



# A Critical Readjustment

*Analyzing the Regional Employment Composition in Norway  
During Times of Change*

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Master's Thesis, MSc in Economics and Business Administration

NORWEGIAN SCHOOL OF ECONOMICS

This thesis was written as a part of the Master of Science in Economics and Business Administration at NHH. Please note that neither the institution nor the examiners are responsible – through the approval of this thesis – for the theories and methods used, or results and conclusions drawn in this work.

## Acknowledgements

This thesis was written as a part of our Master of Science degree in Economics and Business Administration at the Norwegian School of Economics in the spring of 2016. Katrine is majoring in Economics, while Emma is majoring in Energy, Natural Resources and the Environment.

The *boom* and the ongoing discussion of a *bust* in the Norwegian petroleum sector interest both of us, and Norway's dependency on natural resources is a common denominator for our major profiles and thus this thesis. As both of us grew up in Rogaland, a region strongly affected by the current economic downturn, we were motivated to take a regional perspective on the topic.

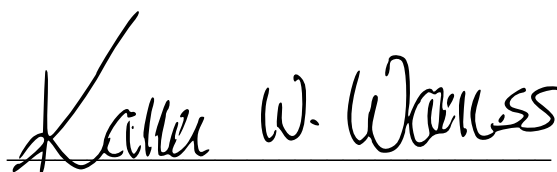
Firstly, we would like to thank Atle Blomgren at IRIS for his dedicated time and generous contribution of data material to this thesis. Without his guidance and vast knowledge on the topic, the work would not have been the same. Furthermore, we are thankful for the contributions on migration statistics from Victoria Hartland Gramstad in Rogaland County Council, and the feedback from all other readers and commentators. This thesis would not have been the same without your support and encouragement.

And last, but not least, we would like to extend our gratitude to our supervisor, Øystein Thøgersen. His academic input has been invaluable, and his enthusiasm and eagerness for the topic has kept our motivation high throughout the thought and writing process.

Bergen, June 2016



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## Abstract

The dramatic fall in the oil price, which started in June 2014, introduced a national debate concerning the future of the petroleum sector in Norway. This thesis examines the sectoral employment composition in Norway, and expands the country-level analysis by looking at regional differences. The main focus is on Rogaland, which is clearly dependent on the petroleum sector. Rogaland's development is compared to three counties that are presumed to be less petroleum dependent, namely Akershus, Oslo and Sør-Trøndelag.

The theoretical foundation is two-sector theory, which aims to explain how different sectors develop as a response to increased resource wealth. The sectoral employment composition in Norway has followed trends in line with the presented theory. The petroleum sector and the non-tradable sector have both increased at the expense of the tradable sector, which has gradually decreased in the period 2000 to 2014.

Labour migration to Norway increased considerably in 2004 and has remained high since then. Rogaland experienced a shortage of labour and the highest average wage growth in the country before the oil price fell. This led to Rogaland having the highest share of labour immigration and the highest total employment growth. Rogaland now faces the highest unemployment rate in the country. The excess of labour now leads to labour emigration rather than immigration, which may dampen the unemployment growth.

Contrary to initial assumptions, the decrease in the tradable sector was less prominent in Rogaland than the national average. Spillover effects from the petroleum sector and a strong total employment growth can contribute to explain this. Furthermore, the non-tradable sector in Rogaland stood out as the smallest among the analyzed counties. This indicates that workers have reallocated from the non-tradable sector to the petroleum sector. The petroleum sector in Rogaland has increased considerably during the analyzed time period. The reasons and possible explanations for these findings are analyzed in detail, highlighting the considerable regional variations in Norway.

The thesis concludes that the sectoral employment in Norway, and particularly in Rogaland, is affected by the petroleum wealth. Finally, we conclude that the petroleum sector will be a part of the Norwegian economy for many years to come, yet its relative importance for Norwegian employment will decline.

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## 1 Introduction

In the early 2000's the petroleum sector in Norway experienced strong growth in production and employment. When the oil price dropped abruptly in 2014, this led to increased unemployment and a discussion about the approaching end of the Norwegian petroleum era. This large disparity and the ongoing debate make an analysis of the Norwegian petroleum sector at present time particularly interesting.

The price drop accelerated the expected decrease in the petroleum sector's role in the Norwegian economy. Rogaland, where about 40 percent of employment is related to petroleum, is the region most affected by the reduced activity in the petroleum sector in Norway (IRIS, 2015). The expected effect of a contracting petroleum sector, accelerated by the recent oil price drop, is a restructuring of the sectoral labour composition in Norway. This adjustment will entail some costs, including a (temporary) higher unemployment rate.

### 1.1 The Norwegian Petroleum Economy

In 2014 the petroleum sector accounted for 18.6 percent of the Norwegian gross domestic product (GDP), approximately 27 percent of the total government revenue and roughly half of the Norwegian exports (Ministry of Petroleum and Energy, 2015). The sector thus constitutes an important role in the Norwegian economy. Since the discovery of the North Sea oil in the late 1960s, necessary structural shifts in the Norwegian labour market have been made to extract these resources. The growing sector has brought with it strong economic growth, increased standards of living and low unemployment rates, as shown in Figure 1.1 and 1.5. Figure 1.1 also shows the separation of the Norwegian GDP into Mainland-GDP and Total GDP. This separation illustrates the importance of the petroleum sector in the Norwegian economy. The difference between the two GDPs peaked in 2004 and has decreased steadily since then, demonstrating a downward trend 10 years before the recent oil price drop.



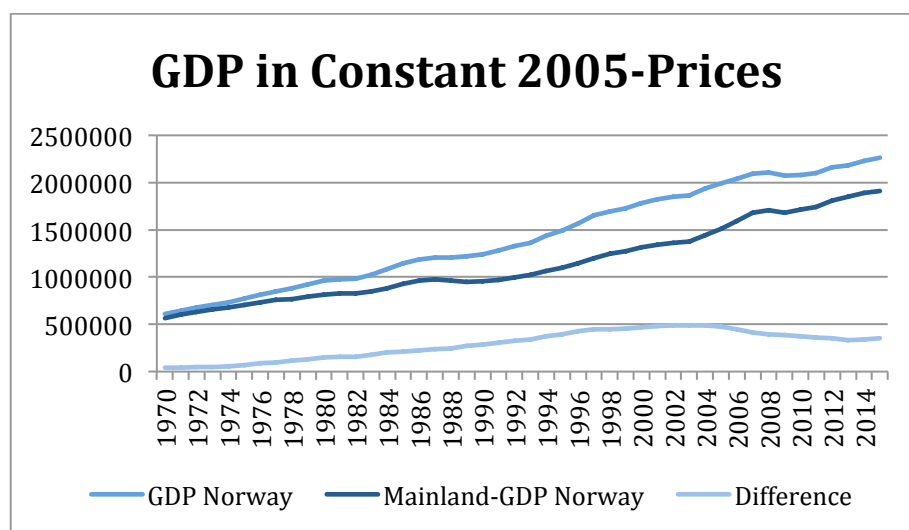


Figure 1.1 Norwegian GDP in constant 2005-prices (Statistics Norway, 2016a; Statistics Norway, 2015a).

When the oil price dropped abruptly during the fall of 2014 it ended a 3-year period of a stable oil price of about USD 100 per barrel. The global economy faced an oversupply of oil, and the demand increased less than expected. This led to a low oil price throughout 2015, and a current oil price of around USD 50 per barrel. The development of the oil price is shown in Figure 1.2.

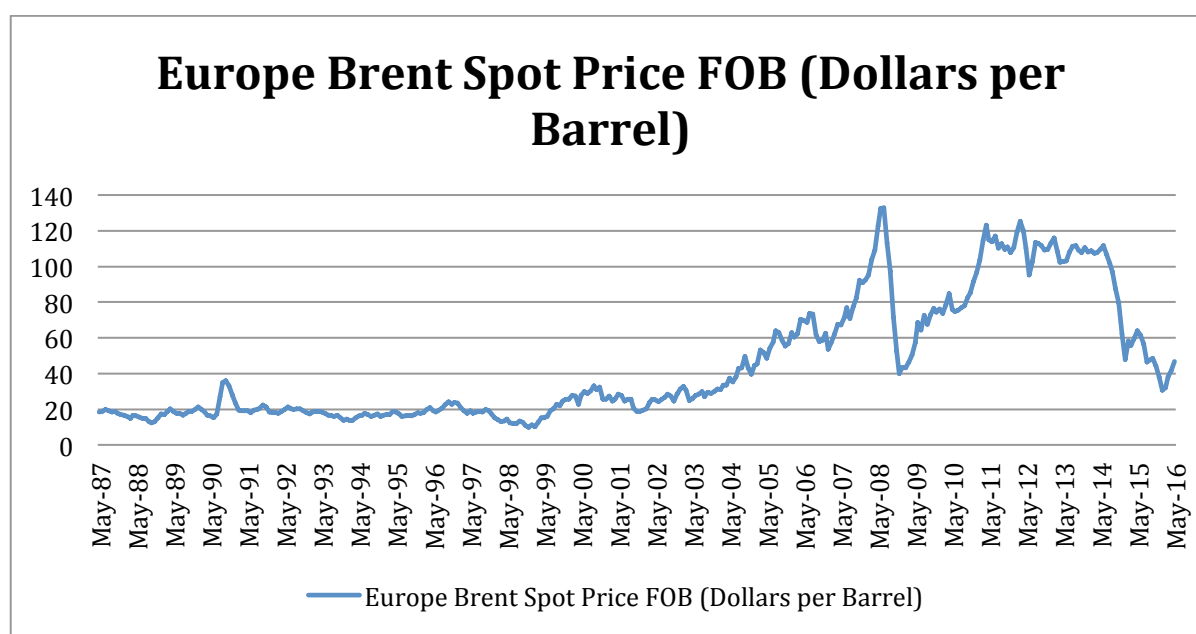


Figure 1.2 Oil price Brent May 1987-Nov 2015 (EIA, 2016).

A consequence of the price drop is reduced economic activity in the Norwegian petroleum sector, including lower investments and reduced exploration activity (Olsen, 2015). The duration of the oversupply of oil has been longer than anyone expected, and this combined

with increasing unemployment, have led to a debate concerning the need for restructuring of the Norwegian economy. However, the price drop only accelerated the expected contraction in the Norwegian petroleum sector. Oil and natural gas are finite natural resources, and the extraction will inevitably end at some point, yet changes in the oil price affect expectations about when this will happen.

## 1.2 The Resource Movement- and Spending Effect

A booming petroleum sector has two effects on the Norwegian economy. The first effect is the *resource movement effect*, which is motivated by the increased demand for labour in the petroleum sector due to a higher marginal product of labour. This leads to a reallocation of labour from other sectors to the booming petroleum sector, and reduced output in all other sectors. The relevant sectors in this thesis are the *petroleum sector*, the *other tradable sector* and the *non-tradable sector*. At constant prices the reduced output in the non-tradable sector leads to excess demand. To balance supply and demand, the price for non-tradable goods has to increase. This, in turn, raises the marginal product of labour, wages, in the non-tradable sector and reduces the reallocation away from this sector.

A boom in the petroleum sector leads to a higher national income. As this income is spent, and given that the income elasticity of demand for goods is positive, this increases the demand for all goods. As the demand for non-tradable goods grows, there is excess demand and the price of non-tradable goods needs to rise. A higher price increases the supply of non-tradable goods, and leads to higher output and employment in the non-tradable sector than before the boom. This effect is called the *spending effect*.

To summarize, both effects lead to decreased output and employment in the tradable sector, i.e. *de-industrialization*, and a higher price for non-tradable goods. However, the combined effect for output and employment in the non-tradable sector is ambiguous. By itself, the resource movement effect will decrease the output and employment in the non-tradable sector. The spending effect, on the other hand, will increase both. Whether output and employment in the non-tradable sector increases or decreases depends on which effect dominates.

As shown in Panel A in Figure 1.3 the demand from the petroleum sector, the resource movement effect, has increased from the 1970s until recently. This period of increased demand is now assumed to have peaked, and the resource movement effect seems to be reversing. The petroleum sector will operate in many years to come, but its relative importance will likely decline.

### **1.2.1 Government Pension Fund Global**

The Norwegian government tries to minimize the spending effect by capturing petroleum rent through taxation and investing the government revenues in financial markets abroad. This enables future generations to benefit from the petroleum wealth, and has contributed to Norwegians being able to permanently maintain the living standard. By collecting the government's petroleum revenues since 1996 in a sovereign wealth fund, named the Government Pension Fund Global (GPF), the government has managed to create the largest sovereign wealth fund in the world. GPF is an instrument for transforming petroleum wealth into financial wealth. By spending the wealth in a sustainable way Norway can avoid tax increases or reductions in public services in the future. In 2001, the Fiscal Rule was implemented to ensure exactly this. The Fiscal Rule states that the amount to be spent from the fund has to be below the 4 percent expected real return in a normal year (Ministry of Finance, NOU 2015:9).

As shown in Panel B in Figure 1.3, the spending effect is expected to decline over time, as a percentage of Mainland-GDP. "Measured as a proportion of output in the mainland economy, the peak [of petroleum revenue spending] will be passed as revenues from oil production decline and the economy continues to grow" (Ministry of Finance, NOU 2015:9, p. 1). In order to avoid a sharp reduction in future spending, it is vital to keep spending growth at a minimum in the years to come. The stronger the growth in spending (referred to as Impulse in Panel B), the sharper the decline will be in the long run.

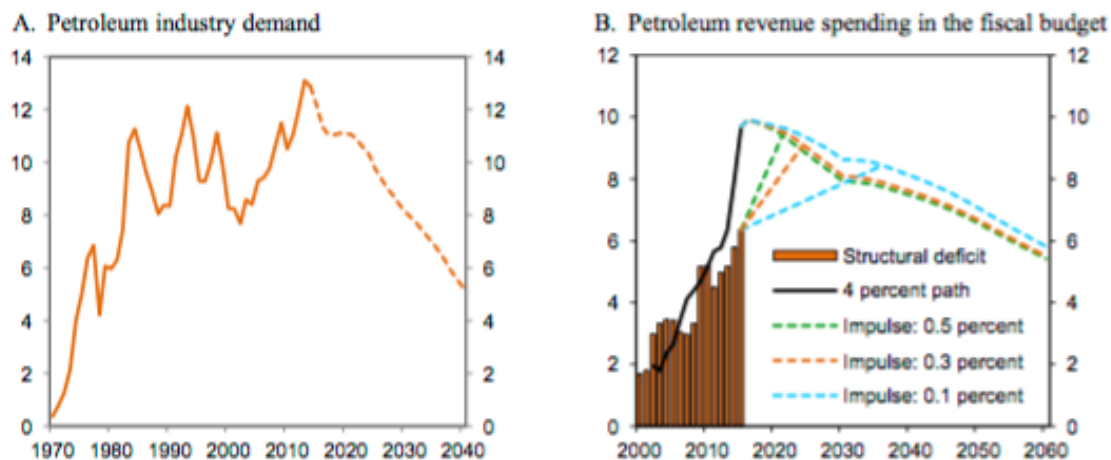
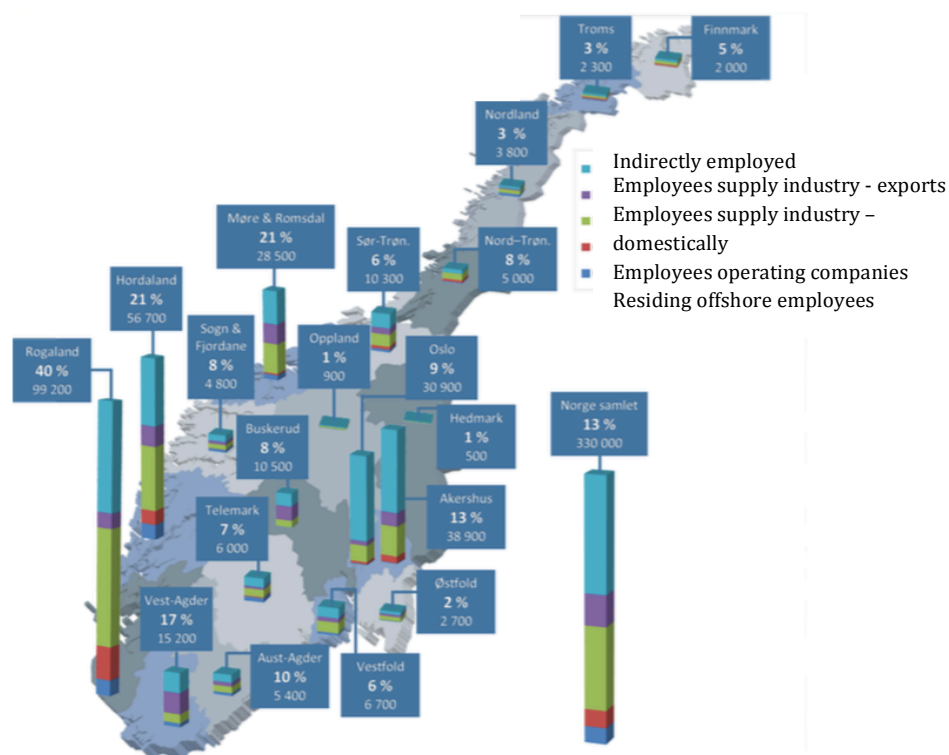


Figure 1.3 Petroleum sector demand and revenue spending in the fiscal budget, percentage of mainland-GDP (Ministry of Finance, NOU 2015:9)

### 1.3 The Regional Petroleum Economy

As in most cases where natural resources have been discovered, the development of the industry has been regional. When the “oil era” of Norway began, in the early 1970s, the petroleum region had to be chosen. Ultimately, Stavanger in Rogaland, geographically situated close to the early petroleum discoveries in the North Sea, was chosen. Since then, the petroleum sector was built up in and around Stavanger. The related governmental institutions and private and state-owned petroleum companies located in the region, and Rogaland experienced extensive labour immigration as a consequence. The employment in the petroleum sector in Rogaland has been high. This is evident today, with the highest amount of petroleum related employment in Norway, at 40 percent, see Figure 1.4.



**Figure 1.4 Indirect and direct employment in the petroleum sector, and share of total employment by county (IRIS, 2015)**

On the basis of the aforementioned argument, this thesis will take a regional perspective on the altered situation in the petroleum sector, and look specifically at Rogaland. Rogaland is a county heavily affected by the petroleum sector, and is the region where changes in this sector will prevail faster and stronger. Hordaland and Møre og Romsdal have substantial shares of petroleum related employment too, at 21 percent.

Throughout the thesis, we will compare Rogaland to Sør-Trøndelag, Oslo and Akershus. These two areas are relatively populous, with big cities (namely Trondheim and Oslo), but are far less influenced by the petroleum sector than Rogaland. From Figure 1.4 we can see that the counties have 6 percent, 9 percent and 13 percent petroleum related employment, respectively. This difference in relative importance allows us to highlight the uniqueness of Rogaland in the situations where it is relevant, while still maintaining an overview of the developments in other parts of Norway.

Following the oil price drop in 2014, and the slowdown in petroleum activity, the unemployment rate has increased, particularly in Rogaland. This increase is evident in Figure 1.5. As of May 2016, Rogaland has the highest unemployment rate in the country, at 4,3 percent (NAV, 2016a). Akershus, Oslo and Sør-Trøndelag have an unemployment rate of 2,3, 3,1 and 2,4 percent, respectively. The national average is 2,9 in May 2016 (NAV, 2016a).

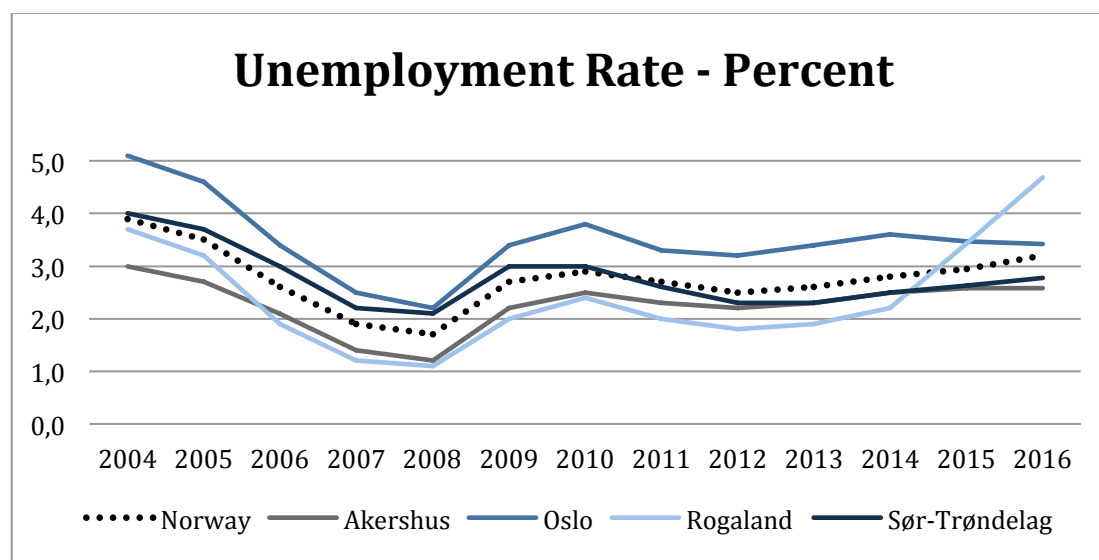


Figure 1.5 Unemployment rate in Norway and selected counties 2004-2015, and calculated average for 2016 (NAV, 2016a).

As evident from Figure 1.5 the unemployment rate in Rogaland has been below the country average since 2004 until the recent surge. The high activity in the petroleum sector has decreased unemployment in Rogaland. Oslo has had a higher unemployment rate than the national average throughout the analyzed period. It is important to note, however, that the unemployment rate in Norway is still low compared to most countries. An unemployment rate of 4,3 percent, which Rogaland has at the moment, is low by global standards, and living conditions in Norway are still high compared to other countries.

## 1.4 Two-Sector Theory

In economic theory, a framework that has gained recognition for analyzing how a country develops in response to an increase in its resource wealth is the split between the non-tradable and tradable sectors. The non-tradable sector can be defined as a sector with production of goods or services that cannot be traded internationally. Generally, these are mostly services like haircuts, retailing and public services. Although it is possible to trade these services

internationally, the costs associated with the trade are often higher than the perceived gain of the trade.

The tradable sector, on the other hand, can be defined as a sector with production of goods and services that compete with international production (Norman & Orvedal, 2012). This entails production of both export- and import competing goods. Although there is a relatively clear-cut distinction in theory, this divide of sectors can be hard to make in practice. Statistics Norway states that “all industries are exposed to foreign competition, but some more than others”, and base their classification on “share of value added from an industry which is based on exports and import shares for the main products of the industry” (Eika, Strøm, & Cappelen, 2013, p. 5). Some of the industries they categorize as tradable are resource-based industry, manufacturing and industries supplying the petroleum sector. As the non-tradable sector is relatively more labour intensive than the tradable sector, a majority of the Norwegian employment is within the non-tradable sector (Norman & Orvedal, 2012).

With a boom in one sector, the petroleum sector, some sectoral adjustment effects are expected, previously defined as the resource movement effect and the spending effect. Primarily, the increased profitability in the booming sector will attract employment from the other sectors. The increased income will have a positive effect on the demand for non-tradable goods, and thus the employment in the non-tradable sector. Employment and output in the tradable sector will decline, often referred to as de-industrialization (Corden & Neary, 1982).

## **1.5 Research Questions**

The question of Norway’s dependency on the petroleum sector is a heavily debated topic and several papers have attempted to examine this dependency. This thesis will analyze Norwegian employment data to explore whether the effects of the two-sector theory are present in Norway, and whether they are more prominent in Rogaland than in the other counties.

The recent developments in the Norwegian economy, and particularly the increased unemployment in Rogaland, give rise to the following four research questions:

1. How does the Norwegian sectoral adjustment of the labour market and economy compare to two-sector theory?
2. How does Rogaland's sectoral development compare to other counties in Norway that are less exposed to the petroleum sector?
3. Has migration played a role in the employment rates in Rogaland?
4. How will a reversal from petroleum dependency affect the regional economy?

