to a higher growth in economic development in the respective airports catchment area over time.

4.4 Concluding remarks and answering relevant research questions

As we saw from chapter 3.3.1, stating that there is a relationship between two variables, and testing this with intermediate is controversial. However, I followed the approach of previous studies on a similar topic and found results in the context of Norwegian air transport. In this chapter I will try to answer the relevant research questions presented in chapter 1.1, in addition I will present an interpretation of the results and these results may affect regional economic development.

RQ 1 *Is there a relationship between regional air transport and regional economic growth in Norway?*

Yes, in this thesis I do find indications that on a general level one can reject the null hypothesis of Homogeneous non-causality for both directional levels. Which lets me assume that there is a bidirectional causality between Air Transport and Economic Growth. However, this relationship is not conclusively determined here, since what I found is that the variables PAX/ARTI seems to effect ARTI/PAX, the strength of the results lies on the strength of these variables in explaining air transport and regional economic development. In addition, the homogeneous causality running from ARTI to PAX have to be further investigated in order to conclude anything.

RQ1.1 *How does the relationship differ among airport types and economic size?*

I found that the directional causality running from ARTI to PAX, did not seem to be heterogeneous. This tells me that economic size (ARTI) would not Granger cause PAX differently if one were to split ARTI into sub-set regions. I was however able to reject the null hypothesis of homogeneous causality when considering the directional relationship running from PAX to ARTI, this let me continue testing for differences between airport types when considering Granger causality running in this one direction.

The results of the HENC test, showed that the causality running from PAX to ARTI at Local Airports seemed to show strong tendencies towards a heterogeneous relationship, while this directional relationship on Regional Airports was a bit weaker. A possible reason for this may be that the marginal utility of air transport may be stronger in the local regions. Nevertheless, the results let me assume that Local and Regional Airports PAX does effect ARTI differently.

These results may work as an indication that air traffic matters for regional development, it seems to boost regional development for both Local and Regional airports. What these results mean for the regional economy is that the presence of air transport may be a facilitator in attracting firms and economic activity to the region. Airports will facilitate growth in these remote regions and in smaller cities, because of the relationship between the centripetal and centrifugal we saw in the theory concerning new economic geography. Furthermore, when applying the heterogeneous causality, we saw that the airport had a much larger significance for the rural Local airports than for the Regional Airports, what this means is that air transport might be of greater importance in these regions. Which seems obvious when considering alternative transport, since in many of these remote areas there exists little alternative to air travel. Therefore, air transport seems to have an important role for the in these regions.

To sum up the results of RQ 1 and 1.1, we saw that the supply side effects are homogeneous for all regions. Differences in aggregated income seems not to change the supply for air travel. While the demand side effects, seems to be more crucial at a Local level and to some extent at the regional level.

RQ 2 *Are there indications of Long and Short run Granger causality between air transport and economic growth in Norway?*

I tested for Long and short run causality on those airports that seemed to have a heterogeneous causality running from PAX to ARTI. I found that for the sub-set Regional Airports there where both a Long and Short run causality running from PAX to ARTI. Which lets me assume that if PAX where to grow at Regional Airports, one would see an immediate effect in the regions aggregated real taxable income. In addition, one might see a tendency of long run growth in the regional economy following this rise in passenger volumes.

For the Local airports these results were not as clear, however we did see here that a short run causality was present. Which implies that a rise in passenger volumes at these Local airports will increase the aggregated income in the region the same year.

The results from these causality tests, confirms the general assumption that air transport facilitates growth, the results however does differ from those found in the previous studies which this analysis is based on (e.g. Baker, Merkert, and Kamruzzaman 2015, Mukkala and Tervo 2013). This is no surprise however, since the structure of air transport supply is quite unique in Norway. What may be the most important factor in these results are not the long and short run Granger causality effects, but the indications of a significant strong Granger causality, which strengthened the belief that the remote and regional airports do matter for economic development in their respective catchment areas.

From a Local airport perspective, these results may serve as a justification for the large amount of subsidies which are spent to facilitate air transport activity in these regions. And we may interpret that the money spent to keep the activity going, does work as a facilitator for economic growth in the region. From a policy perspective we saw that the Norwegian Government wanted to ensure activities in rural regions (Regjeringen 2015a), airports are perceived as a tool to achieve this goal. What we see from the causality may be interpreted as a confirmation, that this perception is correct.

At the regional level, we saw both strong Granger causality and long/short run causality. These Regional Airports are as discussed earlier, important trade or political centers in their respective regions. They serve larger catchment areas and more activity is located here than in the local regions. Most of these airports have less than 1 million PAX per year, and they are with no doubt small regions in a global context and to some extent in a Norwegian context as well. Many of these regions have a prosperous industry, these industries might be located in these regions because of the strong centrifugal forces combined with the good transport links. One example here is the Regional airport of Aalesund which is located close to the globally competitive maritime cluster in Sunnmøre. This cluster is dependent on resources and information inwards to the region, so it is easy to understand that the airport plays a crucial role in the industries operation. If the connection to the global market where weakened, these regions economy surely would see negative effects. One might even state that if the connection is removed, the whole industry might relocate and agglomerate towards a more connected and prosperous region, as proposed in Bergo et al. (1996).

What we have seen in this chapter is that there seems to be a bidirectional causality running between aggregated real taxable income and passenger numbers in Norwegian airport regions. In addition, we saw that the Granger causality running from PAX to ARTI was heterogeneous, that is it had different effects dependent on airport type. Furthermore, I tested for long and short run effects, and found these to some extent at regional and local airports. However, what might be more important is that I found significantly strong statistics on the heterogeneous Granger causality for these sub-sets of local and regional airports. This further strengthens the belief that airports does matter for regional economic development, and that the presence of air transport might be a tool facilitating activity in remote regions.

5.0 Analysis 2 – Testing for productivity effects

In the next sub-sections, I will present the results from the applied 2SLS regression model. I have done several tests over the last few months and in this thesis I will present the regression results for the test which have the most significant instrumental variables (IV). I have chosen to present the test for two sets of airports, the first set consists of all Norwegian airports, while the second test is conducted on airports with less than 1 million passengers in 2013. Optimally the tests should have been conducted on the airport regions which was used in the causality analysis, however when doing this the results and the IV's where less significant for all regions. The tests are computed using Eviews 9.5 and the software's output may be seen in Appendix B, in the thesis main frame I have chosen to present the results in tables which are easier to read then those produced by Eviews. The tables include the first stage regression, as well as the 2SLS regressions performed on the different employment sectors.

5.1 Data and descriptives

In this regression analysis, I assume a continuous relationship between employment and airport efficiency, as opposed to the causality analysis where I worked with lags. Therefore, the availability of data over several periods is not important. However, since I specified in the general model that I assume passenger data is endogenous to employment, I will need to include both exogenous variables effecting regional economic growth and instrumental variables effecting passenger volumes in this dataset. In the process of the data collection, I had to consider which exogenous variables to include in the estimation of employment, in addition to finding at least one variable that correlates with airport efficiency but not with employments error term.

I followed the approach of Brueckner (2003) and Percoco (2010), and used total non-farm employment in the region for the chosen time period. In addition, I want to see if there are differences in the assumed effect when considering service employment and industrial employment individually. The total non-farm employment data will be denoted as EMP in the regression analysis, this data is obtained from Norwegian Statistics (SSB), and the year chosen to study is 2013. All the data from Norwegian Statics (SSB) where composed at a municipality level, I therefore had to aggregate the data into my definition of each airports catchment area. Furthermore, the original data was grouped into industrial segments, such as agriculture, manufacturing, financial services and more, this let me extract the data I needed to examine only service employment and industrial employment. Service employment is denoted SER_EMP in my regression analysis, while industrial employment is denoted IND_EMP. Included in the industrial employment is only those that are employed in a firm classified as a manufacturing firm, which represents category C in SSB (2009) statistical categorization. For service employment I have included the following sectors: Accommodation and food service activities; Information and communication; Financial and insurance activities; Real estate activities; Professional, scientific and technical activities, these categories may be examined in detail in (SSB 2009).

As with the causality analysis from chapter 4.0, passenger data is chosen to represent the airports activity. In the regression this data is denoted PAX, and the year chosen is 2013. Passenger data is used in most econometric studies addressing airport effects, and it seems to be agreed that it is a sufficient parameter representing airport activity/growth. Since I apply my own definition of the airports catchment areas, some airports passenger data is grouped (see chapter 4.1).

When I was considering what exogenous variables to include, I had to consider several variables, however I ended up with a set of three variables that seems to effect employment significantly. These variables are used in either Brueckner (2003) or Percoco (2010) and have proven their effect in these papers. The first exogenous variable chosen is denoted POP, this variable represents total population of the airports catchment area in 2005. The reason for using a population number older than the period I am testing is to avoid yet another endogenous variable, it would be endogenous since POP may in fact be jointly determined with EMP (Brueckner 2003). I expect the POP variable to have a positive effect on Employment on all levels, simply because without a population employment would be almost non-existent (at least on-shore).

The second exogenous variable is the percentage of the 2005 population with a higher education, denoted EDU. Higher education is defined as more than four years of college or university, most of these would have a master degree or higher. I expect education to have a positive effect on employment. I did run some test using the percentage of people with at least 1 year of higher education, however in that case the variable did not affect employment in a significant manner.

The third exogenous variable is a binary variable denoted NORTH, I assume that there are differences in employment levels in the North and South of the country, and thereby this variable might have an effect on employment. The variable has the value 1 if the airport is above Nord-Trøndelag County and zero if it is in or south of Nord-Trøndelag, I assume this variable to have a negative effect on employment, since the employment levels are lower in the northern parts of the country.

In addition to the included variables, I considered variables representing the county center of a region. This variable was considered because I assumed a region that has a county center would see positive employment effects. However, the variable did not affect employment or PAX significantly. Furthermore, I tested a parameter representing road infrastructure in the region, this was computed as the total of m^3 of paved road in the region. This variable did not affect employment in a significant way either. In addition I followed the approach of Brueckner (2003) and Percoco (2010), and tried to include a variable representing the aging population, which were assumed to affect employment negatively. However, this variable did not act as expected and was never significant.

In addition to my exogenous variables, I need to include one or more Instrumental Variable (IV). As discussed previously these variables should correlate with PAX, but not with EMPs (SER_EMP and IND_EMP) error term. Brueckner (2003) applies the instrumental variable hub in his study, this variable represents all hub airports, in addition the author considers the instrumental variable centrality. Similarly Percoco (2010) applies the instruments representing hubs, centrality and tourism in his study. The centrality parameter in Brueckner (2003) is computed as the distance from the center point of the country. In this Norwegian study, geographical centrality was not considered a sufficient instrument affecting airline passengers since we do not have the same structure as the US air transport market. I did however attempt to compute the HUB instrument, but when the variable was tested using the "Hausman endogeneity test" in Eviews it did not make my T-hat variable exogenous. I tested several possible variables using the Durbin-Wu-Hausman test, and ended up choosing the two instruments that performed the best. The first is denoted STAM, which is a binary variable with the value 1 if the airport is classified as a regional (or national) airport by Avinor. These airports range from Oslo Airport with more than 22 million PAX, and down to Lakselv Airport with its 62 387 PAX in 2013. I expected STAM to be correlated with EMPs error term, since I assumed that large airports are locate near large employment markets. However, after testing the variable I found that it did not and was in fact a good IV. In addition to STAM I found that the instrument OIL_HUB performed well in the "Hausman" test. OIL_HUB is a binary variable equal to 1 if the airport is a combined airport and helicopter terminal for offshore traffic. These airports would have a large number of PAX that does not enter or largely effect the local employment market directly. Since these workers are employed offshore they are not counted in the employment force in the airports catchment area or any of the other catchment areas, therefore the binary variable OIL_HUB is not correlated with EMPs error term, only with PAX. OIL_HUB did however only apply to five airports, and when I applied it in the regression as the only IV it did not perform well in the Durbin-Wu-Hausman test, the two variables are therefore applied together. It is important to note that the binary OIL_HUB is assumed not to correlate with the binary STAM.

A summary of the included variables are provided in Table 8, in addition the table also provides some descriptive data for the variables applied, before they were logged using their natural logarithms.

Variable	Definition	Mean	Minimum	Maximum
EMP	Total non-farm employment, 2013	43306,04	218	704636
SER.EMP	Total Employment in the service sector, 2013	7635,04	21	128526
IND.EMP	Total industrial employment, 2013	4460,13	29	63448
PAX	Total passengers travelled, 2013	1091666,17	4035	26654283
POP	Total population, 2005	94197,45	602	1996573
EDU	Percentage of population with at least 4 yrs. higher education, 2005	2,49	0,50	6,67
NORTH	Binary variable, 1 if North	0,55	0	1
STAM	Binary variable, 1 if stam airport	0,32	0	1
OIL_HUB	Binary variable, 1 if Oil hub	0,13	0	1

Table 8, Variable definitions and summary statistics. Source: Own work, Avinor and SSB

5.2 2SLS regression - all airports

In this section, I will address the results from my 2SLS regression on all airport regions. The results from the Durbin-Wu-Hausman endogeneity test (Hausman test) are presented as a note in Table 9. In addition, the reader should note that I expect all the variables to affect PAX positively. For the three employment variables, I expected PAX, POP and EDU to affect employment positively, while NORTH should have a negative effect. The reason why NORTH is expected to affect the PAX and employment differently, is that there are little alternative to air transport in the northern regions, so these airports have much more traffic than the southern airports relative to their population.

	All Airports , instrumental variable = STAM & OIL_HUB			
	PAX (OLS)	**EMP (2SLS)**	**SER_EMP (2SLS)**	**IND_EMP (2SLS)**
C	1,4206 (1,157)	-0,3038 (-1,218)	-2,7039 (-7,069)***	-2,0125 (-2,392)**
PAX		0,0900 (3,176)**	0,1501 (3,4539)**	0,1356 (1,142)
POP	0,9082 (6,9177)***	0,8367 (21,49)***	0,8001 (13,41)***	0,8353 (6,360)***
EDU	-0,3931 (-1,084)	0,3340 (4,625)***	0,4842 (4,372)***	-0,5470 (-2,245)**
NORTH	1,1116 (3,862)***	-0,2110 (-3,036)**	-0,3298 (-3,095)**	-0,9351 (-3,989)***
OIL_HUB	1,1654 (3,375)**			
STAM	2,0481 (6,527)***			
F-stat	58,93***	1460,51***	729,77***	116,74***
Adj. R^2	0,8778			
**P-value < 0,1 ** P-value < 0,05 *** P-value < 0,001 (t-stat in parentheses)*				
NOTE: All variables in LOGs *The independent IND_EMP does not pass the "Hausman-test" at a statistically significant level*				

Table 9, Output from the 2SLS regression model, on all airports. Source: Own work

From the first column in Table 9 (PAX OLS), one can see the coefficient of the included variables effect on PAX, this column represents the first stage regression of the two stage least square method. All the variables affect PAX in the way one would expect, except from EDU which have a negative value (not significant). If we address the significant coefficients, one can see that POP increases much faster than PAX, in addition if the airport were located in the north this would positively effect PAX. If the airport were an OIL_HUB this would increase the passenger numbers a bit, while if the airport is a STAM it would have a great effect on PAX. The idea with these IV's is to identify and control those airports with high numbers of passengers that are not influenced by employment in the region.

From the next three columns, we can see that POP, EDU and NORTH is reacting as I expected, with an appropriate statistical significance on both EMP and SER_EMP. While for IND_EMP, NORTH have a highly negative effect on employment. In addition, EDU also has a negative effect on industrial employment, however this is a sector were one can assume a low share of highly educated workers, and this might explain why it is negative.

Even though it is important that all the variables we treat as constants behave as expected, what we are interested in is the coefficient of PAX in these columns. This coefficient gives an indication to how the airport contributes to growth in a regions employment levels. One can see that PAX is significant for all non-farm employment and for service employment. One can interpret the logarithmic number in the regression to represent percentage change (or as an elasticity of employment). For all non-farm employment, the value of PAX is 0,09. What this tells us is that if passenger volumes would increase by 10 percent, all non-farm employment would increase by 0,9 percent. Similarly, for the service sectors employment, an increase in passenger volumes by 10 percent will lead to an increase in service sector employment of 1,5 percent. The industrial employment effects on the other hand is not statistically significant, so for this industry I cannot state the employment effects from air transport.

These results are similar to those seen in previous studies at the US metropolitan airports (e.g. Brueckner 2003, Green 2007). However they are larger than those found in Percoco (2010) study on Italian airports, which might indicate that Norwegian regions are more dependent on air transport since there exists less alternative modes of transportation than in Italy.

5.3 2SLS regression - small airports

The model performed in the previous chapter provides the employment effects on a generalized level, these results are to some degree applicable when addressing employment effects from Norwegian air transport. However, from the causality analysis I found that the catchment areas of Regional and Local airports seemed to be more influenced by the presence of air transport. I therefore conducted a similar 2SLS model as the one addressing all airports, and changed the dataset to only include airports with less than 1 million passengers. I did conduct a model on the local and regional airports respectively, however this model showed to be less significant. The results of the model conducted on smaller airports are given in Table 10.

	Airports PAX<1M , instrumental variable = STAM & OIL_HUB			
	PAX (OLS)	**EMP (2SLS)**	**SER_EMP (2SLS)**	**IND_EMP (2SLS)**
C	2,8730 (1,903)*	-1,0111 (-3,212)**	-3,1818 (-5,884)***	-2,3195 (-1,821)*
PAX		0,1223 (3,613)***	0,1537 (2,644)**	0,1278 (0,933)
POP	0,7510 (4,559)***	0,8790 (24,67)***	0,8493 (13,88)***	0,8777 (6,086)***
EDU	-0,2812 (-0,664)	0,2789 (3,681***	0,4290 (3,294)**	-0,5872 (-1,194)*
NORTH	1,0114 (3,229)**	-0,2000 (-2,888)**	-0,2983 (2,507)**	-0,9067 (-3,234)**
OIL_HUB	1,2874 (3,049)**			
STAM	1,8001 (4,857)***			
F-stat	17,83***	914,84***	345,16***	49,39***
Adj. R^2	0,7298			
**P-value < 0,1 ** P-value < 0,05 *** P-value < 0,001 (t-stat in parentheses)*				
NOTE: All variables in LOGs *The independent IND_EMP does not pass the "Hausman-test" at a statistically significant level*				

Table 10, Output from the 2SLS regression model, on smaller airports. Source: Own work

Notice that all the coefficient are performing as expected (this was discussed at the beginning of chapter 5.2), except from the coefficients effecting Industrial employment. In addition, the reader should also notice that the POP variable increases, while both EDU and NORTH decreases. This might indicate that population have a larger explaining power with regards to employment in these smaller regions, in addition these less populated regions might have a lower degree of educated people, and therefore this coefficient is affected. The reason for NORTH to have a lower effect might simply be that the share of northern airports has increased.

