NORGES HANDELSHØYSKOLE

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# Migration, Economic Growth and Spatial Distribution

*The Case of Norway*


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NORGES HANDELSHØYSKOLE

# Preface

This thesis has been written in association with our Master degree in International Business at NHH – Norwegian School of Economics and Business Administration which is about to draw to a close.

There has been a great deal of discussion around the topic of migration in the media, both in regards to the enlargement of the EU and the Norwegian asylum policy. We wanted to observe how this large share of migrants that the Norwegian economy ultimately depends on affects the regional economic growth. In addition, half of the world's production is conducted on 1.5 percent of the total land area on the planet. This phenomenon inspired us to also include the regional convergence and migration as factors that determine intra-regional migration.

When we carried out the initial research on the topic, we found that there were not many studies that combine the regional growth with migration in Norway, and even fewer that incorporated the aspect of new economic geography. Thus, we wanted to seize the task at hand, and unite these fields within economics. The theoretical foundation of the thesis has been based on the economics of labor and migration, economic growth, and economics of geography. Through our educational knowledge within research methods and the theory, we would like to present a descriptive representation of the immigration circumstances in Norway. Additionally, we will conduct a quantitative analysis of the regional convergence on the municipal level in order to facilitate a complete basis for recommendations on immigration policies that conform to the current policies of Norway. We hope that our findings can be useful for further research on the topic.

We would like to assign great gratitude towards our thesis supervisor, Gernot Doppelhofer, for guidance and support during the work process. Additionally, we would like to thank Vidar Jensen from the Ministry of Local Government and Regional Development and the staff of Statistics Norway for assistance on data concerns.

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# Abstract

Norway has the largest share of immigration applicants compared to the other Nordic countries. With the addition of the EU-8 in the last round of member admissions in the EU and EEA, the distribution of immigrants from the Eastern European countries has been booming. Therefore, we wanted to examine the effect of this migration on growth.

Additionally, according to the World Development Report 2009, there are ever increasing differences between rural and urban areas. We have decomposed some of the reasons for this skewed distribution of income on the regional level, and assessed whether migration may be a significant contributor to these differences. Thus, we wanted to find an answer to the following research question:

How do in-migrants with different skill diversities contribute to the spatial distribution in Norway, and which migration policies should be applied for the enhancement of further productivity growth?

To be able to answer these questions we looked into the economic theory of migration and growth models, and also conducted an empirical analysis, where the goal is to gain knowledge on Norway's dependency on labor migrants. We include the theoretical framework, where we present models on the effect neoclassical growth models and new economic geography with respect to migration. In our regression analysis we looked at variables for income, technology, education and a structural variable to determine the growth in neoclassical terms. In regards to the new economic geography we added variables that incorporate the effects of agglomeration forces. In respect to migration, we used different instruments to disentangle the simultaneity between migration and economic growth.

We found that the migration has no significant effect on economic growth. In terms of regional convergence, we can see that the poorer regions have been catching up, but at a rather slow speed. And, despite this catching up, we see that the disparity in urban and rural areas continue to grow in Norway due to agglomeration effects. Our empirical analysis gives support to the relevance of new economic geography theory.

# Contents

# 1. Introduction

## 1.1 Background

The globalization trend is a continuous force that makes the world a smaller and smaller place. In just a few decades the world has experienced increased international trade, rapidly improving communications, global branding, multinational companies, and larger flows of migration.

Norway is a small country interacting in an ever changing global economy. "In view of the economic, cultural, and political significance of the issues raised by immigration, it is not surprising that immigration policy is now a central ingredient in the debate over social policy in many countries," (Borjas, 1994). According to statistics Norway, in 2008, there were registered 67,000 immigrants entering Norway. In addition there were 24,000 emigrants, leaving net immigration to 43,000 persons. This is a record high number. Six out of ten migrants came from EU member countries. "The EEA enlargement form May 2004 has had a substantial impact on labor migration to Norway. Despite transitional restrictions on the free flow of labor from eight of the new EEA countries the increase has been significant," (SOPEMI, 2007). Out of the 43,000 net immigrants, 14,400 came from Poland which qualifies as the largest immigrant group.

In addition, the number of asylum seekers and the number of granted residence permits for the asylum seekers has doubled in the first half of 2009 compared to the same period in 2008.

The ongoing debate in the Norwegian media on migration and its effects on the Norwegian labor market and economy has been of inspiration to us when it came to the choice of subject in our Master thesis. The public has also shown a great deal of concern when it comes to immigrants, either in regards to the fear of losing jobs to a cheaper work force, increasing crime, high government spending on the bureaucratic organization of refugee processing centers or simply xenophobia.

Another topic that has received a lot of attention recently is the realization that "the World is not flat". The 2009 World Development Report "Reshaping Economic Geography" has been the root of many debates on the disparities in the World. The report looks at the increased concentration of the economic production and also the convergence or divergence of living

standards. In the words of Robert Florida, the World is getting spikier and theory on the new economic geography can help to provide an answer to why this trend has occurred.

The trend of clustering is also evident in Norway. During the last 50 years, the Norwegian population has increased by 35 percent. However, the population of the Northern region has only increased by 6.4 percent, (Statistics Norway, 2009). Furthermore, the greater part of this increase (64 percent) is contributed by in-migration, while only 36 percent of this increase is related to the net natural increase in the total population.

This discovery caught our interest and motivated us to combine the topic of migration with spatial economics as most research on migration has been carried out in the light of neoclassical theories. However, we wish to also give a presentation on the neoclassical models for comparison. The two theories may also complement each other where one theory alone cannot explain the whole picture.

## 1.2 The Research Question

In Norway, as in the rest of the world, there are ever increasing differences between rural and urban areas. Some regions experience high economic growth while others lag behind. We will try to point out the effects of immigration on these differences. Our main research question in this thesis is the following:

> ***How do in-migrants with different skill diversities contribute to the economic growth and spatial distribution in Norway, and which migration policies should be applied for the enhancement of further productivity growth?***

To be able to answer these questions we will look into the economic theory of migration and growth models, as well as investigating current research that has been made on the subject. We will look at national data and conduct an empirical analysis, where the goal is to gain knowledge on migrants' influence on Norway's economic growth. We will conduct a multiple regression analysis that measure changes in gross income levels between 2001 and 2007, and make use of several independent variables, such as initial income, education and technology in order to find the causality between migration and economic growth. We will also provide a qualitative analysis of the current immigration policies, and give our

recommendation on migration policies that could maintain and even increase the high level of productivity in Norway.

## 1.3 Terms and Definitions

Throughout this paper, we will examine economic aspects in reference to the different types of migrants. We wish therefore to present a short description of the definitions we have applied.

*Immigrants*

Immigrants are individuals who at any time have migrated to Norway. In this paper, the term covers immigrants from all continents, including the Nordic countries where a free labor market is in effect and the latest addition to the EEA (European Economic Area), the so-called EU-10 which consists of Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Hungary, Slovenia, Romania and Bulgaria. The two latter countries joined the EU at a later stage, and the first eight are often referred to as the EU-8.

*Norwegian born with immigrant parents*

This group consists of persons who are born in Norway, while both parents are immigrants. Norwegian born with only one immigrant parent are not considered in this group.

*The natives*

The natives are citizens who do not have two immigrant parents.

*Refugees*

Refugees are those who according to the Norwegian Directorate of Immigration's refugee register have been granted refugee status and residence permits in Norway. However, a significant share of refugees is likely to be included in the wide term of immigrants. Throughout this paper, we define refugees as a certain group of immigrants that are more likely to portray characteristics of lower education and wealth, as many refugees originate from war-stricken regions and third world countries.

## 1.4 Outline of the Paper

The contents of the thesis will be divided into six main chapters. In the next chapter we will present the theoretical framework, where we introduce models on the effect of migration on

the labor market, neoclassical growth models that include migration and relevant theory and models on the new economic geography. The third chapter will present earlier research and findings on the impact of migration on economic growth in different countries with respect to neoclassical growth theory and the new economic geography. In the fourth chapter we will present Norway's give an overview of the Norwegian economy with special focus on growth, changes in the labor market, immigration history and trends and the spatial distribution of the population and the economic activity. In section five we will conduct an empirical analysis of regional growth on the municipal level. The regression analysis will first and foremost be conducted with respect to neoclassical growth models and investigate further the impact of adding migration into the equation. In chapter six, we will provide a discussion on suitable migration policies in Norway. Finally, we will report our conclusions from both our quantitative and qualitative investigation in light of the material that has been presented.

# 2. The Theoretical Framework

In this section we will present theory and theoretical literature in addition to definitions which we find relevant for our choice of research question and thesis. The theory is collected from academic research articles and books on the subject of migration and economics.

We will start by introducing theory on migration's impact in the labor market with respect to wages and labor supply. Further, we will present theory on international trade and the economic benefits to society, and explain the difference between an open and closed economy. Then we will present theory on economic growth, i. e. the neoclassical Solow-Swan model, as an overlap to the growth models which links migration and economic growth. Finally, to round up the part on migration theories, we will present theory on migration's impact on wage levels, and return to capital and point out the difference between an open or closed economy. There is a substantial amount of research on the subject of migration's effect on wage levels, return to capital, and employment rates, however the literature written on the impact on economic growth is not as wide-ranging. We will throughout this section present the relevant theory and also make visible the discussion amongst researchers on the weaknesses of some of these theories.

The aim of this thesis is to present how in-migrants with different skill diversities contribute to the spatial distribution in Norway. The last part of this theory section will therefore be dedicated to theory on spatial distribution and new economic geography (NEG).

## 2.1 Migration

In general, migration can be viewed as a "hump- shaped" curve, where at low income levels people cannot afford to move, and as income rises and becomes high enough, people do not want to move. There are several other factors than income that make a difference when people decide to migrate. These are age, education, and also language and cultural distance. All these factors contribute to make the "migration window" narrow.

### 2.1.1 The immigration Surplus

The theoretical impacts on the host economy due to migration can be explained in this figure:

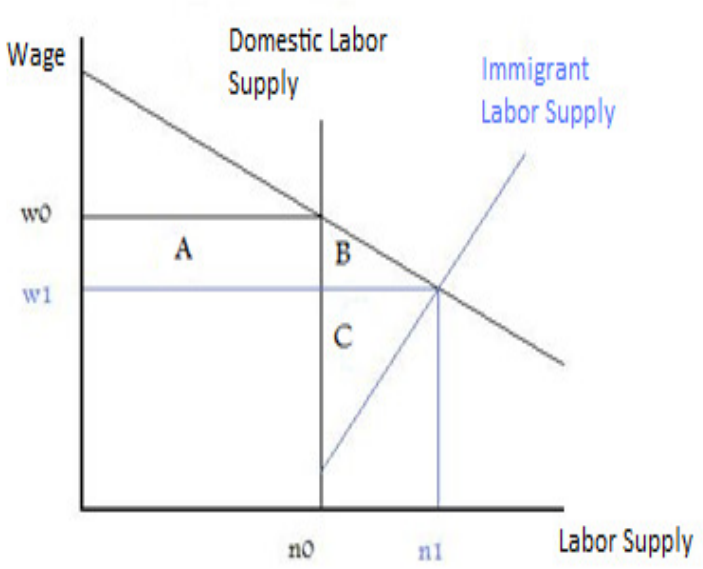


*Figure 1: The Effects of Immigration on the Host Economy (Borjas, 1995:6)*

There will be a gain to domestic firms of area A + B, due to the new wage level $w_1$. The domestic workers will experience a loss equivalent to the area B, also due to the decrease in the wage level. And finally the migrants will gain the area under the graph marked C. This is a very simple overview over the effects of migration on the host country economy and we will expand the theoretical overview below, taking into consideration for example the education level of the immigrants, and also go further in depth to the redistribution effects of migration. There is a general consensus in the literature on migration's redistribution impacts on the host economy.

In the article "The economic benefits from immigration" (1994), Borjas calculates the immigration surplus. Here Borjas shows that an economic benefit from immigration appears when the immigrants actually lower the wage of the natives. The article investigates the relationship between the immigration surplus and the skill composition of the immigrant flow. Borjas finds that:" the immigration surplus is maximized when the immigrant flow is composed of exclusively unskilled or exclusively skilled workers, which implies that the immigrant flow has to be utterly different from the native workforce. The immigration surplus itself is not very large, but immigration has a substantial economic impact since it redistributes wealth from labor to capital." So when the surplus is calculated for the US it amounts to $ 7 billion which is rather small in a $ 7 trillion economy, however, this surplus

disguises a loss of 1.9 percent of GDP, amounting to $ 133 billion, for the native workers, and a gain of approximately 2 percent of GDP to native capital.

In his paper Borjas also finds a weak correlation between the native wage and the immigrant share, still he points out that: "the weak correlation between the native wage and the immigrant share need not to indicate that immigrants have little impact on native earnings opportunities." And, argues that "even though the debate over immigration policy views the possibility that immigrants lower the wage of native workers as a harmful consequence of immigration, the economic benefits from immigration arise only when immigrants do lower the wage of native workers."

On the other hand, Lalonde and Topel (1993) argue that the percentage part of immigrants in most economies is too small to have any large effect on aggregate wages and labor force participation rates. However, they do point out that "immigration populations are highly concentrated in particular geographic areas and industries". This implies that if one wants to observe the impact on wages and labor force growth one must focus on specific areas of the economy and not on the aggregate level. As an example Lalonde and Topel illustrate that "during the 1970s new immigration increased total labor supply in metropolitan Los Angeles by over 30 percent". This mounted up to approximately two thirds of the total labor force growth within a time period of ten years, which illustrates the importance of migration in certain industries or geographic areas.

## 2.2 International Trade and Comparative Advantage

The theoretical models constructed on immigration's impact on the host country`s economy is making assumptions on whether the economy is open or closed to trade. Since part of the purpose of this paper is to show how migration affects a small open economy like Norway, it is useful to point out the theoretical difference between these two types of trade regimes.

It is hard to imagine that Norway could reap the benefits of having such a great variety of products to choose from, without the country being open to trade. The difference between an open and closed economy, is that in an open economy one can detach the domestic consumption from the domestic production, implying that in a closed economy it is not possible to consume more than you produce. When the country is open to trade the consumers would gain more possibilities and options in their choice of products, which imply a higher level of utility. This is shown in the figures below.

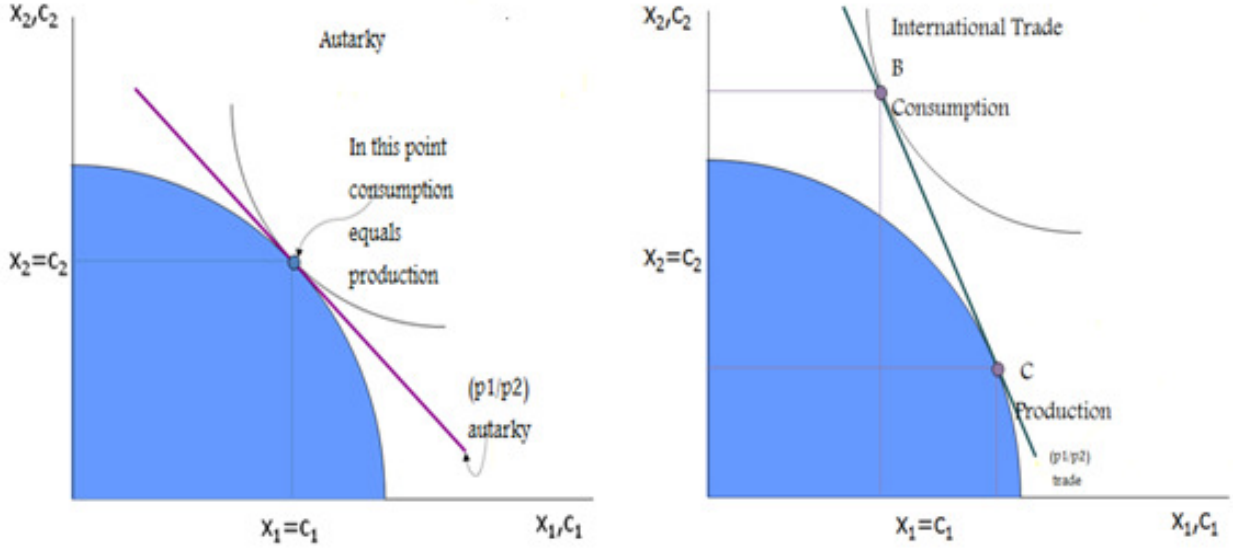


*Figure 2: The Changes in Levels of Production and Consumption by Going from Autarky (left) to International Trade (right),(Norman, 2006)*

These figures show the production and consumption of goods 1 and 2. The budget lines are decided by the relationship between prices at home and abroad. The relative prices between good 1 and good 2 in autarky is $(p1/p2)^A$ and under this trade regime the country cannot consume more than it produces of each good, so $(C1=X1)^A$ . When the country opens up to trade, the price relationship y changes to: $(p1/p2)^T$ and the new budget line locates through point C, which is the new production level. This implies that the country now produces more of good 1 than it consumes, and is able to export the surplus, while it also can consume more of good 2 than it produces as it can import this good at a lower price. The change in the price level makes the consumers in this country locate in point B, where they reach a higher level of utility than they did in point A. The country`s gain from the change in production location from point A to point C is interpreted as the gain from exploiting their comparative advantage. Comparative advantage means that the country is able to produce good 1 cheaper than the rest of the world, and will export this good, and import goods from countries that have other comparative advantages.

In this paper we want to show how in-migration affects a small open economy, with a special focus on productivity growth. Below we will present theory of economic growth by introducing the Solow-Swan model, and also how this is linked with migration. The section below will shed a light on the literature already written on the subject, and the different approaches used.

## 2.3 Economic Growth

The neoclassical growth model also called the Solow (1956) model which specifies constant returns to scale, and diminishing returns to each input (capital and labor), is one of the most popular models when research on economic growth is conducted. The model has proved to have a considerable explanatory power for economic growth.

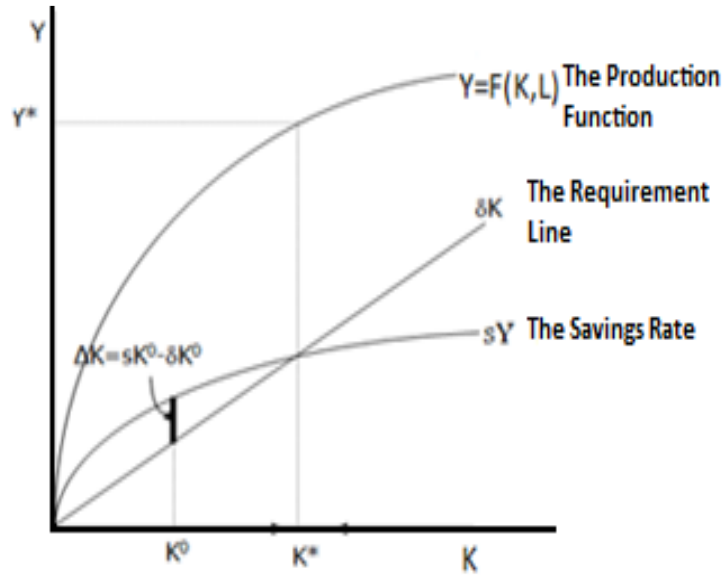


*Figure 3: The Solow (1956) Model for Economic Growth (The Neoclassical Growth Model), (Norman, 2006).*

Where: Y = Output/Income
K = Capital
L = Labor
s = Savings Rate
δ= Depreciation Rate

The building blocks of the model and the components that determine the steady state level, which is the intersection between the investment function and the requirement line (see figure above), is the growth rate of the population, the level of the savings rate, and the position of the production function. "The key aspect of the Solow (1956) model is the neoclassical form of the production function" and " this production function is combined with a constant-saving-rate rule to generate an extremely simple general equilibrium model of the economy," (Barro and Sala-i-Martin, 1995).

In the figure above, if the level of capital K is above $K^*$, then the savings rate exceeds the capital requirement line, and the capital stock grows. If K>K* the stock of capital will

diminish. Also, if one increase the savings rate, and the partial production function remains the same, the intersection between the savings rate and requirement line will be at a higher level of output and capital stock, and the economy will move to a higher steady state. In addition, if the economy experiences an improvement in production technology the partial production function will move upwards, and there will also be an upward shift in the savings rate line. Then the curve will be steeper for all levels of capital stocks. The capital requirement line stays the same, and the economy is not at higher steady state with higher levels of output and capital.

The important difference between a rise in the savings rate and an improvement in production technology, is that "although income rises in both cases, technological progress raises income per capita, while population growth does not" (Gärtner, 2006:234). So the model also predicts that without some sort of technological improvement, per capita growth will cease eventually.

To better be able to the effects of a growing population it is more useful to present the model in per capita terms so that the ordinate measures output pr worker and the abscissa measures capital pr worker. The production function can now be written as: $Y/L=F(K/L,1)$ or preferably: $y=f(k)$ which is the production function in intensive form. In this new model there are three reasons for why capital pr worker changes. Firstly investments, i, adds directly to capital pr worker. Secondly depreciation removes directly a constant fraction of capital pr worker. However the third, and most interesting for our paper, is that new entrants into the workforce, requires capital per worker to fall proportionately with the growth rate of the population, n. So these three effects combined gives: $\Delta k = i - \delta k - nk$ (Gärtner 2006:238).

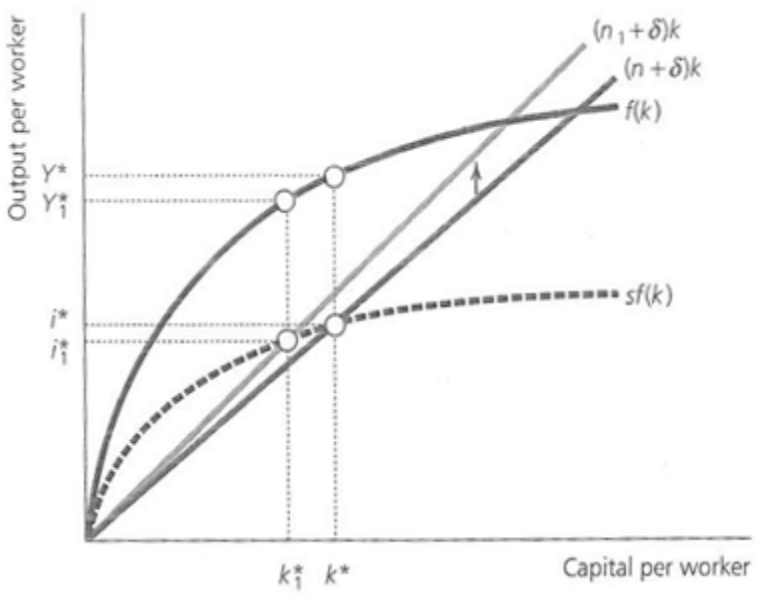


*Figure 4: A Recast Version of the Solow (1956) Model, with the Production Function in Intensive Form*, (Gärtner, 2006).

The figure above shows that the steady state now obtains where the required investments per capita equal per capita savings.

If population growth increases, the requirement line becomes steeper (($n_1$+ δ)k) and the new steady state features less capital, and lower output per worker. It is important to note that in the steady state Δk=0, which now implies that: "investments not only needs to replace capital lost through depreciation, but must also endow new entrants into the workforce with capital" (Gärtner 2006:239). Further this model also takes into consideration that there will be technology developments. This is implemented in the production function as: Y= F(K,ExL) where technology E determines the efficiency of labor (ExL is labor measured in efficiency units). As above, the production function is divided by L on both sides, and we obtain $\hat{y}$ = f($\hat{k}$), where $\hat{y}$ = Y/(EL) and $\hat{k}$ = K/(EL).

Now capital must be invested at a rate that covers the abovementioned requirements but in addition it must: "equip new efficiency units of labor created by technological progress, which we assume to proceed at the rate ε" (Gärtner 2006:240). The new form of the production function is now: $\Delta\hat{k} = \hat{\imath}\ (\delta + n + \varepsilon)\ \hat{k}$. The diagram of this will be analog to the one in Figure 4.

## 2.4 Immigration and Growth

According to Dolado et al. (1994) "Population growth is traditionally associated, by neoclassical theory, with negative effects in per capita terms on output and growth, the reason being the undisputed assumption of decreasing returns to labor in the production function." Since immigration can be viewed as population growth there has also been made assumptions about the negative effects on income growth due to immigration. However, the importance of distinguishing between the newborns lack of human capital and the level of human capital carried by the immigrants are very important. Also "recent development of growth literature invites an explicit consideration of the human capital contributions of immigrants to the host economy," (Dolado et al. 1994). The authors of the paper finds that, in theory, if the size of the inflow of labor is very large, it will have negative effects on output and growth. However, if the immigrants have high human capital levels, the effects will be positive.

There is limited availability of literature and theory on the subject of linking migration and economic growth. In this section we will give an overview over a few articles that are linking these two variables.

According to Friedberg & Hunt (1995) the efforts of linking the effects of migration to (per capita) growth have been few, and inconclusive. Still, they argue that "a simple theoretical analysis can be based on a modified Solow growth model. Production is a function of labor and human capital, which are internationally mobile, and physical capital, which is not. Assume there is no trade between countries. In these models, growth will be speeded up if immigrant human capital levels are higher than the natives' human capital levels." The great disadvantages of these models are their assumption of closed economies.

### 2.4.1 Breziz and Krugman (1993)

Still Brezis and Krugman (1993) make use of a free trade model where "an exogenous increase in the labor force leads first to a drop in the real wages, but then to a surge in investment which gradually rises wages again". However the authors also acknowledge that migration rarely is exogenous to economic factors, but that the immigrants do make choices derived from how they perceive economic opportunities. Breziz and Krugman therefore launch a model where they assume there is an initial labor force $L_0$, and a pool of potential migrants M. The initial wage rate is $w_0$, and all of these potential migrants will migrate only

if they receive a wage greater than $w_M > w_0$. In their paper Brezis and Krugman find that if L ($L_0$+M) rises, then the long run real wage will also rise and exceed $w_M$, in addition to a large enough capital stock (long run), in such a way that R (expected rate of return) = r (the international rate of return), the potential migrants will decide to migrate, and be equipped with the long run capital stock. "So if exogenous immigration occurs, output will increase more than proportionally, which implies a rise in the rate of return to capital as well as an increase in the wage rate. Since the interest rate must equal the world rate, however, the capital to labor ratio will rise in response, further increasing the wage." (Friedberg and Hunt 1995) On the other hand, if there is no change in the labor force, $L=L_0$, the wage rate will be too low for any migrants to decide to move. Brezis and Krugman (1993) conclude that the long run impact of immigration will often be to raise rather than lower real wages, even in countries with a high share of trade in GDP, or in other words relatively open economies.

As a critique to the models mentioned above Friedberg and Hunt (1995) note that "the theoretical models generally predict that a migrant will move either to a country with a higher wage or a country where the expected stream of wages is higher." But if immigration can help to create higher wages that make the immigration attractive in the first place, there will be simultaneity between growth and migration that will be difficult to disentangle empirically. However, this problem can be solved by different econometric methods, as proven by Barro and Sala-i-Martin (1992).

### 2.4.2 Barro and Sala-i-Martin (1995)

Barro and Sala-i-Martin (1995) find that labor mobility works in the same way as capital mobility when it comes to speed up an economy`s convergence to its steady state position. In their model they take into consideration the differences between newborns and migrants when it comes to accumulated human capital, and the fact that the residents also cares about their children's future (and not about the migrants), which also affects saving behavior, and hence the rates of economic growth.

The model is also based on the Solow (1956) model of a closed economy. "Thus we allow for mobility of persons but assume that the economy is closed with respect to foreign goods and assets; that is, we make the unrealistic assumption that people are more mobile than physical capital". They simplify the model by not distinguishing between the different forms of capital in their model (machines and buildings vs human capital) then we have that $\kappa$ is the measurement of this broad capital that each migrant "carries" with them.

The overall growth rate of the domestic population is: $\dot{L}/L$ = n (fertility net of mortality) + M/L (net migration rate) = n+m

It follows that the change in the domestic capital stock is given by:

$\dot{K}$= s(constant gross savings rate) · F(K,Ĺ) – δK + κM, the growth rate of capital per effective worker $\hat{k}$, can be determined from equations $\dot{\hat{k}}$ /$\hat{k}$, where $\hat{k}$ is the growth rate of capital per effective worker, = s · f($\widehat{k}$)/ $\hat{k}$ – (x + n + δ) – m · [ 1 – $\hat{\kappa}$/ $\hat{k}$], where $\hat{\kappa}$ = $\kappa e^{-xt}$ is the capital per " effective immigrant" which means immigrants augmented by the technology factor $e^{xt}$. This factor corresponds to the "efficiency units of labor" explained in the Solow (1956) model above, where we divided the aggregate variables by labor augmented by a technology factor. There it also became evident that labor grows at a rate n and technology at a rate ε.

This technological progress factor measured by x shows that the larger the number of migrants becomes, the more important it is to keep up pace with technological progress. Put differently, in addition to the domestic population growth measured by n, we now also need to take into account the added labor units offered by the migrants and their respective efficiency of labor. This implies that more investment is required to maintain the steady state equilibrium, given the migrant inflow.

Also from the Solow (1956) model, the effective depreciation rate x + n + δ is now augmented by a migration term, m · [ 1 – $\hat{\kappa}$ /$\hat{k}$ ]. "If $\hat{\kappa}$ < $\hat{k}$, the migration term, [ 1 – $\hat{\kappa}$ / $\hat{k}$], adds to the effective depreciation rate if m>0 and subtract from it if m<0." (Barro and Sala-i-Martin 1995:385).

The equation shows that in the next three situations different result with respect to the output occurs. In the first case and perhaps the easiest is when m is zero, in this case there are either immigrants or emigrants. This implies that the model returns to the basic Solow model without migration.

The second case is when m is larger than zero, implying that there is a net inflow of migrants (immigrants). In this case we can see that more investment is required because we assume that migrants have a lower physical capital ratio ($\hat{\kappa}$) when compared to that of the domestic population ($\hat{k}$). One can see that this will add to the overall depreciation of the capital.

The third case is similar to the second, but looks at net emigration, hence a negative m. Still assuming the same capital ratios this implies a net improvement of per capita wealth.

In their model, Barro and Sala-i-Martin postulates a positive relationship between m and $\hat{k}$, so that: "for given conditions in other economies, a higher value of $\hat{k}$ raises the domestic wage rate and tends accordingly to increase the net migration rate, m." (Barro and Sala-i-Martin 1995:386). This migration equation is implemented in the effective depreciation rate, and a higher value of $\hat{k}$ raises the effective depreciation term $(x + n + \delta + \xi(\hat{k})$, where $\xi\hat{k} = m(\hat{k})\cdot[1-(\hat{\kappa}/\hat{k})]$. The term $\xi\hat{k}$ explains the level of capital intensity in the host economy.

When the economy is in the steady state, a permanent improvement in the production function will shift the $s\cdot f(\hat{k})/\hat{k}$ curve upwards, and this will lead to an increase in the steady state level of $\hat{k}^*$ and m*. This shift will also raise the domestic steady state wage rate per unit of effective labor, and thereby increase the migration rate. "Thus an expansion of the supply of immigrants lowers the steady state capital intensity in the domestic economy. This result follows because the immigrants come with relatively little capital." (Barro and Sala-i-Martin 1995:388)

To be able to compute the speed of convergence to the steady state level Barro & Sala-i-Martin assumes a Cobb-Douglas production function $f(\hat{k})=A\hat{k}^{\alpha}$ , and they also estimate the $\xi(\hat{k})$ function in a log linear form: $\xi(\hat{k}) = m(\hat{k}) \cdot [1-(\hat{\kappa}/\hat{k})] \approx b\cdot [\log(\hat{k}/\hat{k}_{world})$, If the term $\xi(\hat{k})$ = 0 this means that: "the domestic economy has the same capital intensity as the rest of the world. By rearranging and differentiating this equation one find a convergence coefficient β.

$$\beta= (1-\alpha)\cdot (x+n+\delta)+b+b\cdot(1-\alpha)\cdot\log(\hat{k}^*/\hat{k}_{world})$$

In popular terms b denotes the easiness by which migrants can relocate. For instance: For a given sensitivity of migration to log $(\hat{k})$, the coefficient b declines if $\hat{\kappa}/\hat{k}$ rises. In particular if $\hat{\kappa} = \hat{k}$ , then b = 0, this means that there is no incentive for migrants to relocate since the capital ratios are equal. The effective depreciation term is again x + n + δ. In a perhaps more realistic situation where $\hat{\kappa}<\hat{k}$, it becomes worthwhile to migrate. The effect on b and hence on β becomes positively related to the derivative of migration to $\hat{k}$. It now depends on how difficult it is to relocate. If for instance the relocation is utterly difficult, say in a limit situation when the derivative becomes zero, then there will be no migration whatsoever. In

this case, the convergence coefficient β returns back to the basic Solow (1956) model. (Barro and Sala-i-Martin 1995:389)

And in a typical economy where $\hat{k}^* = \hat{k}_{world}$ and one assume that b>0, the equation above shows that the potential for migration raises the convergence coefficient, β, above the Solow-Swan value by the amount b.

By using data from several different countries including the United States, the regions of Japan, and five European countries Barro and Sala-I-Martin find that "The regression coefficient for the net migration rate on the log of initial per capita income or product averaged 0,012 per year" they also state that "the sensitivity of international migration to income differentials tends to be smaller than for regions within a country" (Barro and Sala-i-Martin 1995:389) Since one can assume that migrants within a country carries with them more capital.

#### 2.4.3 Dolado et al. (1993)

Dolado et al (1993) make use of the Solow-Swan model augmented by human capital and migration. They summarize their theoretical result by stating: "A larger size of the migration inflow has negative effects on output and growth, while a higher human capital content of the migration inflow has positive effects. And" in addition, migration has a positive effect on the speed of convergence, while the human capital endowment of immigrants has the opposite effect".

So far in the theoretical findings on migrations impact on economic growth, it is important, amongst others, to distinguish whether the model is based on an open or closed economy. Brezis and Krugman (1993) find that in the long run, migration will lead to a rise in real wages also in open economies. Barro and Sala-i-Martin's model which is based on a closed economy finds that a permanent improvement in the production function will lead to a rise in the domestic wage rate, which again will lead to an increase in the migration rate. Dolado et al. introduces the human capital variable into the model, and finds that migration has a positive effect on the speed of convergence.

### 2.5 The impact of Immigrants on Host Country Wages and the Return to Capital

As seen above, there is a consensus in the literature that the effects of immigration depend on the education level of the natives and immigrants and the substitutability between the two

groups. Friedberg and Hunt( 1995) emphasize the importance of whether the economy is regarded as open or closed to trade, in respect to the modeling decision in addition to the substitutability factor. They regard unskilled labor as a substitute to capital and skilled labor, and they view the capital and skilled labor as complementarities. In a closed economy, with an inflow of unskilled labor, the wages of unskilled labor will fall, and the effects on the return to capital and the skilled wages will be ambiguous. When the unskilled labor becomes cheaper, the firms will start to substitute unskilled labor for capital/skilled labor. However the optimal output is now higher, which implies that employers will tend to use more of all input factors. On the other hand, if there is an inflow of skilled immigrants, the wages for skilled workers will be reduced, and because of the scale effect (start to use more of all inputs) the effect on unskilled wages are ambiguous. The return to capital will increase because of the complementarities between capital and skilled labor.

The results are quite different in the Heckscher-Ohlin model for an open economy. In this model one can assume that technology level is the same in all countries, and that trade is driven by factor endowments. According to this theory, the countries will specialize in manufacturing goods which are intensive in the use of the production factors that the country is well endowed with. To simplify, one can assume that developed countries produce goods and services which are intensive in the use of skilled labor, and developing countries produce goods which are intensive in the use of unskilled labor. When countries open up to trade developing countries will import goods that are intensive in the use of skilled labor and export goods that are intensive in the use of unskilled labor. In developed countries this will imply a rise in wages for skilled labor, which is subject to a higher demand, while the sectors using unskilled labor will tend to lose out to the imported goods from developing countries.

According to theory, international trade will lead to factor price equalization, which means that wage differences between skilled and unskilled labor will be equalized between countries. Friedberg and Hunt (1995) state that “in this situation, immigration will cause production of the more labor intensive good to increase, but factor prices will remain unchanged.” This implies that “countries open to trade will compensate by exporting more (or importing less) labor as embodied in goods” (Friedberg & Hunt 1995). It follows from the factor price theorem that there is no “economic reason” for migration to take place within this framework. However, a more realistic model will have to be one where factor price equalization does not occur even if there is free trade because of the countries have very different endowments of factors. This will result in wage differences between the countries,

which again will induce migration. In this situation the impact of migration on the host economy will depend on the size of the inflow. "A large enough inflow will force the country to move to a more labor-intensive mix of products, which will lower the wage (and increase the return to capital)". So if the migration flow is large enough, wage differentials will be eliminated. When the inflow is small, the wages will not be affected, but the country will increase its production of its more labor intensive goods and thus obtain factor price equalization through international trade.

The authors stress that these models do not directly predict that unemployment will be a result from immigration, nevertheless when the wage rate falls, there will be changes in employment and/or hour worked, and some natives will leave the labor force at least in the short run.

Also Friedberg and Hunt (1995) reinforce the importance of looking at certain geographical or industry sectors instead of the aggregate economy. However they also point out that factor mobility and free trade within the host country will provide the validity of the factor price equalization theorem. "In this case, even if immigrants affect native wages at the national level, an uneven distribution of immigrants across the country may not result (in the long run) in cross section wage differences, as wages may be equalized by flows in goods or factors" Still, this is in the long run, and in the short run wage differentials may be the result of supply or demand shocks. And in theory migrants are viewed as very mobile workers and will tend to settle in the part of the country/ sectors where demand shocks have raised the wage level.