## 1.6 Expected Findings

Based on two-sector theory we expect to find

- Increased employment in the petroleum sector, at the expense of the tradable sector
- That the downsizing of the tradable sector has been greater in Rogaland than in other counties
- Increased employment in the non-tradable sector, particularly within services and the public sector

The petroleum wealth can be considered a windfall gain (Norman & Orvedal, 2012), which allows Norway to consume more internationally traded goods than we produce. By using the petroleum wealth we can afford to import goods from other countries, and can use our own labour in the non-tradable sector. This will in theory lead to other competitive industries in Norway being reduced. Labour and capital from this sector shift towards the petroleum sector where the profits are higher. In our analysis we then expect to find decreased employment in the other tradable sector and increased employment in the petroleum sector.

Rogaland, with the highest share of petroleum related employment, is expected to have experienced a more severe downsizing of the tradable sector than the other counties. By comparing the development in Rogaland to other counties we expect to find a stronger growth in the petroleum sector and a stronger de-industrialization.

At the same time, the increased income from the petroleum sector leads to the Norwegian population wanting more of all goods and services. Non-tradable goods must be produced



within the borders of the country, and often in the same location as they are consumed. This means that the increased income from the petroleum sector also leads to an increase in employment within the non-tradable sector.

## **1.7 Structure of the Thesis**

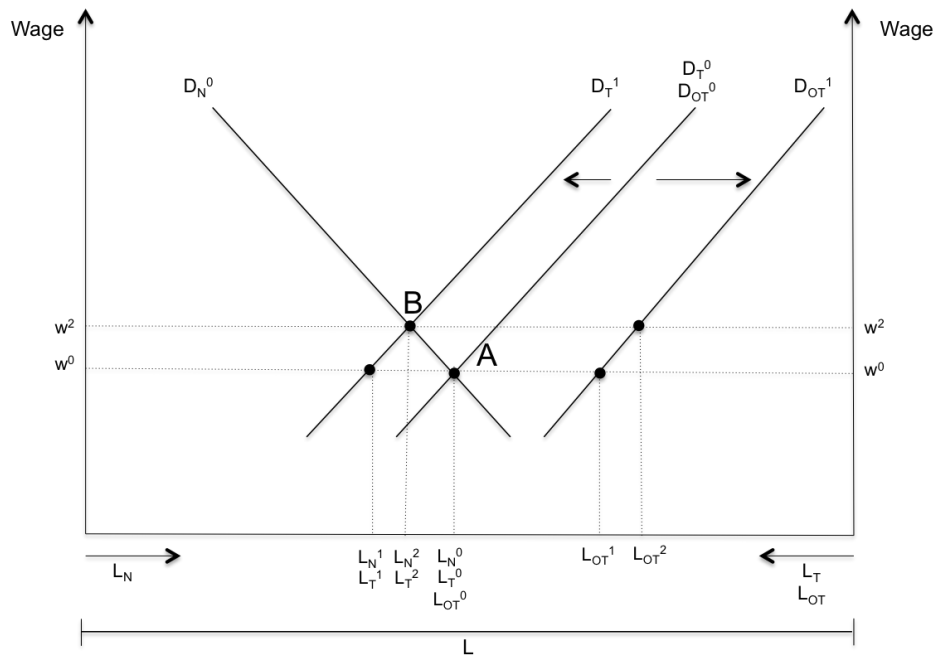
The thesis starts with an overview of two-sector theory. Furthermore, we expand by including migration and the factors complicating reversal to a post-petroleum state. A description of the data set follows, before we analyze whether the findings are consistent with the presented theoretical framework. The next section contains an analysis of the economic development after the oil price fell, complemented by an overview of oil price theory, as well as a postulation of possible future scenarios for market development. The last segment of the thesis contains further discussion and analysis of our findings and projections based on the presented scenarios.

## 2 Two-Sector Theory of Economic Development

The Norwegian petroleum reserves discovered in the late 1960s led to a booming petroleum sector in Norway. Discoveries of natural resources in a small open economy lead to sectoral changes in the demand for labour and capital. These adjustments are described in the so-called two-sector theory, and the following framework and analysis is adopted from Corden and Neary (1982). Two-sector theory is often used as a framework for the analysis of “Dutch disease”. The term Dutch Disease can seem curious: labeling a highly profitable sector like the petroleum sector a disease? Nevertheless, the disease aspect of the term refers to the reversal of this sectoral restructuring, and the potentially involved economic stagnation and increasing unemployment (Steigum, 1989).

The economy before the boom in the petroleum industry is characterized by a *tradable sector* (T) and a *non-tradable sector* (N). The tradable sector produces tradable goods and competes in the global market and faces exogenously given world prices. The non-tradable sector operates in the domestic market, and the prices ( $P_N$ ) are set endogenously to equalize supply and demand of the non-tradable good. The model is simplified by only operating with relative prices and by keeping the trade balance constant. In addition, the theory assumes flexible real wages, a fixed labour stock and full employment at all times.

In order to demonstrate the effects of a booming petroleum sector on the sectoral composition of labour and the wage level, a simple Heckscher-Ohlin framework is used. This framework is illustrated in Figure 2.1. The horizontal axis represents total labour supply, and the two vertical axes represent the wage level. The initial equilibrium in the labour market, i.e. before the boom in petroleum, is given by point A, the intercept between the demand for labour in the non-tradable sector ( $D_N^0$ ) and the demand for labour in the tradable sector ( $D_T^0$ ). At this point the wage level is at  $w^0$ , the amount employed in the non-tradable sector is given by  $L_N^0$  (measured from left to right) and the amount employed in the tradable sector is given by  $L_T^0$  (measured from right to left).



**Figure 2.1 Resource movement effect following a boom in the petroleum sector in the Heckscher-Ohlin framework. (Corden & Neary, 1982)**

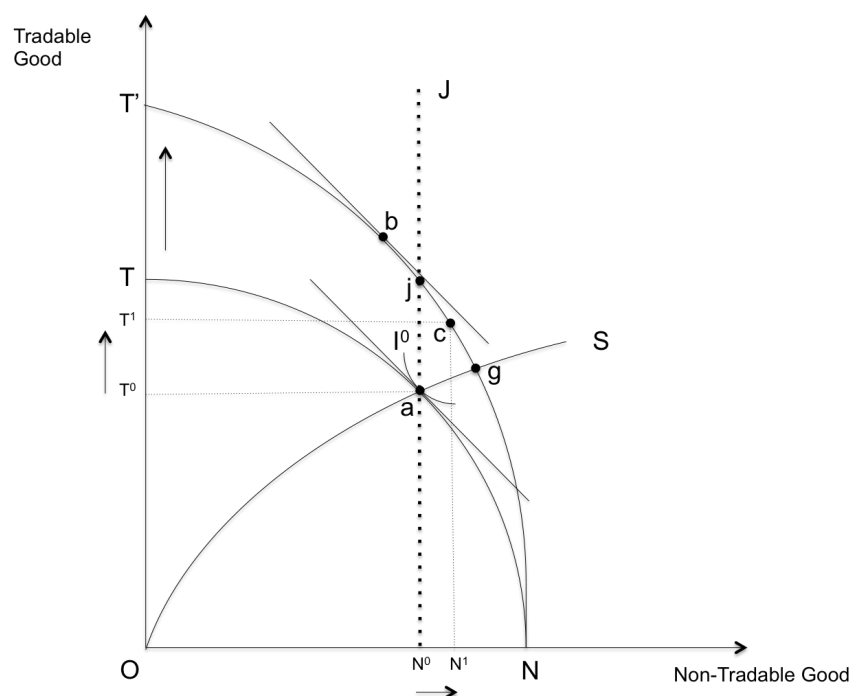
The booming petroleum sector is a part of the tradable sector, and we consequently divide this sector into two parts: the petroleum sector (P) and the other tradable sector (OT). All three parts of the economy share the same labour market (L) and labour is perfectly mobile between sectors. Existing capital is assumed to be specific to each sector, and is thus immobile. To assess only the resource movement effect, we first assume zero income-elasticity of demand.

As the petroleum sector grows, the demand for labour in this sector increases. This moves the demand curve for the entire tradable sector,  $D_T^0$ , to the left, now called  $D_T^1$ . The demand curve for labour in the tradable sector is divided into one total demand curve and one demand curve for the other tradable sector to highlight the effects of the boom. The demand curve for labour in the other tradable sector then moves from  $D_T^0 / D_{OT}^0$  to  $D_{OT}^1$ , decreasing because workers are reallocated to the more profitable petroleum sector. Keeping wages fixed at  $w^0$ , the employment in the non-tradable sector is given by  $L_N^1$ , the employment in other tradable sector is given by  $L_{OT}^1$ , and the amount employed in the petroleum sector is given by the distance between  $L_N^1$  and  $L_{OT}^1$ .

At the current wage level,  $w^0$ , the demand for labour in the non-tradable sector is higher than employment in the sector. With a fixed labour supply, the economy now faces a labour

shortage, thus the wages increase to  $w^2$  to equalize supply and demand. Higher wages reduce the demand for labour in the tradable sector until we end up in equilibrium B, the intercept between  $D_N^0$  and  $D_T^1$ . The introduction of the petroleum sector and the resulting increase in wages both contribute to reducing employment in other tradable sector, thus leading to de-industrialization.

The reallocation between sectors leads to a change in the relative prices of goods produced in the non-tradable and tradable sectors, respectively. To illustrate these changes, the commodity market is illustrated in a production possibility frontier diagram, a so-called Salter diagram (Corden & Neary, 1982). The tradable good is on the vertical axis and the non-tradable good is on the horizontal axis in Figure 2.2. In the diagram,  $P_N$  is treated as an endogenous variable. The initial equilibrium is in point  $a$ , where the production possibilities curve intersects the highest attainable indifference curve,  $I_0$ . The real exchange rate is given by the slope of the tangency line in point  $a$ .

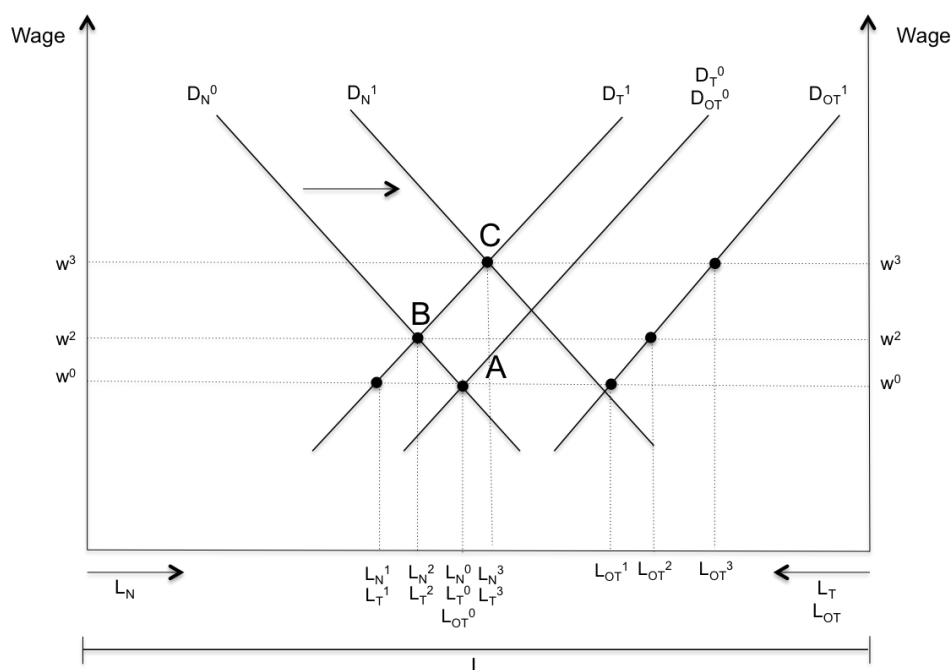


**Figure 2.2 The effects of the boom on the commodity market in a Salter diagram (Corden & Neary, 1982)**

A booming petroleum sector raises the maximum production in the tradable sector, while the maximum production in the non-tradable sector remains unchanged. This shifts the production possibilities curve vertically upwards from  $TN$  to  $T'N$ . Holding the exchange rate constant, the resource movement effect leads to a new production point  $b$ . This point lies to

the left of  $a$ , illustrating the initial reallocation of labour shown in Figure 2.1 from the non-tradable sector to the petroleum sector. Assuming that the income-elasticity of demand for the non-tradable good is zero, to abstract from the spending effect, gives a vertical income-consumption line through  $a$ , which intersects  $T'N$  in  $j$ . This line is illustrated by the dotted line  $J$  in Figure 2.2. Hence the resource movement effect leads to excess demand for the non-tradable good. To equalize supply and demand, the price of the non-tradable good needs to rise. The final adjustment of the resource movement effect will be somewhere between point  $b$  and  $j$ .

To assess the spending effect, the assumption of zero income-elasticity of demand is relaxed. Keeping the real exchange rate fixed, the new production will be in point  $b$  after the boom in the petroleum sector. Demand, on the other hand, moves along the income-consumption curve, the  $OS$  curve in Figure 2.2, to point  $g$ . The income-consumption curve shows the set of stationary equilibria for different levels of income where consumption of non-tradable good equals production. Again, the excess demand causes an appreciation, and the final adjustment of the spending effect will be between point  $j$  and point  $g$ . The total effect will depend on the relative size of the resource movement effect and the spending effect. In this case, the new equilibrium is in point  $c$ , indicating that the spending effect dominates. This will increase the demand for labour in the non-tradable sector. Returning to the Heckscher-Ohlin model, this increase in demand for labour in the non-tradable sector can be illustrated with the shift from  $D_N^0$  to  $D_N^1$  in Figure 2.3. The new equilibrium in the Heckscher-Ohlin framework is point  $C$ , where  $D_N^1$  intercepts  $D_T^1$ , at wage level  $w^3$ .



**Figure 2.3 The resource movement- and spending effect of the boom in a Heckscher-Ohlin framework (Corden & Neary, 1982).**

The total effect of the petroleum boom on employment in the non-tradable sector is ambiguous. The resource movement effect decreases the output of the non-tradable good, thus lowering employment, while the spending effect pulls the output in the opposite direction (Corden & Neary, 1982). In this case, we saw that the spending effect dominated, and consequently employment in the non-tradable sector is higher in the final equilibrium C than in the initial one, A. The effect of a petroleum boom on the other tradable sector is however unambiguous. As Figure 2.1 shows, the resource movement effect reduces employment in this sector from  $L_{OT}^0$  to  $L_{OT}^2$ . The spending effect further reduces employment in the other tradable sector from  $L_{OT}^2$  to  $L_{OT}^3$ . In the case where the spending effect dominates, the final result of a petroleum boom is increased employment in the petroleum sector and the non-tradable sector, at the expense of employment in the other tradable sector.

## 2.1 Migration

Labour migration has been of key importance for Norway during the last decades. In particular the expansion of the European Union in 2004 gave Eastern Europeans the possibility to enter the European Economic Area (EEA) labour market. Since then, labour migration to Norway increased considerably, mainly from Poland and Lithuania (Ministry of Finance, NOU 2015:9). A robust job market, a high wage level combined with a high

standard of living and a strong welfare state are considered the main reasons for Norway's attractiveness.

Theoretically, we see that following a boom in the petroleum sector, immigration is an expected response. The effect on the real wage  $W^*$ , defined "in terms of a consumption basket of [tradable] and [non-tradable goods]" (Corden W., 1984, p. 362), of a petroleum boom is an increase. Increased wages are likely to attract immigrants. Corden (1984) refers to this effect as the *gold rush effect*, after the Australian gold rushes in the mid 19<sup>th</sup> century. The experienced shortage of labour following a boom can be alleviated by immigration, either from other countries or from other regions within the country. The main effect of migration on production is a higher production possibility curve, which enables increased production of both tradable and non-tradable goods, but at the expense of production possibilities in the regions or countries that experience emigration.

Figure 2.4 shows a framework for market equilibrium in the market for non-tradable goods. The vertical axis shows the price of the non-tradable good, while the horizontal axis shows the quantity produced of non-tradable goods. Initially, we will only look at the resource movement effect, implying that demand stays at  $D_N^0$ . In the Heckscher-Ohlin framework, the resource movement effect decreases the labour stock in the non-tradable sector. Consequently, the supply curve,  $S_N^0$ , shifts to the left to  $S_N^1$ . The excess demand for the non-tradable good pushes the market clearing equilibrium from A to B in Figure 2.4. The spending effect increases the demand for non-tradable goods, thus shifting the demand curve to the right to  $D_N^1$ . The equilibrium without immigration is in point C.

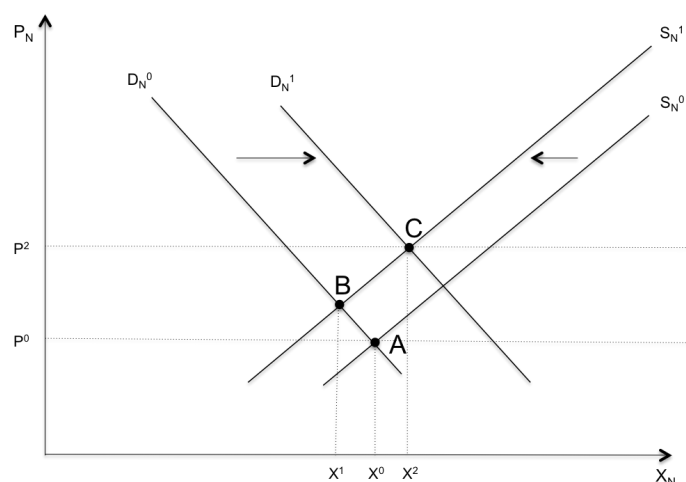


Figure 2.4 Market equilibrium before migration in the market for non-tradable goods (Corden W., 1984)

The new equilibrium is characterized by a higher price for the non-tradable good and a higher wage as seen earlier in the Heckscher-Ohlin framework. In the framework presented earlier, we assumed a fixed labour stock. However, to demonstrate the consequences of migration, this assumption is now relaxed. Higher wages trigger immigration, and thereby an increased labour stock. As the labour stock increases, the employment in the non-tradable sector increases, which shifts the supply curve back to  $S_N^0$ , as shown in Figure 2.5. Migration thus lowers both the price of the non-tradable good and the wage level until point D.

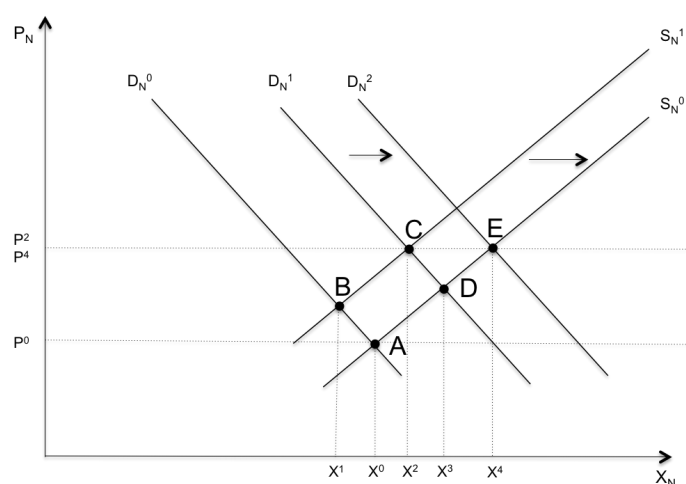


Figure 2.5 Market equilibrium with migration in the market for non-tradable goods (Corden W., 1984).

However, immigration is also likely to increase the spending effect. Immigration will increase the demand for non-tradable goods, moving the demand curve to  $D_N^2$ . The new equilibrium will be in point E. Depending on whether the immigrants' effect is largest on the supply or demand for goods, there might be an effect where *migration fully offsets the de-industrialization* by increasing the output in the other tradable sector. In order to examine this, we must look at  $W$  (the wage in terms of the exposed good) to determine the output level of the other tradable sector.

If there is no spending effect or extra demand for the non-tradable good due to immigration, i.e. no migrants' spending effect,  $W^*$ ,  $W$  and  $P_N$  would be fully restored by immigration and the de-industrialization would be offset, as described above. Conversely, if there is some spending effect or migrants' spending effect, the restoration of  $W$  and  $P_N$  will not be complete, and some de-industrialization remains, mainly due to the increased demand for non-tradable goods. Consequently the price level does not necessarily increase with immigration, but output does. Migration on its own can both lower and raise the price level.



Wage in terms of non-tradable goods, on the other hand, must fall as the output increases, thus increasing the real wage  $W$ . With a higher  $W$ , output in the other tradable sector must be lower in E than in A, indicating that some de-industrialization remains.

On top of the rise in  $W^*$ , there is another effect that might induce immigration. This effect is called the “Alberta effect” and concerns the situation when the extra revenues (rents) from the boom, i.e. the petroleum sector, are collected by the government and subsequently redistributed to the population. This redistribution may come in the form of tax reliefs or improved public services, which attracts immigrants. In this case, immigrants tend to enter both the non-tradable sector and the other tradable sector, thus curbing the de-industrialization.

As demonstrated by Corden’s (1984) analysis, immigration may dampen some of the adverse effects of a booming petroleum sector. Immigration can solve labour shortages, and slow down de-industrialization. In addition, as shown by van Wijnbergen (1984b), countries with immigration may experience a lower real exchange rate, i.e. less appreciation, than countries without immigration.

Furthermore, Allcott and Keniston (2014) have done empirical work examining regional differences and effects of resource booms in the US. In their study, they found that immigration, caused by the increased wage level the booming region experiences, put a downward pressure on the wage level. This effect was nevertheless not found to be an instant one, as migration often occurred about 1-3 years after the resource boom<sup>1</sup>.

The labour migration to Norway has been higher than in other countries in the EEA (Ministry of Petroleum and Energy, 2015). However, experiences from other countries, for example Ireland and Spain, have proven that labour migration is highly cyclical. Given the recent development of the Norwegian economy, we may experience that labour immigrants return to their native country, thus having a positive impact on the Norwegian unemployment. The occurrence of return is related to the length of residence and the scope of rights accrued in the Norwegian welfare system. Consequently, immigrants who have lived and worked in Norway

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<sup>1</sup> Other interesting findings from the study are numerical estimations of percentage growth in population, employment and earnings per worker, on a county-level, following a boom in oil and gas employment. See Allcott & Keniston (2014) for more.

for years, and thus have rights to social welfare programmes, are less likely to return to their native country (Ministry of Finance, NOU 2015:9).

## 2.2 Reversal to a Post-Petroleum State

As a finite natural resource, the extraction of petroleum reserves will inevitably end, and the sectoral distribution of labour will need to be reversed to a post-petroleum state. A negative price shock, like the one experienced from 2014, might expedite the reversal process. A reversal will entail downsizing the petroleum sector, shifting employment from the petroleum sector to the other tradable sector (Steigum, 1989). This reversal process requires a lower wage level, as shown in the Heckscher-Ohlin framework in Figure 2.6. As the petroleum sector is downsized, the demand from the tradable sector moves back to its original level,  $D_T^0/D_{OT}^0$ . The spending effect will also be reversed, shifting the demand from the non-tradable sector back to  $D_N^0$ . The post-petroleum economy has thereby returned to its initial equilibrium A, requiring the corresponding lower wage level,  $w^0$ .