Addressing the PAX coefficient for all non-farm employment, one can see that this have increased for these smaller regions. In this thesis, EMP represents the general employment level, and this increase therefore implies that the smaller regions are more dependent on air transport. A reason for possible increased dependence might be that there exists less alternative transport for the passengers in the regions considered. The new elasticity shows us that if PAX increase by 10 percent, all non-farm employment will increase by 1,2 percent. For service employment, the elasticity is just a fraction higher than in the model addressing all airport regions. Which again indicates that a 10 percent increase in passenger volumes will lead to a 1,5 percent increase in service sector employment. The

PAX variable when considering industrial employment is not significant, in addition the instrumental variables applied on IND_EMP did not pass the "Hausman test".

5.4 Concluding remarks and answering relevant research questions

The method I use to produce these results have been adapted from similar studies on the topic, in this thesis I discussed among others the results of Brueckner (2003) and (Percoco 2010) who used the same methodology and served as an inspiration. Of these two studies, the Italian study of Percoco (2010) is most similar to this Norwegian approach. Nonetheless, in this thesis I produce results greater than those in the authors Italian study, however when addressing a study performed to measure the efficiency of air transport in these two countries (Merkert and Mangia 2014), a possible reason for this difference is eminent. The Norwegian regions have less alternative modes to air transport, and might therefore be more dependent on this transport mode than the Italian regions.

The model would have been stronger if it had been conducted on the sub-regions from the causality analysis in chapter 4.3, however in that case the number of airports and regions considered might not have been sufficient. On the other hand, since I found that Regional and Local airports affect their catchment areas in different manners in chapter 4.2.3, this might indicate that I should have treated these airports differently. However, I did find that both sets of airports showed to have a short-run Granger causality, which at least confirms that it was correct to assume continues relationship between the variables.

Next I will seek to answer the relevant research questions related to this analysis, which are RQ 1, 3, 3.1 and 4. I will mainly apply the results of the first Model on all airports in the answering of research questions. While the results from the model conducted on smaller airports will be applied in a case study on a Local airport in chapter 7.0.

RQ 1 *Is there a relationship between regional air transport and regional economic growth in Norway?*

First of all, this question is answered in chapter 4.4 which is related to causality, however applying 2SLS regressions lets me determine the size of the effects and produce productivity elasticities. We saw from all the four models in the previous sub-sections that there were indications that passenger levels had a positive effect on employment. Which lets me state that an airport will effect a regions productivity in a positive manner. Additionally, I found indications that at all non-farm employment level in a region (which may represent regional productivity), will increase by 0,9 percent when passenger volumes in the regional airport grow by 10 percent. I will therefore confirm that yes, there seems to be a relationship between air transport and economic growth.

RQ 3 *Do airports create catalytic employment in a region?*

To address this research question I will have to find the average direct, indirect and induced employment effects and see if my 2SLS regression creates any additional employment beyond this. From Avinor (2015a) I found that for 2014, the assumed total employment from air transport was approximately 60 000 people (Direct, indirect and induced). If I assume that this number was equal in 2013, I can calculate the number of employees in these activities per million PAX. The result from this calculation shows that 1169 jobs are created per million PAX from direct, indirect and induced activities on all Norwegian airports. So if the PAX where to increase by 1 million, one could assume that 1169 jobs will be created in these activities as a result of it.

Furthermore, if I apply the elasticities produced from my regression analysis, I am able to calculate the number of jobs created from an increase of 1 million PAX. This number will represent the total number of jobs created from, direct, indirect, induced and catalytic effects. When applying the elasticity, I found that a total increase of 1 million PAX in Norway would create as much as 3664 jobs in all non-farm sectors, which lets me assume that a total of 2495 jobs will be created catalytically in the economy. These are rough calculations where I assume that no employment is fixed in the short run, this is off course not an appropriate assumption since neither airports or firms generally practices the hire/fire strategy, in addition there is most likely a minimum number of workers needed to run an airport, therefore the assumption is wrong. However, these calculations do give an indication of how air transport might contribute to economic growth thru employment effects. And since the number of direct, indirect and induced per million PAX is known, one might assume that the 2495 extra units of employment is created catalytically. It will be interesting to see these results when applying them to a case study of Sogndal airport in chapter 7.0, and see how they contribute to growth in such a small and specific region.

RQ 3.1 *Will service employment be more dependent on air transport?*

Previous studies have shown that the service industry is more dependent on air transport than others (e.g. Percoco 2010). I wanted to test this in a Norwegian context as well, and I did find indications that the service sector had a greater effect from potential change in passenger volumes in this thesis. Therefore, I can answer that yes, it seems that service sector employment is more dependent on air transport in Norway.

RQ 4 *Does the industrial structure of a region matter for the airports effects?*

I am not able to answer this question directly, and it is to some extent easier to answer such a question using survey results. However, from the results generated by the 2SLS model, there are indications that air transports effect on the Industry sector seems to be lower than the effects on aggregated employment levels and the service sector employment. This shows that at least industry segments are effected differently from air transport, and if a region is heavily dependent on manufacturing for instance, this region seems to be less dependent on air transport than a region with much of its workforce within the service sector, such as financial services and hospitality for instance. However, it should be noted that an industry goes beyond that of the segments provided by Norwegian Statistics (SSB), an industry is likely to consist of several firms and intermediates involved in different industry segments. I am not able to conclude that the industry structure matters for the airport effects, but there are indications that it might. I will seek to answer the question in chapter 6.0 as well, since a survey would be more appropriate to answer such a specific question.

6.0 Analysis 3 – Survey on the Sogndal region

The survey conducted in the Sogndal region did not get a sufficient amount of response from the local industry, and can therefore not be used to determine the effects of air transport in the region. However, the results are interesting and there seem to be a dependence on air transport from the respondents. In this chapter I will present the main findings of the survey and see if I am able to state something about the local businesses dependence on air transport.

The total number of respondents that filled out the entire questionnaire was 21 businesses. These businesses combined local revenue was approximately 743 million NOK. The firms were asked to give a percentage value on how much of their revenue is dependent on air transport, ten firms answered. From this it is possible to calculate a NOK value created through air transport, I found this to be approximately 8,8 million NOK. Some descriptive data as well as a division into sub-sectors can be seen in Figure 16.

	All sectors	Industry sector	Service sector	Other sectors
Total number of firms	21	3	10	8
Total man years	354	171	60	123
Local revenue all firms*	kr 742 857 125	kr 228 918 000	kr 79 796 000	kr 434 143 125
Number of air travels per year	688	190	147	351
Number of firms dependent on air transport	10	3	6	1
Average revenue dependent on air transport	kr 8 837 053	kr 19 076 500	kr 1 854 843	kr 3 420 000

* For one firm the revenue is published as a consolidated financial statement, therefore their local revenue have been calculated using the average value creation per employee
* Four firms are new, and their financial data are therefore not published for 2014

Figure 16, Descriptive data on the survey respondents. Source: Own work and forvalt.no

Some of the respondents answer that they have no way of stating a percentage value to how much of their revenue is dependent on air transport. As many as sixteen of the twenty-one companies performed at least 1 air travel related to business activities per year. In addition, seven companies are exporters of goods or services, while four companies are organized after the just-in-time principle. This gives an indication that more than the initial ten companies are dependent on air transport in some way, I will continue this chapter with a presentation of the main findings in the survey. The findings are presented in two sub chapters, the first is related to firm activities while the second is related to actual effect on the firm. A list of all the respondents and their key information is presented in Appendix D.

6.1 Airports importance for firms activities

When asking the firms about the importance of air transport, and the frequency which air transport is used, a panel structure was applied to the questions. I shall go thru these questions in this chapters and discuss how relevant and applicable these results are.

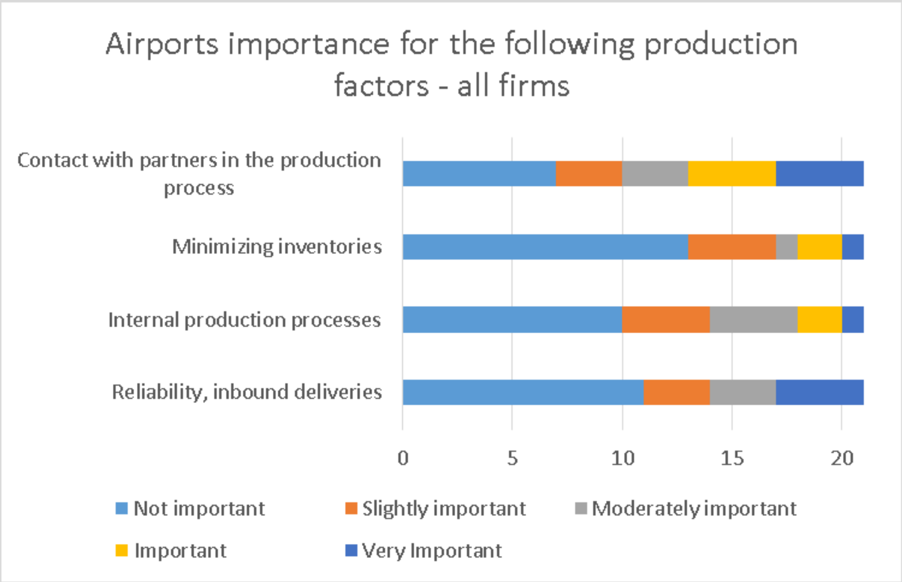

Figure 17, Airports importance for production factors. Source: Own work

From Figure 17 we see that contact with partners in the production process is the factor where Sogndal Airport has the biggest effects. This factor represents the airport as a tool in for example, conducting face-to-face meetings, which are quite important in many industries. Furthermore, we see that the airport is not as important for minimizing inventories, this indicates that air transport is not used to send critical spare parts for instance. However, for the three businesses involved in manufacturing the answers where different. One of the firms answer that air transport slightly important for minimizing inventories, while the two others answers that its important and very important, this seems logical since such production factors should be more important for manufacturers. Furthermore, we see from Figure 17 that the air transport plays a small role for the internal production process and reliability of inbound deliveries. However, again the firms engaged in manufacturing answers that these factors are important, but because of the small sample size this is not seen in the figure.

What I can say is that for the firms which are involved in some sort of production activity, and for those that exports goods, these factors averaging between moderately important and important. However, since the sample has a wide spread of companies involved in everything from energy to retail the effects are not clear.

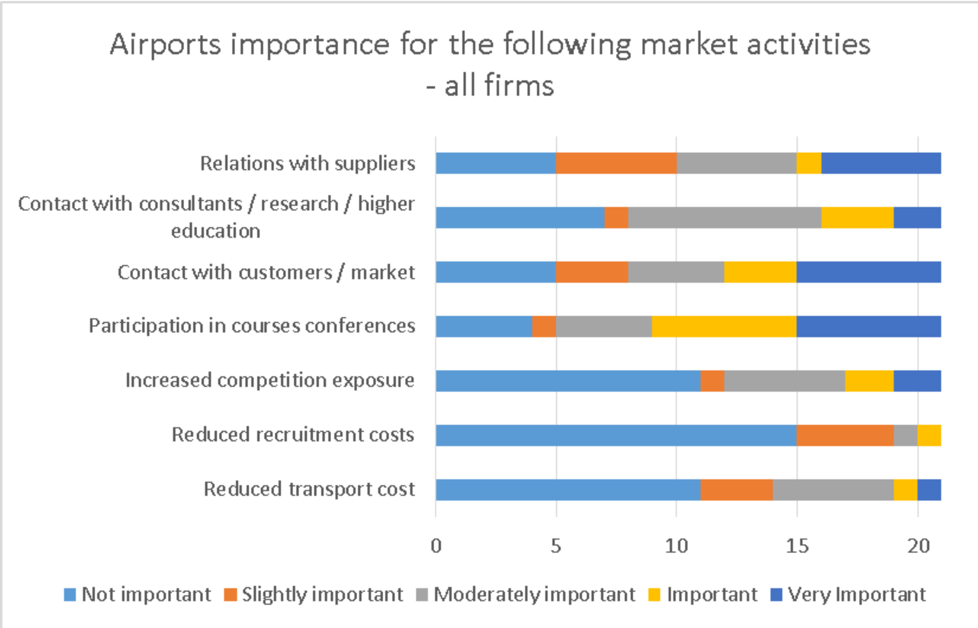

Figure 18, Airports importance for market activities. Source: Own Work

I wanted to look into the airports effect on market activities as well, and as we can see from Figure 18, there are some interesting results when the respondents state the importance of the airport for these activities. It seems that participation in course and conferences is a popular activity that generates air travel, in addition it seems as the airport are somewhat important to keep a relationship with the suppliers as well. Such travels to suppliers or conferences are thought to increase knowledge and productivity in many cases, which further should translate into a more productive environment in the firm. In addition, we see that contact with research institutions and consultants are very important and important for many of these firms. Which may be a result of an evolving business environment, or that the firms need to source knowledge outside the region, however it seems that the presence of air transport has not reduced recruitment costs, which could be interpreted that the firms do not recruit much outside their region. In addition to contact with R&D, contact with customers seems to be a factor which the airport helps facilitating.

It seems as the airport is more important for the market activities than production activities, which is fare since in many service industries are more dependent on travelling to meetings for instance. However, since the sample is so small, and the amount of respondents from the service industry compared with manufacturing is large, such a conclusion cannot be drawn.

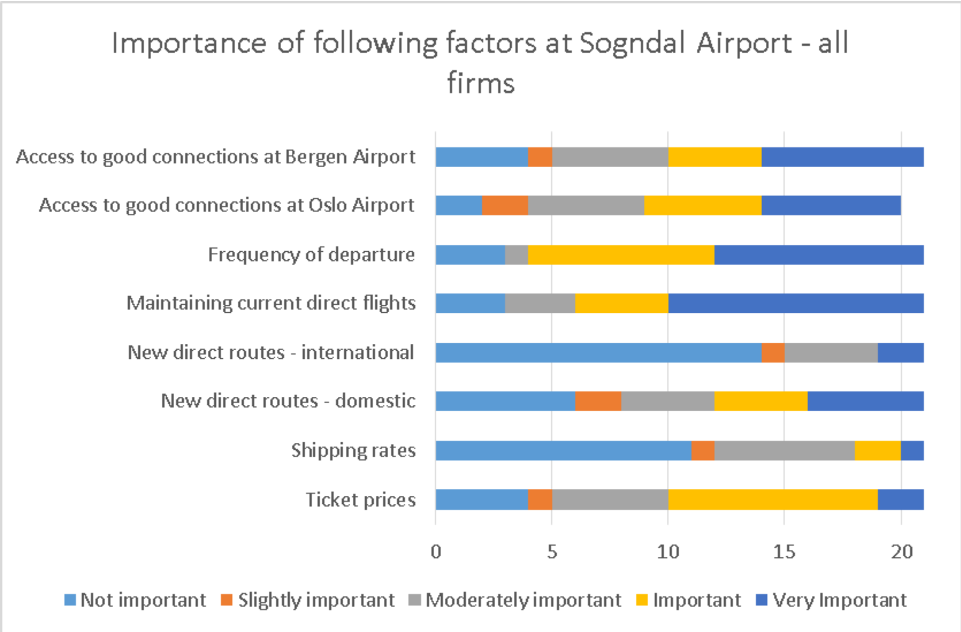

Figure 19, Airport activities importance for firms. Source: Own work

I wanted to find out how important certain factors at the airport is for the firms in the region, and therefore conducted the question in Figure 19. I tried to include questions related to the current state of the route network from Sogndal Airport as well as questions related to future investments. From Figure 19 we can see that the factors that clearly are of highest importance for the 21 firms is maintaining the current direct flights as well as frequency of departure. Furthermore, we can see that access to good connections at other airports are more important than new direct routes. Shipping rates seems not to hold a large importance, however the importance is higher for the manufacturing firms than the others. The respondents seem to agree that ticket prices are important to some degree, but still access is more important for the firms.

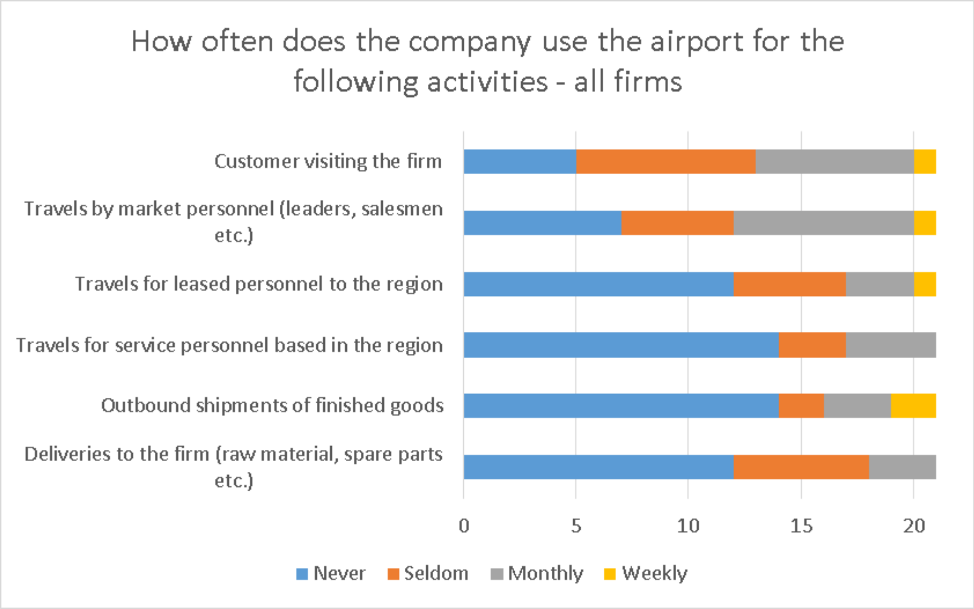

Figure 20, Frequency and purpose for the use of Sogndal airport. Source: Own work

The results regarding the use of the airport for a set of activities is presented in Figure 20, we see that approximately 40 percent of the surveyed firms answer that they use the airport at least monthly for travels by leaders or sales representatives, in addition to inbound customer visits. This again indicates that it is market activities that are most dependent on the presence of an airport, however I must stress that the lack of respondents and few industrial firms in the dataset makes it hard to conclude anything about market activities and production activities.

