Mendel University in Brno
Faculty of Business and Economics

Dutch Disease
Case of Norway

Bachelor Thesis

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Brno 2016

Aknowledments
I take this opportunity to express my gratitude to my supervisor Ing. Miroslav Radiměřský for his help, support and encouragement.

Moreover, I am gratefull to my partner, who courageously took a role of my Sam and went through this venture with me.

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Abstract

Kňazovická, K. Dutch Disease: Case of Norway. Bachelor Thesis. Brno: Mendel University, 2016.

The Bachelor Thesis investigates the effect of the economic phenomena, Dutch Disease, on the Norway's overall economy as well as on the economic performance of the selected regions. Firstly, it introduces the concept of the disease, its symptoms, possible treatments and outlines the macroeconomic indicators and symptoms, which help in the identification of the disease. Moreover, it offers a descriptive account of regions, their main activities and productivity, employment and wages in observed petroleum, manufacturing and tertiary sector of the economy. In the empirical part, it examines, whether the symptoms are present through the time series regression, which is based on OLS method. Furthermore, it inspects the relationship between particular variables to the global oil price, which may indicate the dependency on the oil and gas segment. The thesis found out, that the Norway might not suffer from the Dutch Disease, possibly due to their tight fiscal policy and foundation of the Government Pension Fund Global.

Keywords

Dutch Disease, Norway, appreciation of exchange rate, region.

Abstrakt

Kňazovická, K. Holandská choroba: Nórsko. Bakalárska práca. Brno: Mendelova univerzita v Brne, 2016.

Bakalárska práca skúma účinky ekonomického fenoménu známeho pod termínom Holandská choroba, na Nórsku ekonomiku vnímanú ako celok, ako aj na ekonomickú výkonnosť vybraných regiónov. V prvom rade predstavuje koncept choroby, jej symptómy, možné sposoby ošetrenia a taktiež oboznamuje s makroekonomickými indikátormi, ktoré pomáhajú pri jej identifikácií. Navyše obsahuje popis regiónov, oblasť ich aktivít a produktivitu, zamestnanosť a hladinu miezd v ropnom priemysle, vo výrobe a v sektore služieb. V empirickej časti zisťuje vzťahy medzi jednotlivými indikátormi a cenou ropy, ktoré možu viesť k závislosti na ropnom priemysle, pomocou analýzi regresie časových radov, a najma využívaním metódy najmenších štvorcov. Bakalárska práca zistila, že Nórsko pravdepodobne netrpí Holandskou chorobou, čo môže byť spôsobené striktnou fiškálnou politikou a v neposlednom rade založením Penzijneho foundu.

Kľúčové slová

Holandská choroba, Nórsko, zhodnocovanie meny, menový kurz, regióny.

Obsah

1 Introduction and objectives

1.1 Introduction

In general, the Norwegian economy possesses exceptional reputation of the wealthy and developed country, moreover with the rich natural resources, mainly in petroleum, which is for many countries understood as blessing, but on the other hand, for others as a curse.

The term Resourse Curse is related to the inverse effect of richness, when the countries with larger natural resources are actually poorer than the countries, which do not have such reserves. One of the explanations of the Curse may be the Dutch Disease, which the Bachelor Thesis discusses and which divide the economy into three sectors: booming (in the case of the thesis petroleum industry); the lagging one, which is represented by the manufacturing; and lastly the sector of non-tradable goods, which is expressed byt the services. The term Dutch Disease is bound with the Dutch discovery from the 1959, when the Netherlands found large natural gas deposits. Historically, this led to strengthen of the booming petroleum industry, appreciation of the domestic currency and disability of other sectors to compete. However, the disease does not have to be related only to the natural resources, but also for example to the vast onrush of the foreing assistance, foreign direct investments and others. The scientists have not yeat reached a consensus about the nature of causes and symptoms, but it is concluded that the Dutch Disease consists of the three kinds of effects: the moving, spending and spillover-loss effect, which are further described in chapter dedicated to the indicators. However, the Norway's economic performance and participation in the international trade indicates that this country is the example of the success story, mainly due to the tight fiscal policy and foundation of the Government Pension Fund Global, due to which, the capital is invested abroad with the intention to avoid overheating of the economy.

The majority of the onshore activities related to the petroleum industry are concentrated in Rogaland county, as well as the highest employment in oil and gas sector is in Stavanger, but they have been expanded through the whole country, as e.g. Oslo keeps essential share of petroleum clusters.

The empirical part examines, whether the booming petroleum industry induces real exchange rate appreciation, higher overall wages and moreover the reduced growth in the manufacturing related to the faster service sector growth.The time series regression, which consists of statistical and econometrical testing was used to identify whether these symptoms are present or not in the Norwegian economy. The methods are specified in details in the chapter Methodology.

1.2 Objectives

The Bachelor thesis main goal is to identify the impact of the petroleum industry on the Norwegian economy, in terms of the Dutch Disease, by examining the symptoms of the overall performance as well as the performance of the individual regions. The following structure of the thesis supports the fulfilling of the thesis objectives.

In the chapter Resource curse, the terms such as Resource curse, Dutch disease, its symptoms in general and their main effects are compiled. The overall backgroung for the economic performance of Norway in terms of its growth, export and import, as well as the brief overview of the history of mining, the main characteristics of the regions, their divisions according to the sea area, productivity and scope of activities are outlined in the chapter Norwegian economy. The thesis also introduces the overall performance of the Norwegian economy in terms of GDP per capita, export and import terms.

The chapters followed are divided according to the type of the symptom, which it deals with. In chapter REER appreciation, determinants of the real exchange rate are described in details, mainly oil price, inflation, import and export of the crude oil and gas, trade balance, government revenues, expenditures and cash flow as well as the fiscal policy related to the Norwegian economic performance. The empirical part bound to this symptom examines the relationship between the real exchange rate determinants through the time series regression.

The chapter Higher overall wages, firstly identifies the influence of the resource movement and spending effect on the wage level. It is followed by the analysis of the wage and salary per hour in different sectors of economy as well as the relationship between the global oil price and wage level in the petroleum, manufacturing and tertiary sector.

In the section De-industrialization, the thesis examined the growth pace and employment of the all three selected sectors and their relationship to the global oil price. Moreover, the comparison of the sectors growth in neighboring countries was done in order to find out whether it is the overall trend of the Scandinavian economies or it can be related to the effects of the Dutch disease.

Last but not least, the goal is aimed to be fulfilled by the analysis of the regions, which might be mostly effected by the Dutch Disease and were selected according to the scope of their activities and analyses for the symptoms as in the case of the overall economy.

2 Natural Resource Curse

Humphreys, Sachs and Stiglitz (2007) indicated two main characteristics of the Resource Curse, through which the term was defined. First one is that the curse can occur independently on the other economic processes that usually occur in the particular country, e.g. without linkages to other industrial sectors, participation of the domestic labor force or political processes. The second key feature is that many natural resources, especially oil and gas in which we are interested, are non-renewable, which means that we cannot take it for granted for the future as a source of income. The phenomenon called Resource Curse appears, when the countries with large natural resource capacity perform worse than the countries with smaller or non-resources. For instance, the previous research of Sachs and Warner (1995) demonstrated the negative relationship between the real GDP growth per capita and the ratio of resource exports to GDP using 97 sample countries during the period 1970-1989.

To illustrate this point, Ploeg (2010) refers to resource-rich countries such as Venezuela, Nigeria, Zambia, which suffer from the economic failure due to natural resource boom. On the other hand, resource-poor countries e.g. Asian Tigers (Korea, Taiwan, Hong Kong, Singapore) perform very well, even they do not have any significant natural resource reserves. These countries has achieved their success by the export of the manufactured goods and because they took advantage of their costal status as indicated Humphreys, Sachs and Stiglitz (2007). Nevertheless, one should accept that it does not mean that all countries with natural resource endowment have to be cursed.

The focus of recent research by Nienke Oomes and Katerina Kalcheva (2007) has been concentrated on the three possible explanations of the resource curse. The first aspect to point out is that the resource wealth tends to give rise to a high competition among existing resources and higher engagement in these more yielding activities and on the other hand, less involvement in other sectors, which leads mainly to lower growth and poorer institutional quality (e.g. higher coruption, no transparency). Second explanation implies that the value of resources tends to be unstable, mainly because of the low price elasticity of supply, which at the end causes the uncertain revenues. Thirdly, the Dutch Disease, which analysation is the aim of our thesis, can clarify the resource curse.

Additionaly, Larsen (2004) suggests that the difference between the terms Resource Curse and Dutch Disease is that the curse is related to the aggregate production and the disease to the composition of the export base.

2.1 Dutch Disease

As Gylfason (2001) presents, the term Dutch disease is bound with the Dutch discovery from the 1959, when the Netherlands found large natural gas depository in the northeastern part, Groningen province. Acosta, Lartey and Mandelman (2007) suggested that in general this led to the strengthen of the booming petroleum industry, appreciation of the domestic currency and disability of other sectors to compete.

Besides, Christine Ebrahim-zadeh (2003) proposed that the Dutch disease can arise not only due to discovery of some natural resource, but also due to any development that results in a vast onrush of foreign currency, foreign assistance and foreign direct investment.

Corden and Neary (1982) suggests dividing the market into three different segments, in order to investigate, whether the country has been suffering from the Dutch Disease: booming (in our case petroleum sector), lagging (manufacturing)and non-tradable sector (services). Simply said, as a country founds out its potentional comparative advantage in natural resources (not only, as it was explained above) and starts to move the majority of its factors of production into it and further boost this new booming sector, it influences the incomes, which start to rise as more and more money flows in.

The question is, whether the country spends all foreign exchange only on imports or if it is also used for buying the domestic products and whether the nominal exchange rate is fixed by the central bank or is flexible. Firstly, if there occurs fixed exchange rate, the conversion increases the country's money supply, which leads to increase of the domestic prices due to higher domestic demand and therefore to the appreciation of the REER. On the other hand, if the exchange rate is flexible, the higher supply of the foreign currency pushes up the value of the country's currency, which also leads to the appreciation of the REER, but through the nominal exchange rate (Christine Ebrahim-zadeh, 2003).

2.1.1 Indicators

As Larsen (2004) stated, the scientist have not reached a consensus on the nature of causes and symptoms, but he concluded that the main theory is that the Dutch Disease consists of three kinds of indicators: the resource movement effect, spending effect and the spillover-loss effect. On the other hand, e.g. Corden and Neary (1984) induces that there are just two factors, resource movement and spending effect.

Firstly, **the resource movement effect** represents the reallocation of the factors of production, e.g. land, labour, capital from the other activities to the booming segment of the particular economy (Larsen 2004). Such processes were examined in the Australian gold boom or Colombian coffee in the 1970 as suggested Humphreys, Sachs and Stiglitz (2007). Nienke Oomes and Katerina Kalcheva (2007) assumed that if we suppose that the supply of oil is not perfectly inelastic and the rise in the price of oil occurs, the demand for labour and capital in the natural resource segment increases as well as wages and return on capital. Assuming, the labour and capital are mobile, they can be easily moved from the manufacturing and non-tradable sector to the new boom segment. Because the price of the manufactured goods does not change as they are determined abroad, the problem occurs in the sector of non-tradables as the decline in its output leads to the excess of its demand and therefore to an increase in its price. As a result occurs the appreciation of the real exchange rate. Corden and Neary (1982) denotes it as the *direct de-industrialization*.

Secondly, **the spending effect** is related with the increased aggregate demand, which is caused by the higher earnings from the new created booming segment, caused by the tendency of the labor and capital move to this sector as well as this reaction further causes increasing of the prices and the wages in the part of the economy, which is not internationally tradable (e.g. services). If it happens that the wages and salaries started to increase, companies have to started to lower the number of employed people and also related output. This decline in manufacturing output and its employment is called *indirect de-industrialization* by the Corden and Neary (1982). Simultaneously, the new sector is developing (as prices, wages and profits increase) and the other ones lag behind due to not just because of the outflow of the resources spend there, but mainly because of the home currency depreciation (Larsen 2004). These shifts can be costly for an economy not just because the workers has to adopt and requalified to a new jobs and capital needs to be readjusted, but because if the manufacturing sector is a long-term source of growth, then the decline will have adverse growth consequences (Sachs and Warner 2001). Nienke Oomes and Katerina Kalcheva (2007) suggest also possibility that the labour is not mobile and only effect of a shift in demand is an increase in the relative price of services.

Thirdly, **the spillover-loss effect** explain a situation when due to feeding the new booming sector, the other segments of the economy lose their tradability and therefore the country experiences the loss of the positive externalities and a real exchange rate appreciation (Larsen, 2004; Krugman 1987).

To sum up the most essential indicators, which can lead us consider whether the particular country suffers from the Dutch Disease or not, is real exchange rate appreciation, slower manufacturing growth, faster service sector growth and definetely we can point out also higher overall wages (Nienke Oomes and Katerina Kalcheva 2007).

2.1.2 Possible treatments

The question, which is need to be asked is, how to protect the economy against this disease, how to effectively use the resources or even if is the Dutch Disease a curse or a blessing? In the literature, several theories have been proposed. Some researchers indicate, that the whole problem of the Dutch disease is the impermanence of the influx and therefore, in case that the inflow of the resources would be stable, it will not cost any problem and it will be just self-adjusting mechanism of the economy using the resource advantage. On the other hand, economists, such as Corden and Neary (1982) suggests that even if this occurs as a permanent state, it will lead to the unemployment and de-industrialism. Therefore, the main question appears: How to minimize the potential threat, which the Dutch Disease represents? Pieschacón (2012) indicates that the fiscal policy plays a vital role in the regulating of the impact of oil price shocks. Corden (1984) suggests these possible following plans:

First option is the direct taxing of the booming sector and further use of the money to subsidize losing factors of production of the lagging sector. Secondly, direct support of the employment and also emphasize the need of the short-term unemployment, which serves as a signal to resource reallocation. Thirdly, the infant industry argument suggests that the recent boom is just short-term and both the decline and possible recovery of the lagging sector lead to non-optimal acccumulation of the labour and capital during the time of the boom. The theories, which support this thought argument using externalities, lack of information on the side of the factors of production in the lagging sector, imperfection of the capital market and others.

Two famous protectionist approaches are known. The first one is famous as the exchange rate protection, which simply means avoiding the real appreciation, which leads to the protection of the tradable sector at the expense of the non-tradable. Corden (1984) suggests that it could be done by the exchange rate intervention supported by sterilization, through open market operations or budget surplus, which could lead to desired reduction in spending. The advantage of this approach could lead to the excessive accumulation of foreign assets protect both the lagging and the booming sector at once.

The second policy has the basis in the raising the tariffs or make stricter the import quotas, which will lead to weaken the import-competing industries and on the other hand support the lagging as well as booming sector. The lagging sector is therefore influenced by the bigger real appreciation and also by the direct resource loss of the imported goods and services. This effect can be moderated only by the intensifying the adverse effect on the exported goods and services of the lagging sector. If the main idea is to protect the real income and rents, then it is not such advantageous policy. Obviously, the problem is the effect on the lagging sector. On the other hand, when we take into account the Pareto-efficiency phenomenon, this ordinary protection is used as a cost protection.

3 Norwegian economy

3.1 Overall background

The Norwegian economy maintains the mixed market economy, but some of its sectors, particularly the petroleum industry, agriculture and scarce resources falls under the government control. With respect to the trade policies of Norway, it is a part of the EFTA, which assures free trade between its members, but also worldwide network of free trade and partnership agreements, moreover, the participation in EU internal market based on the European Economic Area Agreement and further cooperation with EU as it is also a member of EEA, Schengen Agreement and it participates on foreign and security policy affairs with EU. The country possesses wealth in terms of natural resources, mainly in petroleum, hydropower, fish, forests and mineral.

3.1.1 Import and export

The international trade mainly with its neighboring countries is well developed. The main exporting partners in 2014 according to OEC are United Kingdom (19%), Germany (17%), the Netherlands (14%), Sweden (6.7%), France (6.1%) and Denmark (3.6%). On the other hand, Norway mostly import from the neighbor country Sweden, which creates 13% of the total import, followed by Germany (12%), China (9.1%), the United Kingdom (6.5%) and Denmark (6.1%) according to OEC in 2014. As the Fig. 1 below illustrates, as the majority of the export is created by the petroleum industry, its value depends on the global oil price, as we can see according the drops in the exports e.g. in 1980s, but also recently in 2014, when the oil prices experienced sharp declines.

The export of goods and services presents over 37% of GDP, while e.g. before the crisis in 2008 it was almost 46%. We can also notice the slowly rising trend in exports from the 1970s as the oil exploitation areas were discovered. Moreover, the majority of the exports according to OEC consists in 2014 of the Crude Petroleum (30%), followed by the Petroleum Gas (29%), Refined Petroleum (4.4%), Non-fillet fresh fish (3.4%) and Raw Aluminium (2.1%).

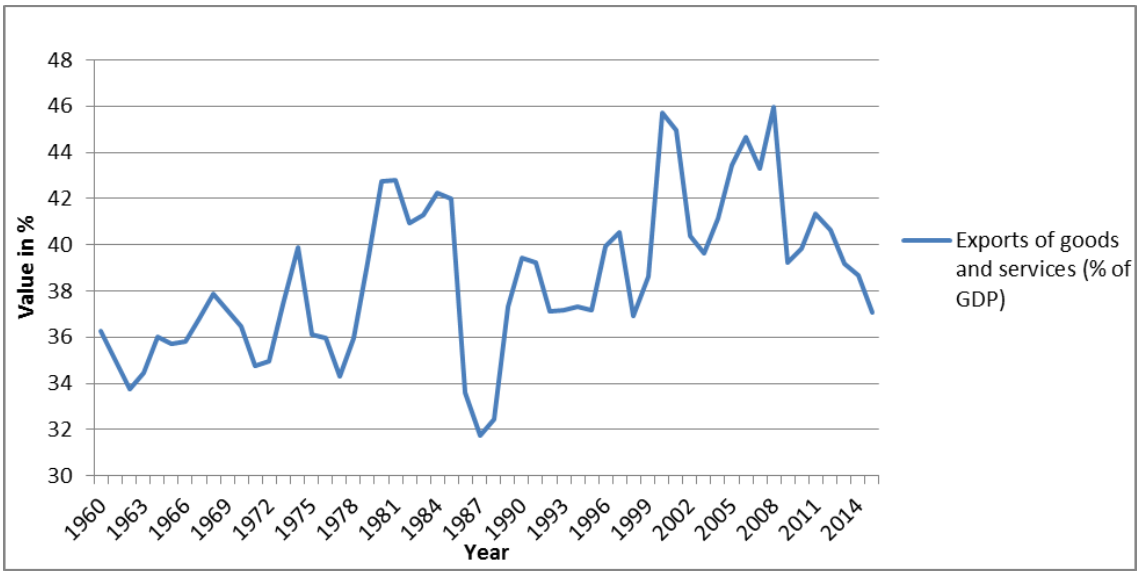

Fig. 1 Export of goods and services (% of GDP)
Source: World Bank

In case of import, last year 2015, it creates more than 31% of GDP, in comparison to the year 1960, with over 37% of GDP. Except of the peak in 1976 (more than 44%) it experiences a slightly decreasing trend (Fig.2).

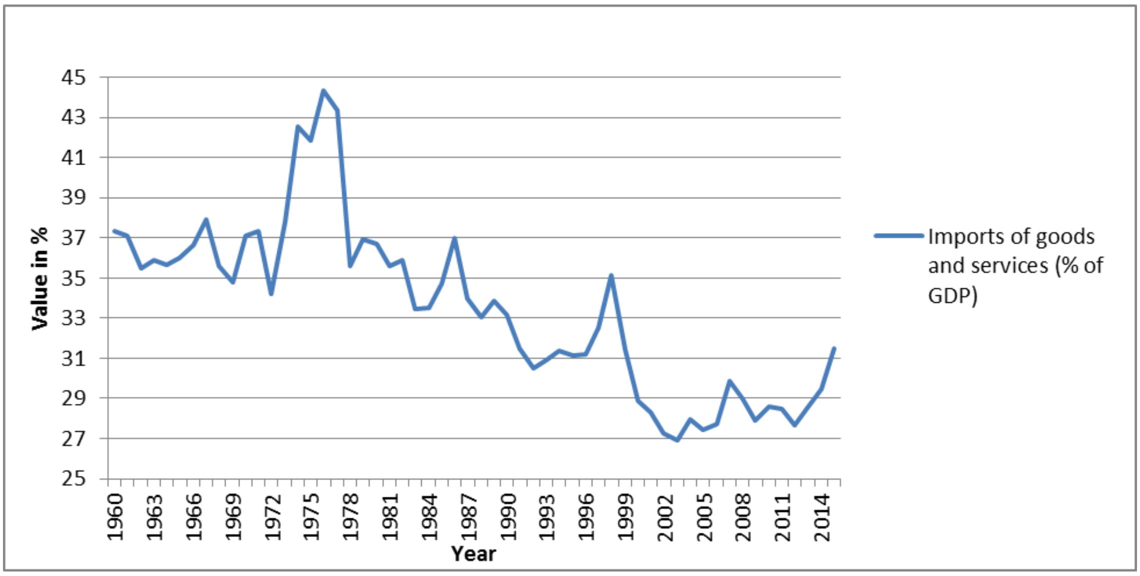

Fig. 2 Imports of goods and services (% of GDP)
Source: World Bank

According to the OEC, in 2014 the most imported goods are Cars (6.1%), Refined Petroleum (3.1%), Passenger and Computers (2.3%), Cargo ships (2.2%) and Nickel Mattes (2.0%).

3.1.2 Growth

From the graphical illustration below (Fig. 3), we can consider the overall growth of the GDP per capita through the years, however, few drops appeared. Firstly in 1980s, particularly in 1982 (value of the GDP per capita was more than 296 billion NOK) and in 1987 with the value more than 359 billion. This was mainly caused by the several devaluations of the currency and also decline in manufacturing sector.
The second decrease was experienced in 2002 as the krone appreciated notably, higher interest rates were imposed by the Norges Bank, high oil prices and also conflicts in the Middle East led to the decline in GDP. Following the financial crisis in 2008 was accompanied with the sharp decline as before the crisis in 2007, the value of GDP per capita was about 553 billion and in 2011, when the last drop was experienced, the GDP had the value 527 billion. From the year 2012, the rising trend occurred again, with the value 542 billion in 2015.

