Eirik Rode Grorud
Gjermund Fredriksen

BI Norwegian Business School

Thesis

Has the Resource Curse hit Norway?

A Study of Break Points in Aggregate Economic Statistics for Three Scandinavian Countries

Date of Submission:
03.09.12

Supervisor:
Erling Røed Larsen

Campus:
BI Oslo

Examination Code and Name:
GRA 19003 Master Thesis

Programme:
Master of Science in Business and Economics
Major in Economics

Acknowledge

The master thesis is our final work and completes the period at BI Norwegian Business School.

We would first of all give our deepest gratitude to our supervisor Erling Røed Larsen for great guidance, motivational support, and important feedback in the process of writing the thesis.

Gratitude is also extended to Christian Emil Rode and Erlend Bendik Myhre for feedback and proofreading of the final product.

Lastly, we will express appreciation to both of our families for the support from the beginning to the end.

Oslo, September 3rd 2012

Gjermund Fredriksen

Eirik Rode Grorud

TABLE OF CONTENTS

Abstract

This thesis examines the possibility for a lurking slowdown in the Norwegian economy. Røed Larsen (2005) observed a possible relative deceleration in the Norwegian GDP per capita compared to the Scandinavian neighbors Sweden and Denmark. In order to analyze the previous results, we replicate and extend the work done by Røed Larsen (2005) with updated data and different variables. The findings in the time series regarding GDP per capita confirms both the structural break in the mid 1970's and the one in the late 1990's. We can also observe a trend in other variables confirming the thoughts from Røed Larsen (2005).

1.0 Introduction

It is conventional wisdom that countries with abundant natural resources are in luck, and will perform well economically. Surprisingly, it has been analyzed and shown empirically that countries rich on natural resources tend to grow slower than economies without (Sachs and Warner 2001). Nigeria, despite its oil wealth, has no higher gross national product (GNP) per capita today than in 1960. From 1968 to 1998, Iran and Venezuela experienced on average -1 percent GNP per capita growth, Libya -2 percent, Iraq and Kuwait -3 percent, and Qatar -6 percent (Gylfason 2001). Their bad performances may have arisen from the negative effects of natural riches on economic activity and policies. The phenomenon is called "The Resource Curse", which occurs when countries rich on natural resources perform worse economically than non-resource rich countries. However, there are countries, such as Norway, that have been able to escape the curse and make the findings of natural resources a blessing.

Erling Røed Larsen (2005) wanted to check if rich countries are immune to the resource curse, and tested the Norwegian economic performance after the country had discovered oil. He searched for structural breaks in time series consisting of the relative differences between Norway and Denmark and Norway and Sweden in gross domestic product (GDP) per capita. The results indicated a relative acceleration in the middle of the 1970's and a deceleration in the late 1990's in Norwegian GDP per capita compared to its neighbors Sweden and Denmark. His findings indicated that Norway escaped the curse for at least two decades, but there might be signs of a relative slowdown in the Norwegian economy. We want to continue the work done by Røed Larsen (2005), and apply the same structural break analysis on updated and larger data set, as well on other aggregate economic variables. This thesis will discuss the findings in relation to the theory on Dutch disease and resource curse.

The introduction will continue with a short presentation of our research question, general information on different aspects Norway needed to handle after the discovery of oil, and information on the magnitude of the revenues from the oil industry. The section on literature review contains general theory in the Dutch disease, the resources curse, and structural breaks. The section on data, PPP and empirical technique introduces the collection of data, the empirical framework, the different variables we will use, and some challenges with our statistics. Empirical findings will be presented in section 4. The section Discussion and perspective will discuss our findings with arguments that will both enhance and weaken the theory of a slowdown in the Norwegian economy. This section will also include some suggestions on why Norway has managed to escape the curse, this far. Section 6 will present a conclusion.

1.1 Research Question

This thesis will analyze the possibility for one or two structural breaks in key economic variables for Norway. The idea is to replicate and continue the work of Røed Larsen (2005) in order to confirm a structural break in the early 1970's, and to explore the possibilities for a second break in the 1990's. We will perform the same structural break technique on updated data and several other economic variables. Our research question is:

Did Norway experience a relative economic slowdown in the 1990's?