6.2 Airports effect on firms

I wanted to see if the airport as a link to other regions, had any effect on the individual firm's investment choice, employment activities and collaboration decision. I addressed the investment choice thru two questions, where the company representatives had to answer one concrete question and one related to the potential situation. I did a similar approach when addressing firms employment decision as well. While I addressed the collaboration effect thru a multiple choice contingency question, with three sub questions. The answers and topics of the questions are presented in six figures below, each question and answer is discussed to a some degree in the text following each of the six figures.

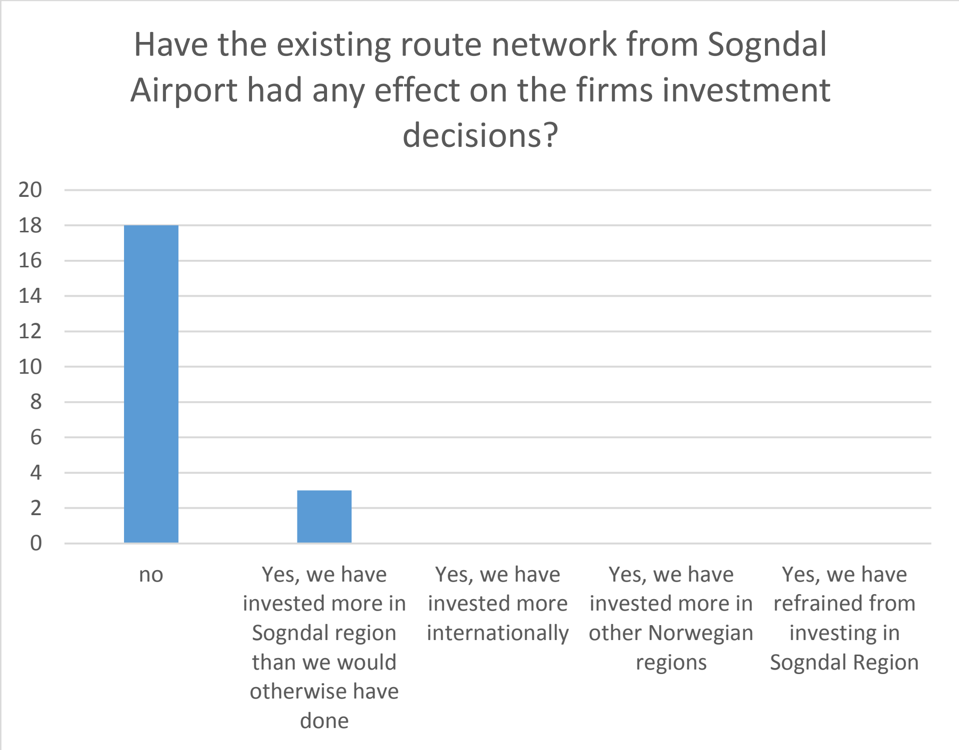

Figure 21, Route networks effect on business investment decisions. Source: Own work

The question in Figure 21 gives a clear-cut answer. I would have expected a bigger spread, however the question may have been misunderstood to some degree or the question is formulated in a manner that does not reflect catalytic investment. However, we do see that three firms have invested more in the Sogndal region because of the presence of an airport and its links to other regions., two of these firms are manufacturing firms involved in the printing industry with a total revenue of 141 million NOK and a total exported value of 55 million NOK. The two companies make respectively 150 and 20 air travels in a given year, which is 1,4 and 1,8 air travels per employee each year. The third firm is a newly registered consultant firm, with one employee and 50 air travels per year. There is no financial data since the company is newly registered. A consultant might have been expected to travel allot dependent on the business there in, however I will not put much emphasis on this one firm.

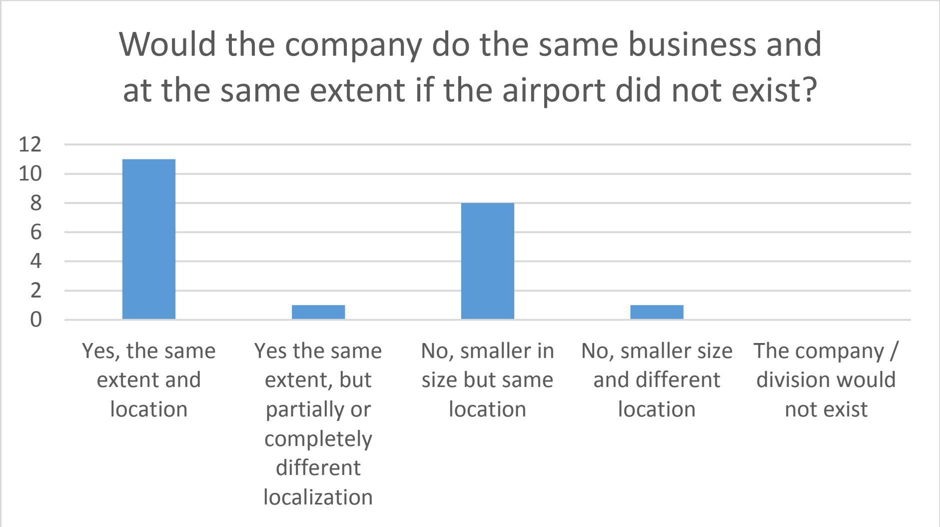

Figure 22, Firms situation if airport did not exist. Source: Own work

In order to investigate whether the airport mattered for the firms existence, I asked the respondents to indicate how things would be if the airport did not exist (see Figure 22). The results show that over half the firms say that it would be business as usual, that nothing would be different. Furthermore, the second largest effect would have been that the firm would be a smaller, but still located in the region. While for two companies, we see that the location would have been different if the airport did not exist. These answers indicate that the airport might not be the reason for the firms location, however it might also be a result of the large catchment area of Sogndal Airport, we might have seen different answers from companies located closer to the airport. However, the answers works as a god reminder that for some companies, air transport does not matter.

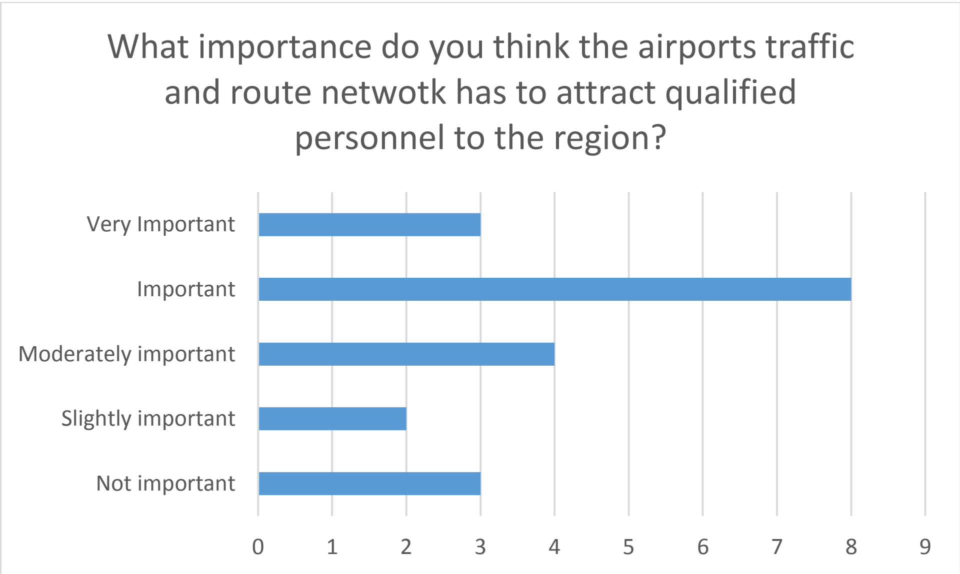

Figure 23, Air transport as an attraction for qualified personnel. Source: Own work

From Figure 23, we see that the respondents think the airports existence and its route network has an effect in attracting qualified personnel. An example could be that the airport helps people feel closer to home when they move to a new region, as we saw from Lian (2007). If this where the case, people with high education might be more likely to locate in the remote Sogndal region, since the airport offers them the opportunity to visit friends and family more easily. However when addressing the question in Figure 24, we see that only two firms have actually hired people as a result of the air transport supply into the Sogndal region.

These two companies are the two largest when it comes to yearly revenue, one of them is a manufacturer in the printing industry while the other is a producer of electricity with more than 300 employees in the region. This shows that large corporations are more likely to attract people from outside the region, moreover the airport might have played a role for these leaders, when making the decision of moving to the Sogndal region, and another possibility is that they might use air transport to commute to and from work in Sogndal. However, these sort of answers would have been easier to find in specific interviews, and this is merely speculations.

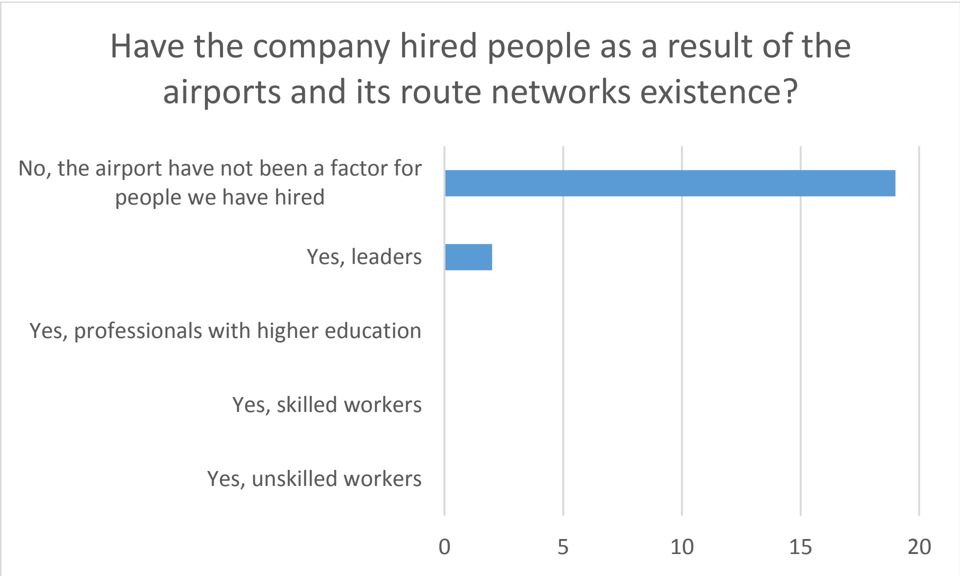

Figure 24, Air transport as a facilitator for recruitment in the firm. Source: Own work

To sum up the employment effects, the businesses state that they do believe the airport helps attracting people to the region. However only two companies have answered that the airport played a role when attracting personnel. I may have been able to produce better results if I had asked if the airport work as a tool to keep qualified personnel in the region, because a result we saw from the NEG theory is that when transport links are not sufficient highly skilled workers might seek employment in agglomerated regions.

Lastly, I wanted to see whether the airport worked as a facilitator for more collaboration and cooperation between firms in the Sogndal region and firms or institutions in other regions. I asked them if the airport had led to more cooperation with suppliers, customers and/or R&D related institutions. The question was a multiple-choice contingency question, which is why there are more than 21 answers in Figure 25.

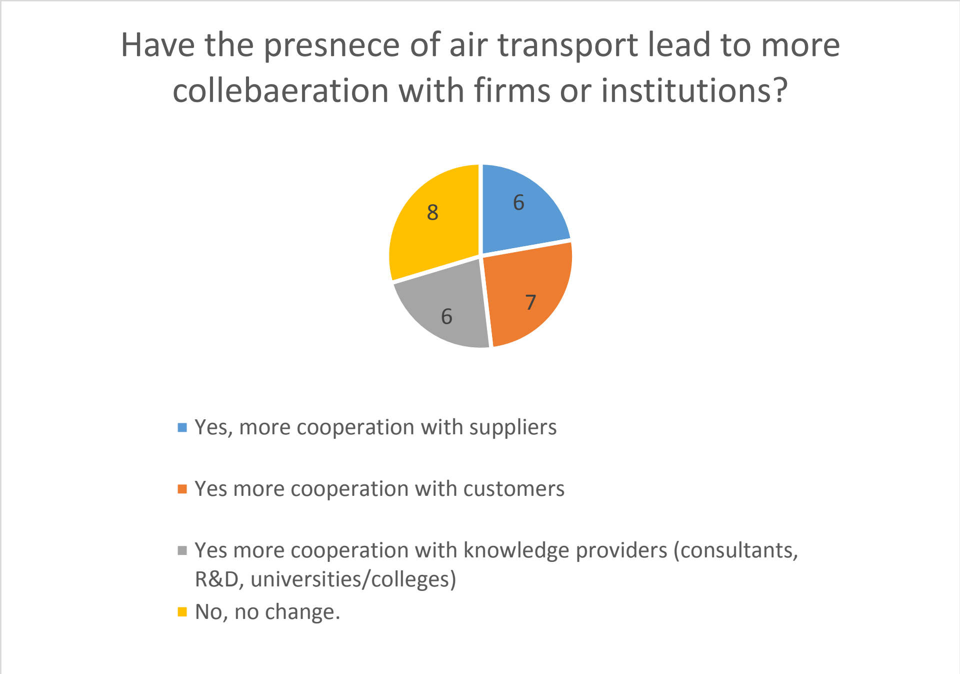

Figure 25, Airports role in collaboration. Source: Own work

Furthermore, a follow up question for each of the alternatives followed. These answers are shown in Figure 26, which combines the results of the three follow up questions.

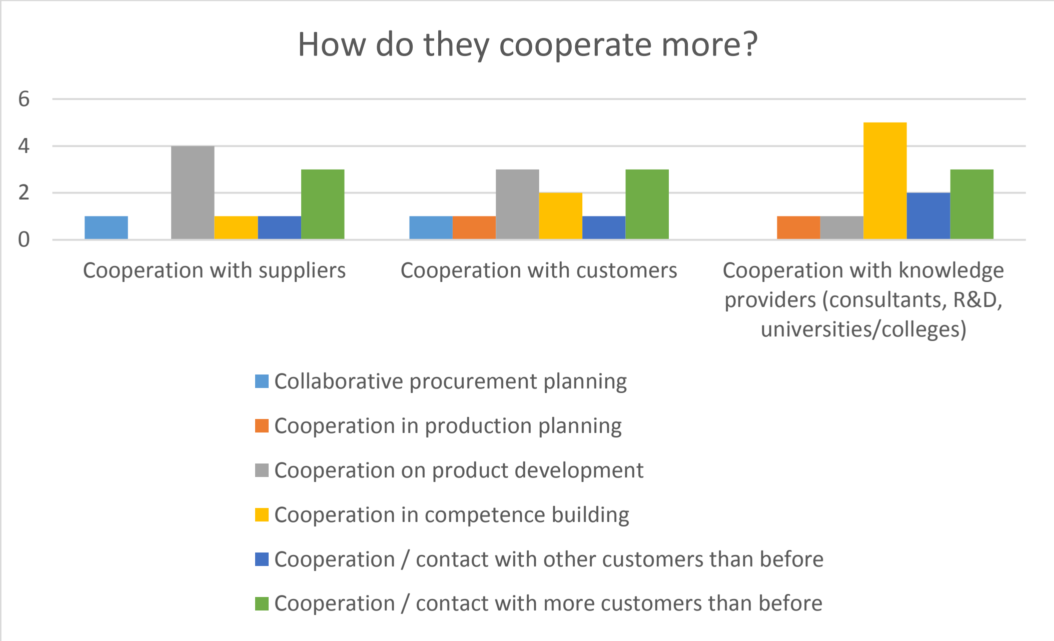

Figure 26, How firms collaborate because of air transport. Source: Own work

We can see that for the six companies who stated that they cooperated more with R&D institutions and consultants, the cooperation is mainly focused on research as well as development of new customers, which might be new segments for instance. These answers seems logical, and such collaboration might increase the productivity of a firm.

The seven firms that cooperate more with customers, seems to focus on product development, competence building and development of new customers. Competence building for instance through providing courses for the customers, is a good example of how to create a higher value for a firm's product, if the customer is located outside the Sogndal region the airport surely plays a role for such competence building.

There were also six companies who answered that they had cooperated more with their suppliers, this cooperation was mainly focused on product development and development of new customers. If the worked together in product development, this might help differencing products and create a new market segment or increase output for the local firm. If the airport can facilitate such operations, it surely is important for the value creation of the firms.

What these results indicate, is that the airport might play an important role for the development of new products and learning activities in a collaborative environment between firms and institutions. If the airport creates links between firms, which further increases competence and productivity, this is surely an important catalytic effect from the presence of air transport in the small region of Sogndal.

6.3 Answering relevant research questions

The insignificant number of respondents influences the survey results. However, there are indications that air transport is important for some of these businesses to keep up a certain activity level, in addition air transport seems to be important for development purposes, such as courses and collaboration with others. The answers are as expected when the survey was developed, however since I was not able to conduct the survey in several regions, the results have less relevance. I will apply these results carefully when conducting the case study of Sogndal Airport, since they do not represent the "population" of firms and industry structure in the Sogndal region in a sufficient manner. I will continue this chapter with answering research questions relevant to the survey analysis.

RQ 4 *Does the industrial structure of a region matter for the airports effects?*

From the econometrics analysis that I was not able to answer research question four, and stated that a survey would be better to answer this question. However, since the survey is only focused on one region and since the number of firms who answered are few, I am not able to give any clear answers here either. There are however indications that some industries might be more dependent on air transport, one example is the two firms involved in manufacturing and printing industry, which seems to have a similar dependence on air transport. A problem when applying results on industry structure is that industry classifications provided by Norwegian Statistics (SSB), does not necessarily represent industry structure in a sufficient manner. Since an industry often consists of linked firms and intermediates. It would have been interesting to survey clusters of firms, to compare industries with each other. This might have been possible, since clusters are agglomerated into small geographical regions, and the local airport might serve as a facilitator to ensure the existence of the cluster.

RQ 5 *Will the presence of air transport encourage investments in a region?*

We saw three firms had invested in the Sogndal region as a result of the air transports existence, and that two firms stated that they might be located elsewhere if the air transport connection did not exist in the region. These results indicate that air transport encourages investments to some degree. However, the low response rate of the survey is too small to conclude anything for certain. This question would be of more interest if I was able to compare regions and industry structure.

RQ 6 *Do air transport facilitate collaboration among firms?*

The results gave indications that firms have collaborated more with their customers, suppliers, consultants and research institutions. Of the 21 firms who answered the survey 13 answered that they had collaborated more with at least one of the groups mentioned above. Furthermore, we saw that product development and customer development was the main collaboration activities between the surveyed firms and their suppliers or customers. We also saw that firms who collaborated with consultants and research institutions did this on competence building and customer development. Therefore, I do see indications that air transport facilitates more collaboration between firms in the Sogndal region and firms/institutions outside the region. However, even though the indication is there I cannot conclude with so few respondents.