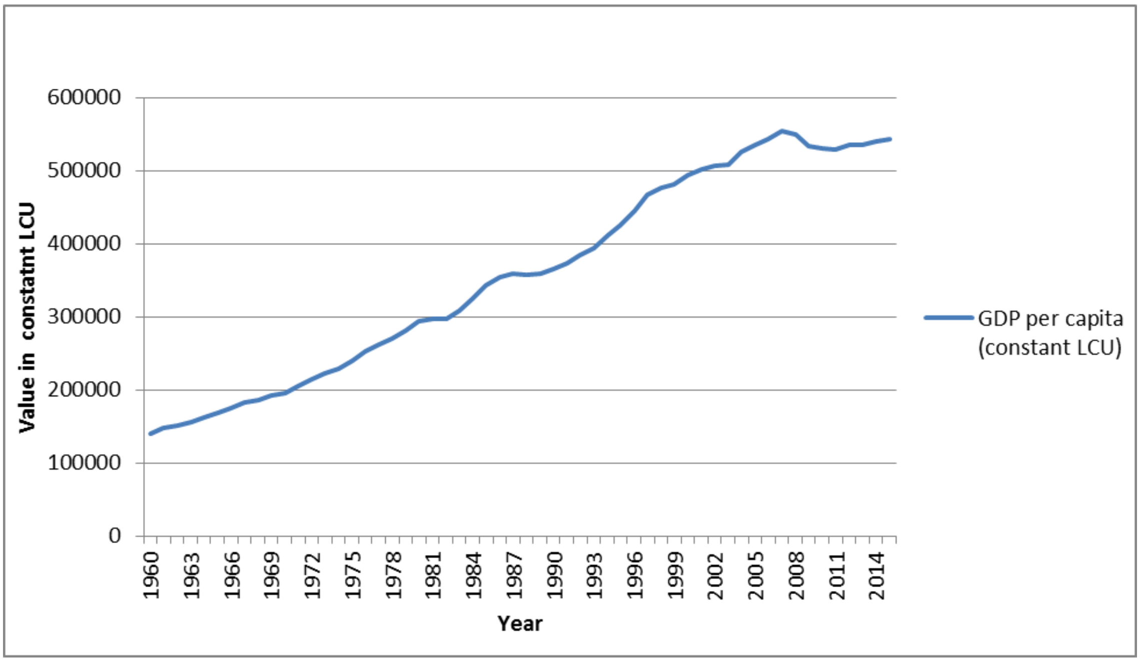

Fig. 3 GDP per capita (constant LCU)
Source: World Bank

3.1.3 Brief insight into the oil and gas mining history

As the Norsk Petroleum states, the petroleum exploitation era started 50 years ago and the first fields appeared in the North Sea. After a while the other fields were also built up across the Norwegian and Barents Sea. The main task to solve, the proclamation of the sovereignity over the Norwegian continental shelf, was successfully resolved in 1963, but there was still a need to clarify the delimitation of the continental shelf, mostly with the Denmark and the United Kingdom boundaries, which took place in 1965.

In 1969, was very important year in the Norway petroleum industry history, as one of the largest offshore oil fields Ekofisk ever was discovered and followed by the production in 1971. Most of the found fields in the 1970s, as the named Ekofisk, but also Statfjord, Oseberg, Gullfaks and Troll have been essential for the development of the Norway's petroleum industry. After the exploration of the most potential areas, the numerous smaller fields were established and the question of the possible connected infrastructure between the major and smaller fields appeared. At the end the production was split between many fields, were the exploitation started.

Later the petroleum activities were further developed in the areas of the Norwegian and Barents Seas by the many foreign companies, which were responsible for this first steps in the development. However, the Norwegian influence was also increasing due to the Norsk Hydro, Saga Petroleum and Statoil, which were established in 1972, with the Norwegian state as the only one owner. The Norwegian Government also established the law that stated the state was to have a 50% ownership interest in every production license. However, the system changed in 1985 and state´s activity was divided into two parts. One related to the Statoil and the other one to the SDFI. It means that the state possesses its share in fields linked to the petroleum extraction as well as in pipelines and onshore activities. Moreover, Norwegian state receives their part of the income from the production licenses for its investments and costs spend there. The role of Statoil is to be responsible for the commercial aspect of SDFI on behalf of the state.

In 2001, the part of the SDFI portfolio was sold to the Statoil (15%), which was the important step towards the part-privatization of the company. The state-owned firm Petoro (May 2001) manage to the SDFI on behalf of the state. Moreover, the Statoil and Norsk Hydro's oil and gas merged in 2007. Nowadays, a large diversity and competition of companies are making business on the Norwegian shelf, which could profit from the resource deposits.

3.2 Norwegian regions

In general, Norway is divided into 19 counties and as the Norsk Petroleum suggests, the oldest petroleum fields were built in the North Sea and by the time, it expanded into the Norwegian and Barents Sea. As the exploitation started in 1971, 100 fields on the Norwegian shelf have been in use. In 2015, 82 fields were productive (65 in the North Sea, 16 in Norwegian Sea and 1 in the Barents Sea). Furthermore, in 2015, 4 new fields started their production, 9 have been still developing at the end of the period.

3.2.1 Production according to the sea are

Annual production of oil from the fields in the North Sea in 2015 presents 56.42 million Sm3 and gas presents 72.09 million Sm3. According to the Fig. 4, the oil had its peak in 1996 when the total production was about 154.87 million Sm3 and gas in 2006, when it reaches 72.9 million Sm3.

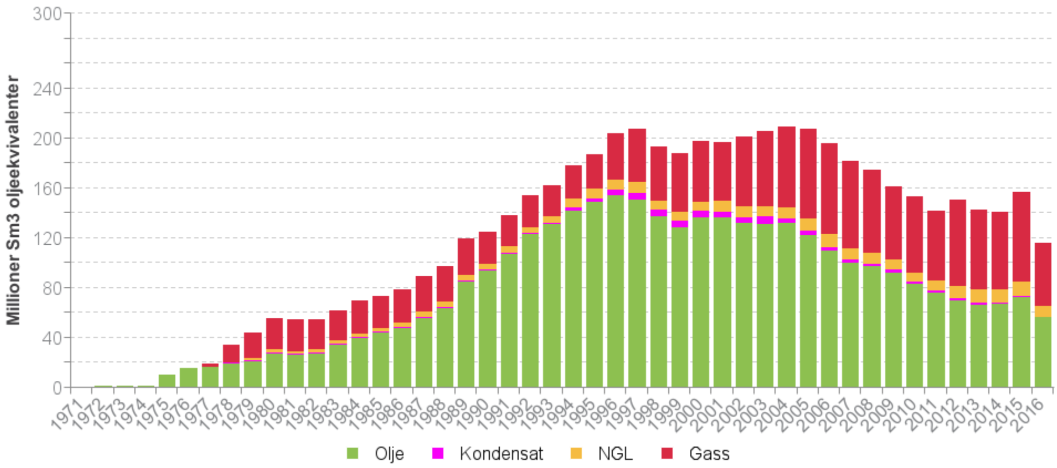

Fig. 4 Annual production in North Sea
Source: Norsk Petroleum

The North Sea has obviously the highest number of the fields and according to the following Tab. 1 also possesses the most productive ones.

Tab. 1 Production per field in 2015

Top 5 total production per field in 2015 (Sm³)					
Field	**Oil**	**Condensate**	**NGL**	**Gas**	**Sum**
TROLL	249.16	4.34	13.72	519.48	786.70
STATFJORD	570.52	0.93	35.43	71.64	678.52
EKOFISK	459.08	0.00	27.17	144.45	630.71
OSEBERG	370.65	0.00	17.54	43.27	431.46
GULLFAKS	360.70	0.00	5.19	23.08	388.96

Source: Norsk Petroleum

The Norwegian's Sea annual production in 2015 in oil resources shows approximately 10.73million Sm3. On the other hand, the gas production has been higher as it presents about 28.89 million Sm3. The peak of oil production was in 2001 (44.64 million Sm3) and gas production in 2009 (42.22 million Sm3).

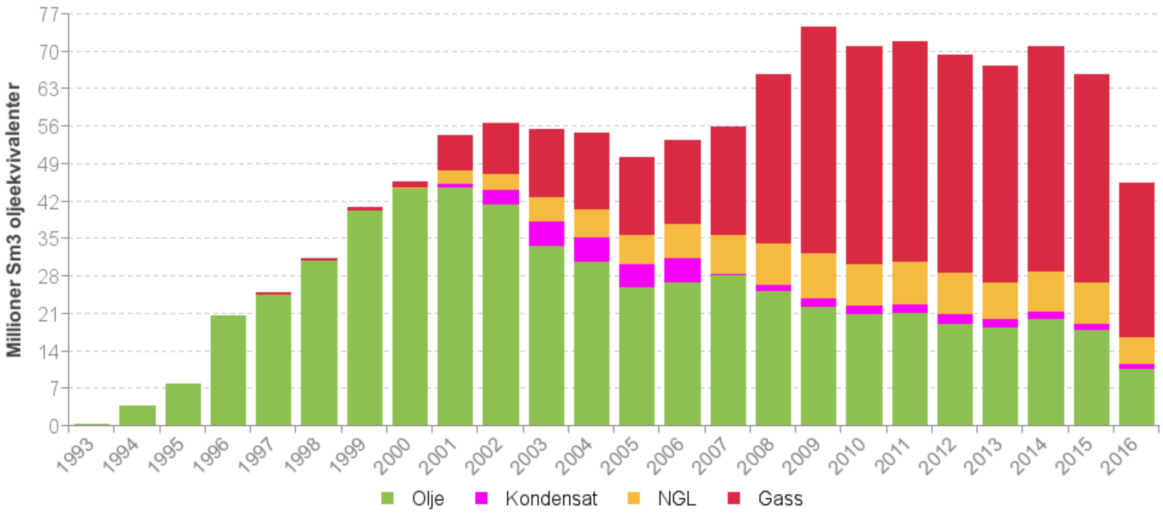

Fig. 5 Annual production in Norwegian Sea
Source: Norsk Petroleum

Last but not least, the annual production of the oil in Barents sea presents the minority as its only production of oil has been recorded in this year 2016 and it represents 1.67 million Sm3 from 7.2 million Sm3 approximate total production. The majority of the extracted resources is represented by the gas, with the value 4.58 million Sm3. The less productivity could be probably caused by length of the Barents Sea fields production life, from which the exploitation started only in 2007 and is still developing.

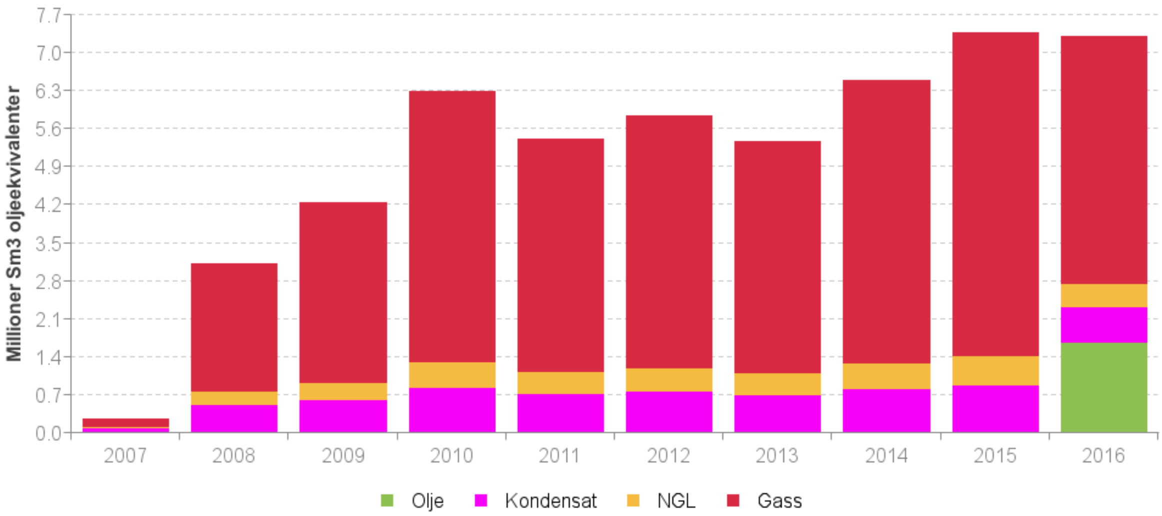

Fig. 6 Annual production in Barent Sea
Source: Norsk Petroleum

When we compare the annual petroleum production in these areas, we can assume that the North Sea area is the one with the highest production oil and gas outcome among these three exploitation areas as it consists of the most fields in number with the highest total production. Moreover, the Norsk Petroleum provides us with the table of the largest companies, which operates in the petroleum sector according to the number of fields on which they are performing as the following: Statoil Petroleum AS with the headquarters in Stavanger and Oslo (32 fields), ConocoPhilips Skandinavia AS (9 fields, headquarters near Stavanger), Aker BP ASA (8 fields, headquarters near to Oslo) and the forth place belongs to the Repsol Norge AS and BP Norge AS, which have 5 fields under their management.

For better illustration of the power of these companies, Statoil owns 4 of the top productive field in the North Sea (Except of the Ekofisk, which is under the ConocoPhillips. We can therefore assume that the petroleum industry has the largest impact on the regions, where these companies operate as they manufacture the majority of the oil and gas fields, which are Hordaland (Bergen), Rogaland (Stavanger) and Oslo (city of Oslo).

3.2.2 Division of onshore petroleum activities

Norsk Petroleum indicates that the majority of the onshore activities related to the petroleum industry are concentrated in Rogaland county, as well as the highest employment in oil and gas sector is in Stavanger, but they have been expanded through the whole country. According to the Amir Sasson and Atle Blomgren (2011) almost 50% of petroleum activities and employment is located in Rogaland and Hordaland.

However, also Oslo/Akershus and Buskerud keep essential share of petroleum clusters. As the Norsk Petroleum suggests, Oslo possesses engineering expertise and seismic companies, Trondheim is a leading in research and education and Bergen and Buskerud is a great platform for maintenance and subsea tools. Moreover, Ålesund holds maritime companies, which are providing shipbuilding.

In order to investigate whether the selected regions (Rogaland, Hordaland and Oslo) can be endangered by the Dutch Disease, we analysed if they possesses the symptoms of absolute and relative de-industrialization and symptom of increasing wage level in the empirical analysis dedicated to them. From the Tab. 2 below, it is obvious, that highest petroleum output has the region Rogaland, with the average value 34,645 million NOK and Hordaland with the average 8,148 million NOK.

Tab. 2 Oil and gas extraction output

Oil and gas extraction including services output (NOK million)							
County	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
02 Akershus	1,665	4,524	4,273	3,925	5,959	6,923	7,345
03 Oslo	2,712	1,962	2,066	3,649	2,465	2,260	2,343
06 Buskerud	41	49	9	15	8	20	27
11 Rogaland	25,555	28,682	34,340	33,749	35,969	42,611	41,611
12 Hordaland	5,295	7,917	5,110	7,425	8,845	11,432	11,013
14 Sogn og Fjordane	57	100	113	78	257	133	217
15 Møre og Romsdal	788	945	646	1,237	1,307	1,636	2,067
16 Sør-Trøndelag	1,247	1,213	1,420	1,027	970	910	1,381

Source: Norsk Petroleum

However, the manufacturing output (Tab. 3) is highest in Hordaland (except of the year 2008) with the average value 22,929.43 million NOK and Rogaland (average value 21,225.14 million NOK).

Tab. 3 Manufacturing output

Manufacturing output (NOK million)							
County	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Akershus	12651	11513	117,92	115,93	116,29	135,79	155,22
Oslo	16494	8949	113,38	120,63	127,01	140,81	14895
Buskerud	13430	12881	139,36	149,54	164,59	168,25	17698
Rogaland	22517	16415	186,13	204,58	228,35	235,30	24208
Hordaland	22260	21160	209,84	228,43	245,69	239,47	24743
Sogn og Fjordane	4610	4320	463,6	535,8	503,9	534,6	5791
Møre og Romsdal	17155	180,18	186,59	192,58	192,53	192,78	19958
Sør-Trøndelag	8397	759,4	976,2	928,6	945,2	102,96	11171

Source: Norsk Petroleum

The total tertiary output (Tab. 4) is quite high in all regions, however, the highest one is in Oslo, where the important petroleum clusters are present, with the average value 389,276 million NOK.

Tab. 4 Output of the tertiary sector

Total services output in NOK million							
County	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Akershus	162,809	167,179	164,727	175,737	190,444	202,227	211,151
Oslo	321,602	329,680	362,219	386,424	419,526	442,042	463,440
Buskerud	61,913	63,224	65,788	68,760	72,698	76,801	79,723
Rogaland	117,745	121,840	131,429	136,132	147,374	155,532	164,825
Hordaland	141,563	140,501	147,687	161,202	175,394	186,300	195,721
Sogn og Fjordane	27,026	27,708	28,804	30,454	31,368	32,674	34,041
Møre og Romsdal	61,105	62,645	66,266	71,791	77,783	83,288	87,265
Sør-Trøndelag	79,810	82,242	85,761	95,551	104,266	110,272	114,745

Source: Norsk Petroleum

4 Methodology

4.1 Time series regression

The second part the thesis consists of the empirical analysis of the four symptoms of the Dutch Disease, in order to confirm or disprove the set hypothesis:

1. Booming petroleum industry induces real exchange rate appreciation
2. Booming petroleum industry induces higher overall wages
3. Booming petroleum industry induces reduced growth in the manufacturing
4. Booming petroleum industry induces faster service sector growth

So far, majority of researchers as e.g. Hutchinson (1990) or Oomes and Kalcheva (2007) uses the methods of cointegration and BEER analysis in order to investigate the relationships and dependency of the performance indicators of the particular economy and petroleum sector. However, we chosed to examine the symptoms trought the time series regression in the econometric software Gretl, as it seems attractive to compare these methods and their results. It was mainly used to find out whether there is a relationship among oil price, which is a proxy to the petroleum industry, and particular variables according to the symptoms.

The analysis was based on the OLS method and following statistical and econometrical tests: Test of significance of the model parameters, RESET test for correct model specification, Non-linearity tests, ANOVA table, Correlation coefficient analysis, Breush-Pagan test, Durbin-Watson test and Normality test. Moreover, the models consist of the quantification of the variables, describtion of the coefficients of determination and adjusted coefficients of determination as well as economic interpretation of the found variables.

4.2 Data

4.2.1 Symptom 1: REER appreciation

REER is defined as the weighted average of a country's currency relative to an index or basket of other major currencies, adjusted from inflation. The database of the World Bank was used as a source from the year 1970 to 2015, however due to the other used data sets; it had to be cut it to the period 1980-2009 as the Gretl does not work with data of different length. The year 2010=100, is used as a basis for calculation. Firstly, it was needed to define, which determinants are significant to analyse the REER in terms of the Dutch Disease. Oomes and Kalcheva (2007) suggested global oil price, government consumption, foreign reserves, productivity differential growth and corruption as the most essential. On the other hand, Hau (2002) added openness to trade and Kakkar and Yak (2014) interest rate and inflation. It was chosed the combination of these suggestions as followed. Firstly, the global oil price was determined as a representative of Terms of Trade. In general, TOT is calculated as the ratio of the exports to imports with respect to the price indices. An increase in the export goods price would cause an increase in TOT, and on the other side, an increase in the import goods price would cause decline in TOT. As the Norway is an important exporter of the oil, we decided that oil price is an essential determinant of the TOT as with the increasing oil price the Norway's TOT would rise as well. The data source for the crude oil was gained from Trading Economics from the year 1980 – 2015. However, we had to adjust it to the period 1980-2009, because of the lenght of other detrminants.

Secondly, government final consumption (GOVS), as Lebdaoui (2013) suggested, the government spending is explained as the proxy for the fiscal policy and it is calculated as the ratio of government spending to GDP. The general government final consumption expenditure (% of GDP) was retrieved from the World Bank databases for the period 1980-2015 and adjusted to 1980-2009.

Thirdly, deflator, as the inflation can be considered as one of the main influencer of the exchange rate as increasing one can cause reduction in the value of the domestic currency to the foreign one and vice versa. Deflator is measured as the ratio of the GDP in constant LCU and GDP of current LCU (base year 2010=100). The data set from the World Bank was used. The initial period was from 1966 to 2014, for our purposes adjusted to 1980-2009.

It is followed by the openness to trade, which is generally calculated as the ratio of the sum of exports and imports to the GDP. Nowadays, in the time of globalization, the relationship between the real exhange rate and the opennes to trade have become an important issue. Hau (2002) suggests that the increase in the openness index decreases the volatility of the real effective exchange rate and therefore it affects it negatively. Lebdaoui (2013) proposed that if there exists higher supply of the imported or exported goods, it futher cause a decline in the supply of non-tradable goods. The World Bank database was used as a source for data for GDP (current LCU), import and export of goods and services (constant LCU). Moreover, the teal interest rate in percentage was used as it has been already adjusted by inflation. The data were retrieved from the World Bank for period 1980-2009. Additionaly, deficit or surplus of the budget, as the policy of the government budget can influence the interest rates in the particular country, it has the impact on the REER, therefore, we analysed its influence in case of the Norway. The data were retrieved from World Bank for the period 1980-2009.

GDP growth was used as the another determinant as the appreciation of the REER can lower the GDP as the exports are more expensive (and therefore there is less demand for them), but on the other hand, imports are cheaper, which caused higher demand for imported goods and less demand for country-made ones, and as the aggregate demand is lower, GDP is lowered too. The World Bank database was used for the period 1980-2015. Moreover, the data for import, export of the crude oil and trade balance were needed and gained from the Norsk Petroleum and Statistical Office of Norway as well as the data for government revenues, cash flow and Government Pension Fund Global, which, however, were used just for illustration, not for time series regression itself.

4.2.2 Symptom 2: Overall wage level rising

In chapter Symptom 2, it was worked mainly with the data concerned percentage change of wages and salaries per hour worked in petroleum, manufacturing and tertiary sector. As the origin data from Statistical office of Norway were in percentage change, but global oil price of which influence needed to be investigated was not in percentage, it needed to be recalculated. The year 1980 was set as a basis with the value 100 and then we calculated all other data according to the formula wage per hour multiplies by % change in wage per hour divided by the base plus the wage per hour. The thesis worked with the division of activities according to the ISIC standards, revision 4, according to the United Nations Statistics Division. Moreover, we used data for employment in petroleum industry during year 1970-2015 from the Statistical Office of Norway.

4.2.3 Symptom 3: De-industrialization

The symptom 3 is analysed in order to find out whether there exists absolute and relative de-industrialization, which could indicate the Dutch Disease. Therefore, the data for output of manufacturing, petroleum and services sector % of GDP from World Bank for period 1970-2015 were retrieved, as well as for its neighbouring countries Sweden, Finland and Denmark, but for period 1990-2015 as it had to be adjusted according to the data availability of Denmark, which started in 1990. However, it was also analysed the data of output for petroleum, manufacturing and services sector in the constant NOK billion from 1980-2015. Data were retrieved from the World Bank. Last but not least, data for employment % in petroleum, manufacturing and services sector from the total employment were retrieved from the World Bank for the period 1980-2014. As the separated data for employment in manufacturing sector and petroleum industry are available only in publication, which is in Norwegian language, the data linked together had to be use. The industry sector consists of mining and quarrying, manufacturing, construction, and public utilities (electricity, gas, and water). The same problem with the data occurs also in the percentage share of the industry to GDP. We had to use the data, which joined mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas.

4.2.4 Symptoms in regions

In case of individual regions data for annual production according to the sea and field was retrieved from the Norsk Petroleum. The data of output from manufacturing, services and oil and gas extraction were gained from Statistical Office of Norway as well as the employment in period 2008-2014. Data for wages in particular sectors were found in Eurostat, but their lengths differ. Wages in manufacturing sector according to regions were available only between years 2002-2007, in sector of mining and quarrying even less 2004-2007 and in case of services it depends on the type of it. The particular data for it are available in enclosure.