As we can observe, the theories on migration's impact on the host economy differ with a view to migrations ability to affect growth. There are unambiguous findings on whether migration spurs economic growth, or if it is the other way around, that economic growth attracts migrants. Especially it is important to be aware of the difference between theories for and open, or a closed economy. Barro and Sala-i-Martin solves the disentanglement problem between migration and economic growth, but the model is based on a closed economy. The effects on the host economy may also be different with different types of migration and the skill level of the migrants, and in some theories the immigration surplus is maximized when the migrants are completely different from the domestic population.

## 2.6 Spatial Distribution and New Economic Geography

As our research question is directed towards in-migration and the spatial distribution in Norway, we find it relevant to also present theory considering economic geography and present the new economic geography theories that contribute to fill in certain gaps in the classical theories on spatial distribution, migration and growth. The theories presented above explain where people will locate in countries and regions based on differences in policy regimes and factor endowments. These are named "first nature" endowments such as: climate, raw materials and the proximity to such. However, they always depend on two regions or countries, being very different. The new economic geography theories can explain why regions, with similar preconditions, start to develop very different industry structures and growth patterns. This kind of development relies on "second nature" characteristics of a region such as organization of production and infrastructure. The theory tries to explain why in some regions, firms cluster together, while in other similar regions they are severely dispersed.

Professor of Business and Creativity and author Richard Florida, in association with geographer Tim Gulden have mapped the population in a three-dimensional map of the World. The figure is presented below and the peaks represent cities; the steeper the peaks are, the larger is the population.

*Figure 5: A three-dimensional portrayal of the World population, (Gulden, 2009 - Creative Class)*

Florida (2005:48) remarks that "the tallest peaks – the cities and regions that drive the world economy – are growing ever higher, while the valleys mostly languish." More people are

clustering in urban areas at the same time as the cities are getting more dispersed. In Europe it is called "the European Hot Banana" which is the area stretching from London to Milan, including the South East part of England, the Netherlands, Belgium and the South East parts of France, the Ruhr area, the Southern parts of Germany and the Northern Italy. This is an example of agglomeration on a large scale. Small scale agglomeration occurs when a relatively small group of firms cluster together to take advantage of technological externalities. An externality can be defined as a "spillover effect" which can be either positive or negative.[1] According to Ottaviano and Puga (1997) in small scale agglomeration, these externalities diminish the further away one locates from the center. So a typical externality in small scale agglomeration would occur through personal interaction. Hence, agglomeration effects arise as we experience an increase in the necessity of valuable human capital. In particular there are three sources of importance for localizing in clusters: (i) local tacit knowledge spillovers, (ii) non-traded local specialist inputs, and (iii) local skilled labor pool. Large scale agglomeration must be explained differently.

We will first provide two conventional location theories that serve as a supplement rather than a part of the new economic theory. These were two of the first models on the topic of spatial economics and set the platform for the new economic geography theory that will be presented further on.

### 2.6.1 The Weber Location-Production Model

The Weber-model was developed by Alfred Weber, often referred to as the father of modern location models. The model examines one price-taker firm with no competition. It describes a two-dimensional relationship between two physical input goods ($m_1$, $m_2$) and one produced output good ($m_3$). Each *M* is the locations of goods 1, 2 and 3; *t* denotes the respective transport costs per ton kilometer; *d* represent the distances for each good; and *p* is the location-specific prices for each good.

When firms seek to maximize their profits, "the only issue which will alter the relative profitability of different locations is the distance of any particular location from the input source and output market points," (McCann, 2001, pg 9). Thus, the *Weber optimum location*

[1] In the case of technology an example would be the bio-tech industry, where the state, i.e. tax payers, is financing and providing the education of bio-tech researchers, which after a while takes their acquired knowledge and starts up their own private company. When they leave they take with them their acquired human capital and, at the same time, leave the university behind with "no payoff" for their R&D investment. This could be viewed as a negative externality.

will be at point *K* in figure 6, where total costs (TC) of relative total inputs and output transport costs are minimized:

$$TC = Min \sum_{i=1}^{3} m_i t_i d_i$$

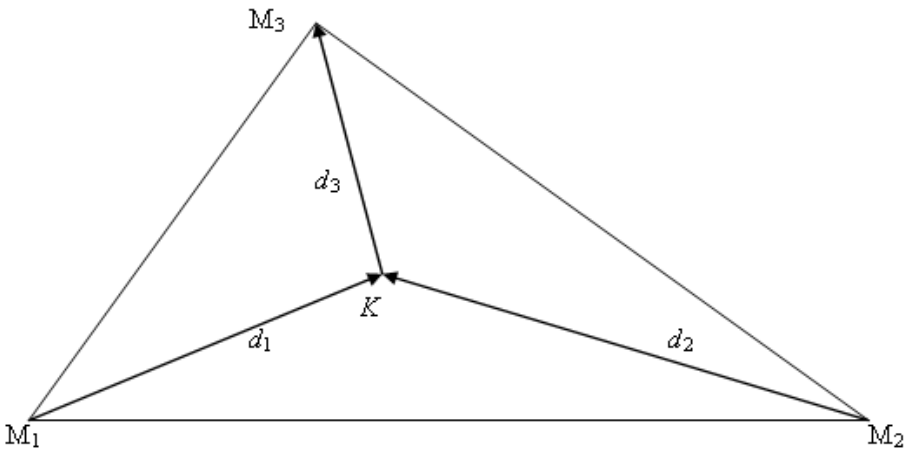


*Figure 6. Weber-model, (McCann, 2001, pg 8).*

There are, however, a lot of limitations to this simple model. The Weber-model assumes that input goods are fixed per unit of output according to theory by the renowned economist Leontief. It also assumes that labor and capital are available at the same factor prices and quality regardless of location, and that land is homogenous. Although these assumptions are somewhat unrealistic, it provides an easy framework for a basic understanding of how firms decide on location.

### 2.6.2 The Hotelling Location Model

The Hotelling location model is a simple model that was first introduced by Harold Hotelling in 1929 which describes the mechanisms of regional clustering. It tries to explain the intriguing phenomenon of why many oligopolistic markets, such as hotels, which offer an identical core product, locate in such close proximity to each other. The figures below illustrate the theoretical steps from left to the right.

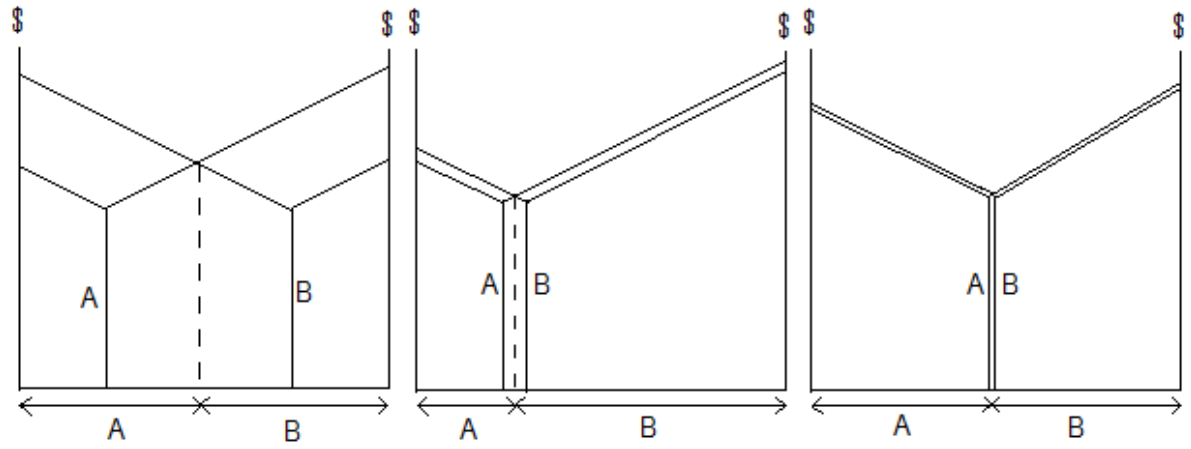


*Figure 7: The Hotelling model (McCann, 2001)*

Imagine a two-dimensional model in which we have to identical firms, A and B. They operate in the simplest form of oligopoly, namely duopoly, with no collusion or relocation costs. Initially, they are located at a certain distance where the both capture an equal share of the market. In the middle figure, firm B discover that if he moves his business closer to firm A, he will increase his share of the market illustrated by a longer arrow B. Consequently, A realizes that he will capture a larger share of the market if he locates to the right of B. Hence, these sequences will continue until both arrive in the middle and they are back to each serving an equal share of the market, (McCann, 2001).

This model is also rather limited as the real world is much more complex. Yet, the model serves as an addition to other theories on why firms may cluster.

### 2.6.3 The Core-Periphery Model

First of all, market access is the determinant factor for where firms localize. Krugman and Venables (1990) created a two sector model with a core region and a periphery. The factor endowments are larger in the core, but relatively the two regions have the same endowment structure. The two sectors differ with respect to one being perfectly competitive with constant returns to scale, and the other having a monopolistic structure with increasing returns to scale. The former sector produces a homogenous commodity, while the latter is producing differentiated products. The following figure illustrates the two regions and the share of industry in each region according to the level of trade costs.

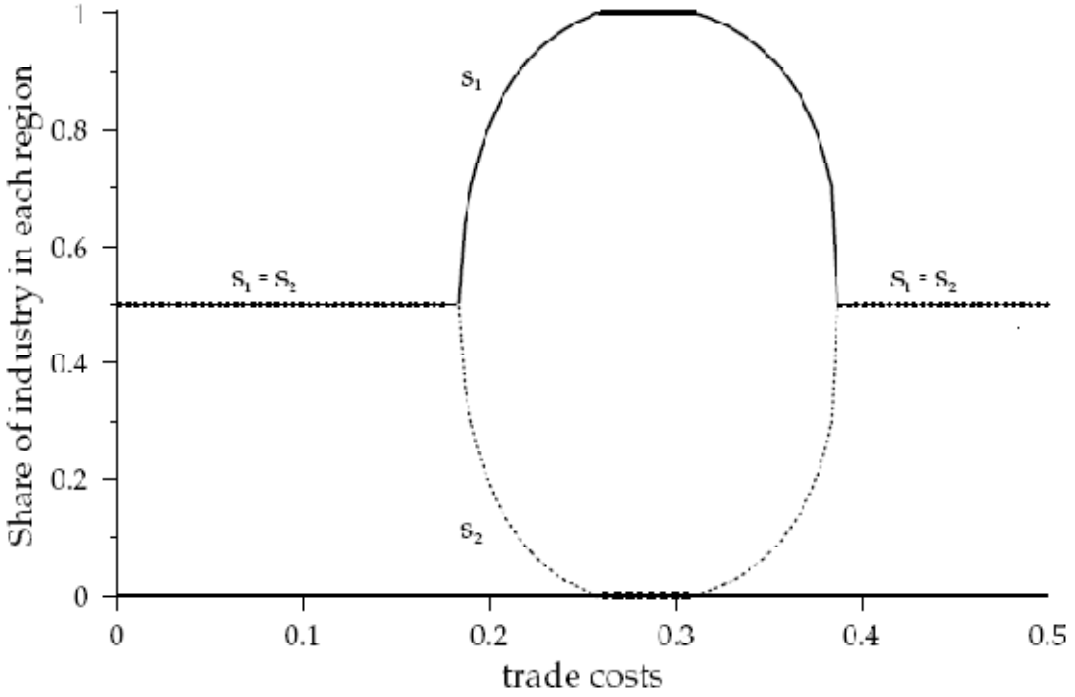


*Figure 8: The Core-Periphery Model (Ottaviano and Puga, 1997:18)*

Ottaviano and Puga (1997) find that in equilibrium, the core has more monopolistically competitive firms than the periphery. And "for finite positive trade costs, the cores share of world industry is larger than its share of world endowments. It is therefore a net exporter of manufactures," (Ottaviano and Puga, 1997). So, in this model increasing returns to scale combined with imperfect competition explains why one experience firms to cluster together in the core region, even though the two regions have the same relative factor endowments.

The second important finding of the Krugman and Venables model is the effect of trade costs. They find that for low values of trade costs, firms are more dispersed since they can serve the market from the location they already have. For intermediate values of trade costs, firms cluster together to take advantage of the forward and backward linkages that occur, and economies of scale. When trade costs become too high, firms will stay dispersed since they cannot afford to move and they decide only to serve their local market.

In Krugman (1991) the model is extended to take into consideration that some factors are mobile between the regions. There are two sectors, namely agriculture and industry. Here each of the regions is using one specific input factor which implies that there is no reallocation of factors between the regions. In addition, only the workers that are employed in the industry sector are mobile. The other workers are called farmers and are immobile.

The two regions are (before any agglomeration) identical with respect to endowments, also when it comes to the immobile factors. So, as firms cluster, the increase in a product's labor demand and the increase in real wages in the prospering region will attract more people, hence induce migration. "This increases local expenditure (a demand linkage) and eases competition in the labor market, and so tends to increase local profits and to attract more firms," (Ottaviano and Puga, 1997). Also, in this model, a big enough reduction in trade costs will induce firms to cluster together to take advantage of the demand linkages that occur. "A larger share of manufacturers in consumer expenditures also favors agglomeration, because it augments the impact of immigration on the size of the local market for manufactures," (Ottaviano and Puga. 1997). An important hindsight here is that the supply of labor from the other regions must be present.

The figure below shows the cumulative causation effects from agglomeration.

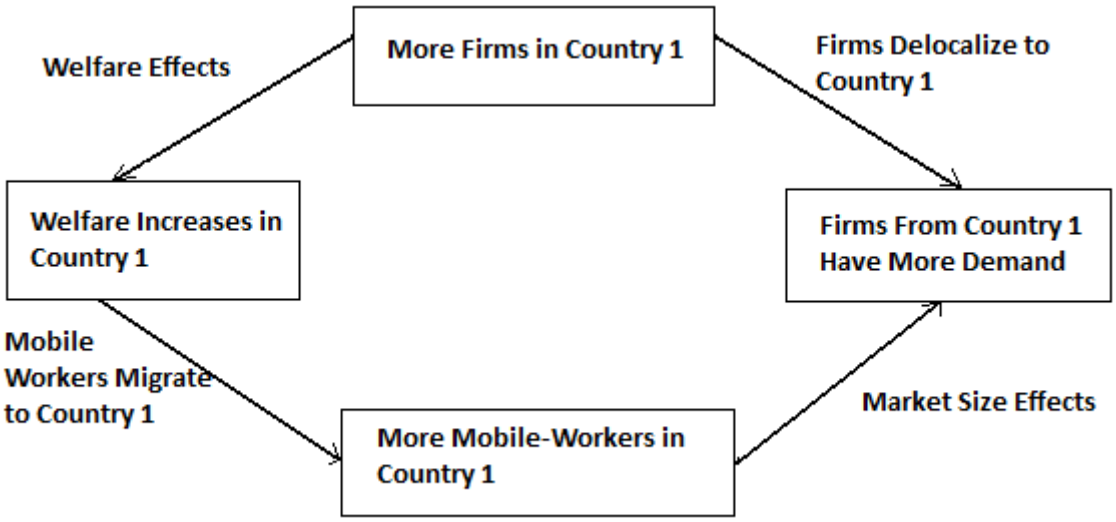


*Figure 9: The Cumulative Causation Effects (Pires, A.G.J., 2008)*

Other authors have also augmented Krugman`s model. Diego Puga (1998b) looks at both interregional migration and input output linkages as forces that drives agglomeration within the Krugman framework. He finds that agglomeration is reinforced by the interregional migration of workers. The second important finding is that if interregional migration does not contribute to the elimination of wage differences between the regions (in equilibrium) it will instead act as a dispersion force. By making it more expensive for firms to locate close to each other, i.e. increased production costs. Other examples of dispersion forces may be: transport costs, congestion (traffic), crime and housing prices. Also Venables (1996) finds

that ”with zero trade costs each firm finds no advantage in location close to the rest of the industry and locates in the region with the lowest wages; therefore, if wages are increasing in industrial employment, for trade costs sufficiently close to zero agglomeration in one region cannot be in equilibrium,” (Ottaviano and Puga, 1997).

The Ottaviano and Puga (1997) article also questions where and why does agglomeration take place? There are different theories on this matter; however there is consensus in the literature that “a small initial asymmetry can be amplified by cumulative causation and give rise to large differences between regions,” (Ottaviano and Puga 1997). In some of the theories constructed this “small initial asymmetry” is named “a historical accident”. Krugman (1993) uses the city of Chicago in the US as an example. There were no “first nature” endowments that would easily explain the growth of Chicago as a city. In Krugman (1991) the phrase “critical level” shows up. “If one region has slightly more population than another when, say, transportation costs fall below some critical level, that region ends up gaining population on the others expense: had the distribution of people at that critical moment been slightly different, the roles of the regions might have been reversed.”

### 2.6.4 Summary of the New Economic Geography

We have provided the background theories and the main aspects of the new economic geography theory. In addition, one can find other theories that promote the idea of how agglomeration is amplified by the exogenous first nature characteristics that give a region a comparative advantage.

Ottaviano and Puga (1997) make it clear that in the theory of spatial distribution and new economic geography there is a common set of conclusions. First of all, when firms decide to locate close to each other, they face a stronger competition in the product and factor markets. Second, the models agree on the importance of increasing returns to scale and intermediate values of trade costs. This makes firms locate in larger markets where they can take advantage of externalities such as forward and backward linkages. Third, is the fact that wherever agglomeration takes place, there will be an increase in factor prices. So in a combination with lowered trade costs: “If most factors and goods can be imported from other regions, rising factor prices simply give an additional kick to agglomeration by inducing immigration.”

To sum up, there will be agglomeration if there are high economies of scale, low transport costs, and a high share of industrial demand on final consumption, so firms cluster together to take advantage of technological spillovers, and forward and backward linkages and economies of scale. Regions with more downstream firms will attract more upstream production because the demand for intermediates is higher there. The specific reason for why such clustering happens in a specific region has not an unambiguous answer. It can be due to an historical incident, first nature endowments, or the mere expectations that it will happen. The clustering becomes a self fulfilling prophesy.

# 3. Findings from Other Studies

In this section we will present earlier studies about the effects of immigration on the labor market and economic growth for different countries. We wanted to include these other findings as there is very little research about the impact of immigration on regional growth in Norway. In addition, the studies will be a contributing source to support the interpretation of the analysis section.

According to Lalonde and Topel (1993) "current immigration controls in developed countries usually restrict flows to three categories of immigrants. These controls allow entry because (i) persons have close relatives in the receiving country, (ii) they have skills that immigration authorities determine as "scarce", or (iii) they are political refugees." These definitions are, of course, very broad and differ between countries. For instance, it is more difficult to qualify as a political refugee in the US than it is in for example Norway or Germany.

The distinction of the "type" of immigrants, with regard to human capital, and how it "fits" with the domestic labor market is an important determinant for the economic effects of migration. This characteristic will be of importance throughout the examination of the other studies.

## 3.1 The Effect of the EU (EEA) Enlargement

### 3.1.1 Dølvik and Eldring (2206)

A study on the Nordic labor market prepared by Dølvik and Eldring (2006) gives an overview of the labor market effects on the Nordic countries after the EU (EEA) enlargement. There are differences between the countries with respect to their policies on opening up their labor markets. As already mentioned, Norway and Denmark implemented some transitional rules regarding wage levels and working hours. Sweden, on the other hand, implemented no such rules and opened up their market entirely from day one. Even though it is a short time span, only one year after the enlargement, the report states that by the end of 2005 one could not observe any major influx of labor immigrants to the Nordic countries. However there were significant differences between the countries. In Norway the influx of individual labor migration is still increasing. In Denmark and Iceland the situation is the

same, while in Sweden the level has been stable in the two following years after the enlargement.

According to Dølvik and Eldring (2006), the effects of the transitional rules can be questioned. In a survey conducted by FaFo (Norwegian Institute for Labor and Social Research) it becomes evident that most of the Norwegian companies that hired foreign labor, reduced their wage costs and incurred more flexible working hours. In sectors of the economy that entails a very small degree of unionization, such as the service industries, one can expect a downward pressure on wages if the high supply of labor continues. Dølvik and Eldring comment that "none of the countries have statutory minimum wage provisions, and extensions of collective agreements are practiced only in Finland, Iceland and partly in Norway". The paper points out that Norway practices a quite low density of collective agreements.

The hiring of posted workers,[2] which mostly work in the construction industry, is also exercised to a large degree and the number has tripled each year since 2004. These posted workers are obliged to work at the home country standard for remuneration which is usually far below the Norwegian standard, and this is done in complete accordance to the law. The existence of labor unions have not always improved the conditions of the foreign workers; "the unions have been content, making the generalized wage level substantially beneath the actual wage level for comparable work within the same industry," (Dølvik and Eldring, 2006:28). With regards to social dumping, these factors might be even more evident for Norway after 2009, when the transitional rules are to be phased out.

The authors acknowledge that the number of labor migrants from the EU-8 countries will be approximately between 0.2 and 0.4 percent of the total Nordic workforce, however the migration between the Nordic countries is still of a much greater volume than the migration from the EU-8 countries. In addition they predict that the future migration flows from the EU-8 countries will be of high importance to the Nordic labor markets, especially because of the aging Nordic workforce. They also assume that the recent business cycle boom and the inclusion of the new EU member states in 2004 created a "first wave" of migrants, and that this will recede, since the competition for labor in the home countries and in Europe in general is increasing. Dølvik and Eldring emphasize that the current and future migration to

[2] "According to the European Commission, a posted worker is a "person who, for a limited period of time, carries out his or her work in the territory of an EU Member State other than the State in which he or she normally works" Source:http://www.eurofound.europa.eu/areas/industrialrelations/dictionary/definitions/postedworkers.htm

the Nordic countries is demand driven, and that there is no reason to believe that this labor migration will cause distortions in the labor markets.

| | Low Influx | Medium Influx | High Influx |
|---|---|---|---|
| **Regular Labor Migrants** | Sweden, Denmark and Finland | Norway and Iceland | |
| **Job-Seekers and Service Providers** | Sweden and Denmark | | Norway, Iceland and Finland |

*Table 1: Overview of the division of labor migrants, from the EU-8 countries, (Dølvik and Eldring, 2006).*

From the table above one can observe that the labor migrants from the EU-8 countries are rather polarized. Norway and Iceland have a significant higher volume of posted job seekers and service providers in comparison to Denmark and Sweden with a relatively low influx of both categories. Finland is somewhere in between with a high influx of job-seekers and service providers and a low influx of regular labor migrants.

In their conclusion Dølvik and Eldring (2006) emphasize that the transitional arrangements have had little effect on the volume of labor immigrants. "In particular in countries with restrictive transitional arrangements- such as Finland and Iceland- these have entailed a strong tendency towards service mobility, this being the main reason why these countries decided to repeal their transitional arrangements from 1. May 2006. In other words, the countries desired more regular labor migration" (Dølvik and Eldring, 2006:45). Also they point out the necessity of the labor migration as "greasing the wheels" of the labor market during a booming business cycle, i.e. enhancing the capacity for growth, and reducing cost inflation. However, with a longer time view, there might be a conflicting goal between the aim of the Nordic countries, which is to have their economies grow based on innovation, skills and quality, and the shift to a more labor intensive production path, due to low wage costs.

### 3.1.2 D'Amuri, Ottaviano and Peri (2008)

In a similar study, D`Amuri, Ottaviano and Peri (2008) investigate the wage and employment effects of immigration to Western Germany in the time period from 1987 until 2001, allowing native and immigrant workers to be perfect substitutes, in addition to imperfect substitutability between old and new immigrants. The Western part of Germany experienced a large flow of migration from the East subsequent to the end of the Cold War. They find that the impact on natives, when it comes to employment, is absent. However, the

wages are somewhat decreasing in the sector of the medium-high education level since in this specific time period the immigrants that entered Western Germany fit in the medium-high education group. On the other hand, the natives in the medium-low education group experienced a slight increase in their wages.

## 3.2 The Influence of Immigration on Economic Growth

### 3.2.1 Morley (2005)

The numbers and patterns in migration flows found by Dølvik and Eldring (2006) can serve as evidence on the paper written by Morley (2005) on the causality between economic growth and immigration. The data in his paper is collected from the time period 1930 to 2002 from the countries Australia, Canada and the USA. He finds that there exists a long-run causality relationship from per capita GDP to immigration but not the other way around. He claims that "despite the tight controls imposed on the levels of immigration in the three countries included in the tests, levels of immigration are not exogenous, but in part determined by the growth or otherwise of the economy". One can then also ask the question to what degree migration responds to host country's legislation on migration controls. It seems that labor migration is only partly affected by these controls, and is for most part affected by factors (such as GDP growth) outside the direct control of the authorities.

### 3.2.2 Østbye and Westerlund (2006)

Østbye and Westerlund (2006) have conducted a study on migration and the regional convergence in Norway and Sweden from 1980-2000. The authors examine the effect of migration on the county level, with a special aim on economic growth. They make use of the neoclassical growth model which implies that when the regions are not in a steady state, the regions with low capital intensity will grow faster than the ones with high intensity to catch up. They also take into account the different skill endowments of the immigrants and natives, stating that if for example a region experiences a net inflow of migrants which are more productive than the non-migrants this might outweigh the decrease in physical capital per worker and enhance the growth in the particular region (a composition effect). However it is important to note that the effects of migration on growth are ambiguous when the labor is heterogeneous. This is also in line with the theoretical findings of Friedberg & Hunt (1995).

The effects of brain drain (i.e. the human capital level of the sending region is decreased by migration) will distort the convergence between regions. "If we keep human capital constant,

we would expect the effect of migration on convergence to be much smaller in cases where the brain-drain or the brain-gain effects were important. This is because these effects work between regions with unequal endowments of human capital," (Østbye and Westerlund, 2006:7).

One of the main findings by Østbye and Westerlund is that gross migration does have a strong effect on convergence, in Norway, and that this is due to the differences in human capital endowments between regions, and the level of migration between regions that differ in this respect, rather than between similar ones. Hence they find clear evidence of the brain drain/gain effect for Norway, meaning that the composition effect, i.e. the effect of a region having a net inflow of migrants that are more productive than the "natives", spurs a strong positive effect on output per capita. A very interesting remark is that Norway, which is supposed to be a very egalitarian society is not so when one examines the regional distribution of GDP per capita at the county level.

In Sweden the situation is the opposite. "When migration is kept constant, the convergence rate drops to close to zero. Hence, migration appears to add to convergence, which is consistent with a dominance of the quantity effect," (Østbye and Westerlund, 2006:24). Also in Sweden it appears that the mobility factor between regions is not as important, for the rate of convergence, as the differences in human capital. The authors question why these two, in so many ways similar, countries experience such different results. Part of their answer is "it could perhaps be that the Swedish and the Norwegian cases describe two different sequences of the same developing process, with Sweden some years ahead".

#### 3.2.3 Barro and Sala-i-Martin (1992)

The majority of papers on the subject of migration and regional growth are inspired by the original study conducted by Barro and Sala-i-Martin in 1992 on regional growth and migration. In this paper they compare two regional data sets of 48 states of the United States and 47 prefectures in Japan. They also make use of the neoclassical growth model as a theoretical framework, which implies an assumption that the per capita growth rate is inversely related to the starting level of output per person, so that theoretically less developed regions should finally "catch up" with the developed ones. Barro and Sala-i-Martin estimate the β-convergence, which was explained in the theory section of this paper: "the β parameter governs the speed of adjustments to the steady state" (Barro and Sala-i-

Martin, 1992:312), so that a positive coefficient implies that poor economies/regions grow faster than the rich ones.

For the Japanese prefectures they find a β coefficient of 0.0279 with and adjusted $R^2$ of 0.92. They also ask the question whether "this convergence process is due to regions catching up or convergence within regions" (Barro and Sala-i-Martin, 1992:319), and find that both convergence processes contribute to the speed of convergence.

For the United States they also find β-convergence over the time period 1880-1988, and also here the convergence process seems to be influenced by both within region convergence and the "catching up" factor. After the establishment of the existence of regional convergence both in Japan and the US, Barro and Sala-i-Martin start to analyze if these patterns of convergence can be explained by migration.

For Japan they find a clear positive correlation (0.58) which can be interpreted as the positive effect income differentials have on migration. In addition "a 10 percent increase in a prefectures per capita income raises net in-migration (only) by enough to raise that prefectures rate of population growth by 0.27 percentage points per year" (Barro and Sala-i-Martin, 1992:334), so even though the coefficient for the speed of migration is highly significant, it also reveals that migration "reacts" very slowly to per capita income differentials.

#### 3.2.4 Aronsson, Lundberg and Wikström (2000)

This paper for the most part serves an empirical purpose to understand which factors that are important to explain the disparities in regional income growth and net migration in Sweden. They do not look at the impact of migration on growth, but rather other factors' influence on growth and subsequently the net migration. The authors investigate a panel data set of the Swedish counties during the period from 1970-1995. The explanatory variables consist of average income and a sophisticated set of vectors that include natural and human capital endowments, region-specific amenities that do not vary over time, national policies on regional public sectors and local businesses, and the regional industry structure.

Aronsson, Lundberg and Wikström find that the neoclassical theory holds and that a higher level of average income indeed reduces the income growth rate, both in the counties that do and do not contain a major city area. While, both initial income and human capital levels affect migration positively. Their results also suggest that the time-fixed amenities, such as

climate, exhibit a negative effect on the different growth patterns of the sparsely populated areas in the north. Thus, people tend to locate in areas where the climate is more agreeable. The labor conditions will have an effect on the migratory situation and income growth as well; however, a high initial unemployment rate is likely to lead to out-migration, but does not have much influence on the in-migration. Finally, they conclude, in accordance with other findings that we have discussed in this section, that they have not found significant evidence that suggest the effectiveness of national policies on the regional growth pattern.

## 3.3 Neoclassical Growth versus New Economic Geography

### 3.3.1 Fingleton and Fischer (2008)

This study compares the rival theories of neoclassical growth and the new economic geography in order to explain cross-regional variations in the economic developments. We wanted to include a summary of their research even though the comparison is made on national level, as it discusses which theoretical model that generates the best quantitative results. Fingleton and Fischer used data on 255 European regions classified as the second level of nomenclatures of territorial units for statistics (NUTS-2) from 1995-2003 as the basis for their empirical testing of the non-nested models.

In their panel regressions of the neoclassical model they found that the logarithm of population growth rate, hence migration, has a notably positive effect on economic growth which is measured by gross value added (GVA) per worker.[3] There is also a larger share of people with higher education related with a higher level of GVA per worker. The authors also imply that the level of technology is autonomously increasing because of an increasing GVA per worker over time.

The results of the NEG wage equation were found to be more coherent according to theoretical expectations and demonstrated decent robustness of the model specifications. The results from the two stage least squares approach "show a significant positive elasticity for the market potential regardless of the instruments adopted, although there is some variation in the magnitude," (Fingleton and Fischer, 2008:13).

[3] "Gva is the net result of output at basic prices less intermediate consumption valued at purchasers' prices, and measured in accordance with the European System of Accounts (ESA) 1995," (Fingleton and Fischer, 2008:11).

When comparing the two in a nesting model, they also find that the neoclassical parameter signs are sometimes insignificant and counterintuitive to the theoretical model and previous evidence. Thus, they conclude that out of the two rival models, the NEG model is more robust and produces estimates that are more consistent with the theoretic models.

### 3.3.2 Peeters (2008)

The focus of this paper is on the effect of population movement with regard to the migrants' skill-levels on the re-distribution of income and the spatial distribution. His analysis is based on the cross-sectional data from the 44 municipalities of the province of Limburg in Belgium from 1991-2000. Based on the Generalized Maximum Entropy (GME) estimates, which allows the separation of observed and unobserved heterogeneity in convergence rates, Peeters find that the mean annual β-convergence rate across municipalities is 4.2 percent, ranging from a minimum of 3.6 percent to a maximum of 5.2 percent. Thus, there is an overall convergence across the municipalities, although the speed of convergence will differ.

He finds that the signs of the coefficients related to in-migration and the initial inverse education match the prior expectations. "Both conditioning variables have a positive effect on the growth rate of per-capita income," (Peeters, 2008:912). The evidence indicates that initially rich municipalities, as well as their immediate neighbors, gained the most from selective in-migration, as well as the positive effect of initial education. His explanations to the latter phenomenon are "(1) diminishing marginal (social) returns to education in terms of subsequent income growth, (2) a "waste" of highly-educated people who decided to move to other municipalities during the study period, or (3) a combination of the two," (Peeters, 2008:912).

The results, however, also imply that both in-migration and initial educational level have a tendency to reduce the convergence speed to the "common balanced-growth path", meaning that at lower values of net in-migration and education a region converges more rapidly towards the balanced growth path.

When it comes to the unobserved effects, Peeters come to the result that agglomeration forces may show co-dependence with respect to the unobserved effects. He specifically finds that there is a notable spatial concentration in the areas where the most important trade centers are situated. Thus, the finding suggests the presence of spillover effects is essential for regional income growth per capita.

#### 3.3.3 Thissen and van Oort (2004)

This paper focuses on labor migration in the EU in the context of new economic geography. The authors specifically look at the presence of commuting possibilities and the influence on labor productivity. Better transportation has led to a narrowing of the geographical area wherein firms can seek for employees. Migration may be a direct consequence of such an investment in infrastructure and may improve labor productivity further as a larger pool of laborers is available for the jobs. In combination with reduced migration costs, with i.e. relief of institutional migration impediments, the reduced commuting costs will lead to a positive net welfare gain as a result of a more efficient labor market.

Thissen and van Oort (2004) come to the conclusion that for the population the effects of migration are always Pareto optimal, meaning that some people are better off with migration without any others being worse off. However, on the country level, the Pareto optimality will not hold as a country may incur a decline in GDP. GDP per capita is a better measure for welfare, yet it does not include preferences for certain amenities that may outweigh the monetary value of production. Nevertheless, reducing barriers to commuting stimulate economic integration and will lead to an increase in the economic growth in Europe. In the case of Austria, they found that "only in case of an extreme inflow of labour there could be a short-run negative effect on Austria's economic growth," (Thissen and van Oort, 2004:16). However, they also argue that such a high labor inflow is highly unlikely given the low historical labor migration among the EU countries.

### 3.4 Summary of Other Findings

The impact of the EU (EEA) enlargement most definitely has had an effect on Nordic labor migration, however, not markedly in Sweden. Especially in a booming market as we have experienced a few years back, the necessity of these EU-8 workers was considerable in order to keep the "ball rolling". Thus, the access to new labor markets has mostly been a positive matter, yet it will become more interesting to look at the effects of this new migration in an economic downturn period that we have been experiencing and are currently going through.

We have discussed evidence from several other papers that have researched the field of migration and its effect on economic growth. In light of these reviews, we cannot find a consensus on whether the empirical data concord with the economic theory. The neoclassical growth model correctly associates the initial income level with the growth rate, ceteris paribus. However, the speed of convergence differs substantially depending on which

countries and what level of regions one investigates. The empirical evidence offers mixed support for the implications of migration on the neoclassical model. Some find that migration had a positive effect on convergence, while others claim that migration does not influence the growth rate, but rather that the growth rate influences the choice of migrants' residences. The neoclassical model is also limited as it does not take into consideration the role of all mechanisms of economic growth, such as entrepreneurship.

The empirical evidence on new economic geography indeed finds evidence that this theory is superior to the neoclassical growth model in terms of support through observed data. Thissen and van Oort (2004) remark that on the EU level, the influx of labor migrants from the Eastern European countries and the effect on GDP is Pareto optimal, however, on each country level the influence of the new migrants on GDP is not exclusively positive, and that one should use other measurements of welfare than GDP. Peeters (2008) do find that there is evidence of convergence in light of new economic geography theory. However, in the event of selective in-migration based on high levels of human capital, the initially rich countries will gain more than the poorer countries.

# 4. The Case of Norway

The purpose of this section is to give an overview over the Norwegian economy, and its developments, the last 50-100 years. We also aim to give an insight to the migration patterns in Norway both with respect to geography, country of origin and skills. We do this by presenting descriptive statistics and stylized facts.

We start by defining the Norwegian economy and provide an insight of the sectors and industries and the structural change which has happened over the last century. The next paragraph will present the development in real wages and prices from 1979 an up until today. Furthermore, there will be an overview of the Norwegian demography and then a presentation on the Norwegian migration policies and restrictions. We then move on to describe the characteristics of the migration into Norway. It is important to keep in mind that the main focus of this thesis is labor migration; as a consequence, we choose to be selective by first and foremost presenting data related to labor migration. Finally, we will present a summary of the findings of this section.

## 4.1 The Norwegian Economy

### 4.1.1 Norway`s Degree of Openness

The Norwegian economy is what we can describe to be a small, open economy. There are three typical features with these types of countries. Firstly, a small country must take the rest of the world as a given, secondly the domestic market is too small to obtain economies of scale, and the unit costs become too high, in addition to a small variety of goods and natural monopolies. Thirdly, a small open economy often possesses a rather one-sided resource endowment, (Norman, 1992).

Norway fits this description rather well. Geographically, the country is not well suited for agriculture, but on the other hand Norway is well endowed with other natural resources such as oil, natural gas, waterpower, and fisheries. As for the domestic market, regarding almost any good, it is small enough for a mid size production facility to serve it. This does have an impact on the product variety. If consumers wish for more product variety they also have to accept higher unit costs, because of shorter production series. And finally, when it comes to the international context, a small open economy, do not have a special impact on the production and demand in other countries. Although Norway is the fifth largest oil exporter and third largest natural gas exporter, the crude oil production, and subsequently the prices

are heavily restrained by OPEC in order to keep the oil prices from harmful and unnecessary fluctuation, (The Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate, 2009).

According to theory on international trade a small open economy should specialize its production to the sectors where the country has a comparative advantage. "To overcome the disadvantages by a one-sided resource endowment and a small domestic market, one has to open up the economy to international trade," (Norman, 1992:27). To a certain extent Norway has done exactly that. Although Norway decided against an EU membership in 1994, the country became a member of the EEA, which implies an agreement on free flow of commodities, labor, services and capital, while agriculture and fisheries are a very limited part of the agreement. The main purpose of the agreement is to ensure equal grounds for competition and today Norway's main trading partner is the EU, where 70 percent of the country's imports and over 80 percent of the exports goes to the countries within the European Union, (European Commission, 2009).