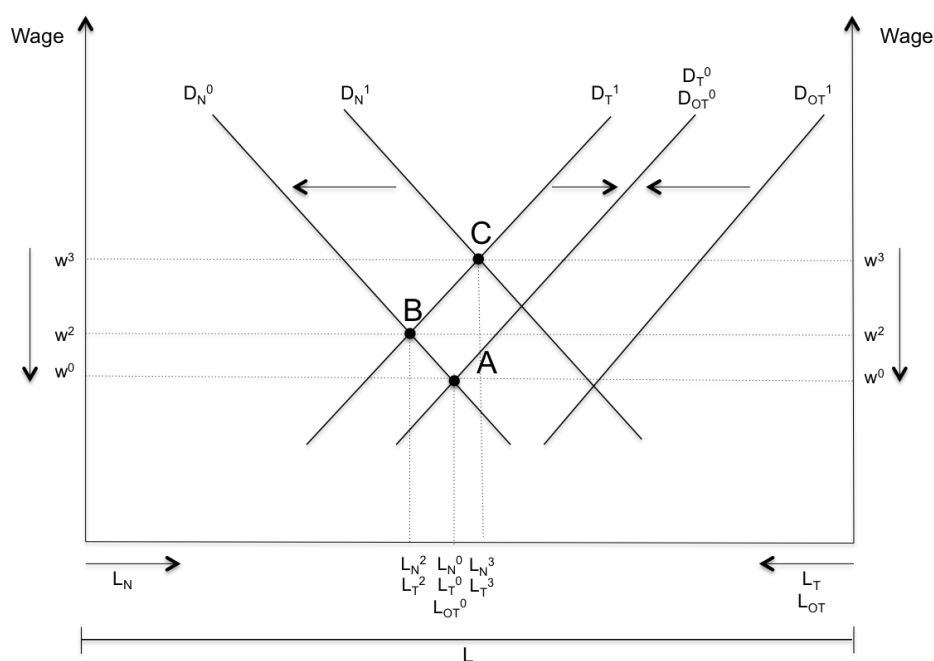
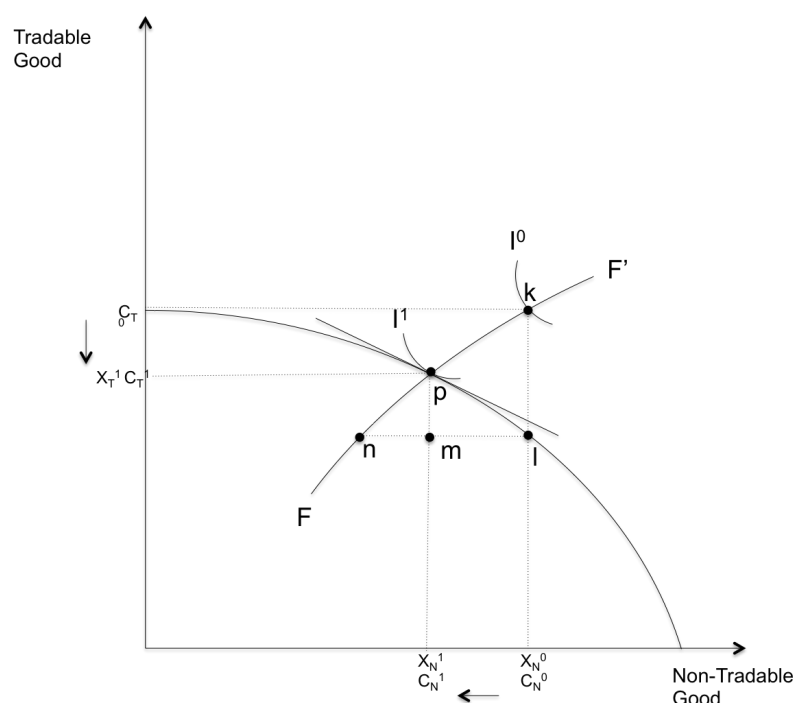


Figure 2.6 Reversal of labour distribution between sectors (Corden & Neary, 1982).

The petroleum sector allowed increased production of non-tradable goods, which resulted in a higher domestic price- and import level compared to the pre-petroleum economy. This is seen by equilibrium  $k$  on the expansion path  $FF'$  in Figure 2.7. However, when the petroleum

reserves end, the country can no longer finance a current account deficit, and consumption has to match production. The expansion path illustrates the reversal the economy has to endure in order to return to consumption of tradable and non-tradable goods that match the production possibility curve.



**Figure 2.7** The reversal process (Norman & Orvedal, 2012).

The reversal to the post-petroleum equilibrium is often problematic. Points  $k$  and  $l$  are the consumption and production equilibria, respectively, and the difference  $kl$  represents the current account deficit. The goal would be to return to point  $p$ , which requires reduced consumption and a transfer of resources from the petroleum sector and non-tradable sector to the other tradable sector.

Steigum (1989) presented two possible problems that delay or prevent structural adjustment, the first being failure to reduce total consumption rapidly. In order to achieve this reduction the government has to enforce a contractionary monetary and fiscal policy. If contractionary measures are not imposed in an adequate time manner, insufficient saving and excessive domestic spending might delay the adjustment of private consumption.

### 2.2.1 Factor Price Rigidities

Steigum (1989) also noted the failure of relative prices and wage adjustments as a problem that exacerbates the reversal problem. If factor prices (wages in our model) are inflexible, particularly downwards, the needed readjustment might not occur. Looking at Figure 2.7, it can be illustrated how nominal wage rigidity might cause unemployment. In a case with downwards wage rigidity, the wage level, measured in foreign currency, will not decrease below point  $l$ . In this case, reduced total demand, from point  $k$  to point  $p$ , will reduce output in the non-tradable sector to point  $m$  instead of  $p$ . The output in the tradable sector will not be affected, as the wage relative to the product price is unchanged. A consequence of this is increased unemployment, and a decreased current account deficit (Steigum, 1984). In order to eliminate the current account deficit, the total demand needs to be reduced further, to point  $n$ . The outcome is then additional unemployment. However, real wage rigidity is more common than nominal wage rigidity, and following a long period of increasing real wages like Norway has experienced (Ministry of Finance, 2013), workers and unions might fight the necessary real wage reductions needed in a period of reversal. Factor price rigidity will cause higher unemployment rates, at least during a transition phase, and the necessary readjustment period in the labour market is prolonged, see Government White Paper (NOU 1988:21).

### 2.2.2 Costs of Sectoral Restructuring

Sectoral restructuring of the labour market will have some associated costs, particularly related to the aforementioned wage rigidity and accompanying unemployment, but also related to the training of employees (Steigum, 1989). Sector-specific knowledge prevents perfect transferability of labour between sectors, which results in increased unemployment rates (Steigum & Thøgersen, 2003).

In any economy, there will always be some unemployment, due to a natural turnover in the labour market. This is referred to as *frictional* unemployment, and is related to imperfect information. In addition to this, short-term unemployment stemming from business cycle variations and wage rigidity can cause higher periodic unemployment, which is called *cyclical* unemployment. The aforementioned oil price drop in 2014 initiated a negative business cycle in Norway, and has caused increased cyclical unemployment. The last type of unemployment is *structural unemployment*. The origin of structural unemployment is a mismatch between the skills needed by firms and the skills possessed by workers (Borjas, 2013). This is

particularly relevant in a case where retrenchment of one sector will result in excess labour that will need to find work in another sector, like in the post-petroleum state. Characteristics of the current Norwegian unemployment will be discussed further in Chapter 5.

In order to resolve the issue of industry-specific knowledge, and thus reduce structural unemployment, there is a need for training of new employees, preferably by experienced workers (Steigum, 1989). Building firm-specific knowledge is the responsibility of the firm, and is thus paid for by the firm. Sector-specific knowledge, on the other hand, differs. In this case, a worker trained in one firm is a perfect substitute for a worker in another firm in the same sector. The firm does not have the incentive to pay for the training, and the worker must consequently pay for it himself. Between sectors however, knowledge will not be transferrable, and workers will need to train themselves or join a government-financed program if they wish to enter a new sector. Lack of the appropriate sector-specific knowledge will cause structural unemployment during a sectoral readjustment of labour.

Theoretical effort has been put into how to manage wage inflexibility, training costs, and the delayed restructuring that follows these rigidities. In his paper, Lapan (1976) discusses the need for subsidies as a measure aimed at driving labour restructuring, if wages are not fully flexible. More specifically, if the wage in the other tradable sector increases insufficiently, this might delay the necessary sectoral transfer of labour from the non-tradable sector to the other tradable sector. Introducing a subsidy or measure that decreases the training costs associated with the sectoral labour transfer, can reduce the transition period.

### **2.2.3 Learning by doing**

Besides unemployment, there is another concomitant effect related to the reversal phase. While the petroleum sector has grown, it has done so at the detriment of the other tradable sector. Relative to a country whose other tradable sector did not face de-industrialization, the other tradable sector has not had the same opportunity to accumulate knowledge and experience, in general the process referred to as “learning by doing” (LBD). It is known that capital accumulation only explains some part of economic growth, while technological progress, often stemming from LBD, accounts for a larger share of the growth (van Wijnbergen, 1984a). During the growth in the petroleum sector, this sector has attracted the main share of (capital) investments, and has gathered necessary and important knowledge for

Countries that have saved their petroleum wealth for future generations, Norway being one example, will not have to fully reverse their consumption. The accumulation of foreign wealth enables countries to sustain a higher consumption of tradable goods than they produce, also post-petroleum. This entails that the severity of the reversal problem can be less for a country like Norway. Although the resource movement effect is present in a reversal phase, a country with a sovereign wealth fund can experience a negative spending effect in the reversal phase. In Figure 2.8, showing the expansion path for a post-petroleum state, the final consumption equilibrium could correspond to point  $o$ , while the production equilibrium is in point  $q$ . These equilibria are characterized by a current account deficit, which is covered by the wealth in the sovereign wealth fund. The practical implication is that full reversal is not needed, implying the possibility for lower transitional unemployment.



An additional advantage of a sovereign wealth fund is that it dampens the spending effect of a booming petroleum sector. By investing the government's petroleum revenues in foreign financial markets, the increase in the national income is less than it would be without the fund. This implies that the petroleum equilibrium  $k$  is closer to post-petroleum equilibrium  $o$  than shown in Figure 2.8, and the need for reversal is even smaller.

### 3 Comparative Sector Employment Analyses

As outlined earlier, the two-sector theory postulates that following a boom in the petroleum sector a sectoral labour adjustment is expected. This includes an increase in petroleum employment at the expense of the tradable sector, while the total effect on employment in the non-tradable sector is ambiguous. If the spending effect dominates, an increase in employment in the non-tradable sector is expected, and conversely a decrease if the resource movement effect is the strongest. This thesis aims to analyze this development in four counties in Norway, highlighting the regional variations within an economy. The petroleum industry in Norway is mainly located in the western parts of the country. By comparing Rogaland, the most petroleum-dependent county, to three other counties we wish to highlight the effects of the petroleum sector.

#### 3.1 Data and Choice of Method

In order to analyze the sectoral developments in Norwegian counties, register-based employment data from Statistics Norway for the years 2000 to 2014 is used (Statistics Norway, 2016b). The data is classified by municipality and 5-digit NACE industry coding<sup>2</sup>. Data sorted by municipality of residence is used, rather than municipality of work. The reason for this is that the municipality of residence is where residents will spend the majority of their income, where employees pay taxes, and where unemployment is registered. Furthermore, this data has been sorted by county and then classified into the three different sectors: petroleum, other tradable and non-tradable.

The time period analyzed here has been reported on two different standards for industrial classification (SIC2002 until 2008 and SIC2007 from 2008 onwards). In order to compare the data from the two reporting standards, the different industries were classified by sector for both SIC2002 and SIC2007. We compared the difference in results for 2008, where we had results reported on both standards, and calculated the difference between the sectors. This difference was then deducted in the data reported by the SIC2002-standard (between 2000 and 2007), to make the results comparable. This method may lead to some discrepancies, but since the relative growth in the three sectors remains unchanged it is not expected to affect the

<sup>2</sup> NACE rev. 2 is the European industry standard, and enables comparisons across time and countries. SIC2007 equals NACE classification.

<sup>3</sup> There is also a fourth category - "undefined". This is employment that Statistics Norway has not been able to categorize. These numbers are very small, and consequently do not affect our findings, but are reported in order



results significantly.

As a basis for the sectoral classification applied to the data set, we have adopted the same procedure as used by Eika, Cappelen and Strøm (2013), see appendix A. In their work, a thorough analysis is done of all industry categories, 2-digit NACE, to determine the degree of exposure to foreign competition. This is done by analyzing the share of exports and the share of imports for the main products in each industry.

**The sector classification used in this thesis is as follows:**

1. Tradable Sector: 2-5, 7-8, 10-17, 19-33 and 50.101
2. Petroleum Sector: 6 and 9
3. Non-tradable Sector: 1, 18, 35-99

This classification is supplemented by the work of Blomgren and Harstad from the International Research Institute of Stavanger (IRIS), see Appendix B, where the share of petroleum related employment in all industries in Norway is estimated on 5-digit NACE industry coding. Industries with 50 percent petroleum related employment or more are classified in the petroleum sector, while industries with less than 50 percent remain in their categories based on Eika, Cappelen and Strøm. By including the 5-digit petroleum dependency, the accuracy level of the petroleum classification increases.

## 3.2 Findings

The following presentation of findings from employment data will be split in three. Firstly, the sectoral composition and growth are presented for Norway, Rogaland, Akershus, Oslo and Sør-Trøndelag. We conjectured that the effects of a booming petroleum sector would be particularly evident in Rogaland, where petroleum employment is undoubtedly largest in Norway. However, we expect these effects to be reflected in the sectoral labour composition in the other three counties as well, as all Norwegian counties have some petroleum activity. Secondly, the developments are compared across counties and further analyzed by sector. Lastly, the analyses are supplemented with data for average wage, employment growth and labour immigration, to highlight any additional effects that need to be considered.

### 3.2.1 National and Regional Analysis

In the following, sectoral composition and growth is presented for Norway and the four counties. The analysis starts by looking at the sectoral composition of employment in the beginning and end of our time period, 2000 and 2014, in absolute and relative numbers, and the national average for sectoral growth.

#### 3.2.1.1 Norway

Evident from Figure 3.1, the non-tradable sector constitutes a sector where a large share of the Norwegian work force is employed. From 2000 to 2014, there was a 2,6-percentage point employment share growth in the non-tradable sector, at the expense of the tradable sector. Considering the low starting point of 11,2 percent of total employment in the tradable sector, the relative reduction is sizeable. In absolute numbers, this has entailed a reduction of almost 50 000 employees in the tradable sector, see Table 3.1. During the period, the share of total employment in the petroleum sector grew from 3,8 percent to 4,9 percent<sup>3</sup>, a growth of approximately 45 000 employees.

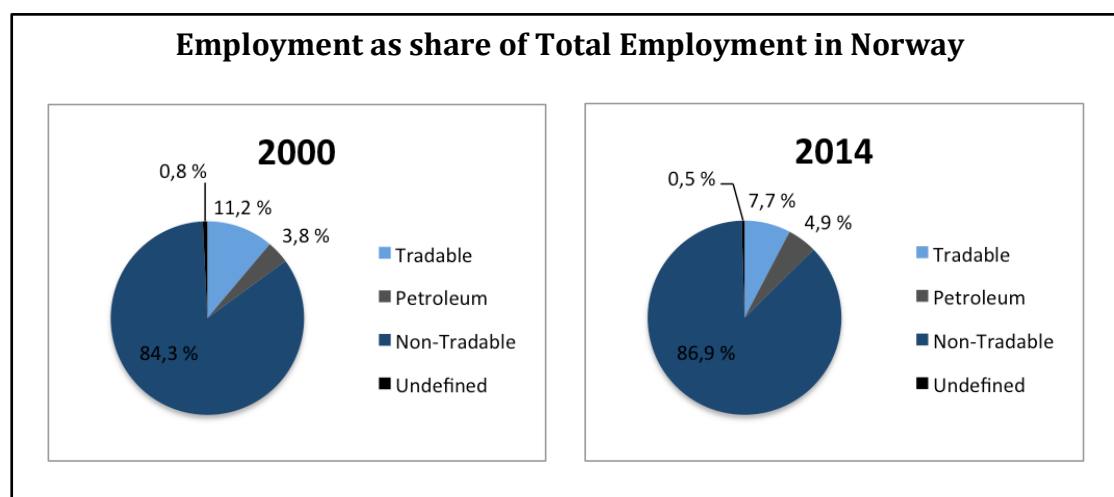


Figure 3.1 Sectoral Employment as share of Total Employment in Norway (Statistics Norway, 2016b).

<sup>3</sup> There is also a fourth category - "undefined". This is employment that Statistics Norway has not been able to categorize. These numbers are very small, and consequently do not affect our findings, but are reported in order to show the correct sum of shares.

Norway	2000	2014	Change
Undefined Sector	17 262	13 045	-24,4 %
Tradable Sector	252 620	204 067	-19,2 %
Petroleum Sector	85 723	130 285	52,0 %
Non-Tradable Sector	1 906 395	2 302 603	20,8 %
<b>Total</b>	<b>2 262 000</b>	<b>2 650 000</b>	<b>17,2 %</b>

Table 3.1 Number of employees by sector in Norway (Statistics Norway, 2016b).

Considering the index for employment development, the aforementioned trends become more evident, see Figure 3.2. The petroleum sector has experienced a rapid growth from 2000 until 2014 of 52 percent. It is important to emphasize that only a 5 percent-share of the work force is employed in the petroleum sector in 2014, because the strong growth came from a low base. Relative to the 2000-numbers, we see that the tradable sector has experienced a decline of roughly 20 percent until 2014. This decreasing trend seems to continue, but at a slower pace now than earlier. In the period from 2000 to 2014, we see a growth in the petroleum and non-tradable sector in Norway at the expense of the tradable sector, consistent with two-sector theory. The growing non-tradable sector implies that the spending effect dominates the resource movement effect.

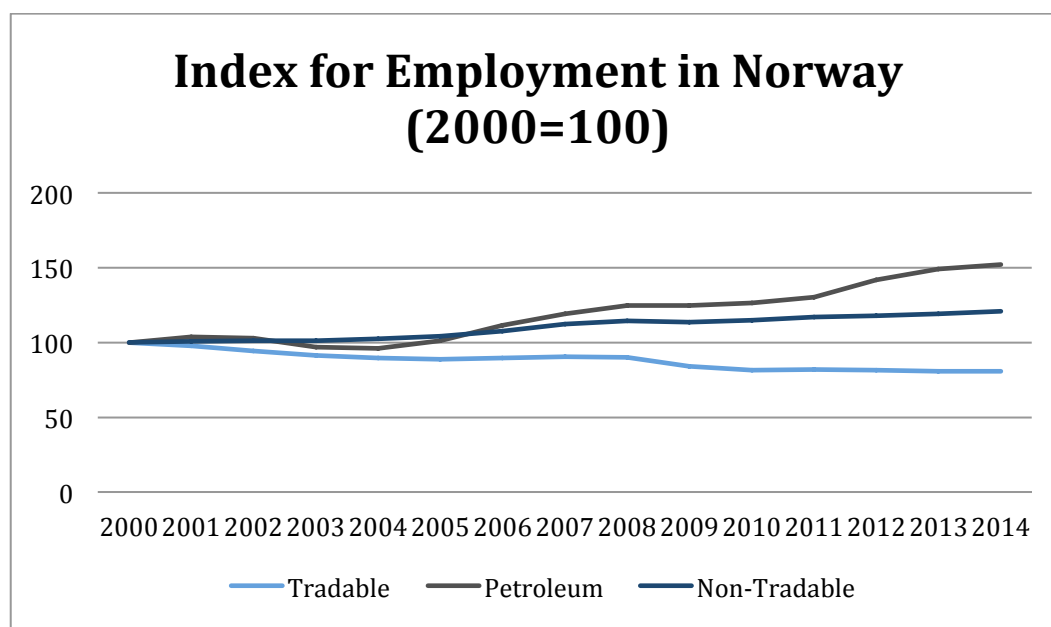


Figure 3.2 Sectoral Employment Development in Norway (Statistics Norway, 2016b).

### 3.2.1.2 Rogaland

The sectoral composition of employment in Rogaland deviates quite strongly from the national averages. Comparing Figure 3.1 and Figure 3.3 makes it evident that the petroleum sector is considerably larger in Rogaland. The share of the work force employed in the non-

tradable sector is well below the national average, indicating that the petroleum sector has grown at the expense of the non-tradable sector. The tradable sector's share of employment equals the national average.

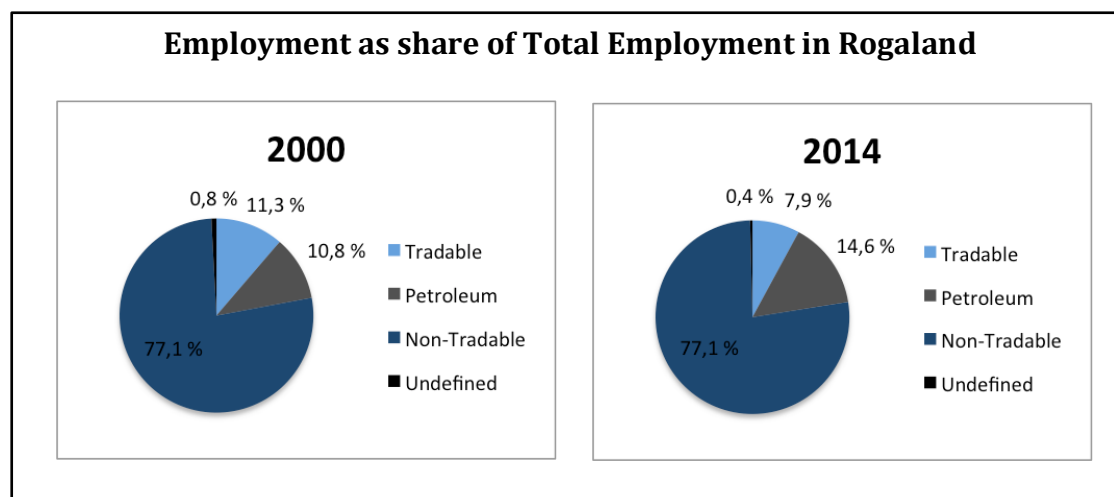


Figure 3.3 Sectoral Employment as share of Total Employment in Rogaland (Statistics Norway, 2016b).

Rogaland	2000	2014	Change
Undefined Sector	1 591	969	-39,1 %
Tradable Sector	21 442	19 768	-7,8 %
Petroleum Sector	20 409	36 365	78,2 %
Non-Tradable Sector	146 224	192 581	31,7 %
<b>Total</b>	<b>189 666</b>	<b>249 683</b>	<b>31,6 %</b>

Table 3.2 Number of employees by sector in Rogaland (Statistics Norway, 2016b).

When assessing the growth in absolute numbers, in Table 3.2 and Figure 3.4, there has been a sizeable growth in the non-tradable sector. This suggests that the spending effect dominates the resource movement effect in Rogaland in the analyzed period. However, the increase in total employment in Rogaland annuls this growth and thus the growth is not evident in the sectoral shares in Figure 3.3. Further findings from Table 3.2 are that employment in the petroleum sector has increased by 78 percent, while employment in the tradable sector has decreased. These findings correspond with two-sector theory. The growth in the petroleum sector is stronger than the national average. However, the decrease in tradable sector has not been as strong in Rogaland as the national average. In fact, in absolute numbers, the reduction in the tradable sector was less than 1700 employees in Rogaland, or about 8 percent. This finding contradicts the initial hypothesis that Rogaland would experience a stronger de-industrialization than other counties in Norway.

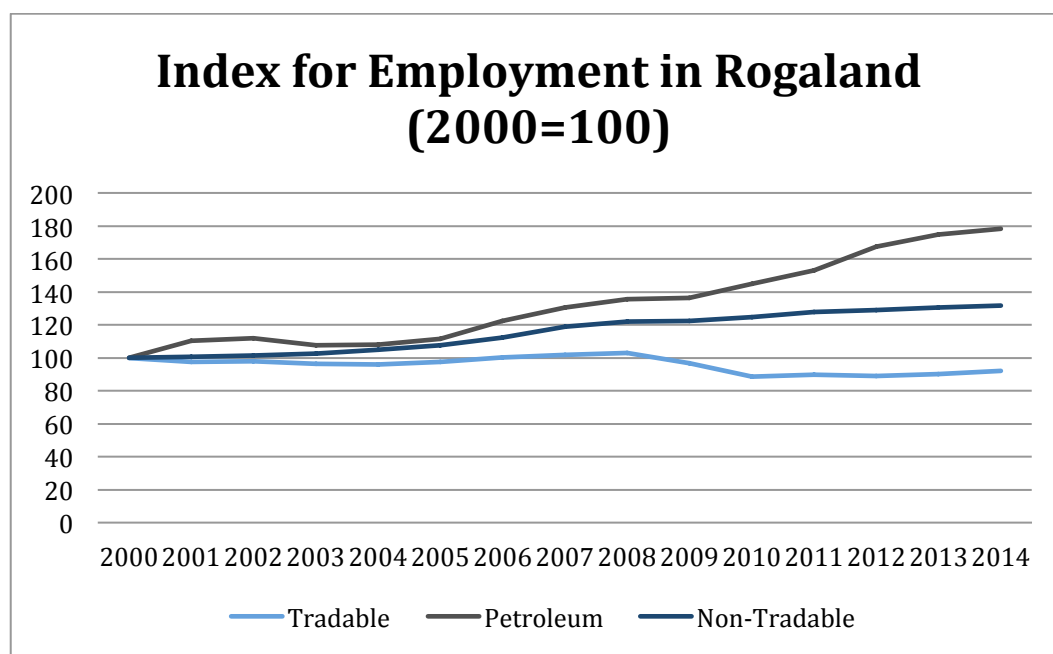


Figure 3.4 Sectoral Employment Development in Rogaland (Statistics Norway, 2016b).