5 REER appreciation

Fist of all, the thesis is concentrated on the analysis of the symptom 1, which is appreciation of the real effective exchange rate. In this section of the thesis, it is present number of potential forces that could have a serious impact on the Norwegian real exchange rate, particularly, we concentrated on the global oil price, trade imports and exports, government spending and fiscal policy, level of inflation, balance of trade deficit, and moreover the Government Pension Fund Global and its effect on the exchange rate. Furthermore, in our empirical analysis, we investigate the long term relationship between the real effective exchange rate and its determinants.

5.1 Exchange rate and inflation in Norway

From the historical point of view, the exchange rate and the inflation of the Norway have been changing through the years as well as the monetary policy, which responds to the actual development of the currency.

As Norge bank suggested, after the World War II economists believed that the Norwegian economy could be tuned by coordinating instruments enacted by the central authorities. However, in 1970s, the economy of Norway experience very high inflation and price/wage spiral. Moreover the significant decline in manufacturing sector was engaged, even the several devaluations from 1976 to 1986 appeared. As a result of the desperate situation, the monetary policy was changed and greater independence was given to the Norges Bank.

Fixed exchange rate was established after the last devaluation in 1986. Nonetheless, it was canceled in 1992, because of the European Monetary System (EMS) crisis and the increasing risk of the stability loss occurred. Though, there did not appear any rapid change in the krone exchange rate.

In 1996, wage growth was significantly high, petroleum revenues fluctuated and international financial markets were in troubles (which effects the krone exchange rate fluctuation). Instability was increasing further and the value of the currency fell in 1998 and due to this, the interest rate was raised, but later it was shown that this is not the ideal instrument to stabilize the exchange rate. In response, Norges Bank attributed greater importance to influencing inflation developments, in order to keep the exchange rate healthy over time.

In 2001, new policies aims were established. The annual consumer price inflation should have not be more than 2.5 per cent and the fiscal policy should have assure that the non-oil government budget deficit should correspond to the long-term real return on the Government Pension Fund Global.

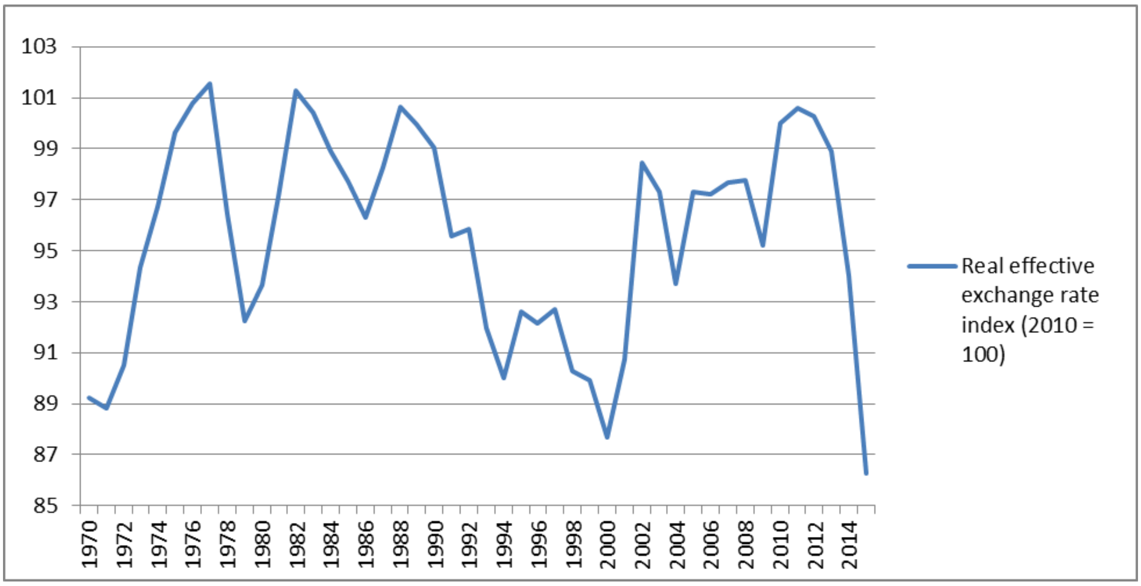

Fig. 7 REER (2010=100) of Norway from 1970 to 2015
Source: World Bank

The IMF further suggested that from year 2000 to 2003, the krone appreciated notably and the potential reasons are higher interest rates imposed by the Norges Bank and also conflicts in the Middle East. This led to the decline in mainland GDP in 2002 and therefore Norges Bank decrease the interest rate from 7 percent to 1.75 percent in 2004. After this act, the 16 percent depreciation in nominal effective terms between 2003 and 2004 appeared. Last depreciations occurred between 2008 and 2009 due to financial crisis and between 2013 and 2014 because of the demand for Norway's oil export decrease.

5.2 Import and export of the oil and gas

Broadly known, Norway is an essential supplier of crude oil and natural gas on the global market, as almost all of these commodities produced here are exported. In fact, Norway is the 8th largest exporter of the crude oil and 3th gas exporter and supplies over 20 percent of the EU gas demand. According to the Norsk Petroleum, the oil and gas export value in 2015, was actually about NOK 450 billion, which is approximately 40 % of the total value of exports.

According to the Statistics of Norway, total exports from 2015 experience a decrease of 8 per cent compared with 2014. Mainly, the value of oil export is lower final figures showed decrease of 30.3% compared to 2014, which is caused by lower oil prices. For a barrel of oil was paid 414 NOK in 2015, which is 32.2 decrease compared to 2014.

On the other hand, exported amount of crude oil in 2015 increased by 2.9% in contrast to the year 2014. The same situation relates to the export of natural gas. In 2015, export of gas was more than NOK 220 billion, which means 1.3% decline on the contrary to 2014. On the other hand, the exported amount was higher by 7.1% compared to the previous year.

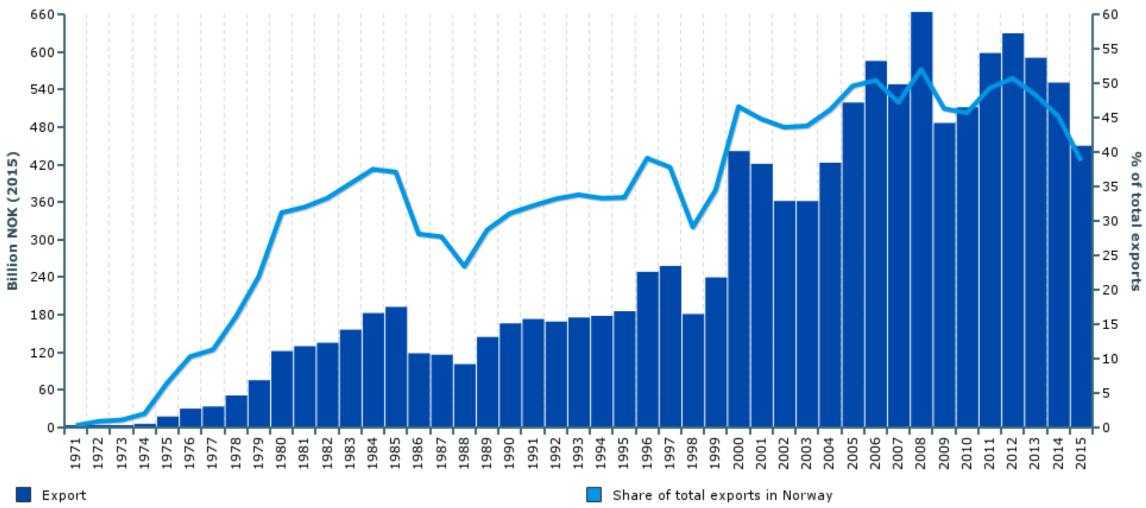

Fig. 8 Export value of oil and gas
Source: Norsk Petroleum

Generally known, Norway mainly imports are cars, refined petroleum, computers, passenger and cargo ships and nickel mattes. Sweden and Germany are the most important importing partners. According to the Statistics of Norway, the imported value in 2015 represents NHOK 140 billion. Follows the Great Britain and Denmark, Statistics of Norway presents that in 2015 Norway's imports increased by 9.5 percent, which represents NOK 616 billion.

Import from European countries increase by 4.8 percent in 2015. Growth of the import value is present from countries of Asia (increase by 28.5 percent) and South America (increase by 20.9 percent). Import from China experiences strong growth – 21.5 percent as well as North Korea – 163.5 percent, caused by import of the oil platforms. Furthermore, the imports from Brazil (food products and inedible crude materials) showed increase by 27.2 percent. On the other hand, import from countries of Oceania and Africa decreased.

The trade balance in 2015 represents NOK 220 369 million, which means 36.4 decrease in comparison to the year 2014. The reason is the 8 percent decrease in exports and 9.5 percent increase of imports.

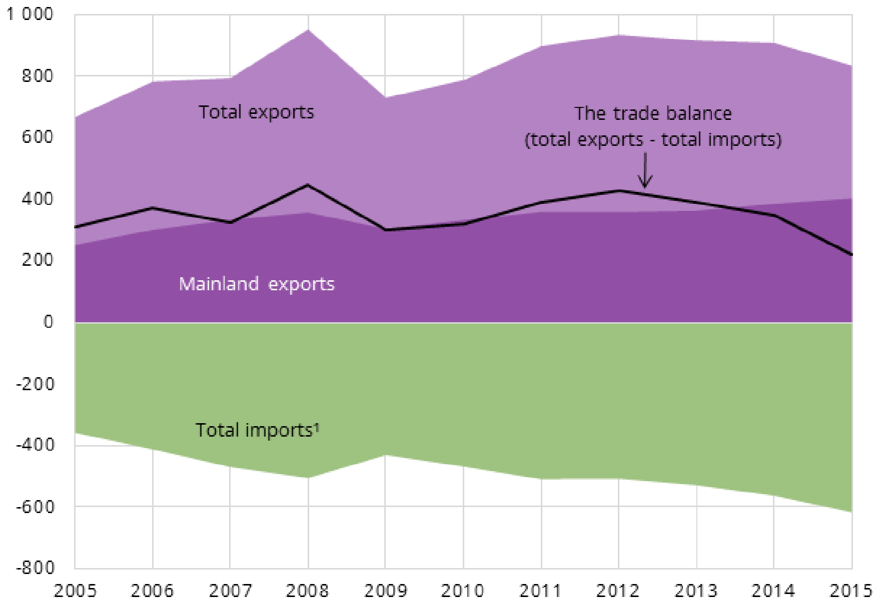

Fig. 9 Trade Balance 2005-2015
Source: Statistical Office of Norway

5.3 Government revenues and cash flow

Generally known, the gas and oil industry is an important part of the Norway´s economy as since the exploitation of these natural resources started in the 1970s. According to the Norsk Petroleum, this sector of the economy has contributed more than NOK 12 000 billion in current NOK to GDP of Norway.

As the graph below presents, the Government revenues consist of the taxes, net cash flow from the SDFI, royalties and area fees and Statoil dividends. As the Norsk Petroleum stated, the government's total net cash flow from petroleum activities in 2015 was NOK 218,3 billion, which represents approximately 20% of total government revenues. On the contrary, in 2014 it was in 2014 NOK 312 billion.

Firstly, the taxes from petroleum activities create an important part of the revenues – in 2015, according to the Norsk Petroleum, it represents NOK 104 billion. The petroleum taxation system consists of the ordinary and additional taxation rules, because of the extraordinary returns on production from oil and gas. According to the Petroleum Taxation Act, the current ordinary company tax rate is 25% and additional one is 53%.

Secondly, the paid environmental taxes – Norway´s carbon tax, tool for reducing the amount of CO_2 emissions, represents NOK 5 billion in 2015. In 2016 the tax rate was increased to NOK 1,02 per litter, in comparison to 2015, when the tax rate was NOK 1 per litter.

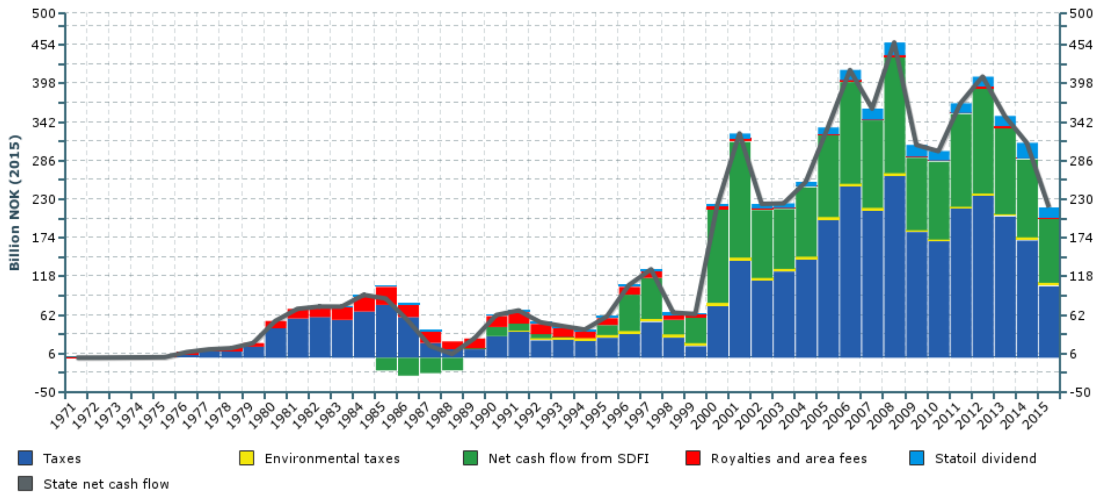

Fig. 10 The net government cash flow from petroleum industry 1971-2015
Source: Norsk Petroleum

Thirdly, the net cash flow from SDFI was in 2015 NOK 92,7 billion. The Norsk Petroleum moreover define the State's Direct Financial Interest as a system under which the Norwegian state owns share in a number fields related to the petroleum extraction, pipelines and onshore activities, covers its share of investment and related costs and receives income from production licenses for return.

The actual situation refers to the direct financial interests in 174 production licenses, 34 producing fields and 15 joint ventures owning pipelines and onshore facilities. Furthermore, the government dividends from Statoil, international energy company, which most of the activities are performed in Norway, represents NOK 15,4 billion. Moreover, the area fees revenues, which represents an intention to ensure efficient exploration, were NOK 1.5 billion.

5.4 Fiscal framework

The fiscal framework of Norway´s economy, consists of the fiscal rules and the Government Pension Fund Global. The fiscal rule states the transfers from the Fund to the central budget should follow the expected real return on the Fund, which is approximately 4% and moreover stresses the stabilizing instruments, in order to reach the low unemployment and thrifty capacity utilization.

On the other hand, the Norge Banks states, the Government Pension Fund Global was established as the long-term solution to limited oil resources and therefore also revenues from the exploitation. The ownership fall under the Ministry of Finance, which simply represents the Norwegian people and the management is under the Norge Bank Investment Management.

Revenues from petroleum are regularly transferred to the fund as it is the integrated part of the government´s annual budget. The inflow consists of all government petroleum revenues, net financial transactions related to the petroleum activities and lastly the net of what is spent to balance the state´s non-oil budget deficit (the net allocations represents the total budget surplus). The capital is invested abroad with the intention to avoid overheating of the economy and be less dependent on the fluctuations of the price of oil. The fund´s investment is divided into 3 parts: the international equity, fixed-income markets and real estate to ensure the diversification and the highest possible risk-adjusted return.

It serves for adjusting of the fiscal policy in case the price of oil change. Moreover, it is used as a effective tool to manage financial challenges, which have been coming with the ageing population and expected decline in the petroleum revenue. The basic idea of the fund is that it is long-term investment, but in case of need it is possible to draw (limitedly). However, the fund does not represent the typical pension liabilities and is not intended to use in order to cover future pension costs. However, the IMF informs about the potential danger from the indirect effects of the natural resources through employment and investment in firms related to the oil and gas industry firms, which could cause a real appreciation and a loss of the competitiveness. As the Norsk petroleum mentions, the market value of the Fund in 2015 was NOK 7 475 billion, in other words, over NOK 1.3 million per person in the Norwegian population.

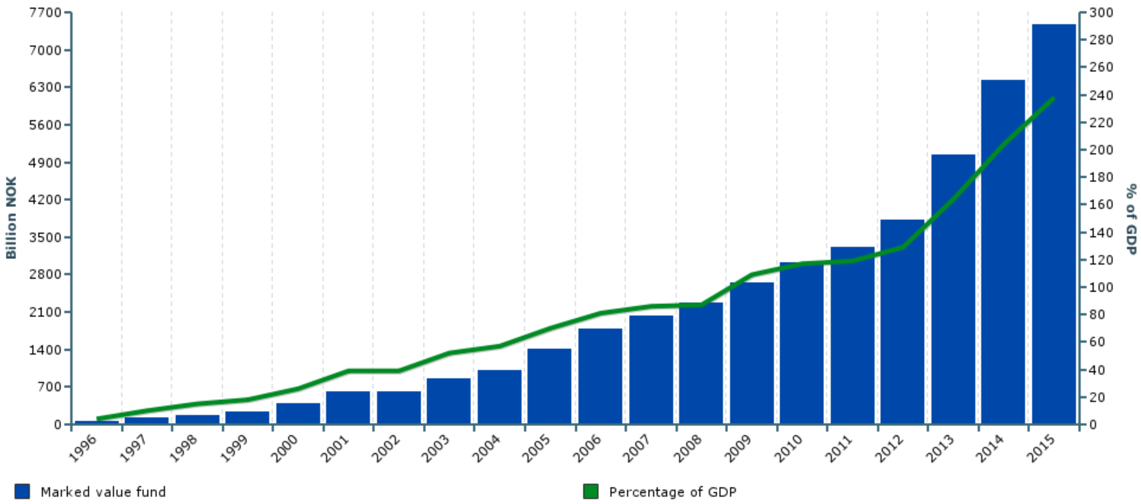

Fig. 11 The market value of the Government Pension Fund Global 1996-2015
Source: Norsk Petroleum

5.5 Government consumption expenditures

The government expenditures are sensitive to fluctuations in domestic, but also in international markets and according to the situation they react to them. It is divided according to the periods in order to be more tabular.

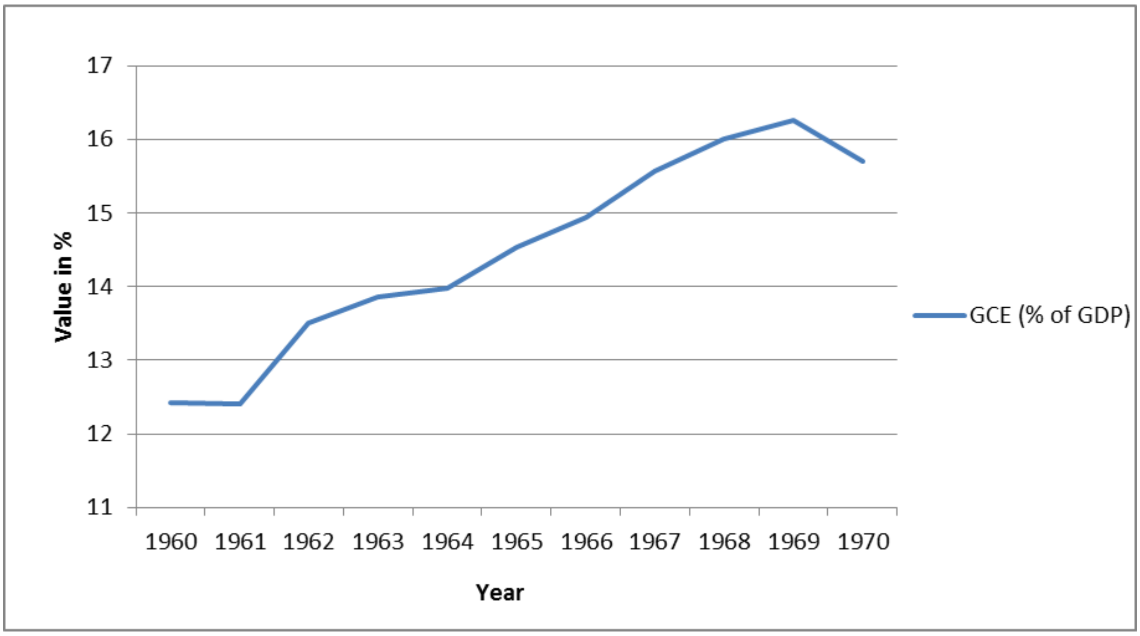

Fig. 12 Government consumption from 1960 to 1970
Source: World Bank

During the 1960s (Fig. 12) the government expenditures were slowly increasing as initial investments into the oil field research were needed. It takes almost 10 years, but finally, the one of the largest offshore oil fields - Ekofisk was discovered in 1969.

Economic History Association proclaimed that the period between 1950 and 1973 is known as the golden era because of GDP growth rate of 3.3%, stable foreign trade, inflation and very low unemployment.

The production from Ekofisk started in 1971 and furthermore, the higher government spending during this period might have been the result of the need to build infrastructure between the units and to search for new fields (Fig. 13).

Moreover, in the 1973 the economy experienced the oil price shock because of the dissolution of the Bretton Woods (between 1971 and 1973).

As a result, the country started using countercyclical policy, which stressed branch and company subsidies, so the competitiveness lowered and de-industrialization took place. The de-industrialization was also caused by the growing profits in oil and gas sector, which further was the source of the very high labour costs (spillover effect), suggests the Economic History Association.

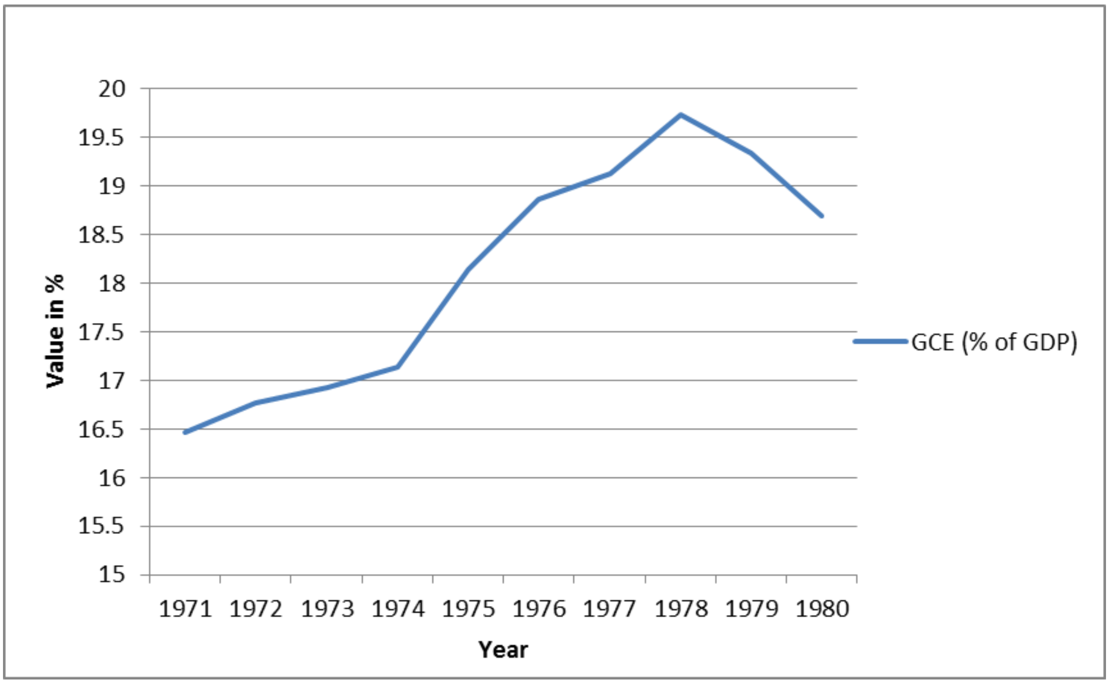

Fig. 13 Government consumption from 1971 to 1980
Source: World Bank

In the first part of the following decade (Fig. 14) still high oil prices were a big issue. Moreover, in 1981 Norway accepted credit liberalization, however, the policy still prevented market forces to set the interests rates and they were created artificially below the market level. As a result a credit boom appeared accompanied with the overheated economy.