An online questionnaire did not work as I hoped, even with distribution help from industry organizations. The results in Sogndal are of high interest, and I would therefore recommend a study in this region, as well as other regions to find indications of how catalytic effects differ with industry structure. I will also recommend interviews with several important and large firms, to get more information on the airport as an attraction of qualified personnel. This might in itself be a rewarding and interesting study.

PART III

7.0 Case study – Air transports effect on the Sogndal region

7.1 Sogndal Airport

Sogndal Airport is located a 25-minute drive outside the city. Sogndal airport is one of 28 STOL airports in Norway built in the late sixties, in addition to Sogndal Airport there are three similar short-runway airports in the county of Sogn og Fjordane. The airports runway is only 1100 meters long, and it can therefore only serve smaller aircrafts (Avinor-IPPC 2013). The routes to and from Sogndal are operated by Widerøe, who operates the routes with Bombardier Dash 8 aircrafts (39 – 78 seats) (Widerøe 2015, Avinor 2015c). The government subsidizes the airports route network to some extent, in order to ensure transportation to and from the region. The airport has 11 departures and 11 arrivals per day (weekdays), the destinations and frequencies are presented in Table 11.

Departures to destination per day. (*Some destinations are reached with one departure*)				
To/From	Oslo	Bergen	Sandane	Ørsta/Volda
Sogndal	6	2	4	1

Table 11, Departures Sogndal Airport. Source: Avinor

The routes to and from Sandane Airports have their origin in Bergen and Oslo, and the route to and from Ørsta/Volda is operated in the same way, with Bergen as the origin. This sort of flight pattern is often used by Widerøe to ensure sufficient frequency and passenger numbers. The number of passengers to and from Sogndal airport in addition to the number of Transfer passengers are shown in Figure 27, the transfer passengers represent those passengers which are on their way to another location than Sogndal airport, such as those flying from Sandane to Bergen for instance.

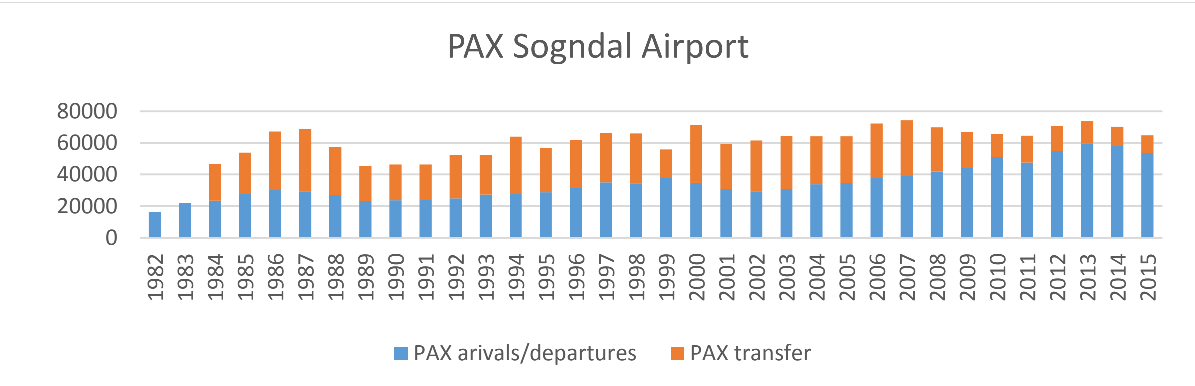

Figure 27, Passenger volumes at Sogndal Airport 1982-2015. Source: Avinor

The number of cargo handled at Sogndal airport has gone down from 110 tons in 2005 to 21 tons in 2013. There has been a steady drop in freight movements to and from the airport during these eight years, with a total drop of about two thirds. Post on the other hand has fallen hard during these eight years, where the airport handled 47 tons of post in 2005, this was down to 0,4 tons in 2013. This is a drop of 1/10 which is significant, however logistics optimization in the postal service and a falling dependence on postal services in the society, might serve as an explanation for this significant drop.

7.2 The Sogndal Region

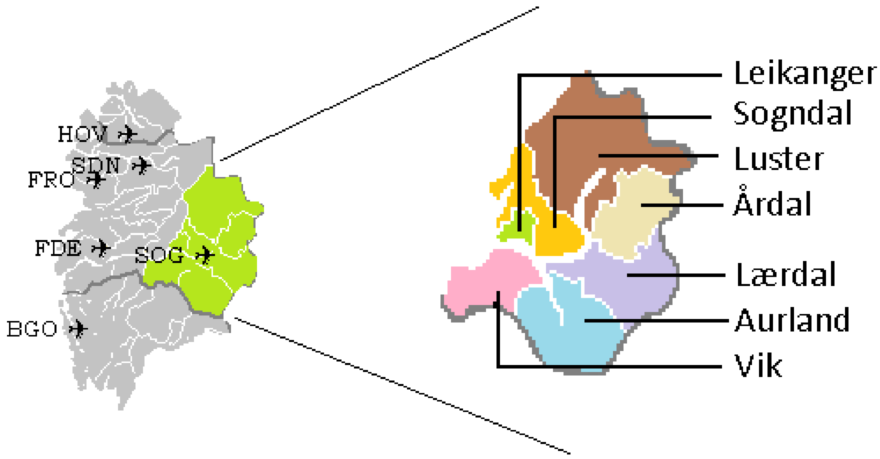

Figure 28, The Sogndal Region. Source: Own work

When I discuss the Sogndal Region I think of the seven municipalities which previously where defined as the airports catchment area. The region is located east in Sogn and Fjordane county, with the 204-kilometer-long Sognefjorden working as a lifeline in the old days. Today however, sufficient road links and ferries connect the region with the county administrative center of Førde. The region average driving distance to Oslo and Bergen is 220 and 330 kilometers, the region is therefore dependent on sufficient air transport to ensure good communication with these national centers.

The total population in the region was 26 195 in 2013. Of these people 3,5% had more than three years of higher education, and as many as 13 874 where employed. In addition, Sogn og Fjordane College's main campus is located in Sogndal. Numbers from Norwegian Statistics (SSB) shows that the total number of students at the college was 3637 in 2013, however a share of these students are located in Førde as well. Previously we have split all non-farm employment into three sub-sectors, the share of employment for each sector in a 7 year period is presented in Figure 29.

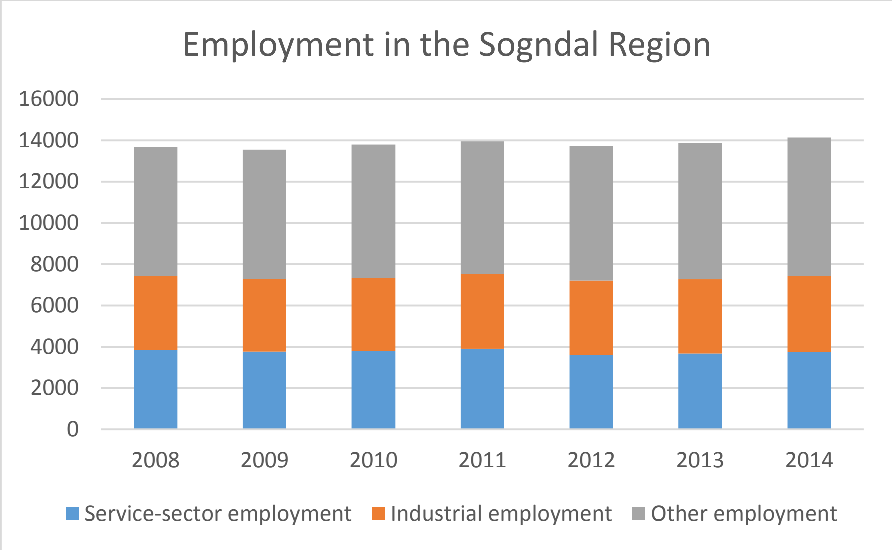

Figure 29, Employment in the Sogndal region. Source: SSB

In addition, several of the regions firms are involved in agriculture, fishing or forestry, in addition manufacturing and tourism is important. Generally, research has shown that it is tourism and the service sector which have been most dependent on air transport. However, from the survey, we saw that also the manufacturing firms seemed to have a dependence, however this should be interpreted carefully.

7.3 Exploring possible effects from air transport

From Figure 30 we can see that 48 percent of the passengers to/from Sogndal airport are business travelers. In addition, the business travelers are grouped in sectors in the figure. When discussing catalytic effects from air transport one usually think of the effects created in the business sector of the region, these effects are as previously discussed often measured in employment figures.

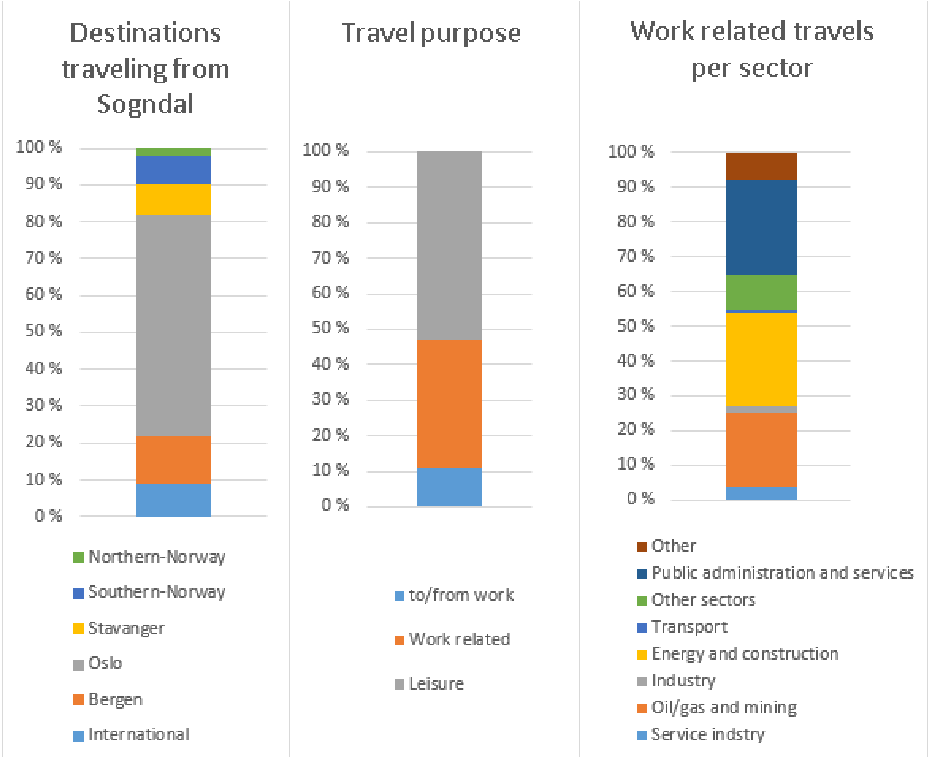

Figure 30, Key figures from the travel purpose survey. Source: Avinor (2014)

From the column on the right hand side in Figure 30 we can see that Oil and Gas, Energy and Construction, and public administration/services, are those businesses that uses the airport most frequently. In the survey, there was only one respondent in these three groupings, this was a large energy producer. This company was one of two companies where the airport had contributed to attract qualified personnel. In addition, the company used the airport frequently and stated that it had facilitated more collaboration with their customers and with R&D institutions and consultants. We saw that some firms in the service industry where dependent on air transport while others were not, this surely is reflected in the low share of travelers to and from the Sogndal region seen in Figure 30, however some of the firms in the service sector might be dependent on inbound tourism facilitated by the airport . Furthermore, I found indications that manufacturing firms where highly dependent on air transport, however only three such firms where surveyed and as we can see, they do not constitute a large share of the total number of travelers. In addition, I am not able to draw any conclusion on the surveyed companies' dependence on air cargo. However, from chapter 7.1 we saw that there where little cargo handled at the airport in 2013, therefore we can assume that there is in general little dependence on air cargo in the region. This brief review shows that the survey is of little use when conducting this case study, and I will continue the study by applying the elasticities found in the econometric model performed in chapter 5.0. However, first I will consider possible effects in the spatial economy from the findings related to Granger causality.

I found indications that for Local airports changes in passenger volumes would Granger cause changes in regional economic development, with a strong statistical significance. What this means for the Sogndal region is that if there would be capacity constraints at the airport for instance, an investment to increase capacity would have a positive effect on the regional economy. However, such a constraint is not likely to occur on this small airport. In Lian, Thune-Larsen, and Rønnevik (2008) increasing the length of Hammerfest airport was suggested to improve the industry structure of the region, by attracting new firms and employment. From the survey results, we saw that firms in the Sogndal region hold a greater importance on keeping the current level of activities at the airport, rather than development of new routes. There seemed to be a general satisfaction with the current route network, therefore such an investment might not be applicable in the rural region of Sogndal. The causality aims to explain why economic development changes, whit a change in passenger volumes. What this means for the Sogndal region, is that the presence of an airport in the region might hold a great importance to ensure a certain level of activity in the region. Earlier in the thesis, I wrote that the Norwegian government had a Goal of preserving the distinctive settlement pattern of the country, the presence of causality might indicate that this goal is met thru air transport.

The Sogndal region does not have any distinctive industrial structure, however Østlandsforskning (2004) showed that the region had a great number of construction firms. In addition, the region is known for its food and beverage industry. These industries might not be the most air transport dependent industries, however it would be safe to assume that some of the productivity effects from the regions airport would affect the food and beverages industry in a positive manner. That I am able to show with a statistical significance, that income in the region will grow with passenger numbers, does show that air transport has an effect on regional productivity. Furthermore, it would be safe to assume that the increased access an airport facilitates between Sogndal and other regions, would increase learning effects and create a more productive labor force. In addition, the airport might be seen as a positive factor for the large number of students studying in the region, these students are assumed to create employment in the region, and if air transport is a factor in their location decision, the students will create a larger labor market and thereby increase aggregated income in the region.

From the 2SLS model, I found elasticities representing potential growth in employment, with an increase in passenger volume. I applied a model, which sought to find such elasticities for Norwegian Airports with less than 1 million PAX, Sogndal Airport is one of these. What the model found, was that with a 10 % increase in total passenger volumes, we would see an increase in non-farm employment of 1,2%. When I apply this elasticity on Sogndal Airport, it indicates that a 10 percent increase in passenger volumes will create 170 jobs. Furthermore, I produced an elasticity representing Service employment as well, this elasticity indicated that a 10 percent increase in passenger volumes would lead to an increase in total service employment of 1,5 percent. In the Sogndal region 3668 people are employed in what I in this thesis define as the service sector, from a 10 percent increase in passenger volumes the employment in this sector will increase by 57.

These employment figures indicate how air transport might contribute to create employment in a region, however one cannot assume that passenger volumes will increase by 10 percent each year. To test the relevance of the elasticity, I have conducted an experimental figure, where the non-farm employment elasticity is computed on historical change in passenger volumes at Sogndal airport. In addition, the figure shows the change employment for each year, this is calculated by subtracting last years employment figure on this year, for the years 2001-2014. The result of the experiment can be seen in Figure 31.

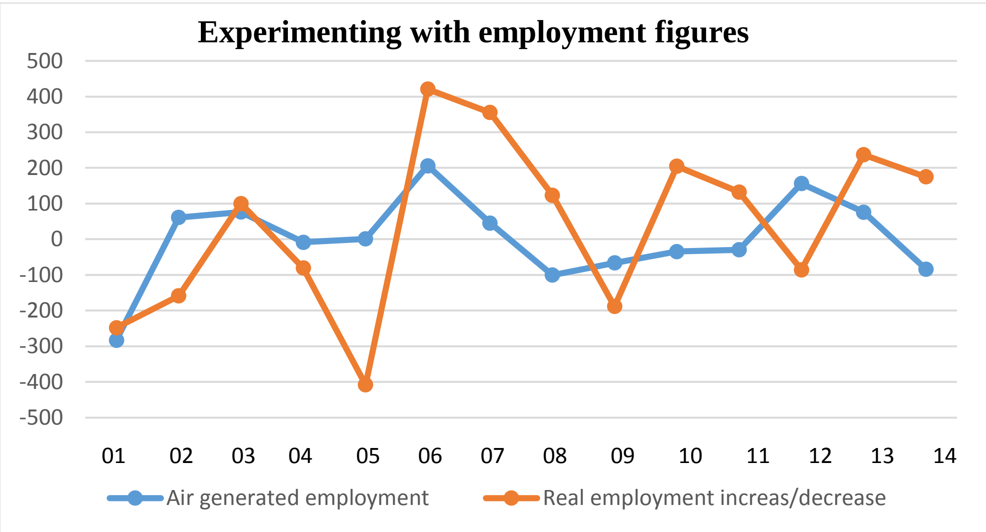

Figure 31, Experimenting with employment elasticity. Source: Own work

Figure 31, should not be interpreted to show real effects, since the elasticity used is conducted on one specific year, and is not meant to explain historical development. However, I will do a visual interpretation of the figure nonetheless. It seems that air transport generated employment might follow the same pattern as employment, but it never shows real extreme effects since passenger volume are quite consistent. A possible reason for these lines to show the same pattern, might be that air transport supply effect employment. However, the reason might also be that employment creates demand for air transport. In the Granger Causality test I was not able to test employment effects, however I did find indications that passenger volumes Granger caused aggregated real taxable income, which would change if employment figures where altered. This is pure speculation, but it may indicate that passenger volumes effect employment, and that this is the reason these two lines follow each other to some extent. Further investigation here is needed, however this experiment serves as an interesting way to apply the results from the econometric models. Though I again have to remind the reader that these models where conducted on the national account, and are not necessarily applicable in a regional case study.

From Avinor (2014) I found that the number of people employed in direct activities on Sogndal airport to be 44. From (Dybedal 2005 cited in Lian et al. 2005) it is proposed that indirect and induced employment is between 1,3 and 1,7 times as high as the direct employment on Norwegian airports. Thereby this employment would be between 57 and 75 full time equivalent jobs in the case of Sogndal Airport. This lets us assume that there are 119 people employed in the Sogndal region as a result of direct, indirect and induced impacts of air transport. This means that there in 2013, was employed approximately 16 people per 10 000 passenger passing thru the airport. If passenger volumes where to increase by 10 000 (this is a 13,5 percent increase), my elasticity predicts a rise in non-farm employment of 1,56 percent, which would mean that a total of jobs created would be 205. If we subtract the employment from the direct, indirect and induced impacts on this total non-farm employment, this should leave us with a total of 189 new jobs created catalytically in the region, as a result of air transport supply.