If the results indicate a downturn in the Norwegian economy, it is interesting to discuss if the findings can be explained by the theories of a resource curse and/or Dutch disease. Our research question is based on the premise, that countries with abundant natural resources will catch the resource curse and/or the Dutch disease, and on the work done by Røed Larsen (2005).

1.2 Background

Norway discovered oil for the first time on the 23rd of December 1969. This is known as an economic turning point for Norway, and the beginning of a new era. During the last few decades, Norway has grown to become one of the richest countries in the world. Early in the process, the Norwegian government decided to control the oil sector and those who participated in extracting the natural resource. Norwegian officials formed guidelines for international corporations that would secure the country's national interests, and one of the key features was the education of Norwegian workers, which enabled Norwegian companies to take over the production in the future.

The initial economic policy was to repay all debts, and as revenues grew, this was done in very few years. Moreover, the politicians realized the importance of restrictions for the use of money received from the oil industry. In 1982 they established a committee to explore all relevant circumstances that could affect further activity in the petroleum industry. Different policies have been implemented since the discovery of oil, and we have seen the establishing of the *Petroleum Fund*[1] in 1990, and the *Trading Rule*[2] in 2001.

From 2005 to 2010 the Norwegian government increased its use of revenues from the oil industry from 49 to 149 billion (NHO 2010) and the Government Pension Fund – Global holds assets worth approximately 625 billion dollar on the 31.08.12. The revenues from the oil extractions have reached an unimaginable level. There are researchers that argue that the trading rule has limited efficiency and is based on "old" assumptions. Bjørnland (2010) suggests a revision of the rule since four percent of the Government Pension Fund – Global is too much for the Norwegian economy to handle, and she fears the outburst of Dutch disease in Norway.

There are several examples of countries rich on natural resources besides oil and gas. For simplicity we call Norway an oil nation (e.g rich on oil), but other natural resources such as gas, gold, and minerals are common lucrative and major resources. One common factor that represents all these nations are that they, in some way, have to phase these major incomes to a tradable currency, and into their national economy. As the examples are many, so are the pitfalls. For many countries, the long-term aspect of lucrative natural resources can be considered a curse rather than a blessing. There are many aspects for one particular situation, but examples from Qatar, Libya, Iraq and Kuwait illustrates the point (Gylfason 2001).

---

[1] The Norwegian Parliament adopts the law "The State Petroleum-fund" with the goal to transfer state revenues from the oil- and gas sector to the fund. In 1998, Norges Bank Investment Management (NBIM) was given the mandate to manage the Government Pension Fund – Global. *Accessed: 21.03.12 URL:www.nbim.no/no/om-oss/statens-pensjonsfond-utland-SPU/Historie*

[2] In St. Meld. Nr. 29 (2000-2001) the Government (Stoltenberg) presented guidelines for the Trading Rule in order to keep a sustainable development in the Norwegian economy. Reducing the use to count for only four percent of the real return.
Accessed 21.03.12: URL:http://www.regjeringen.no/nb/dep/fin/tema/norsk_okonomi/bruk-av-oljepenger-/retningslinjer-for-bruk-av-oljepenger-ha.html?id=450468

Researchers have discussed the views on rules versus discretion. The basic idea is that every country needs an economic strategy or policy to follow. This can be having an inflation target, such as the 2,5 percent inflation target in Norway. The idea is that that the monetary policy in Norway will do what is necessary to keep the inflation level at 2,5 percent in the long run. However, the reality is not that simple. Any policy-maker must consider current and future implications of both current and future actions (Dwyer Jr., 1993).

The discussion of rules versus discretion is important in the quest for sustainable economic development. The two terms can be divided by a clear definition in the context of monetary policy; in *discretion,* a monetary authority is free to act in accordance with its own judgments and what is best for the current situation or economy. *Rule* is a restriction on the monetary authority's discretions, which means that the authority cannot optimize their current choices with respect to daily situations. Rules make restrictions on the monetary policies, keeping the rules of the game consistent in the long run for all participants (Dwyer Jr., 1993).