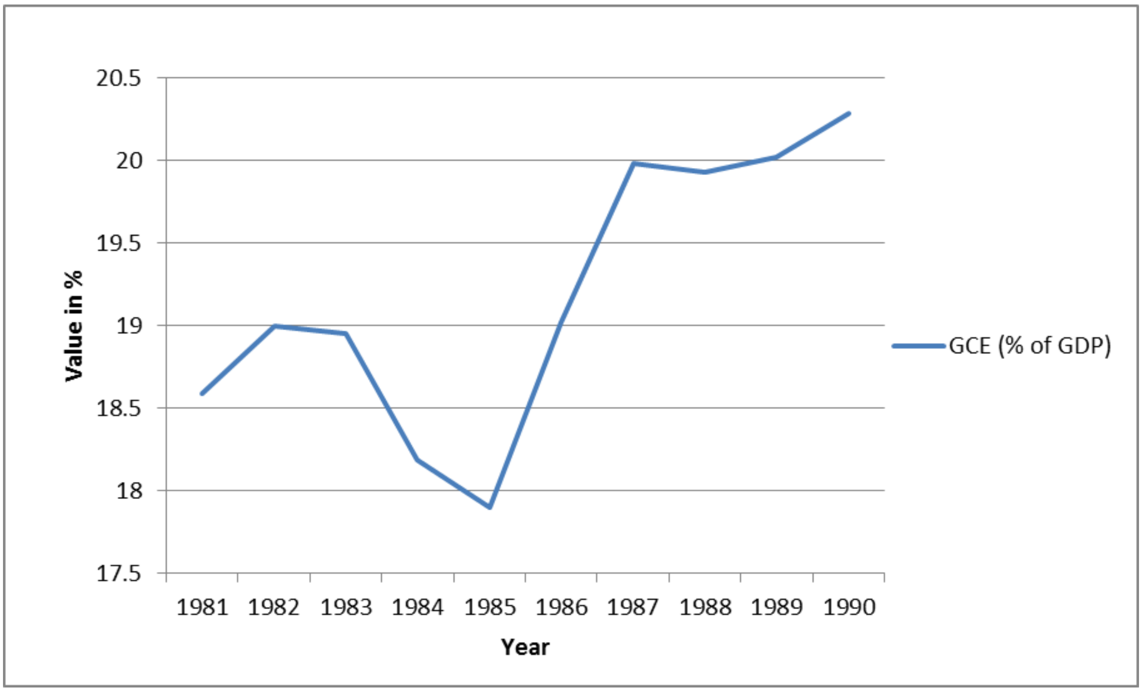

Fig. 14 Government consumption from 1981 to 1990
Source: World Bank

As the Fig. 14 illustrates sharp increasing from 1985 in the government spending, the Economic History Association proposed, it may have been caused by the rapid decline in oil prices and deep deficit. The Norwegian krone officially took part in ECU in 1990, which was also the reason to modify the fiscal policy and keep exchange rate stable. Moreover in 1990 the Fund was created, which may effect the overall government expenditures.

In 1992 the central bank had to prevent the fixed exchange rate to be in force and devaluate it. Under those circumstances Norway experience a financial crisis, during which high government spending occurred (Fig. 15).

Straightaway, the Asian financial crisis influenced the Norwegian stock market and problems among OPEC countries caused decrease in oil prices. Therefore, the currency depreciated, inflation targeting were ratified and strict fiscal policy was used during 1993-1997. As it can be seen on the Fig. 15, the government expenditures were at this point of the economic history of Norway decreasing to prevent negative effects. After that, Norway again came from shadows and started to grow until 1998 due to the increasing prices of oil. The increasing in government expenditures, which reached a peak 1998 could be explained as a tool to stimulate the economy.

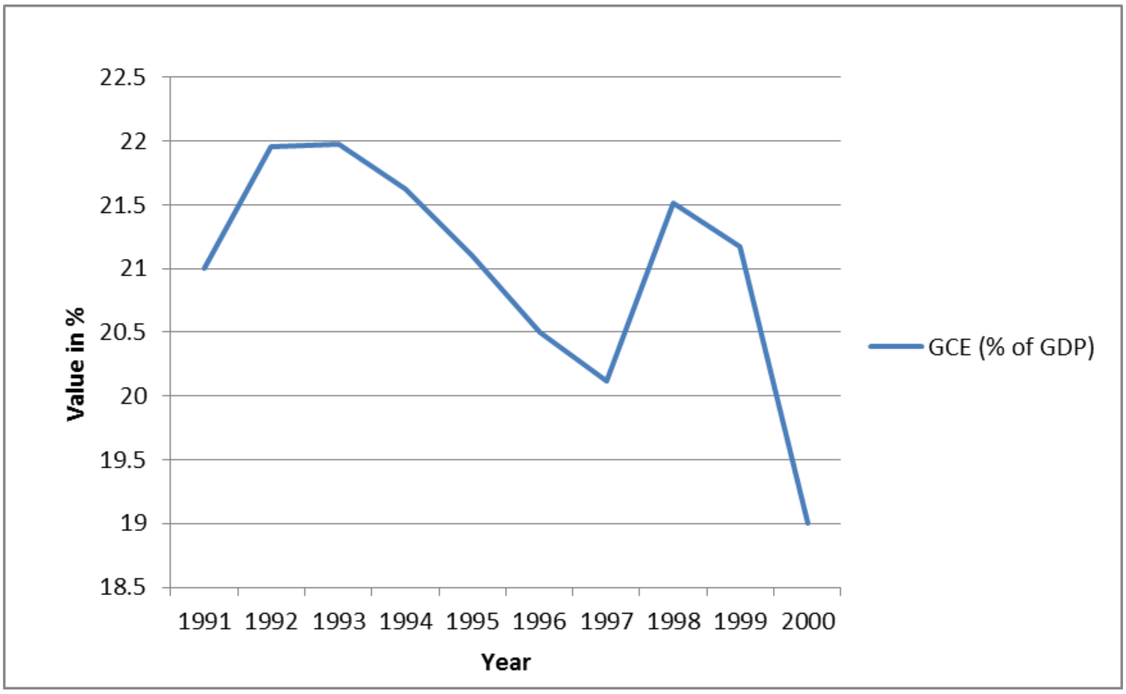

Fig. 15 Government consumption from 1991 to 2000
Source: World Bank

As the Fig. 16 illustrates, the government expenditures in last 15 years is relatively stable. In 2001 the fiscal policy were modified again and introduced the new fiscal rule related to the Fund, which serves to protect the it from withdrawing and overall spending. From 2007 to 2008 the world faced to the financial crisis, but Norway's economy escaped without serious damage as we can see in the Fig. 16, where government spending did not increase significantly during these years.

Recently, the petroleum prices decreased significantly and instantly also the profitability of the companies and investments into the Norwegian continental shelf declined as well. As the Fig. 16 points out, it might be expected increasing of the government expenditures.

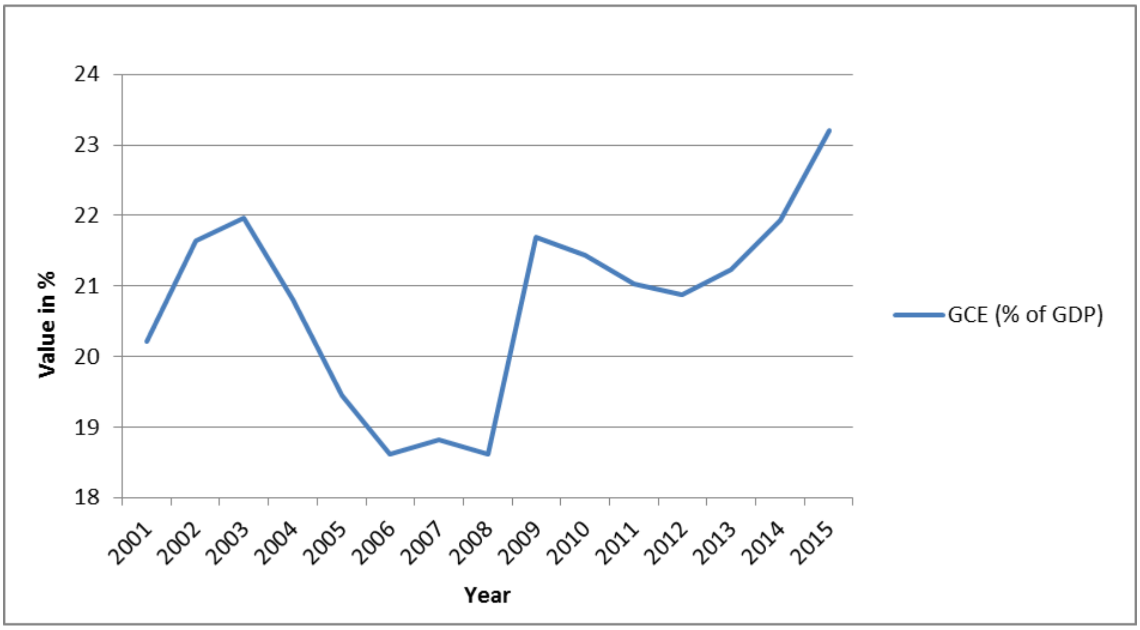

Fig. 16 Government consumption from 2001 to 2015
Source: World Bank

5.6 Empirical analysis of symptom 1

First of all, in order to find the suitable determinants, it was tested for OLS method global oil price, government spending, deflator, openness to trade, real interest rate, Deficit/Surplus of the state budget and GDP in constant LCU. The OLS models (Enclosure A, Tab. 12), compared their model significance (through ANOVA table), specification significance (through RESET test) and their quality of model. We found out that the best model consists of the variables Openness to trade, Real interest rate, GDP and Deficit/ Surplus of the budget, although the last determinant is not significant, it increased the explainability of the model. The variable Global Oil price was not found significant. Without it the model explained by R^2_{adj} 49.71%, on the other hand with this variable included, it explained more than 53%. Therefore we chose it in order to test other analysis and find out the relationship between the explained variable Real Effective Exchange Rate and its regressors.

Firstly, the RESET test (Enclosure A, Tab. 7) was made in order to find out whether the model is corretly specified. As the p-value is higher than the 0.05, we can assume that it is. The following equations and quantified by the OLS method (Enclosure A, Tab. 8)was used for further analysis:

$$REER_{i,t} = \alpha_i - \beta_1 opennes_{i,t} + \beta_2 interest\ rate_{i,t} - \beta_3 GDP_{i,t} + \\ + \beta_4 deficit_{i,t}$$

The comparison of the estimations of the parameters and theoretical expectations confirms that estimated parameter β_1=-7.137306 is lower than zero**.** When the openness to trade in constant LCU increases by one unit, it will cause -7.137306 unit change in REER. The estimated parameter β_2=0.347182 is greater than zero. When the interest rate increases by one unit, it will cause 0.347182 unit change in REER. The estimated parameter β_3=-4.57769e-012 is lower than zero. When the GDP increases by one unit, it will cause -4.57769e-012 unit change in REER. The last estimated parameter β_4=7.33261e-012 is greater than zero. When the deficit increases by one unit, it will cause 7.33261e-012 unit change in REER.

The value of R^2 is 0.557713, which means that the model explains approximately 55.77 % of the variability. The value of R^2_{adj} is 0.48.69, so it holds that $R^2_{adj} \leq R^2$. This coefficient adjusted to the degrees of freedom explains more than 48 % of the variability. We conclude we got an acceptable fit.

In case of ANOVA table (Enclosure A, Tab. 9), we found out that the absolute value of $F_{empirical} > F_{critical}$, which means that the model is significant. The correlation matrix between REER and its determinants Interest Rate and Deficit/Surplus are very low, which means very weak positive linear dependency. Moreover, the matrix also shows the negative correlation between Deficit/Surplus and Interest Rate; GDP and REER; GDP and Interest rate, which is interpreted as negative linear relationship (Enclosure A, Tab. 10). Testing correlation coefficient for significance does not reject the null hypothesis, because the level of p-value is greater than 0.05 level of significance. Therefore, we can assume that there exists linear independence between the variables. After the comparison of the p-value with the significant level it holds that p-value < α, therefore it is concluded that the coefficients are significant, except of the variable Deficit/Surplus, which p-value > α.

According to the results of the econometrical verification (Enclosure A, Tab. 11), it is assumed that the first classical assumption for regression model is not violated as the model is correctly specified according to the Linear test both for squares and logarithms as well as according to the Reset test. Breush-Pagan test does not show an occurrence of the heteroskedasticity, which indicates the fifth classical assumption holds. The test of normality distribution presents normal distribution of the error term and so we can assume that the seventh classical assumption is fulfilled. The Durbin Watson test statistic is in this case 1.176492, which indicates slightly positive serial correlation.

In conclusion, it is assumed that due to the non-significance of the variable Global Oil price, we might not confirm that the Norway experienced the appreciation of the currency induces by the booming petroleum industry and therefore the first symptom of the Dutch Disease is not affirmed.

6 Rising wage level

Rising wage level as the symptom 2 of the Dutch disease is analysed in this part of the thesis. Both, resource movement and spending effect influences the level of wages and salaries in all three sectors. Obviously, the resource movement effect increases wages in oil industry and at the same time due to inter-sector equalization also the level of wages in other industries. The second, spending effect, influences wages to grow in non-tradable sector, which simultaneously increase wages in the rest of the economy, in order to equalize them.

6.1 Empirical analysis of symptom 2

From the data set (Enclosed CD) it is obvious that there is present overall trend in rising wage level in all three sectors, however their speed is different. The wage and salary per hour worked in manufacturing sector in 2015 was approximatelly NOK 679, while in petroleum industry was about NOK 715 at the same year. In the case of the services, the highest wage and salary per hour worked in 2015 was in financial sector roughly NOK 865 and on the other hand the lowest one in ocean transport NOK 243. Therofere we analysed, whether there is a connection between rising wage level and global oil price. By the empirical analysis (Enclosure B), it was checked for the presence of the dependency between the variables in the three following models in three different sectors – oil (Enclosere B.1), manufacturing (Enclosure B.2) and non-tradable services (Enclosure B.3 – B.21) versus global oil price. Firstly, we check whether there exist a correlation between the oil price and the wages in the oil and gas extraction sector. The RESET test (Enclosure B.1, Tab. 13) showed that the model is correctly specified as the p-value is higher than 0.05. After the comparison of the p-value with the significant level it holds that p-value < α, therefore the coefficients are significant. For quantification of the model it was applied the method of the OLS (Enclosure B.1, Tab. 14). The used equation is as followed:

$$\text{Wage in petroleum industry}_{i,t} = \alpha_i + \beta_1 \text{oil price}_{i,t}$$

When the oil price in USD increases by one unit, it will cause 5.17191 unit change in wage and salary per hour worked in petroleum industry (in NOK). The value of R^2 is 0.645884, which means that the model explains approximately 64.59 % of the variability. The value of R^2_{adj} is 0.635469, so it holds that $R^2_{adj} \leq R^2$. This coefficient adjusted to the degrees of freedom explains more than 63 % of the variability. We conclude we got an acceptable fit.

Moreover, according to Gretl output the correlation coefficient is 0.80366897, which means strong positive linear dependency. Testing correlation coefficient for significance rejects the null hypothesis, because the level of p-value is lower than 0.05 level of significance and therefore is is assumed as significant.The ANOVA table (Enclosure B.1, Tab. 15) confirms the model significancy as the absolute value of $F_{emprical}>F_{critical}$.

According to the econometrical results (Enclosure B.1, Tab. 16), we can assume that the first classical assumption for time regression model is not violated as the model is correctly specified according to the Linear test both for squares and logarithm as well as the Reset test. The Breush-Pagan test does not show the heteroskedasticity. The test of good fit presents normal distribution of the error term and so we can assume that the seventh classical assumption is fulfilled.

The empirical results showed the dependency between the salaries and wages in the petroleum sector and the global oil price. Moreover, according to the Norsk petroleum, in 2015 approximately 205 000 people were directly or indirectly employed in this industry, which is about 35 000 fewer than in 2014. We can assume that one of the reasons why less people are employed in this sector is probably a drop of the oil price and therefore lower wages for still working employees.

The second model examines the relationship between the global oil price and the level of wages and salaries in manufacturing sector (Enclosure B.2). The RESET test (Enclosure B.2, Tab. 17) showed that the model is corretly specified as well as the regression coefficients as they are lower than 0.05. For quantification of the model we also applied the method of the OLS (Enclosure B.2, Tab. 18). The used equation is as followed:

$$\text{Wage in manufacturing}_{i,t} = \alpha_i + \beta_1 \text{oil price}_{i,t}$$

The economic verification of the model presents that, if the oil price in USD increases by one unit, it will cause 4.80513 unit change in wage and salary per hour worked in manufacturing (in NOK). The value of R^2 is 0.611546, which means that the model explains approximately 61.55 % of the variability. The value of R^2_{adj} is 0.600121, so it holds that $R^2_{adj} \leq R^2$. This coefficient adjusted to the degrees of freedom explains more than 60 % of the variability. We conclude we got an acceptable fit. According to Gretl output the correlation coefficient is 0.78201415, which means strong positive linear dependency, but obviously it is lower than in the case of the wages in petroleum sector. Testing correlation coefficient for significance rejects the null hypothesis, because the level of p-value is lower than 0.05 level of significance. As the absolute value of $F_{emprical} > F_{critical}$ in ANOVA table (Enclosure B.2, Tab. 19), the model is significant. According to the results of the econometrical verification (Enclosure B.2, Tab. 20), we can assume that the first classical assumption for regression model is not violated as the model is correctly specified according to the Linear test both for squares and logarithm as well as the Reset test. Breush-Pagan test shows homoscedasticity. The test of good fit presents normal distribution of the error term and so we can assume that the seventh classical assumption is fulfilled.

In conclusion the empirical analysis showed the dependency between the wages and salaries in the sector of manufacturing, however, not so strong than in case of the petroleum sector. While the oil price in petroleum sector can cause 5.17191 unit change in wage and salary per hour worked, in the manufacturing it is only 4.80513 unit change. Moreover, the correlation between the oil price and the wages in the petroleum sector shows stronger dependent relationship (0.80366897) than in case of the manufacturing sector (0.78201415).

In the third model, we examined the relationship between the global oil price and sector of services (Enclosure B.3 – B.21). For the regression analysis we examine dependency of the dependent variable Wage and Salaries per hour worked in the sector of services upon the independent variable Global oil price. This segment consists of 20 subgroups of the services according to the type of the activities performed in them. All relationships are linear and all, except the transport via pipelines, shows the strong positive linear relationship. Most correlated are services related to the energy, gas and steam, other transport activities, financial, insurance, real estate services and public administration. Moreover, the inter-correlation between the services were examined, as we suggested at the beginning, it could be caused by the inter-sector equalization as the services can be influenced by each other. By the analysis of this correlation matrix (Enclosure B, Tab. 69-73) we found out that all the services are strongly correlated. All of them reached the correlation over 0.91, which indicates strong positive linear relationship. The exception is only the relationship of the transfer through pipelines and its correlation to other services (except of the accommodation and food services and administrative support services, there the correlation is over 0.91), which is lower, but still strong (over 0.82).

In conclusion, our time regression analysis shows the linear relationship and correlation of the crude oil price and wages in all three sectors of the Norway's economy as well as the correlation between the sectors of services to each other were examined, in order to suggest the inter-equalization of the wages and salaries. Moreover it was found the presence of the overall rising trend in wage level. However, it is understood that to get more precise results, other analysis should be done, and more variables should be analysed as the wages and salaries are influenced by also other determinants, but this would go beyond our thesis scope and therefore it is open to the further research.

6.2 Regions and symptom 2

6.2.1 Wages and salaries in mining and quarrying industry

In case of the mining and quarrying industry, it is observed that the highest overall wages are in Rogaland, as it is the centre of the petroleum industry. Even the data-set consists only 4 years, the rising tendency might be present as in 2004, people employed in this segment earned about 1,221.6 NOK, while at the end of the year 2007 it was more than 3,487.6. Regarding Oslo, the labour prices are not as high as in the case of Rogaland, which is probably caused by the non-mining character of activities connected with the petroleum. For instance, the average wage and salary in Oslo, in the year 2007, has been around 229.2 NOK while in Rogaland county over 3,400 NOK. Moreover, we can regard the great gap between the oil mining counties and those, which are concentrated on other economic activities. For example in case of Nord-Norge county, in 2004 people earned around 34.2 NOK and it did not increase much more even in the year 2007, when the value reached 37.1 NOK. Although the dataset is very small to identify the trend of the wages, we can assume, based on the data and information about the development that it is rising.

Tab. 5 Wages and salaries in mining and quarrying according to the county

Wages and salaries in mining and quarrying industry				
County	**2004**	**2005**	**2006**	**2007**
Rogaland	1,221.6	2,533.2	2,445.4	3,487.6
Oslo	236.1	602.3	414.7	229.2
Hedmark og Oppland	9.4	11.4	14.0	14.4
Sør-Østlandet	42.7	40.5	41.7	50.5
Vestlandet	408.7	242.2	104.2	325.6
Trøndelag	108.1	36.6	50.2	72.8
Nord-Norge	34.2	26.6	30.5	37.1

Source: Eurostat

6.2.2 Wages and salaries in manufacturing

The highest wages in manufacturing sector experienced during the years 2002-2007 mainly Oslo, Rogaland, Vestlandet and Sør-Østlandet. The highest average wage and salary was present in Sør-Østlandet and that was about 2,743.18 NOK, it is followed by the Vestlandet (2,629.57), Rogaland (2,328.45) and Oslo (2,197.87). The lowest one was experienced by the Nord-Norge (599.13). The wages in manufacturing is rising through the years, except of the year 2004, when the drop was monitored in all observed regions except of the Rogaland.

Tab. 6 Wages and Salaries in manufacturing

Wages and Salaries in manufacturing						
County	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Oslo og Akershus	2,054.60	2,047.70	1,980.60	2,206.00	2,487.80	2,410.50
Hedmark og Oppland	794.8	738.7	708.1	769.9	809.9	824.4
Sør-Østlandet	2,747.30	2,485.80	2,449.00	2,785.40	2,973.80	3,017.80
Rogaland	2,236.00	1,987.10	2,052.80	2,300.80	2,662.40	2,731.60
Vestlandet	2,535.70	2,381.80	2,313.20	2,564.40	2,932.50	3,049.80
Trøndelag	784.5	720.5	707.3	807.9	887.8	956.2
Nord-Norge	358.8	596.1	590.6	635.3	673.3	740.7

Source: Eurostat

6.2.3 Wages and salaries in services

Wages in tertiary sector (Enclosure D, Tab. 63-68) are growing in all groups of services, however in some regions more slowly and in others. As the analysis was concentrated on the counties Rogaland and Oslo, it was found that salaries in services are increasing at faster pace in Oslo than in Rogaland. For example, in case of Construction, the Oslo monitored increase in wages from 539.8 NOK in 1995 to 1,525.90 NOK in 2006. On the other side, Rogaland was increasing more slowly with the beginning value 329.4 NOK in 1995 to about 889.1 NOK in 20016. The same trend is observed in Electricity, gas and water supply; Wholesale and retail trade; Transport, storage, documentation, Real estate and Hotels and Services.