This case study has been strongly influenced by the lack of conclusive findings from the survey analysis, however I have performed two experiments with the results obtained from the econometric analysis. These experiments indicate how the results might be applicable for explaining air transports effect on regional economic development. However, the results are only experimental, and actual effects would have been easier to quantify with a generalizable survey.

8.0 Summary and directions for future research

In this thesis I have performed three types of analyzes, all with the goal of determining the effects of air transport on regional economic development. When discussing economic development, the new economic geography has served as a background and a theory to ground the findings. However, I feel the need of going thru the main findings in the thesis, and explain how these findings might affect economic development, and thereby further grounding the findings in the theoretical foundation. In addition, in sub-chapter 8.2 will comment on the work and analyzes used, and give recommendations for future research.

8.1 Summary and relevance of the results

The industrial structure of Norway is dispersed and internationally oriented. Much of the industry has its origin in rural regions and sedentary resources, however with internationalization and the technological leaps during the last decades, the country have become a world leader in technological advanced industries. However, what is most interesting with the Norwegian industry structure is that much of the value creation takes place in rural and remote regions of the country. The Government has a goal of ensuring activity in these regions, this is done thru utilization of local resources, as well as ensuring the attractiveness of the region by providing public services and transport links. From the theory of new economic geography, we saw how the interplay of the centripetal and centrifugal forces would create agglomerated or dispersed industries and settlement patterns. Furthermore, we saw that transport cost played an important role in this interplay. The theory proposed that by changing transport costs and ensuring sufficient links between regions or industries, one might see agglomeration or dispersed effects. If the transport costs where too low, the centripetal forces might attract firms and industries into an agglomerated region. Since the cost of serving the outside market from there, is lower than the benefits of staying in the peripheral. However, when transport costs are high, agglomeration is suggested not to take place. Generally, there will be an interplay between the centripetal and centrifugal forces of regions, involved in a firm’s location decision. Palma et al. (2011) suggested that the relocation followed a bell shaped curve, and that at some point the centrifugal forces would attract formerly agglomerated industries back out into the peripheral.

In this thesis, I found that there is a relationship between air transport and economic development, in addition there were indications that air transport might be more important for the regions with a smaller economic size, than the large economic centers. This indication was found thru two econometric analyzes, performed on different data sets that are both assumed to represent regional economic development in a sufficient manner. The thesis shows that regions with a Local airport and regions with a Regional airport will see greater effects in regional productivity if passenger volumes were to change. On the national account, these results might suggest relocation effects of firms and labor as a result of the airports existence in a region. In that case, the centrifugal forces of the rural region, will outweigh the centripetal forces of an agglomerated region.

The productivity effects from the 2SLS regression showed that the supply of air transport creates additional employment in the region. I found indication that an increase in passenger volumes of 10 percent, would increase service employment by 1,5 percent, and all non-farm employment by 0,9 percent when considering all airports and 1,2 for smaller airports. This indicates that some firms are effected by air transport supply, and that they will be more productive when this supply increase. However, the new employment will have to come from somewhere. This is where the relocation effects from NEG is helpful, this theory tells us that workers will relocate to a region where they can get a higher salary from their input. Therefore, I can assume that these workers relocate from less productive regions elsewhere in the country, or from abroad, especially within the European economic area.

Furthermore, one might expect similar location effects for firms and industries as well. One example of this can be drawn from cluster development, if one assumes there is a prosperous industry in a particular region, sufficient transport linkages may serve as a facilitator for the development of this industry. In addition, transport linkages may serve as a tool to attract labor from other regions to the industry. These effects would increase the productivity of the particular industry, which might further serve as an attraction for intermediate firms in related segments. These intermediates might locate in the region because of the because of the “close to market” effects of the region, or because of the benefit from the increased knowledge of the prosperous region. Furthermore, other industries tied with these intermediates or the industry segment in the region might also locate here at this point, and thereby a cluster of interlinked firms might develop in the region. The firms and industries locate in the region because of the interplay between centripetal and centrifugal forces affecting the firm, in the case of relocation to a potential cluster region the centripetal forces of this region would be strong. Air transport facilitates the access to the potential cluster, as well as access to the global market outside of the cluster, and therefore plays an important role for this development.

The survey analysis was intended to show how these centrifugal and centripetal forces would act at a regional level, though it did not provide us with a significant amount of responses. However, the results did seem to indicate that air transport had a greater importance for market activities, than for production activities in the surveyed firms. Thirteen of the surveyed firms answers that the airport facilitated collaboration with firms and institutions outside the airport region. This collaboration is assumed to create learning and productivity effects in the region. Furthermore, these results are strengthened by the Granger causality results, which indicated that for Local airports such as in Sogndal, a change in passenger volumes were shown to Granger cause the aggregated income in the region. Increased collaboration can therefore be interpreted as pure productivity effects from the airport.

8.2 Recommendations for future research

This thesis consists of three analyzes, all with the goal of explaining how air transport might affect regional economic development.

The first analysis I presented tried to identify whether there as a bidirectional granger causality running from passenger volumes to aggregated real taxable income. The approach of this model followed that of previous authors on a similar topic. However, I conducted two test in this analysis. The first was performed to test whether the bidirectional causality was heterogeneous, and the second model intended to find long and short run effects. Performing the first test, let me avoid biased results when testing short and long run effects, and further strengthened my findings. However, I did not further investigate the homogeneous causality running from ARTI to PAX. This surely is a limitation of this study since this might give indication of how demand for air transport is effected, and possible long and short run in this relationship. Furthermore, when I state that air transport Granger causes regional economic development, this is dependent on the strength of my variables. Since what is true, is that passenger volumes affect aggregated real taxable income. Furthermore, the choice of Johansen cointegration was based on the recommendation of a user guide, if I have applied the wrong cointegration tests, my results might be biased, since the cointegrative relationship is important when applying a VEC test. The testing procedure in Eviews was complex, and I had to develop several residual series before the test could be conducted. However, I would recommend doing this type of test when addressing policies or investments that might affect the supply of air transport. Since this testing procedure lets split the airports into sub groups, this would make it easier for investors to examine the effects of their investments on Local airports for instance. The method and results should be applied carefully, but this sort of analysis might provide good additional information on the effects of an investment when conducted correctly.

I performed a second econometric analysis with the intent to quantify the effects of air transport on regional economic development. In this model however, I chose employment levels to represent economic development. This testing procedure was conducted on different sub-sets than the causality analysis, since those sub-sets did not perform well in the models, this surely is a limitation of this study. In addition, the modeling procedure is highly dependent on the instruments applied. However, I tried to safe-guard the test by applying the Durbin-Wu-Hausman test provided in the econometrics software Eviews. Applying this safe-guard ensured me that the instruments where applicable and the test is fairly simple to conduct in a econometrics software. However, the strength of the model lies in the author applying correct variables, as well as good instruments. I would recommend this model to be used, when considering employment effects in general. However, as we saw from the case study as well as research question 4, it cannot easily be used to determine catalytic employment.

I found the econometric models to be challenging, especially the causality test. Nonetheless, I do see that these have an explanatory power on the national account, and would therefore recommend these models when considering large investments or policies effecting air transport supply on an aggregated level. However, the results are not easily applicable on regional case studies. Furthermore, since I assume that airports are heterogeneous, these results might not be applicable afterall. The causality test tells us that sub-groups of airports are heterogeneous, however within these subgroups one might also assume that the regions surrounding these airports react differently on the supply of air transport.

As stated before the initial idea was to conduct a thesis based on survey analysis in two regions. However, even though allot of time was spent on the development of a sufficient questionnaire, the analysis left me with a low response rate. The questionnaire was created in the online software Questback, and a link to this was distributed by industry organizations, one in Ålesund, a local bank in the Sogndal region, and a set of industry organizations who are members of the Sogndal regions industry development organization. Therefore, the problem with the questionnaire is not that it did not reach enough respondents, but that it was online based and answering it is likely to have been put off and forgotten. I believe the questions in the survey are interesting and would recommend the use of these in future research. However, I would also recommend asking about the airport as a facilitator of ensuring employment, rather than asking about recruitment.

I would recommend conducting a survey when considering regional effects, however the researcher should be aware of the low response rate a questionnaire might have. A possible reason to avoid this would be to survey firms thru face-to-face interviews. In such cases, one could pick out a set of respondents and assure that the respondents represent the population sufficiently. In addition, I recommend studying the airports role in clusters. Cluster development holds a great importance in Norway. And I believe a study of the airports role in development of new clusters, and as a facilitator for mature clusters would be an interesting future research regarding air transport and economic development.

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APPENDIX A – Catchment areas

OSLO Gardermoen Torp Rygge	0101 Halden 0118 Aremark 0104 Moss 0135 Råde 0136 Rygge 0137 Våler (Østf.) 0105 Sarpsborg 0106 Fredrikstad 0111 Hvaler 0128 Rakkestad 0124 Askim 0125 Eidsberg 0127 Skiptvet 0123 Spydeberg 0138 Hobøl 0122 Trøgstad 0121 Rømskog 0119 Marker 0213 Ski 0211 Vestby 0215 Frogn 0217 Oppegård 0214 Ås 0216 Nesodden 0219 Bærum 0220 Asker 0231 Skedsmo 0230 Lørenskog 0229 Enebakk	0221 Aurskog-Høland 0226 Sørum 0227 Fet 0228 Rælingen 0234 Gjerdrum 0233 Nittedal 0236 Nes (Ak.) 0235 Ullensaker 0237 Eidsvoll 0238 Nannestad 0239 Hurdal 0301 Oslo 0402 Kongsvinger 0418 Nord-Odal 0419 Sør-Odal 0420 Eidskog 0423 Grue 0425 Åsnes 0403 Hamar 0412 Ringsaker 0415 Løten 0417 Stange 0501 Lillehammer 0521 Øyer 0522 Gausdal 0502 Gjøvik 0528 Østre Toten 0529 Vestre Toten 0532 Jevnaker	0538 Nordre Land 0534 Gran 0533 Lunner 0602 Drammen 0626 Lier 0624 Øvre Eiker 0625 Nedre Eiker 0623 Modum 0627 Røyken 0628 Hurum 0621 Sigdal 0605 Ringerike 0612 Hole 0622 Krødsherad 0702 Holmestrand 0714 Hof 0704 Tønsberg 0701 Horten 0716 Re 0720 Stokke 0722 Nøtterøy 0723 Tjøme 0719 Andebu 0706 Sandefjord 0709 Larvik 0728 Lardal 0713 Sande (Vestf.) 0711 Svelvik
Fagernes, Leirin	0542 Nord-Aurdal 0541 Etnedal	0544 Øystre Slidre 0543 Vestre Slidre	0540 Sør-Aurdal
Skien, Geiteryggen	0901 Risør 0819 Nome 0805 Porsgrunn 0830 Nissedal	0814 Bamble 0912 Vegårshei 0817 Drangedal 0811 Siljan	0911 Gjerstad 0815 Kragerø 0806 Skien 0831 Fyresdal

Notodden	0807 Notodden	0833 Tokke	0821 Bø (Telem.)
	0834 Vinje	0822 Sauherad	0828 Seljord
	0827 Hjartdal	0826 Tinn	0829 Kviteseid
	0604 Kongsberg	0631 Flesberg	0632 Rollag
	0633 Nore og Uvdal		
Kristiansand, Kjevik	0906 Arendal	0914 Tvedestrand	0904 Grimstad
	0919 Froland	0926 Lillesand	0928 Birkenes
	0937 Evje og Hornnes	0935 Iveland	1001 Kristiansand
	1018 Søgne	1017 Songdalen	1014 Vennesla
	1002 Mandal	1029 Lindesnes	1021 Marnardal
	1027 Audnedal	1032 Lyngdal	1003 Farsund
	1034 Hægebostad	1004 Flekkefjord	1037 Kvinesdal
Stavanger, Sola	1101 Eigersund	1144 Kvitsøy	1103 Stavanger
	1111 Sokndal	1141 Finnøy	1102 Sandnes
	1112 Lund	1130 Strand	1127 Randaberg
	1114 Bjerkreim	1129 Forsand	1133 Hjelmeland
	1124 Sola	1122 Gjesdal	1120 Klepp
	1121 Time	1142 Rennesøy	1119 Hå
Haugesund, Karmøy	1211 Etne	1160 Vindafjord	1216 Sveio
	1154 Vindafjord (1965-2005)	1146 Tysvær	1145 Bokn
	1159 Ølen (-2005)	1149 Karmøy	1106 Haugesund
	1151 Utsira		
Bergen, Flesland	1201 Bergen	1246 Fjell	1252 Modalen
	1251 Vaksdal	1266 Masfjorden	1245 Sund
	1241 Fusa	1242 Samnanger	1243 Os (Hord.)
	1247 Askøy	1263 Lindås	1265 Fedje
	1260 Radøy	1264 Austrheim	1253 Osterøy
	1256 Meland	1235 Voss	1238 Kvam
	1244 Austevoll	1234 Granvin	1259 Øygarden
	1233 Ulvik		
Stord, Sørstokken	1221 Stord	1219 Bømlo	1222 Fitjar
	1223 Tysnes		
Florø	1401 Flora	1438 Bremanger	

Sogndal, Haukåsen	1420 Sogndal	1422 Lærdal	1421 Aurland
	1424 Årdal	1426 Luster	1419 Leikanger
	1417 Vik		
Førde	1416 Høyanger	1429 Fjaler	1412 Solund
	1411 Gulen	1430 Gaular	1433 Naustdal
	1418 Balestrand	1428 Askvoll	1432 Førde
	1413 Hyllestad		
Sandane, Anda	1431 Jølster	1445 Gloppen	1439 Vågsøy
	1441 Selje	1443 Eid	
Molde, Årø	1502 Molde	1545 Midsund	1543 Nesset
	1539 Rauma	1547 Aukra	1546 Sandøy
	1548 Fræna	1563 Sunndal	1551 Eide
Kristiansund, Kvernberget	1556 Frei (-2007)	1573 Smøla	1503 Kristiansund (-2007)
	1569 Aure (-2005)	1505 Kristiansund	1572 Tustna (-2005)
	1557 Gjemnes	1560 Tingvoll	1554 Averøy
	1576 Aure	1571 Halsa	
Ålesund, Vigra	1504 Ålesund	1532 Giske	1523 Ørskog
	1534 Haram	1526 Stordal	1528 Sykkylven
	1529 Skodje	1524 Norddal	1531 Sula
	1525 Stranda		
Ørsta-Volda, Hovden	1449 Stryn	1515 Herøy (M. og R.)	1516 Ulstein
	1444 Hornindal	1517 Hareid	1519 Volda
	1511 Vanylven	1520 Ørsta	1514 Sande (M. og R.)
Trondheim, Værnes	1601 Trondheim	1566 Surnadal	1567 Rindal
Ørland	1617 Hitra	1624 Rissa	1635 Rennebu
	1621 Ørland	1620 Frøya	1627 Bjugn
	1630 Åfjord	1638 Orkdal	1612 Hemne
	1632 Roan	1653 Melhus	1613 Snillfjord
	1633 Osen	1657 Skaun	1636 Meldal
	1634 Oppdal	1662 Klæbu	1622 Agdenes
	1648 Midtre Gauldal	1663 Malvik	1664 Selbu
	1665 Tydal	1736 Snåase Snåsa	1702 Steinkjer
	1723 Mosvik (-2011)	1724 Verran	1729 Inderøy (-2011)

Trondheim, Værnes Ørland	1718 Leksvik	1756 Inderøy	1719 Levanger
	1714 Stjørdal	1721 Verdal	1717 Frosta
	1711 Meråker		
Røros	1640 Røros	0438 Alvdal	0439 Folldal
	1644 Holtålen	0441 Os (Hedm.)	0437 Tynset
	0436 Tolga		
Namsos	1725 Namdalseid	1743 Høylandet	1744 Overhalla
	1703 Namsos	1742 Grong	1738 Lierne
	1748 Fosnes	1740 Namsskogan	1739 Røyrvik
	1749 Flatanger		
Rørvik, Ryum	1750 Vikna	1755 Leka	1751 Nærøy
Bodø	1804 Bodø	1849 Hamarøy	1838 Gildeskål
	1848 Steigen	1836 Rødøy	1839 Beiarn
	1842 Skjerstad (-2004)	1837 Meløy	1841 Fauske
	1845 Sørfold	1840 Saltdal	
Brønnøysund, Brønnøy	1813 Brønnøy	1815 Vega	1812 Sømna
	1811 Bindal	1816 Vevelstad	
Sandnessjøen, Stokka	1820 Alstahaug	1822 Leirfjord	1827 Dønna
	1818 Herøy (Nordl.)		
Mosjøen, Kjærstad	1824 Vefsn	1826 Hattfjelldal	1825 Grane
Mo i Rana, Røssvoll	1834 Lurøy	1828 Nesna	1832 Hemnes
	1833 Rana		
Svolvær, Helle	1865 Vågan		
Leknes	1859 Flakstad	1874 Moskenes	1860 Vestvågøy
Røst	1856 Røst		
Værøy	1857 Værøy		

Stormarknes, Skagen	1870 Sortland 1866 Hadsel	1867 Bø (Nordl.)	1868 Øksnes
Andøya	1871 Andøy		
Harstad/Narvik, Evenes Narvik	1901 Harstad (-2012) 1903 Harstad 1911 Kvæfjord 1913 Skånland	1805 Narvik 1852 Tjeldsund 1853 Evenes 1854 Ballangen	1851 Lødingen 1850 Tysfjord 1915 Bjarkøy (-2012) 1919 Gratangen
Tromsø	1902 Tromsø 1936 Karlsøy	1938 Lyngen	1939 Storfjord
Bardufoss	1917 Ibestad 1933 Balsfjord 1924 Målselv 1923 Salangen	1931 Lenvik 1925 Sørreisa 1927 Tranøy 1928 Torsken	1929 Berg 1926 Dyrøy 1920 Lavangen 1922 Bardu
Sørkjosen	1941 Skjervøy 1940 Gáivuotna Kåfjord	1942 Nordreisa	1943 Kvænangen
Vadsø	2003 Vadsø	2027 Nesseby	2025 Tana
Vardø, Svartnes	2002 Vardø		
Berlevåg	2024 Berlevåg		
Båtsfjord	2028 Båtsfjord		
Hammerfest	2004 Hammerfest	2017 Kvalsund	
Lakselv, Banak	2020 Porsanger	2018 Måsøy	2021 Karasjok
Honningsvåg, Valan	2019 Nordkapp		
Mehamn	2022 Lebesby	2023 Gamvik	
Alta	2012 Alta	2014 Loppa	2011 Kautokeino
Hasvik	2015 Hasvik		
Kirkenes, Høybuktmoen	2030 Sør-Varanger		