The degree of openness is, according to Norman (1992) dependent on the share of GDP produced in sectors facing foreign competition. In Norway these sectors are coal, mining, forestry, fisheries, oil production and drilling, and different types of industries such as chemical, metallic, machine, electronic and ship construction industries, to mention some, in addition to shipping and air transport.

The sectors which are not exposed to foreign competition are the private and public production of services, in addition to agriculture, and construction, (Norman, 1992).

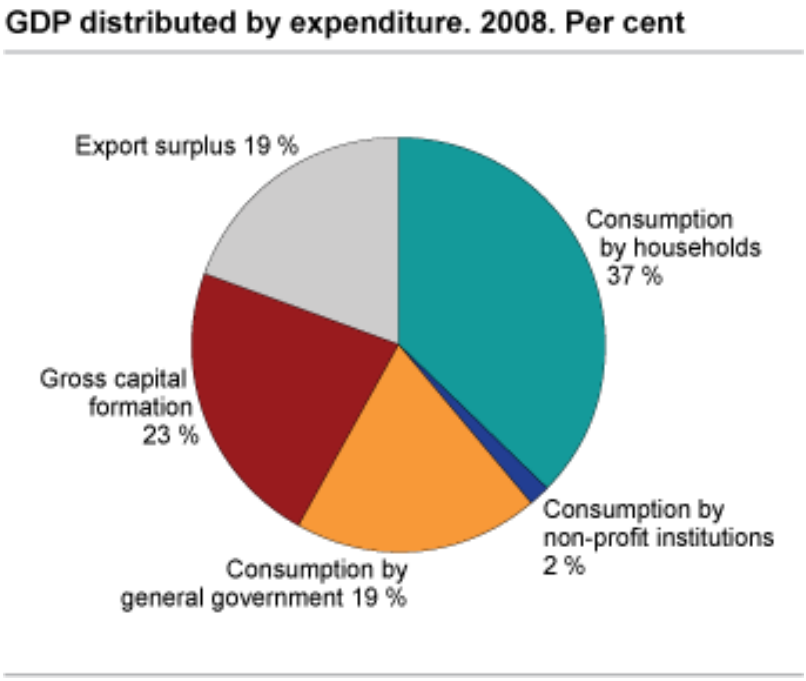


*Figure 10: GDP distributed by expenditure in 2008, (Statistics Norway, 2009a)*

The figure above shows that Norway certainly is an open economy. And the 19 percent of GDP stemming from net exports is to a great extent reflecting the large increase in oil exports. In the period from 1979 and onwards the net export has been positive and contributed to GDP growth in every year, except for during the years of oil crisis in 1986-88.

### 4.1.2 GDP Development in Norway

GDP or gross domestic product, is a measure of a country`s total production of goods and services. In 2008, Norway's GDP amounted to 2,548 billion NOK, and the country had an export surplus of 493 billion NOK, which is approximately 19 percent of the total GDP.

The export surplus indicates that the value of Norway's production is higher than the country's expenditures. In 2008 the GDP per capita was 534,440 NOK, and this reflects a formidable growth since 1970, when the GDP per capita was 23,500 NOK. These numbers also reflect the high growth in prices for this time period. If one adjusts for the inflation the GDP per capita in 1970 amounted to 161,611 NOK measured in 2008 NOK. So there has been a significant growth in GDP levels the last 40 years. However, the growth has not been equally strong over the whole period. This is further illustrated by the following figure:

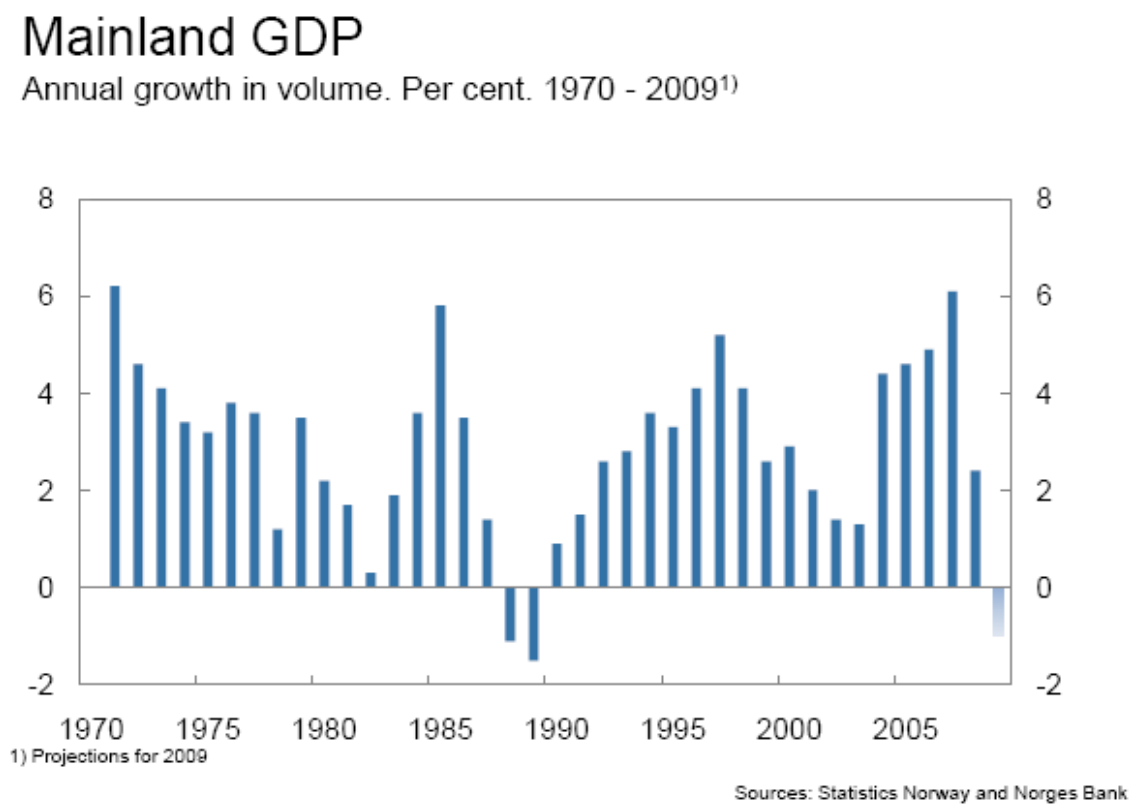


*Figure 11: Percentage GDP growth from 1970-2009, (Gjedrem, 2009)*

The strongest annual growth was reported at 6.1 percent in 1971 and 1985. This growth has over the years made Norway one of the richest countries in the world. In comparison to Europe it is presently ranked as the second richest based on the purchasing power parity (PPP) adjusted GDP per capita. Norway's PPP adjusted GDP amounted to USD 52,000 in 2008 (OECD, 2008b), which is 84 percent higher than the average in EU (Statistics Norway, 2009a).

It should be mentioned however, that Norway's high GDP is highly affected by the oil and gas sector. This sector is depleting national resources of which all of the production cannot directly be stated as a value creating activity.

As for the development in prices and wages, there has been a higher growth in wages than in prices the since the 1990s. This implies a real wage growth the last 25 years. In addition, factors like high growth in productivity, increased imports from low cost countries and stronger competition has contributed to a relatively low growth in prices. During the last five years the CPI in Norway has increased with an annual average of 1.5 percent. This low growth is partly connected with the fact that Norwegian households import around 30

percent of its commodities from low cost countries such as China, and there has been an average annual reduction in prices of imported goods the last five years.

However, according to the Ministry of Finance, the growth in wages has been moderate. This is in part due to the labor immigration, where the foreign workforce has been paid relatively less for the same amount of work and thereby contributed to a dampening of the growth in certain sectors, (Ministry of Finance, 2008). Since wages are the most important part of the corporation's costs, it is important to mention that a rise in the real wages, also mean a reduction in the ability of competing with foreign countries. In the period from 1997 until 2006 the relationship between industry wage costs per hour in Norway and the wage costs of the country's trading partners, measured in the same currency, has increased by an average of 2 percent annually. It is important to note that an increasing wage level does not necessarily mean a weakening of the ability to compete internationally as long as there is a corresponding increase in productivity.

#### 4.1.3 Productivity

"Productivity growth is considered a key source of economic growth and competitiveness and as such forms a basic statistic for many international comparisons and country assessments," (OECD, 2008a).

And since productivity it is a determinant factor for a high living standard, it is important to point out which factors have contributed to the Norwegian productivity growth. From the classical growth theory, presented in section 2, we learned that there are different factors contributing to a country's certain growth path. For example: an increase in the labor force will result in a steeper production function for all levels of capital stocks and , for a given savings rate, this upward shift in the production function will also lead to a corresponding upward shift in the savings rate. So at each level of capital, more is being produced. Nevertheless, productivity can also be raised by more effective exploitation of the capital stock already existing. This can be done by increasing the knowledge and competence of the workforce, innovation, and improved working processes.

This is also known as increased total factor productivity (TFP). In the case of Norway, figure 12 illustrates the productivity development in different sectors from 1970 and onwards measured in percent.

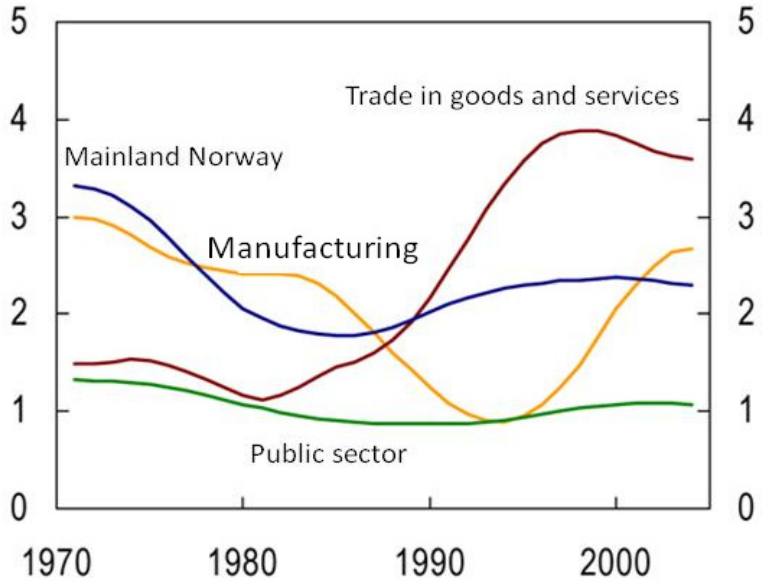


*Figure 12: Percentage productivity growth (vertical axis) in main sectors from 1971-2004 (horizontal axis). (The Norwegian Central Bank, 2009).*

There has been a tremendous productivity growth within the trade in goods and services the last 30 years. One important source for this development is the large technological advancements such as the internet and other improvements concerning information technology which makes communication and collaboration easier and more efficient. As for the other sectors the growth has been slightly more moderate, and for the public sector in particular, the growth has been around 1 percent.

#### 4.1.4 Labor Productivity

Labor productivity is a commonly used measure to assess a country's productivity. However, Norway`s high levels of GDP, does not necessarily mean that the country`s labor force is better or inherently different from other countries inhabitants.

The figure below shows how the growth in GDP per capita can be decomposed into two variables, namely "growth in GDP per hour worked" and "growth in labor utilization" which is measured in hours worked per capita. As for Norway, one can easily see that the contribution to growth in GDP per capita is mainly due to the first variable mentioned. The low growth in labor utilization is due to less people contributing to GDP, i.e. lower working hours, higher unemployment and lower participation of older workers.

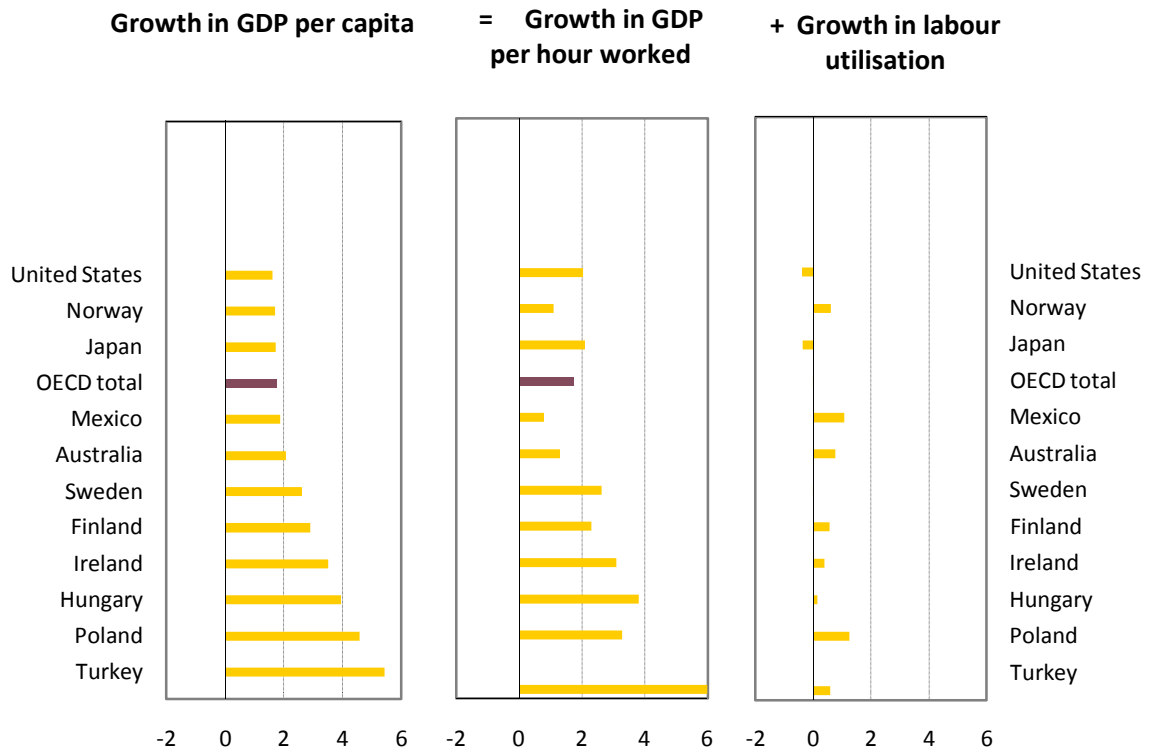


*Figure 13: The Contribution of Labor productivity and Labor Utilization to GDP Per Capita percentage Change 2001-2007, Annual Rate, (OECD, 2008a)*

According to the OECD compendium for productivity indicators (2006), Norway's situation in the figure above, with stronger growth in GDP per hour worked than the growth in labor utilization, could indicate a greater use of capital, and or non employment of low productivity workers. Another important factor that will raise GDP without affecting the labor utilization is the influx of labor migration. As mentioned above labor productivity is the most common way to measure productivity on a national basis, however there are other variables that contribute to GDP growth.

The global competitiveness report 2009-2010 defines competitiveness as "the set of institutions, policies and factors that determine the level of productivity of a country," (World Economic Forum, 2009). In this report Norway is ranked 14 out of the 133 countries evaluated, and the economy is defined as being in an innovation driven stage. Which implies that the Norwegian economy: "are able to sustain higher wages and the associated standard of living only if their businesses are able to compete with new and unique products" (World Economic Forum, 2009). In this report there are twelve pillars that lay the foundation for measuring competitiveness. These can explain other reasons for economic growth. For

example the first pillar is "institutions" where Norway scores very high on "property rights"," public trust in politicians", "strength of auditing and reporting standards", and the" protection of minority shareholders interests", amongst others. Another pillar is the" Macroeconomic stability", here Norway scores very high when it comes to "government surplus/deficit", and "interest rate spread". When it comes to the pillar named "labor market efficiency" Norway scores a 6 on" brain drain", and a 13 on "female participation in the labor force." Especially the last variable can be viewed as a comparative advantage in itself since more of the qualified workforce is participating. As for "innovation" the country scores a 14 on "capacity for innovation" and a 15 on "university-industry collaboration in R&D". All of these variables are determinants for the growth capacity of the Norwegian economy, and reflects the importance of good institutions, macroeconomic stability and openness to trade.

#### 4.1.5 The Norwegian Demography

Norway's total population today is almost 5 million people, and the demographical development the next 10- 15 years states that there will be more people exiting the labor market than entering it domestically. So there is no doubt that the working part of the population will decrease. On a short time view, the labor migration has been very effective fulfilling a need for labor in the Norwegian labor market during the economic upturn the last four years. In a longer time horizon the effect of labor migration does not solve the problem of an ever aging population. However Norway has had lower unemployment rates than most other countries over a longer time period, and it also seems that the country`s "location" in the business cycle is determinant for how long people wants to stay in work before they retire.

With a view to migration it is important to look upon the effects of the immigrants decision whether to stay on an intermediate or a permanent basis and also if their families settles down. "Permanent settlement the labor migration will not only contribute to increased production, but also to an increased population, and hence, more people to split the national income," (Ministry of Labour and Social Inclusion, 2008).

In addition to "growing older", the country statistics shows that Norway have a highly educated workforce. In the segment of the population between 25-64 years, the average number of schooling is 14 years. This is two years above the OECD average, (Ministry of Finance, 2009). Currently one quarter of a million Norwegians are undertaking higher

education, and this is also contributing to narrowing the "working window", i.e. the active time spent on the labor market. With respect to the urbanization issue described above it is important to present the main differences between the three biggest cities in Norway, and the country average.

| Percent of the population | Below upper secondary education | Upper secondary education | Tertiary education |
|---|---|---|---|
| **Total** | 30.9 | 43.1 | 25.9 |
| **Oslo** | 23.4 | 34.8 | 41.8 |
| **Bergen** | 26.9 | 40.0 | 33.1 |
| **Stavanger** | 25.6 | 40.3 | 34.1 |

*Table 2: Educational level in Norway in 2009, (Statistics Norway, 2009)*

Table 2 display the education level in three cities, and in totals for Norway. In Oslo the percentage of people having a tertiary education is 41.8. Which is to a great extend higher than the national average. Stavanger and Bergen is also above the national average with 34.1 and 33.1 respectively. This demonstrates that highly educated people living in Norway are more likely to locate in cities, than low educated people. Norway's higher education institutions such as universities are also located in these cities, and the labor demand here is higher.

#### 4.1.6 Employment and Structural Changes

With a few exceptions, Norway has experienced a steady increase in employment in Norway since the Second World War. The most important exception was the four year period from 1988 until 1992, when the country experienced an economic recession. This led employment to drop with 116,000 persons. Since 2004, Norway has experienced an economic boom and, in 2007 the growth in employment were exceptionally high with 4,1 percent, (Hansen and Skoglund, 2008). Since the peak of the business cycle in 2007, Norway has seen an increase in the unemployment rate accumulating to 3.2 percent of the total work force in August 2009. From May until August 2009, there was a reduction in the employment of 22,000 workers. Some argue, however, that an unemployment rate of 3.2 percent is not far above the natural unemployment rate, and that the repercussions from the global financial crisis that started in 2007 have been miniscule in Norway compared to most other nations, (Statistics Norway, 2009).

Since before the Second World War there have been great structural changes in the Norwegian economy, from the primary and secondary sectors towards the service or tertiary sector.

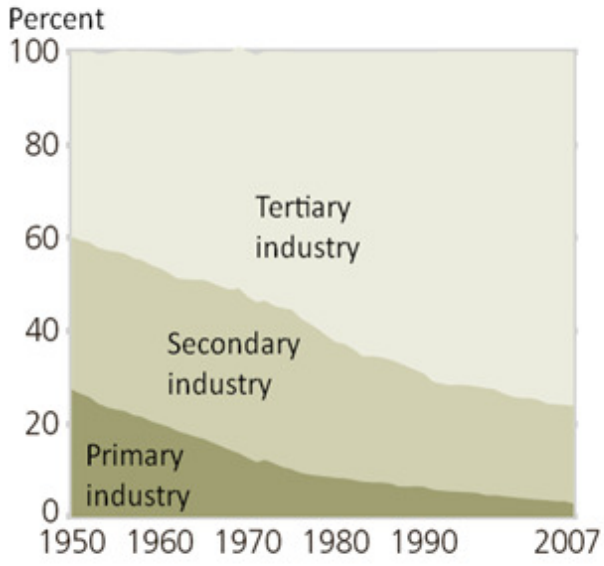


*Figure 14: Employment after industry. (Statistics Norway, 2009b).*

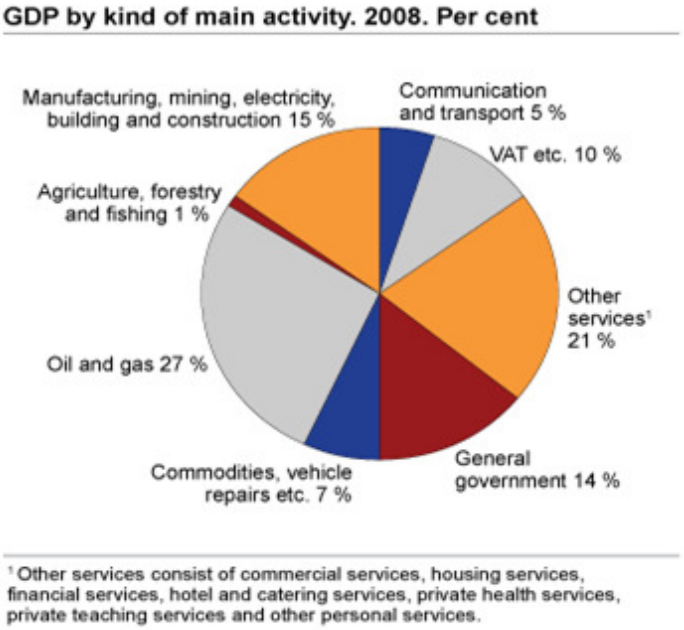


*Figure 15: Origin of GDP in 2008 (Statistics Norway, 2009a)*

Figure 14 demonstrates that more than half of the population is working in the service industry, and the percentage rate is still growing. The employment in the primary/agricultural sector has been reduced with approximately 350 000 persons since 1930. And the employment in the industry sector has been reduced with roughly 100 000 persons within the period 1974 until 2007, (Hansen and Skoglund, 2008). The main development shows the primary and secondary sectors losing out to the service industries, but one should also take into consideration the contribution these "expired sectors" currently make to the GDP. For example in 2007 the secondary industries, including oil production, contributed approximately 43 percent to the GDP, (Statistics Norway, 2008a).

## 4.2 Norway's Migration Policies

"Every developed country regulates the flow and composition of its immigrant population. The intent is to mitigate the adverse effects that these population flows have on the distribution of income and on the costs of social welfare systems," (Lalonde and Topel, 1997).

Different countries operate with different migration policies. However, the differences in the number of immigrants cannot necessarily be explained only by a certain political system, other mechanisms such as geography and living standards may also influence migration decisions.

#### 4.2.1 Types of Immigration

The Norwegian Confederation of Trade Unions (LO) distinguishes between four main types of migration policies:

1) *The cynical model:*
   Migration flows according to the domestic labor market. Work permits are given in only short periods, conditional on having a job offer, in order to maintain flexibility. The immigrant will not be able to enjoy the benefits of a welfare system, and this type of migration should not lead to family establishment and permanent residency. Several Middle Eastern and Asian nations employ this immigration model.

2) *The continental foreign worker model:*
   Migration flows frequently with short term work permits, seasonal workers, and day-time commuters between nations. The system resembles the cynical model, however, this version is slightly more lenient and more assignments end in permanent residency. Germany and Switzerland are examples of countries that follow this type of migration policies.

3) *The oversea selection model:*
   This model is more based on permanent immigration than the continental model. On the other hand, it makes up for this "openhandedness" in the possibility for permanent residency by tightening the criteria for entry into the country. The focus is first and foremost on attaining specialists and qualified workers. Examples of countries that abide by this policy form are Australia and Canada.

4) *The idealistic model:*
   This model places emphasis on the immigrants' needs and is in agreement to the idea of migration as a gateway to permanent residency and not a forced departure. At the same time, the pursuers of this model make an effort not to withdraw all of the

qualified labor from the poorer countries (so-called "brain-drain"). Norway and the other Scandinavian countries feature elements of this model in its asylum policies and its family immigration.

Norway certainly has elements of the idealistic model, however, when it comes to labor migration, Norway does not have a clear cut migration policy that fit perfectly in any of the above categories. These general types of policies, however, do not consider the importance of the common Nordic labor markets or the free flow of labor within the EEA.

#### 4.2.2 The Common Nordic Labor Market

The common Nordic Labor Market was ratified in 1954 and consists of Denmark, Finland, Sweden and Norway, (Pedersen et al. 2008). This union shares the same recognition for higher education and helps maintain a high quality in the influx of laborers from the Nordic countries and explain the high numbers in workers from the other Nordic countries. However, there has been an increase in the influx of lower skilled workers from particularly Sweden, taking on temporary work as the wage level has been substantially higher in Norway.

#### 4.2.3 The European Economic Area

As previously mentioned, Norway is also part of a common European labor market through the EEA agreement and the EFTA convention. "The labor and welfare service cooperates with other European national employment services and the EU commission through the EURES network (European Employment Services) with a view to improving the recruitment of labor from abroad," (Ministry of Labour and Social Inclusion). Additionally, "the Immigration Act of June 1988 regulates the entry of foreign nationals into Norway, and their right to residence and work. In simplified terms, four categories of immigrants are admitted, namely labor migrants (i.e. persons with a concrete job offer), refugees and others in need of protection or residence on humanitarian grounds, persons with close family links to persons residing in Norway, and, finally, students, trainees and au pairs," (SOPEMI, 2007).

There are two kinds of permits that can be granted; residence permits and work permits. Work permits confer both the right to reside and to take up gainful employment, while a residence permit will not make a person able to take up gainful work, (SOPEMI, 2007). Members of the EEA and EFTA can freely enter the country and start to work immediately, on the prerequisite that they obtain a work and residence permit as soon as possible.

However, because of initial concern of social dumping" the EEA agreements principles of free movement of labor do not apply in full to the ten new member states that became part of EU on the 1st of May 2004, and 1st of August 2007 respectively; Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Hungary, Slovenia, Bulgaria and Romania." (Ministry of Labour and Social Inclusion, 2009). When it comes to these countries, Norway has implemented some transitional rules. These rules imply that workers coming from these countries must have a concrete job offer (i.e. a contract) and be able to show that the requirements for a satisfactory pay and workplace conditions are met. The rules were phased out on the 1st of May 2009, and for Bulgaria and Romania the period of transitional rules ran originally until the 1st of August 2009, with an option for renewal until 1st of January 2012. However, these transitional rules will be deliberated each year and may be repealed if required, (Fafo, 2009).

The transitional rules were implemented to assure more control and overview of the supply of labor, however, there has been a low level of individual migration which has caused a debate whether these rules have had "a limiting effect on the recruitment of desired labor," (Dølvik and Eldring, 2006). A report conducted by Fafo compares the different effects of the transitional rules on the labor markets of the Nordic countries. Norway and Denmark implemented the same transitional rules, while Sweden opted for free entry to their labor market from day one. Finland and Iceland on the other hand, had even more stricter rules than Norway and Denmark. The report finds that the transitional rules can only explain some of the variations in the entry of more high skilled labor (individual job seekers), and the report concludes that the demand side linkages are playing an important role. For Norway the many linkages and important networks that were created during the nineties due to the increase in seasonal work have had a fortifying effect on the growth of labor migration in 2005 and 2006, in addition to the relatively high wage level of unskilled labor, (Dølvik and Eldring, 2006).

The report also states that when the transitional rules are to be phased out, an increased downward pressure on the wage level in the sectors that have a great influx of migration, since "the requirement for national wage conditions will cease to apply" and further "All countries have a statutory defense against discrimination, which in principle should protect foreign workers against wage discrimination in relation to other worker within the same enterprise. However, this will be ineffective if there is a continued emergence of enterprises

within certain industries that "specialize in the use of low-wage foreign labor," (Dølvik and Eldring, 2006).

Norway has experienced many years of a booming business cycle when the labor immigrants have been a necessity in maintaining such a high production level. However, now that the trend has reversed, the employment rate for labor migrants has also started to drop. This is a new challenge that policy makers have started to consider in recent time. It is also important to keep in mind that Norway suffers from an ageing population where there soon will be a shortage in workers' tax payments compared to the pension payments for this elderly population. Immigration may be a part of the solution to this important issue.

## 4.3 The immigration to Norway

### 4.3.1 General Characteristics

According to Statistics Norway, the number of immigrants residing in Norway varies with the government's immigration policy, labor market needs and shifting global crises. Norway has received more in-migrants than out-migrants since the late 1960's with the arrival of refugees from Eastern Europe as an outcome of the Second World War and the commencement of labor immigration from Europe and the rest of the world. Subsequent to the halt in labor migration from 1975, the boost in the influx of asylum seekers became increasingly significant (SOPEMI, 2007). Immigration also increased during and after the Balkan wars of the 1990s. In recent years, the majority of new immigrants have come to Norway as a result of family immigration and the enlargement of the EU of the Eastern European countries.

In the figure below one can see the development in immigration and the causes of immigration from 1951-2007 and 1991-2008, respectively.

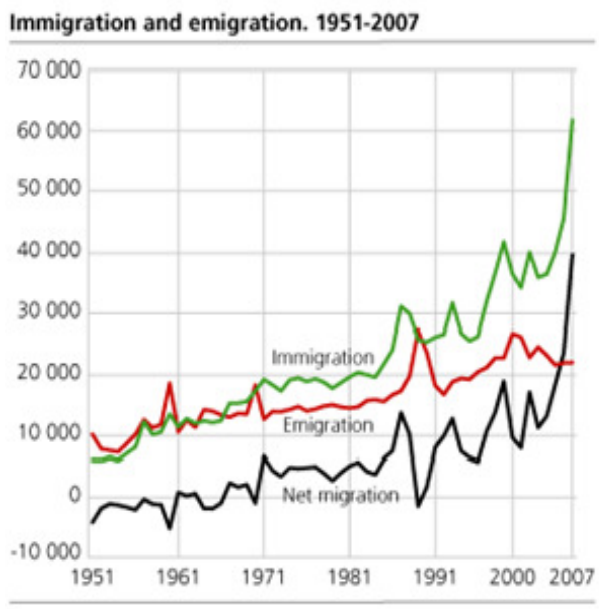


*Figure 16: Migration in Norway, 1951-2007, (Statistics Norway, 2009d)*

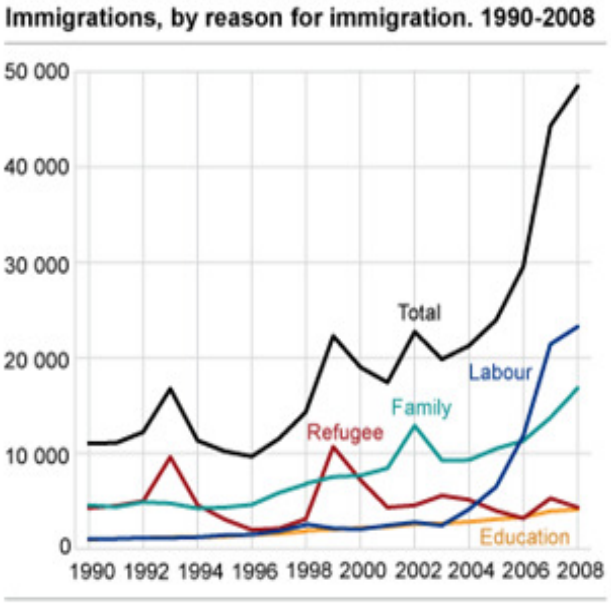


*Figure 17: Immigration by reason for immigration from 1990-2008, (Statistics Norway, 2009d)*

These figures also illustrate that Norway has had net immigration since the late 1960s and the almost exponential increase since the 1960s. The annual average almost doubled from the late 1980s to the next decade, and increased further in the early 2000s. "From 2005 to 2006 there was an increase of almost 5300 persons in net immigration" (SOPEMI report, 2007:10). In 2008, the number of first-time immigrants from non-Nordic countries to Norway amounted to a record high of 48,000 citizens, according to Statistics Norway. Both labor migration and family reunification increased to the highest number ever recorded. The labor migration represented approximately half of the total immigration, while one third arrived for family reasons.

The figure below illustrates the distribution of the largest immigrant groups in Norway as of 1th of January 2009.

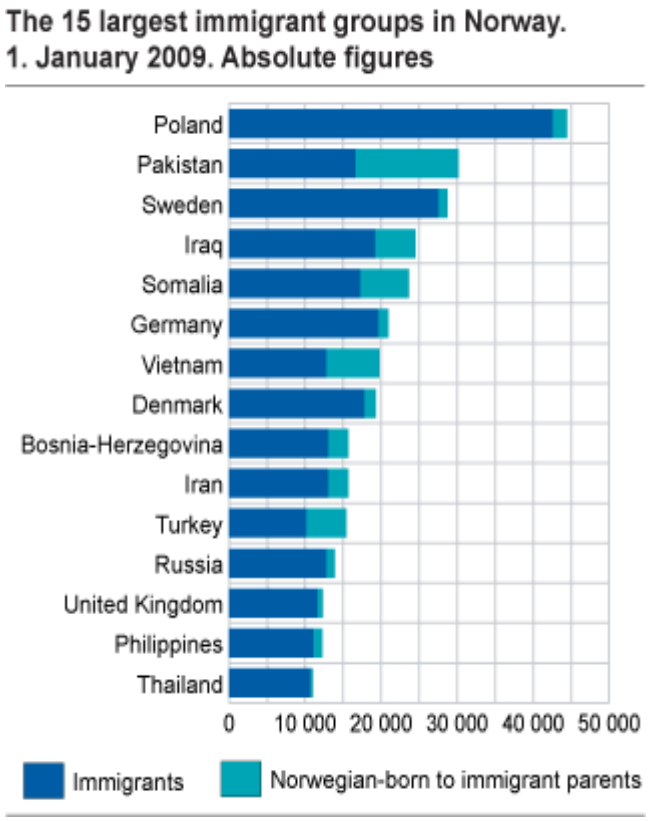


*Figure 18: The 15 largest immigrant groups in Norway in 2009, (Statistics Norway, 2009d)*

This figure indicates that Norway receives the majority of its first generation immigrants from Europe, while Asia and Africa represent the other key groups. This conforms to the fact that Norway has experienced a large number of labor migrants due to the open labor market between the Nordic countries and the free flow of workers within the EEA countries. In 2008, one third of the labor migrants came from Poland, while the seven remaining EU-8 countries represented another third. "40,500 new working permits were granted, this is an increase from 28,400 in 2005. 29 100 of permit-holders were from the new EEA-countries (including Bulgaria and Romania). Moreover, working permit renewals accounted for 30,300 in 2006, an increase of 36 percent from 2005. 25,800 of the renewals were granted to nationals from the new EEA-countries. Combining new permits and renewals, there was an increase of more than 20,000 permits from 2005 to 2006" (SOPEMI report 2007:17).

There has also been an increase in the number of granted permits for skilled workers, which requires that the applicant has specialist training or special qualifications. Close to 3,000 skilled worker permits were given in 2007, of who most were from India.

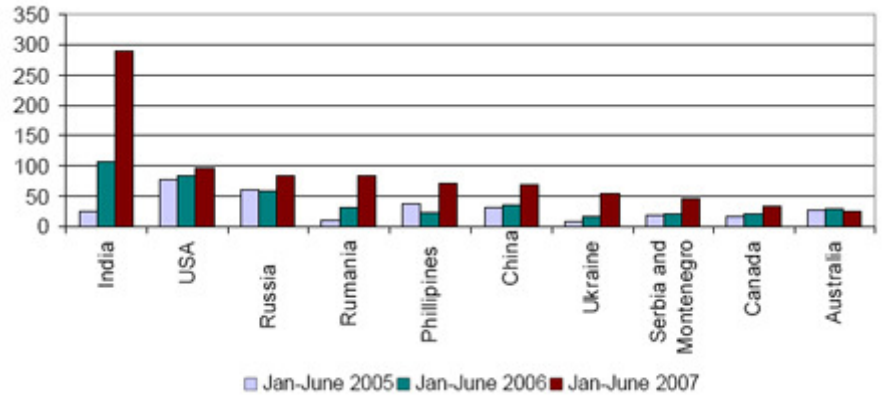


*Figure 19: The largest skilled immigration groups in Norway 2005-2007, (UDI, 2007)*

In figure 19, one can observe the steady increase in permits for skilled labor. However, Norway's quota of yearly accepting 5,000 specialists and qualified labor immigrants has never been reached (Holmberg, 2005). Note that skilled immigrants from the EU-15 and the Nordic countries are not included in the graph as they conform to the free labor market and some organizations, i.e. the Norwegian Directorate of Immigration, separates this group from other migrants.

In general, employment varies more among immigrants than the native population. In boom conditions, employment among immigrants could increase more than among natives. Although for certain immigrant groups, it is evident that the unemployment is still high in spite of a booming economy.