In conclusion, it is assumed the overall rising in the wage and salary level is present in the individual economic performance of the regions as well as in the of the economy as a whole.

7 De-industrialization

The symptom 3, de-industrialization describes the situation, when due to the both, resource movement and spending effect, the employment and the output in manufacturing sector decline. Furthermore Robert Rowthorn and Ramana Ramaswamy (1997) suggest, it is closely related with the increase in performance and employment in the sector of services.

Oomes and Kalcheva (2007) proposed that we can distinguish between absolute and relative de-industrialization. Absolute one means negative manufacturing growth. On the other side, relative one that even there is not present the absolute de-industrialization, the i.e. slower growth in the manufacturing sector than in other sectors can be present.

7.1 Empirical analysis of symptom 3

From the graphical illustration below (Fig. 17) is obvious that the absolute de-industrialization is not present as the share of the manufacturing sector is decreasing (Fig. 17) in the last years, but absolute growth is not negative.

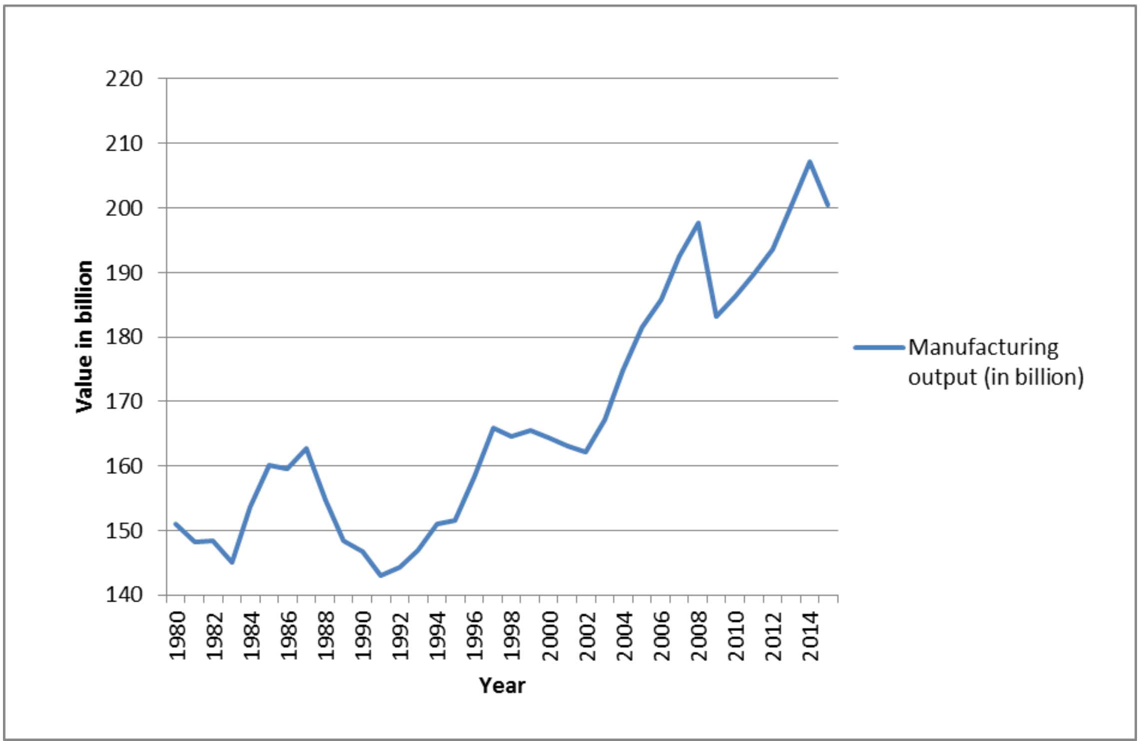

Fig. 17 Manufacturing output in constant LCU
Source: World Bank

The total output has a rising trend as in the 1980 when the first data are available the value was approximately 151 billions and nowadays it reached more than 200 billions. However, the share on total GDP is decreasing (Fig. 18). At the beginning of the 1970s the share of manufacturing to GDP was approximately 20 % and in the end of the year 2015 only about 8 %, which could be caused by the developing of the petroleum industry and therefore related to the level of the oil price. It was investigated the relationship and correlation between the manufacturing output and the oil price by the time series based on OLS method (Enclosure C). First of all, the correct specification of the model was investigated through the RESET test (Enclosure C, Tab. 59), which shows the p-value is higher than the significant level and therefore we could assume that the model is correctly specified. Significance test for the regression coefficients shows that p-value < α, therefore the coefficients are significant. For the quantification of the model we used OLS method (Enclosure C, Tab. 60) and this equation was used:

$$\text{Manufacturing output}_{i,t} = \alpha_i + \beta_1 \text{oil price}_{i,t}$$

The empirical analysis shows the positive linear relationship between the global oil price and manufacturing output, as it confirms that estimated parameter $\beta_1 = 0.586629$ is greater than zero. When the oil price in USD increases by one unit, it will cause 0.586629 unit change in manufacturing output (in constant LCU). Moreover, the correlation coefficient is 0.86373768, which means strong positive linear dependency. Testing correlation coefficient for significance rejects the null hypothesis, because the level of p-value is lower than 0.05 level of significance and therefore we can assume that it is significant as it differes from zero. The value of R^2 is 0.746043, which means that the model explains approximately 74.60 % of the variability. The value of R^2_{adj} is 0.738573, so it holds that $R^2_{adj} \leq R^2$. This coefficient adjusted to the degrees of freedom explains more than 73 % of the variability. We conclude we got an acceptable fit. By the ANOVA table (Enclosure C, Tab. 61) it was found out that the model is significant as its $F_{emprical} > F_{critical}$. According to the econometric verification (Enclosure C, Tab. 62), we can assume that the first classical assumption for regression model is not violated as the model is correctly specified according to the Linear test, both for squares and logarithms as well as the Reset test. Breush-Pagan test shows no occurrence of the heteroskedasticity, therefore the fifth classical assumption holds as well. The test of a good fit presents normal distribution of the error term as the p-value is higher than the significance level 0.05 and so we can assume that the seventh classical assumption is fulfilled. The Durbin Watson test statistic is 0.44617, which can indicate positive serial correlation.

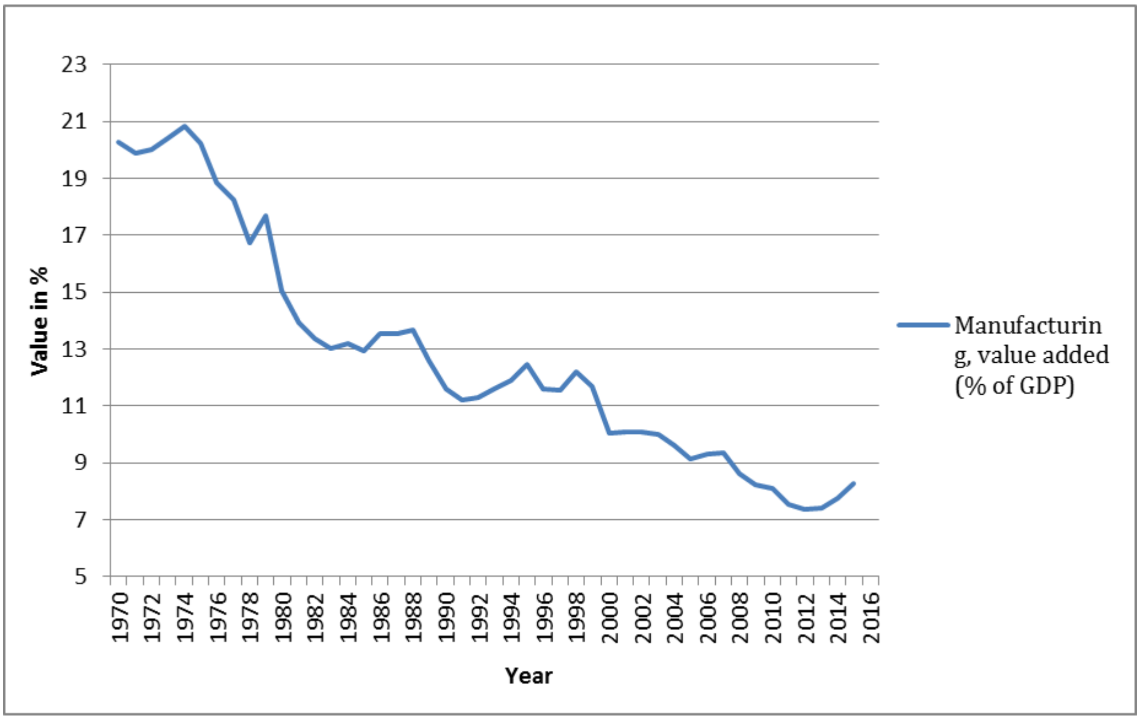

Fig. 18 Manufacturing output (% of GDP)
Source: World Bank

Moreover, we graphically analysed the situation of the manufacturing sector output and its percentage of the GDP of the neighbours of Norway in order to investigate, whether their economies experience the same development trends as well. As the Fig. 19 suggests, all analysed countries might experience the declining share of manufacturing on percentage of GDP, however Norway has the lowest share as in 1990 it was about 15% of GDP and in 2015 only arond 10%, in comparison with e.g. Denmark, which in 1990 experienced aroung 40% of GDP and nowadays around 25%, toghether with Sweden and Finland, which values are slightly lower than in case of Denmark and Sweden, which may indicate the relative de-industrialization.

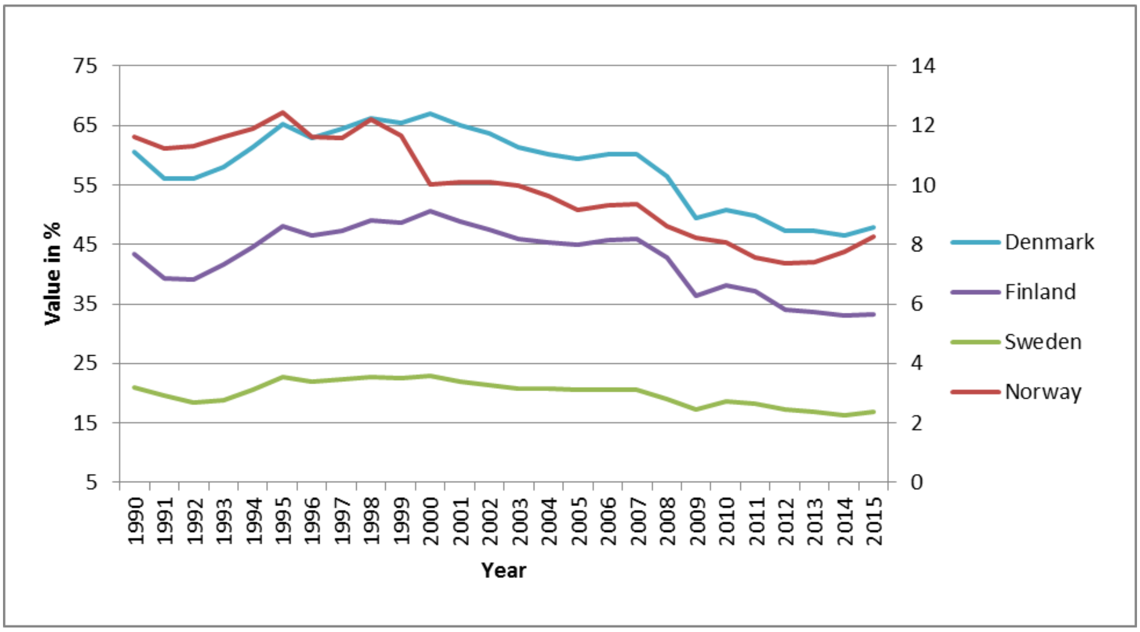

Fig. 19 Manufacturin (% of GDP) Neighbouring countries
Source: World Bank

From the Fig. 20, we can assume that Norway and Denmark might possesses the similar development, which is obviously slower than in case of Sweden. Finland has the lowest output value as in 1990 it was about 16 billion and last year 25 billion. Its output in peak in 2007 reach only almost 40 billion, which is far less than in case of any compared country. For instance before the recession, in 2007, the value of output of Sweden represents 600.359 billion, Denmark's over 221 billion and Norway's over 192 billion.

The similarity of Norway's and Denmark's value of the output may be caused by the similar oil and gas exploitation activities in Norgh Sea. In case of Finland, the small output may have been caused by the NOKIA decline as it has created large share of the Finland economy. From the overall data we might indicate that Norway experiences slower growth of manufacturing than their neighbours except of Finland and therefore the relative deindustrialization can be in play.

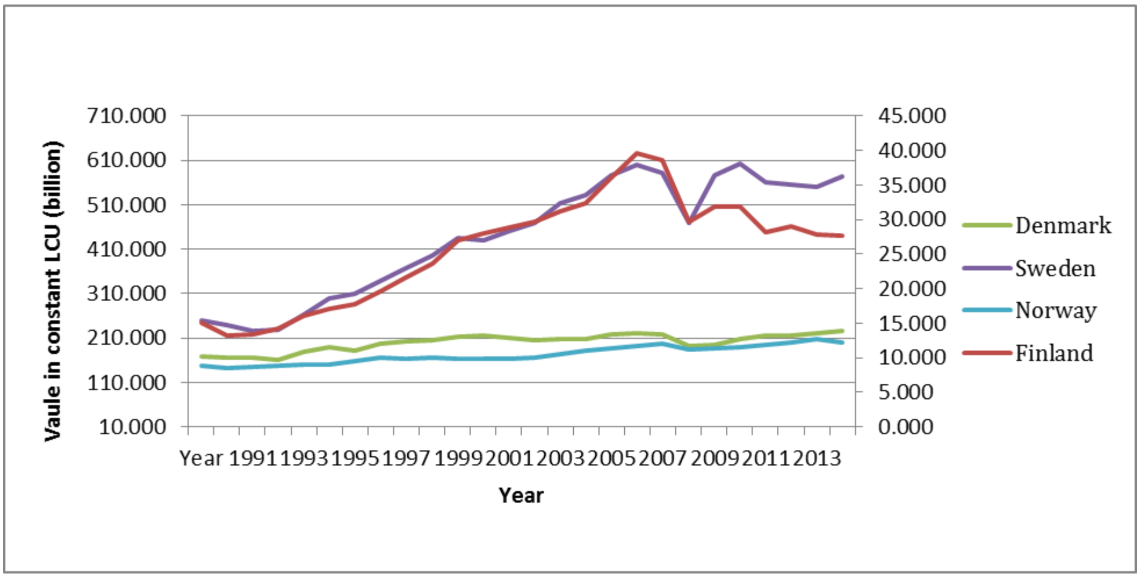

Fig. 20 Manufacturing output - Neighbouring countries
Source: World Bank

As the Figure 21 presents, the employment in manufacturing and industry has a decreasing trend during the observed period. In 1980 more than 29 % was employed in these sectors, while in 2014 only 20.5 %.

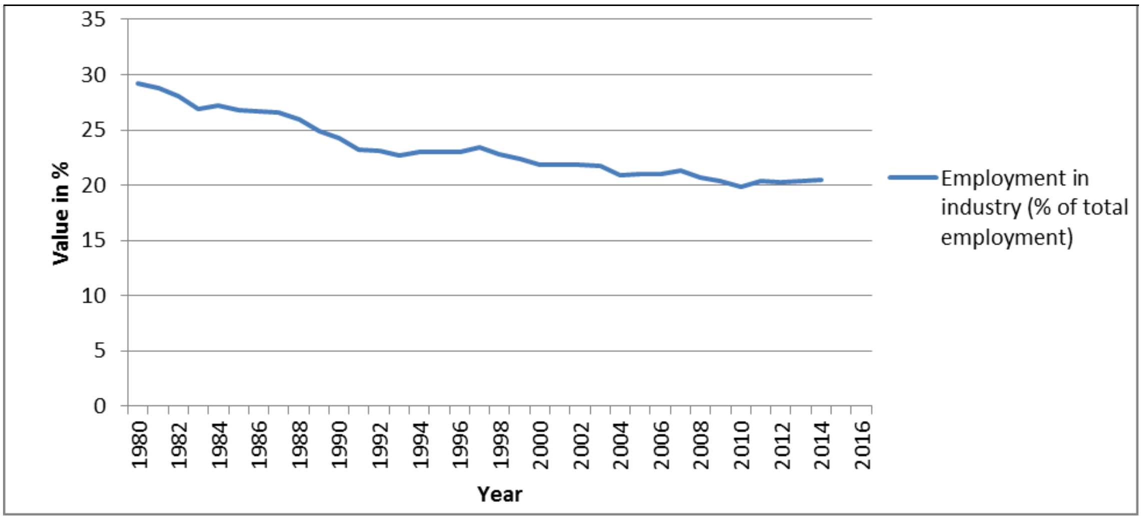

Fig. 21 Employment in industry (% of total employment)
Source: World Bank

According to the report Norway 2016, manufacturing sector employs approximately only 10 % of people compared to the peak 1974.The number of work positions in manufacturing and mining decreased as well by almost one third, from 387 000 to 252 000 at the breakthrough of the 1970s and 1980s. However, with the respect to the petroleum industry, Statistical Office of Norway suggests that the employment was continuously increasing from the 1972 until the year 2014 (32 000 employees), when the oil price decreased and fall in employment occurred. In 2015, 29 000 people were working in the extraction of the petroleum resources.

From the graphical illustration below (Fig. 22), we can estimate the increasing trend of the percentage share of the industry to overall GDP until the year 2009, when the financial crisis appeared, the share dropped from the overall peak in 2008 (above 44 %) to approximately 38 % of the GDP and in during the last year 2015 it reaches 34.96 %.

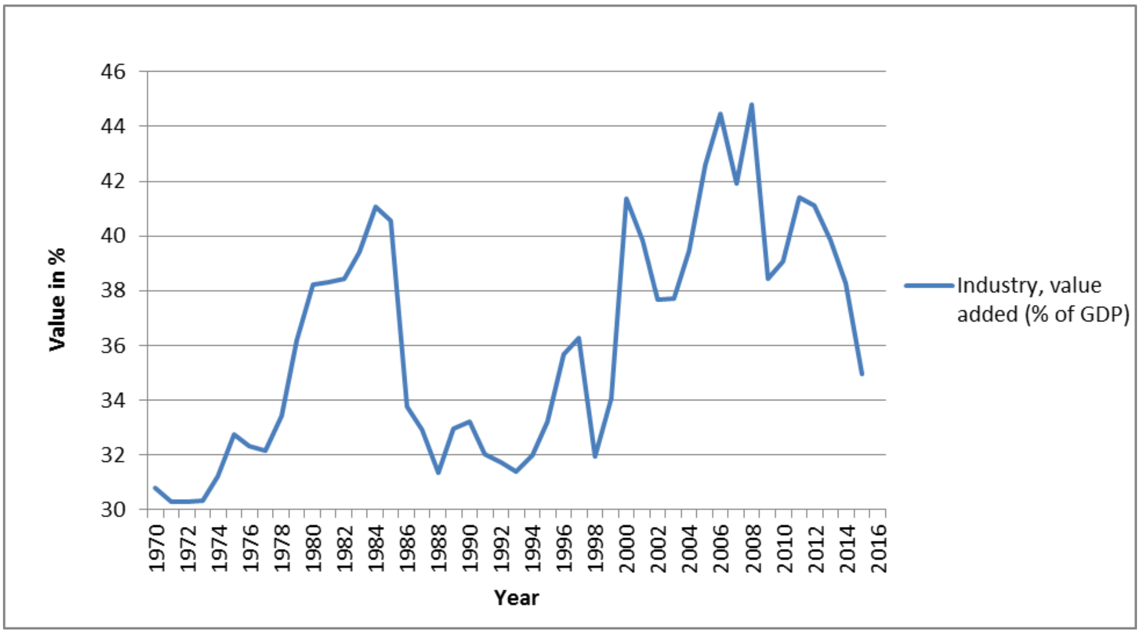

Fig. 22 Industry output (% of GDP)
Source: World Bank

The tertiary sector (Fig. 23) sharpest decline was present between the year 2006 and 2008, when the percentage share of the services on total GDP decrease to approximately 54 %. Before the economic crisis the share was about 60%. In the last year 2015, it was 63.22 % with the comparison to the beginning of the measured values in 1970, when the share reaches about 63.37 %, it is obscure difference.

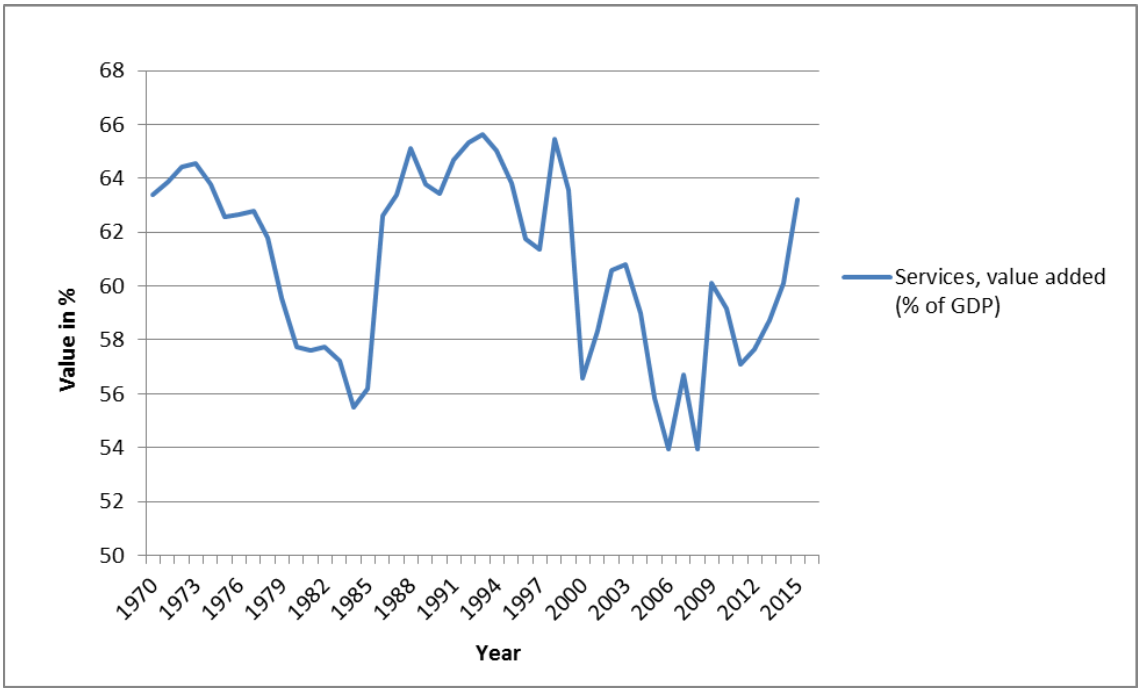

Fig. 23 Output in Services (% of GDP)
Source: World Bank

Despite to the decreasing trend in manufacturing employment, the tertiary sector employment has increased to 2 100 0000, in comparison to the 1960s, when it was just 750 000 (Fig. 24).