### 3.2.1.3 Akershus

A striking difference in employment shares in Akershus compared to the national average, and particularly relative to Rogaland, is the share of employment in the non-tradable sector. This can be explained by the proximity to the national capital, where the non-tradable sector is expected to be larger, with many of Akershus' inhabitants working in Oslo. From 2000 to 2014 this share increased from 92 percent to 93,6 percent, see Figure 3.5, making the sector the clearly dominant one.

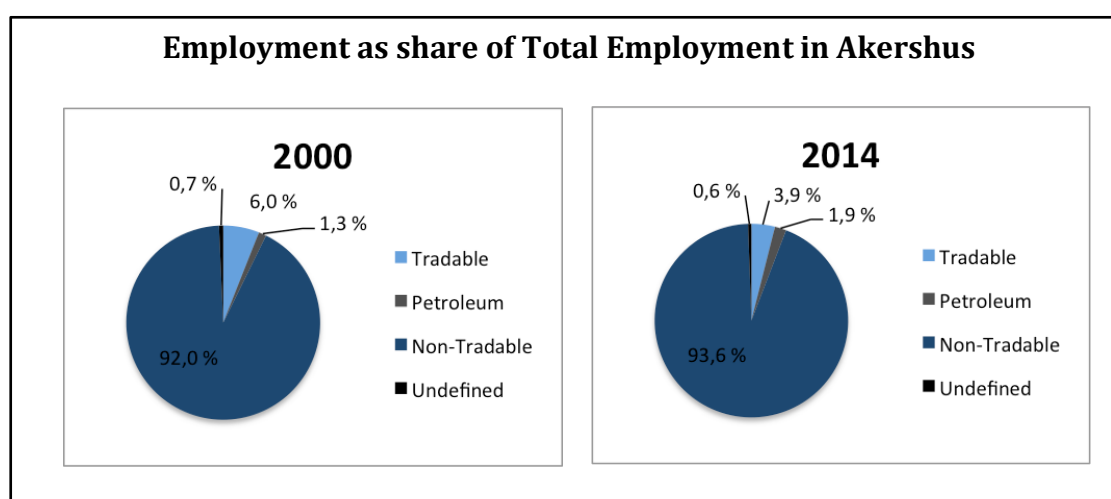


Figure 3.5 Sectoral Employment as share of Total Employment in Akershus (Statistics Norway, 2016b).

Table 3.3 illustrates this dominance in absolute numbers, displaying an increase of over 47 000 employees, or 20 percent, in the 14 year period. In terms of share, employment in the tradable sector has decreased, while the share of employment in the petroleum sector has increased somewhat, in line with the national trends.

Akershus	2000	2014	Change
Undefined Sector	1 774	1 671	-5,8 %
Tradable Sector	15 347	11 857	-22,7 %
Petroleum Sector	3 268	5 761	76,3 %
Non-Tradable Sector	234 723	282 105	20,2 %
<b>Total</b>	<b>255 112</b>	<b>301 394</b>	<b>18,1 %</b>

Table 3.3 Number of employees by sector in Akershus (Statistics Norway, 2016b).

In terms of absolute changes in employment in the different sectors in Table 3.3 and Figure 3.6, this corresponds relatively well with the rest of Norway. Similar to Rogaland, the growth in the petroleum sector has been stronger in Akershus than the national average, at a 76 percent increase compared to 52 percent in Norway on average.

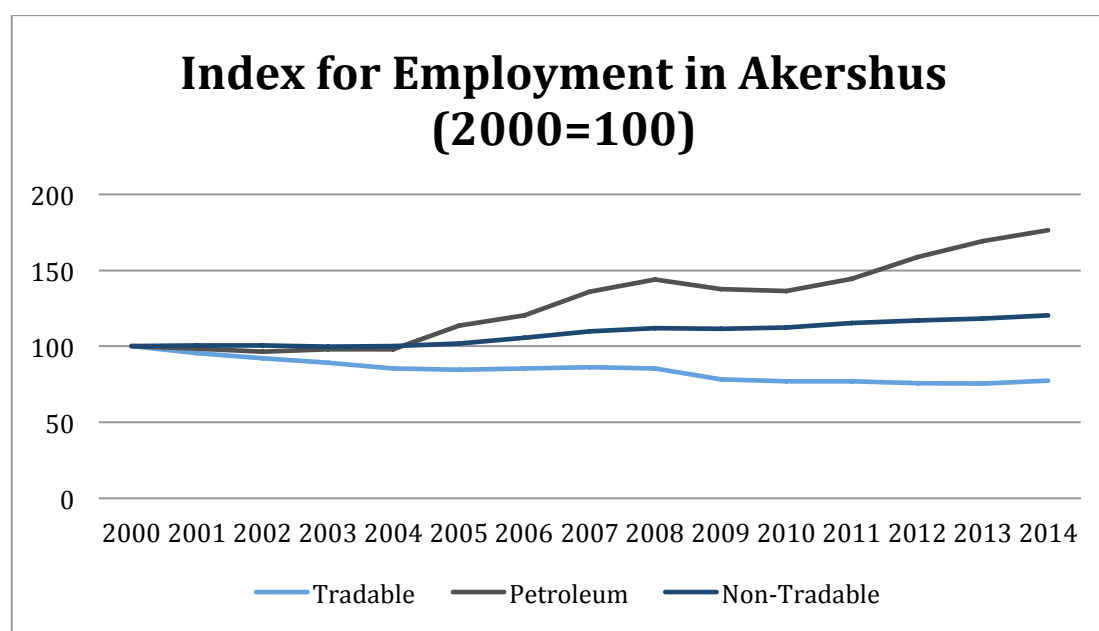


Figure 3.6 Sectoral Employment Development in Akershus (Statistics Norway, 2016b).

### 3.2.1.4 Oslo

Similarly to Akershus, Oslo has a non-tradable sector that is considerably larger than the national average. This share also increased somewhat, from 94 to 95 percent, see Figure 3.7. The dominance of the non-tradable sector in Oslo and Akershus infers that, compared to the national average, the share of employment in the tradable and petroleum sector are well below average.

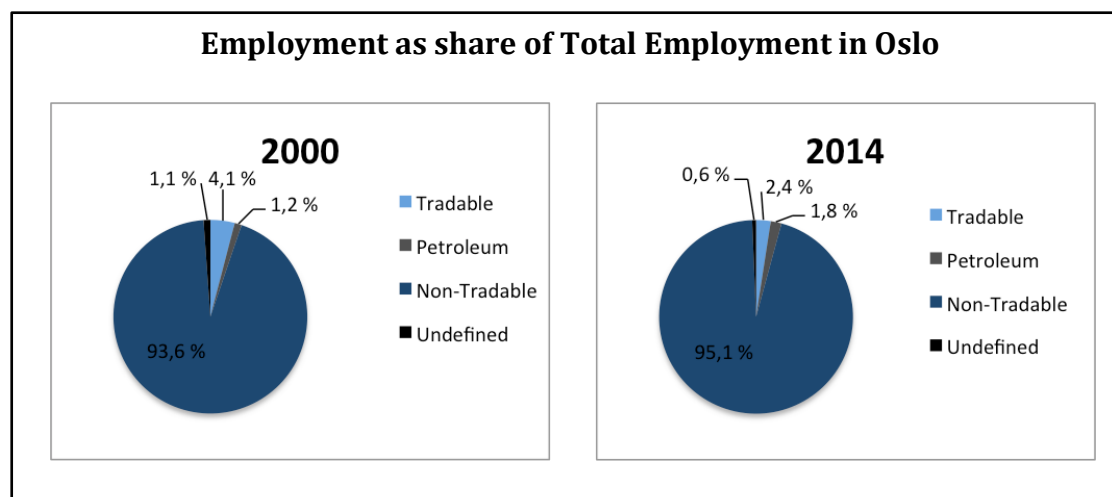


Figure 3.7 Sectoral Employment as share of Total Employment in Oslo (Statistics Norway, 2016b).

Oslo	2000	2014	Change
Undefined Sector	3 060	2 242	-26,7 %
Tradable Sector	11 012	8 532	-22,5 %
Petroleum Sector	3 151	6 290	99,6 %
Non-Tradable Sector	253 982	332 918	31,1 %
<b>Total</b>	<b>271 205</b>	<b>349 982</b>	<b>29,0 %</b>

Table 3.4 Number of employees by sector in Oslo (Statistics Norway, 2016b).

The growth in the petroleum sector is, however, larger than the national average growth. Employment in the petroleum sector has doubled from 2000 to 2014, see Table 3.4 and Figure 3.8, but similarly to Akershus it can be explained by a low starting point. Apart from this, the employment development corresponds relatively well with the national average.

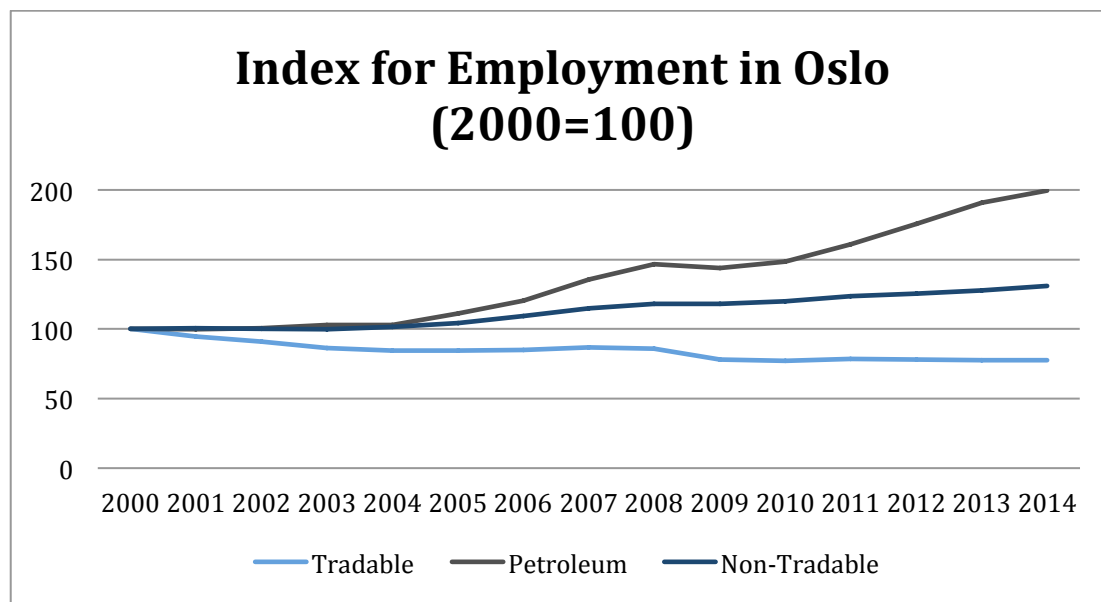


Figure 3.8 Sectoral Employment Development in Oslo (Statistics Norway, 2016b).

### 3.2.1.5 Sør-Trøndelag

The sectoral shares of employment in Sør-Trøndelag correspond with the national average, apart from the petroleum sector being slightly smaller, see Figure 3.9. The development of sectoral shares is identical to the national average, with an increase in the petroleum- and non-tradable sectors, while the tradable sector experienced a decrease in relative employment.

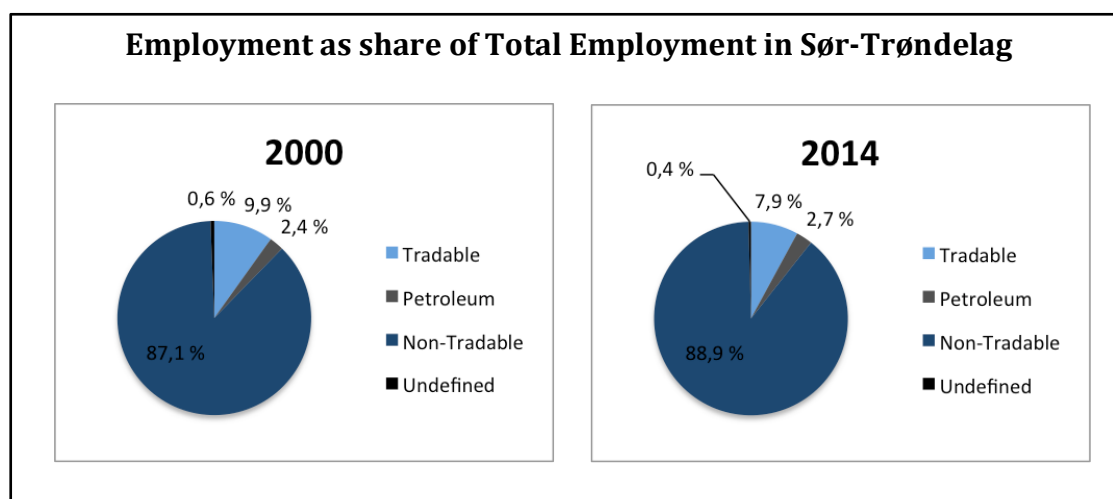


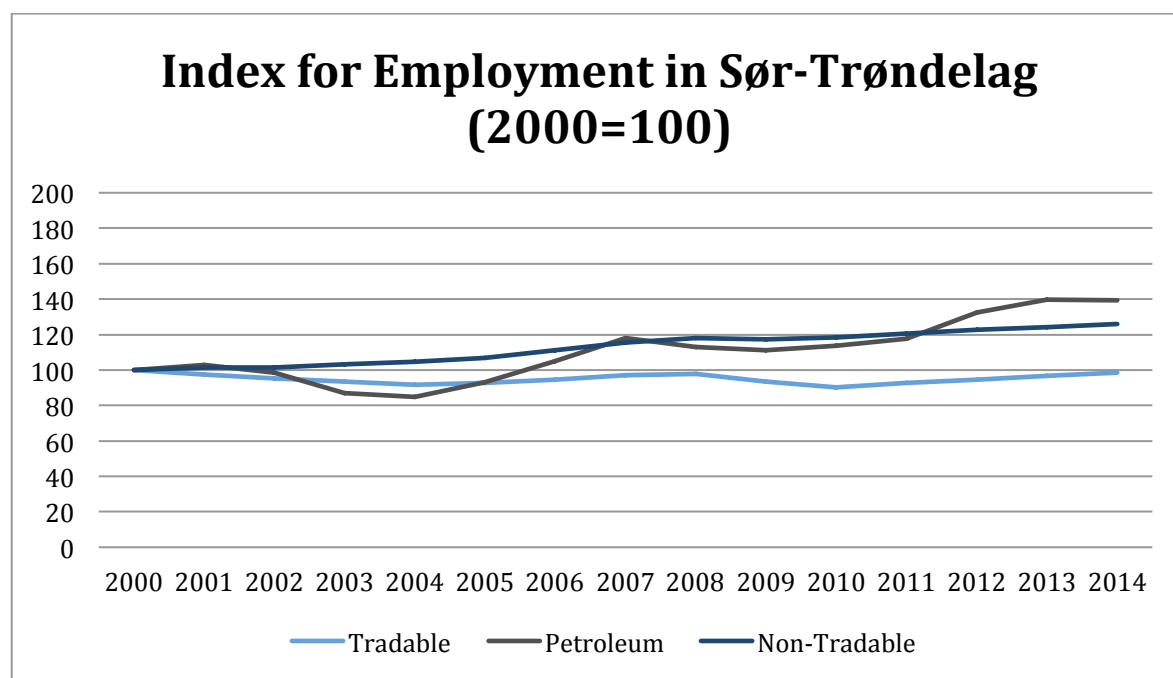
Figure 3.9 Sectoral Employment as share of Total Employment in Sør-Trøndelag (Statistics Norway, 2016b).



<b>Sør-Trøndelag</b>	<b>2000</b>	<b>2014</b>	<b>Change</b>
Undefined Sector	827	665	-19,6 %
Tradable Sector	13 082	12 876	-1,6 %
Petroleum Sector	3 184	4 440	39,4 %
Non-Tradable Sector	115 029	144 712	25,8 %
<b>Total</b>	<b>132 122</b>	<b>162 693</b>	<b>23,1 %</b>

**Table 3.5** Number of employees by sector in Sør-Trøndelag (Statistics Norway, 2016b).

The changes in absolute and relative employment in Sør-Trøndelag differ somewhat from other counties. The growth in petroleum is weaker, and the decrease in the tradable sector is smaller than the national trend. In fact, in terms of absolute numbers, the tradable sector is about the same size in 2014 as in 2000, see Table 3.5. The reason why the relative share of employment in the tradable sector is still smaller in 2014 than in 2000 is due to the growth in the total labour stock, which camouflages the absolute changes. The increase in the non-tradable sector is somewhat higher in Sør-Trøndelag than in Norway, see Figure 3.10.



**Figure 3.10** Sectoral Employment Development in Sør-Trøndelag (Statistics Norway, 2016b).

### 3.2.2 Sectoral Analysis of Employment Shares

In addition to examining the selected counties, this thesis highlights the developments in each sector to clearly illustrate the different sectors' changes in shares of total employment over the analyzed time period.

### 3.2.2.1 Petroleum Sector

The petroleum sector does not constitute a large share of employment in Norway, with a national average between 4 and 5 percent in the analyzed time period. However, Figure 3.11 shows that this varies across counties in Norway. Rogaland clearly has the highest share, and all other analyzed counties are in fact below the national average. This is interesting when considering the strong growth we saw in Oslo, where employment in the petroleum sector roughly doubled in the 14-year period. So even though Oslo has experienced a massive growth in petroleum employment, this was from such a low base that the share is still well below average in 2014. This illustrates that the petroleum sector is much more important in the western parts of Norway.

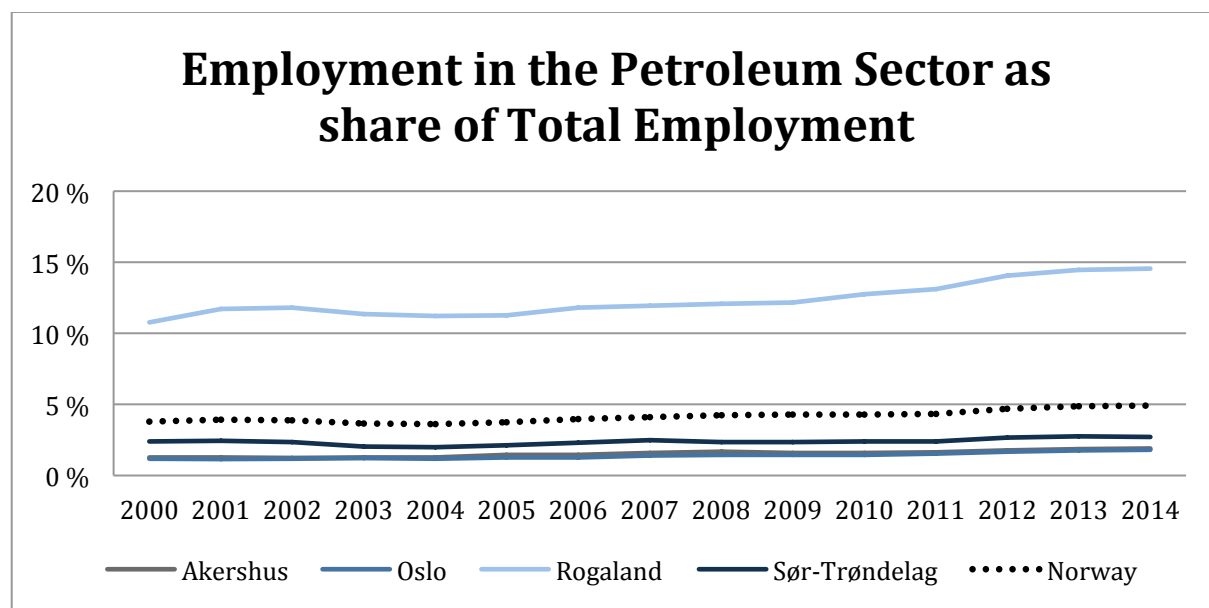


Figure 3.11 Employment in the Petroleum Sector as share of Total Employment (Statistics Norway, 2016b).

### 3.2.2.2 Non-Tradable Sector

As noted earlier, the non-tradable sector is large in Norway. This is common in most industrialized countries. As countries develop, the tertiary sector usually grows disproportionately more than the primary and secondary sectors, and because the tertiary sector mainly consists of non-tradable goods and services, the non-tradable sector increases. In addition to this, similarly to the other Scandinavian countries, the public sector is a large employer in Norway, adding to the size of the non-tradable sector. The national average is approximately 87 percent, and three of four analyzed counties are above this average, see Figure 3.12. Although all analyzed counties have a high share of employment in the non-

tradable sector, Rogaland is the county with the lowest, likely due to the relatively large share of employment in the petroleum sector. In light of two-sector theory the non-tradable sector should increase if the spending effect dominates. This seems to be true for Norway and all analyzed counties when considering absolute change.

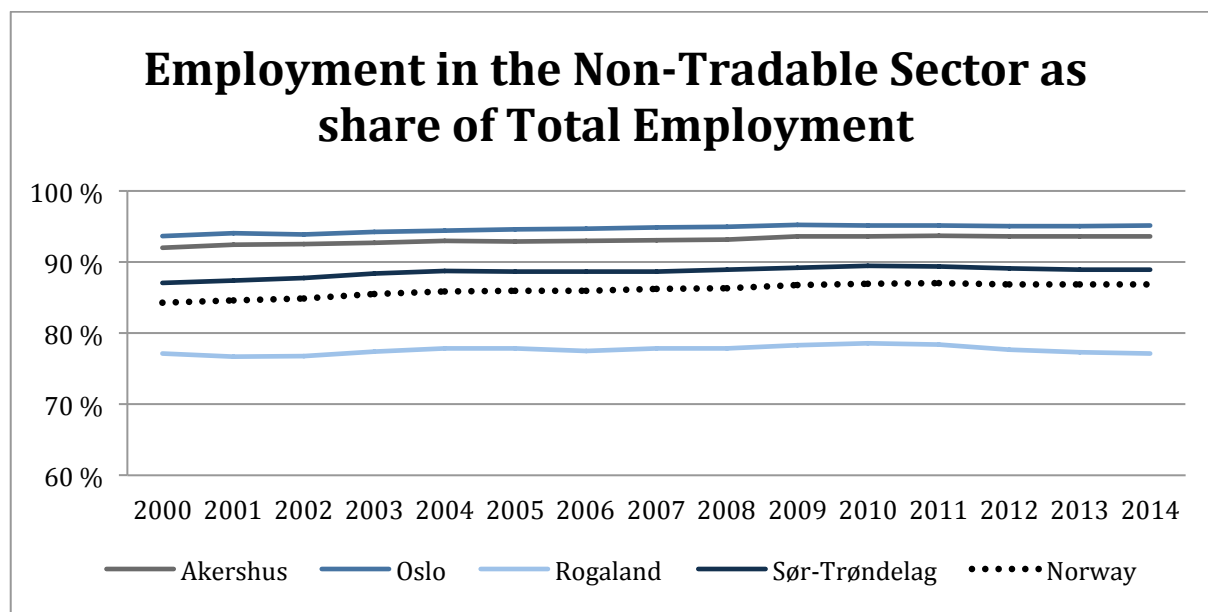


Figure 3.12 Employment in the Non-Tradable Sector as share of Total Employment (Statistics Norway, 2016b).

### 3.2.2.3 Tradable Sector

In accordance with the initial hypothesis, the share of employment in the tradable sector has slowly decreased from 2000 to 2014. The national average share was approximately 11 percent in 2000, and by 2014 this had been reduced to an 8 percent share. This de-industrialization is illustrated in Figure 3.13. What might be surprising is that Rogaland, the county where the petroleum industry is the most dominating, does not seem to have a stronger decrease as a consequence of the petroleum dependency, like initially hypothesised. As a matter of fact the share of employment in the tradable sector in Rogaland is *above* the national average. This is also contrary to what was initially hypothesised for Rogaland, where it was assumed that the petroleum dependency in the county would have an adverse effect on employment in the tradable sector. Possible explanations for this discrepancy will be analyzed further in Chapter 5.