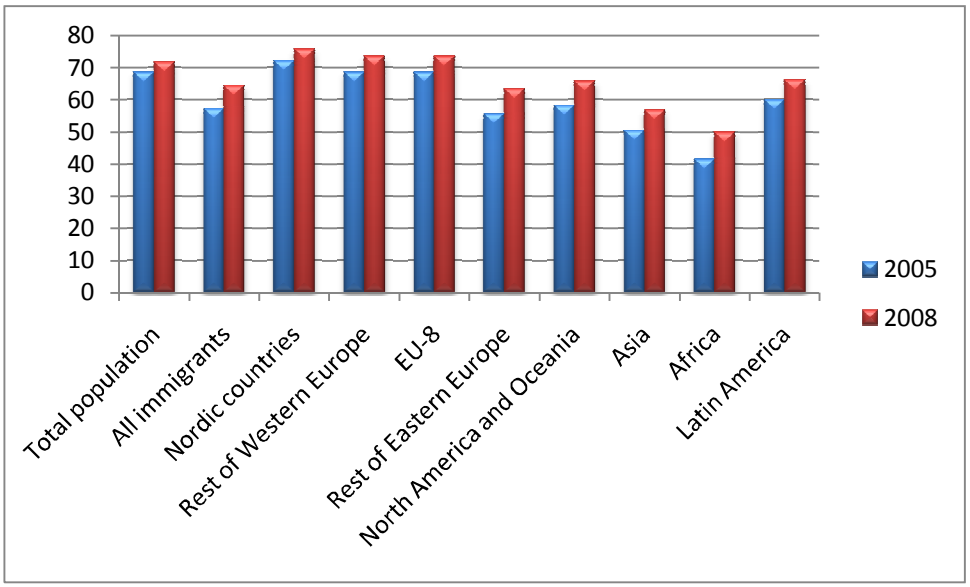


*Figure 20. Percentage employment among immigrants between 15-74 years in 2005 and 2008, (Statistics Norway, 2009).*

Figure 20 also show how the employment rate has increased for all groups of immigrants since 2005. There is a significant variation, however, in employment rates among the immigrants of working age. While the immigrants from the EU countries are doing quite well, Africa and Asia seem to lag behind.

### 4.3.2 The Sectors that Receive Labor Eemployment

It is interesting to notice that the large increase in inflow from 2005-2006 mainly consisted of immigrants from other industrialized countries, and EU countries in particular. As mentioned in the introduction, 35 percent of the immigrants in 2007 came from Poland. "By the end of September 2007, nearly 70 percent of the work related permits and renewals concerned Poles," (SOPEMI, 2007:19). In addition, out of the 30,952 currently employed immigrants from EU countries in Eastern Europe, 6,702 persons were employed in the construction sector, and 4818 persons in other industry and mining sector. According to a report by NAV EURES (The Norwegian Labour and Welfare Administration's European Employment Services) the use of European labor force is just as usual in the public as in the private sector. But the sectors differ in the different recruitment lands. The public sector is dominated by Swedish labor force (48 percent), while in the private sector most of the majority of the recruitment (42 percent) comes from Poland, (NAV, 2009). Also, according to a Fafo study from 2006, comprising Norwegian enterprises, there is a widespread use of immigrant labor from the new EU membership countries, still the most common sectors are the construction and also hotel, catering and cleaning services, (Dølvik and Eldrin, 2006). The agricultural sector has been the main receiver of seasonal workers, and still a large share of the labor immigrants receives a short term work permit. However, there has been an increase in the permits granted for a longer time period and in 2006 over 60 percent of the work permits had duration for more than 3 to 12 months. Also, the increase in applications for renewal and family reunification indicates that the immigration is shifting towards a more permanent residency, (Dølvik and Eldring, 2006).

There is no doubt that the favorable situation in Norway attracts immigrants from sending countries with a less favorable situation. This is the result of Norway's high demand for labor. In the short run this demand is caused by a booming business cycle. However, in the long run the demand is derived from and an ageing population. These factors combined with a relatively high wage level makes Norway an attractive host country for immigration.

## 4.4 Regional Clustering in Norway

The regional development in Norway is affected by several different variables such as the economic development, both national and international, different policy choices both national and international, and of course the underlying structures and endowments of the regions themselves. The regional differences become very evident in this country because of the geography, and the relatively few inhabitants compared to for example some of the continental European countries. According to the Norwegian Public Study (NOU) 2004:2, which researched the effects of the governmental involvement in regional development and the aims of regional policies in Norway, "the economic structure in the less populated regions are dominated by the primary sector and the public sector and lacks economic diversity. These areas are also affected by people moving away to more densely populated areas. In more central areas the situation is the other way around. The economic structure is more diverse and potential growth industries (in the service sector) are highly evident" Also, it is the young people that move away from the "periphery" regions, and in the "core" regions the age distribution is considered to be more diverse and favorable.

The main aim for the regional policies in Norway is to maintain the existing settlement patterns and equal standards of living across the country. Another important aim is that the regional policies contribute to the development of an economic structure that is competitive, profitable able to undergo restructuring, (NOU, 2004:2). Examples are heavy subsidizing of the agricultural sector, higher salaries to doctors and teachers who are willing to undertake employment in these areas and a relief of employer's national insurance contributions to firms that are established in peripheral areas.[4] Yet, the illustrations in the following sections demonstrate that these policies have a minor effect on the general net migration within Norway and that regional clustering in Norway is highly evident. This trend demonstrates that the current governmental programs for regional settlement have been inefficient in achieving the stated goals of maintaining existing settlement patterns. The depopulation of certain counties, such as Nordland, Troms and Finnmark is particularly severe. These trends are also fitting for the immigrant population as well as the population in general.

[4] The government has recognized that some companies has cheated the system by allocating administrative head quarters in peripheral areas while most of the employees work in areas where there is no such tax relief. From 2010, it has been suggested that companies should pay the employer's national insurance contribution according to the zone where the lion's share of the work is done.

### 4.4.1 Sectoral Locations

It is relevant to also make a note of the effects on the location of the different sectors due to government policies. The primary sector, containing agriculture, fisheries, forestry, and so on is naturally located in line with the natural endowments (first nature), so fisheries are located along the cost and the most of the small scale farmers are located outside the city regions. However, large scale farmers are located closer to the cities to save on transport costs. Even though it is the natural endowments that are a determinant for the location, the government regulates it through economic incentives, such as production subsidies.

When it comes to the secondary sector involving industrial production and construction, the public regulations are more general, nevertheless the government have, since the 1950s, been directing the location of industries that were believed to be crucial for economic growth. The aim was to develop industry on an even spatial distribution all over the country. But also in this sector the location was favored to places that had a port, and close connection to energy supplies such as water power. This implies locations in the southern part of Norway, and especially on the west coast.

As for the service sector the most important location factor is the proximity to other companies. In the cities the access to government officials, and other networks are easier to obtain. In this sector it is the second nature effects that are important, and the government has not been influencing the location of this sector as much as the first or secondary sectors.

*Figure 21: Net migration flows between regions in 2007, Statistics Norway (2009c)*

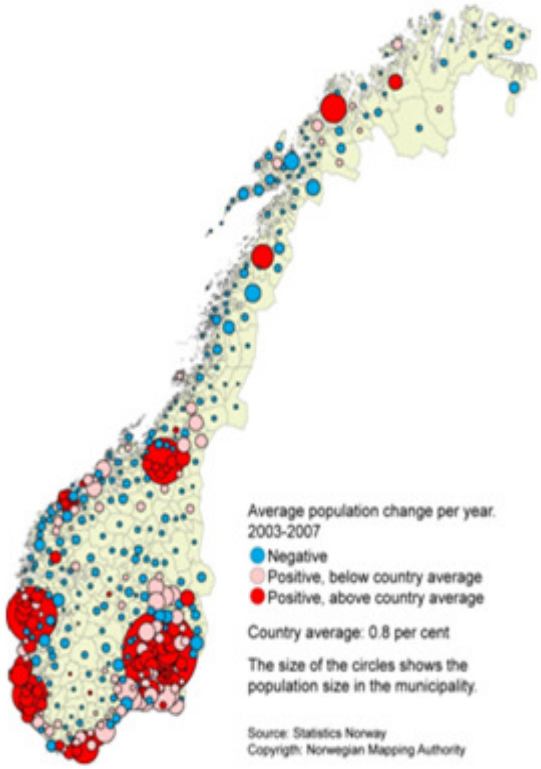


*Figure 22: Average population change per year, 2003-2007, Statistics Norway (2009c)*

As we can observe from the left figure, the main movement of people between the regions of Norway is headed towards the capital Oslo and its surrounding area. This is partly reflecting the rather dramatic structural changes in the economy described earlier, in addition to shed a light upon the agglomeration effects taking place within the country. In 2004, roughly 80 percent of Norway's inhabitants were living in cities, and also around 81 percent of the countries' workplaces were located in these central areas, (NOU, 2004:2). The employment growth has indeed been different in different parts of the country. Labor migration is determined by the economic development (business cycles) in the core regions, and is relatively independent of the business cycle in the periphery. In the figure to the right we observe the average populations change pr year in different municipalities from 2003-2007. The figure displays the ten largest urban areas in Norway. In short, the population is moving from north to the south, from inland to the coast, from the rural areas and into cities, and the geographically average location of the population moving towards the European market. In addition the NOU (2004), referred to above, states that for non-western immigrants the distribution is significantly higher than the country average in the central Oslo region. There are systematically fewer immigrants with non-western background in the more peripheral regions.

### 4.4.2 The Oslo Metropolitan Area

Oslo is the main centre for Norway's economic activities. As a comparison in Oslo, almost 30 percent of the total are is urban settlement area, while in Finnmark only 0.09 percent is of the total area is urban settlements area[5], (Statistics Norway, 2009). Geographically, Oslo is located closer to other big cities such as Stockholm and Copenhagen, and the Western European market. The tertiary (service) sector is strongly represented here, and in this kind of industries it is getting more important to be able to engage in face to face contact to meet the competition and demand from competitors and customers. This is a typical agglomeration effect where big companies locate close to each other to take advantage of externalities and forward and backward linkages.

The last four decades, Norway's ever increasing openness to trade is reflected in the in-migration patterns, location of industries, and the population growth of Oslo.

### 4.4.3 The Moving Patterns of Immigrants

Norway experienced a large surge in the centralization of its population throughout the last three decades. The population developments in the urban areas, and especially the large urban areas, have led to a "natural growth force" which implies a continuing movement towards an increasing urban population, (NOU, 2004:2). The differences between the regions can partly be explained by differences in immigration.

| | Eastern Norway | Southern Norway | Western Norway | Middle Norway | Northern Norway | Sum |
|---|---|---|---|---|---|---|
| **Large urban areas** | 224 | | 93 | 84 | | 170 |
| **Urban areas** | 73 | 90 | 46 | 32 | 45 | 66 |
| **Rural areas** | 62 | 55 | 52 | 26 | 46 | 47 |
| **Small rural areas** | 59 | 89 | 37 | 39 | 49 | 47 |
| **Countryside areas** | 36 | 39 | 30 | 18 | 26 | 28 |
| **Sum** | 140 | 85 | 65 | 53 | 43 | 100 |

*Table 3: The number of immigrants in percentage of the number of citizens in different types of regions and provinces. National index = 100 (Corresponds to 4.2 percent), (NOU 2004:2)*

The table above summarizes the distribution of non-Western immigration in the different regions of Norway. It reflects how the majority of these immigrants move to the large urban areas of Eastern Norway, in other words to the Oslo metropolitan area. The table illustrates a

[5] Statistics Norway defines an urban area as "A hub of buildings is to be registered as a urban settlement if it is inhabited by at least 200 persons. The distance between the buildings must not exceed 50 meters" Agglomeration that naturally belongs to the urban settlement with up to a distance of 400 meters from the center of the urban settlement is also included.

systematic decline in the share of non-Western migrants as you move from large urban areas to countryside areas and also as you move along the coastline from the Eastern province to the Northern provinces.

# 5. Empirical Analysis

In this section we will provide an empirical analysis of the impact of in-migration to Norway on the speed of regional convergence.

Our initial hypothesis states that poorer regions will tend to grow faster than rich ones in terms of per capita according to neoclassical theory, thus we experience convergence between municipalities. Then we move on to investigate the significance of the role of migration on growth. Finally, we will add some additional variables according to new economic geography that may account for some of the growth that neoclassical cannot.

In order to investigate this we will apply quantitative methods and conduct a multiple regression analysis that account for the effect of migration on growth. The dependent variable in our analysis will be a measurement of regional income convergence which we regress with respect to factors that could represent explanations for growth. As the theoretical basis of our econometric analysis we have used Stock and Watson's "Introduction to Econometrics" from 2003.

We will start this section by presenting the research model and analyzing the descriptive statistics, and move on to investigating the pattern of convergence across different districts in Norway. We have chosen to concentrate our analysis on the available selection of 410 municipalities spread around the whole country.

## 5.1 The Research Model

One definition of a model is "an abstraction from reality that orders and simplifies our view of reality by representing its essential characteristics," (Frankfort-Nachmias and Nachmias, 1996:44).

The model we have developed is based on various economic literature on economic growth and migration. We have altered the model several times, but we believe that this final model includes the most important determinants of growth. However, since we focus on regional growth, we will exclude the four categories that relate to the national level, as the variation within the municipalities will be too small, or the measurements are too difficult to obtain.

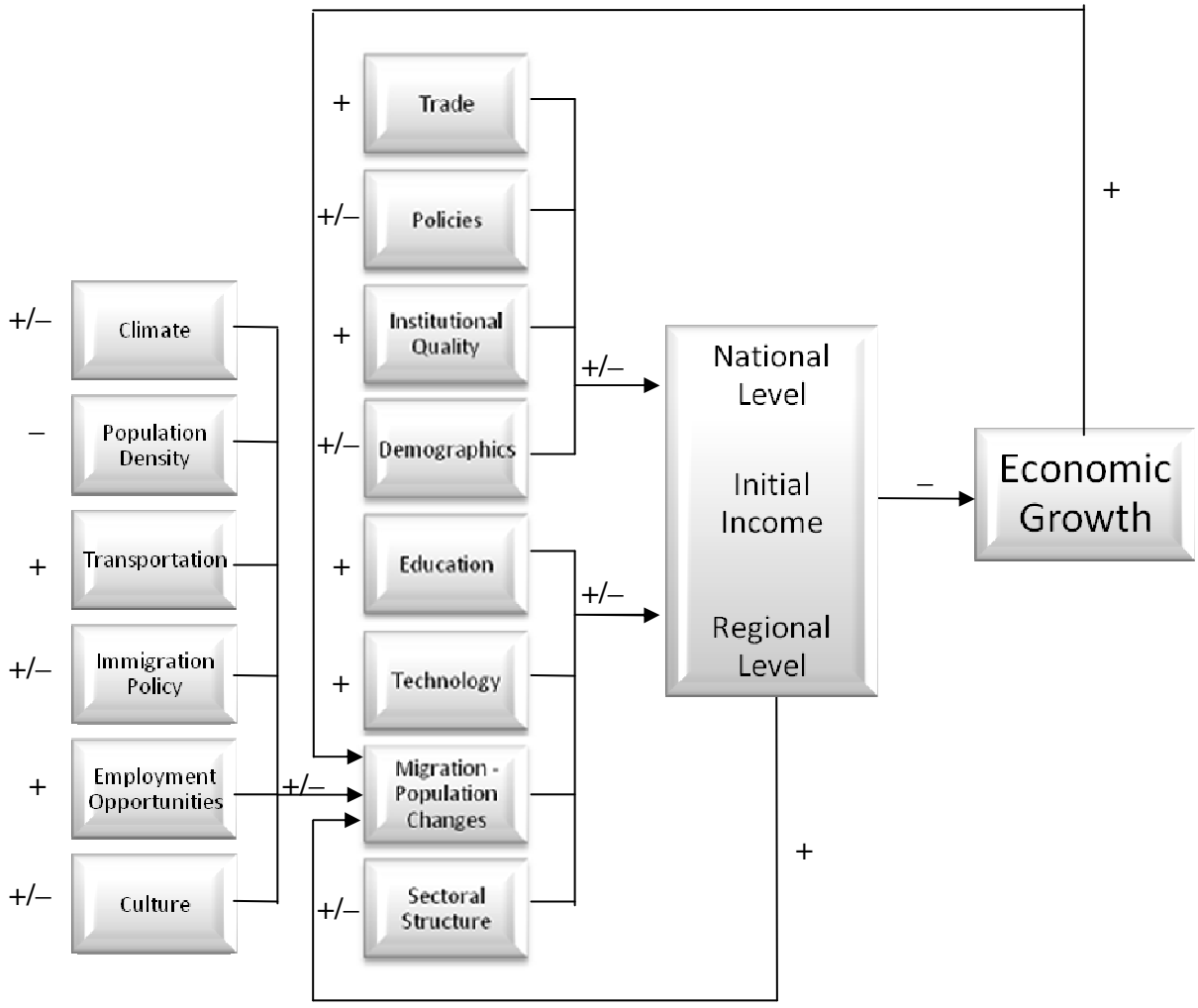


*Figure 23: The research model*

On the left hand side the model shows the variables that can influence migration decisions. While the middle column represents the factors that affect income, and ultimately income growth. On the left side of each of the textboxes we have marked our initial expectations on how each variable will influence the next link in the model.

Definitions of the concepts from our model and the hypothesis developed will be discussed further in the next parts.

## 5.2 The Sample Data

The data that are applied in this report are constructed as cross-sectional data as we include average statistics on different independent variables from several regions for only one

specific time period. By using the average over a 7 year spread in time from 2001-2007[6], we can to some extent discount any arbitrary events that might have influenced the data. Our sample includes average variables from 410 of the 430 municipalities in mainland Norway from the time period 2001-2007. Consequently, we have the number of observations n = 410. This should be sufficiently large for the law of large number to be applied, so the sample average ($\overline{Y}$) should be near the mean of $\overline{Y}$ ($\mu_Y$) of the whole population of 430 municipalities. Additionally, the central limit theorem will be valid with a large number of n, indicating that Y is approximately normally distributed.

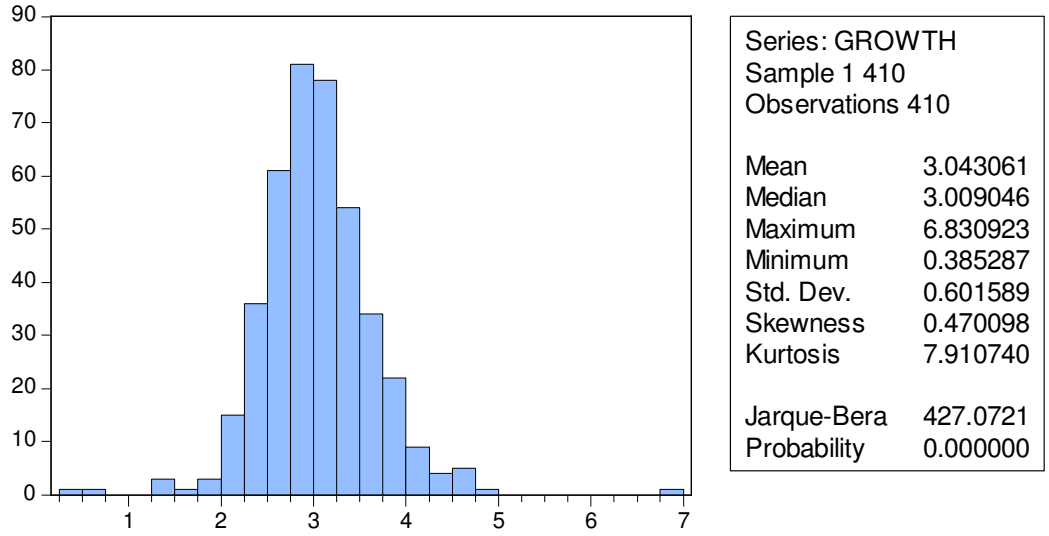


*Figure 24. Distribution of the dependent variable income growth in Norway.*

Figure 24 illustrates regional income growth among the municipalities in the sample. Although it is not perfectly normally distributed, we see an approximate bell-shape around the mean. Accordingly, we observe a fairly low skewness of 0.47, suggesting that the real values are consistent with the law of large numbers and the central limit theorem. Yet, the kurtosis of the distribution is quite high with a value of 7.92, which implies relatively long tails and a highly peaked curve. Nonetheless, this sample should be able to present a good estimate of the total population.

The data have been collected primarily from the statistics bank of Statistics Norway. Other data on land area and borders of each municipality have been retrieved from the Norwegian Mapping Authority, while the weather data are from the Norwegian Meteorological Institute.

[6] For many of the variables we wanted to include in the regressions, we could not get a hold of data for a longer time period and of the most recent date as the statistics base of Statistics Norway is somewhat limited on data on the municipality level.

## 5.3 β-convergence across Norwegian Municipalities

We usually distinguish between two concepts of convergence which was first introduced by Barro and Sala-i-Martin: β-convergence and σ-convergence. β-convergence relates to the question of whether poorer economies tend to catch up to the richer economies. The concept of σ-convergence, on the other hand, "relates to the decline of the cross-sectional dispersion of per capita income or product," (Barro and Sala-i-Martin, 1992:318). In this paper we will focus on the β-convergence, as we are interested in the how quickly and to what extent of the per capita income of municipalities in Norway are prone to catch up to the regional average.

We will exercise the approach of Barro and Sala-i-Martin (1992) and begin with the investigation of regional convergence in Norway without the impact of migration. One distinction, however, is that we look at Norway as an open economy where income levels reflect the gains from trade. The results from these first regressions will form the basis of our discussion on whether migration indeed has an impact on regional economic growth.

### 5.3.1 Breaking Down the Variables

The dependent variable was initially intended to be growth based on the regional gross product (GRP) on municipality level. However, there were no data available on GRP or a similar measure on value creation from either Statistics Norway or the Ministry of Local Government and Regional Development. As a result, we used income as a proxy for GRP. The income growth, $y_{i,t}$ was constructed as an annual growth rate of the median income from 2001 to 2007, $\Delta Y_{i,t}/Y_{i,t-T}$ where $i$ refers to the n = 1,…,N different municipalities in our sample. The income data has been deflated by the national consumer price index (CPI) with 1998 as the base year. We could not find any source of a regional price index; however, Barro and Sala-i-Martin (1992) found robust results using the country-wide CPI measure in their paper on regional convergence in the US and Japan. Additionally, Shioji (1995) found that the use of CPI on the national level opposed to the regional level does not portray a significant problem in Japanese prefectures. Thus, we concluded that such a process of convergence would be similar regardless of using country-wide or regional CPI data in Norway as well.

To determine the base specifications of regressors that would be most appropriate to use, we considered different variables that might affect economic growth across the regions and gathered inspiration from the article by Aronson et al. (2000). Most of the articles we came

across regarding topics on economic growth discuss convergence on the national level. However, many of the factors discussed in these cross-country comparisons, such as openness to trade and life expectancy will not vary significantly, if at all in a regional comparison. Thus, we found it necessary to assess which factors that would affect the Norwegian economy on municipality level. We elaborate on the most relevant variables in this section and a list of other potential variables is provided in appendix 1.

*Income*

The main argument of neoclassical growth models is how poorer regions tend to grow faster than richer regions; so naturally, we agreed that the income level would be an essential independent variable. It is reasonable, however, to think that if income levels change, the change in the growth rate will not decline immediately as a result of only higher income. Thus, we use the lagged income, $Y_{i,t-1}$ which is the initial income at the beginning of the period. As income is also likely to portray characteristics of positive, yet diminishing effects on growth, it is more suitable to use the natural logarithmic function of the lagged income that can capture this non-linearity.

When analyzing the GDP-deflated gross income per capita from the 410 observations since year 2000, we look at the coefficient of variation, which is simply the standard deviation divided by the mean. It has steadily decreased over the past few years, indicating that we have σ-convergence between the Norwegian municipalities.[7]

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|
| Mean | 208 918 | 209 999 | 223 519 | 225 208 | 229 103 | 233 591 | 236 886 | 258 735 |
| Median | 204 100 | 206 052 | 218 456 | 221 781 | 224 310 | 229 506 | 232 504 | 254 592 |
| Maximum | 352 800 | 328 759 | 361 070 | 363 910 | 374 051 | 370 729 | 365 954 | 405 720 |
| Minimum | 155 500 | 158 887 | 171 367 | 167 421 | 173 091 | 179 910 | 185 716 | 203 799 |
| Std, Dev, | 26 633 | 23 942 | 26 860 | 28 134 | 28 464 | 26 735 | 25 677 | 28 498 |
| Skewness | 1,56813 | 1,32516 | 1,53305 | 1,18182 | 1,32944 | 1,25919 | 1,22817 | 1,23173 |
| Kurtosis | 7,35395 | 5,99503 | 7,13613 | 5,50586 | 6,20010 | 5,90368 | 5,70214 | 5,89233 |
| Sum | 85 656 300 | 86 099 636 | 91 642 572 | 92 335 273 | 93 932 160 | 95 772 130 | 97 123 168 | 106 000 000 |
| Observations | 410 | 410 | 410 | 410 | 410 | 410 | 410 | 410 |
| Coefficient of Variation | 12,75 | 11,40 | 12,02 | 12,49 | 12,42 | 11,45 | 10,84 | 11,01 |

*Table 4. Descriptive statistics of average income per capita in years 2000-2007.*

These income numbers are also GDP-deflated by the national CPI rather than regional CPI. The use of the national CPI was justified earlier in this section.

[7] Østbye and Westerlund made a similar connotation with a longer time span from 1950-1990 and found similar results.

*Education*

Another variable that would be interesting to investigate is the level of human capital since superior human capital tends to lead to greater productivity and higher income. We constructed several education variables that could potentially suit as an indicator of human capital: the percentage of the population that had finished elementary school, those with any kind of tertiary education, those who had long higher education and the percentage growth in the completion of long higher education.

*Technology*

An additional determinant of income growth could be technological spread. In the endogenous growth model, technology is no longer given from outside parameters and technology is widely proved to have an influence on economic growth. The proxies we constructed for technology was the municipalities' net operational costs of maintaining a technological progress per capita, the municipalities' gross investment in new technology, the municipalities' contributions to promoting business innovation and the growth in broadband access in the private sector.

*Structural variable*

We also wanted to develop a structural variable that identifies the impact of having a certain sectoral composition in a municipality. There are constantly new occurrences of aggregate shocks and disturbances that impinge on the economic state of each region in a different manner according to the industrial structure of that specific region. However, we found the construction of such a variable problematic with a fairly limited set of data. Therefore we chose to rather create a variable that only represented the proportion of employees within the oil and gas sector, $o_i$. The petroleum industry is the leading sector in the Norwegian economy representing 27 percent of the nation's GDP in 2008, (The Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate, 2009). However, the industry is highly vulnerable to outside price shocks and the growth of the regions with a large dependence on oil and gas are more likely to fluctuate with the oil prices. "Because of the positive correlation between aggregate [oil] shock and initial per capita income, the estimated β-coefficient is biased downward," (Barro and Sala-i-Martin, 1992:319). By introducing an oil and gas variable that accounts for this correlation, we attempt to capture the effect of growth due to the high output in the so-called oil regions.

*Interaction term*

Lastly, we considered the effects of implementing an interaction term between the continuous variables for income and education as by and large people with higher education earn more than people with lower education. From the correlation matrix in appendix 2, we find that the correlation between the two is quite sizable; in fact, it is one of the higher inter-independent variable correlations with a value of 0.679. Interaction terms are useful as one independent variable's effect on Y, may depend on another independent variable.

### 5.3.2 The Validity and Reliability of the Data

The concepts of validity and reliability are central conception in statistics that bring about the sources of measurement error (Frankfort-Nachmias and Nachmias, 1996). The data may be reliable and not valid, but they cannot be valid without being reliable. Thus, reliability is a necessary but not sufficient condition for validity. The available data are seldom perfect, accordingly we will comment on any suspicious data to ensure the quality of our research. However, all the data that we use in our empirical analysis have been collected from national government agencies where the transparency is high and the numbers are handled by top economists and social scientists. Therefore, we have no particular reason to doubt that the data represent the true demographics of Norway. Validity, on the other hand, can be measured with the co-movement with the dependent variable. However, one must incorporate relevant theory to ensure that the correlation is not simply a coincidence.

To determine which of the variables within education and technology that would be more suitable to explain the variation in income growth we examined the individual scatter plots and created a correlation matrix which illustrates the extent in which two random variables move together. The closer the correlation is to 1, the more closely they move together. The correlation matrix also serves as a useful tool to exclude any perfect multicollinearity problems, in which two or more regressors are perfectly correlated. We found that the strongest correlations with respect to the dependent variable, income growth, were the proportion of citizens with long higher education, $e_i$ with 0.326, and the growth in broadband access among private households, $t_i$ with 0.165[8]. Although these correlations were the strongest among the available variables, they were relatively weak compared to the

[8] The number of private households receiving high-speed internet access through broadband has increased tremendously the past few years and is a rather new phenomenon. Thus Statistics Norway only provide this information from 2004-2007, and the yearly growth figures do not portray any growth subsequent to 2004.

correlations the structural oil variable of 0.679. The regression lines from the scatter-plots further substantiate these weak results, and the two variables for education and technology hold a trivial share of the explanatory power in the regression. Nevertheless, we decided to test both of these variables in addition to the lagged income and the petroleum variable for additional strength in the regression model.

From the scatter-plots we can also see that the independent variables act in a heteroskedastic manner, meaning that the error term, $u_i$ has a non-constant variance for different values of $i$. Since we do not have compelling evidence for having homoskedastic variables, we applied White's heteroskedasticity consistent coefficient covariance in order to obtain heteroskedastisticity-robust standard errors, as these are valid even when variables are homoskedastic. This will improve the quality of the statistical inference, such as retrieving the correct critical values when analyzing t-statistics.

Still, we do recognize that we might encounter the omitted variable bias which may distort the results of the regressions. If an included regressor partly determines the dependent variable, and is correlated with a regressor that is excluded from the analysis, we are subjected to an omitted variable bias. However, due to insufficient data material, we are not able to prove the presence of any omitted variables.

#### 5.3.3 Analysis of Regional Convergence in Norway

Table 5 summarizes the estimates of the convergence coefficients, $\beta_x$, in the four initial base regressions. In the first row, we find the number of each regression, while the first column denotes the different regressors (X).

Dependent variable: Growth; 410 observations.

| Regressor | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Logarithm of lagged income (X1) | -1.361** | -2.156** | -2.639** | -2.475** | -1.157* | -2.677** |
| | (0.317) | (0.280) | (0.391) | (0.439) | (0.502) | (0.494) |
| Employment in oil (X2) | | 0.403** | 0.417** | 0.415** | | 0.416** |
| | | (0.032) | (0.034) | (0.034) | | 0.034 |
| Higher education (X3) | | | 0.055* | 0.057* | 0.004 | -1.084 |
| | | | (0.028) | (0.028) | (0.003) | (-0.885) |
| Broadband growth (X4) | | | | 0.002 | 0.003 | 0.002 |
| | | | | (0.001) | (0.002) | (0.001) |
| Lagged income x Higher education (X5) | | | | | | 0.092 |
| | | | | | | (0.098) |
| Intercept | 19.77** | 29.34** | 35.15** | 33.06** | 17.15** | 35.58** |
| | (3.88) | (3.43) | (0.42) | (5.36) | (6.13) | (6.06) |
| Summary statistics | | | | | | |
| SER | 0.584 | 0.506 | 0.504 | 0.503 | 0.584 | 0.504 |
| Adjusted R2 | 0.057 | 0.292 | 0.299 | 0.301 | 0.060 | 0.300 |

Note: Standard errors are given in the parentheses under the coefficients. Individual coefficients are statistically significant at the *5% or **1% significance level.

*Table 5: Base regressions*

First, we performed a simple regression based on only the logarithm of lagged income, $Y_{i,t-1}$. The results reveal that although the lagged income variable is statistically significant, it demonstrates little explanatory power with an adjusted $R^2$ of only 0.057 and the standard error of the regression (SER) being highest of the four equations. We were surprised by this lack of robustness in comparison to Barro and Sala-i-Martin's (1992) amazing fit on similar regressions for the US and Japan. The vast difference in the results can largely be explained by the length of the time horizon from 1930-1987 for Japan and 1880-1988 for the US, which was considerably longer than in our study. When examining their regressions in five year periods, the $R^2$ ranges from as little as 0.07 to as high as 0.78. Additionally, Barro and Sala-i-Martin studied the US states, which could be compared to the whole country of Norway, while Japanese prefectures are more similar to Norwegian counties. Even when taking into account the possibility of a better fit using a log-log regression, including also non-linearity in the growth variable, the adjusted $R^2$ only increased to 0.079. In spite of this increased fit of the regression line, we decided to keep the actual values of growth and lagged income as the rest of the variables showed a poorer response to the logarithm of growth than to the percentage value of growth.

In regression (2), we also included the structural oil variable which we predicted to have a major influence as the correlation was relatively strong. The positive coefficient indicates that a large oil sector in the region will have a positive effect on growth. Regression (2) proved to have a quite an impact on the adjusted $R^2$ of 0.292. Still, only 29.2 percent of the sample variance is explained by the lagged income and having a large share of employees in the oil sector. Both of these independent variables are also statistically significant at the 1 percent significance level.

The significance level is an important notion as it allows us to reject or not reject the null hypothesis ($H_0$) at different t-statistics. In order to test if a certain independent variable will affect the income growth, we would set up the null hypothesis as, $H_0$: $X_i = 0$, then in a two-sided hypothesis test, the alternative hypothesis will be $H_1$: $X_i \neq 0$. We normally test hypotheses at the 10 percent, 5 percent or 1 percent significance level. For an infinite amount of degrees of freedom in the two-sided test, the critical values are respectively 1.64, 1.96, and 2.58. If the absolute t-statistic that we obtain from our regression software is higher than these critical values, we can be 90 percent, 95 percent, or 99 percent confident that the coefficient of $X_i$ is not equal to zero, and hence we can reject $H_0$.

Regressions (3) and (4) also comprise the education and technology variables in which both variables affect the growth in positively. Throughout both of these regressions, we find both of the variables of regression (2) to still be statistically significant at the 1 percent level. The percentage of the population with a long higher education is only found to be statistically significant at the 5 percent level, while growth in broadband access in the private households is not statistically significant even at the 10 percent level. The goodness of fit of regression (2) is only affected by a miniscule increase when adding each of the other variables. Even in regression (4) when we add in all the variables, we only find a slightly improved adjusted $R^2$ of 0.301 and a slightly reduced SER of 0.503.

As the inclusion of the oil variable has a great possibility of altering the results, we omitted this variable to see the effect on the other variables in regression (5). As expected, the standard errors increased as well as we obtained lower t-statistics, reducing the statistical significance on all of the independent variables. Overall, omitting such a significant variable will lower the adjusted $R^2$, while at the same time increasing the SER significantly, indicating that the regression line is a worse fit than when the oil variable is included.

In the final regression (6) we also included the interaction term between income and education. Although the interaction term exhibits statistical significance at the 5 percent level, it did not improve the overall regression.

In the field of econometrics we normally look at the regression that is most parsimonious, meaning if fewer variables could give the same explanatory power as with more, we choose to go with the least amount of variables possible. In this case we would advocate regression (4) with the variables lagged income, employees in the oil industry, proportion of inhabitants with long higher education, and growth in high-speed internet as it gives us the same high adjusted $R^2$ and low SER as regression (6) without adding the extra interaction term. Although the values are only vaguely improved compared to regression (2) and (3); regression (4) will nonetheless be slightly more precise in projecting the actual annual income growth of each municipality according to the key figure in determining the best regression line which is the adjusted $R^2$. Yet, we would prefer a higher explanatory power among the included regressors of the equation as only 30.1 percent of the independent variables explain the movements of the dependent variable growth. We expect that the main reason for this poor quality of the regression estimates on economic growth are due to data insufficiency, both in regards to the short time span and also omitted variables.

Following the regression results, we arrived at the estimation equation expressed as:

$$\widehat{y_{i,t}} = \beta_0 + \beta_1 * lnY_{i,t-1} + \beta_2 * o_i + \beta_3 * e_i + \beta_4 * t_i$$

When the βs are substituted by the β-coefficients, the equation can be written as:

$$\widehat{y_{i,t}} = 33.06 - 2.475 * lnY_{i,t-1} + 0.403 * o_i + 0.057 * e_i + 0.002 * t_i$$

We can conclude that the initial income will accordingly to neoclassical growth theories have a significant impact on income growth. The $\beta$-coefficient is negative, thus we expect regions with higher initial income to have lower growth rates than those poorer regions of Norway.[9] All the other variables, on the other hand, portray positive signs that indicate higher level of oil production, more people with high education, and more wide-spread technology will increase the economic growth of a region. One would think that education and income are highly correlated; therefore it seemed contrary to our initial belief that higher

9 In this paper we do not account for intra-regional growth which may in part be a reason for this inter-regional convergence.

education will increase the growth rate while initial income will decrease the growth rate. Yet, looking back at new economic geography theory, this phenomenon can partly be explained by knowledge spillovers and agglomeration effects in urban areas, where the education level is highest on average (Statistics Norway, 2009).

## 5.4 The Effect of In-migration on β-convergence across Norwegian Municipalities

It is not uncommon knowledge among economists that demographic changes may have significant effects on macroeconomic variables like economic growth. There are many articles dealing with regional convergence, but not many of them incorporate the influence of immigration on growth. We believe that migration may be a source of additional convergence or divergence, depending on the level of human capital among the migrants.

We are aware of the fact that when wealth is as unevenly distributed as it is among today's nations, differences in factor prices will drive migrants from poorer regions to richer regions, such as Norway where the wages are higher. This type of migration in the Western part of Germany was found by D`Amuri, Ottaviano and Peri (2008) to have no influence in the employment of the natives. However, the wages are somewhat decreasing in the sector of the same education level of the immigrants that entered the country in the aftermath of the Cold War. In the long-run, the shift to a more labor intensive production path, due to lower wage costs caused by the inflow of lower skilled labor migrants may conflict with the Norwegian economy that is based on innovation, skills and quality. On the other hand, Dølvik and Eldring (2006) point out the necessity of the labor migration in labor markets during booming business cycles as it increases the capacity for growth, and reduces cost inflation.

Our hypothesis is that migration will have a positive effect on the overall economy according to the migration theory of Borjas (1994), but that the actual income growth rate will decrease in the urban regions that accept the vast majority of immigrants, thus reducing the gap between richer and poorer regions. If we view migration as mode of increasing the population growth, the requirement line of the Solow-Swan model becomes steeper, and the new steady state features less capital, and lower output per worker.