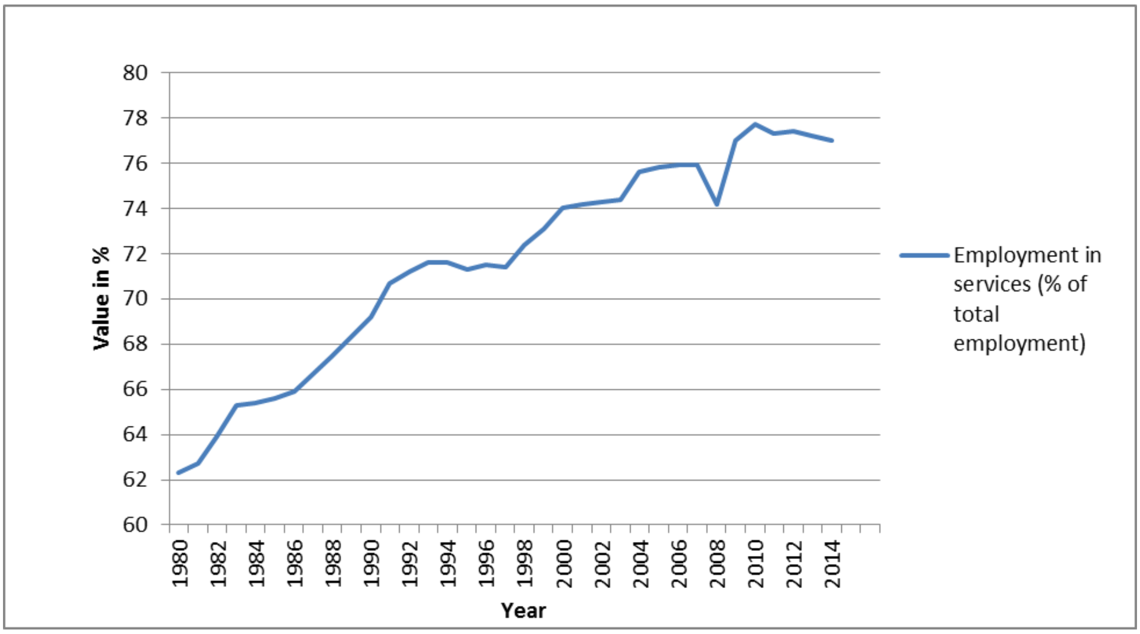

Fig. 24 Employment in services (% of total employment)
Source: World Bank

In 2014, it represents 77 % of all employees working in Norway's economy. The Statistical Office of Norway indicates that the largest part of the employment in services sector is at the moment public administration, including health and social work, education and administration. We might conclude that the employment in services is continuously increasing as in the 1980 approximately 66 % of total employment was included here, in comparison to the year 2015, when 77 % was employed in this sector.

In conclusion, we can assume that the absolute de-industrialization is not present in the case of the Norway's economy, because the manufacturing output is not negative. However, as the total share of manufacturing to GDP is decreasing, we decided to analyse the relationship between the global oil price and the manufacturing output as we suggested that the lower share could be caused by the developing of the petroleum sector. The found relationship confirms our hypothesis that the manufacturing output and the oil price are related as the empirical part affirms the positive linear relationship and strong correlation between the chosen variables. Although, the neighbouring countries have the same development of the share of the manufacturing, but it is not as sharp as in the case of the Norway. However, we could not suggest that the oil price is the only variable, which influences the manufacturing output as the trend in other countries is also decreasing.

Nonetheless, the relative de-industrialization could be still a threat as the employment in manufacturing is decreasing, but the employment and also the total share of services on the GDP is rising as well as in the case of the industry sector. Furthermore, we observed slower growth in manufacturing output than in other neighbouring countries, except of Denmark, which has the similar growth. It might be caused by the involvement in the oil and gas extraction. However, to determine whether the relative de-industrialization is present or not, further research is needed, which would go beyond the scope of this thesis.

7.2 Regions and symptom 3

7.2.1 Rogaland

In case of Rogaland, the total manufacturing output through the years 2008-2014 (Fig. 25) is not negative, but has slightly increasing trend from the year 2009, when the significant drop in output (value approximately 16,415 NOK million, which means around 8.96% of total manufacturing production) was experienced, probably due to the worldwide economic crisis. The output in the year 2014 creates 24,208 NOK million (approximately 11.69% of total manufacturing output).

However, in comparison to the petroleum industry, the manufacturing is growing slower as the output value before the crises was about 25,555 NOK million (above 26.58% of total petroleum production) and before the drop in oil price in 2013 experienced its peak 42,611 NOK million (47.55 % of total oil and gas production). In the last year of observation 2014, the output presents 41,611 NOK million (around 45.30% of total production of the petroleum industry).

The tertiary sector grows constantly through the years and does not experience any significant drop. The starting value in 2008 was more than 117 NOK millions (approximately 8.773% of total output of services) and at the end of the observed data it increased to the value 164,825 NOK million (above 11.012% of total production in tertiary sector), which suggests much higher growth than in case of both manufacturing and petroleum industry.

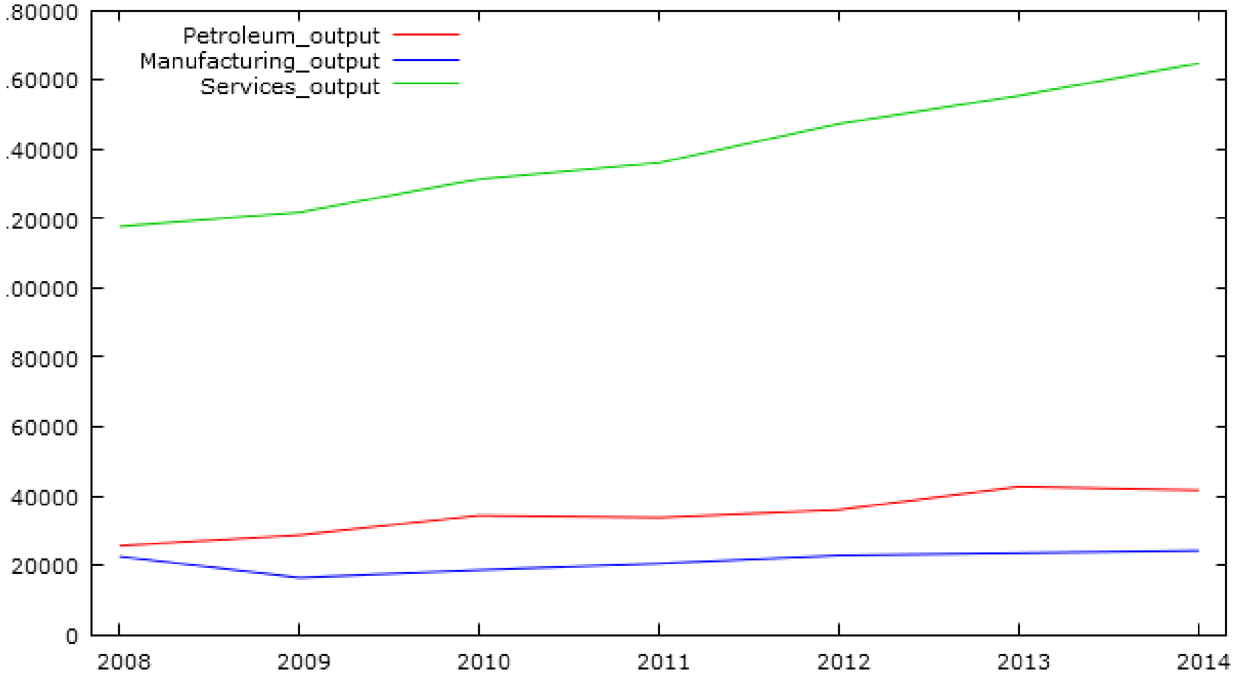

Fig. 25 Total output of Rogaland 2008-2014
Source: Statistical Office of Norway

According to the data from the Norwegian statistical office, the employment in the petroleum sector (Fig. 26) is slightly increasing from the value 19,700 employed people in 2008 to approximately 26,900 employees in 2014. The highest rise happened from the year 2009 to 2010, from 20,000 to 22,700 people. At the end of the year 2014, the petroleum industry employed 26,900 people.

On the other hand, the employment in manufacturing is slowly decreasing. In the year 2008 34,400 people were employed in this sector while in 2014 only about 30,400. The lowest number was in 2011, when 28,000 people were employed in the segment. However, this sector still employs more people than in case of the petroleum industry in this region.

Employment in services is increasing from approximately 180,500 people employed in tertiary sector in 2008 to 201,300 employees in 2014. In the year 2010, a slight drop was experienced when the number of employed decrease roughly by 1000 people.

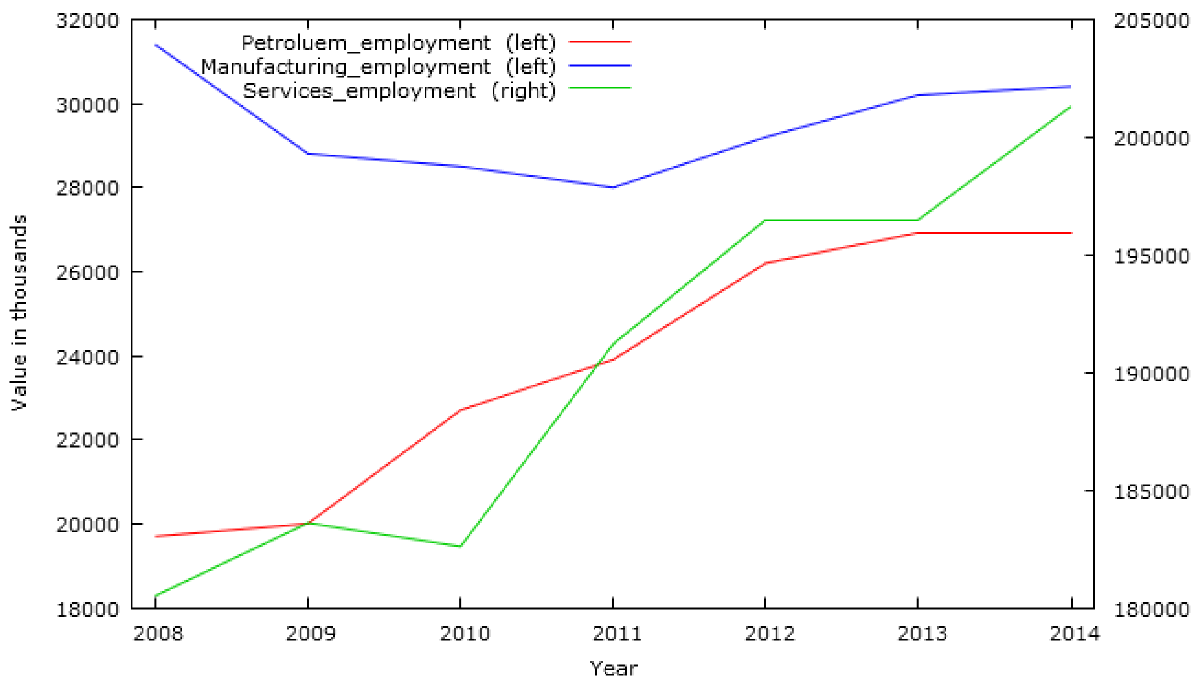

Fig. 26 Employment in Rogaland 2008-2014
Source: Eurostat

7.2.2 Hordaland

The oil and gas output in Hordaland (Fig. 27) was in the first years of observation unstable, but from the year 2010 (5,110 NOK million, which represents above 5.67% of total oil and gas production) is increasing until the year 2013 (11,432 NOK million, which is approximately 12.76% of total petroleum output) and followed by the drop in 2014 to the value 11,013 NOK million (around 11.99% of total production in this particular sector). In the case of this region oil and gas output is lower (except of the year 2008 and 2009) than the total output of manufacturing, which lowest value was in the year 2010 20,984 NOK million (which represents above 11.26% of total manufacturing output). The decrease by 1,276 NOK million was probably caused by the effects of the worldwide financial crisis. The peak of the manufacturing value was dated two year ago in 2014, when the value increases to 24,743 NOK million (around 11.945% of total output). In general, we could conclude the percentage increase during the observed period about 0.68%.

According to the Fig. 27 we can assume that the output level of services is rapidly increasing from the year 2009, when the value represents 140,501 NOK million (the lowest value, which represents 10.52% of total production in tertiary sector) to the output value 195,721 NOK million in 2014 (which is approximately 13.076% of total output of services). The graph indicates, that the value of tertiary sector output was always higher than the manufacturing one, except the year 2008 and 2009, again probably financial crisis.

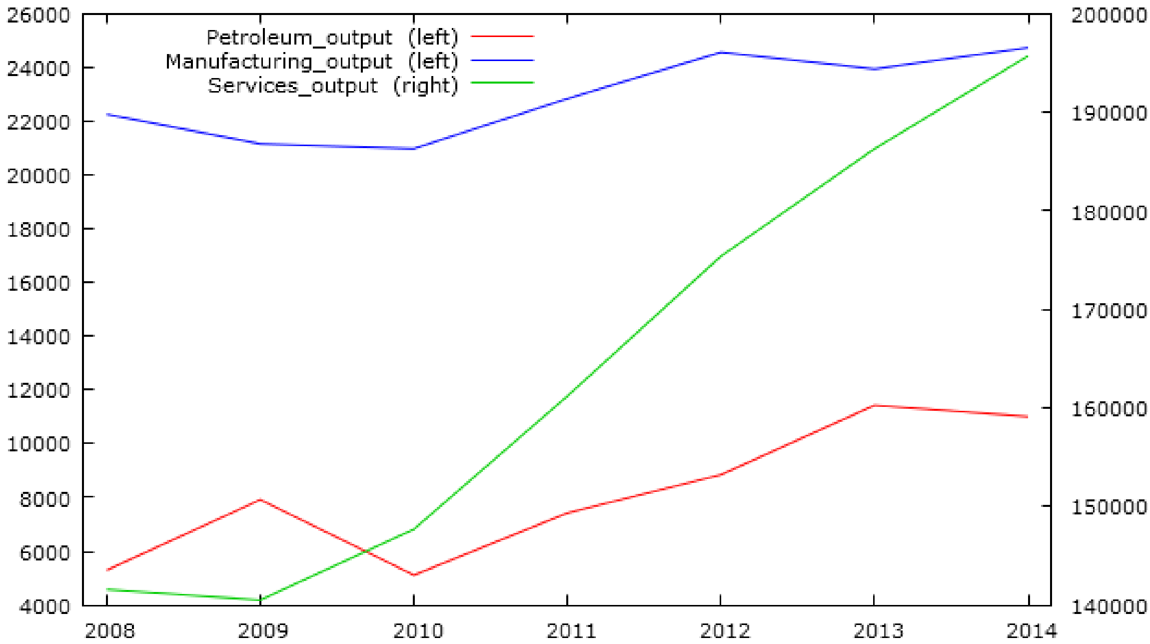

Fig. 27 Total output of Hordaland 2008-2014
Source: Statistical Office of Norway

In the case of the Hordaland region employment (Fig. 28), least number of people is employed in the petroleum sector, even their number is increasing through the years. At the beginning of the observed data (2008) more than 5,600 people were working in this sector. In 2013, employment experienced its peak, which represents 8,700 employees. Then the number is decreasing, might be due to decreasing global oil price, to the value 8,200 employed people in 2014. On the other side, the employment in manufacturing has slightly decreasing trend with the biggest drop in 2011, when the employed number of people dropped from 31,100 to 28,000. At the end of 2014, manufacturing was employing 29,600 people. From the point of view of tertiary sector, the number of employed people increased compared to the year 2008 about 19,200 in 2014, which represents 236,700 employed persons. We can assume that the segment of services is developing much faster than manufacturing or petroleum industry in this region.

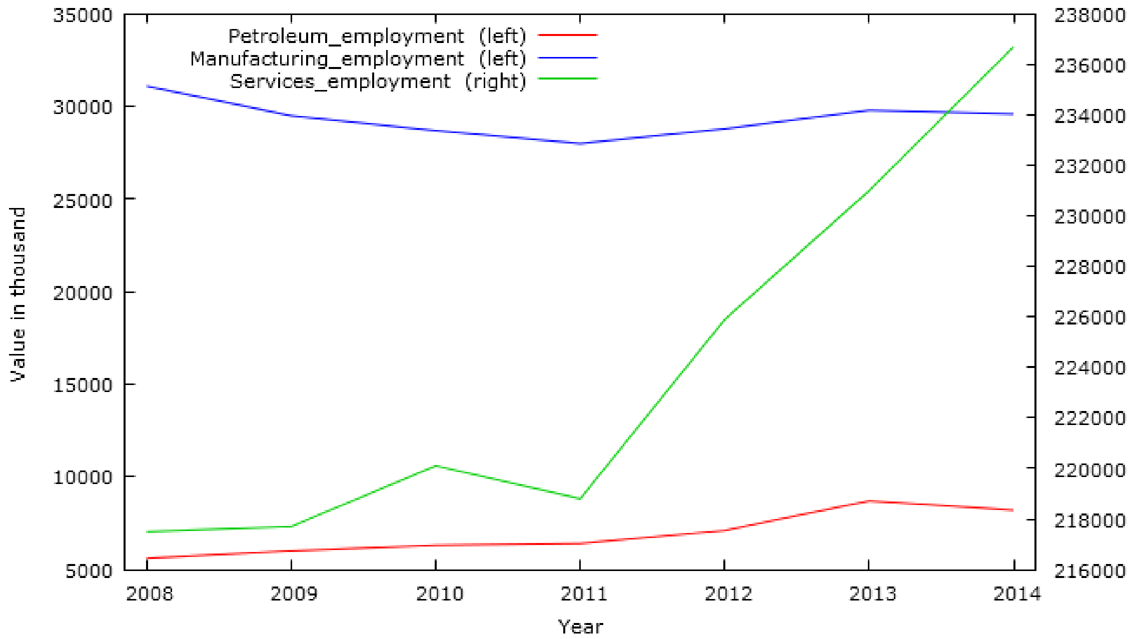

Fig. 28 Employment in Hordaland 2008-2014
Source: Eurostat

7.2.3 Oslo

In case of petroleum industry in Oslo, we assumed that its output should be lower than the output of the manufacturing and services, simply because the oil and gas extraction is not one of the main domains of Oslo. On the other hand, the county concentrates on services and manufacturing also related to the petroleum resources as the biggest clusters are placed there. From the Fig. 29 below we could indicate that the petroleum activities have their peak in the year 2011, when they produce output in value more than 3,649 NOK million (which represents above 4.11 of total production of petroleum). From this period, the value was slowly decreasing to the amount 2,343 NOK million (above 2.55% of total oil and gas production).

The level of manufacturing is particularly high in Oslo as the beginning value in 2008 was about 16,494 NOK million (8.34% of total manufacturing output). In 2009, probably due to financial crisis, the amount of output dropped to 8,949 NOK million (above 4.88% of total production), but from that time, it is increasing. In the last year of observation it kept value 14,895 NOK million (approximately 7.19% of manufacturing total output.

The level of services is increasing rapidly through the years, which might be caused by development of more companies related to the clusters. In the beginning of the observation, the value was about 321,602 NOK million (which represents above 23.96% of total output of tertiary sector) and at the end of the year 2014, the amount was 463,440 NOK million (above 30.96% of total output of services).

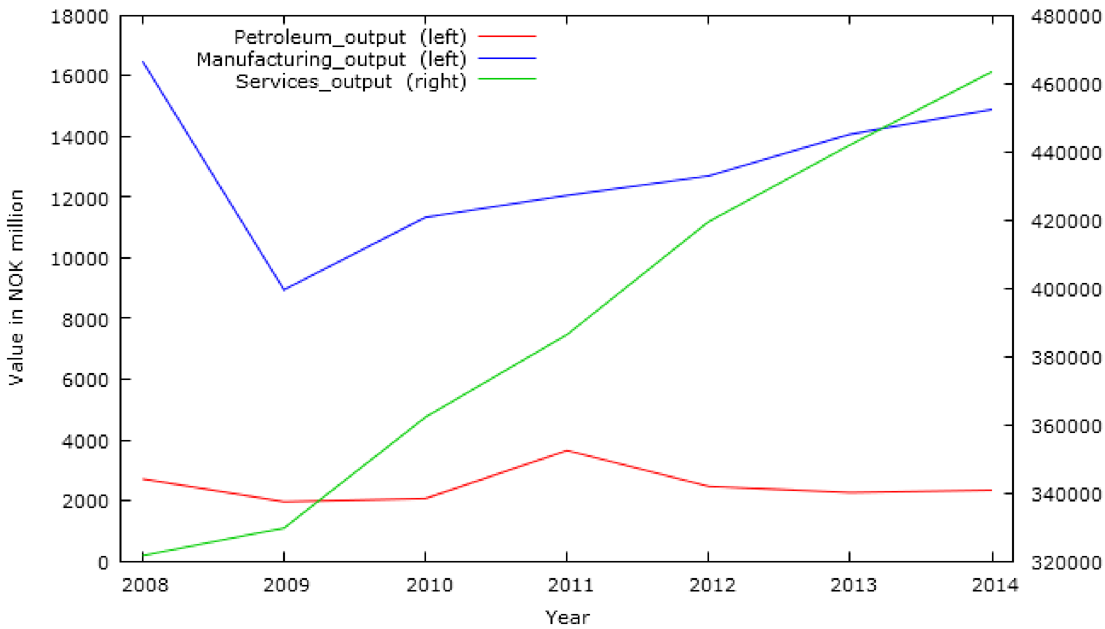

Fig. 29 Total output of Oslo 2008-2014
Source: Statistical Office of Norway

The lowest level of employment in region Oslo is present in petroleum sector (Fig. 30). The peak of employment was experienced in the year 2011, when it employed 2,800 people, however from that time, it is decreasing and in the year 2014, 1,300 people were employed in this segment.

On the other hand, manufacturing employment is much higher than in oil and gas sector as two years ago, it employed more than 14,900 people. However, the highest number was in 2008, when it was more than 19,900. From that year, the number of employees is decreasing.

In case of tertiary sector, its employment is rising. Compared to the year 2008, when 433,600 people were engaged in services, in 2014 it is more than 458,800.