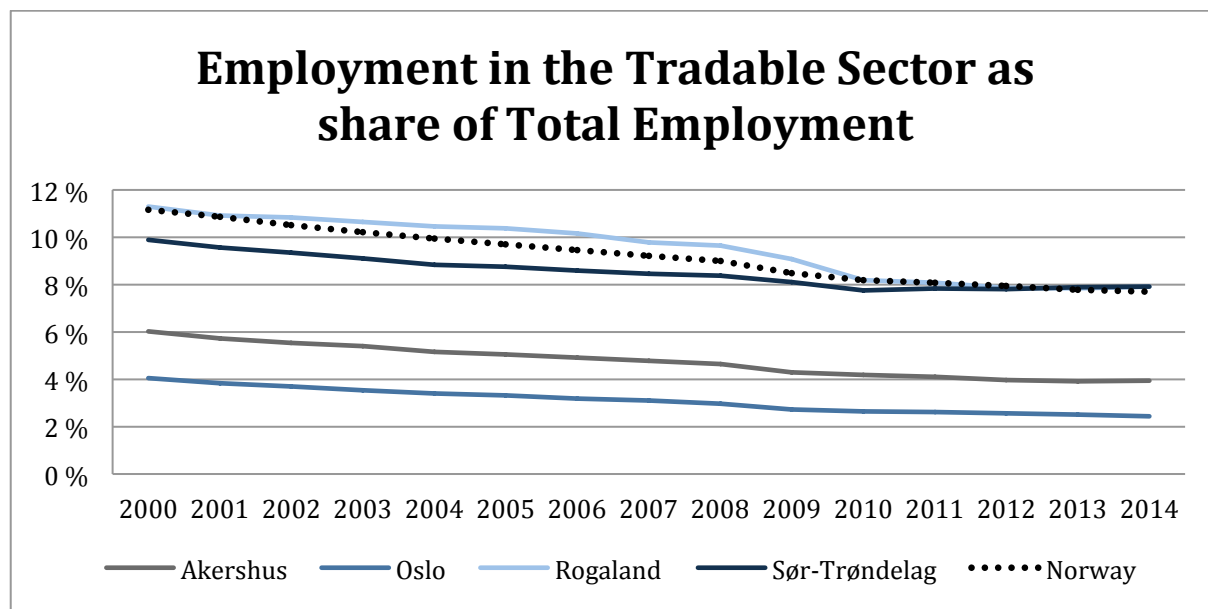


Figure 3.13 Employment in the Tradable Sector as share of Total Employment.(Statistics Norway, 2016b).

### 3.2.3 Wage, Total Employment and Immigration Analyses

In the following, graphical representations of average wage growth and total employment growth are presented. In order to highlight a contributing factor to the employment developments seen in this time period, we also present data on labour immigration to Norway.

#### 3.2.3.1 Wage

The wages in Norway have increased from 2000 to 2014, see Figure 3.14<sup>4</sup>. Until the mid-2000s the four analyzed counties had relatively similar growth, however from 2005 discrepancies appeared. Rogaland has experienced a stronger wage growth than the other counties, and a growth well above the Norwegian average. By 2014, the average wage in Rogaland has nearly doubled. Conversely, the wage growths in Oslo and Akershus are below the national average, and these counties have experienced a growth of approximately 60 percent from 2000 to 2014.

<sup>4</sup> There is an exception in 2006 due to new tax regulation concerning dividends for self-employed persons. This affected the measured gross income in 2006 negatively. The wage earnings in 2006, on the other hand, increased by approximately 8 percent from 2005 (Statistics Norway, 2007).

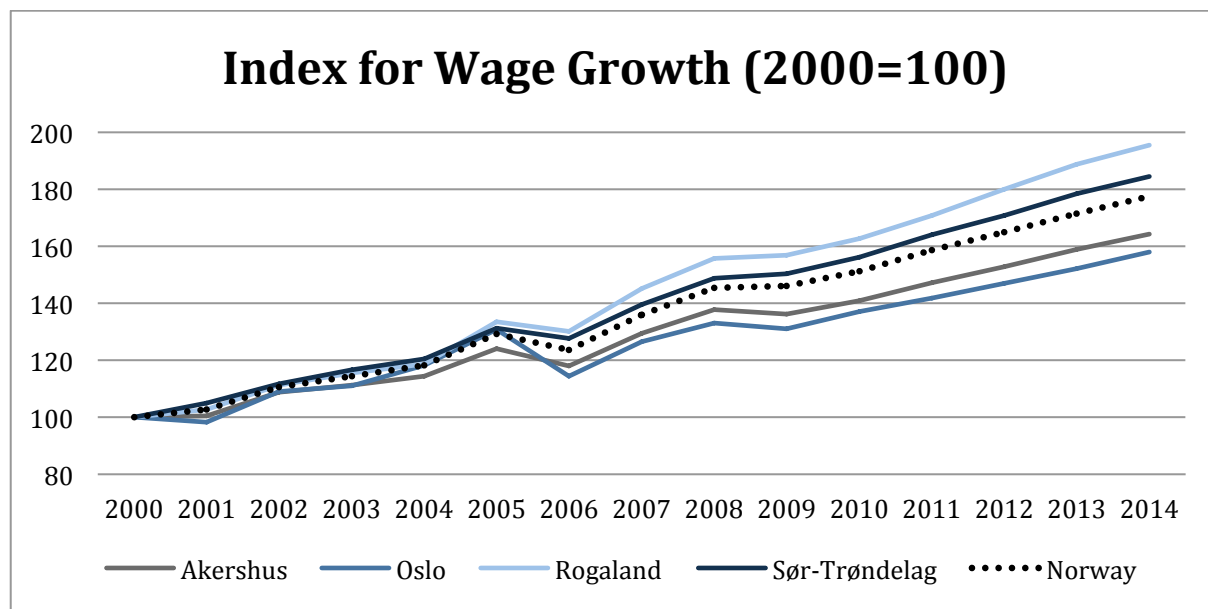


Figure 3.14 Wage Growth in Norway, indexed (Statistics Norway, 2016c).

### 3.2.3.2 Total Employment

In the previous subchapters, it has been illustrated how growth in employment in some sectors have not resulted in changes in the sectoral shares. A growing total employment in a region may explain such an observation, and for this reason it is interesting to look at the total employment growth in Norway and the four counties. From Figure 3.15 it is evident that there has been a strong growth in total employment from 2004, which may be related to the expansion of the European Union, combined with an attractive labour market in Norway, in addition to the general increase in population.

During the financial crisis of 2008-2009 the total employment decreased slightly, but from 2009 the period of strong growth continued. All analyzed counties exhibit a higher growth in total employment than the national average, except for Akershus before 2011. Rogaland is the county with the strongest total employment growth, followed by Oslo. Two-sector theory states that immigration is a natural consequence of a petroleum boom because the wages and welfare increase, which attracts workers from other regions. The considerable growth in wages in Rogaland, compared to the other counties, motivates workers to move to Rogaland. This will in turn lead to a high total employment growth.

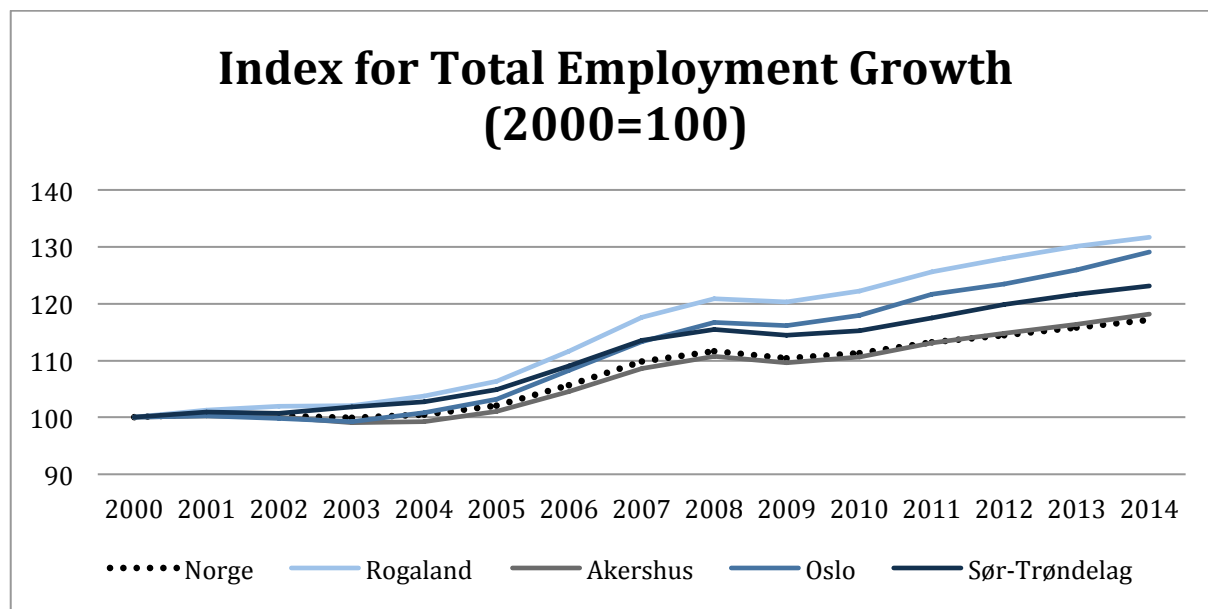


Figure 3.15 Total Employment Growth in Norway, indexed (Statistics Norway, 2016b).

### 3.2.3.3 Immigration

As suggested above, the growth in total employment in Norway from 2004 relates to the expansion of the European Union, and the following increase in labour migration from the East Block Countries. A relatively strong labour market in Norway, where high oil investments and an increasing oil price attracted many workers to the petroleum industry, left a void in the market for vocational employment, for example within construction. In addition, the wage level in Norway is among the highest in the EEA, explaining why Norway was on the receiving end of this flow of immigration. The migration to Norway from 1990 to 2014 is displayed in Figure 3.16. This figure demonstrates the massive growth in labour immigration from 2004, and how it fell from 2008 to 2009 following the financial crisis. From 2009 there was a strong growth in labour immigration until 2011, and since then it has dropped. Despite this drop, there were still more than 20 000 labour immigrants arriving in Norway in 2014.

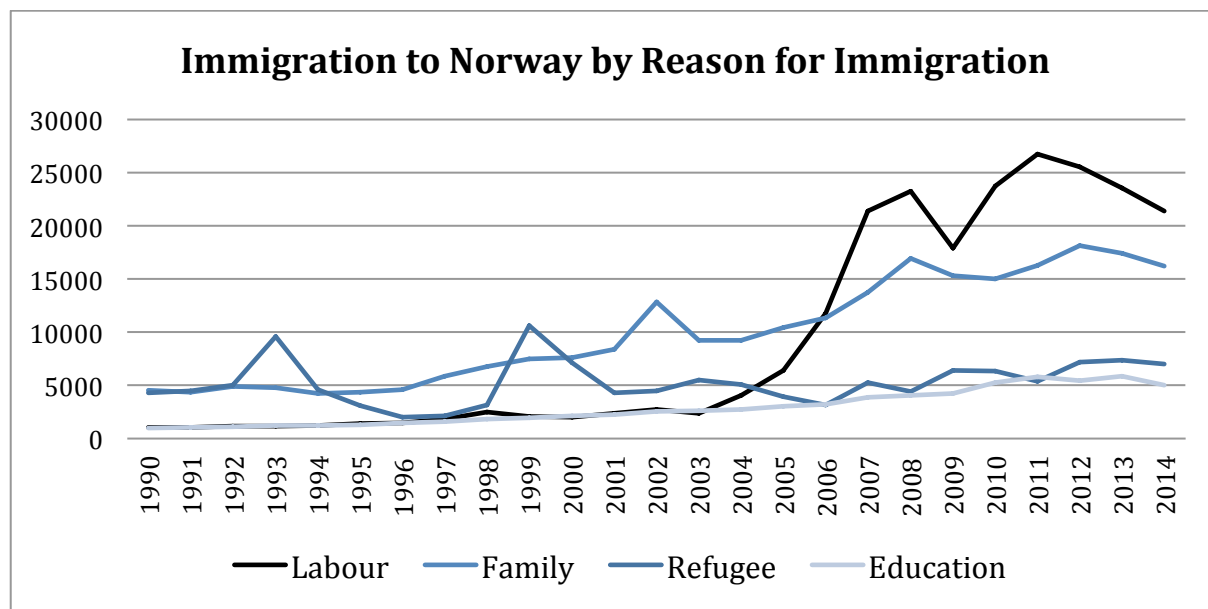


Figure 3.16 Immigration to Norway by reason for immigration, 1990-2014 (Statistics Norway, 2015c).

To further disseminate these findings, Table 3.6 displays the massive growth in labour immigration, both as a percentage of total immigration and in absolute numbers in the analyzed counties. The data is split into two time periods, the first capturing the period before labour immigration surged. As evident, all counties have been consistently above the national average, and Rogaland, in particular, has experienced strong labour immigration, both before and after 2005.

	1990-2005		2006-2014	
	Share	Labour Immigrants	Share	Labour Immigrants
Akershus	11,02 %	2 169	45,56 %	18 954
Oslo	9,57 %	4 698	45,54 %	27 490
Rogaland	14,83 %	2 297	50,64 %	19 841
Sør-Trøndelag	12,91 %	1 131	47,49 %	7 745
Country average	10,35 %	19 000	45,62 %	151 602

Table 3.6 Labour immigration as percentage of total immigration to Norway (Statistics Norway, 2015b).

## **4 Consequences of the Oil Price Drop and Predictions for the Coming Years**

In this chapter we will look at the main consequences of the 2014-oil price drop in terms of important factors and indicators that affect the development of the Norwegian economy. This chapter will also outline predictions for the Norwegian economy after an oil price drop, and predictions for the development of important indicators in the years to come.

### **4.1 Consequences**

The development of the oil price is important for the prospects of the Norwegian economy. This has been evident since the oil price dropped considerably in 2014. The economic growth has slowed down, and the interest rates were lowered considerably to encourage investments and spending. The unemployment rate has increased, especially in Rogaland, and the government has spent more of the Government Pension Fund Global (GPF) than in previous years (Ministry of Finance, 2016a). A connection between the oil price and the exchange rate is evident, and the Norwegian tradable sector has profited in the international market since the Norwegian krone's (NOK) value dropped.

#### **4.1.1 Expansionary Monetary Policy**

The key interest rate in Norway, controlled by the Norwegian central bank, was held at 1,50 percent from 2012 until the oil price fell considerably in 2014. Since then the key interest rate has been reduced to 0,50 percent (Norges Bank, 2016b). The Norwegian central bank sets the key interest rate based on measures for inflation, production and a measure of financial stability (Norges Bank, 2011). As the activity in the oil industry was reduced and investments postponed, the central bank needed to motivate companies and private actors to invest. This was done by lowering the key interest rate.

The key interest rate works through several channels. The three main channels are the currency exchange rate, investments and consumption. The value of the Norwegian Krone is decided in international markets, and depends on the profitability of different currencies. Lowering the interest rate reduces the relative profitability of investments made in NOK and the currency thus depreciates. As the key interest rate is reduced it becomes cheaper to borrow



money, and economic agents are motivated to invest instead of keeping their funds in the bank. This leads to higher investment levels. Cheaper loans lead to higher disposable incomes in the Norwegian households, which again lead to higher consumption levels. Increased international competitiveness due to a depreciating currency combined with increased levels of investment and consumption lead to increased economic activity, and counteracts the negative impulses from the lower oil price (Norges Bank, 2004).

#### **4.1.2 Expansionary Fiscal Policy**

The GPFG allows the government to separate the spending of petroleum revenues from the earning of petroleum revenues. A deficit in the fiscal budget is covered by funds from the GPFG. The government has increased the deficit after the oil price fell from 5,2 percent of mainland-GDP in 2013, 5,8 percent in 2014, 6,4 percent in 2015 to 7,5 percent in 2016 (Ministry of Finance, 2014; Ministry of Finance, 2016a). The increase in government spending sustains the GDP-levels, and dampens the increasing unemployment rate. By investing in, among other things infrastructure, the government can contribute to higher employment and counteract downturns.

The reduced oil price has affected the Norwegian regions differently. Particularly the south-western parts of Norway have been hit by the reduced activity in the petroleum industry. As a consequence, extra funds have been granted in the revised fiscal budget for 2016 to increase employment in the regions that have been affected the most. NOK 900 million have been dedicated to measures aimed at decreasing unemployment in Aust-Agder, Vest-Agder, Rogaland, Hordaland, Sogn og Fjordane and Møre og Romsdal (Ministry of Finance, 2016c).

#### **4.1.3 Mainland-GDP**

The growth in mainland-GDP has slowed since the oil price fell. The yearly growth was 2,3 percent in 2013 and 2014, compared to 1,0 percent in 2015 (Statistics Norway, 2016a). The weaker growth is caused by, among others, a higher unemployment rate and lower investment levels. The expansionary fiscal policy and the growth in the other tradable sector, caused mainly by the changes in the exchange rate, increase the growth in GDP. The Ministry of Finance has predicted the growth in GDP to be 1,0 percent in 2016 (Ministry of Finance, 2016b).

### 4.1.4 The Foreign Exchange Rate

A positive effect of the expansionary monetary policy and lower growth in GDP is the weakening of the Norwegian Krone. The value of the Krone decreases as the growth in the Norwegian economy slows down, as well as when the interest rate is lowered. This leads to more favourable terms of trade and increased production in the other tradable sector (Norges Bank, 2004). The weaker exchange rate also decreases the oil price fall measured in NOK. Since the oil price started to fall in late June 2014, the Krone has dropped in value compared to other currencies. As shown in Table 4.1, the US Dollar has become 35,9 percent more expensive while the Euro and British Pound have increased in value by 13,4 percent and 17,3 percent respectively.

Currency	June 2014	May 2016	Percentage Change
USD	6,1	8,2	35,9 %
EUR	8,2	9,3	13,4 %
GBP	10,2	12,0	17,3 %

Table 4.1 Currency exchange rates, monthly average (Norges Bank, 2016c)

### 4.1.5 Unemployment

The Norwegian unemployment rate has increased since the oil price drop. Compared to June 2014, the unemployment rate has increased from 2,7 percent to 2,9 percent in May 2016. The regional differences are evident in Table 4.2. Unemployment in Rogaland has increased from 2,1 to 4,3 percent since June 2014, while unemployment in Oslo has decreased in the same period. The growth in employment slowed down in 2015 compared to 2014 too, with 0,6 percent growth compared to 1,2 percent growth (Ministry of Finance, 2016d; Statistics Norway, 2015a).

	June 2014		May 2016	
	Unemployment	Unemployment Rate	Unemployment	Unemployment Rate
Norway	73 458	2,7 %	80 342	2,9 %
Akershus	7 438	2,4 %	7 331	2,3 %
Oslo	12 663	3,5 %	11 669	3,1 %
Rogaland	5 175	2,1 %	11 099	4,3 %
Sør-Trøndelag	3 973	2,4 %	4 056	2,4 %

Table 4.2 Changes in unemployment since the oil price fell (NAV, 2016a).

A sizeable amount of the recent personnel cuts in the oil industry have been made through early retirement packages (Haugan, 2015). This implies that the unemployment numbers above may not fully reflect the total amount of dismissals in the sector, because they are registered as benefit recipients instead of unemployed. In addition, students who have recently graduated are less likely to appear in these statistics, as they have limited rights to social benefits and consequently do not register. Some graduates might also continue studying, and will not be registered as unemployed (Knudsen, 2016). Consequently, the *actual* unemployment is most likely higher than what is reflected in the official numbers from NAV.

#### 4.1.6 Investments

The amount of oil investments fell considerably as the oil price dropped (Statistics Norway, 2016a). As Table 4.3 illustrates, the amount of investments in mainland-Norway did not change from 2014 to 2015, but is predicted by the Ministry of Finance to increase by 2,5 percent in 2016.

Change in Investments	2013	2014	2015	Predicted 2016
Mainland Norway	2,9 %	1,3 %	0,0 %	2,5 %

Table 4.3 Change in investments (Ministry of Finance, 2016b; Statistics Norway, 2016a).

The decrease in investments has unsurprisingly been largest for the petroleum sector (most of which is separated from the mainland economy), while public investments have increased in the period since the oil price drop (Statistics Norway, 2016a).

#### 4.1.7 Inflation

The inflation target is a stable inflation close to 2,5 percent. For the last 15 years the inflation has on average been about 2 percent. This is considered to be close to the target (Norges Bank, 2016d). The increase in the consumer price index has been about 3 percent in 2016 (Norges Bank, 2016a). This is likely to be temporary as most of this growth is due to imported goods becoming more expensive because of the depreciation. Housing prices differ considerably between regions. During last year, housing prices in Oslo have increased by 10,5 percent, while the prices have fallen in Stavanger by 7,2 percent (Ministry of Finance, 2016a).

## **4.2 Predictions for the Norwegian Economy in the Case of a Fall in the Oil Price**

Bjørnland and Thorsrud (2014a) predict the effects of different oil price falls on the Norwegian economy. They separate between two types of oil price shocks, one demand-driven and one supply-driven, where both shocks lead to a fall in the oil price of 25 percent. The results they find are based on a model that accounts for historic responses to shocks. Their predictions were made in October 2014, and should be about fulfilled at the time this thesis is submitted. The predictions and the actual developments will be compared in Chapter 5, and reasons for potential deviations will be outlined.

### **4.2.1 Demand-Driven**

The effects of a demand-driven oil price shock are predicted to be considerable for the Norwegian economy. If the shock is driven by a reduction in global activity, then the demand for petroleum, as well as the demand for other goods and services, will be affected. As the global economy slows down at the same time as the Norwegian economy is slowing down, the other tradable sector will not benefit as much from the depreciation of the Krone. Other industries, as well as the petroleum industry, will have difficulties selling their goods and services on the global market. This will lead to more severe consequences than if the oil price shock is supply-driven, and the mainland-GDP is expected to decrease by 2-2,5 percent after two years.

### **4.2.2 Supply-Driven**

The effects of a supply-driven oil price shock are less severe for the Norwegian economy. As the supply of oil on the global market is the reason for the drop in oil prices, the oil importers will benefit from the lower price, and demand for other goods and services will increase. This will reduce the negative consequences for the Norwegian economy, and the decrease in mainland-GDP is estimated to be 0,5 percent after two years.

	<b>Demand-Driven</b>	<b>Supply-Driven</b>
<b>Investments</b>	Decrease by 4-6 % after two years	Decrease by 1,5-2 % in the first year
<b>Employment</b>	Decrease by 1,5-2 % after two years	Decrease by 0,9 % after 2-3 years
<b>Real Wages</b>	Decrease by 2,5-3 % after two years	Decrease by 1 % after 2-3 years
<b>Real Exchange Rate</b>	Depreciate with 2,5-3 % on impact	Depreciate by 2,5 % on impact
<b>Mainland-GDP</b>	Decrease by 2-2,5 % after two years	Decrease by 0,5 % after two years

**Table 4.4 Predicted effects of two different negative price shocks (Bjørnland & Thorsrud, 2014a)**

At the time of Bjørnland and Thorsrud's (2014a) predictions, the oil price had decreased by 22 percent from USD 110 per barrel in January 2014 to just above USD 85 in October 2014. The oil price reached a believed bottom level in January 2016 at USD 28, and is around USD 50 in June 2016 (Bloomberg, 2016). The price drop has thereby been more severe than Bjørnland and Thorsrud predicted. This should increase the negative effects of the price drop on the Norwegian economy. At the most, the oil price had decreased by around 75 percent in two years, while compared to the current price the reduction is about 55 percent.

Bjørnland and Thorsrud (2014a) also present factors that may imply milder or more severe consequences from oil price shocks on the Norwegian economy than found in their report. More expansionary monetary- and fiscal policy than has been seen before could increase domestic demand and spending temporarily. The long-term effects of such expansionary policies are, however, less certain. The adjustment of real wages and the real exchange rate may affect the development of the Norwegian economy. The exchange rate is assumed to be flexible, and the recent depreciation shows that this holds for a decrease in the oil price. Real wages may be less flexible, and rigid real wages may affect the competitiveness of the tradable sector, and thus the Norwegian economy.

In the report the price drop is assumed to last for 1,5-2 years before the effect is gone. If the price fall is more permanent, then the negative effects are also assumed to be more persistent. It is now almost two years since the oil price fell, and the price is expected to remain relatively low for the coming years (Ministry of Finance, 2016a). This is predicted to lead to more challenges in the future, and a more severe adjustment process than modeled by Bjørnland and Thorsrud.

Another factor that may increase the effects of the oil price drop is if the price decrease is driven by a combination of the two types of price shocks. A combination of a demand-driven and a supply-driven shock may affect the Norwegian economy harder than they will separately, and the low price level may persist longer.

### 4.3 Forecasts for the Norwegian Economy

The future of the Norwegian economy is dependent on the price of oil, as well as actions taken by the government and the central bank. This subchapter will present theory on the pricing of oil, as well as three oil price scenarios and predictions for the key interest rate, the unemployment rate, GDP growth and inflation.