### 5.4.1 Setting the Stage

As mentioned in a previous section, in-migration to Norway consists primarily of a mix of differently-skilled workers from the EU countries, family reunification, and refugees seeking

asylum. In figure 18 we provided the distribution of the top 15 countries that the accumulated number of immigrants to Norway originate from in 2008. The table showed that there is an overwhelming surge of migration from Poland and a few other Eastern European countries during this time period. Many of these specialize in the bottom tier in the hierarchy of the construction industry. Although they represent a vital part of the work force, we do not believe that this particular group of immigrants along with refugees from third world countries will contribute to a momentous increment in the economic growth. As Dolado et al. (1993) affirm, a population growth of lower skilled migrants is related to decreasing output in per capita terms.

We have previously declared how the new economic geography theory focuses on spatial divergence rather than convergence, and the indication that the world is getting more spiky rather than flat in terms of urbanization (Florida, 2005). Because of higher demand in urban areas, one can also find a larger supply of features that are attractive to immigrants. There are often more jobs available, wages are higher, and one can benefit from the large array of amenities such as cultural, educational, and social offers. Pettersen (2009) also describe that there are more immigrants who share a similar heritage in densely populated areas, and that social networks among immigrants and the possibility for running "ethnic entrepreneurship" may strengthen the immigrants' desires to move to a city area. Thus, the addition of these new workers may help boost the speed of convergence as most of them tend to move to heavily populated areas.

However, we have seen at several occasions that migrants contribute to higher productivity if there is a large surplus of jobs and too few workers in a country. Additionally, a quantity of migrants may have added human capital and be more productive than the natives, or their skills may contribute to fill up or exert as complementarities to scarce skills of the natives, or if the immigrants have additional human capital that outweigh the reduced capital intensity per worker. In this case, migration will lead to faster growth in urban areas than in rural areas in accordance to new economic geography theory.

Unfortunately, we do not have access to data on the different skill levels of the migrants, and even if we did, it would propose a rather difficult predicament of evaluating the quality of education depending on the origin of the workers. For instance, does one value the skills of a doctor equally, regardless of whether the person has earned his degree from Sierra Leone or Switzerland? Therefore, we will look at the workers as a whole, and disregard the skill level

and just look at the effect of overall migration on economic growth in our regression analysis.

We will add an extra independent variable that represents migration, $M_i$. The new equation can now be written as:

$$y_{i,t} = \beta_0 + \beta_1 * lnY_{i,t-1} + \beta_2 * o_i + \beta_3 * e_i + \beta_4 * t_i + \beta_5 * M_i + u_i$$

But as one may recall, we debated on how it may be difficult to disentangle migration and economic growth and on could ask: is it the migrants that cause the increased growth or is it the high growth that attracts migrants?

### 5.4.2 Two Stage Least Squares Approach

Including migration into our original regression may create a reliability problem. Migration is likely to demonstrate a simultaneous causality bias towards economic growth. Migrants are inclined to move to countries and subsequently regions that have experienced high economic prosperity. At the same time, economic growth may be decreased where there is a high population growth, or put differently, where there is a high surge of immigrants; or it may be increased due to the immigrants' attributes of high human capital levels. So how can we solve this bias econometrically? In order to look purely at the effect of migration on regional growth and not vice versa, we use an estimator called the two stage least squares (TSLS) which include the use of instrumental variables.

Borjas (1994) in opposition to the bias provides a relevant note that many countries have rigorously regulated immigration policies, which could imply little or even no causality between economic growth and migration. However, Norway does not have strict enough regulations for this causality to be non-existent.

Migration is our single endogenous regressor (X5) in the previous equation. In order to make the variable exogenous we will add the instruments (Z) that represent migration and replace migration with the new predicted values for migration.

The decomposition of the variables from section 5.3 of this report, gives us no reason to modify any of the independent variables from base regression (4) from table 5. However, from examining at the scatter-plots, we took the liberty to apply the natural logarithmic function of migration, as there might be a slight improvement on the regression function due to a non-linear relationship with annual income growth. This logarithmic function assumes

that the slope of the curves for in-migration could be considered to be positive with a weakening effect for high values of in-migration as the growth cannot increase into infinity. Consequently, a percentage change in in-migration is associated with change in the annual income growth of $0.01\beta_i$. The notion of implementing this logarithmic function contradicts our initial hypothesis where we expected migration to have a slightly negative effect on growth.

The figure below illustrates the actual relationship between in-migration and growth in a scatter-plot.[10]

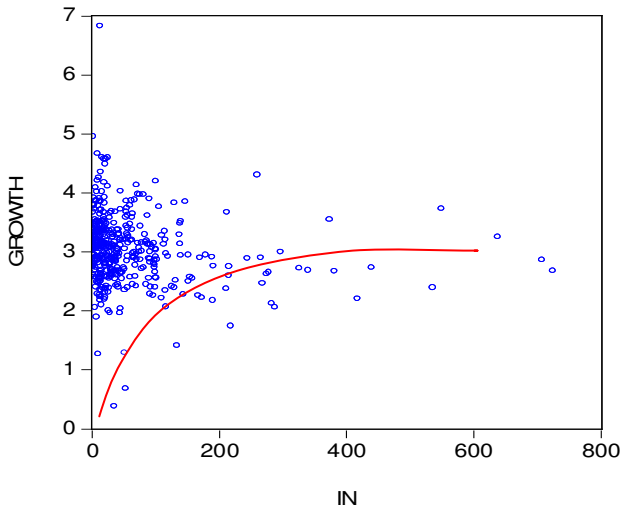


*Figure 25: Scatter-plot of linear-log regression.*

In figure 25, we can observe a faint inclination of a positive, yet diminishing curve that would be a slightly better fit than a linear line.

### 5.4.3 Instrument Relevance and Exogeneity

The TSLS method is a very straightforward and probably the simplest way to evade problems with variable endogeneity, but it also has some drawbacks. The requirements for an instrument to be valid are rather challenging. Firstly, the instrument has to be relevant, which entails that the instrument is somewhat correlated with the endogenous variable. Secondly, it has to be exogenous, meaning that the instrument has to be independent of the error term. It is also necessary to have more instruments than endogenous regressors as a requirement for the instrumental variable regression model is exact identification or over identification. Rigobon and Rodrik (2005) have raised questions about the plausibility of

[10] We excluded some of the outliers in the sample to improve the graphics as the majority of the occurrences are clustered at low numbers of in-migration.

using instruments to rule out the reverse causality problem. In particular, they comment on the difficulty of uncovering truly exogenous variables that also satisfy the exclusion restriction, which entails that indicators can be argued to influence the endogenous variable solely through the determinant for which they are instrumenting.

*The endogenous regressor*

We chose to use the in-migration variable rather than net-migration as it would better portray the effect of Norwegian immigration policies. We also believe that the reasons for out-migration in Norway are less income-driven than for people moving in to Norway, thus the net-migration might be somewhat distorted.

*Climate*

Other factors, such as climate, can affect people's affinity or aversion towards residing in certain areas. Landes (1998) refers to nature's inequalities and climate as a core origin of the disparity of wealth in the world. In spite of its small population size, Norway spreads over 13 degrees of latitude from its northernmost point, North Cape to its southernmost point, Lindesnes (The Norwegian Meteorological Institute, 2009). Thus, there is a vast difference in climate throughout the year. The weather variable also represents other the first nature endowments that attract migrants as well as amenities that people can benefit from when living in close proximity to larger urban areas. The use of weather as a representative of other underlying amenities can be justified as "market rents are expected to adjust so as to leave utility constant over space" (Graves, 1980). Hence, migration is present accordingly to changes in demand for location-fixed amenities, such as access to theatres, night life and the like. More than 80 percent of Norway's population lives in the south of Norway which also is the most temperate part of the country (Statistics Norway, 2009). This could point to the possibility that the amenities are likely to be found in southern Norway as a result of the temperate climate.

We have collected weather measurements from the weather stations in each municipality where available, while taking a neighboring municipality's weather station or one at the approximate latitude in the same county where weather stations are non-existent. The list of weather stations that were used for the different weather measurements is attached in appendix 3. All the data are gathered from the web application *E-klima* from the Norwegian Meteorological Institute. We tested a whole set of different weather parameters, such as minimum, maximum and average temperature, a constructed temperature measurement that

took the root of the square difference between average and the extreme temperatures, snow depth in centimeters and precipitation in millimeters per year. Out of these, the average temperature was the variable that had the closest correlation with any of the migration variants, and we chose to include it as the instrumental variable, $w_i$. The correlation proves the instrument's relevance, and the weather is considered to be constant (or changing in an insignificantly slow pace) regardless of the economic situation of Norway, thus the instrument is also exogenous.

*Population density*

We found the population density of the municipalities by dividing the total population by total area of the respective municipalities. Next, we linked the bordering municipalities (by land or road connection) by looking at a map and averaged the population densities of all the neighboring regions. We retrieved the area sizes from the Norwegian Mapping Authority and the population numbers from Statistics Norway. In appendix 4 we provide a list of all municipalities and the neighboring regions according to our recognition of bordering municipalities. We ignored the island municipalities that only have ferry connections to other regions. Consequently, we have missing data in the population density of neighboring regions, which are passed on to the new predicted variable for in-migration in the second stage of the regression. Densities are likely to have an off-putting function as high densities are related to congestion, pollution, noise, more crime etc. Thus, we expect that the higher the density, the more unattractive it will be to move there. By using the neighboring population density, $p_i$ rather than the actual density of a particular municipality we reduce the possibility of statistical unreliability as some municipalities grow faster due to a large share of migrants. Consequently, the instrument will be exogenous, while also being relevant as it has a certain degree of correlation to migration.

*Employment*

We also thought it would be interesting to look at the employment opportunities in each municipality, or the lack there of through unemployment rates. However, we found the data for unemployment to show almost no correlation to migration. The employment rates for respectively the total population, all immigrants, immigrants from outside Europe, and especially immigrants from European countries in each region, on the other hand, all had considerably better correlation to migration than the unemployment rate. A recent report made by Pettersen (2009) studied the demography, living circumstances and employment among immigrants and Norwegian born with immigrant parents from 17 different countries

in 61 of Norway's municipalities. Unfortunately, the data sample for these variables had a great deal of missing data. With the number of observations being less than one fifth of the rest of the sample, and most of the observations being collected in the major city areas, we felt that these variables would be somewhat biased and distort the estimate results.

As an alternative variable for the distribution of employment we looked at the ratio of employment of people with residence in the municipality versus working in the municipality. If this ratio, $l_i$ is higher than it 1 indicates that more people live in the region than people working there. And as we predicted, there are especially many high values in the Oslo metropolitan area. (See appendix 5.) This instrument also relates to the commuting opportunities that will be discussed in the next segment.

*Infrastructure*

The final instrument that we would like to include in the two stage least squares approximation is a variable that incorporate the transport opportunities for commuters. The commuting possibilities will somewhat outweigh the density issue as one can live close to all the amenities available in the larger cities, and still live in more rural surroundings which are often less costly. Thus, transportation can contribute to changing the attitude towards population density. Also, Thissen and van Oort (2004), although in a much larger scheme, found that an increased level in the investment of infrastructure could lead to increased economic growth. We tried to find measures that could reveal the combined possibilities of public transportation as well as motorway access that leads to shorter commuting distance. We could not, however find such a measure. Instead, we looked at the possibility of using the variables for public investments on roads and public transportation or the net cost of maintaining them, but we found that the average kilometers of municipal roads with street lights per capita would be the closest fit to migration. This commuting variable will from now on be referred to as the instrumental variable, $c_i$.

### 5.4.4 Stage One

Now that we have arrived at a set of valid and exogenous instruments, we can estimate the reduced form equation which links the endogenous variable with the instruments using ordinary least squares (OLS):

$$Ln(M_i) = \pi_0 + \pi_1 * p_i + \pi_2 * w_i + \pi_3 * l_i + \pi_4 * c_i + \beta_1 * lnY_{i,t-1} + \beta_2 * o_i + \beta_3 * e_i + \beta_4 * t_i + v_i$$

Where $\pi_0$ is the intercept, $\pi_1$ to $\pi_4$ are the slopes of the instruments for migration, and $v_i$ is the error term for i = 1,…,N municipalities. However, with the TSLS approach we disregard the error term $v_i$ to remove the problematic component that is correlated with the error term $\upsilon_i$. It is also necessary to include the other exogenous variables from the original equation that were explained more closely in section 5.3.1. These determinants of economic growth (lagged income, structural oil variable, education, and technology) could also affect migration as the simultaneous causality concept involves economic growth to have an effect on migration. Especially regional income is likely to affect the habitation decision. But, the migrants will not be able to react immediately as takes time to quit their jobs, sell their homes, etc. before they are able to move to another country. Thus, it is pertinent to use the lagged income in this case as well.

Dependent variable: Logarithm of in-migration; 410 observations.

| Regressor | (1) |
|---|---|
| Logarithm og lagged income (X1) | 4.602** |
| | (0.674) |
| Employment in oil (X4) | -0.070 |
| | (0.058) |
| Higher education (X3) | 0.114* |
| | (0.055) |
| Broadband growth (X2) | -0.006** |
| | (0.002) |
| Average temperature (Z1) | 0.018 |
| | (0.019) |
| Neighboring population density (Z2) | -0.0002 |
| | (0.0006) |
| Employment (Z3) | -0.470** |
| | (0.129) |
| Average road (Z4) | 0.006** |
| | (0.001) |
| Intercept | -52.92** |
| | (8.22) |
| Summary statistics | |
| SER | 0.803 |
| Adjusted R2 | 0.642 |
| F-statistic | 92.49 |

Note: Standard errors are given in the parentheses under the coefficients. Individual coefficients are statistically significant at the *5% or **1% significance level.

*Table 6: First stage in the TSLS*

From table 6 we can interpret that the equation gives a decent approximation of the real logarithmic value of in-migration. It has an adjusted $R^2$ of 0.642, so 64.2 percent of the sample variance is explained by these variables. The lagged income, level of education, increment of broadband users, ratio of employees, and average municipality governed roads were all significant at the 1 percent level, indicating that they all are 99 percent likely to have a value other than zero.

When we only have a single endogenous regressor, like in our circumstance, we can compute the F-statistic that test of the hypothesis that all of the slope coefficients of the instruments in a regression are zero in the first-stage regression of the TSLS. The more information content that is caught by the instruments, the larger is the expected value of the F-statistic. A general rule of thumb is that one need not worry about weak instruments if the firs-stage F-statistic exceeds 10. In our first-stage regression, we obtained an F-statistic of 92.49, which indicates that the instruments are not weak.

We inserted the estimated values of the $\beta$-coefficients from the first-stage regression results and the substituted equation can be expressed as:

$$\widehat{Ln(M_i)} = -52.92 * -0.0002 * p_i + 0.018 * w_i - 0.470 * l_i + 0.006 * c_i + 4.602 * Y_{i,t-1} - 0.070 * o_i + 0.114 * e_i - 0.006 * t_i$$

Now we can compute the predicted values from this regression for the logarithm of in-migration that was explained by factors that cannot be influenced by the economic growth.

#### 5.4.5 Stage Two

To arrive at the TSLS estimators we regress the dependent variable income growth on the predicted values of the logarithm of in-migration that was found in the first stage. To control the suitability of this new predicted variable, we checked the correlation with the real value of the logarithm of in-migration. The value was foreseen to be fairly good with its high F-statistic, and the correlation met the initial expectations with a value of 0.98. However, when graphing a new scatter-plot of the estimated migration values, the non-linearity could no longer be seen. For that reason, we decided use the predicted migration ($e^{\widehat{\ln(M_i)}} = \widehat{M}_i$) rather than the predicted logarithm of migration.

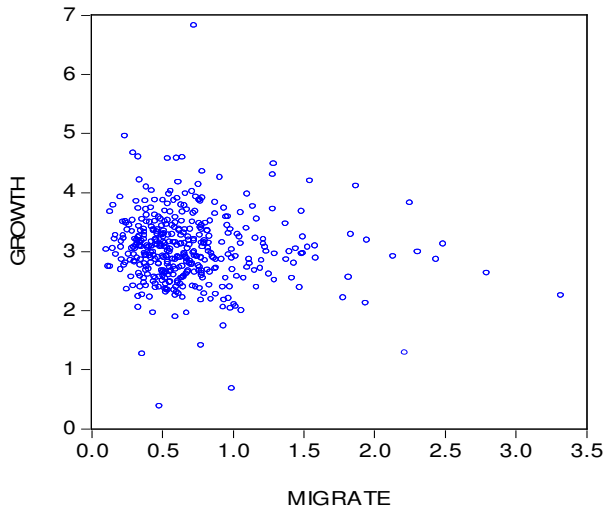


*Figure 26: Scatter-plot of the predicted immigration rate and growth*

We replace all the instruments for logarithm of migration with the new logarithm of migration calculation and get the following second-stage regression:

$$y_{i,t} = \beta_0 + \beta_1 * Y_{i,t-1} + \beta_2 * o_i + \beta_3 * e_i + \beta_4 * t_i + \beta_5 * \widehat{M_i} + u_i$$

Dependent variable: Growth; 410 observations.

| Regressor | (8) | (9) |
|---|---|---|
| Logarithm of lagged income (X1) | -2.438** | -2.477** |
| | (0.459) | (0.441) |
| Employment in oil (X4) | 0.404** | 0.415** |
| | (0.033) | (0.034) |
| Higher education (X3) | 0.055 | 0.058* |
| | (0.032) | (0.030) |
| Broadband growth (X2) | 0.002 | 0.002 |
| | (0.001) | (0.001) |
| Estimated in-migration (X5) | 3.01E-05 | |
| | (4.36E-05) | |
| Actual in-migration (X6) | | -8.72E-06 |
| | | (2.37E-05) |
| Intercept | 32.61** | 33.09** |
| | (5.60) | (5.38) |
| Summary statistics | | |
| SER | 0.511 | 0.504 |
| Adjusted R2 | 0.286 | 0.300 |

Note: Standard errors are given in the parentheses under the coefficients. Individual coefficients are statistically significant at the *5% or **1% significance level.

*Table 7: Stage two of the TSLS*

In table 7 regression (8) we recapitulate the findings from the second-stage regression. The table shows that the migration has a negative sign which implies that more migrants will lead to decrease in growth which complies with our preliminary assumption. Evidence show that most migrants tend to move to the larger city areas, thus a larger influx of migrants may suggest a decrease in the economic growth rate of the urban areas as the population increase reduces the output per worker. Hence, migration may induce the poor peripheral regions to catch up as the initial high average income of the urban areas attracts the migrants in the first place. But again, this depends on the type of immigrants. If the immigrants show high levels of human capital there may be less scope for convergence. Agglomeration theories that have less or no diminishing returns could be an explanation for why migration may not reduce the economic growth.

However, the coefficient shows little significance with a t-value of only -0.689. The inclusion of the migration variable also reduces the strength of the initial base regression from table 5. The new adjusted $R^2$ is now 0.286 and the estimated migration variable gives no extra explanatory power to determine economic growth. We therefore assume that migration itself cannot provide a significant explanation on the income growth in Norway as we cannot reject the null hypothesis at any significance level. Although the correlation between the new predicted in-migration and the actual in-migration turned out to be as high as 0.978, the poor results have led us to believe that the instruments for migration may be rather weak and could be an explanation for the similarities of the findings of the OLS and the TSLS.

For comparison we also regressed the equation replacing the predicted values for migration with the actual values of migration in regression (9). This did not improve the results from the second-stage regression and had a remarkably weak t-statistic of -0.368. Nevertheless, this is not a valid variable to include because of the simultaneity with the dependent variable. In both regressions we also find that none of the migration estimators are statistically significant even at the 10 percent level. Thus, we conclude that in-migration will be a poor determinant of income growth in the Norwegian regions according to neoclassical theory.

## 5.5 New economic geography

Other research on immigration (i.e. Breziz and Krugman (1993), Peeters (2008) and Morley (2005)) and the new economic geography theory suggest that the location of migrants may

be a result of economic growth, and not vice versa as we tested in the previous section. The cumulative causation effects describe in the theory section clearly state that the agglomeration and growth of firms induce labor mobility and thus migration. In the previous section we could observe that the instruments for migration may not have been optimal. However, restrictions on data for migration in the municipalities over a longer time period makes the task of constructing a regression that capture the movements in migration without being caught by the simultaneity bias too time consuming for the scope of our thesis. (As you may recall, the initial migration instruments proved to give poor results.) Thus, in this section we will focus on the incorporation of other variables related to the theory on new economic geography in order to find causation on economic growth.

### 5.5.1 The Independent Variables

Also when it comes to new economic theory variables, we found the low access to data constraining. A lot of the research available has only been conducted at the country, province or county level. And if the data on municipal level is found in the statistics bank of Statistics Norway, it is often only for one period or too recent periods compared to our sample between 2001 and 2007. Yet, we do believe that current statistics and the NEG theory will have a consequence in the location of firms, and consequently natives and immigrants alike.

*Agglomeration effects*

It is not very easy to measure the extent of agglomeration effects as a lot of the benefits are gathered through local tacit knowledge spillovers. We could not find many variables on this subject on municipality level; however, we used the presence of a tertiary education institution as a proxy as it represents an accumulation of knowledge in that area. We found that the presence or absence of a university or college did not have a significant impact on the economic growth.

*Firm attractiveness*

One vital aspect of the new economic geography is the clustering of firms due to the agglomeration effects mentioned in the theory section. We therefore looked into government contributions to innovation and the business environment and the growth in the number of firms to capture the attractiveness of firms to establish in certain regions. However, we did not find that the government subsidies to firms attributed to the income growth. One reason for this lack of influence may be the considerable difference in the municipalities' accounts from year to year. There was no pattern in the level of subsidies and the use of an average

term did not improve the quality of the variable any further. The growth in the number of firms, on the other hand, showed a correlation of 0.249 which we found significant enough to include the variable for growth in firms, $f_i$ into the regression.

*Climate*

Similarly to the deliberation of the importance of amenities in the section on migration, we uncovered that the level of other amenities that are found attractive in considerations on location, and thus include a weather variable, $w_i$. We used the same data from *e-Klima* as we used in section 4.4. However, for the economic growth, we found that the annual rainfall was a better fit with a higher correlation of 0.351.

### 5.5.2 The Regression Results

The regression results are described in regression (10) in table 8. For comparison we included regression (4) from the discussion on the neoclassical model.

Dependent variable: Growth; 410 observations.

| Regressor | (4) | (10) | (11) |
|---|---|---|---|
| Logarithm of lagged income (X1) | -2.475** | -3.446** | -3.525** |
| | (0.439) | (0.429) | (0.447) |
| Employment in oil (X2) | 0.415** | 0.337** | 0.357** |
| | (0.034) | (0.039) | (0.034) |
| Higher education (X3) | 0.057* | 0.059* | 0.052 |
| | (0.028) | (0.027) | (0.028) |
| Broadband growth (X4) | 0.002 | | |
| | (0.001) | | |
| Growth in number of firms (X6) | | 0.087** | 0.085** |
| | | (0.023) | (0.024) |
| Annual precipitation in mm (X7) | | 0.0001** | |
| | | (4.76E-05) | |
| Average temperature (X8) | | | 0.032* |
| | | | (0.013) |
| Intercept | 33.06** | 44.84** | 45.82** |
| | (5.36) | (5.22) | (5.42) |
| Summary statistics | | | |
| SER | 0.503 | 0.486 | 0.489 |
| Adjusted R2 | 0.301 | 0.346 | 0.339 |

Note: Standard errors are given in the parentheses under the coefficients. Individual coefficients are statistically significant at the *5% or **1% significance level.

*Table 8: Neoclassical model versus the new economic geography*

In regression (10) we tried to incorporate the effect of the presence of agglomeration effects and other amenities that could increase productivity and economic growth, and consequently in-migration according to Dolado et al. (1994) among others. The results plainly indicate that there is a causality running from the growth in number of firms and the annual precipitation to economic growth. They both showed statistical significance at the 1 percent significance level which signify that both variables are highly likely to have an influence on the income growth. The growth in the number of firms showed a positive sign in accordance to the new economic growth. The annual amount of rain, however, also indicates more income growth which goes against our intuition as more rain would (for the most part) lower the propensity to locate in a certain area. We believe that this unrealistic result stems from the association of heavy rainfall on the West Coast and the location of most of Norway's oil municipalities, which also happen to be in the Western part of Norway. The adjusted $R^2$ of 0.346 is the highest of all our regressions. Even though it is still insufficiently low to predict the future growth rates, it suggests that the new economic geography can contribute to the elucidation of the economic growth.

In the final regression (11) we accounted for the questionable precipitation variable that may be more coincidental to the natural resource endowments of oil and gas than an actual cause of localization and also the economic growth. We added the average temperature measure and found that the temperature does have a positive effect on growth. The vast amount of the inhabitants of Norway live in the Southern regions and accordingly, most of the production is observed here. However, the temperature variable is only significant at the 5 percent level and the regression's goodness of fit is slightly reduced to 0.339. We also found that the higher education variable now was statistically significant at no more than the 10 percent level.

Nevertheless, we found that each of the regressions (10) and (11) that include variables that is explained by NEG theory surpass the best fitting regression (4) which is rooted in neoclassical growth models. Thus, we can conclude that the NEG theory can function as a supplementary explanation on economic growth where neoclassical growth alone is insufficient. However, we do recognize that the values for the adjusted $R^2$ are low and that the research could be interesting to analyze in view of panel data over a longer time period. Omitted variables, such as better fitting variables for growth in technology and agglomeration effects may also contribute to enhanced robustness of the regressions. Finally, better instruments on the in-migration to Norway may show that there is some relevance

between migration and growth; alternatively one could employ more complex econometric models to circumvent the simultaneous causality.

## 5.6 Discussion and Conclusion of our Empirical Analysis.

There is evidence that poorer regions do grow faster than richer regions in Norway according to neoclassical growth theory with a negative sign of initial income to the growth rate. Although, the seven year period from 2001-2007 may be too short of a time span to see the real extent of the speed of convergence. The low adjusted $R^2$ of only 0.301 suggest that the lagged initial income in combination with a structural variable, education and technology advances only correspond to 30.1 percent of the explanation for the economic growth in the Norwegian municipalities. Barro and Sala-i-Martin ran a similar regression over a time horizon from 1930-1987 in Japan, and found that initial income gives a remarkably high explanation for the economic growth.

However, Barro and Sala-i-Martin assume a closed economy, while we have looked at an open economy. Authors, such as Breziz and Krugman (1993), find that migration will lead to a rise in real wages also in an open economy, thus causing a cycle of migration spurring growth and growth spurring migration. We tried to disentangle the two variables by using the two least squares approach in our multiple regression analysis. In order to examine the effect of migration we used the average temperatures, neighboring population densities, a measure of employment and the average road distance as instrumental variables to circumvent the simultaneous causality bias. These variables were proven to portray a reasonable fit for the real values of in-migration to Norway. When including migration in the second stage of the TSLS analysis, however, we found that in-migration does not show statistical significance on any of the significance levels and consequently we cannot reject the null hypothesis that in-migration has no influence on the economic growth. Also, the inclusion of migration did not improve the adjusted $R^2$, instead, it reduced the explanatory power of the regression. The real values of in-migration, on the other hand, showed the approximate goodness of fit as the original OLS regression that excludes migration as an explanatory variable. Yet, an adjusted $R^2$ of only 0.286 and 0.300 respectively, is insufficient to be deemed satisfactory at the same time as the variables had little statistical significance.

We therefore conclude that in-migration is a poor determinant for neoclassical income growth. Our results are in accordance to the research of Morley (2005) that suggests little or

no causality stemming from migration to economic growth. However, our empirical findings cannot confirm or reject the opposite hypothesis that in-migration is affected by the initial level of economic growth. Up till now, most data on immigration and settlement habits find that immigrants tend to flock together in the urban areas where the economic prospects are presumed to be superior. This fact led us to believe that the new economic geography could assign further rationalization on the pattern of economic growth.

The NEG theory looks at agglomeration forces and the value of human capital and increased personal interaction as a source of regional clustering. By including variables that account for these agglomeration effects, i.e. growth in the number of firms and a climate variable we found that these variables were statistically significant and that the adjusted $R^2$ was increased to 0.346.

The neoclassical growth model predicts that higher capital levels per capita will reduce the income growth and lead to regional convergence. The regression results supports this theory, however, the speed of convergence is different between the regions. On the other hand, NEG theory does not portray any qualities of diminishing returns to agglomeration forces, and the regression on economic growth was strengthened when including factors that could explain the auxiliary growth in the already rich municipalities. We therefore conclude that our sets of regressions cannot sufficiently prove the superiority of either theory, but that they may complement each other when it comes to explaining the economic growth.

When it comes to migration, the Solow-Swan model illustrates how an increase in the population growth through migration will lead to a lower steady state level with less capital and output per capita. Dolado et al. (1994) confirm this notion, but add the fact that there is a vast difference in the human capital levels of immigrants and newborns that cause the natural population growth. The inconclusiveness of our empirical findings may be a result of this ambiguousness in the human capital levels of immigrants. Borjas (1994) elaborates on how the immigration surplus is dependent on a reduction of the domestic wage level and that the surplus is maximized when immigrant flows are composed of exclusively skilled or unskilled workers. In Norway, we have a highly differentiated mix of skilled workers and unskilled workers. As a result, the composition of the immigrants will be of importance when one decides upon immigration policies to spur economic growth and promote spatial convergence.

# 6. Discussion on Migration Policies

There are many factors that have contributed to the high level of productivity in Norway. Norway has from early on practiced openness to trade, except for its heavily subsidized agricultural sector. For instance, Norway was among the first nations to reduce its own textile production to trade with China and other Asian countries. This openness has led Norway to channel its resources into companies and industries where mainland Norway has its comparative advantages and where the international prices have gone up.

Beneficial macroeconomic policies and economic stability has improved Norway's position as a choice of investment in addition to the numerous investment opportunities created by the oil and gas industry. The investments in the Norwegian industries have improved the demand for workers, and consequently resulted in low unemployment rates.

The productivity can further be explained by technological advances. According to the 2008-2009 global competitiveness report, Norway ranks as number 13 out of 134 countries on environment for innovation. A large amount of investment in specific human capital has improved Norway's competitiveness, especially in the areas of telecommunications, maritime technologies, hydro power and energy related technologies.

Additionally, Norway ranks 2$^{nd}$ out of 108 countries in the gender empowerment measure, reflecting a high degree of equality, (Statistics Norway, 2008). Many view this as a comparative advantage as more of the eligible work force is contributing to a higher production.

However, immigration has not been highly recognized as a contributor to the productivity growth in the Norwegian media. We believe that one reason for the disregard of immigration as a source of the high productivity level is too much focus on the idealistic policy model, where the immigrants consists of mainly refugees and reunified families. In the midst of the debates on poor routines for accepting asylum seekers, underprivileged integration into Norwegian society, and the assemblage of criminals among these new countrymen, one can easily forget that a much larger group of immigrants contributes purely positively to the Norwegian economy.

In this section we will provide a discussion of the importance of in-migration to Norway and the policies we think should be adopted in order to gain most of the immigrant force.

## 6.1 What Immigration Policies Do We Recommend?

The influence of immigration on productivity performance is largely dependent on the characteristics of the migrants. Migrants may add to productivity growth through contribution to innovation or increased knowledge spillovers. Additionally, a quantity of high skilled migrants may be more productive than the natives, or their skills may contribute or exert as complementarities to scarce skills of the natives. While low skilled migrants may add more value to industries that conventionally are considered less fruitful. According to Statistics Norway, Norway's immigrant population consists of people from 214 different countries with a wide range of reasons for their decisions to migrate. Thus, there is no key to confirm what type of workers is more beneficial to a nation's economy.

Furthermore, the issue of immigration policies is complex and it is hard to predict the outcome of any specific policies as many country studies have proven policy effects to be inconsistent, (i.e. Iredale et al. (2002), Hammar (1985), and Kangasniemi et al. (2008)). These papers consider country-specific characteristics, such as the nations' public opinions, as fundamental motives for the success or failure of migration policies, rather than the findings of academic research.

### 6.1.1 Presence of Migration versus the Absence of Migration

The traditional theory on migration implies that migration is solely a positive matter. Borjas (1994) explicitly point out that migration is beneficial for the economy. The immigration surplus is especially large when the migrants portray entirely different skill levels than the native workers. In Norway, we receive migrants with a wide range of skill levels, and these all contribute to the perceived immigration surplus.

There is no doubt that we wish to recommend the continuation of migration. However, we believe that a political laissez-faire model is not optimal. In order to achieve the most of today's state of migration the policies of the government will play an important role. Today the main goal of Norwegian immigration policy is to ensure that workers entering the Norwegian labor market, as a result of increased demand for labor, should be able to enter their work as quickly as possible. In addition there should be provided for intercultural exchange and interactions contributing to exchange of knowledge. Also, there is a binding framework to secure that immigrants, residing on the basis on family reunification, have a

good opportunity to take part, and contribute to the society, (Ministry of Social Inclusion, 2009).

In addition to the more theoretical economic benefits from migration, there are arguments for why a country`s immigration policies should be more restrictive and hence reduce the level of migration. This has to do with the effects on the welfare state.

Norway`s social security system is financed through progressive taxation, and hence aim to redistribute wealth from higher income earners to low income earners. A well known argument for a more restrictive migration policy is the pressure from globalization on such a system. Globalization is a rather wide term, but within this context it points to the free movement of capital and labor.

"A higher degree of international factor mobility thus implies that redistribution diminishes the tax base, while increasing the pressure on public expenditure," (Sandmo, 2002:2) so when labor can move freely, the immigrants would choose to reside in a state with high welfare contributions. This implies that the people who earn high wages (and most likely not dependent on social contributions) find it more beneficial to move to a country with lower taxes, while, one the other hand, the people who would be in need of a good welfare system (and hence most likely to be in the lower scale of the income distribution) would choose to immigrate. This would diminish the tax base.

If this is the case, then government intervention is highly necessary and especially with a view to the ageing Norwegian labor force. As mentioned in section 4.1.5 in this thesis, there will be more people exciting than entering the labor market within the next ten to fifteen years. This will also affect the tax base in a negative way. Since Norway`s pensions are financed through a "pay- as- you go" (PAYGO) system, meaning that the taxes levied on the current working population is distributed directly over the state budget to the pensioners. "With PAYGO finance, other things being equal, an increase in the ratio of pensioners to workers require a larger tax on each worker to finance a given real pension" Barr (1992:769)

It becomes evident that the labor market, especially in the long run, is in need of more people contributing to the welfare system. Even if this means that a majority of the entering workforce contributes in the lower scale of the income distribution, they are indeed needed to ensure, preferably, a higher ratio of workers to pensioners. Migration of unskilled labor may be resisted by the native population because, being relatively low earners, migrants are

net beneficiaries of the fiscal system of a welfare state. The findings of Razin and Sadka (1999) however, show that the reception of low skilled labor migrants may be improved with a pay-as-you-go pension as the migrants provide a net contribution to the increasing pension payments.

The role of the government must be to ensure a stable tax base. It can affect the levels of migration, in addition to secure the "quality" of the labor force by introducing policies of education and further integration into the Norwegian labor market. These polices will be determinant for the further productivity growth, and functioning of the Norwegian welfare state. Below we will give advice on different migration policies we believe is necessary for Norway to either change or further develop.

### 6.1.2 Selective Immigration Policy

For small and open economies like Norway, it is reasonable to assume that a lot of the productivity growth is driven by technological progress in other countries. Several empirical studies have demonstrated that import in these small countries will be important in order to attain knowledge spillovers, (Coe & Helpman, 1995). Thus, "import" of specialists and qualified workers, in addition to the nation's own R&D efforts will be imperative to exploit the accumulated knowledge that exists beyond the borders. Additionally, it has been shed light on the importance of export and domestic firms' focus on foreign markets a determinant for increased absorption of foreign knowledge, (Statistics Norway, 2008).

As previously mentioned in section 4, the skilled migration to Norway is increasing, yet Norway is far from filling up the objective of 5,000 skilled workers per year. However, when accounting for the fact that the industrial structure has changed significantly over the past years, one can to a small extent defend this small influx of high skill workers. We mentioned earlier how the oil sector represents 27 percent of Norway's GDP. In this specific field of subsea oil technology, Norway holds the title to some of the World's leading expertise, and the necessity for foreign skilled workers is not as high as it might have been in other sectors. An additional aspect of the change in the structural composition is the increase of workers in the tertiary industry. Most of the jobs in the service industry do not require high skilled workers. However, we do see a significant increase in the use of outsourcing as a measure to make their core business more efficient. And the need for qualified foreign workers may increase in line with the need for knowledge outsourcing, such as financial consultants and IT services.

In spite of this attempt to justify the low numbers of skilled foreign workers, we believe that accumulating high levels of human capital is essential for continuing the productivity growth in Norway. This is of special importance in the public sector where the TFP growth has virtually been at a standstill the past 40 years.

The Norwegian government could therefore support firm efforts to recruit competent personnel from abroad if there are insufficient skills domestically. The government could also, directly or indirectly, subsidize foreign specialists, through for instance a marginal income tax relief, as the surplus for an individual worker with long education may be lower in Norway due to a tax-system that is unfavorable to the higher-income end.

The public sector could employ a higher degree of foreign skilled workers. There have been made several feeble attempts by the government to increase its own share of immigrant workers, but there has not been a great deal of focus on high skilled migrants. Alternatively, the government could indirectly increase the immigration of skilled workers by reducing public ownership. Public ownership in Norway is high with the state owning around 50 percent of all industries. Norway only scores 50.5 percent on government size in the 2009 Index of Economic Freedom, while the average is 65 percent, (The Heritage Foundation, 2009). Although many of these state-owned companies are profitable, a high degree of public ownership can be detrimental to competition, foreign direct investment, innovation and growth. In fact, public ownership has increased in the past years, (OECD, 2009a).

Rather than sustaining this high scope of government involvement, Norway should adopt policies that encourage privatization to attract more investment and improve the ease of doing business in the country and consequently attract a larger share of skilled migrants.