APPENDIX B – Analysis 1

Homogeneous non-causality, From PAX to ARTI

Dependent Variable: LOG_ARTI
Method: Panel Least Squares
Date: 04/11/16 Time: 10:37
Sample (adjusted): 1997 2014
Periods included: 18
Cross-sections included: 47
Total panel (unbalanced) observations: 845
LOG_ARTI = C(1)*LOG_ARTI(-1) + C(2)*LOG_ARTI(-2) + C(3)*LOG_ARTI(-3) + C(4)*LOG_ARTI(-4) + C(5)*LOG_PAX(-1) + C(6)*LOG_PAX(-2) + C(7)*LOG_PAX(-3) + C(8)*LOG_PAX(-4) + C(9)

	Coefficient	Std. Error	t-Statistic	Prob.
LOG_ARTI(-1)	0.744269	0.034038	21.86584	0.0000
LOG_ARTI(-2)	0.168218	0.042250	3.981526	0.0001
LOG_ARTI(-3)	0.199500	0.042375	4.707977	0.0000
LOG_ARTI(-4)	-0.110721	0.034197	-3.237691	0.0013
LOG_PAX(-1)	0.012858	0.005737	2.241054	0.0253
LOG_PAX(-2)	0.011734	0.007531	1.558131	0.1196
LOG_PAX(-3)	-0.005719	0.006432	-0.889057	0.3742
LOG_PAX(-4)	-0.016342	0.004872	-3.354388	0.0008
C	0.028428	0.018316	1.552141	0.1210

R-squared	0.999553	Mean dependent var	22.38269
Adjusted R-squared	0.999548	S.D. dependent var	1.755414
S.E. of regression	0.037301	Akaike info criterion	-3.728996
Sum squared resid	1.163185	Schwarz criterion	-3.678517
Log likelihood	1584.501	Hannan-Quinn criter.	-3.709654
F-statistic	233547.1	Durbin-Watson stat	2.051337
Prob(F-statistic)	0.000000		

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	2.241054	836	0.0253
F-statistic	5.022321	(1, 836)	0.0253
Chi-square	5.022321	1	0.0250

Null Hypothesis: C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5)	0.012858	0.005737

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	1.558131	836	0.1196
F-statistic	2.427773	(1, 836)	0.1196
Chi-square	2.427773	1	0.1192

Null Hypothesis: C(6)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	0.011734	0.007531

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.889057	836	0.3742
F-statistic	0.790423	(1, 836)	0.3742
Chi-square	0.790423	1	0.3740

Null Hypothesis: C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	-0.005719	0.006432

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-3.354388	836	0.0008
F-statistic	11.25192	(1, 836)	0.0008
Chi-square	11.25192	1	0.0008

Null Hypothesis: C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	-0.016342	0.004872

Homogeneous Causality, from PAX to ARTI

Dependent Variable: RESID02
Method: Panel Least Squares
Date: 04/11/16 Time: 20:51
Sample (adjusted): 2002 2014
Periods included: 13
Cross-sections included: 47
Total panel (unbalanced) observations: 610
RESID02 = C(1)*RESID02(-1) + C(2)*RESID02(-2) + C(3)*RESID02(-3) + C(4)*RESID02(-4) + C(5)*RESID01(-1) + C(6)*RESID01(-2) + C(7)*RESID01(-3) + C(8)*RESID01(-4) + C(9)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.803851	0.216163	-3.718733	0.0002
C(2)	-1.106860	0.222192	-4.981548	0.0000
C(3)	0.245770	0.228513	1.075519	0.2826
C(4)	-0.116849	0.230298	-0.507381	0.6121
C(5)	0.709058	0.213392	3.322796	0.0009
C(6)	1.045361	0.218088	4.793295	0.0000
C(7)	-0.259897	0.224579	-1.157261	0.2476
C(8)	0.134394	0.226102	0.594397	0.5525
C(9)	-0.004395	0.001458	-3.013514	0.0027

R-squared	0.064586	Mean dependent var	-0.005935
Adjusted R-squared	0.052134	S.D. dependent var	0.035294
S.E. of regression	0.034362	Akaike info criterion	-3.889099
Sum squared resid	0.709621	Schwarz criterion	-3.823982
Log likelihood	1195.175	Hannan-Quinn criter.	-3.863769
F-statistic	5.186997	Durbin-Watson stat	1.909024
Prob(F-statistic)	0.000003		

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	3.322796	601	0.0009
F-statistic	11.04097	(1, 601)	0.0009
Chi-square	11.04097	1	0.0009

Null Hypothesis: C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5)	0.709058	0.213392

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	4.793295	601	0.0000
F-statistic	22.97568	(1, 601)	0.0000
Chi-square	22.97568	1	0.0000

Null Hypothesis: C(6)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	1.045361	0.218088

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-1.157261	601	0.2476
F-statistic	1.339252	(1, 601)	0.2476
Chi-square	1.339252	1	0.2472

Null Hypothesis: C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	-0.259897	0.224579

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	0.594397	601	0.5525
F-statistic	0.353308	(1, 601)	0.5525
Chi-square	0.353308	1	0.5522

Null Hypothesis: C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	0.134394	0.226102

Restrictions are linear in coefficients.

Hetrogeneous non-causality, from PAX to ARTI - LOCAL

Dependent Variable: RESID_LOC
Method: Panel Least Squares
Date: 04/11/16 Time: 21:09
Sample (adjusted): 2002 2014
Periods included: 13
Cross-sections included: 31
Total panel (unbalanced) observations: 402
RESID_LOC = C(1)*RESID_LOC(-1) + C(2)*RESID_LOC(-2) + C(3)
*RESID_LOC(-3) + C(4)*RESID_LOC(-4) + C(5)*RESID01(-1) + C(6)
*RESID01(-2) + C(7)*RESID01(-3) + C(8)*RESID01(-4) + C(9)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.698920	0.287213	-2.433457	0.0154
C(2)	-1.077033	0.300805	-3.580500	0.0004
C(3)	0.364562	0.293124	1.243714	0.2143
C(4)	-0.132089	0.280525	-0.470862	0.6380
C(5)	0.606502	0.287319	2.110902	0.0354
C(6)	1.019719	0.300010	3.398947	0.0007
C(7)	-0.385998	0.288480	-1.338041	0.1817
C(8)	0.173520	0.275176	0.630581	0.5287
C(9)	-0.006487	0.001900	-3.413894	0.0007

R-squared	0.066010	Mean dependent var	-0.007037
Adjusted R-squared	0.046998	S.D. dependent var	0.038445
S.E. of regression	0.037531	Akaike info criterion	-3.705190
Sum squared resid	0.553557	Schwarz criterion	-3.615718
Log likelihood	753.7433	Hannan-Quinn criter.	-3.669765
F-statistic	3.471933	Durbin-Watson stat	1.832202
Prob(F-statistic)	0.000696		

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	2.110902	393	0.0354
F-statistic	4.455909	(1, 393)	0.0354
Chi-square	4.455909	1	0.0348

Null Hypothesis: C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5)	0.606502	0.287319

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	3.398947	393	0.0007
F-statistic	11.55284	(1, 393)	0.0007
Chi-square	11.55284	1	0.0007

Null Hypothesis: C(6)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	1.019719	0.300010

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-1.338041	393	0.1817
F-statistic	1.790353	(1, 393)	0.1817
Chi-square	1.790353	1	0.1809

Null Hypothesis: C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	-0.385998	0.288480

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	0.630581	393	0.5287
F-statistic	0.397632	(1, 393)	0.5287
Chi-square	0.397632	1	0.5283

Null Hypothesis: C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	0.173520	0.275176

Restrictions are linear in coefficients.

Hetrogeneous non-causality, from PAX to ARTI - REGIONAL

Dependent Variable: RESID_REG
Method: Panel Least Squares
Date: 04/11/16   Time: 21:15
Sample (adjusted): 2002 2014
Periods included: 13
Cross-sections included: 12
Total panel (balanced) observations: 156
RESID_REG = C(1)*RESID_REG(-1) + C(2)*RESID_REG(-2) + C(3)
*RESID_REG(-3) + C(4)*RESID_REG(-4) + C(5)*RESID01(-1) + C(6)
*RESID01(-2) + C(7)*RESID01(-3) + C(8)*RESID01(-4) + C(9)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.072170	0.177861	0.405768	0.6855
C(2)	-0.161939	0.181118	-0.894107	0.3727
C(3)	0.372198	0.174790	2.129399	0.0349
C(4)	0.192150	0.174781	1.099372	0.2734
C(5)	-0.181599	0.161238	-1.126279	0.2619
C(6)	0.081596	0.158227	0.515690	0.6068
C(7)	-0.294616	0.153705	-1.916770	0.0572
C(8)	-0.135415	0.154974	-0.873792	0.3837
C(9)	-0.003697	0.002044	-1.808093	0.0726

R-squared	0.065162	Mean dependent var	-0.002686
Adjusted R-squared	0.014287	S.D. dependent var	0.024315
S.E. of regression	0.024140	Akaike info criterion	-4.553904
Sum squared resid	0.085665	Schwarz criterion	-4.377950
Log likelihood	364.2045	Hannan-Quinn criter.	-4.482439
F-statistic	1.280817	Durbin-Watson stat	2.137919
Prob(F-statistic)	0.257728		

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-1.126279	147	0.2619
F-statistic	1.268505	(1, 147)	0.2619
Chi-square	1.268505	1	0.2600

Null Hypothesis: C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5)	-0.181599	0.161238

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	0.515690	147	0.6068
F-statistic	0.265936	(1, 147)	0.6068
Chi-square	0.265936	1	0.6061

Null Hypothesis: C(6)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	0.081596	0.158227

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-1.916770	147	0.0572
F-statistic	3.674006	(1, 147)	0.0572
Chi-square	3.674006	1	0.0553

Null Hypothesis: C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	-0.294616	0.153705

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.873792	147	0.3837
F-statistic	0.763513	(1, 147)	0.3837
Chi-square	0.763513	1	0.3822

Null Hypothesis: C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	-0.135415	0.154974

Restrictions are linear in coefficients.

Hetrogeneous non-causality, from PAX to ARTI - NATIONAL

Dependent Variable: RESID_NASJ
Method: Panel Least Squares
Date: 04/11/16 Time: 21:21
Sample (adjusted): 2002 2014
Periods included: 13
Cross-sections included: 4
Total panel (balanced) observations: 52
RESID_NASJ = C(1)*RESID_NASJ(-1) + C(2)*RESID_NASJ(-2) + C(3)
*RESID_NASJ(-3) + C(4)*RESID_NASJ(-4) + C(5)*RESID01(-1) + C(6)
*RESID01(-2) + C(7)*RESID01(-3) + C(8)*RESID01(-4) + C(9)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.075149	0.314258	-0.239130	0.8121
C(2)	-0.419098	0.291800	-1.436251	0.1582
C(3)	0.345513	0.293970	1.175336	0.2463
C(4)	0.048676	0.263391	0.184804	0.8543
C(5)	-0.029391	0.286914	-0.102438	0.9189
C(6)	0.317908	0.222420	1.429314	0.1601
C(7)	-0.090806	0.229796	-0.395160	0.6947
C(8)	-0.008442	0.192811	-0.043782	0.9653
C(9)	-0.000285	0.004038	-0.070677	0.9440

R-squared	0.094870	Mean dependent var	-0.000452
Adjusted R-squared	-0.073526	S.D. dependent var	0.025248
S.E. of regression	0.026160	Akaike info criterion	-4.293076
Sum squared resid	0.029426	Schwarz criterion	-3.955360
Log likelihood	120.6200	Hannan-Quinn criter.	-4.163604
F-statistic	0.563375	Durbin-Watson stat	2.032961
Prob(F-statistic)	0.801657		

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.102438	43	0.9189
F-statistic	0.010493	(1, 43)	0.9189
Chi-square	0.010493	1	0.9184

Null Hypothesis: C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5)	-0.029391	0.286914

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	1.429314	43	0.1601
F-statistic	2.042940	(1, 43)	0.1601
Chi-square	2.042940	1	0.1529

Null Hypothesis: C(6)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	0.317908	0.222420

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.395160	43	0.6947
F-statistic	0.156151	(1, 43)	0.6947
Chi-square	0.156151	1	0.6927

Null Hypothesis: C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	-0.090806	0.229796

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.043782	43	0.9653
F-statistic	0.001917	(1, 43)	0.9653
Chi-square	0.001917	1	0.9651

Null Hypothesis: C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	-0.008442	0.192811

Restrictions are linear in coefficients.

Homogeneous non-causality, from ARTI to PAX

Dependent Variable: PAX
Method: Panel Least Squares
Date: 04/11/16 Time: 19:27
Sample (adjusted): 1997 2014
Periods included: 18
Cross-sections included: 47
Total panel (unbalanced) observations: 845
PAX = C(1)*PAX(-1) + C(2)*PAX(-2) + C(3)*PAX(-3) + C(4)*PAX(-4) + C(5)
*ARTI(-1) + C(6)*ARTI(-2) + C(7)*ARTI(-3) + C(8)*ARTI(-4) + C(9)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.846130	0.033760	25.06301	0.0000
C(2)	0.078257	0.044316	1.765886	0.0778
C(3)	0.019080	0.037850	0.504083	0.6143
C(4)	0.044389	0.028668	1.548374	0.1219
C(5)	-0.212684	0.200292	-1.061873	0.2886
C(6)	-0.336033	0.248612	-1.351633	0.1769
C(7)	-0.053637	0.249348	-0.215111	0.8297
C(8)	0.627767	0.201230	3.119649	0.0019
C(9)	-0.309327	0.107775	-2.870113	0.0042

R-squared	0.987751	Mean dependent var	11.36296
Adjusted R-squared	0.987634	S.D. dependent var	1.973778
S.E. of regression	0.219493	Akaike info criterion	-0.184402
Sum squared resid	40.27598	Schwarz criterion	-0.133924
Log likelihood	86.91003	Hannan-Quinn criter.	-0.165061
F-statistic	8426.682	Durbin-Watson stat	2.098044
Prob(F-statistic)	0.000000		

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-1.061873	836	0.2886
F-statistic	1.127573	(1, 836)	0.2886
Chi-square	1.127573	1	0.2883

Null Hypothesis: C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5)	-0.212684	0.200292

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-1.351633	836	0.1769
F-statistic	1.826911	(1, 836)	0.1769
Chi-square	1.826911	1	0.1765

Null Hypothesis: C(6)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	-0.336033	0.248612

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.215111	836	0.8297
F-statistic	0.046273	(1, 836)	0.8297
Chi-square	0.046273	1	0.8297

Null Hypothesis: C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	-0.053637	0.249348

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	3.119649	836	0.0019
F-statistic	9.732212	(1, 836)	0.0019
Chi-square	9.732212	1	0.0018

Null Hypothesis: C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	0.627767	0.201230

Restrictions are linear in coefficients.

Homogeneous causality, from ARTI to PAX

Dependent Variable: RESID02
Method: Panel Least Squares
Date: 04/11/16 Time: 21:35
Sample (adjusted): 2002 2014
Periods included: 13
Cross-sections included: 47
Total panel (unbalanced) observations: 610
RESID02 = C(1)*RESID02(-1) + C(2)*RESID02(-2) + C(3)*RESID02(-3) + C(4)*RESID02(-4) + C(5)*RESID01(-1) + C(6)*RESID01(-2) + C(7) *RESID01(-3) + C(8)*RESID01(-4) + C(9)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.485887	0.764981	0.635162	0.5256
C(2)	0.498071	0.708369	0.703123	0.4823
C(3)	-0.393806	0.702941	-0.560226	0.5755
C(4)	0.604585	0.689605	0.876713	0.3810
C(5)	-0.485251	0.765918	-0.633555	0.5266
C(6)	-0.514777	0.710778	-0.724244	0.4692
C(7)	0.323896	0.716909	0.451796	0.6516
C(8)	-0.751529	0.699032	-1.075099	0.2828
C(9)	0.006372	0.009548	0.667401	0.5048

R-squared	0.056960	Mean dependent var	0.010409
Adjusted R-squared	0.044408	S.D. dependent var	0.224658
S.E. of regression	0.219613	Akaike info criterion	-0.179255
Sum squared resid	28.98617	Schwarz criterion	-0.114138
Log likelihood	63.67277	Hannan-Quinn criter.	-0.153925
F-statistic	4.537619	Durbin-Watson stat	2.221003
Prob(F-statistic)	0.000022		

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.633555	601	0.5266
F-statistic	0.401392	(1, 601)	0.5266
Chi-square	0.401392	1	0.5264

Null Hypothesis: C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5)	-0.485251	0.765918

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability

t-statistic	-0.724244	601	0.4692
F-statistic	0.524529	(1, 601)	0.4692
Chi-square	0.524529	1	0.4689

Null Hypothesis: C(6)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	-0.514777	0.710778

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	0.451796	601	0.6516
F-statistic	0.204119	(1, 601)	0.6516
Chi-square	0.204119	1	0.6514

Null Hypothesis: C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	0.323896	0.716909

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-1.075099	601	0.2828
F-statistic	1.155837	(1, 601)	0.2828
Chi-square	1.155837	1	0.2823

Null Hypothesis: C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	-0.751529	0.699032

Restrictions are linear in coefficients.

Granger causality test - Local

Dependent Variable: D(LOC_ARTI)
Method: Panel Least Squares
Date: 04/11/16 Time: 21:55
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 31
Total panel (unbalanced) observations: 588
D(LOC_ARTI) = C(1)*(LOC_ARTI(-1) - 3.41069344471*LOC_PAX(-1) +
13.3095087388) + C(2)*D(LOC_ARTI(-1)) + C(3)*D(LOC_ARTI(-2)) +
C(4)*D(LOC_PAX(-1)) + C(5)*D(LOC_PAX(-2)) + C(6)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.000758	0.000524	-1.444661	0.1491
C(2)	-0.224429	0.040908	-5.486250	0.0000
C(3)	-0.110087	0.040599	-2.711566	0.0069
C(4)	0.006019	0.006075	0.990872	0.3222
C(5)	0.012624	0.005405	2.335634	0.0198
C(6)	0.088021	0.004492	19.59318	0.0000

R-squared	0.064172	Mean dependent var	0.066247
Adjusted R-squared	0.056132	S.D. dependent var	0.042718
S.E. of regression	0.041502	Akaike info criterion	-3.516015
Sum squared resid	1.002429	Schwarz criterion	-3.471355
Log likelihood	1039.708	Hannan-Quinn criter.	-3.498614
F-statistic	7.981800	Durbin-Watson stat	2.098157
Prob(F-statistic)	0.000000		

Short-run Granger causality test - Local

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.837553	(2, 582)	0.0594
Chi-square	5.675105	2	0.0586

Null Hypothesis: C(4)=C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4)	0.006019	0.006075
C(5)	0.012624	0.005405

Restrictions are linear in coefficients.