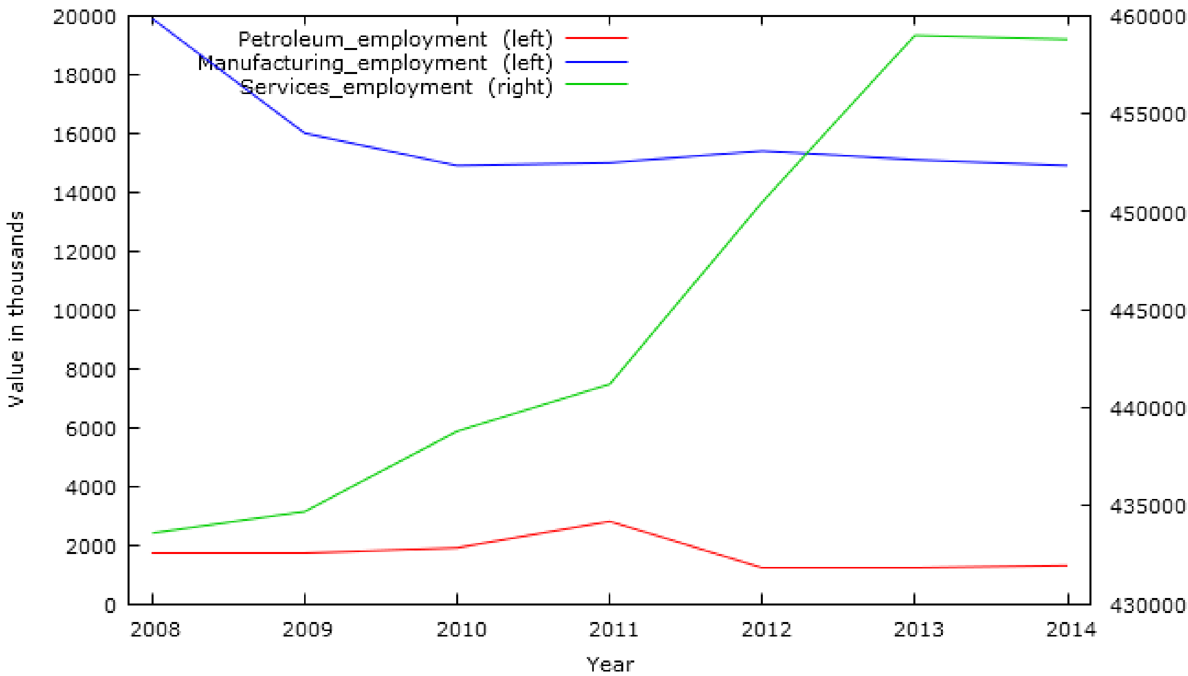

Fig. 30 Employment in Oslo 2008-2014
Source: Eurostat

In coclusion, the absolute de-industrialization can be excluded as the manufacturing output has still been increasing and it has not been negative. In case of relative one, we observed that the manufacturing output is higher than the petroleum one, but it is slowly decreasing. However, the level of output of services as well as its employment is much bigger than in case of manufacturing, in which case the employment is slowly declining its value.

8 Discussion

The results of the researchers, which are related to the performance of Norway associated to the Dutch Disease, differ. For instance, Bjørnland (1998) interrogated that production output from manufacturing sector actually took the advantage from the rising level of oil profit. On the other hand, Hutchison (1990) identified detrimental effect on the manufacturing segment due to the oil boom. In contrast to our research, the method of cointegration was used to detect the symptoms by Hutchinson (1990), bul also Oomes and Kalcheva (2007).

Additionaly, Larsen (2004) induces that during the started exploitation era in Norway, mainly in 70s and 80s, some of the indicators of the Dutch Disease were present; however Norway economy regulated the non-oil trade sector and reversed the situation. Moreover, Stevens (2003) stressed the importance of the foundation Government Pension Fund Global, which succesfully protected the Norwegian economy from the nominal appreciation and excessive demand. Nonetheles, even the time series regression was used in the thesis, the symptoms, which could surely confirm the presence of the Dutch Disease were not found as well as in the case of the recent researchers.

Anyhow, Larsen (2004) suggests that there is an existing harmony among these different opinions as they describe two phases of the Norway economy. Firstly, when the Norway discovered its oil and gas field in North Sea, the petroleum industry boomed and needed a lot of factors of production to develop itself and it led into the decline in other sectors of economy, because of the movement resource effect. Despite of this, the realization of the possible future problem came quickly and therefore revenues from oil and gas sector managed to be constant and therefore rising dependence on the segment did not occurred, as well as the movement of employees stayed moderate. Consequently, Larsen (2004) concluded that even that the petroleum sector is the essential part of the economic performance; Norway has not been the regular example of a country suffered from Dutch Disease, which supported our research, as we did not confirm that the real appreciation is influenced by the oil price as in our time series regression analysis was not denoted as the significant determinant.

Moreover, the absolute de-industrialization is not present as well as the manufacturing growth is not negative. However, the possibility of the relative de-industrialization presence is not excluded, as the output from manufacturing is rising slowly and even in slower pace than in other neighboring countries e.g. Sweden. Also the employment in this sector is moderately decreasing, which might be a sign of the relative de-industrialization; however, the more detailed research in terms of e.g. pannel data anlysis would be needed to confirm or deny it. The rising wage level is also present, as we investigated the trend of the wages and salaries per hour in all three specified sectors. Moreover, the relationship between wage level and oil price was found, however, Norway has been using centralized wage formation system to regulate the rise of the wages, so the increase could be caused by the inter-equalization. We understood that the oil cannot be the only determinant of the wages and therefore, we cannot say that it is the effect of the Dutch Disease as further investigation is needed, e.g. by the pannel data study as in the case of the symptom 2.

In addition, the research of the potential threat – the Dutch Disease on the individual counties of Rogaland, Hordaland and Oslo supported by the overall economic performance of Norway was analysed. It was found out that in generally, the manufacturing output is growing more slowly, as well as the employment in this sector is declining and rising wage level might be present. However, the research is limited by the not sufficient data availability.

Larsen (2004) proposed the policies and tools by which Norway could manage the movement resource, spending and spillover-loss effect. First of all, by the centralized wage and salary system, which helped to regulate the income in order to tame the petroleum effect on other sectors. Secondly, the tight fiscal policy and creation of the Government Pension Fund Global to which the revenues from oil and gas industry flow into. Also development of the education and research in the petroleum issues helped to nurture their own specialists and trained people instead of employing foreign specialists, which forego to spillover-loss and movement resource effect. Last but not least, holding varied exports, and control the growth of the industrial activities.

9 Conclusion

The thesis main objective, to investigate whether Norway has been suffering from the Dutch Disease, is analysed by examining of the presence of main symptoms in their overall economic performance as well as in the individual regions of Rogaland, Hordaland and Oslo. First symptom, appreciation of the REER due to the booming petroleum industry, was inspected. The hypothesis might be denied as the oil price was not found as one of the significant determinant of the REER in time series regression and so we cannot stated, that the rising level of REER is caused by the booming petroleum sector.

The second symptom, increasing wage level was found as present in the Norway economy. The relationship between wages and salaries in all three specified sectors and oil price was explored and we the positive linear relationship and strong correlation among them through time series regression was found out. However, the hypothesis that the petroleum industry is primarily responsible for it due to the movement resource or spending effect and cannot be confirmed as the wages are determined by more variables then just oil price and further research is needed to be done. Moreover, Norway has been using centralized wage and salary system to avoid the overall oil effect in remuneration system, which can indicate that other determinants might be in play.

Thirdly, the de-industrialization was observed and tested through the time series regression, for petroleum, manufacturing and tertiary sectors output, as well as for the employment trends in these segments. The absolute de-industrialization was not found, as the growth of the manufacturing sector is not negative. However, relative one might be present, as the manufacturing output is growing more slowly than in the case of the other sectors, especially services, which experienced rapid growth in output and rising trend in employment. Moreover, the growth of the manufacturing value added is lower than in neighbouring countries, particularly Sweden, Finland and Denmark, although, the output growth in Denmark is similar, which might be caused by the comparable development of the petroleum sector.

Furthermore, the thesis analysed the presence of the Dutch Disease symptoms in particular counties, for which it may be the threat, as the petroleum sector is concentrated there. First of all, we investigated the region Rogaland, with the administrative centre in Stavanger as most of the onshore activities and also employment related to the petroleum industry is located here. It is followed by the Hordaland, which is also significantly engaged in the extraction of the petroleum resources. Lastly we analysed the output and employment in Oslo, as it possesses engineering expertise and seismic companies. In case of Rogaland, the total manufacturing output through the years 2008-2014 is not negative, but has slightly increasing trend from the year 2009. However, in comparison to the petroleum and tertiary sector, the manufacturing is growing slower. On the other hand, the employment is decreasing moderately, however it still employs more people than in case of petroleum industry. In Hordaland, the manufacturing output is slightly increasing and is higher than in petroleum industry, although in comparison to the tertiary sector is increasing in slower pace. The employment in manufacturing has slightly decreasing trend, on the other side, tertiary sector employs more and more people. In case of petroleum industry in Oslo, the output in petroleum industry is and should be lower than the output of the manufacturing and services, simply because the oil and gas extraction is not one of the main domains of Oslo as it mainly provides the technological solutions, but not the exploitation itself. The employment in manufacturing is for the observed period higher than in case of petroleum industry, but from the year 2009 is slowly decreasing. In case of tertiary sector, its employment is rising.

The second symptom, rising wage level is present in the economic performance of the regions, as well as in the case of the overall economy. In conclusion, the particular analysed regions showed the same trend as the whole economy. The country might not suffer from the Dutch Disease, as according to our time series regression, the REER is not dependent on the oil price, the manufacturing output is not crowded out as well as the employment is not significantly decreasing in case of manufacturing. However, the tertiary sector shows better performance, both in the output and the employment; however it could not be said that this is caused particularly by the Dutch Disease. The overall level of wages and salaries is increasing; moreover, the regression shows the correlation and positive linear relationship with the oil price. Anyhow, we could not state, that the Dutch Disease is the cause, as the wages models are influenced by also other determinants, not just oil and further research, which is beyond the scope of this thesis, is needed.

Our results correspond to the other researches outcome related to the topic, even the methods differ as mostly, the BEER method, cointegration is used to determine the long-term relationship. The thesis remains open the possibility to explore the issue more deeply, as the wages determinants, but also manufacturing output and employment, their relationship and dependence on the oil price can be analysed in more details and the panel method applicated.

10 Resources

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11 List of Figures

12 List of Tables

13 List of Abbreviations

CD	Compact Disk
ECU	European Currency Unit
EEA	European Economic Area
EFTA	European Free Trade Association
e.g.	For example
EMS	European Monetary System
EU	European Union
Fig.	Figure
GOVS	Government spending
Gov. spending	Government spending
IMF	International Monetary Fund
LCU	Local constant unit
OLS	Ordinary least squares method
OPEC	The Organization of the Petroleum Exporting Countries
REER	Real effective exchange rate
Rev.	Revision
SDFI	State's Direct Financial Interest
Std. error	Standart error
TOT	Terms of Trade

Enclosures

A Empirical analysis of Symptom 1

Tab. 7 Reset test for Model 1

RESET test	T statistic	P-value
Squares	1.186095	0.287
Cubes	1.194322	0.285
Squares and cubes	0.643314	0.535

Tab. 8 OLS method for Model 1

Model 1: OLS, using observations 1990-2009 (T=30)					
Dependent variable: REER HAC standard errors, bandwidth 2, Bartlett kernel					
	coefficient	std. error	t-ratio	p-value	
constant	107.769	2.98735	36.08	4.40E-23	***
Openness	-7.17306	2.6618	-2.695	0.0124	**
Real interest rate	0.347182	0.110311	3.147	0.0042	***
GDP	-4.58E-12	2.19E-12	-2.092	0.0467	**
Deficit	7.33E-12	1.06E-11	0.6948	0.4936	
Mean dependent variable	95.58275		S.D dependent variable	3.668931	
Sum squared residuals	172.6559		S.E. of regression	2.627972	
R^2	0.557713		R^2_{adj}	0.486947	
F (4,25)	7.881084		P-value (F)	0.000297	
Log-likehood	-68.72971		Akaike criterion	147.6394	
Schwarz criterion	154.6454		Hannah-Quinn	149.8807	
rho	0.358404		Durbin-Watson	1.176492	

Tab. 9 ANOVA table for Model 1

Source of variability	Sum of squares	Degrees of freedom	Mean squares	$F_{empirical}$	$F_{critical}$ $1\text{-}\alpha;(4,25)$
RSS	217.715	4	54.4286	7.88108	2.7587
ESS	172.656	25	6.90624		
TSS	390.37	29	13.4611		

Tab. 10 Correlation matrix for Model 1

Correlation matrix				
	REER	**Interest Rate**	**Deficit/ Surplus**	**GDP**
REER	1	0.2131	0.0201	-0.3186
Interest Rate		1	-0.5575	-0.4215
Deficit/Surplus			1	0.8142
GDP				1

Tab. 11 Econometric testing for Model 1

Test	Statistics	P value	Conclusion
Linear test (squares)	1.28989	0.863089	Model is correctly specified
Linear test (logarithm)	0.32322	0.850773	Model is correctly specified
Breush-Pagan test	0.347563	0.986541	Homoscedasticity
Test of good fit	0.068	0.96647	Normal distribution
Durbin-Watson test	1.17649	0.00132071	Possible serial correlation

Tab. 12 OLS medhod for model of symptom 1

	P-value	RESET test	ANOVA table	R^2	R^2_{adj}
Model 2		correctly specified	correctly specified	60.92%	50.72%
Constant	***				
Oil price					
Gov spending					
Deflator					
Openness	**				
Real interest rate	**				
Deficit					
GDP	**				
Model 3		correctly specified	correctly specified	60.58%	50.30%
Constant	***				
Gov spending					
Deflator					
Openness	***				
Real interest	*				
Deficit					
GDP	**				
Model 4		correctly specified	correctly specified	54.91%	49.71%
Constant	***				
Openness	***				
Real interest rate	***				
GDP	***				

B Empirical analysis of Symptom 2

B.1. Wages in petroleum sector vs. oil price

Tab. 13 Reset test for model Wages in petroelum sector

RESET test	T-statistic	P-value
Squares	0.057420	0.812
Cubes	0.177193	0.677
Squares and Cubes	2.463383	0.101

Tab. 14 OLS method for model Wages in petroleum sector

Model 2: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Wage per hour in petroleum industry (in NOK) HAC standard errors, bandwidth 2 (Bartlett kernel)					
	coefficient	std. error	t-ratio	p-value	
constant	135.987	38.6522	3.518	0.0013	***
Global oil price	5.17191	0.514325	10.06	1.01E-11	***
Mean dependent variable	349.8711		S.D dependent variable	180.1319	
Sum squared residuals	402156.4		S.E. of regression	108.7572	
R^2	0.645884		R^2_{adj}	0.635469	
F (1,34)	101.1177		P-value (F)	1.01E-11	
Log-likehood	-218.8612		Akaike criterion	441.7224	
Schwarz criterion	444.8894		Hannah-Quinn	442.8277	
rho	0.788801		Durbin-Watson	0.456895	

Tab. 15 ANOVA table for model Wages in petroleum industry

Source of variability	Sum of squares	Degrees of freedom	Mean squares	$F_{empirical}$	$F_{critical}$ 1-α;(1,34)
RSS	733506	1	733506	62.0137	4.130
ESS	402156	34	11828.1		
TSS	1.13566e+006	35	32447.5		

Tab. 16 Econometric tests for model Wages in petroleum sector

Test	Statistics	P value	Conclusion
Linear test (squares)	0.0625309	0.80254	Model is correctly specified
Linear test (logarithm)	0.21433	0.643395	Model is correctly specified
Breush-Pagan test	6.213656	0.956697	Homoscedasticity
Test of good fit	5.398	0.06728	Normal distribution
Durbin-Watson test	0.456895	4.2862e-009	Serial correlation

B.2. Wages in manufacturing vs. oil price

Tab. 17 Reset test for model Wages in manufacturing

RESET test	T-statistic	P-value
Squares	0.067319	0.797
Cubes	0.184061	0.671
Squares and Cubes	2.43962	0.103

Tab. 18 OLS method for model Wages in manufacturing

Model 3: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Wage per hour in manufacturing (in NOK) HAC standard errors, bandwidth 2 (Bartlett kernel)					
	coefficient	std. error	t-ratio	p-value	
constant	151.959	32.6544	4.654	4.81E-05	***
Global oil price	4.80513	0.656781	7.316	1.78E-08	***
Mean dependent variable	350.6746		S.D dependent variable	171.9915	
Sum squared residuals	402181		S.E. of regression	108.7605	
R^2	0.611546		R^2_{adj}	0.600121	
F (1,34)	53.52648		P-value (F)	1.78E-08	
Log-likehood	-218.8623		Akaike criterion	441.7246	
Schwarz criterion	444.8916		Hannah-Quinn	442.8299	
rho	0.813603		Durbin-Watson	0.384699	

Tab. 19 ANOVA table for model Wages in manufacturing

Source of variability	Sum of squares	Degrees of freedom	Mean squares	$F_{empirical}$	$F_{critical}$ $1\text{-}\alpha;(1,34)$
RSS	633157	1	633157	53.5265	4.130
ESS	402181	34	11828.9		
TSS	1.03534e+006	35	29581.1		

Tab. 20 Econometric tests for model Wages in manufacturing 0.384699

Test	Statistics	P value	Conclusion
Linear test (squares)	0.0732898	0.786606	Model is correctly specified
Linear test (logarithm)	0.189273	0.663522	Model is correctly specified
Breush-Pagan test	0.751485	0.100288	Homoscedasticity
Test of good fit	2.049	0.35901	Normal distribution
Durbin-Watson test	0.384699	1.80577e-009	Possibility of serial correlation

B.3. Wages in energy, gas, steam vs. oil price

Tab. 21 Reset test for model Wages in energy, gas, steam

RESET test	T-statistic	P-value
Squares	0.357447	0.554
Cubes	0.646495	0.427
Squares and Cubes	2.889326	0.0702

Tab. 22 OLS method for model Wages in energy, gas and steam

Model 4: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Wage per hour in electricity, gas and steam (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	122.861	36.5031	3.366	0.0019	***
Global oil price	6.19922	0.73419	8.444	7.35E-10	***
Mean dependent variable	379.2296		S.D dependent variable	210.8767	
Sum squared residual	502571.9		S.E. of regression	121.5793	
R^2	0.677096		R^2_{adj}	0.667599	
F (1,34)	71.29461		P-value (F)	7.35E-10	
Log-likehood	-222.8733		Akaike criterion	449.7467	
Schwarz criterion	452.9137		Hannah-Quinn	450.8521	
rho	0.758644		Durbin-Watson	0.512216	

B.4. Wages in watersupply, sewerage, waste vs. oil price

Tab. 23 RESET test for model Wages in watersupply, sewerage and waste

RESET test	T-statistic	P-value
Squares	0.061533	0.806
Cubes	0.179210	0.675
Squares and Cubes	2.523057	0.0961

Tab. 24 OLS method for model Wages in watersupply, sewerage and waste

Model 5: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Wage per hour in water supply, sewerage and waste (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	142.997	30.8529	4.635	5.08E-05	***
Global oil price	4.75631	0.620548	7.665	6.55E-09	***
Mean dependent variable	339.6943		S.D dependent variable	167.2798	
Sum squared residual	359030.9		S.E. of regression	102.7606	
R^2	0.633413		R^2_{adj}	0.622631	
F (1,34)	58.7475		P-value (F)	6.55E-09	
Log-likehood	-216.8194		Akaike criterion	437.6388	
Schwarz criterion	440.8058		Hannah-Quinn	438.7442	
rho	0.793307		Durbin-Watson	0.431243	

B.5. Wages in construction vs. oil price

Tab. 25 RESET test for model Wages in construction

RESET test	T-statistic	P-value
Squares	0.123555	0.727
Cubes	0.259752	0.614
Squares and Cubes	2.440857	0.103

Tab. 26 OLS method for model Wage per hour in construction

Model 6: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Wage per hour in construction (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	143.885	25.8045	5.576	3.06E-06	***
Global oil price	3.82901	0.519009	7.378	1.49E-08	***
Mean dependent variable	302.2337		S.D dependent variable	136.6113	
Sum squared residual	251148		S.E. of regression	85.94595	
R^2	0.615507		R^2_{adj}	0.604199	
F (1,34)	54.42819		P-value (F)	1.49E-08	
Log-likehood	-210.3868		Akaike criterion	424.7736	
Schwarz criterion	427.9407		Hannah-Quinn	425.879	
rho	0.803081		Durbin-Watson	0.39017	

B.6. Wages in wholesale, retail trade and repair of motor vehicles vs. oil price

Tab. 27 RESET test for model Wages in wholesale, retail trade and repair of motor vehicles

RESET test	T-statistic	P-value
Squares	0.107478	0.745
Cubes	0.247243	0.622
Squares and Cubes	2.509550	0.0972

Tab. 28 OLS method for model Wages in Wholesela, retail trade and repair of motor vehicles

Model 7: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Wage per hour in wholesale and retail activities (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	161.571	34.8355	4.638	5.04E-05	***
Global oil price	4.96946	0.700651	7.093	3.41E-08	***
Mean dependent variable	367.0828		S.D dependent variable	180.072	
Sum squared residual	457703.1		S.E. of regression	116.0252	
R^2	0.596704		R^2_{adj}	0.584843	
F (1,34)	50.30543		P-value (F)	3.41E-08	
Log-likehood	-221.19		Akaike criterion	446.38	
Schwarz criterion	449.5471		Hannah-Quinn	447.4854	
rho	0.820933		Durbin-Watson	0.356463	

B.7. Wages in transport via pipelines vs. oil price

Tab. 29 RESET test for model Wages in transport via pipelines

RESET test	T-statistic	P-value
Squares	0.360922	0.552
Cubes	0.434099	0.515
Squares and Cubes	1.641136	0.21

Tab. 30 OLS method for model Wages in transport via pipelines

Model 8: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Transport via pipelines (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	149.54	15.1311	9.883	1.58E-11	***
Global oil price	0.991771	0.304334	3.259	2.50E-03	***
Mean dependent variable	190.5552		S.D dependent variable	56.90253	
Sum squared residual	86353.72		S.E. of regression	50.39658	
R^2	0.238009		R^2_{adj}	0.215598	
F (1,34)	10.61995		P-value (F)	2.54E-03	
Log-likehood	-191.1702		Akaike criterion	386.3404	
Schwarz criterion	389.5074		Hannah-Quinn	387.4457	
rho	0.887538		Durbin-Watson	0.180911	

B.8. Wages in ocean transport vs. oil price

Tab. 31 RESET test for model Wages in ocean transport

RESET test	T-statistic	P-value
Squares	1.017780	0.32
Cubes	1.103299	0.301
Squares and Cubes	1.013347	0.374

Tab. 32 OLS method for model of Ocean transport

Model 9: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Ocean transport (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	124.652	7.83948	15.9	2.60E-17	***
Global oil price	1.03694	0.157676	6.576	1.55E-07	***
Mean dependent variable	167.5342		S.D dependent variable	38.79076	
Sum squared residual	23180.01		S.E. of regression	26.11063	
R^2	0.559862		R^2_{adj}	0.546917	
F (1,34)	43.24862		P-value (F)	1.55E-07	
Log-likehood	-167.4973		Akaike criterion	338.9945	
Schwarz criterion	342.1616		Hannah-Quinn	340.0999	
rho	0.750366		Durbin-Watson	0.440596	

B.9. Wages in transport excluding ocean transport vs. oil price

Tab. 33 RESET test for model Wages in transport excluding ocean transport

RESET test	T-statistic	P-value
Squares	0.178794	0.675
Cubes	0.372265	0.546
Squares and Cubes	2.802241	0.0756