These are examples of initiatives that could induce higher human capital gains and subsequently higher productivity. However, it is important to keep in mind the prerequisite to quality assure these workers by for instance presenting courses and tests, in order for the qualified workers competencies to be acknowledged no matter the origin of the education.

#### 6.1.3 Improved Integration Programs

Even though we propose to increase the attention to skilled migration, we recognize that this segment will constitute only a small fraction of the total immigration to Norway. Asylum seekers and family immigration make out a large group of immigrants that have a lot more significance to the Norwegian economy because of the sheer scope. With its high living

standards, high wages and a generous welfare state, Norway is a highly desired destination for this type of migrants.

Statistics Norway recently completed a survey on the attitudes towards immigrants. It revealed an increase in the aversion towards asylum seekers of 11 percent from 2008 to 2009. This is largely explained by the rising development in the number of asylum seekers and the negative attention in the media, but also the profound lack of integration in the Norwegian society. For instance, only 35.7 percent of the active working population of Somalis in Norway were employed at the beginning of 2009 according to Statistics Norway.

The municipalities receive a large amount of funding to implement introduction programs for foreigners. However, preceding documentation (The Directorate of Integration and Diversity, 2009) reveals that the quality of the integration programs, and especially language training programs, have been poor. This terrible introduction to the Norwegian labor market makes these mostly low skilled workers a prime object for social benefit schemes provided by the government. Compared to other OECD countries, where the employment rate for low skilled foreign workers is approximately the same as for low skilled native workers, Norway's employment rate for low skilled foreign workers is exceptionally low. The main reasons for this poor level of employment are a limited number of unskilled jobs and a low functional level when it comes to Norwegian reading and writing skills compared to low skilled natives.

Total government expenditures of maintaining an expensive welfare system are high. In the most recent year, government spending (including public ownership) equaled 40.6 percent of GDP, (The Heritage Foundation, 2009). Although, the conservative welfare system in Norway ensures high quality of life also for those who are less fortunate (where approximately two out of ten social benefit receivers are immigrants), "labor utilization is held back by extensive use of [unemployment compensation,] sick leave and disability schemes, often leading directly to early retirement," (OECD, 2009a:96). According to Statistics Norway, approximately 5 percent of the population receives social benefits. 19 percent of these receivers were immigrants, of which 25 percent were non-Western immigrants. Concerning long term beneficiaries they find that 40 percent have immigration backgrounds.

The welfare system and the employment services has merged their activities under one organization which may increase the efficiency of administrative work and get employers back into the labor market faster. However, they need to further tighten access to social benefits in order to reduce exploitation of such a favorable welfare system. Moreover, they should create incentives that encourage employment rather than accepting welfare money, and help reallocating partially disabled to work in other sectors where they can perform in spite of their disabilities. In order to accomplish this for the whole large group of immigrants, as well as the rest of the population, it would obligate the public institutions to improve the language training of foreigners, introduce Norwegian culture and provide education where needed.

With an increasing fraction of academics in Norway, the country is dependent on help from foreign workers to keep a well-functioning labor market without soaring wages or reduction in human capital efforts.

#### 6.1.4 Labor Migration

In addition to the two previous groups of migrants, Norway receives a large amount of labor migrants from the other Nordic countries and the rest of Europe. Since the EEA enlargement, Norway has especially experienced a steady growth in the entry of labor migrants from the Eastern European countries, thus the amount of labor migrants has surpassed the number of family migrants.

The majority of these workers are low skilled workers where the largest group of origin is Poland. In a report presented by the Directorate of Integration and Diversity from 2008 on the labor migration from Poland and the Baltics, the Directorate discovered that also in this group of immigrants, the language barrier is one of the main obstacles in regards to attaining necessary information, establish social networks and to exploit their skills fully. Thus, the requirement for the government to expand the access to language training would improve the quality of integration.

Additionally, not all of these labor migrants have easy access to the necessary information on rights, duties and legal statutes of Norway. A large amount of foreign workers, and especially Eastern Europeans in the construction industry, reside under poor living and working conditions, not receiving the social insurance they are entitled to. On the other hand, a lot of these workers are paid in the black market where one cannot claim these insurances.

The large share of workers in the black markets can to a small extent be contributed to the lack of information, but most of the time, it is because of too low incentives for both employers and employees to abide by the rules.

Quite a substantial part of these migrants are planning on staying in Norway long term, and the opportunities to own or rent housing with possibility for family reunification will be important. Also, the social aspect of integration in the community, sport organizations etc., will be of special importance of this group of permanent residents.

Finally, for this group as well as the refugees, it will be important to utilize the competence and skills of the whole family of labor migrants, and not only the father which is mostly the case of today's labor immigration. A greater focus on the employment of female immigrants could contribute positively to the productivity further.

The survey that Statistics Norway conducted on natives' attitudes toward immigrants revealed that seven out of ten in the native population value these labor immigrants as a benefit to the society. It will therefore be important to implement policies that will improve the language skills and access to information for these valued immigrants and facilitate improved living and working standards.

#### 6.1.5 Regional Migration Policies

The Weber location-production model states that there are two main aspects that drive the firms' decisions of locations with respect to distance and transaction costs i.e. transport costs: (i) the location of the inputs, and (ii) the output market. As transaction costs have been reduced dramatically with faster and cheaper transport and better communication systems, we have seen a shift in location of production to clusters where each firm can benefit from agglomeration effects, such as knowledge spillovers and a local skilled labor pool. Especially with the growth in the service sector, we experience a growth of knowledge-hubs in the cities. For instance, all major cities have a financial center where the firms recognize the importance of local tacit knowledge spillovers and promptness.

The clustering of Norwegian cities has also been evident, in part due to a large share of immigrant influx to the city areas. The Norwegian Government, however, wish to maintain the spatial diversity and promote growth in the rural areas and gives large amounts in agricultural subsidies and other tax relieves to certain occupations and firms in the peripheral areas of Norway. Their main objectives for the rural and regional policies are "that all people

are free to choose their place of residence; to ensure equal living conditions and to utilize all resources throughout the country; to maintain settlement patterns in order to sustain and further develop the diversity of history, culture and the resources therein; [and] to ensure that an active and target-oriented rural and regional policy helps generate added value, employment and welfare throughout the country," (Ministry of Local Government and Regional Development, 2009).

A majority of the immigrants tend to move to city regions. However, a study by Pettersen (2008) shows that the more central municipalities[11] do not have higher employment among immigrants than in more rural areas, rather it shows that the unemployment rate is highest in the cities. 66 percent of immigrants are employed in the least central municipalities opposed to 59.6 percent in the most central regions. This trend is limited to apply to the immigrant population as the trend is opposite for the native population. Despite the obvious advantages of settling in a larger city where the social network of immigrants with same backgrounds are available as well as the possibility to establish exotic restaurants and other culturally relevant businesses, the employment is interestingly enough lower in municipalities where the number and share of immigrants are relatively high. For instance in Oslo, where 25 percent of the population are foreigners (Statistics Norway, 2009) the employment rate is only 58 percent.

The unintuitive figures may have causation to the possibility that immigrants get closer follow-up and a better acquaintance of the local community and labor market in smaller regions. In addition, the composition of migrants and their educational level may differ considerably between municipalities. For instance, the employment rates among Polish workers tend to be relatively high and many of these workers to get jobs in more rural areas than many other immigrant groups, Pettersen (2008).

Moreover, we believe again that the language barrier is a key reason for the success of workers in more rural areas. One can imagine that these workers would have to learn Norwegian more rapidly than immigrants of urban areas as there are less people to communicate their mother tongue with.

[11] The term of centrality refers to the proximity of the municipalities to a major city area (category 3), a town of more than 15,000 inhabitants (category 2) the less central municipalities with closeness to villages of minimum 5,000 people (category 1) and the least central regions (category 0).

Despite the government's efforts to relocate some of their own institutions to more rural areas, the presented numbers in this section and figure 21 on moving patterns within Norway from section 4, clearly illustrate that the regional policies have failed in Norway. We believe that the incentives of living in the rural areas must be further increased for citizens to remain or move out to rural areas. It can be harder to find relevant jobs in rural areas, and especially if you are in a relationship where there are two people who have to find fulfilling jobs in a restricted labor market. In addition one may have to give up certain cultural offers and other possibilities that the diversity of the cities offer. Moreover, the subsidies and tax cuts must be monitored better and loopholes must be removed so the incentives work more efficiently if the maintenance of regional diversity is in focus.

However, the citizens of Norway and the different political parties of Norway are split in their opinions on the importance of maintaining a regional settlement. Economically speaking when it comes to regional policies, the most efficient solution would be to let the market work on its own. The government support of regional settlement keeps resources in low-productivity activities rather than in more efficient sectors. The agricultural subsidies in Norway remain among the highest in the OECD, (OECD, 2009). The government should rather cut tariffs, both explicit and implicit, and reduce production-linked subsidies. Yet, such a lenient policy would most likely result in a detriment for the advocates of spatial diversity. On the other hand, these regional advocates would now be forced to find other solutions such as creating more tourism and other measures to sustain their livelihoods.

# 7. Conclusion

In this thesis we have tried to give an answer to (i) how do in-migrants with different skill diversities contribute to the economic growth and spatial distribution in Norway, and (ii) which migration policies should be applied for the enhancement of further productivity growth.

*(i) How do in-migrants with different skill diversities contribute to the economic growth and spatial distribution in Norway?*

We have presented relevant theory on both neoclassical growth, new economic geography and the impact of migration on economic growth.

Looking at evidence from several other papers on the subjects of the effects of the EEA enlargement, migration and neoclassical growth as well as new economic geography, we found that there was little consensus in the results. Wages can become lower or higher depending on the skill level on migrants and whether the outlook is short term or long term. The authors find that neoclassical growth model correctly associates the initial income level with the growth rate, holding everything else constant. However, the speed of convergence differs substantially depending on which countries and what level of regions one investigates. The empirical evidence offers mixed support for the implications of migration on the neoclassical model while empirical data on the new economic geography seem to be more consistent in its findings on the positive influence of agglomeration on economic growth. However, some authors mention how the economic growth influences the choice of migrants' settlement decision rather than vice versa.

We ran several regression sets in order to find empirical conformity to the theories. There is evidence that poorer regions do growth faster than richer regions in Norway according to neoclassical growth theory, however, the income alone accounted only for 5.7 percent of the explanation. Including educational level, a structural oil variable and the technology progress we still had included only 30.1 percent of the explanatory variables.

With respect to the influence of migration, we used the average temperatures, neighboring population densities, a measure of employment and the average road distance as instrumental variables in TSLS approach to circumvent the simultaneous causality bias. However, we found that in-migration does not show statistical significance on any of the significance

levels and we cannot with confidence rule out that migration has a positive or even no effect on growth. Therefore, we conclude that in-migration is a poor determinant for neoclassical income growth.

The NEG theory looks at agglomeration forces and the value of human capital and increased personal interaction as a source of regional clustering. In a final regression set we included growth in the number of firms and a climate variable to account for agglomeration effects. We found these variables to be statistically significant and an increase in the regressions' goodness of fit to 34.6 percent.

We found both theories to contribute to explain the pattern of economic growth, however, our regressions cannot sufficiently prove the superiority of either theory, and that they rather work as complementarities to each other.

*(ii) Which migration policies should be applied for the enhancement of further productivity growth?*

In regards to migration policies we find that a laissez-faire policy will not be optimal as Norway would receive all sorts of immigrants that would struggle with the adaptation to the language as well as the culture. Especially with the generosity of the welfare state, a free flow of immigrants could unravel the whole system. For the most part there are three groups of immigrant that move to Norway: 1) refugees 2) families and 3) labor migrants, in which we can differ between skilled and unskilled migrants.

Refugees and family reunification is in accordance to the idealistic model where a focus on the needs of the immigrants is maintained. This group can be important to Norway if they are properly integrated into the work force. However, in at present time there are an overwhelming amount of these immigrants that do not contribute to the high productivity levels of Norway.

The low skilled immigrants have been a positive contribution to the Norwegian economy over the past years, but also this group is in need of better information so as to reduce the extent of the black markets in certain industries. There will be an issue nonetheless in regards to the future inflow of this type of migrants in a downturn economy that we are currently seeing.

We encourage further dedication towards the recruitment of skilled immigrants to Norway. This group can contribute to the innovation and research and development of the nation and are considered purely supportive of the productivity in Norway.

## 7.1 Limitations

The empirical analysis has been somewhat restricted due to the lack of data material on the municipal level as well as the time horizon we have looked into. Therefore our results did not have as much explanatory power as we would have liked and migration showed no statistical significance towards the economic growth. We believe however, that a decomposition of the immigrants into groups of originating countries or the immigrants' skill levels would give a better description of migration's influence on growth. As high skilled and low skilled workers are likely to show opposite transfers to growth, such decomposition could effectively distinguish the type of immigrant's effect on growth. But again, we run into the problem of defining skills as education in one country may differ from the equivalent education in another country.

## 7.2 Further research

The limitations invite for further research as it would be interesting to look at the different skill levels of immigrants on economic growth.

Additionally, the current financial crisis that started in 2007, has led to the dismissal of 870 Eastern Euopeans in Norway that currently have to receive unemployment benefits from NAV, (Human Rights Service, 2009). The number has probably increased since these numbers were published in the beginning of 2009. The unemployment benefits in Norway correspond to often more than full pay in their home countries. In addition some workers are entitled to child benefits and other social benefits. Nevertheless, several labor migrants have already returned to their home countries as their access to unemployment benefits are limited. It would be interesting to see how an aggravation of the financial crisis could affect labor migration and the already settled labor migrants after years of economic prosperity in which these Eastern Europeans have contributed as one central building block for achieving such a high production.

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# Appendices

### Appendix 1 – List of Independent Variables in the Regressions Models

In addition to the list we used polynomial and logarithmic values on a selection of variables.

| Variable | Measure | Abbreviation Eviews 6.0 |
|---|---|---|
| In-migration | Number of persons | In |
| Out-migration | Number of persons | Out |
| Net migration | Number of persons | Net |
| Number of immigrant inhabitants | Number of persons | Immigrants |
| Percentage of immigrants | Percentage | Prin |
| Annual growth in the number of immigrants | Percentage | Grin |
| Average temperature | Celcius | At |
| Minimum temperature | Celcius | Mint |
| Maximum temperature | Celcius | Maxt |
| Annual precipitation | Millimeters | Rain |
| Annual snow depth | Centimeters | Snow |
| Difference in average temperature and extreme temperature | Celcius | Temp |
| Neighboring population | Number of persons | Npop |
| Unemployment rate | Percentage | Unem |
| Income | Kroners per capita | Inc |
| Lagged income | Kroners per capita | Laginc |
| Neighboring lagged income | Kroners per capita | Nlaginc |
| Net government transport costs | Kroners per capita | Transc |
| Gross government transport investment | Kroners per capita | Transinv |
| Persons with both short and long tertiary education | Percentage | Edu |
| Persons with long tertiary education | Percentage | Longedu |
| Persons with any education | Percentage | Predu |
| Growth in long tertiary education | Percentage | Grlongedu |
| Neighboring persons with long tertiary education | Percentage | Nlongedu |
| Income growth | Percentage | Growth |

| | | |
|---|---|---|
| Predicted in-migration | Number of persons | Newmig |
| Growth in Broadband Access | Percentage | Grint |
| Structural oil variable | Percentage | Proil |
| Neighboring structural oil variable | Percentage | Nproil |
| Municipalities with large oil sector | Dummy | Oil |
| Government subsidies to firm innovation | Kroners per capita | Bin |
| Average roads lit by government funding | Kilometers per capita | Avroad |
| Neighboring average roads | Kilometers per capita | Navroad |
| Employment living versus working in the municipality | Percentage | Sysbo |
| Total employment | Percentage | Sys |
| Immigrant employment | Percentage | Sysi |
| European immigrant employment | Percentage | Syseu |
| Other immigrant employment | Percentage | Sysa |
| Share of immigrants employed to total population | Percentage | Prsin |
| Neighboring employment rate | Percentage | Nempl |
| Average energy spending | Kilowatts per capita | Aven |
| Growth energy spending | Percentage | Gren |
| Growth in firm establishment | Percentage | Grfirms |
| Presence of University or College | Dummy | Uni |
| Presence of the 25 major cities | Dummy | Mc |

## Appendix 2 – Correlations of the Independent Variables and the Instruments

| | GROWTH | AT | AVEN | AVROAD | AVTAX | BIN | EDU | GRFIRMS | GRIN | GRINT | GRLONGEDU | IN | IMMIGRANTS | LAGINC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GROWTH | 1,000 | | | | | | | | | | | | | |
| AT | 0,351 | 1,000 | | | | | | | | | | | | |
| AVEN | 0,126 | -0,035 | 1,000 | | | | | | | | | | | |
| AVROAD | 0,068 | 0,206 | 0,037 | 1,000 | | | | | | | | | | |
| AVTAX | -0,196 | -0,082 | -0,149 | 0,189 | 1,000 | | | | | | | | | |
| BIN | 0,073 | 0,280 | 0,082 | 0,105 | -0,206 | 1,000 | | | | | | | | |
| EDU | -0,102 | 0,089 | -0,173 | 0,507 | 0,531 | -0,057 | 1,000 | | | | | | | |
| GRFIRMS | 0,249 | 0,391 | -0,103 | 0,122 | 0,335 | -0,035 | 0,197 | 1,000 | | | | | | |
| GRIN | 0,200 | 0,244 | 0,046 | 0,008 | 0,109 | 0,024 | -0,056 | 0,426 | 1,000 | | | | | |
| GRINT | 0,096 | -0,212 | 0,133 | -0,378 | -0,619 | -0,056 | -0,481 | -0,263 | -0,145 | 1,000 | | | | |
| GRLONGEDU | 0,345 | 0,167 | -0,033 | -0,019 | -0,001 | 0,015 | -0,022 | 0,340 | 0,046 | -0,026 | 1,000 | | | |
| IN | -0,002 | 0,095 | -0,064 | 0,810 | 0,215 | 0,017 | 0,441 | 0,106 | -0,019 | -0,234 | 0,013 | 1,000 | | |
| IMMIGRANTS | -0,033 | 0,075 | -0,063 | 0,776 | 0,200 | 0,005 | 0,406 | 0,091 | -0,030 | -0,219 | 0,006 | 0,994 | 1,000 | |
| LAGINC | -0,215 | 0,086 | -0,176 | 0,285 | 0,848 | -0,154 | 0,672 | 0,391 | 0,036 | -0,606 | 0,018 | 0,291 | 0,268 | 1,000 |
| MAXT | -0,326 | -0,069 | -0,133 | 0,173 | 0,284 | 0,064 | 0,131 | 0,038 | 0,194 | -0,314 | 0,036 | 0,107 | 0,111 | 0,199 |
| MC | 0,010 | 0,129 | -0,042 | 0,550 | -0,079 | 0,100 | 0,340 | 0,030 | 0,029 | -0,342 | -0,008 | 0,314 | 0,301 | -0,007 |
| MINT | 0,514 | 0,866 | 0,101 | 0,137 | -0,204 | 0,319 | 0,042 | 0,346 | 0,152 | -0,023 | 0,196 | 0,061 | 0,037 | -0,019 |
| NAVROAD | -0,159 | -0,125 | 0,042 | -0,062 | 0,055 | 0,051 | -0,096 | -0,012 | -0,013 | -0,027 | -0,060 | -0,052 | -0,047 | 0,008 |
| NEMPL | 0,220 | 0,071 | -0,189 | -0,002 | 0,496 | -0,182 | 0,053 | 0,226 | 0,083 | -0,227 | 0,159 | 0,102 | 0,087 | 0,439 |
| NET | 0,033 | 0,127 | -0,068 | 0,850 | 0,221 | 0,038 | 0,470 | 0,130 | 0,006 | -0,259 | 0,025 | 0,990 | 0,973 | 0,299 |
| NLAGINC | -0,200 | 0,074 | -0,197 | 0,217 | 0,808 | -0,077 | 0,488 | 0,344 | 0,098 | -0,552 | -0,056 | 0,252 | 0,240 | 0,855 |
| NLONGEDU | -0,226 | -0,020 | -0,187 | 0,155 | 0,696 | -0,160 | 0,590 | 0,261 | -0,027 | -0,407 | -0,081 | 0,198 | 0,192 | 0,792 |
| NPOP | -0,159 | 0,018 | -0,193 | 0,137 | 0,714 | -0,096 | 0,429 | 0,294 | 0,015 | -0,499 | -0,041 | 0,194 | 0,197 | 0,757 |
| NPROIL | 0,679 | 0,449 | 0,120 | 0,149 | 0,056 | 0,058 | -0,045 | 0,360 | 0,234 | -0,169 | 0,294 | 0,037 | -0,010 | 0,090 |
| NUNEM | 0,005 | 0,234 | 0,126 | 0,077 | -0,342 | 0,288 | 0,011 | 0,076 | -0,041 | -0,021 | 0,054 | -0,053 | -0,052 | -0,145 |
| OIL | 0,554 | 0,417 | 0,261 | 0,094 | -0,068 | 0,127 | -0,146 | 0,335 | 0,248 | -0,079 | 0,267 | 0,022 | -0,016 | 0,046 |
| POPULATION | -0,061 | 0,108 | -0,129 | 0,723 | 0,487 | -0,026 | 0,618 | 0,202 | -0,020 | -0,473 | -0,035 | 0,749 | 0,723 | 0,563 |
| PREDU | -0,243 | -0,267 | 0,031 | 0,166 | -0,154 | 0,053 | 0,190 | -0,669 | -0,336 | 0,009 | -0,197 | 0,095 | 0,101 | -0,175 |
| PRIN | -0,009 | 0,040 | -0,088 | 0,297 | 0,253 | -0,389 | 0,434 | 0,045 | -0,093 | -0,012 | -0,063 | 0,388 | 0,352 | 0,319 |
| PROIL | 0,679 | 0,443 | 0,164 | 0,144 | 0,013 | 0,039 | -0,049 | 0,322 | 0,202 | -0,120 | 0,268 | 0,039 | -0,007 | 0,093 |
| PRSIN | -0,158 | -0,315 | -0,140 | -0,136 | 0,261 | -0,256 | -0,015 | 0,048 | -0,042 | -0,030 | 0,113 | -0,105 | -0,114 | 0,272 |
| RAIN | 0,543 | 0,400 | 0,146 | 0,037 | -0,108 | 0,145 | -0,058 | 0,371 | 0,277 | 0,002 | 0,289 | -0,002 | -0,031 | -0,061 |
| SNOW | -0,057 | -0,602 | -0,027 | -0,116 | -0,122 | -0,308 | 0,003 | -0,257 | -0,144 | 0,215 | -0,020 | -0,086 | -0,077 | -0,194 |
| SYS | 0,146 | -0,056 | -0,166 | -0,088 | 0,612 | -0,287 | 0,140 | 0,325 | 0,096 | -0,199 | 0,243 | 0,074 | 0,063 | 0,525 |
| SYSA | -0,013 | -0,195 | -0,181 | -0,118 | 0,400 | -0,278 | 0,011 | 0,218 | 0,024 | -0,077 | 0,129 | -0,034 | -0,043 | 0,395 |
| SYSBO | -0,207 | -0,108 | -0,128 | -0,357 | 0,279 | -0,008 | -0,227 | 0,116 | 0,051 | -0,109 | 0,049 | -0,212 | -0,190 | 0,163 |
| SYSEU | -0,107 | -0,283 | -0,203 | -0,029 | 0,447 | -0,314 | 0,106 | 0,126 | -0,030 | -0,157 | 0,219 | 0,064 | 0,060 | 0,398 |
| SYSI | -0,055 | -0,262 | -0,177 | -0,145 | 0,476 | -0,329 | 0,053 | 0,191 | 0,016 | -0,112 | 0,199 | -0,047 | -0,058 | 0,445 |
| TEMP | -0,532 | -0,777 | -0,122 | -0,073 | 0,257 | -0,259 | -0,004 | -0,291 | -0,073 | -0,066 | -0,152 | -0,024 | -0,002 | 0,071 |
| TRANSC | 0,087 | -0,243 | 0,138 | -0,211 | -0,258 | -0,264 | -0,232 | -0,282 | -0,265 | 0,439 | 0,081 | -0,204 | -0,206 | -0,245 |
| TRANSINV | 0,145 | 0,250 | -0,056 | -0,035 | -0,255 | 0,090 | -0,130 | -0,003 | 0,097 | 0,214 | 0,105 | -0,015 | -0,009 | -0,101 |
| UNEM | 0,000 | 0,313 | 0,173 | 0,347 | -0,414 | 0,310 | 0,010 | -0,088 | -0,043 | -0,094 | 0,011 | 0,203 | 0,206 | -0,290 |

| | MAXT | MC | MINT | NAVROAD | NEMPL | NET | NLAGINC | NLONGEDU | NPOP | NPROIL | NUNEM | OIL | POPULATION | PREDU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MAXT** | 1,000 | | | | | | | | | | | | | |
| **MC** | 0,169 | 1,000 | | | | | | | | | | | | |
| **MINT** | -0,319 | 0,061 | 1,000 | | | | | | | | | | | |
| **NAVROAD** | 0,152 | -0,091 | -0,147 | 1,000 | | | | | | | | | | |
| **NEMPL** | 0,024 | -0,164 | 0,137 | -0,083 | 1,000 | | | | | | | | | |
| **NET** | 0,113 | 0,365 | 0,094 | -0,055 | 0,111 | 1,000 | | | | | | | | |
| **NLAGINC** | 0,237 | -0,099 | -0,067 | 0,047 | 0,482 | 0,252 | 1,000 | | | | | | | |
| **NLONGEDU** | 0,150 | -0,132 | -0,106 | 0,014 | 0,260 | 0,187 | 0,842 | 1,000 | | | | | | |
| **NPOP** | 0,166 | -0,127 | -0,106 | 0,001 | 0,348 | 0,179 | 0,796 | 0,830 | 1,000 | | | | | |
| **NPROIL** | -0,120 | 0,072 | 0,533 | -0,212 | 0,320 | 0,088 | 0,066 | -0,042 | 0,093 | 1,000 | | | | |
| **NUNEM** | -0,015 | 0,128 | 0,177 | 0,072 | -0,672 | -0,045 | -0,209 | -0,056 | 0,025 | 0,061 | 1,000 | | | |
| **OIL** | -0,090 | 0,032 | 0,525 | -0,166 | 0,334 | 0,068 | -0,012 | -0,109 | 0,003 | 0,739 | 0,053 | 1,000 | | |
| **POPULATION** | 0,194 | 0,332 | 0,000 | 0,003 | 0,217 | 0,772 | 0,552 | 0,491 | 0,497 | 0,075 | -0,043 | -0,003 | 1,000 | |
| **PREDU** | -0,003 | 0,233 | -0,300 | 0,035 | -0,338 | 0,092 | -0,161 | -0,086 | -0,124 | -0,347 | 0,093 | -0,398 | 0,074 | 1,000 |
| **PRIN** | -0,055 | 0,132 | 0,037 | -0,128 | 0,239 | 0,413 | 0,205 | 0,241 | 0,120 | 0,119 | -0,214 | 0,009 | 0,398 | 0,033 |
| **PROIL** | -0,139 | 0,056 | 0,527 | -0,215 | 0,330 | 0,085 | 0,047 | -0,046 | 0,076 | 0,909 | 0,019 | 0,814 | 0,078 | -0,310 |
| **PRSIN** | 0,085 | -0,230 | -0,259 | 0,068 | 0,331 | -0,114 | 0,232 | 0,229 | 0,182 | -0,073 | -0,240 | -0,065 | -0,028 | -0,177 |
| **RAIN** | -0,195 | 0,006 | 0,542 | -0,130 | 0,242 | 0,043 | -0,153 | -0,202 | -0,102 | 0,537 | 0,064 | 0,543 | -0,067 | -0,451 |
| **SNOW** | -0,005 | 0,116 | -0,519 | -0,005 | -0,200 | -0,096 | -0,272 | -0,097 | -0,156 | -0,214 | -0,038 | -0,196 | -0,143 | 0,241 |
| **SYS** | 0,065 | -0,279 | 0,011 | 0,006 | 0,796 | 0,076 | 0,470 | 0,336 | 0,390 | 0,224 | -0,556 | 0,195 | 0,141 | -0,439 |
| **SYSA** | 0,041 | -0,247 | -0,123 | 0,019 | 0,595 | -0,036 | 0,358 | 0,281 | 0,307 | 0,074 | -0,396 | 0,065 | 0,060 | -0,360 |
| **SYSBO** | 0,084 | -0,404 | -0,239 | 0,000 | 0,161 | -0,250 | 0,368 | 0,229 | 0,274 | -0,160 | -0,072 | -0,090 | -0,170 | -0,133 |
| **SYSEU** | 0,116 | -0,168 | -0,200 | 0,086 | 0,544 | 0,063 | 0,314 | 0,265 | 0,269 | -0,018 | -0,426 | 0,000 | 0,133 | -0,227 |
| **SYSI** | 0,092 | -0,300 | -0,190 | 0,054 | 0,609 | -0,053 | 0,388 | 0,327 | 0,316 | 0,044 | -0,432 | 0,040 | 0,042 | -0,340 |
| **TEMP** | 0,571 | -0,007 | -0,960 | 0,171 | -0,103 | -0,050 | 0,121 | 0,130 | 0,137 | -0,490 | -0,164 | -0,472 | 0,052 | 0,255 |
| **TRANSC** | -0,201 | -0,165 | -0,097 | -0,076 | 0,118 | -0,202 | -0,354 | -0,217 | -0,280 | -0,031 | -0,138 | -0,010 | -0,253 | 0,123 |
| **TRANSINV** | -0,106 | 0,075 | 0,353 | -0,145 | 0,159 | -0,005 | -0,117 | -0,155 | -0,162 | 0,178 | -0,016 | 0,276 | -0,015 | -0,033 |
| **UNEM** | 0,008 | 0,473 | 0,271 | -0,009 | -0,460 | 0,230 | -0,310 | -0,312 | -0,264 | 0,060 | 0,548 | 0,106 | 0,164 | 0,310 |

| | PRIN | PROIL | PRSIN | RAIN | SNOW | SYS | SYSA | SYSBO | SYSEU | SYSI | TEMP | TRANSC | TRANSINV | UNEM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRIN** | 1,000 | | | | | | | | | | | | | |
| **PROIL** | 0,141 | 1,000 | | | | | | | | | | | | |
| **PRSIN** | 0,050 | -0,093 | 1,000 | | | | | | | | | | | |
| **RAIN** | -0,035 | 0,503 | -0,039 | 1,000 | | | | | | | | | | |
| **SNOW** | 0,068 | -0,209 | 0,101 | -0,186 | 1,000 | | | | | | | | | |
| **SYS** | 0,226 | 0,179 | 0,345 | 0,241 | -0,044 | 1,000 | | | | | | | | |
| **SYSA** | 0,150 | 0,040 | 0,871 | 0,128 | 0,019 | 0,659 | 1,000 | | | | | | | |
| **SYSBO** | -0,319 | -0,169 | 0,222 | -0,097 | -0,128 | 0,222 | 0,226 | 1,000 | | | | | | |
| **SYSEU** | 0,095 | -0,056 | 0,692 | 0,010 | 0,080 | 0,679 | 0,685 | 0,144 | 1,000 | | | | | |
| **SYSI** | 0,149 | 0,011 | 0,901 | 0,082 | 0,059 | 0,717 | 0,951 | 0,271 | 0,823 | 1,000 | | | | |
| **TEMP** | -0,046 | -0,491 | 0,257 | -0,518 | 0,453 | 0,018 | 0,127 | 0,231 | 0,218 | 0,201 | 1,000 | | | |
| **TRANSC** | 0,270 | -0,015 | 0,293 | 0,064 | 0,345 | 0,085 | 0,250 | -0,144 | 0,214 | 0,264 | 0,036 | 1,000 | | |
| **TRANSINV** | 0,067 | 0,193 | -0,037 | 0,109 | -0,197 | 0,051 | 0,040 | -0,172 | 0,071 | -0,007 | -0,332 | 0,251 | 1,000 | |
| **UNEM** | -0,006 | 0,091 | -0,380 | 0,074 | -0,148 | -0,669 | -0,531 | -0,308 | -0,466 | -0,589 | -0,237 | -0,072 | 0,113 | 1,000 |

*Correlations between the migration instruments:*

| | LNIN | IN | OUT | NET | IMMIGRANTS | LAGINC | AT | MINT | MAXT | TEMP | RAIN | SNOW | AVROAD | SYSBO | NPOP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LNIN** | 1,000 | | | | | | | | | | | | | | |
| **IN** | 0,423 | 1,000 | | | | | | | | | | | | | |
| **OUT** | 0,384 | 0,997 | 1,000 | | | | | | | | | | | | |
| **NET** | 0,499 | 0,988 | 0,973 | 1,000 | | | | | | | | | | | |
| **IMMIGRANTS** | 0,376 | 0,992 | 0,996 | 0,965 | 1,000 | | | | | | | | | | |
| **LAGINC** | 0,643 | 0,305 | 0,286 | 0,340 | 0,276 | 1,000 | | | | | | | | | |
| **AT** | 0,249 | 0,104 | 0,089 | 0,132 | 0,092 | 0,360 | 1,000 | | | | | | | | |
| **MINT** | 0,148 | 0,060 | 0,049 | 0,083 | 0,046 | 0,223 | 0,774 | 1,000 | | | | | | | |
| **MAXT** | 0,180 | 0,089 | 0,082 | 0,103 | 0,090 | 0,263 | 0,430 | -0,087 | 1,000 | | | | | | |
| **TEMP** | -0,067 | -0,020 | -0,013 | -0,034 | -0,006 | -0,099 | -0,513 | -0,916 | 0,473 | 1,000 | | | | | |
| **RAIN** | 0,023 | -0,002 | -0,011 | 0,017 | -0,012 | 0,147 | 0,485 | 0,490 | 0,158 | -0,366 | 1,000 | | | | |
| **SNOW** | -0,122 | -0,080 | -0,074 | -0,093 | -0,075 | -0,233 | -0,594 | -0,496 | -0,134 | 0,386 | -0,212 | 1,000 | | | |
| **AVROAD** | 0,694 | 0,770 | 0,737 | 0,824 | 0,719 | 0,467 | 0,206 | 0,138 | 0,129 | -0,075 | 0,014 | -0,149 | 1,000 | | |
| **SYSBO** | -0,167 | -0,155 | -0,140 | -0,184 | -0,134 | 0,145 | 0,145 | -0,008 | 0,181 | 0,079 | 0,009 | -0,130 | -0,242 | 1,000 | |
| **NPOP** | 0,373 | 0,227 | 0,222 | 0,233 | 0,224 | 0,668 | 0,265 | 0,111 | 0,242 | -0,005 | 0,074 | -0,198 | 0,264 | 0,330 | 1,000 |

## Appendix 3 – List of Weather Stations in the Respective Municipalities

The weather data has been gathered from the Norwegian Meteorological Institute from the latest normal period from 1961 to 1990. In the municipalities where no weather stations are available we have used a neighboring municipality's weather station or a weather station at the approximate latitude.