Strong Granger causality test - Local

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.943000	(3, 582)	0.0325
Chi-square	8.829000	3	0.0317

Null Hypothesis: C(1)=C(4)=C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	-0.000758	0.000524
C(4)	0.006019	0.006075
C(5)	0.012624	0.005405

Restrictions are linear in coefficients.

Granger causality test - Regional

Dependent Variable: D(REG_ARTI)
Method: Panel Least Squares
Date: 04/11/16 Time: 22:03
Sample (adjusted): 1998 2014
Periods included: 17
Cross-sections included: 12
Total panel (balanced) observations: 204
D(REG_ARTI) = C(1)*(REG_ARTI(-1) - 4.67717261287*REG_PAX(-1) + 37.2017583265) + C(2)*D(REG_ARTI(-1)) + C(3)*D(REG_ARTI(-2)) + C(4)*D(REG_ARTI(-3)) + C(5)*D(REG_ARTI(-4)) + C(6)*D(REG_PAX(-1)) + C(7)*D(REG_PAX(-2)) + C(8)*D(REG_PAX(-3)) + C(9)*D(REG_PAX(-4)) + C(10)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.001396	0.000512	-2.728613	0.0069
C(2)	-0.280341	0.066975	-4.185734	0.0000
C(3)	0.008710	0.068487	0.127181	0.8989
C(4)	0.124004	0.067403	1.839724	0.0673
C(5)	-0.217110	0.062439	-3.477148	0.0006
C(6)	0.067475	0.023768	2.838930	0.0050
C(7)	0.066615	0.024436	2.726049	0.0070
C(8)	0.025620	0.024411	1.049556	0.2952
C(9)	0.089442	0.024363	3.671271	0.0003
C(10)	0.094455	0.011111	8.501172	0.0000

R-squared	0.337622	Mean dependent var	0.073464
Adjusted R-squared	0.306893	S.D. dependent var	0.028089
S.E. of regression	0.023385	Akaike info criterion	-4.625658
Sum squared resid	0.106091	Schwarz criterion	-4.463005
Log likelihood	481.8171	Hannan-Quinn criter.	-4.559862
F-statistic	10.98710	Durbin-Watson stat	2.066330
Prob(F-statistic)	0.000000		

Short run Granger causality test - Regional

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	8.295373	(4, 194)	0.0000
Chi-square	33.18149	4	0.0000

Null Hypothesis: C(6)=C(7)=C(8)=C(9)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	0.067475	0.023768
C(7)	0.066615	0.024436
C(8)	0.025620	0.024411
C(9)	0.089442	0.024363

Restrictions are linear in coefficients.

Strong Granger causality test - Regional

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	9.367189	(5, 194)	0.0000
Chi-square	46.83595	5	0.0000

Null Hypothesis: C(1)=C(6)=C(7)=C(8)=C(9)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	-0.001396	0.000512
C(6)	0.067475	0.023768
C(7)	0.066615	0.024436
C(8)	0.025620	0.024411
C(9)	0.089442	0.024363

Restrictions are linear in coefficients.

APPENDIX C – Analysis 2 – 2SLS Regression

The Hausman endogenity test approach.

The Hausman test of simultaneity may be adapted in order to test a dataset for endogeneity/exogeneity (Gujarati 2003). In the econometrics software Eviews 9.5, such a method have been developed and lets one test whether a variable is endogenous or exogenous, however a draw back of the test is that it has to be performed after the 2SLS model is computed. In this chapter this method will be formally explained and presented based on the textual resources provided by Startz (2015)

The idea is to test whether the explanatory variable (T_i) are in fact endogenous, which would favour the use of a 2SLS method. The hypothesis in the Durbin-Wu-Hausman tests are as follows:

H_0 : T_i is exogenous?
H_1 : T_i Is endogenous?

The test estimates two models, where model 1 assumes that the explanatory variable is exogenous, while model 2 assumes endogeneity. The resulting J statistics are then compared and for the null hypothesis:

$$H = J_2 - J_1,$$

Where J_2 are the J-statistics of model 2 and J_1 are the J-statistics of model 1. Notice that the χ^2 distribution has the number of freedom of the number of included variables.

TEST 1

EMP	2013
SER.EMP	2013
IND.EMP	2013
PAX	2013
POP	2005
EDU	msc 2005
NORTH	instrumental
STAM	stamflyplass
OIL.HUB	olje_hub

First stage regression

Dependent Variable: PAX				
Method: Least Squares				
Date: 03/29/16 Time: 20:18				
Sample: 1 47				
Included observations: 47				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
POP	0.908175	0.131282	6.917747	0.0000
EDU	-0.393049	0.362641	-1.083850	0.2848
NORTH	1.111615	0.287822	3.862155	0.0004
OIL_HUB	1.165405	0.345286	3.375187	0.0016
STAM	2.048073	0.313767	6.527362	0.0000
C	1.420570	1.227770	1.157032	0.2540
R-squared	0.877846	Mean dependent var		11.55317
Adjusted R-s	0.862949	S.D. dependent var		2.041002
S.E. of regres	0.755587	Akaike info criterion		2.396099
Sum squared	23.40735	Schwarz criterion		2.632288
Log likelihoo	-50.30832	Hannan-Quinn criter.		2.484978
F-statistic	58.92839	Durbin-Watson stat		1.386844
Prob(F-statis	0.000000			

Second stage regression (all three employment categories)

Dependent Variable: EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:17				
Sample: 1 47				
Included observations: 47				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.089990	0.028338	3.175593	0.0028
POP	0.836685	0.038927	21.49398	0.0000
EDU	0.334025	0.072225	4.624781	0.0000
NORTH	-0.210967	0.069483	-3.036236	0.0041
C	-0.303803	0.249415	-1.218063	0.2300
R-squared	0.992853	Mean dependent var		9.177070
Adjusted R-s	0.992173	S.D. dependent var		1.792507
S.E. of regres	0.158588	Sum squared resid		1.056306
F-statistic	1460.508	Durbin-Watson stat		1.668285
Prob(F-statis	0.000000	Second-Stage SSR		0.873713
J-statistic	0.560191	Instrument rank		6
Prob(J-statis	0.454183			

Dependent Variable: SER_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:32				
Sample: 1 47				
Included observations: 47				
Instrument specification: POP EDU NORTH C OIL_HUB STAM				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.150089	0.043455	3.453892	0.0013
POP	0.800596	0.059692	13.41213	0.0000
EDU	0.484214	0.110754	4.371991	0.0001
NORTH	-0.329793	0.106549	-3.095220	0.0035
C	-2.703901	0.382466	-7.069653	0.0000
R-squared	0.985753	Mean dependent var		7.161446
Adjusted R-s	0.984396	S.D. dependent var		1.946833
S.E. of regres	0.243187	Sum squared resid		2.483877
F-statistic	729.7692	Durbin-Watson stat		1.879013
Prob(F-statis	0.000000	Second-Stage SSR		1.713294
J-statistic	0.065148	Instrument rank		6
Prob(J-statis	0.798537			

Dependent Variable: SER_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:32				
Sample: 1 47				
Included observations: 47				
Instrument specification: POP EDU NORTH C OIL_HUB STAM				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.150089	0.043455	3.453892	0.0013
POP	0.800596	0.059692	13.41213	0.0000
EDU	0.484214	0.110754	4.371991	0.0001
NORTH	-0.329793	0.106549	-3.095220	0.0035
C	-2.703901	0.382466	-7.069653	0.0000
R-squared	0.985753	Mean dependent var		7.161446
Adjusted R-s	0.984396	S.D. dependent var		1.946833
S.E. of regres	0.243187	Sum squared resid		2.483877
F-statistic	729.7692	Durbin-Watson stat		1.879013
Prob(F-statis	0.000000	Second-Stage SSR		1.713294
J-statistic	0.065148	Instrument rank		6
Prob(J-statis	0.798537			

Endogeneity test results

Endogeneity Test				
Null hypothesis: PAX are exogenous				
Equation: UNTITLED				
Specification: EMP PAX POP EDU NORTH C				
Instrument specification: POP EDU NORTH C OIL_HUB STAM				
Endogenous variables to treat as exogenous: PAX				
	Value	df	Probability	
Difference ir	4.488223	1	0.0341	
J-statistic summary:				
	Value			
Restricted J-:	5.093155			
Unrestricted	0.604932			
Restricted Test Equation:				
Dependent Variable: EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:22				
Sample: 1 47				
Included observations: 47				
Instrument specification: POP EDU NORTH C OIL_HUB STAM PAX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.052207	0.020630	2.530681	0.0152
POP	0.874264	0.032993	26.49809	0.0000
EDU	0.360852	0.068340	5.280290	0.0000
NORTH	-0.162114	0.062762	-2.582994	0.0134
C	-0.287654	0.239893	-1.199094	0.2372
R-squared	0.993382	Mean dependent var		9.177070
Adjusted R-s	0.992752	S.D. dependent var		1.792507
S.E. of regres	0.152611	Sum squared resid		0.978180
F-statistic	1576.036	Durbin-Watson stat		1.545593
Prob(F-statis	0.000000	Second-Stage SSR		0.978180
J-statistic	5.093155	Instrument rank		7
Prob(J-statis	0.078349			
Unrestricted Test Equation:				
Dependent Variable: EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:22				
Sample: 1 47				
Included observations: 47				
Instrument specification: POP EDU NORTH C OIL_HUB STAM				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.089990	0.027270	3.299973	0.0020
POP	0.836685	0.037459	22.33584	0.0000
EDU	0.334025	0.069503	4.805922	0.0000
NORTH	-0.210967	0.066864	-3.155157	0.0030
C	-0.303803	0.240014	-1.265771	0.2126
R-squared	0.992853	Mean dependent var		9.177070
Adjusted R-s	0.992173	S.D. dependent var		1.792507
S.E. of regres	0.158588	Sum squared resid		1.056306
Durbin-Wats	1.668285	J-statistic		0.604932
Instrument r	6	Prob(J-statistic)		0.436702

Endogeneity Test				
Null hypothesis: PAX are exogenous				
Equation: UNTITLED				
Specification: SER_EMP PAX POP EDU NORTH C				
Instrument specification: POP EDU NORTH C OIL_HUB STAM				
Endogenous variables to treat as exogenous: PAX				
	Value	df	Probability	
Difference ir	8.960570	1	0.0028	
J-statistic summary:				
	Value			
Restricted J-:	9.036107			
Unrestricted	0.075536			
Restricted Test Equation:				
Dependent Variable: SER_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:33				
Sample: 1 47				
Included observations: 47				
Instrument specification: POP EDU NORTH C OIL_HUB STAM PAX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.071083	0.030529	2.328346	0.0248
POP	0.879173	0.048827	18.00603	0.0000
EDU	0.540311	0.101135	5.342481	0.0000
NORTH	-0.227639	0.092881	-2.450877	0.0185
C	-2.670134	0.355015	-7.521189	0.0000
R-squared	0.987713	Mean dependent var		7.161446
Adjusted R-s	0.986542	S.D. dependent var		1.946833
S.E. of regres	0.225847	Sum squared resid		2.142279
F-statistic	844.0322	Durbin-Watson stat		1.990720
Prob(F-statis	0.000000	Second-Stage SSR		2.142279
J-statistic	9.036107	Instrument rank		7
Prob(J-statis	0.010910			
Unrestricted Test Equation:				
Dependent Variable: SER_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:33				
Sample: 1 47				
Included observations: 47				
Instrument specification: POP EDU NORTH C OIL_HUB STAM				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.150089	0.040357	3.719083	0.0006
POP	0.800596	0.055436	14.44192	0.0000
EDU	0.484214	0.102856	4.707673	0.0000
NORTH	-0.329793	0.098951	-3.332872	0.0018
C	-2.703901	0.355194	-7.612462	0.0000
R-squared	0.985753	Mean dependent var		7.161446
Adjusted R-s	0.984396	S.D. dependent var		1.946833
S.E. of regres	0.243187	Sum squared resid		2.483877
Durbin-Wats	1.879013	J-statistic		0.075536
Instrument r	6	Prob(J-statistic)		0.783440

Endogeneity Test				
Null hypothesis: PAX are exogenous				
Equation: UNTITLED				
Specification: IND_EMP PAX POP EDU NORTH C				
Instrument specification: POP EDU NORTH C OIL_HUB STAM				
Endogenous variables to treat as exogenous: PAX				
	Value	df	Probability	
Difference ir	0.493834	1	0.4822	
J-statistic summary:				
	Value			
Restricted J-	0.671836			
Unrestricted	0.178001			
Restricted Test Equation:				
Dependent Variable: IND_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:34				
Sample: 1 47				
Included observations: 47				
Instrument specification: POP EDU NORTH C OIL_HUB STAM PAX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.091890	0.072007	1.276130	0.2089
POP	0.878767	0.115163	7.630618	0.0000
EDU	-0.515961	0.238538	-2.163013	0.0363
NORTH	-0.878497	0.219070	-4.010123	0.0002
C	-1.993825	0.837344	-2.381130	0.0219
R-squared	0.918072	Mean dependent var		6.911846
Adjusted R-s	0.910270	S.D. dependent var		1.778284
S.E. of regres	0.532686	Sum squared resid		11.91766
F-statistic	117.6618	Durbin-Watson stat		1.472856
Prob(F-statis	0.000000	Second-Stage SSR		11.91766
J-statistic	0.671836	Instrument rank		7
Prob(J-statis	0.714682			
Unrestricted Test Equation:				
Dependent Variable: IND_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:34				
Sample: 1 47				
Included observations: 47				
Instrument specification: POP EDU NORTH C OIL_HUB STAM				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.135637	0.095186	1.424972	0.1616
POP	0.835258	0.130751	6.388145	0.0000
EDU	-0.547023	0.242599	-2.254844	0.0294
NORTH	-0.935060	0.233389	-4.006450	0.0002
C	-2.012522	0.837767	-2.402246	0.0208
R-squared	0.917352	Mean dependent var		6.911846
Adjusted R-s	0.909481	S.D. dependent var		1.778284
S.E. of regres	0.535021	Sum squared resid		12.02239
Durbin-Wats	1.536171	J-statistic		0.178001
Instrument r	6	Prob(J-statistic)		0.673096

TEST 2

EMP	2013
SER.EMP	2013
IND.EMP	2013
PAX	2013
POP	2005
EDU	msc 2005
NORTH	instrumental
STAM	stamflyplass
OIL.HUB	olje_hub

First stage regression

Dependent Variable: PAX				
Method: Least Squares				
Date: 03/29/16 Time: 20:26				
Sample: 1 39				
Included observations: 39				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
POP	0.750990	0.164738	4.558683	0.0001
EDU	-0.281153	0.423501	-0.663878	0.5114
NORTH	1.011473	0.313168	3.229808	0.0028
OIL_HUB	1.287388	0.422150	3.049599	0.0045
STAM	1.800054	0.370595	4.857200	0.0000
C	2.872993	1.509705	1.903016	0.0658
R-squared	0.729804	Mean dependent var		10.85475
Adjusted R-s	0.688865	S.D. dependent var		1.372167
S.E. of regres	0.765388	Akaike info criterion		2.443770
Sum squarec	19.33200	Schwarz criterion		2.699702
Log likelihoc	-41.65351	Hannan-Quinn criter.		2.535596
F-statistic	17.82669	Durbin-Watson stat		1.402449
Prob(F-statis	0.000000			

Second stage regression

Dependent Variable: EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:27				
Sample: 1 39				
Included observations: 39				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.122256	0.033835	3.613354	0.0010
POP	0.879027	0.035628	24.67211	0.0000
EDU	0.278991	0.075803	3.680487	0.0008
NORTH	-0.200004	0.069256	-2.887887	0.0067
C	-1.011091	0.314740	-3.212464	0.0029
R-squared	0.990782	Mean dependent var		8.651465
Adjusted R-s	0.989697	S.D. dependent var		1.427059
S.E. of regres	0.144849	Sum squared resid		0.713357
F-statistic	914.8391	Durbin-Watson stat		1.813396
Prob(F-statis	0.000000	Second-Stage SSR		0.609593
J-statistic	0.249429	Instrument rank		6
Prob(J-statis	0.617477			

Dependent Variable: SER_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:28				
Sample: 1 39				
Included observations: 39				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.153677	0.058130	2.643681	0.0123
POP	0.849329	0.061212	13.87529	0.0000
EDU	0.429025	0.130234	3.294272	0.0023
NORTH	-0.298250	0.118986	-2.506592	0.0171
C	-3.181822	0.540742	-5.884182	0.0000
R-squared	0.975795	Mean dependent var		6.574494
Adjusted R-s	0.972947	S.D. dependent var		1.513028
S.E. of regres	0.248858	Sum squared resid		2.105633
F-statistic	345.1612	Durbin-Watson stat		1.819586
Prob(F-statis	0.000000	Second-Stage SSR		1.487797
J-statistic	0.017094	Instrument rank		6
Prob(J-statis	0.895978			

Dependent Variable: IND_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:30				
Sample: 1 39				
Included observations: 39				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.127816	0.136957	0.933260	0.3573
POP	0.877671	0.144218	6.085740	0.0000
EDU	-0.587194	0.306837	-1.913699	0.0641
NORTH	-0.906710	0.280337	-3.234355	0.0027
C	-2.319475	1.274014	-1.820604	0.0775
R-squared	0.853080	Mean dependent var		6.418331
Adjusted R-s	0.835795	S.D. dependent var		1.446915
S.E. of regres	0.586322	Sum squared resid		11.68830
F-statistic	49.39419	Durbin-Watson stat		1.442433
Prob(F-statis	0.000000	Second-Stage SSR		11.63371
J-statistic	0.223114	Instrument rank		6
Prob(J-statis	0.636677			