#### 4.3.1 Oil price theory

The oil price is highly volatile, and varies vastly across time. Attempts have been made to theorize how the price is formed and how it develops.

##### 4.3.1.1 Economic model for oil production

The economic model for oil production is an optimization problem where the future revenue flows from an oil field must exceed the investment costs (net present value), see below

$$(1) \quad V = -cq_0 + \int_0^T q_0 (pe^{-kt} - a)e^{-rt} dt$$

Where  $cq_0$  = investment costs ( $c$  = fixed cost per well and  $q_0$  = number of wells),  $p$  = price,  $a$  = operating costs,  $r$  = discount rate,  $t$  = time,  $k$  = a constant reflecting the rate of production decline, and it is assumed that there are no dismantling costs (Hannesson, 1998).

Solving the integral yields

$$(2) \quad V = -cq_0 + \frac{pq_0}{k+r} (1 - e^{-(k+r)T}) - \frac{aq_0}{r} (1 - e^{-rT}).$$

When the net revenue stream is no longer positive, it is not profitable to continue producing from the field. This is dependent on the oil price, operating costs, discount rate, and the

number of wells in production, in addition to physical aspects of the well, such as initial pressure.

This model assumes that a producer will keep producing and selling oil at the given market price  $p$ , and that the market is characterized by perfect competition. If one or some producers have market power, this will affect the market price. Imperfect competition will be covered later.

#### *4.3.1.2 Intertemporal Pricing of oil and the Hotelling rule*

Modelling the oil market, and how much to produce and when, is an intertemporal problem constrained by a *given* supply that is of *unknown magnitude*. In addition, there are uncertainties regarding the future of petroleum – new technologies, future discoveries, and ever more relevant are the alternatives to petroleum and the growth in renewable energy sources.

One of the early contributions to oil price theory was made by Harold Hotelling in 1931, and was named the Hotelling rule. The rule states that the price of a finite resource must rise at a rate equal to the discount rate,  $r$ , and has consequently been called the  *$r$  percent rule*. Hotelling assumes a market characterized by perfect competition and many, small producers (Hotelling, 1931).

If the price rises faster than the discount rate, then the producers would keep all their reserves under ground until the price had increased considerably. Otherwise, if the oil price would grow at a rate less than  $r$ , the producers would sell all their oil immediately and invest the profits in the financial markets. The price needs to rise at the rate of discount to keep producers indifferent about leaving reserves in the ground temporarily and investing the petroleum revenues in financial markets.

Analytically, this can be proven through a simple two-period model. For the sake of simplification, let us disregard the fact of uncertainty regarding the magnitude of reserves and treat them as fixed and known. Knowing that the reserves are exhaustible forces the agents to make a trade-off between extraction in period 1, so one does not run out of oil prematurely, and period 2, so one avoids being left with reserves when they might become worthless.

Consequently, we are left with a decision regarding intertemporal allocation of resources, which is guided by prices.

The price must be such that vast use in any period is discouraged by sufficiently high prices. In order to illustrate this, a simple two-period diagram is provided, see Figure 4.1. The length of the horizontal axis symbolizes the fixed and known reserves of petroleum,  $S_0$ , and any point on the line shows how the amount should be distributed between the two periods. The amount used in period 1 is measured from left to right, while the amount used in period 2 is measured from right to left.

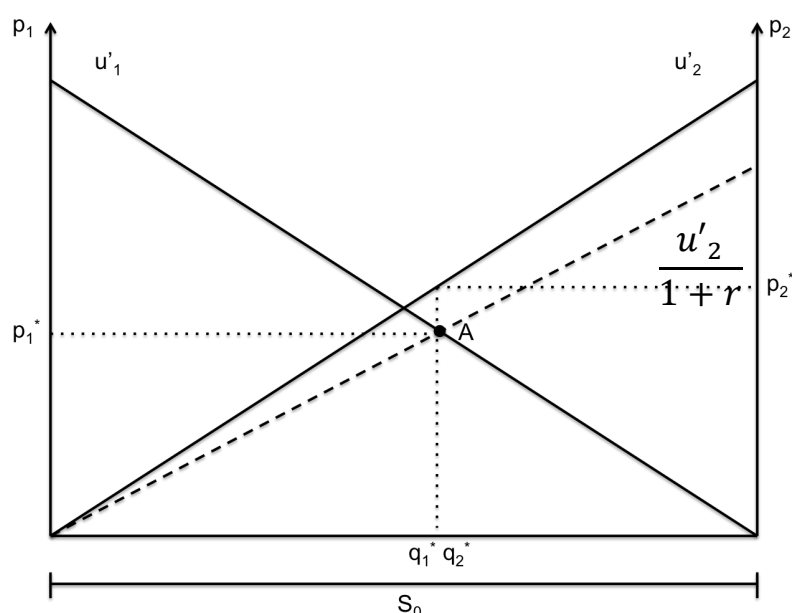


Figure 4.1 Optimal division of petroleum reserves between two periods, "now" and "later" (Hannesson, 1998).

The allocation between the two periods is determined by the usefulness of oil consumed in the periods. We assume that the marginal utility is declining for every unit consumed in both periods, which is illustrated by the downward-sloping lines,  $u'_1$  and  $u'_2$ . The optimal allocation between the two periods, where the consumers would be indifferent between consuming one unit in period 1 and period 2, would be where the two lines intersect. However, discounting is not included at this point. The dashed line is consequently added, where we take into consideration that consumption today is worth more than consumption tomorrow by discounting  $u'_2$ . This dashed line is now comparable to the marginal utility in period 1, and optimal allocation between the two periods must be in point A in Figure 4.1, where



$$(3) \quad u'_1 = \frac{u'_2}{1+r}$$

As for any good, the intertemporal allocation is determined by prices (Hannesson, 1998). A higher price for one good indicates that the marginal utility for that good must be higher, if the two goods are both consumed. This applies to oil, too. Consequently, the ratio of oil consumed in two following periods is equal to the ratio of marginal utilities, in an optimal allocation

$$(4) \quad \frac{p_2}{p_1} = \frac{u'_2}{u'_1}.$$

Substituting (4) into (3), we have

$$(5) \quad \frac{(p_2 - p_1)}{p_1} \equiv \frac{\Delta p}{p} = r$$

i.e. that the price of oil must increase at the rate equal to the discount rate,  $r$ . This is the Hotelling rule. Note that costs of extraction is not included in this example, solely the fact that the oil reserve is finite has determined the price (Hannesson, 1998). In other words, *scarcity* gives value to a finite resource. This has been called “scarcity rent” (Livernois, 2008). In practice, this means that the consumption is somewhat higher in period 1 than in period 2, enabled by a lower price in period 1. For supply and demand to be equal, consumers must be indifferent between consuming in period 1 and waiting until period 2 to consume, hence (5) must be satisfied.

#### 4.3.1.3 Intertemporal Pricing of oil and Backstop Price

Although helpful, the explanation above is overly simplified. The finiteness of the resources is not known, and the distinction between “now” and “later” is vague. Additionally, the issue of future technological development or *alternative* resources that can replace oil is not accounted for. This replacement is known as backstop technology. As petroleum becomes scarcer and more expensive, alternative resources can become economically viable. The price where this occurs is known as the backstop price,  $\bar{p}$ . This is the highest price which oil could be sold for, before oil becomes uncompetitive (Hannesson, 1998).

Knowing that the backstop price will be the highest possible price for oil, and that until that point the price increases at the rate of the discount rate,  $r$ , we can “backtrack” the price from the end to the present. What is still unknown is when we reach the backstop price, the time  $T$ . However, we do know that the price at time  $T$  will be  $p_T = \bar{p}$ . The price path, which gives prices at any given time,  $t$ , is then

$$(6) \quad p_t = \bar{p}e^{r(t-T)}.$$

It is evident that the interest rate,  $r$ , will affect how fast the price increases. A higher interest rate will increase the price growth, thus increasing the rate of extraction and consequently reducing the total extraction period (Hannesson, 1998). Increases in the backstop price will shift the price path up, consequently extending the extraction period. Today, however, it seems more likely that the backstop price will decrease. This is due to the large technological innovations and strong growth within renewable energy (Livernois, 2008). The new discoveries are on the other hand simultaneously extending the total extraction period of oil, and it is consequently challenging to conclude on the lifetime of oil reserves.

#### 4.3.1.4 Introducing Extraction Costs

Extraction costs have not been included in the Hotelling rule so far. When introducing a unit cost of extraction,  $c$ , to the model, the  $r$  percent rule still holds, but is modified to

$$(7) \quad \frac{d(p-c)}{dt} = (p - c)r.$$

The  $r$  percent rule now applies to the *net price* rather than the gross price of oil. The cost of extraction is likely to increase. This is because the fields with the lowest costs are extracted first, and consequently the cost of extraction rises as time passes. The main implication of this tendency, in addition to the presence of backstop technology, is that it might not be economically optimal to extract the entire oil reserve. The extraction costs may catch up with the price, and the amount extracted is decided by when the marginal costs of extraction exceed the marginal utility of consumption for oil (Hannesson, 1998). In practice, it is common to abandon wells long before they are physically empty, indicating increased marginal costs associated with further extraction.

#### 4.3.1.5 Empirical Significance of the Hotelling Rule

Proving the empirical significance of the Hotelling rule has been the subject of several academics, among them Margaret Slade. In her paper from 1982, price trends for 12 commodities were analyzed. In 11 of these 12 cases she found evidence of U-shaped price paths (Slade, 1982). These findings correspond with a *modified* Hotelling rule, which accounts for cost-reducing technological innovation, which is stronger in the beginning, and a cost-increasing degradation effect, which increases costs later. Exploration and its related costs also explain the U-shape found in the paper.

#### 4.3.1.6 Monopolized Markets

As the Hotelling rule states, the price should increase with the rate of interest,  $r$ , under perfect competition. However, the market for oil is characterized by imperfect competition. The oil cartel Organization of the Petroleum Exporting Countries (OPEC) has market power, as became evident during the price increase in 1973 for example, and the price development will therefore differ from the Hotelling rule.

First, we analyze the pricing strategy in a monopoly. It is assumed that there is a sole owner that controls the global oil reserves,  $S_0$ , and this monopolist is assumed to have zero costs. The monopolist is assumed to know the market demand,  $p(q_t)$  and can thus adjust the production, and thereby the price, to maximize the discounted sum of all future revenues,  $R(q_t) = p(q_t)q_t$ . The discount rate is equal to the interest rate,  $r$  (Hannesson, 1998).

The two-period optimization problem that the monopolist solves is:

$$(8) \quad \max_{q_1, q_2} R(q_1) + \frac{R(q_2)}{1+r}$$

$$s. t. S_0 = q_1 + q_2$$

Solution:

$$(9) \quad \frac{MR_2 - MR_1}{MR_1} = r$$

For the monopolist we thus find a modified  $r$  percent rule. This rule states that the marginal revenue should grow at the rate of interest;  $r$ . Marginal revenue can be written as

$$(10) \quad MR = p \left( 1 - \frac{1}{\varepsilon} \right), \text{ where } \varepsilon \text{ is the elasticity of demand.}$$

Thus, how fast the price increases depends on whether the elasticity of demand remains constant, increases or decreases over time.

Rewriting the solution:

$$(11) \quad \frac{p_2 \left(1 - \frac{1}{\varepsilon_2}\right) - p_1 \left(1 - \frac{1}{\varepsilon_1}\right)}{p_1 \left(1 - \frac{1}{\varepsilon_1}\right)} = r.$$

Defining  $E_i = 1 - \frac{1}{\varepsilon_i}$ ,  $i = 1, 2$  and rewriting gives

$$(12) \quad \frac{p_2 E_2 - p_1 E_1}{p_1 E_1} = r.$$

With constant elasticity of demand,  $E_1 = E_2 = E$ . Then equation 12 simplifies to

$$(13) \quad \frac{p_2 - p_1}{p_1} = r.$$

This is the Hotelling rule, and the pricing strategy in a monopoly will be the same as it is with perfect competition, thus rising with the rate of interest. The quantity produced in the two periods will be the same as it will be in a perfectly competitive market. This contradicts conventional monopoly theory, which states that a monopolist will always produce less than the competitive market (Hannesson, 1998). The reason for this contradiction is that the monopolist has nothing to gain from withholding some of the given petroleum reserves permanently. This differs from a monopolist in a traditional commodity market with a flow of inputs.

However, when including a backstop price the amount supplied by a monopolist is lower than the amount supplied in a perfectly competitive market. When a backstop price is included, the supply of oil from the monopolist can be divided into two phases; one where the marginal revenue rises at the rate of interest and one where the price equals the backstop price. The monopolist has market power in the first phase, but has no power to increase the price in the second phase. With constant elasticity of demand the price will rise with the rate of interest, but will start at an initially higher price than in a competitive market. This leads to a lower supply of oil than in the competitive market and resource conservation because of the longer exhaustion time.

#### 4.3.1.7 *Cartel Model*

The market for oil is neither characterized by perfect competition nor a monopoly. The cartel OPEC has acted as a price leader on several occasions, while the other oil producers are considered price takers, called the competitive fringe. The price leader has to take into account that the competitive fringe needs the price to rise at the rate of interest to be indifferent about producing today or withholding production for later. This means that, as in a monopoly, the market will be divided into two phases; the first phase where the price rises at the rate of interest where the competitive fringe will exhaust their reserves, and the second phase where the price equals the backstop price and OPEC sells its remaining reserves.

OPEC discovered its market power in 1973 during the Arab oil embargo. The price rose considerably after the Arab OPEC members decided to reduce their supply to the US and the Netherlands. In 1975 OPEC decided to increase the price. How much market power OPEC has had in the oil market has varied, and has been challenged by lack of cooperation within the cartel as well as large non-OPEC oil producers being able to affect the market price. From 2005-2008 the price rose considerably due to the low spare capacity of OPEC and considerable demand growth from China, and the price grew steadily from late 2008 to 2011. The period 2011-2014 was characterized by a stable price around USD 100 per barrel. In 2014 shale oil production in the US increased the supply of oil on the market, while Saudi Arabia and the rest of OPEC refused to reduce their production to uphold market shares. This, combined with weaker growth in oil demand than expected, has characterized the price development since then (Baumeister & Kilian, 2016).

Norway is in the competitive fringe and consequently faces a given oil price. According to theory the price should rise at the rate of interest until Norway and the other competitive producers have exhausted their oil reserves. Then OPEC should produce their remaining reserves and sell them at the backstop price. In reality however, the uncertainty of the size of the total oil reserves and the backstop price, as well as the occurrence of different price shocks lead to a very different oil price pattern from what theory suggests. The large differences in cost levels between producers, as well as the differences in oil quality, further complicate the analysis of oil price development.

Two factors that also contribute to explain why the oil price has not followed the expected growth path are i) technological innovations that occur at all stages of natural resource

production and distribution that change current costs as well as expected future costs, and ii) unanticipated non-renewable resource discoveries (Livernois, 2008). A technological innovation that reduces costs associated with recovery will increase the amount of reserves considered economically retrievable, and will thus reduce the price of oil through lowering the scarcity rent.

A large unanticipated discovery of oil reserves will have a negative effect on the scarcity rent and thus the price of oil (Livernois, 2008). Large unconventional oil reserves like shale oil and oil sands are examples of both technological innovation and unanticipated large discoveries. As the total amount of oil is unknown, the optimization problem will depend on the current beliefs about the magnitude of reserves and will most likely not be intertemporally optimal, thus differing from the modified Hotelling rule.

#### *4.3.1.8 The Cobweb Theory*

Certain markets and most commodity markets are characterized by a lag in supply, and the supply in the following period is consequently decided by the current price and investments. The cobweb theory aims to explain these periodic price fluctuations. Other names for the cobweb theory are hog cycle and cattle cycle; illustrating markets where the future supply is decided in previous periods. How the price will fluctuate depends on the elasticity of supply and demand. The following explanations are presented by Ezekiel (1938). The demand curve in Figure 4.2 shows the total demand and consequent price in period 1 while the supply curve shows the total supply available in period 2 for varying prices paid in period 1.

When the supply and demand curves are equally elastic, the market is characterized by continuous fluctuation. The fluctuations are illustrated in Figure 4.2. The quantity in the first period is initially large,  $Q_1$ , and the price in period 1 is therefore relatively low,  $P_1$ . The low price discourages investments and the supply in the next period is consequently low,  $Q_2$ . With such a low quantity, the price in the next period becomes high,  $P_2$ . This high price motivates investments, and the supply in the following period consequently increases to  $Q_3$  with the corresponding low price  $P_3$ . Since  $P_3$  equals  $P_1$ , the price and quantity will follow the same path in the following periods as well.

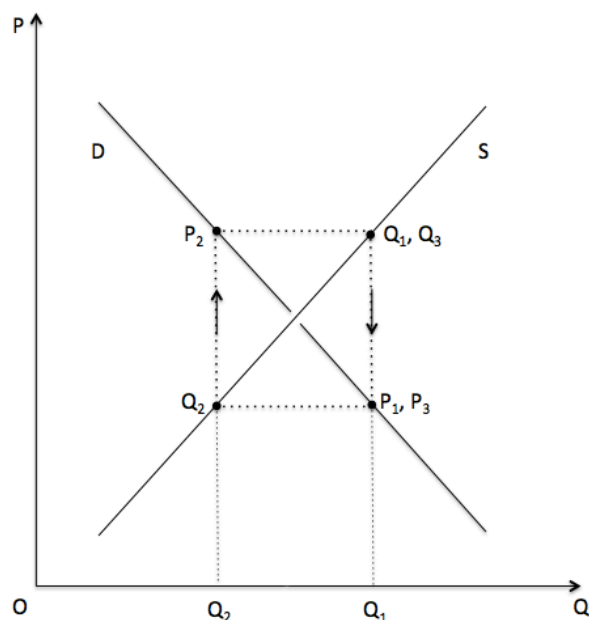


Figure 4.2 The cobweb theory under constant fluctuation (Ezekiel, 1938)

In this theory the price is assumed to be completely dependent on supply, and the supply in the following period is assumed to be completely dependent on the price in the current period. The supply and demand curves are also assumed to have the same elasticity at their overlap. When these assumptions are fulfilled, the rotating path will continue indefinitely and equilibrium will never be approached or reached. If the elasticity of supply is greater than the elasticity of demand, then the path will expand over time and might continue to expand until the price falls to zero, production is completely terminated, or the supply reaches a limit to available resources so that the elasticity of supply changes. If the elasticity of demand is greater than the elasticity of supply, then the path will approach equilibrium. This is the only case where the market follows the manner assumed by equilibrium theory. The cobweb theory has been expanded to include markets where the lags in supply reach over more than one period, but since the paths are the same these expansions will not be presented here.

The implication for the oil market is that the current price will affect investments and consequently the future price. As the price of oil remains low, the amount of investments are reduced, and the supply of oil in the following period will be lower than it is in the current period. This will lead to a higher price of oil in the following period, reducing demand. With a high price, competition in the oil market increases, leading to higher investment levels and a downward pressure on prices. For example Krugman (2001) argues that the oil market has

been characterized by oil-hog cycles and that the cycles are predicted to repeat themselves in the future too.

### **4.3.2 Oil Price Scenarios**

The three scenarios for future oil price development, presented below, attempt to take into account the theory for oil price development as well as the complicating factors of the oil market.

#### **4.3.2.1 A “High” Scenario**

Jarand Rystad, CEO of the energy consultancy company Rystad Energy, predicts an oil price of more than USD 60 per barrel in 2016, USD 60-80 in 2017 and USD 113 per barrel in 2020 (Ekeseth, 2015). He expects the price to suddenly turn and increase considerably. As companies have downsized in order to survive the low oil prices, and have postponed investments, production from existing fields falls. As demand continues to increase and producers are unable to increase production accordingly, the price starts to increase. This is consistent with cobweb theory described above, and Rystad in fact refers to this theory in the Norwegian debate (Nissen-Meyer, 2015).

#### **4.3.2.2 A “Medium” Scenario**

Thina Saltvedt, senior oil analyst in Nordea, believes that the oil price reached bottom, for now, in January, and that the price will be USD 50 per barrel by the end of 2016. By the end of 2017 she expects the oil price to be at USD 66 (Nordea Markets, 2016). A price above USD 50-55 will encourage the American shale oil producers to increase production by investing in new projects. This increased production may limit the oil price increase for a period. The cuts in the oil investments after the price drop will affect production at some point in time. When this happens the price may increase considerably (Nordea Markets, 2016).

#### **4.3.2.3 A “Low” Scenario**

The revised 2016 fiscal budget gives somewhat more conservative and less specific predictions for the oil price. The government expects the oil price to increase slowly, at the rate of the futures market, to NOK 500 at fixed 2016-NOK in 2025, and stay at that price from 2025 onwards (Ministry of Finance, 2016a). Their predicted development is shown in



Figure 4.3. The estimated prices are reported in NOK, and will thereby depend on the currency exchange rate. NOK 500 will at the current exchange rate of 8,2 NOK per USD equal about USD 61. Since the Norwegian Krone will probably appreciate as the oil price increases, the actual US dollar value will be higher than 61.

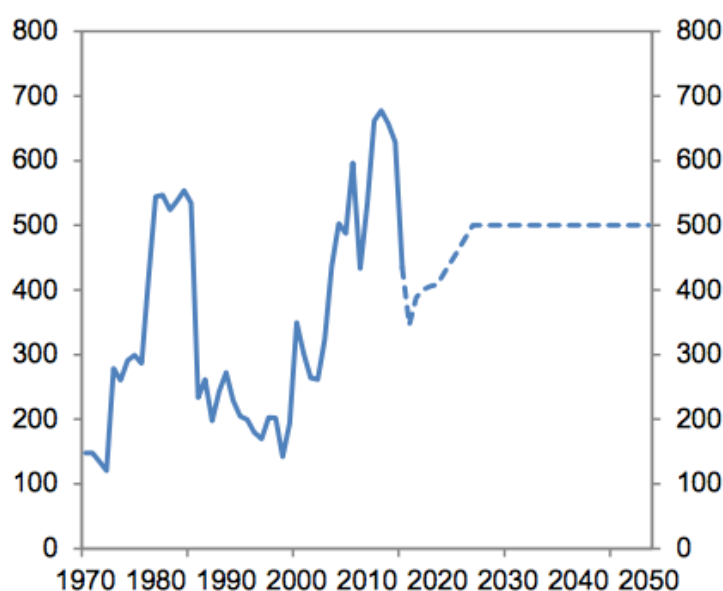


Figure 4.3 Oil price predictions in fixed 2016-NOK/bbl (Ministry of Finance, 2016a)

### 4.3.3 Forecasts for the Key Interest Rate

The key interest rate is expected to remain low in the forthcoming years. The central bank estimates the interest rate to be lowered even further in 2016 and 2017, before it is expected to increase in 2018. Inflation is expected to decrease in the coming years, which calls for a lower key interest rate (Norges Bank, 2004).

In addition to inflation considerations, the Norwegian central bank highlights the importance of a stable and robust monetary policy (Norges Bank, 2011). As the current activity in the Norwegian economy is low, and inflation is weaker than expected, a lower key interest rate is called for. The criteria that the monetary policy is to be robust, to avoid unstable growth in housing prices as well as in debt levels, has limited the central bank's reduction of the interest rate (Norges Bank, 2016a).

Depending on the oil price development, the predictions for the key interest rate may change. If the oil price increases fast, for example according to the “High” scenario described above, the interest rate will likely not follow the dotted path displayed in Figure 4.4. If the Norwegian economy performs better in the coming years, the key interest rate may be increased to slow down the increase in debt levels among Norwegian households, and to work countercyclically. The interest rate is close to zero, and it is uncertain what the effects of such low interest rates are. In addition, even though other countries have experimented with negative interest rates, and that they have had some effect, it is uncertain how large the effects might be for the Norwegian economy. This puts a limit on how much the interest rate can possibly be lowered (Norges Bank, 2016a).