| Municipal ID | Municipality | Weather station - Temperature | Weather station - Precipitation | Weather station - Snow depth |
|---|---|---|---|---|
| 0101 | Halden | Prestebakke | Prestebakke | Prestebakke |
| 0104 | Moss | Rygge | Moss Brannstasjon | Moss Brannstasjon |
| 0105 | Sarpsborg | Sarpsborg | Sarpsborg | Sarpsborg |
| 0106 | Fredrikstad | Strømtangen fyr | Strømtangen fyr | Sarpsborg |
| 0111 | Hvaler | Strømtangen fyr | Hvaler | Hvaler |
| 0118 | Aremark | Prestebakke | Strømfoss sluse | Strømfoss sluse |
| 0119 | Marker | Sarpsborg | Ørje | Ørje |
| 0121 | Rømskog | Aurskog II | Aurskog II | Bjørkelangen II |
| 0122 | Trøgstad | Aurskog II | Aurskog II | Bjørkelangen II |
| 0123 | Spydeberg | Aurskog II | Enebakk | Enebakk |
| 0124 | Askim | Aurskog II | Enebakk | Enebakk |
| 0125 | Eidsberg | Rygge | Moss Brannstasjon | Moss Brannstasjon |
| 0127 | Skiptvet | Rygge | Moss Brannstasjon | Moss Brannstasjon |
| 0128 | Rakkestad | Sarpsborg | Sarpsborg | Sarpsborg |
| 0135 | Råde | Rygge | Moss Brannstasjon | Moss Brannstasjon |
| 0136 | Rygge | Rygge | Moss Brannstasjon | Moss Brannstasjon |
| 0137 | Våler | Rygge | Fløter | Fløter |
| 0138 | Hobøl | Aurskog II | Igsi i Hobøl | Igsi i Hobøl |
| 0211 | Vestby | Asker | Asker | Asker |
| 0213 | Ski | Asker | Asker | Asker |
| 0214 | Ås | Asker | Asker | Asker |
| 0215 | Frogn | Asker | Drøbak | Drøbak |
| 0216 | Nesodden | Asker | Asker | Blekslitjern |
| 0217 | Oppegård | Asker | Asker | Asker |
| 0219 | Bærum | Asker | Horni | Horni |
| 0220 | Asker | Asker | Asker | Asker |
| 0221 | Aurskog-Høland | Aurskog II | Aurskog II | Bjørkelangen II |
| 0226 | Sørum | Hakadal | Hakadal | Hakadal |
| 0227 | Fet | Aurskog II | Aurskog II | Bjørkelangen II |
| 0228 | Rælingen | Aurskog II | Aurskog II | Bjørkelangen II |
| 0229 | Enebakk | Aurskog II | Enebakk | Enebakk |
| 0230 | Lørenskog | Aurskog II | Aurskog II | Bjørkelangen II |
| 0231 | Skedsmo | Hakadal | Hakadal | Hakadal |
| 0233 | Nittedal | Hakadal | Hakadal | Hakadal |

| | | | | |
|---|---|---|---|---|
| 0234 | Gjerdrum | Hakadal | Hakadal | Hakadal |
| 0235 | Ullensaker | Gardermoen | Gardermoen | Gardermoen |
| 0236 | Nes | Gardermoen | Svanfoss | Svanfoss |
| 0237 | Eidsvoll | Gardermoen | Eidsvoll Verk | Eidsvoll Verk |
| 0238 | Nannestad | Gardermoen | Ukkestad | Ukkestad |
| 0239 | Hurdal | Gardermoen | Gardermoen | Gardermoen |
| 0301 | Oslo | Blindern | Blindern | Blindern |
| 0402 | Kongsvinger | Kongsvinger | Kongsvinger | Skotterud |
| 0403 | Hamar | Hamar | Hamar | Elverum |
| 0412 | Ringsaker | Kise på Hedmark | Kise på Hedmark | Vea |
| 0415 | Løten | Rena | Rena | Rena |
| 0417 | Stange | Flisa | Flisa | Flisa |
| 0418 | Nord-Odal | Flisa | Nord-Odal | Nord-Odal |
| 0419 | Sør-Odal | Flisa | Flisa | Flisa |
| 0420 | Eidskog | Kongsvinger | Skotterud | Skotterud |
| 0423 | Grue | Flisa | Flisa | Flisa |
| 0425 | Åsnes | Flisa | Flisa | Flisa |
| 0426 | Våler | Flisa | Flisa | Flisa |
| 0427 | Elverum | Rena | Elverum | Elverum |
| 0428 | Trysil | Trysil | Trysil | Linnes |
| 0429 | Åmot | Rena | Rena | Rena |
| 0430 | Stor-Elvdal | Evenstad | Atnsjøen | Atnsjøen |
| 0432 | Rendalen | Drevsjø | Finstad | Finstad |
| 0434 | Engerdal | Drevsjø | Drevsjø | Drevsjø |
| 0436 | Tolga | Tynset | Ellefsplass | Ellefsplass |
| 0437 | Tynset | Tynset | Tynset | Ellefsplass |
| 0438 | Alvdal | Drevsjø | Drevsjø | Drevsjø |
| 0439 | Folldal | Tynset | Atndalen - Eriksrud | Atndalen - Eriksrud |
| 0441 | Os | Drevsjø | Drevsjø | Drevsjø |
| 0501 | Lillehammer | Lillehammer | Lillehammer | Vest-Torpa II |
| 0502 | Gjøvik | Vest-Torpa II | Biri | Biri |
| 0511 | Dovre | Fokstugu | Fokstugu | Fokstugu |
| 0512 | Lesja | Kjøremsgrende | Kjøremsgrende | Kjøremsgrende |
| 0513 | Skjåk | Bråtå | Bråtå | Bråtå |
| 0514 | Lom | Juvasshøe | Bøverdal | Bøverdal |
| 0515 | Vågå | Skåbu | Preststulen | Preststulen |
| 0516 | Nord-Fron | Skåbu | Skåbu | Skåbu |
| 0517 | Sel | Skåbu | Sjoa | Sjoa |
| 0519 | Sør-Fron | Skåbu | Espedalen | Espedalen |
| 0520 | Ringebu | Venabu | Venabu | Venabu |
| 0521 | Øyer | Løken i Volbu | Beito | Beito |
| 0522 | Gausdal | Løken i Volbu | Gausdal | Gausdal |
| 0528 | Østre Toten | Østre Toten | Østre Toten | Vest-Torpa II |
| 0529 | Vestre Toten | Vest-Torpa II | Einavatn | Einavatn |
| 0532 | Jevnaker | Vest-Torpa II | Vest-Torpa II | Vest-Torpa II |

| | | | | |
|---|---|---|---|---|
| 0533 | Lunner | Vest-Torpa II | Lunner | Lunner |
| 0534 | Gran | Vest-Torpa II | Vest-Torpa II | Vest-Torpa II |
| 0536 | Søndre Land | Vest-Torpa II | Vest-Torpa II | Vest-Torpa II |
| 0538 | Nordre Land | Vest-Torpa II | Vest-Torpa II | Vest-Torpa II |
| 0540 | Sør-Aurdal | Åsbjørnsbråten | Grimsrud | Grimsrud |
| 0541 | Etnedal | Åsbjørnsbråten | Åsbjørnsbråten | Åsbjørnsbråten |
| 0542 | Nord-Aurdal | Åsbjørnsbråten | Åsbjørnsbråten | Åsbjørnsbråten |
| 0543 | Vestre Slidre | Løken i Volbu | Beito | Beito |
| 0544 | Øystre Slidre | Løken i Volbu | Beito | Beito |
| 0545 | Vang | Løken i Volbu | Beito | Beito |
| 0602 | Drammen | Drammen | Drammen | Ask på Ringerike |
| 0604 | Kongsberg | Kongsberg Brannstasjon | Kongsberg Brannstasjon | Kongsberg Brannstasjon |
| 0605 | Ringerike | Hønefoss | Ask på Ringerike | Ask på Ringerike |
| 0612 | Hole | Hønefoss | Ask på Ringerike | Ask på Ringerike |
| 0615 | Flå | Gulsvik II | Gulsvik II | Gulsvik II |
| 0616 | Nes | Nesbyen | Nesbyen | Nesbyen |
| 0617 | Gol | Hemsedal II | Gol | Gol |
| 0618 | Hemsedal | Hemsedal II | Hemsedal Hølto | Hemsedal Hølto |
| 0619 | Ål | Geilo | Ål III | Ål III |
| 0620 | Hol | Geilo | Geilo | Bakko i Hol |
| 0621 | Sigdal | Veggli II | Hiåsen | Hiåsen |
| 0622 | Krødsherad | Gulsvik II | Grimeli | Grimeli |
| 0623 | Modum | Hønefoss | Modum | Modum |
| 0624 | Øvre Eiker | Hønefoss | Ask på Ringerike | Ask på Ringerike |
| 0625 | Nedre Eiker | Hønefoss | Ask på Ringerike | Ask på Ringerike |
| 0626 | Lier | Hønefoss | Ask på Ringerike | Ask på Ringerike |
| 0627 | Røyken | Hønefoss | Ask på Ringerike | Ask på Ringerike |
| 0628 | Hurum | Hønefoss | Ask på Ringerike | Ask på Ringerike |
| 0631 | Flesberg | Hønefoss | Ask på Ringerike | Ask på Ringerike |
| 0632 | Rollag | Veggli II | Veggli S Bjørkgård | Veggli S Bjørkgård |
| 0633 | Nore og Uvdal | Nesbyen | Tunhovd | Tunhovd |
| 0701 | Horten | Melsom | Stokke - Solli | Stokke - Solli |
| 0702 | Holmestrand | Galleberg | Galleberg | Borrevatn |
| 0704 | Tønsberg | Melsom | Stokke - Solli | Stokke - Solli |
| 0706 | Sandefjord | Torp | Sandefjord | Sandefjord |
| 0709 | Larvik | Torp | Hedrum | Hedrum |
| 0711 | Svelvik | Galleberg | Galleberg | Borrevatn |
| 0713 | Sande | Galleberg | Galleberg | Borrevatn |
| 0714 | Hof | Galleberg | Galleberg | Borrevatn |
| 0716 | Re | Melsom | Ramnes - Berg | Ramnes - Berg |
| 0719 | Andebu | Melsom | Stokke - Solli | Stokke - Solli |
| 0720 | Stokke | Melsom | Stokke - Solli | Stokke - Solli |
| 0722 | Nøtterøy | Færder fyr | Sandefjord | Sandefjord |
| 0723 | Tjøme | Færder fyr | Sandefjord | Sandefjord |

| | | | | |
|---|---|---|---|---|
| 0728 | Lardal | Galleberg | Galleberg | Borrevatn |
| 0805 | Porsgrunn | Gvarv | Godal | Godal |
| 0806 | Skien | Gvarv | Godal | Godal |
| 0807 | Notodden | Notodden flyplass | Notodden | Notodden |
| 0811 | Siljan | Gvarv | Godal | Godal |
| 0814 | Bamble | Jomfruland | Drangedal | Drangedal |
| 0815 | Kragerø | Jomfruland | Drangedal | Drangedal |
| 0817 | Drangedal | Jomfruland | Drangedal | Drangedal |
| 0819 | Nome | Gvarv | Drangedal | Drangedal |
| 0821 | Bø | Gvarv | Lifjell | Lifjell |
| 0822 | Sauherad | Gvarv | Lifjell | Lifjell |
| 0826 | Tinn | Møsstrand II | Bergeligrend | Bergeligrend |
| 0827 | Hjartdal | Notodden flyplass | Seljord | Seljord |
| 0828 | Seljord | Notodden flyplass | Seljord | Seljord |
| 0829 | Kviteseid | Høydalsmo II | Kvitseid | Kvitseid |
| 0830 | Nissedal | Gvarv | Drangedal | Drangedal |
| 0831 | Fyresdal | Gvarv | Kilegrend | Kilegrend |
| 0833 | Tokke | Høydalsmo II | Kvitseid | Kvitseid |
| 0834 | Vinje | Møsstrand II | Bergeligrend | Bergeligrend |
| 0901 | Risør | Nelaug | Risør Brannstasjon | Risør Brannstasjon |
| 0904 | Grimstad | Landvik | Dovland | Dovland |
| 0906 | Arendal | Torungen fyr | Mykland | Mykland |
| 0911 | Gjerstad | Nelaug | Gjerstad | Gjerstad |
| 0912 | Vegårshei | Nelaug | Nelaug | Nelaug |
| 0914 | Tvedestrand | Lyngør fyr | Gjerstad | Gjerstad |
| 0919 | Froland | Torungen fyr | Gjerstad | Gjerstad |
| 0926 | Lillesand | Landvik | Dovland | Dovland |
| 0928 | Birkenes | Landvik | Dovland | Dovland |
| 0929 | Åmli | Nelaug | Nelaug | Nelaug |
| 0935 | Iveland | Landvik | Dovland | Dovland |
| 0937 | Evje og Hornnes | Nelaug | Nelaug | Nelaug |
| 0938 | Bygland | Byglandsfjord | Byglandsfjord | Byglandsfjord |
| 0940 | Valle | Byglandsfjord | Brokke kraftstasjon | Brokke kraftstasjon |
| 0941 | Bykle | Hovden | Bykle | Bykle |
| 1001 | Kristiansand | Kjevik | Kjevik | Kjevik |
| 1002 | Mandal | Lindesnes fyr | Lindesnes fyr | Lindesnes fyr |
| 1003 | Farsund | Lista fyr | Lista fyr | Lista fyr |
| 1004 | Flekkefjord | Lista fyr | Bakke | Bakke |
| 1014 | Vennesla | Kjevik | Kjevik | Kjevik |
| 1017 | Songdalen | Konsmo | Finsland | Finsland |
| 1018 | Søgne | Kjevik | Kjevik | Kjevik |
| 1021 | Marnardal | Konsmo | Konsmo | Bjelland kraftverk |
| 1026 | Åseral | Sirdal - Tjørhom | Åserål | Åserål |
| 1027 | Audnedal | Konsmo | Konsmo | Konsmo |

| | | | | |
|---|---|---|---|---|
| 1029 | Lindesnes | Lindesnes fyr | Lindesnes fyr | Lindesnes fyr |
| 1032 | Lyngdal | Lindesnes fyr | Kvåvik | Kvåvik |
| 1034 | Hægebostad | Konsmo | Konsmo | Konsmo |
| 1037 | Kvinesdal | Konsmo | Risnes i Fjotland | Risnes i Fjotland |
| 1046 | Sirdal | Sirdal - Tjørhom | Sirdal - Tjørhom | Sirdal - Tjørhom |
| 1101 | Eigersund | Obrestad fyr | Egersund | Egersund |
| 1102 | Sandnes | Sola | Sviland | Sviland |
| 1103 | Stavanger | Sola | Sola | Sola |
| 1106 | Haugesund | Nedre Vats | Nedre Vats | Nedre Vats |
| 1111 | Sokndal | Eik - Hove | Eik - Hove | Eik - Hove |
| 1112 | Lund | Eik - Hove | Eik - Hove | Eik - Hove |
| 1114 | Bjerkreim | Obrestad fyr | Varhaug | Varhaug |
| 1119 | Hå | Obrestad fyr | Varhaug | Varhaug |
| 1120 | Klepp | Særheim | Hognestad | Hognestad |
| 1121 | Time | Særheim | Hognestad | Hognestad |
| 1122 | Gjesdal | Særheim | Søyland i Gjesdal | Søyland i Gjesdal |
| 1124 | Sola | Sola | Sola | Sola |
| 1127 | Randaberg | Kvitsøy - Nordbø | Kvitsøy - Nordbø | Kvitsøy - Nordbø |
| 1129 | Forsand | Fister - Sigmundstad | Lysebotn | Lysebotn |
| 1130 | Strand | Fister - Sigmundstad | Bjørheim i Ryfylke | Bjørheim i Ryfylke |
| 1133 | Hjelmeland | Fister - Sigmundstad | Bjørheim i Ryfylke | Bjørheim i Ryfylke |
| 1134 | Suldal | Nedre Vats | Sand i Ryfylke II | Sand i Ryfylke II |
| 1135 | Sauda | Sauda | Sauda | Sauda |
| 1141 | Finnøy | Kvitsøy - Nordbø | Kvitsøy - Nordbø | Kvitsøy - Nordbø |
| 1142 | Rennesøy | Kvitsøy - Nordbø | Kvitsøy - Nordbø | Kvitsøy - Nordbø |
| 1145 | Bokn | Utsira fyr | Utsira fyr | Utsira fyr |
| 1146 | Tysvær | Utsira fyr | Utsira fyr | Utsira fyr |
| 1149 | Karmøy | Haugesund Lufthavn | Sand i Ryfylke II | Sand i Ryfylke II |
| 1160 | Vindafjord | Nedre Vats | Nedre Vats | Nedre Vats |
| 1201 | Bergen | Bergen - Florida | Bergen - Florida | Bergen - Florida |
| 1211 | Etne | Midtlæger | Eikemo | Eikemo |
| 1216 | Sveio | Slåtterøy fyr | Straumøy | Straumøy |
| 1219 | Bømlo | Slåtterøy fyr | Litlabø -Dale | Litlabø -Dale |
| 1221 | Stord | Stord lufthavn | Litlabø -Dale | Litlabø -Dale |
| 1222 | Fitjar | Slåtterøy fyr | Fitjar - Prestbø | Fitjar - Prestbø |
| 1223 | Tysnes | Stord lufthavn | Litlabø -Dale | Litlabø -Dale |
| 1224 | Kvinnherad | Midtlæger | Rosendal | Rosendal |
| 1227 | Jondal | Kvamsøy | Kvåle | Kvåle |
| 1228 | Odda | Midtlæger | Røldal | Røldal |
| 1231 | Ullensvang | Fet i Eidfjord | Kinsarvik | Kinsarvik |
| 1232 | Eidfjord | Fet i Eidfjord | Eidfjord II | Eidfjord II |
| 1233 | Ulvik | Finsevatn | Bulken | Bulken |
| 1234 | Granvin | Kvamsøy | Kvamsøy | Kvamsøy |
| 1235 | Voss | Vossevangen | Bulken | Bulken |
| 1238 | Kvam | Kvamsøy | Kvamsøy | Kvamsøy |

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|---|---|---|---|---|
| 1241 | Fusa | Kvamskogen - Jonshøgdi | Kvamskogen - Jonshøgdi | Kvamskogen - Jonshøgdi |
| 1242 | Samnanger | Kvamskogen - Jonshøgdi | Kvamskogen - Jonshøgdi | Kvamskogen - Jonshøgdi |
| 1243 | Os | Kvamskogen - Jonshøgdi | Kvamskogen - Jonshøgdi | Kvamskogen - Jonshøgdi |
| 1245 | Sund | Bergen - Florida | Bergen - Florida | Bergen - Florida |
| 1246 | Fjell | Bergen - Florida | Bergen - Florida | Bergen - Florida |
| 1247 | Askøy | Bergen - Florida | Bergen - Florida | Bergen - Florida |
| 1251 | Vaksdal | Vossevangen | Eksingedal | Eksingedal |
| 1252 | Modalen | Modalen II | Modalen II | Modalen II |
| 1253 | Osterøy | Kvamskogen - Jonshøgdi | Kvamskogen - Jonshøgdi | Kvamskogen - Jonshøgdi |
| 1256 | Meland | Bergen - Florida | Bergen - Florida | Bergen - Florida |
| 1259 | Øygarden | Modalen II | Modalen II | Modalen II |
| 1260 | Radøy | Modalen II | Modalen II | Modalen II |
| 1263 | Lindås | Modalen II | Eikanger - Myr | Eikanger - Myr |
| 1264 | Austrheim | Modalen II | Modalen II | Modalen II |
| 1266 | Masfjorden | Modalen II | Haukeland - Storevatn | Haukeland - Storevatn |
| 1401 | Flora | Florø Lufthavn | Værlandet | Værlandet |
| 1411 | Gulen | Takle | Takle | Takle |
| 1413 | Hyllestad | Fureneset | Hovlandsdal | Hovlandsdal |
| 1416 | Høyanger | Takle | Sørebø | Sørebø |
| 1417 | Vik | Vangsnes | Vik i Sogn III | Vik i Sogn III |
| 1418 | Balestrand | Førde LH | Sygna | Sygna |
| 1419 | Leikanger | Sogndal lufthavn | Sogndal - Selseng | Sogndal - Selseng |
| 1420 | Sogndal | Sogndal lufthavn | Sogndal - Selseng | Sogndal - Selseng |
| 1421 | Aurland | Lærdal - Moldo | Aurland | Aurland |
| 1422 | Lærdal | Lærdal - Moldo | Lærdal - Moldo | Lærdal - Moldo |
| 1424 | Årdal | Sogndal lufthavn | Sogndal - Selseng | Sogndal - Selseng |
| 1426 | Luster | Sogndal lufthavn | Veitastrond | Veitastrond |
| 1428 | Askvoll | Fureneset | Værlandet | Værlandet |
| 1429 | Fjaler | Fureneset | Hovlandsdal | Hovlandsdal |
| 1430 | Gaular | Førde LH | Sygna | Sygna |
| 1431 | Jølster | Førde - Terfe | Skei i Jølster | Skei i Jølster |
| 1432 | Førde | Førde - Terfe | Førde - Terfe | Førde - Terfe |
| 1433 | Naustdal | Førde - Terfe | Førde - Terfe | Førde - Terfe |
| 1438 | Bremanger | Florø Lufthavn | Daviknes | Daviknes |
| 1439 | Vågsøy | Kråkenes | Refvik | Refvik |
| 1441 | Selje | Kråkenes | Stadlandet | Stadlandet |
| 1443 | Eid | Kråkenes | Nordfjordeid | Nordfjordeid |
| 1444 | Hornindal | Stryn - Kroken | Hornindal | Hornindal |
| 1445 | Gloppen | Sandane | Sandane | Sandane |
| 1449 | Stryn | Stryn - Kroken | Briksdal | Briksdal |
| 1502 | Molde | Molde lufthavn | Istad kraftstasjon | Istad kraftstasjon |
| 1504 | Ålesund | Hjelvik | Brusdalsvatn II | Brusdalsvatn II |

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|---|---|---|---|---|
| 1505 | Kristiansund | Kristiansund lufthavn | Tingvoll | Tingvoll |
| 1511 | Vanylven | Fiskåbygd | Fiskåbygd | Fiskåbygd |
| 1514 | Sande | Fiskåbygd | Fiskåbygd | Fiskåbygd |
| 1515 | Herøy | Svinøy Fyr | Sæbø | Sæbø |
| 1516 | Ulstein | Ørsta - Volda lufthavn | Sæbø | Sæbø |
| 1517 | Hareid | Ørsta - Volda lufthavn | Sæbø | Sæbø |
| 1519 | Volda | Ørsta - Volda lufthavn | Sæbø | Sæbø |
| 1520 | Ørsta | Ørsta - Volda lufthavn | Sæbø | Sæbø |
| 1523 | Ørskog | Hjelvik | Ørskog | Ørskog |
| 1524 | Norddal | Tafjord | Tafjord | Tafjord |
| 1525 | Stranda | Tafjord | Tafjord | Tafjord |
| 1526 | Stordal | Tafjord | Tafjord | Tafjord |
| 1528 | Sykkylven | Ørsta - Volda lufthavn | Ørsta - Volda lufthavn | Ørsta - Volda lufthavn |
| 1529 | Skodje | Hjelvik | Hjelvik | Hjelvik |
| 1531 | Sula | Ørsta - Volda lufthavn | Ørsta - Volda lufthavn | Ørsta - Volda lufthavn |
| 1534 | Haram | Vigra | Hildre | Hildre |
| 1535 | Vestnes | Hjelvik | Hjelvik | Hjelvik |
| 1539 | Rauma | Hjelvik | Hjelvik | Hjelvik |
| 1543 | Nesset | Sunndalsøra II | Eresfjord | Eresfjord |
| 1547 | Aukra | Molde lufthavn | Istad kraftstasjon | Istad kraftstasjon |
| 1548 | Fræna | Ona II | Hustadvatn | Hustadvatn |
| 1551 | Eide | Tingvoll | Eide på Nordmøre | Eide på Nordmøre |
| 1557 | Gjemnes | Tingvoll | Tingvoll | Tingvoll |
| 1560 | Tingvoll | Tingvoll | Tingvoll | Tingvoll |
| 1563 | Sunndal | Sunndalsøra II | Sunndalsøra II | Sunndalsøra II |
| 1566 | Surnadal | Tågdalen | Tågdalen | Tågdalen |
| 1567 | Rindal | Tågdalen | Rindal | Rindal |
| 1571 | Halsa | Tingvoll | Tingvoll | Tingvoll |
| 1576 | Aure | Tingvoll | Tingvoll | Tingvoll |
| 1601 | Trondheim | Trondheim - Voll | Leinestrand | Leinestrand |
| 1612 | Hemne | Orkdal | Hemne | Hemne |
| 1613 | Snillfjord | Orkdal | Skjenaldfossen i Orkdal | Skjenaldfossen i Orkdal |
| 1621 | Ørland | Ørland III | Ørland III | Ørland III |
| 1622 | Agdenes | Orkdal | Skjenaldfossen i Orkdal | Skjenaldfossen i Orkdal |
| 1624 | Rissa | Åfjord II | Breivoll | Breivoll |
| 1627 | Bjugn | Ørland III | Ørland III | Ørland III |
| 1630 | Åfjord | Åfjord II | Breivoll | Breivoll |
| 1632 | Roan | Buholmråsa fyr | Bessaker | Bessaker |
| 1633 | Osen | Buholmråsa fyr | Buholmråsa fyr | Buholmråsa fyr |
| 1634 | Oppdal | Oppdal - Sæter | Oppdal - Sæter | Oppdal - Sæter |
| 1635 | Rennebu | Berkåk | Berkåk | Berkåk |
| 1636 | Meldal | Soknedal | Soknedal | Soknedal |
| 1638 | Orkdal | Orkdal | Skjenaldfossen i Orkdal | Skjenaldfossen i Orkdal |

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|---|---|---|---|---|
| 1640 | Røros | Røros lufthavn | Røros lufthavn | Røros lufthavn |
| 1644 | Holtålen | Røros lufthavn | Haltdalen III | Haltdalen III |
| 1648 | Midtre Gauldal | Soknedal | Soknedal | Soknedal |
| 1653 | Melhus | Berkåk | Løksmyr | Løksmyr |
| 1657 | Skaun | Trondheim - Voll | Leinestrand | Leinestrand |
| 1662 | Klæbu | Selbu II | Lien i Selbu | Lien i Selbu |
| 1663 | Malvik | Trondheim - Voll | Leinestrand | Leinestrand |
| 1664 | Selbu | Selbu II | Lien i Selbu | Lien i Selbu |
| 1665 | Tydal | Røros lufthavn | Aunet | Aunet |
| 1702 | Steinkjer | Steinkjer | Utgård | Utgård |
| 1703 | Namsos | Namsos lufthavn | Bangdalen | Bangdalen |
| 1711 | Meråker | Meråker | Meråker | Meråker |
| 1714 | Stjørdal | Værnes | Værnes | Værnes |
| 1717 | Frosta | Værnes | Værnes | Værnes |
| 1718 | Leksvik | Værnes | Leksvik | Leksvik |
| 1719 | Levanger | Verdal | Buran | Buran |
| 1721 | Verdal | Verdal | Verdal | Verdal |
| 1723 | Mosvik | Verdal | Mosvik | Mosvik |
| 1724 | Verran | Steinkjer | Steinkjer | Holden |
| 1725 | Namdalseid | Namdalseid | Namdalseid | Namdalseid |
| 1729 | Inderøy | Verdal | Verdal | Verdal |
| 1736 | Snåsa | Kjøbli i Snåsa | Kjøbli i Snåsa | Kjøbli i Snåsa |
| 1738 | Lierne | Nordli | Nordli | Nordli |
| 1739 | Røyrvik | Nordli | Nordli | Nordli |
| 1740 | Namsskogan | Namskogan | Namskogan - Bergli | Namskogan - Bergli |
| 1742 | Grong | Gartland | Gartland | Gartland |
| 1743 | Høylandet | Gartland | Gartland | Gartland |
| 1744 | Overhalla | Gartland | Overhalla | Overhalla |
| 1748 | Fosnes | Namsos lufthavn | Bangdalen | Bangdalen |
| 1749 | Flatanger | Namdalseid | Namdalseid | Namdalseid |
| 1750 | Vikna | Rørvik lufthavn | Liafoss | Liafoss |
| 1751 | Nærøy | Sklinna fyr | Liafoss | Liafoss |
| 1755 | Leka | Sklinna fyr | Liafoss | Liafoss |
| 1804 | Bodø | Bodø | Heggmoen ved Bodø | Styrkesnes |
| 1805 | Narvik | Narvik lufthavn | Skjomen | Skjomen |
| 1811 | Bindal | Majavatn V | Øksningøy | Øksningøy |
| 1812 | Sømna | Brønnøysund lufthavn | Sømna | Sømna |
| 1813 | Brønnøy | Brønnøysund lufthavn | Sausvatn | Sausvatn |
| 1816 | Vevelstad | Mosjøen lufthavn | Høyholm | Høyholm |
| 1820 | Alstahaug | Tjøtta | Leirfjord | Leirfjord |
| 1822 | Leirfjord | Mosjøen lufthavn | Leirfjord | Leirfjord |
| 1824 | Vefsn | Mosjøen lufthavn | Mosjøen Nyrud | Mosjøen Nyrud |
| 1825 | Grane | Majavatn V | Majavatn V | Majavatn V |
| 1826 | Hattfjelldal | Varntresk | Varntresk | Varntresk |
| 1828 | Nesna | Mo i Rana lufthavn | Mo i Rana III | Mo i Rana III |

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|---|---|---|---|---|
| 1832 | Hemnes | Mosjøen lufthavn | Bjerka | Bjerka |
| 1833 | Rana | Mo i Rana lufthavn | Mo i Rana III | Mo i Rana III |
| 1834 | Lurøy | Svolvær III | Lurøy | Lurøy |
| 1836 | Rødøy | Myken | Myken | Myken |
| 1837 | Meløy | Glomfjord | Reipå | Reipå |
| 1838 | Gildeskål | Glomfjord | Reipå | Reipå |
| 1839 | Beiarn | Saltdal | Saltdal | Saltdal |
| 1840 | Saltdal | Saltdal | Saltdal | Saltdal |
| 1841 | Fauske | Saltdal | Sulitjelma | Sulitjelma |
| 1845 | Sørfold | Bodø | Styrkesnes | Styrkesnes |
| 1848 | Steigen | Drag | Steigen | Steigen |
| 1849 | Hamarøy | Drag | Tømmerneset | Tømmerneset |
| 1850 | Tysfjord | Drag | Drag | Sørfjord Kraftverk |
| 1851 | Lødingen | Svolvær lufthavn | Laupstad | Laupstad |
| 1852 | Tjeldsund | Evenes lufthavn | Liland | Liland |
| 1853 | Evenes | Evenes lufthavn | Liland | Liland |
| 1854 | Ballangen | Narvik lufthavn | Bjørkåsen | Bjørkåsen |
| 1859 | Flakstad | Leknes lufthavn | Leknes i Lofoten | Leknes i Lofoten |
| 1860 | Vestvågøy | Leknes lufthavn | Leknes i Lofoten | Leknes i Lofoten |
| 1865 | Vågan | Svolvær lufthavn | Laupstad | Laupstad |
| 1866 | Hadsel | Stokmarknes LH | Laupstad | Laupstad |
| 1867 | Bø | Bø i Vesterålen III | Alsvåg i vesterålen II | Alsvåg i vesterålen II |
| 1868 | Øksnes | Sortland | Alsvåg i vesterålen II | Alsvåg i vesterålen II |
| 1870 | Sortland | Sortland | Alsvåg i vesterålen II | Alsvåg i vesterålen II |
| 1871 | Andøy | Andøya | Alsvåg i vesterålen II | Alsvåg i vesterålen II |
| 1901 | Harstad | Harstad stadion | Harstad stadion | Grovfjord |
| 1902 | Tromsø | Tromsø | Tromsø | Tromsø |
| 1911 | Kvæfjord | Harstad stadion | Harstad stadion | Grovfjord |
| 1913 | Skånland | Harstad stadion | Harstad stadion | Grovfjord |
| 1915 | Bjarkøy | Harstad stadion | Harstad stadion | Grovfjord |
| 1917 | Ibestad | Harstad stadion | Harstad stadion | Grovfjord |
| 1919 | Gratangen | Harstad stadion | Harstad stadion | Grovfjord |
| 1920 | Lavangen | Harstad stadion | Harstad stadion | Grovfjord |
| 1922 | Bardu | Bardufoss | Sætermoen II | Sætermoen II |
| 1923 | Salangen | Bardufoss | Bardufoss | Bardufoss |
| 1924 | Målselv | Bardufoss | Bardufoss | Bardufoss |
| 1925 | Sørreisa | Bardufoss | Bardufoss | Bardufoss |
| 1926 | Dyrøy | Bardufoss | Bardufoss | Bardufoss |
| 1927 | Tranøy | Senja | Senja | Senja |
| 1928 | Torsken | Senja | Grunnfarnes | Grunnfarnes |
| 1929 | Berg | Senja | Senja | Senja |
| 1931 | Lenvik | Senja | Senja | Senja |
| 1933 | Balsfjord | Skibotn II | Storsteinnes i Balsfjord | Storsteinnes i Balsfjord |
| 1936 | Karlsøy | Torsvåg fyr | Grunnfjord | Grunnfjord |

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|---|---|---|---|---|
| 1938 | Lyngen | Tromsø | Lyngseidet | Lyngseidet |
| 1939 | Storfjord | Skibotn II | Skibotn II | Skibotn kraftverk |
| 1940 | Gáivuotna Kåfjord | Sørkjosen lufthavn | Sørkjosen lufthavn | Sørkjosen lufthavn |
| 1941 | Skjervøy | Torsvåg fyr | Skjervøy | Skjervøy |
| 1942 | Nordreisa | Sørkjosen lufthavn | Sørkjosen lufthavn | Sørkjosen lufthavn |
| 1943 | Kvænangen | Nordstraum i Kvænangen | Nordstraum i Kvænangen | Nordstraum i Kvænangen |
| 2002 | Vardø | Vardø radio | Vestre Jakobselv | Vestre Jakobselv |
| 2003 | Vadsø | Vadsø Lufthavn | Vestre Jakobselv | Vestre Jakobselv |
| 2004 | Hammerfest | Hammerfest Lufthavn | Porsa II | Porsa II |
| 2011 | Guovdageaidnu Kautokeino | Kautokeino | Kautokeino | Kautokeino |
| 2012 | Alta | Alta Lufthavn | Alta Lufthavn | Alta Lufthavn |
| 2014 | Loppa | Alta Lufthavn | Alta Lufthavn | Alta Lufthavn |
| 2015 | Hasvik | Hasvik Lufthavn | Porsa II | Porsa II |
| 2017 | Kvalsund | Hammerfest Lufthavn | Porsa II | Porsa II |
| 2018 | Måsøy | Fruholmen fyr | Porsa II | Porsa II |
| 2019 | Nordkapp | Honningsvåg | Lebesby | Lebesby |
| 2020 | Porsanger Porsángu Porsanki | Banak | Lebesby | Lebesby |
| 2021 | Kárásjohka Karasjok | Karasjok | Karasjok | Karasjok |
| 2022 | Lebesby | Banak | Lebesby | Lebesby |
| 2023 | Gamvik | Mehamn | Gamvik | Gamvik |
| 2024 | Berlevåg | Berlevåg lufthavn | Vestre Jakobselv | Vestre Jakobselv |
| 2025 | Deatnu Tana | Rustefjelbma | Rustefjelbma | Rustefjelbma |
| 2027 | Unjárga Nesseby | Rustefjelbma | Rustefjelbma | Rustefjelbma |
| 2028 | Båtsfjord | Båtsfjord | Vestre Jakobselv | Vestre Jakobselv |

**Appendix 4 – Municipal Division of Norway**

We have arranged the neighboring municipalities according to connecting land borders and by road connection. We have only included the municipalities of mainland Norway. The data is retrieved from The Norwegian Mapping Authority.

| Municipal ID | Municipality | Neigboring municipalities | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **0101** | Halden | Aremark | Rakkestad | Sarpsborg | | | | | |
| **0104** | Moss | Rygge | Vestby | Våler | Hvaler | | | | |
| **0105** | Sarpsborg | Halden | Rakkestad | Hvaler | Fredrikstad | Råde | Våler | Skiptvet | |
| **0106** | Fredrikstad | Hvaler | Sarpsborg | Råde | | | | | |
| **0111** | Hvaler | Fredrikstad | Sarpsborg | Halden | | | | | |
| **0118** | Aremark | Halden | Rakkestad | Marker | | | | | |
| **0119** | Marker | Rakkestad | Aremark | Eidsberg | Aurskog-Høland | Rømskog | | | |
| **0121** | Rømskog | Marker | Aurskog-Høland | | | | | | |
| **0122** | Trøgstad | Eidsberg | Spydeberg | Askim | Aurskog-Høland | Fet | Enebakk | | |
| **0123** | Spydeberg | Askim | Skiptvet | Våler | Hobøl | Enebakk | Trøgstad | | |
| **0124** | Askim | Spydeberg | Skiptvet | Eidsberg | Trøgstad | | | | |
| **0125** | Eidsberg | Askim | Marker | Trøgstad | Rakkestad | Skiptvet | | | |
| **0127** | Skiptvet | Eidsberg | Spydeberg | Askim | Våler | Rakkestad | Sarpsborg | | |
| **0128** | Rakkestad | Skiptvet | Eidsberg | Sarpsborg | Aremark | Marker | Halden | | |
| **0135** | Råde | Fredrikstad | Sarpsborg | Våler | Rygge | | | | |
| **0136** | Rygge | Råde | Moss | Våler | | | | | |
| **0137** | Våler | Rygge | Råde | Moss | Skiptvet | Sarpsborg | Spydeberg | Hobøl | Vestby |
| **0138** | Hobøl | Våler | Spydeberg | Vestby | Ås | Ski | Enebakk | | |
| **0211** | Vestby | Moss | Våler | Hobøl | Ås | Frogn | | | |
| **0213** | Ski | Hobøl | Ås | Oppegård | Enebakk | Oslo | | | |
| **0214** | Ås | Ski | Hobøl | Vestby | Frogn | Oppegård | | | |
| **0215** | Frogn | Nesodden | Ås | Vestby | Hurum | | | | |
| **0216** | Nesodden | Frogn | | | | | | | |
| **0217** | Oppegård | Ås | Ski | Oslo | | | | | |
| **0219** | Bærum | Asker | Lier | Hole | Ringerike | Oslo | | | |
| **0220** | Asker | Bærum | Lier | Røyken | | | | | |
| **0221** | Aurskog-Høland | Trøgstad | Fet | Sørum | Nes | Marker | Rømskog | Eidskog | |
| **0226** | Sørum | Aurskog-Høland | Nes | Ullensaker | Gjerdrum | Skedsmo | Fet | | |
| **0227** | Fet | Aurskog-Høland | Trøgstad | Enebakk | Rælingen | Skedsmo | Sørum | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| **0228** | Rælingen | Fet | Enebakk | Lørenskog | Skedsmo | | | | | |
| **0229** | Enebakk | Trøgstad | Spydeberg | Hobøl | Ski | Oslo | Rælingen | Fet | Lørenskog | |
| **0230** | Lørenskog | Rælingen | Enebakk | Oslo | | | | | | |
| **0231** | Skedsmo | Fet | Rælingen | Lørenskog | Oslo | Nittedal | Gjerdrum | Sørum | | |
| **0233** | Nittedal | Skedsmo | Gjerdrum | Nannestad | Oslo | Lunner | | | | |
| **0234** | Gjerdrum | Skedsmo | Nittedal | Nannestad | Ullensaker | Sørum | | | | |
| **0235** | Ullensaker | Sørum | Nes | Eidsvoll | Nannestad | Gjerdrum | | | | |
| **0236** | Nes | Ullensaker | Eidsvoll | Sørum | Aurskog-Høland | Nord-Odal | Sør-Odal | Eidskog | | |
| **0237** | Eidsvoll | Nes | Ullensaker | Nannestad | Hurdal | Østre Toten | Stange | Nord-Odal | | |
| **0238** | Nannestad | Ullensaker | Eidsvoll | Hurdal | Gran | Lunner | Nittedal | Gjerdrum | | |
| **0239** | Hurdal | Eidsvoll | Nannestad | Gran | Østre Toten | | | | | |
| **0301** | Oslo | Oppegård | Bærum | Ringerike | Ski | Enebakk | Lørenskog | Skedsmo | Nittedal | Lunner |
| **0402** | Kongsvinger | Eidskog | Sør-Odal | Grue | | | | | | |
| **0403** | Hamar | Ringsaker | Åmot | Løten | Stange | | | | | |
| **0412** | Ringsaker | Hamar | Åmot | Gjøvik | Lillehammer | Øyer | Stor-Elvdal | | | |
| **0415** | Løten | Hamar | Åmot | Elverum | Våler | Stange | | | | |
| **0417** | Stange | Hamar | Løten | Våler | Åsnes | Nord-Odal | Eidsvoll | | | |
| **0418** | Nord-Odal | Stange | Sør-Odal | Nes | Eidsvoll | Åsnes | Grue | | | |
| **0419** | Sør-Odal | Nord-Odal | Nes | Eidskog | Kongsvinger | Grue | | | | |
| **0420** | Eidskog | Kongsvinger | Sør-Odal | Aurskog-Høland | Nes | | | | | |
| **0423** | Grue | Kongsvinger | Sør-Odal | Nord-Odal | Åsnes | | | | | |
| **0425** | Åsnes | Grue | Nord-Odal | Stange | Våler | | | | | |
| **0426** | Våler | Åsnes | Stange | Løten | Elverum | Trysil | | | | |
| **0427** | Elverum | Trysil | Våler | Åmot | Løten | | | | | |
| **0428** | Trysil | Våler | Elverum | Åmot | Rendalen | Engerdal | | | | |
| **0429** | Åmot | Trysil | Elverum | Løten | Hamar | Ringsaker | Stor-Elvdal | Rendalen | | |
| **0430** | Stor-Elvdal | Åmot | Rendalen | Ringsaker | Øyer | Ringebu | Sør-Fron | Folldal | Alvdal | |
| **0432** | Rendalen | Stor-Elvdal | Alvdal | Tynset | Tolga | Engerdal | Trysil | Åmot | | |
| **0434** | Engerdal | Rendalen | Trysil | Tolga | Os | Røros | | | | |
| **0436** | Tolga | Engerdal | Os | Rendalen | Tynset | | | | | |