Tab. 34 OLS method for model Wages in transport excluding oceant transport

Model 10: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Transport activities excluding ocean transport (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	139.395	31.7204	4.395	1.00E-04	***
Global oil price	5.06099	0.637995	7.933	3.06E-09	***
Mean dependent variable	348.6923		S.D dependent variable	175.8151	
Sum squared residual	379503		S.E. of regression	105.6497	
R^2	0.64922		R^2_{adj}	0.638903	
F (1,34)	62.92685		P-value (F)	3.06E-09	
Log-likehood	-217.8176		Akaike criterion	439.6351	
Schwarz criterion	442.8022		Hannah-Quinn	440.7405	
rho	0.784892		Durbin-Watson	0.427772	

B.10. Wages in postal and courier services vs. oil price

Tab. 35 RESET test for model Wages in postal and courier services

RESET test	T-statistic	P-value
Squares	0.118536	0.733
Cubes	0.272388	0.605
Squares and Cubes	2.71633	0.0814

Tab. 36 OLS method for model Wages in postal and courier services

Model 11: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Postal and courier activities (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	142.721	29.2235	4.884	2.43E-05	***
Global oil price	4.55318	0.587776	7.746	5.19E-09	***
Mean dependent variable	331.0175		S.D dependent variable	159.5182	
Sum squared residual	322110.3		S.E. of regression	97.33362	
R^2	0.638327		R^2_{adj}	0.627689	
F (1,34)	60.00751		P-value (F)	5.19E-09	
Log-likehood	-214.8661		Akaike criterion	433.7323	
Schwarz criterion	436.8993		Hannah-Quinn	434.8377	
rho	0.78359		Durbin-Watson	0.433109	

B.11. Wages in accomodation and food services vs. oil price

Tab. 37 RESET test for model Wages in accomodation and food

RESET test	T-statistic	P-value
Squares	0.122353	0.729
Cubes	0.242491	0.626
Squares and Cubes	2.246402	0.122

Tab. 38 OLS method for model Accomodation and food

Model 12: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Accommodation and food (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	185.993	32.8159	5.668	2.33E-06	***
Global oil price	4.22449	0.660029	6.4	2.61E-07	***
Mean dependent variable	360.6964		S.D dependent variable	159.96	
Sum squared residual	406168.6		S.E. of regression	109.2984	
R^2	0.54646		R^2_{adj}	0.533121	
F (1,34)	40.96585		P-value (F)	2.61E-07	
Log-likehood	-219.0399		Akaike criterion	442.0797	
Schwarz criterion	445.2468		Hannah-Quinn	443.1851	
rho	0.829838		Durbin-Watson	0.298279	

B.12. Wages in information and communication vs. oil price

Tab. 39 RESET test for model Wages in information and communication

RESET test	T-statistic	P-value
Squares	0.122363	0.729
Cubes	0.278038	0.602
Squares and Cubes	2.234371	0.124

Tab. 40 OLS method for model Wages in information and communication

Model 12: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Information and communication (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	141.446	37.95	3.727	7.00E-04	***
Global oil price	5.91891	0.763292	7.754	5.07E-09	***
Mean dependent variable	386.2226		S.D dependent variable	207.2885	
Sum squared residual	543202.3		S.E. of regression	126.3983	
R^2	0.638804		R^2_{adj}	0.62818	
F (1,34)	60.13165		P-value (F)	5.07E-09	
Log-likehood	-224.2727		Akaike criterion	452.5454	
Schwarz criterion	455.7125		Hannah-Quinn	453.6508	
rho	0.806395		Durbin-Watson	0.419118	

B.13. Wages in financial and insurence services vs. oil price

Tab. 41 RESET test for model Wages in financial and insurence services

RESET test	T-statistic	P-value
Squares	0.197921	0.659
Cubes	0.430170	0.516
Squares and Cubes	2.713630	0.0815

Tab. 42 OLS method for model Wages in financial and insurance services

Model 13: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Financial and insurance services (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	115.131	39.2547	2.933	6.00E-03	***
Global oil price	6.85645	0.789533	8.684	3.80E-10	***
Mean dependent variable	398.68		S.D dependent variable	231.167	
Sum squared residual	581194		S.E. of regression	130.7438	
R^2	0.689257		R^2_{adj}	0.680117	
F (1,34)	75.41515		P-value (F)	3.80E-10	
Log-likehood	-225.4896		Akaike criterion	454.9791	
Schwarz criterion	458.1462		Hannah-Quinn	456.0845	
rho	0.79499		Durbin-Watson	470918	

B.14. Wages in real estate services vs. oil price

Tab. 43 RESET test for model Wages in real estate services

RESET test	T-statistic	P-value
Squares	0.119831	0.731
Cubes	0.283228	0.598
Squares and Cubes	2.380508	0.109

Tab. 44 OLS method for model Real estate services

Model 14: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Real estate services (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	128.629	35.2953	3.644	9.00E-04	***
Global oil price	5.72825	0.709899	8.069	2.09E-09	***
Mean dependent variable	365.5204		S.D dependent variable	197.8213	
Sum squared residual	469865.5		S.E. of regression	11.5567	
R^2	0.656948		R^2_{adj}	0.646859	
F (1,34)	65.11043		P-value (F)	2.09E-09	
Log-likehood	-221.6621		Akaike criterion	447.3242	
Schwarz criterion	450.4912		Hannah-Quinn	48.4295	
rho	0.802165		Durbin-Watson	0.453492	

B.15. Wages in proffessional, scientific and technical services vs. oil price

Tab. 45 RESET test for model Wages in proffessional, scientific and technical services

RESET test	T-statistic	P-value
Squares	0.084694	0.773
Cubes	0.217225	0.644
Squares and Cubes	2.351144	0.112

Tab. 46 OLS method for model Wages in proffessional, scientific and technical services

Model 15: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Proffessional, scientific services (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	147.83	35.4331	4.172	2.00E-04	***
Global oil price	5.41886	0.71267	7.604	7.80E-09	***
Mean dependent variable	371.9269		S.D dependent variable	191.1445	
Sum squared residual	473541.1		S.E. of regression	118.0156	
R^2	0.629689		R^2_{adj}	0.618798	
F (1,34)	57.81481		P-value (F)	7.80E-09	
Log-likehood	-221.8023		Akaike criterion	447.6047	
Schwarz criterion	450.7717		Hannah-Quinn	448.7101	
rho	0.810369		Durbin-Watson	0.4036	

B.16. Wages in administrative and support services vs. oil price

Tab. 47 RESET test for model Wages in administrative and suport services

RESET test	T-statistic	P-value
Squares	0.070883	0.792
Cubes	0.159979	0.692
Squares and Cubes	1.861640	0.172

Tab. 48 OLS method for model Wages in administrative and support services

Model 16: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Administrative and support services (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	171.918	30.9203	5.56	3.21E-06	***
Global oil price	4.05173	0.621904	6.515	1.86E-07	***
Mean dependent variable	339.4773		S.D dependent variable	152.2008	
Sum squared residual	360601.2		S.E. of regression	102.985	
R^2	555241		R^2_{adj}	0.54216	
F (1,34)	42.44586		P-value (F)	1.86E-07	
Log-likehood	-216.8979		Akaike criterion	437.7959	
Schwarz criterion	440.9629		Hannah-Quinn	438.9013	
rho	0.835162		Durbin-Watson	0.312858	

B.17. Wages in public administration and defence vs. oil price

Tab. 49 RESET test for model Wages in public administration and defence

RESET test	T-statistic	P-value
Squares	0.211653	0.648
Cubes	0.427208	0.518
Squares and Cubes	2.639285	0.0869

Tab. 50 OLS method for model Public administration and defence

Model 17: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Public administration and defence services (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	124.325	33.3167	3.732	7.00E-04	***
Global oil price	5.55296	0.670102	8.287	1.14E-09	***
Mean dependent variable	353.9674		S.D dependent variable	190.0551	
Sum squared residual	418660.8		S.E. of regression	110.9664	
R^2	0.668842		R^2_{adj}	0.659102	
F (1,34)	68.67		P-value (F)	1.14E-09	
Log-likehood	-219.5851		Akaike criterion	443.1703	
Schwarz criterion	446.3373		Hannah-Quinn	444.2757	
rho	0.782159		Durbin-Watson	0.468707	

B.18. Wages in education vs. oil price

Tab. 51 RESET test for model Wages in education

RESET test	T-statistic	P-value
Squares	0.149609	0.701
Cubes	0.311982	0.58
Squares and Cubes	2.591792	0.0905

Tab. 52 OLS method for model Wages in education

Model 18: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Education (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	141.077	28.3556	4.975	1.85E-05	***
Global oil price	4.37505	0.57032	7.671	6.43E-09	***
Mean dependent variable	322.007		S.D dependent variable	153.8227	
Sum squared residual	303261.5		S.E. of regression	94.44287	
R^2	0.633808		R^2_{adj}	0.623038	
F (1,34)	58.84758		P-value (F)	6.43E-09	
Log-likehood	-213.7808		Akaike criterion	431.5615	
Schwarz criterion	434.7286		Hannah-Quinn	432.6669	
rho	0.796649		Durbin-Watson	0.41291	

B.19. Wages in health care and social work vs. oil price

Tab. 53 RESET test for model Wages in health care and social work

RESET test	T-statistic	P-value
Squares	0.127456	0.723
Cubes	0.272940	0.605
Squares and Cubes	2.301794	0.116

Tab. 54 OLS method for model Wages in health care and social work

Model 19: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Health and social work services (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	150.164	32.4228	4.631	5.14E-05	***
Global oil price	4.84668	0.652123	7.432	1.28E-08	***
Mean dependent variable	350.5988		S.D dependent variable	172.4325	
Sum squared residual	396497		S.E. of regression	107.9892	
R^2	0.618992		R^2_{adj}	0.607786	
F (1,34)	55.23703		P-value (F)	1.25E-08	
Log-likehood	-218.6061		Akaike criterion	441.2121	
Schwarz criterion	444.3792		Hannah-Quinn	442.3175	
rho	0.811155		Durbin-Watson	0.393626	

B.20. Wages in art, entertainment and other services vs. oil price

Tab. 55 RESET test for model Wages in art, enterteinment and other services

RESET test	T-statistic	P-value
Squares	0.108690	0.744
Cubes	0.240844	0.627
Squares and Cubes	2.257764	0.121

Tab. 56 Table 1 OLS method for model Wages in art, entertainment and other services

Model 20: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Arts, entertainment services (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	149.943	30.887	4.855	2.65E-05	***
Global oil price	4.57916	0.621233	7.371	1.52E-08	***
Mean dependent variable	339.3136		S.D dependent variable	163.4302	
Sum squared residual	359823.1		S.E. of regression	102.8739	
R^2	0.615092		R^2_{adj}	0.603771	
F (1,34)	54.33285		P-value (F)	1.52E-08	
Log-likehood	-216.8591		Akaike criterion	4377181	
Schwarz criterion	440.8852		Hannah-Quinn	438.8235	
rho	0.813747		Durbin-Watson	0.385507	

B.21. Wages in Mainland Norway vs. oil price

Tab. 57 RESET test for model Wagesn in Mainland Norway

RESET test	T-statistic	P-value
Squares	0.127035	0.724
Cubes	0.281149	0.599
Squares and Cubes	2.459154	0.102

Tab. 58 OLS method for model Wages in Mainland Norway

Model 21: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Mainland Norway (in NOK)					
	coefficient	std. error	t-ratio	p-value	
constant	145.769	32.6361	4.466	8.35E-05	***
Global oil price	4.97838	0.656412	7.584	8.25E-09	***
Mean dependent variable	351.6497		S.D dependent variable	175.7732	
Sum squared residual	401729.9		S.E. of regression	108.6995	
R^2	0.628498		R^2_{adj}	0.617572	
F (1,34)	57.52046		P-value (F)	8.25E-09	
Log-likehood	-218.8421		Akaike criterion	441.6842	
Schwarz criterion	444.8512		Hannah-Quinn	442.7895	
rho	0.804786		Durbin-Watson	0.403081	

C Empirical analysis of Symptom 3

Tab. 59 RESET test for model of symptom 3

RESET test	T-statistic	P-value
Squares	0.442648	0.51
Cubes	0.506907	0.481
Squares and Cubes	2.246276	0.122

Tab. 60 OLS method for model of symptom 3

Model 1: OLS, using observations 1980-2015 (T=36)					
Dependent variable: Manufacturing output (in NOK) HAC standard errors, bandwidth 2 (Bartlett kernel)					
	coefficient	std. error	t-ratio	p-value	
constant	142.949	3.72138	38.41	1.35E-29	***
Global oil price	0.586629	0.0561653	10.44	3.78E-12	***
Mean dependent variable	167.2091		S.D dependent variable	19.01071	
Sum squared residual	3212.369		S.E. of regression	9.720157	
R^2	0.746043		R^2_{adj}	0.738573	
F (1,34)	109.0914		P-value (F)	3.78E-12	
Log-likehood	-131.9242		Akaike criterion	267.8484	
Schwarz criterion	271.0154		Hannah-Quinn	268.9538	
rho	0.836604		Durbin-Watson	0.44617	

Tab. 61 ANOVA table for model of symptom 3

Source of variability	Sum of squares	Degrees of freedom	Mean squares	$F_{empirical}$	$F_{critical}$ 1-α;(1,34)
RSS	9436.88	1	9436.88	99.8808	4.130
ESS	3212.37	34	94.4815		
TSS	12649.3	35	361.407		

Tab. 62 Econometric verification for model of symptom 3

Test	Statistics	P value	Conclusion
Linear test (squares)	0.476497	0.490013	Model is correctly specified
Linear test (logarithm)	0.0143465	0.90466	Model is correctly specified
Breush-Pagan test	0.149177	0.699323	Homoscedasticity
Test of good fit	1.830	0.40058	Normal
Durbin-Watson test	0.44617	4.25432e-009	Possible serial correlation

D Regions

Tab. 63 Wages and salaries in Electricity, gas and water supply sector

Electricity, gas and water supply			
County	**2004**	**2005**	**2006**
Oslo og Akershus	124.7	184.4	184.5
Agder og Rogaland		90.3	108.6
Hedmark og Oppland	59.4	58.8	73
Sør-Østlandet		79.3	90.9
Vestlandet		151.9	167.5
Trøndelag		92.9	94.6
Nord-Norge		91.7	97.7

Source: Eurostat

Tab. 64 Wages and salaries in Construction section

Construction										
County	**1995**	**1996**	**1997**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Oslo og Akershus	593.8	669.6	848.8	1,004.90	1,056.20	1,168.10	1,212.30	1,147.20	1,346.50	1,525.90
Agder og Rogaland	329.4	325.2	408.8	508.6	548.7	630	638.8	666.5	772.5	889.1
Hedmark og Oppland	131	151.6	200.3	265.2	287.5	320.3	315.7	328	373.1	399.6
Sør-Østlandet	379.7	444.6	557	721.9	799.7	898.6	848.7	857.8	1,009.40	1,171.90
Vestlandet	386.3	407.2	500.9	605.2	634.5	717.3	756.6	754.6	878.4	1,001.70
Trøndelag	172.2	207.3	270.1	317.2	346.1	393.2	422.3	444	485.2	537.9
Nord-Norge	190.6	200.6	278.2	328	356.5	399.2	419.2	450.8	504.3	551.3

Source: Eurostat

Tab. 65 Wages and salaries in wholesale and retail trade, repair of vehicles, motorcycles and personal and household goods

Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods										
County	**1995**	**1996**	**1997**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Oslo og Akershus	2,351.10	2,478.00	2,786.50	3,408.00	3,558.30	3,847.50	3,662.20	3,680.30	3,972.40	4,116.90
Agder og Rogaland	668.9	736.4	809.1	994.1	1,012.00	1,109.30	1,083.10	1,102.30	1,233.50	1,328.10
Hedmark og Oppland	330.9	363.8	395.7	480.3	505.5	546.5	526.1	535.9	595.4	621.8
Sør-Østlandet	942.4	1,053.00	1,150.90	1,453.40	1,517.10	1,669.40	1,586.60	1,601.00	1,784.20	1,913.80
Vestlandet	767.4	859	940.2	1,152.60	1,199.60	1,299.90	1,247.30	1,265.00	1,400.50	1,489.00
Trøndelag	423.8	457.6	484.6	588.2	617.7	669.3	656.1	666.5	731.3	766.7
Nord-Norge	414.4	457.3	513.2	618.2	635.2	685.4	662.9	661.3	736.4	768.8

Source: Eurostat

Tab. 66 Wages and salaries in hotels and restaurants sector

Hotels and restaurants						
County	**2000**	**2002**	**2003**	**2004**	**2005**	**2006**
Oslo og Akershus	426.5	496.7	466.4	456.3	498.3	539.6
Agder og Rogaland	189.1	199.3	195	187.3	194.7	225.9
Hedmark og Oppland	106.9	120.1	109.8	109.1	118.7	123.9
Sør-Østlandet	195.9	221.5	211.5	205.4	221.3	238.8
Vestlandet	234.3	246.6	243.7	232.3	249.9	267.7
Trøndelag	106.8	121.6	118.7	121.7	130	136.8
Nord-Norge	179.9	228.5	203.4	193.2	224.4	235.1

Source: Eurostat

Tab. 67 Wages and salaries in transport, storage and communication sector

Transport, storage and communication						
County	**2000**	**2002**	**2003**	**2004**	**2005**	**2006**
Oslo og Akershus	1,933.90	2,598.70	2,470.50	2,272.50	2,265.70	2,412.30
Agder og Rogaland	473	705.7	602.6	642.7	712.6	803.8
Hedmark og Oppland			241.9	231.6	248.8	261.9
Sør-Østlandet		619.6	575.4	562	602.6	629.7
Vestlandet	703.8	1,063.30	945.1	905.5	1,008.10	1,112.00
Trøndelag	318.8	379	346.1	320.2	359.5	373.1
Nord-Norge	506.5		553.1	583.8	660.3	728.7

Source: Eurostat

Tab. 68 Wages and salaries in real estate, renting and business activities

Real estate, renting and business activities							
County	**1995**	**1996**	**2000**	**2003**	**2004**	**2005**	**2006**
Oslo og Akershus	1,632.50	1,870.70	3,893.00	3,960.60	3,972.70	4,484.30	5,191.60
Agder og Rogaland	413.3	466.6	766.4	943.2	937.8	1,133.10	1,412.50
Hedmark og Oppland	:	111.5	237.8	261.8	270.9	308.1	343.5
Sør-Østlandet	379.2	395	761.8	877.1	929.7	1,083.10	1,257.80
Vestlandet	365.5	386.7	772.7	912.9	934.3	1,106.40	1,331.90
Trøndelag	255.8	281.3	506.9	588.6	592.8	687.8	782.7
Nord-Norge	:	150.7	295.8	354.2	373	431.1	498.1

Source: Eurostat

E Correlation matrix for Symptom 2

Tab. 69 Correlation matrix for wholesale, retail and repair; transport via pipelines, ocean transport and transport exc. ocean transport

Wholesale, retail and repair	**Transport via pipelines**	**Ocel and transport**	**Transport exc. ocean transport**	
0.7725	0.4879	0.7482	0.8057	Global oil price
0.9909	0.8278	0.9358	0.9961	Electricity, gas and steam
0.9957	0.8498	0.9381	0.9975	Watersupply
0.9992	0.8737	0.9379	0.9988	Construction
1	0.8877	0.9357	0.9977	Wholesale, retail, repair
	1	0.8306	0.8581	Transport via pipelines
		1	0.939	Ocean transport
			1	Transport exc. Ocean transport

Tab. 70 Correlation matrix for real estate, professional, scientific and technical; administrative services and public aministrative and defence services

Real estate	Professional, scientific, technical	Administrative services	Public administration and defence	
0.8105	0.7935	0.7451	0.8178	Global oil price
0.9982	0.9964	0.9839	0.9987	Electricity, gas and steam
0.999	0.9994	0.9915	0.9987	Watersupply
0.9953	0.999	0.9964	0.9964	Construction
0.9923	0.9977	0.998	0.9939	Wholesale, retail, repair
0.8356	0.8605	0.9033	0.8385	Transport via pipelines
0.9402	0.9415	0.9403	0.9421	Ocean transport
0.9961	0.9987	0.9929	0.9982	Transport exc. Ocean transport
0.997	0.9992	0.9929	0.9984	Postal and courier services
0.9813	0.9903	0.9988	0.9835	Accomodation and food
0.9982	0.9995	0.993	0.9989	Info and communication
0.9985	0.9966	0.9829	0.9992	Financial and insurane
1	0.9982	0.9865	0.9992	Real estate
	1	0.994	0.9986	Professional, scientific, technical
		1	0.9879	Administrative services
			1	Public administration and defence

Tab. 71 Correlation matrix for postal and courier services, accomodation and food; info and communication and financial and insurance services

Postal and courier services	Accomodation and food	Info and communication	Financial and insurane	
0.799	0.7392	0.7993	0.8302	Global oil price
0.996	0.9801	0.996	0.9988	Electricity, gas and steam
0.9982	0.9873	0.9988	0.9969	Watersupply
0.9986	0.9944	0.9982	0.9939	Construction
0.9975	0.9968	0.9968	0.9909	Wholesale, retail, repair
0.8577	0.9139	0.8579	0.825	Transport via pipelines
0.9405	0.9331	0.9463	0.9361	Ocean transport
0.9994	0.9907	0.9986	0.9966	Transport exc. Ocean transport
1	0.9899	0.999	0.9967	Postal and courier services
	1	0.9888	0.9784	Accomodation and food
		1	0.9968	Info and communication
			1	Financial and insurane

Tab. 72 Correlation matrix for electricity, gas and steam; watersupply; construction services

Global oil price	Electricity, gas and steam	Watersupply	Construction
1	0.8229	0.7959	0.7845
	1	0.9978	0.9943
		1	0.9978
			1

Tab. 73 Correlation matrix for education, health care and social work; art, entertainment and others and Mainland Norway

Education	Health care and social work	Art, entertainment and others	Mainland Norway	
0.7961	0.7868	0.7843	0.7928	Global oil price
0.9965	0.9958	0.9953	0.9961	Electricity, gas and steam
0.9985	0.9989	0.9988	0.9989	Watersupply
0.9993	0.9993	0.9994	0.9995	Construction
0.9983	0.9984	0.9987	0.9986	Wholesale, retail, repair
0.8622	0.8683	0.8699	0.8656	Transport via pipelines
0.9389	0.9426	0.9414	0.9409	Ocean transport
0.9995	0.9985	0.9984	0.9993	Transport exc. Ocean transport
0.9992	0.9987	0.9986	0.9994	Postal and courier services
0.992	0.9927	0.9934	0.9922	Accomodation and food
0.9988	0.9992	0.9989	0.9994	Info and communication
0.9963	0.9953	0.9948	0.9961	Financial and insurane
0.9969	0.9972	0.9967	0.9973	Real estate
0.9994	0.9996	0.9996	0.9998	Professional, scientific, technical
0.9945	0.9957	0.9962	0.9951	Administrative services
0.9981	0.9977	0.9973	0.9982	Public administration and defence
1	0.9994	0.9995	0.9998	Education
	1	0.9999	0.9998	Health care and social work
		1	0.9998	Art, entertainment and others
			1	Mainland Norway