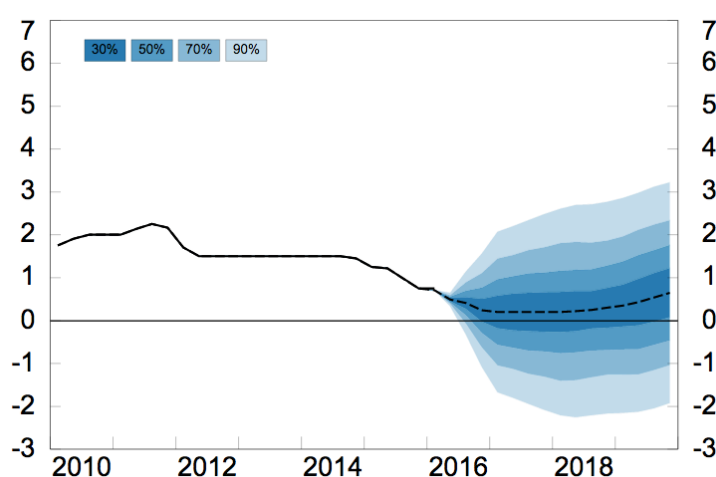


Figure 4.4 Actual and predicted path for the key interest rate (Norges Bank, 2016e)

#### 4.3.4 Forecasts for the Unemployment Rate

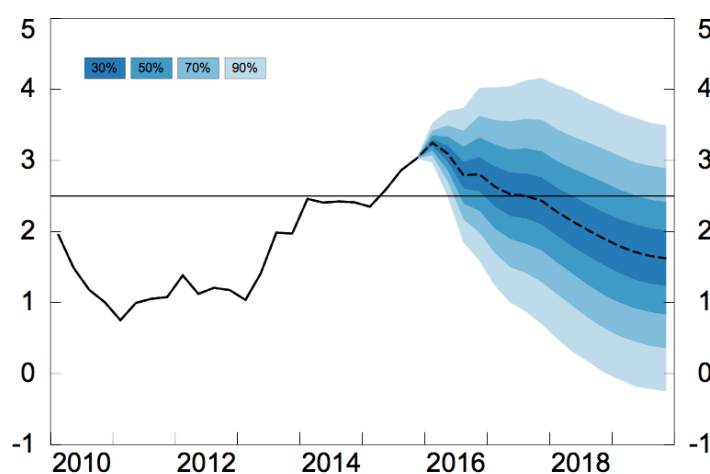
The growth in employment is predicted to be 0,2 percent in 2016 and 0,7 percent in 2017, according to the Ministry of Finance (2016a). This is weaker than the growth experienced in 2014 and 2015. The unemployment rate is expected to be 3,2 percent in 2016 and 3,3 percent in 2017 compared to 2,8 percent in 2014 and 3,0 percent in 2015 (Ministry of Finance, 2016a). NAV expects the unemployment rates to continue to differ between Norwegian regions. For instance, Rogaland is expected to have a higher unemployment rate than other counties. Lower oil investments lead to increased unemployment in petroleum dependent regions, while a depreciated currency and low interest rates increase the activity in the export industry. NAV expects the unemployment rate to decrease somewhat from 2017 and onwards (NAV, 2016b).

### 4.3.5 Forecasts for GDP Growth

The revised 2016 fiscal budget predicts the growth in mainland-GDP to be 1,7 percent in 2017, measured in fixed prices. After 2017, the growth is expected to return to the trend-growth. The estimates for the GDP growth are uncertain, and depend on the oil- and gas prices, as well as how consumption and investments are affected by lower interest rates, a depreciated currency and a higher unemployment rate. The debt level among Norwegian households is high, and consumption may be severely affected if their household income is reduced. This may lead to a fall in housing prices as well as a larger decrease in the Norwegian activity level (Ministry of Finance, 2016a).

### 4.3.6 Inflation Forecasts

The objective of Norway's monetary policy is to keep inflation around 2,5 percent. The recent increase in inflation is due to a depreciated currency. In the coming years inflation is expected to decrease (Norges Bank, 2016a). As the currency stabilizes, the price of import goods stabilizes, and the inflation will decrease. This is in line with the key interest rate predictions from the Norwegian central bank (Norges Bank, 2016f). As inflation decreases, the interest rate needs to be lowered accordingly. Figure 4.5 shows the actual and predicted inflation path.



**Figure 4.5** Consumer price index (CPI-ATE) adjusted for tax changes, excluding energy products (Norges Bank, 2016g)

All these outlined predictions for Norway's economy will form the basis for the second half of Chapter 5. Bjørnland and Thorsrud's predicted effects of an oil price drop will be compared with the actual outcomes seen in the Norwegian economy today. In addition, we will predict outcomes for the Norwegian economy in the coming years, and discuss how these will affect the restructuring of the sectoral composition of employment.

## 5 Discussion

In the following chapter, we will discuss the findings from Chapter 3 and 4 in further detail. Part one focuses on the findings from our data analysis. In part two we continue by comparing Bjørnland and Thorsrud's predictions to the actual outcomes of the oil price drop. Finally, we will predict the outcome for the Norwegian economy and discuss the restructuring of the sectoral composition of employment.

### Part One

#### 5.1 Regional Analysis

For a summary of the findings from Chapter 3, see Table 5.1 below. A booming petroleum sector has entailed changes in the sectoral distribution of workers in Norway. Evident from the table below, there are considerable regional differences within Norway. In this chapter the focus is, however, mainly on Rogaland, while still explaining interesting findings from the other counties.

Tradable Sector		Shares of Employment		Absolute Changes 2000-2014
		2000	2014	
	<i>Norway</i>	<i>11,2 %</i>	<i>7,7 %</i>	<i>-19,2 %</i>
	Akershus	6,0 %	3,9 %	-22,7 %
	Oslo	4,1 %	2,4 %	-22,5 %
	Rogaland	11,3 %	7,9 %	-7,8 %
	Sør-Trøndelag	9,9 %	7,9 %	-1,6 %
<b>Non-Tradable Sector</b>				
	<i>Norway</i>	<i>84,3 %</i>	<i>86,9 %</i>	<i>20,8 %</i>
	Akershus	92,0 %	93,6 %	20,2 %
	Oslo	93,6 %	95,1 %	31,1 %
	Rogaland	77,1 %	77,1%	31,7 %
	Sør-Trøndelag	87,1 %	88,9%	25,8 %
<b>Petroleum Sector</b>				
	<i>Norway</i>	<i>3,8 %</i>	<i>4,9 %</i>	<i>52,0 %</i>
	Akershus	1,3 %	1,9 %	76,3 %
	Oslo	1,2 %	1,8 %	99,6 %
	Rogaland	10,8 %	14,6 %	78,2 %
	Sør-Trøndelag	2,4 %	2,7 %	39,4 %

Table 0.1 Summarization of employment shares and absolute changes from Chapter 3, split by sector and county.

##### 5.1.1 Tradable Sector - Reduced Competitiveness?

During the analyzed time period the share of employment in the tradable sector has decreased in Norway, and all analyzed counties. This is in line with two-sector theory following a

petroleum boom. A diminishing tradable sector is a phenomenon seen in many parts of the developed world, and the importance of the petroleum sector is not necessarily the main reason for this development. An argument for stating this can be seen by looking at the numbers for Rogaland, where the employment share in the tradable sector was *above* the national average during the whole period. There is thus no evidence that Rogaland's petroleum dependency directly reinforced de-industrialization.

On the other hand, it is reasonable to believe that the petroleum sector has created a need for certain industries by demanding highly specialized services that the tradable sector can deliver. The tradable sector has consequently accumulated experience and knowledge that can be exported, which can help explain some of the relatively high employment in the tradable sector, in Rogaland.

In their report Bjørnland and Thorsrud (2014b) found significant, positive spillover effects from the petroleum sector to the other two sectors in the Norwegian economy. They identified productivity-, technological- and learning spillovers, and the most positively affected industries were construction, business services and real estate. These spillovers have likely dampened the de-industrialization, and may contribute to explain the relatively small decrease in the tradable sector found in Rogaland.

#### *5.1.1.1 Learning by Doing*

The growing petroleum sector has to some degree deprived other industries and sectors of the capital and labour input needed to develop. The consequence of this may have been relative underdevelopment, while the petroleum sector has thrived. Considering that the pace of technological improvement is increasing ever more rapidly, missing out on a just a few years of the effects of learning-by-doing can be quite damaging.

On the other hand, the decline in employment in the Norwegian tradable sector has not been that prominent, indicating that this effect may not be as detrimental as feared. In addition, the competitive advantages the petroleum sector has accumulated, such as technological advancements, during the existence of the sector may also be transferable to other industries in the future, particularly within subsea and marine industries.

### **5.1.1.2 Foreign Exchange Rate**

The tradable sector is very sensitive to changes in the exchange rate. For a long period, the Norwegian Krone has been very strong, which has implied lower price competitiveness compared to trading partners. This is believed to have affected the tradable sector, and thus the labour demand from this sector. However, since the drop in the oil price, the Norwegian Krone has depreciated and thereby increased the competitiveness of the Norwegian export industry. Due to time restrictions in our data, we are not able to analyze whether this has had an effect on employment in the tradable sector.

### **5.1.2 Non-Tradable Sector – the Dominating Sector**

The non-tradable sector is composed of many different industries, like construction, hotel and restaurant, transport, banking and finance, in addition to public services like healthcare, education and public administration. As in most developed countries, the non-tradable sector is large in Norway. However, there were findings from Chapter 3 that were surprising, in particular Rogaland's deviation from the national average. No other county analyzed had such a low share of employment in the non-tradable sector, with an average share of 77 percent. The national average was 87 percent in the same time period.

A factor that naturally explains this low share of employment in the non-tradable sector in Rogaland is particularly the fact that the petroleum sector employs many workers, and consequently leaves fewer workers for the non-tradable sector to hire. This is what is called the resource movement effect. That the wages in the petroleum sector have been more competitive than what the non-tradable sector has offered helps explain the low share of employment in this sector. The petroleum sector has grown in Norway since the 1960s and some of the resource movement effect that has occurred in Rogaland is consequently not visible in the data series of this thesis. The low share of the non-tradable sector in Rogaland indicates that the resource movement effect has been stronger than the spending effect in Rogaland before year 2000.

In the analyzed period, on the other hand, the growth in the non-tradable sector indicates that the spending effect has dominated the resource movement effect in Rogaland, as well as in the other counties. Another explanation for the growth in the non-tradable sector in this period may be the positive spillover effects identified by Bjørnland and Thorsrud (2014b). The most

positively affected industries are mainly categorized as non-tradable, and positive spillovers will then contribute to increasing this sector's growth.

Oslo and Akershus had an average share of employment in the non-tradable sector of approximately 93 percent, which is well above the national average of 87 percent. Oslo's high share can be explained by the fact that many of the government's offices and departments are in Oslo, most of the large corporations in Norway have their headquarters there, and that Oslo is the political, cultural and economic capital of Norway. Keeping in mind that these numbers are based on municipality of residence, Akershus' high share in the non-tradable sector is explained by the geographical proximity to Oslo, and thus that many of Akershus' inhabitants work in Oslo.

Sør-Trøndelag also has an above-average share of employment in the non-tradable sector, but the employment share is closer to the average than Oslo and Akershus' shares. Comparing Sør-Trøndelag to Rogaland it is evident that employment within research and development, as well as education, is higher in Sør-Trøndelag. This is unsurprising considering the location of the Norwegian University of Science and Technology (NTNU) and its connected research institutes. Since research & development and education are categorized as non-tradable, this contributes to increasing the share of employment in the non-tradable sector.

The developments in the non-tradable sector give indications to which of the two effects is the strongest, the resource movement effect or the spending effect. Common for all analyzed counties throughout the period is a relatively stable development, none of the counties have a strong increase or decrease in employment shares. Corden and Neary (1982) suggest that the non-tradable sector increases when the spending effect dominates, while it decreases if the resource movement effect is dominant. The absolute growth in the non-tradable sector in the analyzed period indicates that the spending effect dominates the resource movement effect for Norway as well as for all analyzed counties. This suggests that the spending effect has not been completely avoided, as was the intention of the GPFG. However, if equivalent data were available from the beginning of the petroleum boom in Norway, it is possible that we could have reached a different conclusion.

### **5.1.3 Petroleum Sector**

The growth in petroleum employment has been high in Rogaland, due to an increasing and relatively high oil price and production. In addition, from approximately 2000 and onwards, oil service companies started exporting their products and services to foreign markets. This development can be linked to the appearance of clusters. Clusters are concentrations of specialized industries in one geographic area, and have several benefits. The petroleum sector in Rogaland has demanded several specialized services to be provided and easily accessible for the sector, and consequently a knowledge cluster has appeared.

The petroleum sector in Norway has spent decades building important knowledge and technology, which is world leading, and thus has a competitive advantage within subsea technology. Starting around the millennium, some of these companies started exploiting this advantage by exporting some of this knowledge and technology abroad, too. Today, a large part of the employees in oil service companies are involved in export related activities (IRIS, 2015).

The growth in petroleum employment in Oslo and Akershus is considerable, but from a low level. This may indicate a trend that many oil and gas companies are moving more resources and employees to the eastern part of Norway, and possibly also moving their headquarters to the capital region. A possible explanation for this may be that they wish to be closer to the political power center of Norway, Oslo, and the policy makers.

## **5.2 Reduced Activity – Permanent Downsizing?**

Following a lower activity level in the petroleum sector, accelerated by the sudden oil price drop, a severe downsizing in the Norwegian petroleum sector has occurred. An estimate performed by the investment-banking department in the largest Norwegian bank, DNB Markets, has registered that more than 35 000 jobs have been cut in the Norwegian petroleum sector from the oil price drop in 2014 until April 2016 (NTB, 2016).

Although the oil price drop in 2014 expedited this downsizing process further, many of the largest oil and gas companies in Norway were already in the process of cutting costs, and consequently jobs, in their companies. These numbers are however not included in the numbers reported by DNB Markets. The initial cuts are likely to give rise to what is termed



structural unemployment, which is derived from the mismatch of sector-specific skills possessed by dismissed workers from the petroleum sector and the skills needed by firms in other sectors. The programmes have often been labelled as cost reduction and efficiency programmes, with the stated goal to enhance their competitiveness. The fact that these programmes had already been initiated before the price drop, gives an indication that re-hiring of all the dismissed personnel presumably will not occur. This has also been stated by Karl-Eirik Schjøtt-Pedersen, the director-general of the industry organization for the Norwegian oil and gas industry (Barstad, 2016).

The initial retrenchment of the petroleum sector leaves the question of what will be the “next oil” in Norway, and where the dismissed workers will go? This is a debate with many participants, and three alternatives have emerged. Seeing that the work stock in the petroleum sector is highly skilled and educated, there are good opportunities for developing or strengthening other technology- and capital-intensive industries. The three most likely alternatives for the petroleum sector are i) an intra-sectoral adjustment, away from petroleum related activities, over to non-petroleum related industries, ii) a stronger focus on exporting the accumulated petroleum related knowledge, and/or iii) development or strengthening of non-petroleum industries. Related to the lattermost alternative, Norway has a strong history within marine industries, like shipping, fishing and aquaculture that have been viewed as the industries that can become the “next oil” (Blomgren, 2015). However, the economic rent specific for the oil industry will be difficult or impossible to replace.

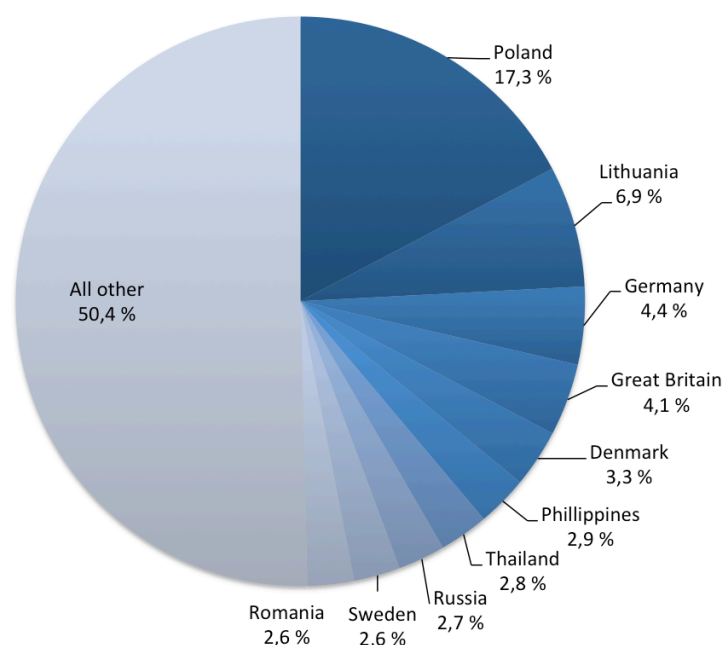
### **5.3 Labour Market and Labour Market Rigidities**

With a booming petroleum sector, a shortage of labour in other sectors and industries appeared. The shortage naturally varied between regions, depending on the growth in petroleum employment. Rogaland experienced a considerable growth in petroleum related employment, of 78,2 percent, and this was from a sizeable base level.

#### **5.3.1 Labour Migration’s Role**

In the very beginning of the Norwegian petroleum era, there was a shortage of qualified labour in the petroleum sector, which was resolved in part by labour immigration of experienced professionals from countries like the UK and the US, and by increased focus on

petroleum education in Norway. In addition, the profitable petroleum industry paid wages that attracted many workers from other industries and sectors, leaving a shortage of employment in those industries and sectors. Labour immigration has been crucial for filling these shortages. In Rogaland, Polish and Lithuanian immigrants in particular, make up the largest immigrant groups, among 172 nationalities, see Figure 5.1 below (Rogaland Fylkeskommune, 2016a). A considerable amount of these are employed in the construction industry (Sagmoen & Dalen, 2016).



**Figure 0.1 Immigrants in Rogaland by country of origin in 2015, 10 largest groups (Statistics Norway, 2016d)**

The oil price drop, and the subsequent economic downturn in Norway, has impacted the different regions of Norway quite differently. Rogaland and the other petroleum-dependent counties of Vest-Agder, Aust-Agder and Hordaland have seen a higher increase in unemployment rates than other counties (NAV, 2016a). However, this downturn has not only affected the petroleum sector.

In the fall of 2015 there was evidence that the economic downturn had spread to other sectors (Knudsen, 2016). For instance, the construction industry is highly cyclical, similar to the petroleum industry. It is heavily affected by the business cycles in the economy in general, and because of the downturn in the Norwegian economy the construction industry is now starting to feel the consequences, with lower demand and higher unemployment rates. This unemployment stemming from business cycle variations is called cyclical unemployment, and

comes in addition to the existing low structural unemployment in the Norwegian labour market.

In order to reduce some of the structural unemployment that follows a retrenchment of the petroleum sector in Norway, training programmes should be initiated. The training programmes enables workers to enter a new sector or industry, by teaching them new industry-specific skills. Following the dismissal of many petroleum engineers in Norway, some universities offer additional pedagogical education in order for them to work as teachers in Norwegian middle and high schools (Andersen I., 2015). By offering these programmes, the unemployed engineers are filling the shortage of science teachers, which has been an issue in many Norwegian municipalities for years. This is one of several examples of retraining of dismissed workers that will reduce the amount of structural unemployment.

Currently, some of the labour immigrants in Rogaland have left the country. This is indicated by the fact that as the numbers of dismissals increase, the unemployment numbers do not increase accordingly. Immigrants returning to their native country can have many explanations, an apparent one being that the immigrants had not accrued the social benefits needed for them to stay in Norway. The phenomenon of more dismissals than unemployed can also be explained by domestic migration (Andersen E., 2016).

In 2015, the net immigration to Rogaland was at a historically low level, of only 718 people, compared to the previous five years. This was mainly caused by a net domestic emigration from Rogaland to other parts of Norway in 2015 (Rogaland Fylkeskommune, 2016b). Prior to 2015 the net immigration to Rogaland has been considerably higher, 5814, 4319 and 3437 people in 2012, 2013 and 2014, respectively (Rogaland Fylkeskommune, 2016b). A high net immigration may have contributed to dampening an even stronger wage growth in Rogaland. As Corden (1984) suggested, the net immigration may have put pressure on keeping wages low in certain industries, and has consequently worked countercyclically. Now, the migration flow can also work countercyclical, when the market situation is the reverse of what it has been the last decades. If low net immigration to Rogaland continues, and possibly net emigration, it can reduce the growth in unemployment rates and the downward pressure on wages, thereby easing some of the negative consequences of the economic downturn in Rogaland.

In sum, we see that the cyclical unemployment following the economic downturn in Norway comes *on top of* increased structural unemployment, due to lower economic activity in the petroleum sector. The cost reduction programmes in several oil and gas companies were initiated before the oil price drop, and the price drop has only exacerbated the negative employment effects of the programmes. However, it seems like the flow of migration, domestic and foreign, is somewhat relieving the pressure in the labour market.

### 5.3.2 Historically High Wages - Moderations in Sight?

A high average wage level, combined with a strong Norwegian job market, has attracted many immigrants to Norway, particularly since the expansion of the European Union in 2004. The considerable increase in migration to Norway from 2004 may have dampened the wage growth in a period of strong economic growth. Nevertheless, the graph from Chapter 3 exhibiting the gross income growth in Norway from 2000 to 2014 reveals a considerable growth in the time period. Rogaland differs somewhat from the other counties, by showing stronger wage growth, as expected. Looking at the time period as a whole, the wage growth has been between 58 percent in Oslo and 95 percent in Rogaland from 2000 to 2014.

Currently, Norway is facing an economic downturn with low interest rates, low investments levels, and relatively high regional unemployment rates. Although the current situation of retrenchment of the petroleum sector in Norway is not the end of the petroleum sector, it is the beginning of a long process of downsizing and dismantling the sector. While we will likely see spikes in profits and employment, in conjunction with new discoveries or higher oil prices, the petroleum activities will inevitably be reduced and gradually phased out, due to the finiteness of the petroleum reserves. The reversal of sectoral labour distribution following the dismantling will entail a shift of employment from the petroleum sector to the other sectors, and/or a transition to export oriented petroleum related activities in the supplier industry, and requires a lower wage level than earlier (Steigum, 1989).

In order to minimize the negative effects of the downturn in the Norwegian economy, wage flexibility is needed. As emphasized by Steigum (1989), downwards wage rigidity may exacerbate the negative consequences of a reversal. The wage settlements in Norway are negotiated at a national level, setting a precedent for the local settlements across the country. In 2016, the national settlement set the norm of a *nominal* wage growth of 2,4 percent. Taking

inflation of 3,3 percent into account, the *real* wage growth for this year's settlement is *negative*, at -0,9 percent (Norges Bank, 2016a). This indicates that both sides of the labour market in Norway, across sectors, have realized the importance of flexibility in this year's settlement. The reason is that a moderate growth in wages can suppress some of the increase in unemployment rates in Norway.

Some might argue that it is pointless to oppose the downsizing of the petroleum industry by accepting cuts in wages, as it is a restructuring of the Norwegian economy that is inevitable. However, as not only the petroleum sector is affected by the current economic situation, limiting wage growth can also have positive implications for the other affected sectors. Regardless of the current market situation, the Norwegian petroleum sector will continue to exist in many decades to come, given the reserves on the Norwegian continental shelf.

Conclusively, the Norwegian labour market has been through a strong period since the early 2000s. When most of the western world's labour markets were in distress during the financial crisis of 2008 and the euro-crisis in 2011-2012, the Norwegian labour market was characterized by unprecedented low unemployment rates and a high average wage level. The market has been aided by migration on several occasions. Firstly, by high net immigration to Rogaland in a period of strong growth dampened the wage growth in many sectors, and secondly now, when the significantly lower net immigration in Rogaland helps reduce the growth in unemployment rates.

## Part Two

### 5.4 Looking Ahead

Looking ahead and predicting how the Norwegian economy will develop, is challenging. Many factors contribute to the situation we see today. Oil and gas companies had already initiated cost-cutting programmes before the oil price fell, resulting in dismissals in the Norwegian petroleum sector. On top of this, the declining oil price has caused diminished revenues and profit in the petroleum sector, further increasing the unemployment rates. This ripples to a lower Norwegian tax income, both through lower petroleum taxes and lower tax revenues from labour income. On the other hand, the Norwegian currency has depreciated following the oil price drop, benefitting the Norwegian tradable sector.

## 5.4.1 Predictions Compared to Actual Development

### 5.4.1.1 Type of Price Shock

Bjørnland and Thorsrud (2014a) predicted that the Norwegian economy would be severely affected by a 25 percent decrease in the oil price. They separated the types of price shocks according to whether they were demand-driven or supply-driven. The predicted effects of these price shocks are represented in Table 5.2.