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| **0437** | Tynset | Tolga | Os | Rendalen | Alvdal | Folldal | Oppdal | Rennebu | Midtre Gauldal |
| **0438** | Alvdal | Tynset | Folldal | Stor-Elvdal | Rendalen | | | | |
| **0439** | Folldal | Alvdal | Tynset | Stor-Elvdal | Sør-Fron | Sel | Dovre | Oppdal | |
| **0441** | Os | Tolga | Engerdal | Tynset | Røros | Holtålen | Midtre Gauldal | Røros | |
| **0501** | Lillehammer | Øyer | Ringsaker | Gjøvik | Nordre Land | Gausdal | | | |
| **0502** | Gjøvik | Østre Toten | Vestre Toten | Ringsaker | Lillehammer | Nordre Land | Søndre Land | | |
| **0511** | Dovre | Lesja | Vågå | Sel | Folldal | Oppdal | | | |
| **0512** | Lesja | Dovre | Vågå | Lom | Skjåk | Oppdal | Sunndal | Nesset | Rauma |
| **0513** | Skjåk | Lesja | Lom | Rauma | Norddal | Stranda | Stryn | Luster | |
| **0514** | Lom | Skjåk | Lesja | Vågå | Vang | Luster | | | |
| **0515** | Vågå | Lom | Vang | Øystre Slidre | Nord-Fron | Sel | Dovre | Lesja | |
| **0516** | Nord-Fron | Vågå | Sel | Sør-Fron | Øystre Slidre | | | | |
| **0517** | Sel | Nord-Fron | Folldal | Sør-Fron | Dovre | Vågå | | | |
| **0519** | Sør-Fron | Nord-Fron | Sel | Folldal | Stor-Elvdal | Ringebu | Gausdal | Øystre Slidre | |
| **0520** | Ringebu | Sør-Fron | Stor-Elvdal | Gausdal | Øyer | | | | |
| **0521** | Øyer | Lillehammer | Gausdal | Ringebu | Stor-Elvdal | Ringsaker | | | |
| **0522** | Gausdal | Lillehammer | Nordre Land | Øyer | Ringebu | Sør-Fron | Øystre Slidre | Nord-Aurdal | |
| **0528** | Østre Toten | Hurdal | Eidsvoll | Vestre Toten | | | | | |
| **0529** | Vestre Toten | Østre Toten | Gjøvik | Søndre Land | Gran | | | | |
| **0532** | Jevnaker | Lunner | Gran | Ringerike | | | | | |
| **0533** | Lunner | Gran | Jevnaker | Oslo | Nittedal | Nannestad | Ringerike | | |
| **0534** | Gran | Lunner | Jevnaker | Søndre Land | Vestre Toten | Hurdal | Nannestad | Ringerike | |
| **0536** | Søndre Land | Gran | Vestre Toten | Gjøvik | Nordre Land | Sør-Aurdal | Ringerike | | |
| **0538** | Nordre Land | Søndre Land | Gjøvik | Lillehammer | Etnedal | Sør-Aurdal | Gausdal | Nord-Aurdal | |
| **0540** | Sør-Aurdal | Nord-Aurdal | Etnedal | Nordre Land | Søndre Land | Ringerike | Flå | Gol | Nes |
| **0541** | Etnedal | Nord-Aurdal | Sør-Aurdal | Nordre Land | | | | | |
| **0542** | Nord-Aurdal | Etnedal | Sør-Aurdal | Gausdal | Øystre Slidre | Vestre Slidre | Hemsedal | Gol | |
| **0543** | Vestre Slidre | Øystre Slidre | Vang | Nord-Aurdal | Hemsedal | | | | |
| **0544** | Øystre Slidre | Vestre Slidre | Vang | Vågå | Nord-Fron | Sør-Fron | Gausdal | Nord- | |

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| **0545** | Vang | Vestre Slidre | Øystre Slidre | Vågå | Lom | Hemsedal | Lærdal | Årdal | Luster | | | |
| **0602** | Drammen | Lier | Nedre Eiker | Svelvik | Sande | Hof | | | | | | |
| **0604** | Kongsberg | Flesberg | Øvre Eiker | Hof | Lardal | Notodden | Sauherad | Skien | Siljan | | | |
| **0605** | Ringerike | Hole | Modum | Krødsherad | Flå | Sør-Aurdal | Søndre Land | Gran | Jevnaker | Lunner | Oslo | Bærum |
| **0612** | Hole | Ringerike | Bærum | Lier | | | | | | | | |
| **0615** | Flå | Nes | Sør-Aurdal | Ringerike | Krødsherad | Sigdal | Nore og Uvdal | | | | | |
| **0616** | Nes | Flå | Gol | Ål | Nore og Uvdal | Sør-Aurdal | | | | | | |
| **0617** | Gol | Nes | Ål | Hemsedal | Nord-Aurdal | Sør-Aurdal | | | | | | |
| **0618** | Hemsedal | Gol | Ål | Nord-Aurdal | Vestre Slidre | Vang | Lærdal | | | | | |
| **0619** | Ål | Hemsedal | Gol | Nes | Nore og Uvdal | Hol | Lærdal | | | | | |
| **0620** | Hol | Ål | Nore og Uvdal | Lærdal | Aurland | Ulvik | Eidfjord | | | | | |
| **0621** | Sigdal | Flå | Nore og Uvdal | Krødsherad | Rollag | Flesberg | Øvre Eiker | Modum | | | | |
| **0622** | Krødsherad | Sigdal | Flå | Ringerike | Modum | | | | | | | |
| **0623** | Modum | Ringerike | Krødsherad | Sigdal | Øvre Eiker | Lier | | | | | | |
| **0624** | Øvre Eiker | Nedre Eiker | Modum | Sigdal | Flesberg | Kongsberg | Hof | | | | | |
| **0625** | Nedre Eiker | Øvre Eiker | Lier | Drammen | | | | | | | | |
| **0626** | Lier | Drammen | Nedre Eiker | Modum | Hole | Bærum | Asker | Røyken | | | | |
| **0627** | Røyken | Lier | Asker | Hurum | | | | | | | | |
| **0628** | Hurum | Røyken | Svelvik | Frogn | | | | | | | | |
| **0631** | Flesberg | Rollag | Sigdal | Øvre Eiker | Kongsberg | Notodden | Tinn | | | | | |
| **0632** | Rollag | Flesberg | Sigdal | Nore og Uvdal | Tinn | | | | | | | |
| **0633** | Nore og Uvdal | Rollag | Sigdal | Flå | Nes | Ål | Hol | Eidfjord | Tinn | Vinje | | |
| **0701** | Horten | Tønsberg | Re | | | | | | | | | |
| **0702** | Holmestrand | Sande | Hof | Re | | | | | | | | |
| **0704** | Tønsberg | Horten | Re | Stokke | Nøtterøy | | | | | | | |
| **0706** | Sandefjord | Stokke | Larvik | Andebu | | | | | | | | |
| **0709** | Larvik | Sandefjord | Andebu | Lardal | Siljan | Porsgrunn | | | | | | |
| **0711** | Svelvik | Hurum | Drammen | Sande | | | | | | | | |
| **0713** | Sande | Svelvik | Drammen | Hof | Holmestrand | | | | | | | |

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| **0714** | Hof | Sande | Drammen | Øvre Eiker | Kongsberg | Holmestrand | Re | Lardal | |
| **0716** | Re | Holmestrand | Hof | Lardal | Andebu | Stokke | Tønsberg | Horten | |
| **0719** | Andebu | Stokke | Re | Lardal | Larvik | Sandefjord | | | |
| **0720** | Stokke | Re | Andebu | Sandefjord | Tønsberg | | | | |
| **0722** | Nøtterøy | Tønsberg | Tjøme | | | | | | |
| **0723** | Tjøme | Nøtterøy | | | | | | | |
| **0728** | Lardal | Larvik | Andebu | Re | Hof | Kongsberg | Siljan | | |
| **0805** | Porsgrunn | Larvik | Siljan | Skien | Bamble | | | | |
| **0806** | Skien | Porsgrunn | Siljan | Kongsberg | Sauherad | Nome | Bamble | Drangedal | |
| **0807** | Notodden | Sauherad | Bø | Seljord | Hjartdal | Tinn | Kongsberg | Flesberg | |
| **0811** | Siljan | Porsgrunn | Skien | Kongsberg | Larvik | Lardal | | | |
| **0814** | Bamble | Porsgrunn | Kragerø | Drangedal | Skien | | | | |
| **0815** | Kragerø | Bamble | Drangedal | Risør | Gjerstad | | | | |
| **0817** | Drangedal | Bamble | Kragerø | Skien | Nome | Kviteseid | Nissedal | Gjerstad | |
| **0819** | Nome | Skien | Sauherad | Bø | Kviteseid | Drangedal | | | |
| **0821** | Bø | Seljord | Notodden | Sauherad | Nome | | | | |
| **0822** | Sauherad | Bø | Nome | Skien | Notodden | Kongsberg | | | |
| **0826** | Tinn | Flesberg | Rollag | Nore og Uvdal | Vinje | Seljord | Hjartdal | Notodden | |
| **0827** | Hjartdal | Notodden | Tinn | Seljord | | | | | |
| **0828** | Seljord | Hjartdal | Tinn | Vinje | Tokke | Kviteseid | Bø | Notodden | |
| **0829** | Kviteseid | Seljord | Tokke | Fyresdal | Nissedal | Drangedal | Nome | | |
| **0830** | Nissedal | Kviteseid | Fyresdal | Drangedal | Gjerstad | Åmli | Vegårshei | | |
| **0831** | Fyresdal | Nissedal | Kviteseid | Tokke | Valle | Bygland | Åmli | | |
| **0833** | Tokke | Fyresdal | Kviteseid | Seljord | Vinje | Bykle | Valle | | |
| **0834** | Vinje | Tinn | Seljord | Tokke | Bykle | Nore og Uvdal | Ullensvang | Odda | Suldal |
| **0901** | Risør | Kragerø | Gjerstad | Vegårshei | Tvedestrand | | | | |
| **0904** | Grimstad | Arendal | Froland | Birkenes | Lillesand | | | | |
| **0906** | Arendal | Tvedestrand | Froland | Grimstad | | | | | |
| **0911** | Gjerstad | Risør | Tvedestrand | Vegårshei | Nissedal | Drangedal | Kragerø | | |
| **0912** | Vegårshei | Gjerstad | Risør | Tvedestrand | Åmli | Nissedal | | | |

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| **0914** | Tvedestrand | Risør | Vegårshei | Froland | Arendal | Åmli | | | | |
| **0919** | Froland | Arendal | Tvedestrand | Åmli | Bygland | Evje og Hornnes | Birkenes | Grimstad | | |
| **0926** | Lillesand | Grimstad | Birkenes | Kristiansand | | | | | | |
| **0928** | Birkenes | Grimstad | Froland | Evje og Hornnes | Iveland | Vennesla | Kristiansand | Lillesand | | |
| **0929** | Åmli | Vegårshei | Tvedestrand | Froland | Bygland | Fyresdal | Nissedal | | | |
| **0935** | Iveland | Evje og Hornnes | Birkenes | Vennesla | | | | | | |
| **0937** | Evje og Hornnes | Iveland | Birkenes | Froland | Bygland | Åseral | Audnedal | Marnardal | Vennesla | |
| **0938** | Bygland | Valle | Åmli | Evje og Hornnes | Froland | Fyresdal | Sirdal | Kvinesdal | Åseral | |
| **0940** | Valle | Bygland | Bykle | Tokke | Fyresdal | Sirdal | | | | |
| **0941** | Bykle | Valle | Tokke | Vinje | Suldal | Hjelmeland | Forsand | Sirdal | | |
| **1001** | Kristiansand | Lillesand | Birkenes | Vennesla | Songdalen | Søgne | | | | |
| **1002** | Mandal | Søgne | Marnardal | Lindesnes | | | | | | |
| **1003** | Farsund | Lyngdal | Kvinesdal | Flekkefjord | | | | | | |
| **1004** | Flekkefjord | Farsund | Kvinesdal | Sirdal | Lund | Sokndal | | | | |
| **1014** | Vennesla | Kristiansand | Songdalen | Marnardal | Evje og Hornnes | Iveland | Birkenes | | | |
| **1017** | Songdalen | Vennesla | Kristiansand | Søgne | Marnardal | | | | | |
| **1018** | Søgne | Songdalen | Kristiansand | Marnardal | Mandal | | | | | |
| **1021** | Marnardal | Søgne | Mandal | Lindesnes | Audnedal | Evje og Hornnes | Songdalen | Vennesla | | |
| **1026** | Åseral | Kvinesdal | Hægebostad | Audnedal | Evje og Hornnes | Bygland | | | | |
| **1027** | Audnedal | Hægebostad | Lyngdal | Lindesnes | Songdalen | Marnardal | Evje og Hornnes | Åseral | | |
| **1029** | Lindesnes | Mandal | Marnardal | Audnedal | Lyngdal | | | | | |
| **1032** | Lyngdal | Lindesnes | Audnedal | Hægebostad | Kvinesdal | Farsund | | | | |
| **1034** | Hægebostad | Lyngdal | Kvinesdal | Åseral | Audnedal | | | | | |
| **1037** | Kvinesdal | Flekkefjord | Farsund | Lyngdal | Hægebostad | Åseral | Bygland | Sirdal | | |
| **1046** | Sirdal | Kvinesdal | Flekkefjord | Lund | Bjerkreim | Gjesdal | Forsand | Bykle | Valle | Eigersund |
| **1101** | Eigersund | Sokndal | Lund | Sirdal | Bjerkreim | Hå | | | | |
| **1102** | Sandnes | Gjesdal | Time | Klepp | Stavanger | Sola | Forsand | | | |
| **1103** | Stavanger | Sandnes | Randaberg | Sola | | | | | | |
| **1106** | Haugesund | Karmøy | Tysvær | Sveio | | | | | | |

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| **1111** | Sokndal | Lund | Eigersund | Flekkefjord | | | |
| **1112** | Lund | Sokndal | Flekkefjord | Sirdal | Eigersund | | |
| **1114** | Bjerkreim | Gjesdal | Time | Hå | Eigersund | Sirdal | |
| **1119** | Hå | Eigersund | Bjerkreim | Time | Klepp | | |
| **1120** | Klepp | Hå | Time | Sandnes | Sola | | |
| **1121** | Time | Hå | Bjerkreim | Gjesdal | Sandnes | Klepp | |
| **1122** | Gjesdal | Bjerkreim | Sirdal | Forsand | Sandnes | Time | |
| **1124** | Sola | Klepp | Sandnes | Stavanger | | | |
| **1127** | Randaberg | Stavanger | Rennesøy | | | | |
| **1129** | Forsand | Gjesdal | Sirdal | Bykle | Hjelmeland | Strand | Sandnes |
| **1130** | Strand | Forsand | Hjelmeland | | | | |
| **1133** | Hjelmeland | Strand | Suldal | Bykle | Forsand | Finnøy | |
| **1134** | Suldal | Hjelmeland | Vindafjord | Sauda | Odda | Bykle | |
| **1135** | Sauda | Suldal | Odda | Etne | | | |
| **1141** | Finnøy | Hjelmeland | Rennesøy | | | | |
| **1142** | Rennesøy | Stavanger | Finnøy | | | | |
| **1144** | Kvitsøy | | | | | | |
| **1145** | Bokn | Tysvær | | | | | |
| **1146** | Tysvær | Bokn | Karmøy | Haugesund | Sveio | Vindafjord | |
| **1149** | Karmøy | Tysvær | Haugesund | | | | |
| **1151** | Utsira | | | | | | |
| **1160** | Vindafjord | Tysvær | Sveio | Etne | Suldal | | |
| **1201** | Bergen | Askøy | Fjell | Os | Samnanger | Osterøy | Meland |
| **1211** | Etne | Sauda | Vindafjord | Odda | Kvinnherad | | |
| **1216** | Sveio | Vindafjord | Haugesund | Tysvær | Stord | | |
| **1219** | Bømlo | Stord | | | | | |
| **1221** | Stord | Fitjar | Sveio | Bømlo | | | |
| **1222** | Fitjar | Stord | | | | | |
| **1223** | Tysnes | Fusa | | | | | |
| **1224** | Kvinnherad | Jondal | Etne | Odda | Fusa | Kvam | |
| **1227** | Jondal | Kvinnherad | Ullensvang | | | | |

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| **1228** | Odda | Etne | Sauda | Suldal | Vinje | Ullensvang | Kvinnherad | |
| **1231** | Ullensvang | Odda | Vinje | Eidfjord | Ulvik | Granvin | Kvam | Jondal |
| **1232** | Eidfjord | Ullensvang | Ulvik | Hol | Nore og Uvdal | | | |
| **1233** | Ulvik | Hol | Eidfjord | Granvin | Ullensvang | Aurland | | |
| **1234** | Granvin | Ulvik | Voss | Kvam | Ullensvang | | | |
| **1235** | Voss | Ulvik | Granvin | Kvam | Vaksdal | Aurland | Vik | |
| **1238** | Kvam | Fusa | Kvinnherad | Samnanger | Vaksdal | Voss | Granvin | Ullensvang |
| **1241** | Fusa | Kvinnherad | Tysnes | Kvam | Samnanger | | | |
| **1242** | Samnanger | Fusa | Kvam | Vaksdal | Os | Bergen | | |
| **1243** | Os | Bergen | Samnanger | | | | | |
| **1244** | Austevoll | | | | | | | |
| **1245** | Sund | Fjell | | | | | | |
| **1246** | Fjell | Sund | Bergen | Øygarden | | | | |
| **1247** | Askøy | Bergen | | | | | | |
| **1251** | Vaksdal | Osterøy | Samnanger | Kvam | Voss | Modalen | Vik | |
| **1252** | Modalen | Vaksdal | Lindås | Masfjorden | Vik | Høyanger | | |
| **1253** | Osterøy | Vaksdal | Bergen | | | | | |
| **1256** | Meland | Bergen | | | | | | |
| **1259** | Øygarden | Fjell | | | | | | |
| **1260** | Radøy | Lindås | Austrheim | | | | | |
| **1263** | Lindås | Radøy | Austrheim | Masfjorden | Modalen | | | |
| **1264** | Austrheim | Radøy | Lindås | | | | | |
| **1265** | Fedje | | | | | | | |
| **1266** | Masfjorden | Lindås | Gulen | Høyanger | Modalen | | | |
| **1401** | Flora | Bremanger | Gloppen | Naustdal | | | | |
| **1411** | Gulen | Masfjorden | Høyanger | | | | | |
| **1412** | Solund | | | | | | | |
| **1413** | Hyllestad | Fjaler | Høyanger | | | | | |
| **1416** | Høyanger | Hyllestad | Gulen | Masfjorden | Modalen | Vik | Balestrand | Fjaler |
| **1417** | Vik | Balestrand | Høyanger | Modalen | Vaksdal | Voss | Aurland | |
| **1418** | Balestrand | Høyanger | Vik | Leikanger | Sogndal | Førde | Gaular | |

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| **1419** | Leikanger | Balestrand | Sogndal | | | | | |
| **1420** | Sogndal | Leikanger | Balestrand | Førde | Jølster | Luster | | |
| **1421** | Aurland | Lærdal | Vik | Voss | Ulvik | Hol | | |
| **1422** | Lærdal | Aurland | Årdal | Hol | Ål | Hemsedal | Vang | |
| **1424** | Årdal | Lærdal | Vang | Luster | | | | |
| **1426** | Luster | Årdal | Skjåk | Lom | Vang | Stryn | Jølster | Sogndal |
| **1428** | Askvoll | Fjaler | Førde | Gaular | | | | |
| **1429** | Fjaler | Askvoll | Hyllestad | Gaular | Høyanger | | | |
| **1430** | Gaular | Høyanger | Fjaler | Askvoll | Førde | Balestrand | | |
| **1431** | Jølster | Førde | Naustdal | Gloppen | Stryn | Luster | Sogndal | |
| **1432** | Førde | Gaular | Sogndal | Askvoll | Naustdal | Jølster | Balestrand | |
| **1433** | Naustdal | Jølster | Førde | Gloppen | Flora | | | |
| **1438** | Bremanger | Flora | Gloppen | | | | | |
| **1439** | Vågsøy | Selje | Eid | | | | | |
| **1441** | Selje | Vågsøy | Vanylven | | | | | |
| **1443** | Eid | Vågsøy | Volda | Vanylven | Hornindal | Stryn | | |
| **1444** | Hornindal | Eid | Stryn | Volda | Ørsta | Stranda | | |
| **1445** | Gloppen | Bremanger | Flora | Stryn | Jølster | Naustdal | | |
| **1449** | Stryn | Gloppen | Eid | Hornindal | Jølster | Luster | Stranda | Skjåk |
| **1502** | Molde | Aukra | Fræna | Gjemnes | Nesset | | | |
| **1504** | Ålesund | Skodje | Sula | | | | | |
| **1505** | Kristiansund | Gjemnes | | | | | | |
| **1511** | Vanylven | Volda | Selje | Vågsøy | Eid | | | |
| **1514** | Sande | Herøy | | | | | | |
| **1515** | Herøy | Sande | Ulstein | | | | | |
| **1516** | Ulstein | Hareid | Herøy | | | | | |
| **1517** | Hareid | Ulstein | | | | | | |
| **1519** | Volda | Vanylven | Ørsta | Eid | Hornindal | | | |
| **1520** | Ørsta | Volda | Hornindal | Stranda | Sykkylven | | | |
| **1523** | Ørskog | Stordal | Skodje | Vestnes | | | | |
| **1524** | Norddal | Stordal | Stranda | Rauma | Skjåk | | | |

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| **1525** | Stranda | Norddal | Stordal | Sykkylven | Ørsta | Hornindal | Stryn | Skjåk |
| **1526** | Stordal | Norddal | Stranda | Sykkylven | Ørskog | Vestnes | Rauma | |
| **1528** | Sykkylven | Ørsta | Stranda | Stordal | | | | |
| **1529** | Skodje | Ørskog | Ålesund | Haram | Vestnes | | | |
| **1531** | Sula | Ålesund | | | | | | |
| **1532** | Giske | | | | | | | |
| **1534** | Haram | Skodje | Vestnes | | | | | |
| **1535** | Vestnes | Haram | Skodje | Ørskog | Stordal | Rauma | | |
| **1539** | Rauma | Vestnes | Stordal | Norddal | Nesset | Skjåk | Lesja | |
| **1543** | Nesset | Rauma | Molde | Gjemnes | Sunndal | Lesja | | |
| **1545** | Midsund | | | | | | | |
| **1546** | Sandøy | | | | | | | |
| **1547** | Aukra | Molde | | | | | | |
| **1548** | Fræna | Molde | Eide | Gjemnes | | | | |
| **1551** | Eide | Fræna | Gjemnes | | | | | |
| **1554** | Averøy | | | | | | | |
| **1557** | Gjemnes | Fræna | Eide | Molde | Nesset | Kristiansund | | |
| **1560** | Tingvoll | Sunndal | | | | | | |
| **1563** | Sunndal | Tingvoll | Nesset | Surnadal | Lesja | Oppdal | | |
| **1566** | Surnadal | Sunndal | Rindal | Halsa | Oppdal | | | |
| **1567** | Rindal | Surnadal | Oppdal | Rennebu | Meldal | Hemne | Orkdal | |
| **1571** | Halsa | Surnadal | Hemne | | | | | |
| **1573** | Smøla | | | | | | | |
| **1576** | Aure | Hemne | | | | | | |
| **1601** | Trondheim | Malvik | Melhus | Klæbu | | | | |
| **1612** | Hemne | Aure | Surnadal | Rindal | Orkdal | Snillfjord | | |
| **1613** | Snillfjord | Hemne | Agdenes | Orkdal | | | | |
| **1617** | Hitra | | | | | | | |
| **1620** | Frøya | | | | | | | |
| **1621** | Ørland | Bjugn | | | | | | |
| **1622** | Agdenes | Snillfjord | Orkdal | | | | | |

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| **1624** | Rissa | Bjugn | Åfjord | Leksvik | Verran | | | | |
| **1627** | Bjugn | Ørland | Rissa | Åfjord | | | | | |
| **1630** | Åfjord | Roan | Bjugn | Rissa | Namdalseid | Verran | | | |
| **1632** | Roan | Osen | Åfjord | Namdalseid | | | | | |
| **1633** | Osen | Roan | Namdalseid | Flatanger | | | | | |
| **1634** | Oppdal | Surnadal | Rindal | Sunndal | Lesja | Dovre | Folldal | Tynset | Rennebu |
| **1635** | Rennebu | Oppdal | Tynset | Rindal | Meldal | Midtre Gauldal | | | |
| **1636** | Meldal | Rennebu | Rindal | Orkdal | Melhus | Midtre Gauldal | | | |
| **1638** | Orkdal | Meldal | Hemne | Snillfjord | Rindal | Agdenes | Skaun | Melhus | |
| **1640** | Røros | Engerdal | Os | Holtålen | Tydal | | | | |
| **1644** | Holtålen | Røros | Os | Midtre Gauldal | Selbu | Tydal | | | |
| **1648** | Midtre Gauldal | Rennebu | Tynset | Os | Holtålen | Selbu | Melhus | Meldal | |
| **1653** | Melhus | Midtre Gauldal | Selbu | Klæbu | Trondheim | Skaun | Orkdal | Meldal | |
| **1657** | Skaun | Orkdal | Meldal | Melhus | | | | | |
| **1662** | Klæbu | Trondheim | Melhus | Selbu | | | | | |
| **1663** | Malvik | Selbu | Trondheim | Stjørdal | | | | | |
| **1664** | Selbu | Malvik | Klæbu | Midtre Gauldal | Holtålen | Tydal | Stjørdal | Meråker | |
| **1665** | Tydal | Røros | Holtålen | Selbu | Meråker | | | | |
| **1702** | Steinkjer | Namdalseid | Inderøy | Verran | Verdal | Snåsa | Overhalla | Namsos | |
| **1703** | Namsos | Steinkjer | Namdalseid | Overhalla | Fosnes | | | | |
| **1711** | Meråker | Tydal | Selbu | Stjørdal | Verdal | | | | |
| **1714** | Stjørdal | Malvik | Levanger | Selbu | Meråker | | | | |
| **1717** | Frosta | Levanger | | | | | | | |
| **1718** | Leksvik | Rissa | Verran | Mosvik | | | | | |
| **1719** | Levanger | Frosta | Stjørdal | Verdal | | | | | |
| **1721** | Verdal | Levanger | Meråker | Inderøy | Steinkjer | | | | |
| **1723** | Mosvik | Leksvik | Verran | | | | | | |
| **1724** | Verran | Mosvik | Leksvik | Rissa | | | | | |
| **1725** | Namdalseid | Flatanger | Namsos | Steinkjer | Verran | Åfjord | Roan | Osen | |
| **1729** | Inderøy | Verdal | Steinkjer | | | | | | |

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| **1736** | Snåsa | Verdal | Steinkjer | Grong | Overhalla | Lierne | | |
| **1738** | Lierne | Snåsa | Røyrvik | Grong | | | | |
| **1739** | Røyrvik | Hattfjelldal | Lierne | Namsskogan | | | | |
| **1740** | Namsskogan | Røyrvik | Grong | Høylandet | Bindal | Grane | | |
| **1742** | Grong | Lierne | Snåsa | Overhalla | Høylandet | Namsskogan | | |
| **1743** | Høylandet | Grong | Namsskogan | Overhalla | Fosnes | Nærøy | Bindal | |
| **1744** | Overhalla | Grong | Høylandet | Snåsa | Steinkjer | Namsos | Fosnes | |
| **1748** | Fosnes | Namsos | Overhalla | Høylandet | Nærøy | | | |
| **1749** | Flatanger | Osen | Namdalseid | | | | | |
| **1750** | Vikna | Nærøy | | | | | | |
| **1751** | Nærøy | Vikna | Leka | Fosnes | Høylandet | Bindal | | |
| **1755** | Leka | Nærøy | Bindal | | | | | |
| **1804** | Bodø | Sørfold | Fauske | Saltdal | Beiarn | Gildeskål | | |
| **1805** | Narvik | Ballangen | Evenes | Gratangen | Lavangen | Skånland | Bardu | |
| **1811** | Bindal | Nærøy | Leka | Høylandet | Namsskogan | Grane | Brønnøy | Sømna |
| **1812** | Sømna | Brønnøy | Bindal | | | | | |
| **1813** | Brønnøy | Bindal | Sømna | Grane | Vefsn | Vevelstad | | |
| **1815** | Vega | | | | | | | |
| **1816** | Vevelstad | Brønnøy | Vefsn | | | | | |
| **1818** | Herøy | Dønna | | | | | | |
| **1820** | Alstahaug | Leirfjord | | | | | | |
| **1822** | Leirfjord | Alstahaug | | | | | | |
| **1824** | Vefsn | Vevelstad | Brønnøy | Grane | Hattfjelldal | Hemnes | Leirfjord | |
| **1825** | Grane | Hattfjelldal | Vefsn | Brønnøy | Bindal | Namsskogan | | |
| **1826** | Hattfjelldal | Røyrvik | Grane | Vefsn | Hemnes | | | |
| **1827** | Dønna | Herøy | | | | | | |
| **1828** | Nesna | Rana | | | | | | |
| **1832** | Hemnes | Hattfjelldal | Vefsn | Leirfjord | Rana | | | |
| **1833** | Rana | Hemnes | Nesna | Lurøy | Rødøy | Meløy | Beiarn | Saltdal |
| **1834** | Lurøy | Rana | Rødøy | | | | | |
| **1835** | Træna | | | | | | | |

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| **1836** | Rødøy | Lurøy | Rana | Meløy | | | |
| **1837** | Meløy | Rødøy | Rana | Beiarn | Gildeskål | | |
| **1838** | Gildeskål | Meløy | Beiarn | Bodø | | | |
| **1839** | Beiarn | Bodø | Gildeskål | Meløy | Rana | Saltdal | |
| **1840** | Saltdal | Beiarn | Rana | Bodø | Fauske | | |
| **1841** | Fauske | Saltdal | Bodø | Sørfold | | | |
| **1845** | Sørfold | Bodø | Fauske | Steigen | Hamarøy | | |
| **1848** | Steigen | Sørfold | Hamarøy | | | | |
| **1849** | Hamarøy | Steigen | Sørfold | Tysfjord | | | |
| **1850** | Tysfjord | Hamarøy | Ballangen | | | | |
| **1851** | Lødingen | Tjeldsund | Sortland | Hadsel | Kvæfjord | Vågan | |
| **1852** | Tjeldsund | Lødingen | Evenes | Skånland | Harstad | | |
| **1853** | Evenes | Narvik | Skånland | Tjeldsund | | | |
| **1854** | Ballangen | Narvik | Tysfjord | | | | |
| **1856** | Røst | | | | | | |
| **1857** | Værøy | | | | | | |
| **1859** | Flakstad | Moskenes | Vestvågøy | | | | |
| **1860** | Vestvågøy | Flakstad | Vågan | | | | |
| **1865** | Vågan | Vestvågøy | Hadsel | Lødingen | | | |
| **1866** | Hadsel | Vågan | Lødingen | Sortland | | | |
| **1867** | Bø | Sortland | Øksnes | | | | |
| **1868** | Øksnes | Bø | Sortland | | | | |
| **1870** | Sortland | Øksnes | Bø | Hadsel | Lødingen | Andøy | Kvæfjord |
| **1871** | Andøy | Sortland | | | | | |
| **1874** | Moskenes | Flakstad | | | | | |
| **1901** | Harstad | Kvæfjord | Tjeldsund | Bjarkøy | Skånland | | |
| **1902** | Tromsø | Karlsøy | Lyngen | Storfjord | Balsfjord | | |
| **1911** | Kvæfjord | Lødingen | Sortland | Tjeldsund | Harstad | | |
| **1913** | Skånland | Tjeldsund | Evenes | Narvik | Gratangen | | |
| **1915** | Bjarkøy | Harstad | | | | | |
| **1917** | Ibestad | Salangen | | | | | |

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| **1919** | Gratangen | Lavangen | Bardu | Skånland | Narvik | | | | |
| **1920** | Lavangen | Gratangen | Narvik | Salangen | Bardu | | | | |
| **1922** | Bardu | Lavangen | Narvik | Målselv | Sørreisa | Salangen | | | |
| **1923** | Salangen | Lavangen | Bardu | Ibestad | Dyrøy | Sørreisa | | | |
| **1924** | Målselv | Bardu | Sørreisa | Lenvik | Balsfjord | Storfjord | | | |
| **1925** | Sørreisa | Dyrøy | Salangen | Bardu | Målselv | Lenvik | | | |
| **1926** | Dyrøy | Sørreisa | Salangen | | | | | | |
| **1927** | Tranøy | Lenvik | Torsken | Berg | | | | | |
| **1928** | Torsken | Berg | Tranøy | | | | | | |
| **1929** | Berg | Torsken | Tranøy | Lenvik | | | | | |
| **1931** | Lenvik | Tranøy | Berg | Målselv | Sørreisa | | | | |
| **1933** | Balsfjord | Målselv | Storfjord | Tromsø | | | | | |
| **1936** | Karlsøy | Tromsø | | | | | | | |
| **1938** | Lyngen | Tromsø | Storfjord | | | | | | |
| **1939** | Storfjord | Lyngen | Målselv | Balsfjord | Tromsø | Gáivuotna Kåfjord | | | |
| **1940** | Gáivuotna Kåfjord | Storfjord | Nordreisa | | | | | | |
| **1941** | Skjervøy | Nordreisa | | | | | | | |
| **1942** | Nordreisa | Gáivuotna Kåfjord | Kvænangen | Skjervøy | Guovdageaidnu Kautokeino | | | | |
| **1943** | Kvænangen | Nordreisa | Guovdageaidnu Kautokeino | Alta | Loppa | | | | |
| **2002** | Vardø | Vadsø | Båtsfjord | | | | | | |
| **2003** | Vadsø | Vardø | Båtsfjord | Unjárga Nesseby | Deatnu Tana | | | | |
| **2004** | Hammerfest | Hasvik | Alta | Kvalsund | | | | | |
| **2011** | Guovdageaidnu Kautokeino | Nordreisa | Kvænangen | Kárásjohka Karasjok | Alta | | | | |
| **2012** | Alta | Guovdageaidnu Kautokeino | Kvænangen | Kárásjohka Karasjok | Porsanger Porsángu Porsanki | Kvalsund | Hammerfest | Hasvik | Loppa |
| **2014** | Loppa | Alta | Kvænangen | | | | | | |
| **2015** | Hasvik | Hammerfest | Alta | | | | | | |
| **2017** | Kvalsund | Alta | Hammerfest | Måsøy | Porsanger Porsángu Porsanki | | | | |
| **2018** | Måsøy | Porsanger | Nordkapp | Kvalsund | | | | | |

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| | | Porsángu Porsanki | | | | | | |
| **2019** | Nordkapp | Måsøy | Porsanger Porsángu Porsanki | Lebesby | | | | |
| **2020** | Porsanger Porsángu Porsanki | Nordkapp | Måsøy | Lebesby | Deatnu Tana | Kárásjohka Karasjok | Kvalsund | Alta |
| **2021** | Kárásjohka Karasjok | Guovdageaidnu Kautokeino | Alta | Porsanger Porsángu Porsanki | Deatnu Tana | | | |
| **2022** | Lebesby | Porsanger Porsángu Porsanki | Nordkapp | Gamvik | Deatnu Tana | | | |
| **2023** | Gamvik | Deatnu Tana | Lebesby | | | | | |
| **2024** | Berlevåg | Deatnu Tana | Båtsfjord | | | | | |
| **2025** | Deatnu Tana | Kárásjohka Karasjok | Porsanger Porsángu Porsanki | Lebesby | Gamvik | Berlevåg | Vadsø | Unjárga Nesseby |
| **2027** | Unjárga Nesseby | Deatnu Tana | Vadsø | Sør-Varanger | | | | |
| **2028** | Båtsfjord | Berlevåg | Vadsø | Vardø | | | | |
| **2030** | Sør-Varanger | Unjárga Nesseby | | | | | | |