Endogeneity test results

Endogeneity Test				
Null hypothesis: PAX are exogenous				
Equation: UNTITLED				
Specification: EMP PAX POP EDU NORTH C				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Endogenous variables to treat as exogenous: PAX				
	Value	df	Probability	
Difference ir	3.423834	1	0.0643	
J-statistic summary:				
	Value			
Restricted J-	3.699757			
Unrestricted	0.275923			
Restricted Test Equation:				
Dependent Variable: EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:29				
Sample: 1 39				
Included observations: 39				
Instrument specification: POP EDU NORTH OIL_HUB STAM C PAX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.079609	0.022442	3.547352	0.0012
POP	0.902795	0.031345	28.80188	0.0000
EDU	0.317866	0.068942	4.610667	0.0001
NORTH	-0.153490	0.060860	-2.522011	0.0165
C	-0.824928	0.281828	-2.927058	0.0061
R-squared	0.991667	Mean dependent var		8.651465
Adjusted R-s	0.990687	S.D. dependent var		1.427059
S.E. of regres	0.137719	Sum squared resid		0.644860
F-statistic	1011.548	Durbin-Watson stat		1.730837
Prob(F-statis	0.000000	Second-Stage SSR		0.644860
J-statistic	3.699757	Instrument rank		7
Prob(J-statis	0.157256			
Unrestricted Test Equation:				
Dependent Variable: EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:29				
Sample: 1 39				
Included observations: 39				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.122256	0.032169	3.800417	0.0006
POP	0.879027	0.033875	25.94938	0.0000
EDU	0.278991	0.072072	3.871025	0.0005
NORTH	-0.200004	0.065847	-3.037392	0.0046
C	-1.011091	0.299248	-3.378773	0.0018
R-squared	0.990782	Mean dependent var		8.651465
Adjusted R-s	0.989697	S.D. dependent var		1.427059
S.E. of regres	0.144849	Sum squared resid		0.713357
Durbin-Wats	1.813396	J-statistic		0.275923
Instrument r	6	Prob(J-statistic)		0.599386

Endogeneity Test				
Null hypothesis: PAX are exogenous				
Equation: UNTITLED				
Specification: SER_EMP PAX POP EDU NORTH C				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Endogenous variables to treat as exogenous: PAX				
	Value	df	Probability	
Difference ir	5.871872	1	0.0154	
J-statistic summary:				
	Value			
Restricted J-	5.892080			
Unrestricted	0.020208			
Restricted Test Equation:				
Dependent Variable: SER_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:29				
Sample: 1 39				
Included observations: 39				
Instrument specification: POP EDU NORTH OIL_HUB STAM C PAX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.060855	0.037297	1.631636	0.1120
POP	0.901058	0.052094	17.29678	0.0000
EDU	0.513635	0.114578	4.482854	0.0001
NORTH	-0.197013	0.101147	-1.947796	0.0597
C	-2.776644	0.468386	-5.928114	0.0000
R-squared	0.979525	Mean dependent var		6.574494
Adjusted R-s	0.977116	S.D. dependent var		1.513028
S.E. of regres	0.228882	Sum squared resid		1.781165
F-statistic	406.6381	Durbin-Watson stat		2.103972
Prob(F-statis	0.000000	Second-Stage SSR		1.781165
J-statistic	5.892080	Instrument rank		7
Prob(J-statis	0.052547			
Unrestricted Test Equation:				
Dependent Variable: SER_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:29				
Sample: 1 39				
Included observations: 39				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.153677	0.053464	2.874408	0.0069
POP	0.849329	0.056298	15.08625	0.0000
EDU	0.429025	0.119780	3.581778	0.0011
NORTH	-0.298250	0.109435	-2.725354	0.0101
C	-3.181822	0.497337	-6.397723	0.0000
R-squared	0.975795	Mean dependent var		6.574494
Adjusted R-s	0.972947	S.D. dependent var		1.513028
S.E. of regres	0.248858	Sum squared resid		2.105633
Durbin-Wats	1.819586	J-statistic		0.020208
Instrument r	6	Prob(J-statistic)		0.886958

Endogeneity Test				
Null hypothesis: PAX are exogenous				
Equation: UNTITLED				
Specification: IND_EMP PAX POP EDU NORTH C				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Endogenous variables to treat as exogenous: PAX				
	Value	df	Probability	
Difference ir	0.154493	1	0.6943	
J-statistic summary:				
	Value			
Restricted J-:	0.378677			
Unrestricted	0.224184			
Restricted Test Equation:				
Dependent Variable: IND_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:30				
Sample: 1 39				
Included observations: 39				
Instrument specification: POP EDU NORTH OIL_HUB STAM C PAX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.089339	0.095315	0.937309	0.3552
POP	0.899114	0.133129	6.753701	0.0000
EDU	-0.552120	0.292810	-1.885594	0.0679
NORTH	-0.864745	0.258486	-3.345422	0.0020
C	-2.151518	1.196986	-1.797446	0.0812
R-squared	0.853781	Mean dependent var		6.418331
Adjusted R-s	0.836578	S.D. dependent var		1.446915
S.E. of regres	0.584922	Sum squared resid		11.63255
F-statistic	49.63179	Durbin-Watson stat		1.359260
Prob(F-statis	0.000000	Second-Stage SSR		11.63255
J-statistic	0.378677	Instrument rank		7
Prob(J-statis	0.827506			
Unrestricted Test Equation:				
Dependent Variable: IND_EMP				
Method: Two-Stage Least Squares				
Date: 03/29/16 Time: 20:30				
Sample: 1 39				
Included observations: 39				
Instrument specification: POP EDU NORTH OIL_HUB STAM C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PAX	0.127816	0.136630	0.935494	0.3561
POP	0.877671	0.143873	6.100307	0.0000
EDU	-0.587194	0.306104	-1.918279	0.0635
NORTH	-0.906710	0.279668	-3.242097	0.0027
C	-2.319475	1.270972	-1.824962	0.0768
R-squared	0.853080	Mean dependent var		6.418331
Adjusted R-s	0.835795	S.D. dependent var		1.446915
S.E. of regres	0.586322	Sum squared resid		11.68830
Durbin-Wats	1.442433	J-statistic		0.224184
Instrument r	6	Prob(J-statistic)		0.635871

APPENDIX D – analysis 3 - Survey

Letter distributed with the survey

Luftfartens betydning for næringslivet i Sogndalregionen

Luftfart er en svært viktig del av transporttilbudet i mange regioner, og danner ofte en premiss for et variert næringsliv og en god offentlig tjenesteproduksjon. Dette er et felt der det trengs mer kunnskap. Vi ønsker derfor å invitere din bedrift til å delta i en undersøkelse av hvilke konsekvenser tilgang til en flyplass kan ha for næringslivet i Sogndalregionen, når det gjelder innvirkning på ulike elementer som påvirker produktiviteten i foretakene.
Denne undersøkelsen gjennomføres som del av et mastergradsstudium i logistikk ved Høgskolen i Molde. Vi har gjennom flere år arbeidet med analyser av lufttransport, blant annet i samarbeid med Avinor, Samferdselsdepartementet og EU. Masteroppgaver og doktorgradsarbeider er en integrert og viktig del av denne aktiviteten.
Undersøkelsen gjennomføres ved hjelp av en nettbasert tjeneste. En lenke til denne finner du lenger nede på siden. Utfylling av spørreskjemaet vil ta omtrent 10 minutter. Det inneholder ingen spørsmål som er av sensitiv eller strategisk natur, men svarene vil likevel bli behandlet konfidensielt. Som en liten kompensasjon for bruk av din tid, så vil du få tilsendt rapporten ved avkrysning i slutten av undersøkelsen.
Skulle du ha noen spørsmål i forbindelse med undersøkelsen kan du kontakte oss på telefonnummeret eller e-postadressen som er notert under.
Vi håper at du finner tid til å svare på undersøkelsen, og takker på forhånd for god hjelp.

Med vennlig hilsen

André Ree
476 17 271
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Masterstudent, Høgskolen i Molde

Svein Bråthen
Professor, Høgskolen i Molde
Veileder

https://response.questback.com/andreree/5wkovc48lj

Copy of the questionnaire

1. Hva er bedriftens navn?

2. Hva er ditt navn, og stilling i bedriften?

3. Hvor mange årsverk har bedriften totalt?

4. Hvor mange årsverk har bedriften i Sogndalregionen?

5. Driver bedriften med eksport av varer og/eller tjenester?

6. Kan du anslå verdien av bedriftens eksport ut av Sogndalregionen? (i mill NOK)

7. Hvor stor var bedriftens omsetning skapt i Sogndalregionen 2014? (i mill. NOK)

8. Hvor stor andel av omsetningen er etter bedriftens vurdering avhengig av flytilbudet ved Sogndal lufthavn? (Oppgi ca % andel)

9. Er bedriftens produksjon organisert etter JIT (just-in-time) prinsippet?
   a. Ja
   b. Nei
   c. Vet ikke

10. Hvilken betydning har flytransport for bedriften når det gjelder følgende faktorer i selve produksjonsprosessen?
    Vertikal Akse
    a. Leveransesikkerhet, inngående leveranser
    b. Interne produksjonsprosesser
    c. Minimere lagerhold
    d. Kontakt med samarbeidspartnere i produksjonssammenheng
    Horisontal Akse
    e. 1. Ingen
    f. 2. Liten
    g. 3. Middels
    h. 4. Stor
    i. 5. Veldig stor

11. Har flyforbindelsen ved Sogndal lufthavn medført noen virkninger for følgende markedsaktiviteter?

    Vertikal Akse

    a. Reduserte transportkostnader
    b. Reduserte rekrutteringskostnader
    c. Økt konkurranseeksponering
    d. Deltakelse på kurs og konferanser
    e. Kontakt med kunder/markedet
    f. Kontakt med konsulenter/ FoU/høyere utdanning
    g. Kontakt med leverandører

    Horisontal Akse

    h. 1. Ingen
    i. 2. Liten
    j. 3. Middels
    k. 4. Stor
    l. 5. Veldig stor

12. Hvor viktig er følgende faktorer ved Sogndal lufthavn for bedriftens konkurranseevne?

    Vertikal Akse

    a. Billettpriser
    b. Fraktpriser
    c. Nye direkteruter innenlands
    d. Nye direkteruter utenlands
    e. Opprettholdelse av nåværende direkteruter
    f. Avgangsfrekvens
    g. Tilgang til gode videreforbindelser fra Oslo lufthavn
    h. Tilgang til gode videreforbindelser fra Bergen lufthavn

    Horisontal Akse

    i. 1. Ingen
    j. 2. Liten
    k. 3. Middels
    l. 4. Stor
    m. 5. Veldig stor

13. Hvor mange flyreiser foretar bedriften via Sogndal lufthavn i et typisk år?

14. Har flytilbudet ved Sogndal lufthavn påvirket bedriftens investeringsbeslutninger?
    a. Ja, vi har avstått fra å investere i Sogndalregionen
    b. Ja, vi har investert i andre norske regioner
    c. Ja, vi har investert i utlandet
    d. Ja, vi har investert mer i Sogndalregionen enn det vi ellers ville ha gjort
    e. Nei
    f. Vet ikke
    g. Annet (spesifiser)

15. Hvor stor betydning tror du flyplassens eksistens og rutenett har for å tiltrekke kvalifisert arbeidskraft til Sogndalregionen?
    a. Ingen betydning
    b. Lav betydning
    c. Middels betydning
    d. Høy betydning
    e. Avgjørende betydning

16. Har bedriften foretatt nyansettelser i regionen som følge av flytilbudet?
    a. Ja, ufaglærte arbeidere
    b. Ja, fagarbeidere
    c. Ja, fagpersonell med univ./høgskole utdanning
    d. Ja, ledere
    e. Nei, ingen ansettelser foretatt som følge av flytilbudet

17. Ville bedriften hatt samme virksomhet uten flytilbudet ved Sogndal lufthavn?
    a. Ja, samme omfang og beliggenhet
    b. Ja samme omfang, men helt eller delvis annen lokalisering
    c. Nei, mindre omfang, men samme beliggenhet
    d. Nei, mindre omfang og annen beliggenhet
    e. Bedriften/avdelingen ville ikke eksistert

18. Hvor ofte benytter bedriften flytransport fra Sogndal lufthavn til utførelsen av følgende aktiviteter?

    Vertikal Akse

    a. Leveranser til bedriften (råvarer, komponenter)
    b. Utgående leveranser av ferdigvarer/sluttprodukter
    c. Reiser for servicepersonell med base i regionen
    d. Reiser for innleid servicepersonell
    e. Reiser utført av markedspersonell (ledere, selgere o.l.)
    f. Kundebesøk inn til bedriften

    Horisontal Akse

    g. Aldri
    h. Sjelden
    i. Månedlig
    j. Ukentlig

19. Har flytilbudet medført økt samarbeid med andre bedrifter?
    a. Ja, mer samarbeid med leverandører
    b. Ja mer samarbeid med kunder
    c. Ja mer samarbeid med kunnskapsmiljøer (konsulenter, FOU, høgskoler o.l.)
    d. Nei, ingen endring.

20. På hvilke områder samarbeider bedriften mer med leverandørene som følger av flytilbudet?
    a. Samarbeid om innkjøpsplanlegging

b. Samarbeid om produksjonsplanlegging
c. Samarbeid om produktutvikling
d. Samarbeid om annen kompetanseutvikling
e. Samarbeid/kontakt med andre kunder enn før
f. Samarbeid/kontakt med flere kunder enn før

21. På hvilke områder samarbeider bedriften mer med kunder som følger av flytilbudet?
    a. Samarbeid om innkjøpsplanlegging
    b. Samarbeid om produksjonsplanlegging
    c. Samarbeid om produktutvikling
    d. Samarbeid om annen kompetanseutvikling
    e. Samarbeid/kontakt med andre kunder enn før
    f. Samarbeid/kontakt med flere kunder enn før

22. På hvilke områder samarbeider bedriften mer med kunnskapsmiljøer som følger av flytilbudet?
    a. Samarbeid om innkjøpsplanlegging
    b. Samarbeid om produksjonsplanlegging
    c. Samarbeid om produktutvikling
    d. Samarbeid om annen kompetanseutvikling
    e. Samarbeid/kontakt med andre kunder enn før
    f. Samarbeid/kontakt med flere kunder enn før

23. Ønsker du å få tilsendt rapporten etter studien er fullført?
    a. Ja
    b. Nei

Key figures and list of respondents

Industri	Kommune	bransje	omsettning	resultat	eksport verdi	flyavhengig or	Årsverk lokal	Antall flyreis
Avery Dennison NTP	Luster	18.120 Trykking ellers	kr 121 555 000	kr 9 639 000	kr 30 000 000	15 %	110	150
Digital Etikett AS	Luster	18.130 Ferdiggjøring før trykking og	kr 19 424 000	kr 4 525 000	kr 25 000 000	10 %	11	20
Luster Mekaniske Industri AS	Luster	25.110 Produksjon av metallkonstru	kr 87 939 000	kr 4 494 000	-	50 %	50	20
		SUM	*kr 228 918 000*	*kr 18 658 000*	*kr 55 000 000*		*171*	*190*
		GJENNOMSNITT	*kr 76 306 000*	*kr 6 219 333*	*kr 27 500 000*	*25 %*	*57*	*63,3333333*
			kr 140 979 000				1,818181818	
							1,363636364	
Service	**Kommune**	**bransje**	**omsettning**	**resultat**	**eksport verdi**	**flyavhengig or**	**Årsverk lokal**	**Antall flyreis**
Walaker Hotell	Luster	55. Drift av hoteller, pensjonater og	kr 9 231 000	kr 1 854 000	kr 10 000 000	10 %	8	10
Gandrudbakken Etiketter AS (	Luster	74.101 Industridesign, produktdesi	-	-	-	25 %	11	30
AAA Miljø AS (nyregistrert)	Lærdal	70.220 Bedriftsrådgivning og anner	kr 1 000 000	-	-	50 %	1	50
Aarethun AS	Lærdal	55.300 Drift av campingplasser	kr 9 241 000	kr 735 000	kr 7 000 000	0 %	9	0
Bystøl AS	Vik i Sogn	71.121 Byggeteknisk konsulentvirks	kr 15 534 000	kr 1 910	kr 9 000 000	5 %	11	10
Highsoft AS	Vik i Sogn	62.010 Programmeringstjenester	kr 40 189 000	kr 30 171 000	kr 59 000 000	0 %	16	20
Interplan AS (nyregistrert)	Balestrand	70.220 Bedriftsrådgivning og anner	kr 500 000	-	kr 300 000	50 %	1	12
Balestrand Rekneskapskontor	Balestrand	69.201 Regnskap og bokføring	kr 1 079 000	kr 415 000	-	0 %	1	0
Balestrand Bygdahus SA	Balestrand	68.209 Utleie av egen eller leid fast	-	-	-	0 %	0	0
Sogn Næring AS	Sogndal	70.220 Bedriftsrådgivning og anner	kr 3 022 000	kr 143 000	-	50 %	2	15
		SUM	*kr 79 796 000*	*kr 33 319 910*	*kr 85 300 000*		*60*	*147*
		GJENNOMSNITT	*kr 9 974 500*	*kr 5 553 318*	*kr 17 060 000*	*19 %*	*6*	*14,7*
Annet	**Kommune**	**bransje**	**omsettning**	**resultat**	**eksport verdi**	**flyavhengig or**	**Årsverk lokal**	**Antall flyreis**
Statkraft energi*	Luster	35.111 Produksjon av elektrisitet fr	kr 354 703 125	kr 209 015 625	-	0 %	75	300
B&B Creativa AS	Lærdal	46.900 Uspesifisert engroshandel	kr 93 000	kr 47 000	-	0 %	1	1
Vik elektro AF	Vik i Sogn	47.540 Butikkhandel med elektrisk	-	-	-	0 %	2	4
West-maskin as	Lærdal	45.200 Vedlikehold og reparasjon a	kr 6 913 000	kr 340 000	-	0 %	6	0
Byggmester Aleksander Heen	Årdalstangen	41.200 Oppføring av bygninger	kr 1 000 000	-	-	0 %	1	10
Coop Byggmix og Extra Vik	Vik i Sogn	47.521 Butikkhandel med bredt utv	-	-	-	0 %	14	4
SIMAS IKS	Kaupanger	38.210 Behandling og disponering a	kr 60 034 000	kr 145 000	-	0 %	20	20
Menes og Haraldsson Butikkd	Balestrand	47.111 Butikkhandel med bredt var	kr 11 400 000	-	-	30 %	4	12
		SUM	*kr 434 143 125*	*kr 209 547 625*	*kr 0*		*123*	*351*
		GJENNOMSNITT	*kr 72 357 188*	*kr 52 386 906*	*#DIV/0!*	*4 %*	*15,375*	*43,875*