	Demand-Driven	Supply-Driven
<b>Investments</b>	Decrease by 4-6 % after two years	Decrease by 1,5-2 % in the first year
<b>Employment</b>	Decrease by 1,5-2 % after two years	Decrease by 0,9 % after 2-3 years
<b>Real Wages</b>	Decrease by 2,5-3 % after two years	Decrease by 1 % after 2-3 years
<b>Real Exchange Rate</b>	Depreciate by 2,5-3 % on impact	Depreciate by 2,5 % on impact
<b>Mainland-GDP</b>	Decrease by 2-2,5 % after two years	Decrease by 0,5 % after two years

**Table 0.1 Predicted effects of two different types of negative price shocks of 25 % (Bjørnland & Thorsrud, 2014a).**

The price shock in 2014 was mainly supply-driven, and the actual consequences then have to be compared to the supply-driven predictions. The supply of oil on the world market increased more than expected when shale-oil production in the US increased considerably. This led to a downward pressure on prices. Saudi Arabia, and the rest of OPEC, could have reduced production to uphold the price level, which would infer loss of market share, so they decided to uphold production. The prices thus had to fall to equalize supply and demand (Krauss, 2016).

On the other hand, the demand for oil increased less than expected, making it somewhat demand-driven too. The demand for oil is closely related to the economic activity. Slower growth in China, as well as weak economic growth in Western countries, dampened the growth in oil demand. At the same time, energy efficiency is improving and there is a growing trend to switch to other fuels than oil (The Economist, 2014). The negative oil price shock was mainly supply-driven, yet since normal demand reactions to lower oil prices are weaker than usual, the actual consequences may be more severe than Bjørnland and Thorsrud (2014a) predicted.

#### *5.4.1.2 Comparison of Actual Development and Predictions*

Bjørnland and Thorsrud (2014a) predicted that the mainland-GDP would decrease by 0,5 percent after two years. Since the experienced oil price drop was above 25 percent, we would expect mainland-GDP for 2016 to have decreased by more than 0,5 percent. As it turns out, mainland-GDP increased both in 2014 and 2015 (Statistics Norway, 2016a), and is predicted to increase by 1,0 percent in 2016 (Ministry of Finance, 2016b). This goes against the predictions made by Bjørnland and Thorsrud, even when the oil price drop was larger than what they predicted.

Investments were expected to decrease as the price dropped. This has been the case for investments in the petroleum sector, but the investments for mainland Norway increased in 2014 and remained unchanged in 2015 (Statistics Norway, 2016a; Statistics Norway, 2016b). Investments are expected to increase in 2016, making the consequences less severe than predicted (Ministry of Finance, 2016b).

Employment was predicted by Bjørnland and Thorsrud to decrease by 0,9 percent after 2-3 years. The actual consequences have been an increase in employment, though the growth has slowed down compared to previous years. Employment is predicted to grow by 0,2 percent in 2016 and 0,7 percent in 2017 (Ministry of Finance, 2016a). This makes the consequences for employment less severe than predicted as well. The consequences differ, however, across regions in Norway. The south-western parts of Norway have seen large increases in unemployment since the oil price fell, and the consequences are thereby more severe for these parts of the country.

Real wages were predicted to decrease by 1 percent after 2-3 years. In the recent national settlement the parts agreed to a 0,9 percent decrease in real wages. This is very close to the prediction by Bjørnland and Thorsrud, even though the price shock has been more severe than they predicted.

The real exchange rate was predicted to depreciate by 2,5 percent on impact. Compared to three important international currencies, US Dollars, Euro and British Pounds, the depreciation has been between 13,4 percent (EUR) and 35,9 percent (USD) from June 2014 to May 2016 (Norges Bank, 2016c). This depreciation has been more severe than what Bjørnland and Thorsrud predicted, however the period is longer than what would be

characterized as “on impact”. As the prediction was made for an immediate depreciation, the changes made to the key interest rate since the oil price drop would not have been taken into account.

#### ***5.4.1.3 Explanations for the Discrepancies***

One reason for the differences between the predictions and the actual consequences of the oil price drop may be that as the currency depreciated more than predicted, this contributed more to the other traded sector than predicted by Bjørnland and Thorsrud. A more severe real depreciation will also dampen the effects of the oil price shock for the Norwegian petroleum companies that have most of their costs in Norwegian Kroner.

Furthermore, another explanation for the discrepancies can be that the Norwegian government has carried out a more expansionary policy than Bjørnland and Thorsrud predicted. In their report they state that more expansionary monetary- and fiscal policy than used in the past can increase domestic demand and thereby dampen the effects of the oil price shock temporarily. Since the oil price started to fall, the Norwegian central bank has lowered the interest rate by 1 percentage point and the fiscal budget deficit has been increased. This means that both the monetary- and fiscal policy in Norway have been quite expansionary since the oil price dropped, and have consequently counteracted some of the negative effects of the oil price drop.

#### **5.4.2 What will happen in the Next Few Years?**

The future of the Norwegian economy is to a large extent dependent on the development of the oil price. There are considerable uncertainties associated with predicting the future oil price, and during recent years most oil analysts have been proven wrong. Nevertheless, three perspectives on the future oil price development have been presented in Chapter 4. They differ in how much weight they put on the effects of the decrease in investments that have followed the oil price shock. The “Low” scenario assumes an even, slow growth in line with the futures market, thereby assuming that the supply will be able to keep up with the demand even though investments in exploration of new oil fields have been much lower than in previous years. The “High” scenario assumes the oil price to increase rapidly because of the lack of available oil reserves as demand increases over time, which is consistent with the cobweb theory. The “Medium” scenario corresponds with the “High” scenario regarding the



decline in investments affecting the oil price, but is not as certain that it will happen in the near future. The common thread of the three scenarios is that the price will increase in the coming years.

#### *5.4.2.1 The Oil Price will Increase*

As the oil price increases, the Norwegian economy is expected to perform better than in the last two years. This will lead to an appreciation of the real exchange rate, and an incentive for the Norwegian central bank to increase the key interest rate. The current prediction for the key interest rate is that it will be lowered even further, and then increased slowly from 2018 onward. These predictions will likely change as the central bank knows more about the future oil price and the growth of the Norwegian economy.

The unemployment rate is expected to be 3,4 percent in 2016 and 3,3 percent in 2017 (Ministry of Finance, 2016a). NAV still expects the unemployment rate to differ between regions. As the oil price increases, the petroleum sector will have incentives to hire more workers. This will likely reduce unemployment in petroleum-dependent regions. Depending on how fast the oil price rises, and how large the need for new employees will be, the effects on unemployment are uncertain. A possible delaying factor is that the oil companies might be slow in their reaction to a higher oil price and improved cash flow, in order to improve their balance sheets and reduce debt levels. However, a higher oil price and increased growth in the Norwegian economy indicate that the unemployment rate should decrease.

#### *5.4.2.2 What if the Oil Price does not increase in the Coming Years?*

The current oil price, in June 2016, is approximately USD 50 per barrel. At this price, only a few of the proposed new oil fields are profitable, and the petroleum revenues will be small, if not negative (E24.no, 2016). If the petroleum sector continues to perform poorly and the unemployment rate continues to rise, the population's purchasing power will be affected. The temporary, positive effects of increased government spending have decreased the effects of the downturn in the petroleum sector. However, the growth in mainland-GDP has still decreased by 1,3 percentage points from 2014 to 2015 and 2016. This highlights the significance of the petroleum sector on the Norwegian mainland economy.

If the petroleum sector continues its downsizing, then the significant downturn in Rogaland's economy will most likely spread to other parts of the country. It is not sustainable for the government to spend more of the GPFG than the return of the fund, so the downturn will be more significant as government spending has to be reduced. The unemployment rate will most likely increase on the national level and in regions that have been mostly unaffected until now, which will reduce their purchasing power. This may affect the housing market in other regions, for example Oslo, as well as employment in other sectors of the economy. A fall in housing prices in the capital and further increased unemployment will likely decrease the growth in mainland-GDP even further.

#### *5.4.2.3 Predictions based on Findings*

Employment in the petroleum sector in Rogaland increased every year from 2000 to 2014, but the growth slowed down toward the end of the period. This coincides with the cost reduction programmes in the oil and gas industry, and can be seen in a slowdown in the employment growth. From 2013 to 2014 the employment in the petroleum sector increased by 684 people compared to 2901 people from 2011 to 2012 and 1525 people from 2012 to 2013. The decrease in growth from 2011-2012 to 2012-2013 is assumed to mainly come from cost reductions, while the further decrease in growth in 2013-2014 is assumed to come from the price drop as well.

If the price increases, employment in the petroleum sector in Rogaland is assumed to return to its previous diminishing growth pattern. This may involve a considerable growth in employment in the beginning, before it slows down due to high wage levels in Norway. The unemployment rate in Rogaland will most likely decrease in the years following an oil price increase. Regardless, the petroleum sector will probably focus more on costs than they did before the oil price fell, and try to minimize the cost increases after the oil price increases. This may limit the decrease in unemployment. However, investments and maintenance work that have been postponed are now needed to maintain production, consequently the sector needs to increase activity and employment.

The tradable sector has decreased in relative importance from 2000-2014, but the de-industrialization has been rather small in Rogaland. During the current period of a low oil price, the tradable sector has gained better terms of trade and has had better access to

available workers than when the petroleum sector could pay higher wages. This has most likely increased the growth in the tradable sector. If the oil price increases, the tradable sector will be affected by both an appreciation of the Norwegian Krone and increased competition for qualified employees. This makes it likely that de-industrialization will continue, but since it happens at a slow pace, the tradable sector can continue to perform well in the years to come.

### **5.4.3 The Inevitable Downsizing**

The finiteness and increasing scarcity of petroleum resources leave no doubt that the petroleum sector needs to be gradually downsized and that employment in this sector needs to shift to other sectors. The uncertainties are when this downsizing will happen and how fast. The demand from the petroleum industry seems to have peaked, and will continue to decrease in the years to come. The speed of decline depends on the oil price development. Decreased demand will lead to necessary downsizing of the companies supplying the petroleum sector with goods and services. The petroleum revenue spending in the fiscal budget has increased in recent years, and may peak as a percentage of mainland-GDP in the near future. As the deposits into the fund decline, we gradually approach the point where the size of the fund and the spending rule combine to limit the spending over the fiscal budget. In addition, whether four percent average real return is realistic in the next 10-15 years is questionable (Ministry of Finance, NOU 2015:9).

As presented in Chapter 2, without petroleum revenues, the production and consumption of tradable goods and services have to be equal. The petroleum revenues temporarily increase the production possibilities curve, and the Norwegian population adapts to a higher level of consumption of both tradable and non-tradable goods. As the petroleum reserves are emptied, the production possibilities curve moves back towards its original level. To avoid a current account deficit, a country has to adapt its consumption to the new production level. With a sustainable spending of the Norwegian sovereign wealth fund, the consumption of tradable goods and services does not have to match production neither now nor in the future, because revenues from the GPF can cover the difference. Production and consumption of non-tradable goods and services, by definition, always have to match.

#### *5.4.3.1 The GPFG and the Reversal*

During the inevitable downsizing of the petroleum sector, there are two main effects that need to be reversed – the spending effect and the resource movement effect (Corden & Neary, 1982). The GPFG has enabled Norway to avoid some of the spending effect, by investing the government's petroleum revenues in foreign financial markets. This accumulation of wealth enables a higher consumption post-petroleum than countries without sovereign wealth funds. In theory, Norway can experience less reversal problems, including lower transitional unemployment, due to the establishment of the GPFG. What Norway is left with, is then in theory mainly the resource movement effect, and the reversal of this effect.

Empirically we found that the spending effect and the resource movement effect seem to be of roughly equal size. This implies that the GPFG has not been able to remove the entire spending effect from the Norwegian economy, though it has reduced it, and that we have to reverse some of the spending effect as well. Sustainable spending of the GPFG can however allow us not to reverse entirely to the original production possibilities curve after the oil reserves are emptied. The more of the fund that is spent now, the more Norway has to reduce consumption or increase production of tradable goods and services in the future.

#### *5.4.3.2 Regional Variations*

The need for reversal will be more prominent in the south-western part of Norway. In practice, this means that there needs to be a reversal of the labour (and in theory also capital) that the petroleum sector has deprived other sectors of. Workers from the diminishing petroleum sector thus need to find work in new industries and sectors. The discussion of which industries and sectors, is not the topic of this thesis, although some proposed alternatives are briefly mentioned earlier.

From the data collected for Norway and the different counties it is evident that the non-tradable sector is smaller in Rogaland than the Norwegian average. This difference was likely caused by a resource movement effect present before the time period analyzed in this thesis. The petroleum sector has employed workers previously employed in the non-tradable sector so that both the absolute and relative share of employment in this sector is lower than it would have been without petroleum. The downsizing of the non-tradable sector in Rogaland while the petroleum sector was highly profitable means that the non-tradable sector will probably

increase in Rogaland when the petroleum sector is later downsized, closer to the national average. Further research could reveal whether the high level of non-tradable goods and services in Norway is sustainable even after the petroleum revenues are gone, but is outside the scope of this thesis.

## **5.5 Limitations and Suggestions for Further Research**

There are limitations to the two-sector theory framework, and further expansions could have been included. This involves cluster theory, which could help explain how the different sectors in Rogaland have developed over the last decades.

Furthermore, the distinction between the tradable and the non-tradable sector is not clear, and that many industries fall somewhere in between the two categories, for instance because they are only partly offering tradable goods. This complicates the classification work, and may affect our findings.

The data used in this thesis is from a limited time period, and thus we are not able to analyze the earliest effects of the booming petroleum sector, dating back to the 1960s. Restrictions in the reporting and collection methods of Statistics Norway preclude this type of analysis.

However, this thesis analyzes both a booming petroleum sector until 2014 and the possible start of a petroleum bust since then. The large disparities between the two periods allow a thorough analysis despite the relatively short time period.

Most importantly, however, are the simplifications made when merging the data reported on the two different industry standards (SIC). These simplifications may obstruct some of our results, but since the data are aggregated on a sector-level, we assume these discrepancies to be of minor importance.

Setting a limit of minimum 50 percent petroleum employment is a simplification that may have distorted our petroleum related employment numbers and is important to be aware of. In practice this means that a 5-digit NACE activity with 51 percent petroleum employment has been categorized as in the petroleum sector, and counted as 100 percent petroleum employment. On the other hand, this also implies that a 5-digit NACE activity with 49 percent

petroleum employment has *not* been included in the petroleum sector, and has 0 percent petroleum employment.

Additional data and increased precision of utilized data could also have benefited the discussions in this thesis. In particular, specific and detailed migration data on a regional level for all counties would have been beneficial.

Suggestions for further research on this topic include an even more detailed classification of the petroleum sector, extending the time series, preferably back to the 1960s, and adding additional regional migration data in order to analyze our findings in further detail.

## 6 Summary and Final Remarks

The objective of this thesis has been to examine the sectoral employment composition in Norway, and go beyond a country-level analysis by looking at regional differences. This was achieved through examining sectoral employment developments in four counties where we expected the sectoral composition to differ. The main focus has been on Rogaland, a county clearly dominated by the petroleum sector, and its development was compared to counties assumed to be less petroleum dependent.

### 6.1 Main Findings

The sectoral employment composition in Norway has followed some clear trends, in line with the presented two-sector theory. The petroleum sector and the non-tradable sector have both increased in relative and absolute size, at the expense of the tradable sector, which has gradually decreased from 2000 to 2014.

Not all expected findings were found to be true for Rogaland – the most petroleum dependent county. Contrary to initial assumptions and what theory postulates, the decrease in the tradable sector was not found to be more prominent in Rogaland than in the other analyzed counties. A reason that contributes to explain this is positive spillover effects from the petroleum sector to industries in the tradable sector. Another finding from the data material was the relatively small size of the non-tradable sector in Rogaland. As expected, the percentage growth in the petroleum sector has been strong in Rogaland from 2000 to 2014, yet it was found to be weaker than in Oslo. The low starting point in Oslo contributes to explaining this strong growth.

Rogaland experienced a strong growth in total employment during the analyzed time period, which may have lessened the de-industrialization. The employment growth was aided by increasing labour immigration. From 2004 migration to Norway accelerated, and Rogaland experienced the highest share of labour immigration of the analyzed counties. The labour migration to Rogaland decreased the shortage of labour. However, some shortage remained, reflected by the fact that Rogaland had the lowest unemployment rate in the country and the average wages nearly doubled during the analyzed period. The growth in the non-tradable sector in Rogaland indicates that the spending effect seems to have dominated the resource movement effect. However, the relatively low share of employment in the non-tradable sector

gives reason to believe that the resource movement effect dominated in Rogaland *before* our data period began.

The oil price started falling in June 2014, and reached its lowest level of USD 28 per barrel in January 2016. Since then the price has steadily increased to approximately USD 50 per barrel. Important consequences of the oil price drop in Norway are a significant increase in regional unemployment, lower investment levels, and a stagnant growth in the activity level in the Norwegian economy. The central bank and the government have implemented expansionary monetary and fiscal policies in order to limit some of these consequences. As of today, Rogaland has the highest unemployment rate in the country.

## **6.2 The Way Ahead**

The current situation in the petroleum sector has prompted some industry experts to call for increased countercyclical activity, in order to exploit potential global market opportunities as described by the cobweb theory. This entails that the oil and gas companies should invest now, when the oil price is low, as the oil price will rise again. Doing so would limit an increasing unemployment rate in Norway, and increase future petroleum production. Investing now will, according to this line of reasoning, create a competitive advantage when the oil price increases.

In this thesis we have presented three scenarios for the future oil price. In the coming years we will argue that the oil price will increase. Whether we will see prices as high as they were between 2011 and 2014 is still doubtful. What is less doubtful, however, is that the petroleum sector will try to avoid reaching the same cost levels seen in the past decade. During the period of high oil prices, the sector accumulated a cost level that has been considered excessive. The cost cutting programmes that were initiated by many of the largest oil and gas companies even before the oil price fell indicate that some of the current downsizing in these companies is not just cyclical. The fact that the production level is expected to decrease also supports this prediction. Furthermore, technological innovation enables production with less labour input. Consequently, even though the oil price increases, the magnitude of the petroleum sector as a share of Norwegian mainland-GDP and employment is assumed to decrease.



In the really long run, as the reserves are exhausted, there will be an inevitable downsizing of the petroleum sector. This entails a phasing out of all petroleum and petroleum related activities in Norway, even if petroleum related activities for export might still be important. The uncertainty regarding the size of the petroleum reserves and the oil price development will affect when, and the speed at which, this downsizing will occur.

### **6.3 A Regional Perspective on the Future of the Petroleum Sector**

Considering the short-term effects of the current economic situation, primarily in Rogaland, it is expected that the unemployment rate will continue to increase in the near future. Consequently, the government has allocated a substantial amount in the recently revised fiscal budget for 2016 to the most affected counties in the south-western part of Norway.

These contributions will limit the cyclical unemployment, but will not eliminate the underlying structural unemployment caused by the downsizing of the petroleum sector. In the long run employment in this sector will be gradually reduced and will move to the other tradable and non-tradable sectors. With this development, Rogaland will likely approach the national average for employment in the non-tradable sector and the share of employment working in this sector will consequently increase.

The relative size of the tradable and non-tradable sector in Norway will depend on the current and future spending of the GPFG, in addition to future deposits to and the obtained returns on the fund. Without sufficient funds to enable the current level of consumption of tradable goods, Norway will need to expand its tradable sector. This can be done by creating new industries, or further developing existing ones where we have a competitive advantage, like marine and shipping industries.

### **6.4 The Need for Sustainable Spending**

The fiscal rule states that the spending should on average be equal to the expected annual return, indicating that higher spending is allowed in periods like the one Norway is experiencing now. However, the petroleum revenue spending as a proportion of mainland-GDP may peak in the near future as petroleum revenues decrease while the economy continues to grow. Even though the current petroleum revenue spending is well below the

fiscal rule, a slow spending increase is recommended to avoid a sharp reduction in the future. In addition, it is likely that the real return on the fund in the next 10-15 years will be well below 4 percent (Ministry of Finance, NOU 2015:9). If spending is higher than the expected real return on the fund over time, or the returns are lower than expected, the fund will decrease and consequently leave less for future generations post-petroleum. This will exacerbate the negative consequences of the reversal for the Norwegian economy.

To summarize, there have been and will be negative consequences of the downsizing of the petroleum sector in Norway. These consequences are and will be larger in Rogaland than in other parts of the country. As our analysis shows, the effects of the oil price drop have not been as serious as predicted by Bjørnland and Thorsrud (2014a). Expansionary monetary- and fiscal policy, combined with a depreciated currency, have contributed considerably. The recent economic downturn should consequently not be considered a national crisis, but rather a necessary re-adjustment of the Norwegian petroleum sector with serious regional effects.

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## Appendix A – Sector Classification, Competitive Industries

The following table is the basis for the sector classification of the tradable sector, including petroleum, in this thesis. The table is from Eika, Strøm and Cappelen (2013), and the sector titles below correspond with the classification names in the NACE-standard.

<b>Directly and indirectly based on local natural resources (resource based industries)</b>
Extraction of crude oil and natural gas
Mining
Fish, catch and aquaculture
Forestry
Lumber- and wood industry, excluding furniture
Production of metals
Production of paper and paper goods
Food-, drinks- and tobacco industry
<b>Mainly based on supplies to the extraction industry (supply industry)</b>
Services linked to the extraction of crude oil and natural gas
Reparation and installation of machines and equipment
Shipbuilding industry and other transport equipment industry
Pipe transport
<b>Non-stationary industries</b>
Foreign shipping
Oil refinement, chemical and pharmaceutical industry
Production of metal goods, electronic equipment and machines
Textiles-, clothing- and leather goods industry
Rubber commodity- and plastic industry, mineral products industry
Manufacturing of furniture and other manufacturing

## Appendix B – Share of Petroleum Employment

On 5-digit NACE, above 50 percent classified as petroleum.

Code	Industry	Employed company population	Employed	Share
64202	Special Holding Companies	87	11	786 %
30116	Fitting and Installation work performed on oil platforms and modules	3 038	2 669	114 %
9109	Other services connected to extraction of Crude Petroleum and Natural Gas	21 513	19 692	109 %
50201	Foreign ocean transport with goods	4 920	4 850	101 %
6100	Extraction of Crude Petroleum	24 661	24 625	100 %
9101	Support Activities for Petroleum and Natural Gas Extraction	15 426	15 672	98 %
52223	Supply Base	1 336	1 372	97 %
49500	Pipeline	228	239	95 %
30113	Construction of oil platforms and modules	11 448	12 039	95 %
30111	Construction of ships and hull above 100 gross tons	3 346	3 630	92 %
6200	Extraction of Natural Gas	1 555	1 717	91 %
50203	Tugboats	562	631	89 %
28940	Manufacturing of machine and equipment for the textile-, clothing and leather industry	24	27	89 %
28920	Manufacturing of machines and equipment for the mining- and construction industry	5 416	6 400	85 %
28130	Manufacturing of pumps and compressors	2 528	3 066	82 %
30115	Fitting and installation work performed on ships above 100 gross tons	1 486	1 888	79 %
19200	Manufacturing of refined petroleum products	912	1 195	76 %
13950	Manufacturing of non-woven textiles and textile products, except clothing	45	61	74 %
22190	Manufacturing of rubber products, not mentioned elsewhere	371	504	74 %
28120	Manufacturing of components for hydraulic and pneumatic equipment	905	1 252	72 %
24540	Casting of other non-ferrous metals	57	81	70 %
50204	Supply and other sea transport offshore services	5 321	6 449	83 %
28110	Manufacturing of motors and turbines, except motors for aircrafts and motor vehicles	1 039	1 566	66 %
26510	Manufacturing of measuring-, control- and navigational instruments	3 192	4 861	66 %
30112	Construction of ships under 100 gross tons	618	979	63 %
28221	Manufacturing of lifting and handling equipment for ships and boats	1 559	2 470	63 %
33200	Installation of industry machines and equipment	1 600	2 575	62 %
27320	Manufacturing of other electronic and electric wires and cables	1 328	2 166	61 %
33110	Repair of processed metal products	432	705	61 %
28210	Manufacturing of industry- and laboratory furnaces and burners	80	136	59 %
28229	Manufacturing of lifting and handling equipment, not mentioned elsewhere	925	1 600	58 %
25210	Manufacturing of radiators and kettles for central heating	35	61	57 %
71122	Geological surveys	2 061	3 615	57 %
24200	Manufacturing of other tubes and steel fittings for tubes	239	426	56 %
28140	Manufacturing of taps and valves, not mentioned elsewhere	256	486	53 %
33140	Repair of electrical equipment, not mentioned elsewhere	284	551	52 %
24330	Cold rolling and pressing of profiled sheets and profiles	9	18	50 %