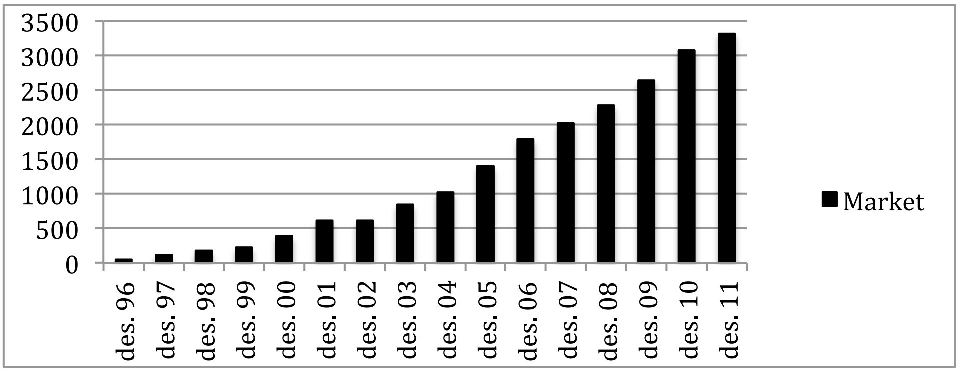
The common general observation used to be that a discretionary monetary policy would perform better than a rule-based authority. From the articles written by Kydland and Prescott (1977) Calvo (1978), and Barro and Gordon (1983b) it was shown that this might be wrong. They were able to show that a discretionary policy, based on optimizing their choices every day, might result in worse outcomes than a rule based policy. In summary, the monetary policy decisions are determined by authority's incentives, the actual economy performances are most likely to perform worse with discretion rather than rules.

We believe that a clear understanding of the debate between rules versus discretion is highly relevant because of the major implications of an undefined mandate. This might generate massive uncertainty in the economy. Since the Petroleum Fund is relatively large, the use of this money might change the rules of the game for several sectors. A sharply defined mandate is needed to keep a sustainable development. Politicians do have incentives to spend more oil money in order to push through their core policies and win elections. But these incentives cannot control the spending, since repeatedly increased spending will be unhealthy for the economy (Gjedrem 2010).

1.3 The Build-up - Norwegian oil money

To get an impression of the possible consequences of being rich on natural resources, it is important to understand the magnitude of the oil revenues. The figure below illustrates development of The Government Pension Fund – Global. The fund has developed in a way that no one could imagine, and the government receipts have made Norway a candidate for both the Disease and the Curse. (figure 1.3.1)

Fig. 1.3.1 Market value, Government Pension Fund – Global. Year 1996 - 2011



Source: Original data from NBIM[3], own illustrations

According to the trading rule, the Norwegian government should limit the use of its riches and only phase in four percent of the real return into the Norwegian economy. As the fund grows, the average real return will increase. Therefore, during time, the Norwegian government will phase in more and more revenues from oil into the Norwegian economy, potentially making the economy more oil dependent. According to The Confederation of Norwegian Enterprise (2010)[4] the increased use of real return from the pension fund may potentially crowd out other important sectors from the Norwegian economy. This creates a fake illusion of good economic performance and increases the need to phase in extra oil money to balance the economy.

This thesis will not discuss how Norway should spend the oil money or if the four percent level is correct. Instead we will focus our research on the occurrence of potential structural breaks that could link Norway to both the resource curse and

[3] *The numbers are collected from individual annual reports made by Norwegian Bank Investment Management from 1996 to 2011* . Accessed: 15.05.12 URL: www.nbim.no
[4] *The Confederation of Norwegian Enterprise, published 04.03.10. Accessed:27.06.12 www.nho.no/oekonomisk-politikk-og-analyser/oljepengene-brukes-feil-article21772-86-html*

the Dutch Disease. Structural breaks in key variables of the Norwegian economy may help us determine whether Norway has a healthy way of handling its natural resources, or if there are indications of a possible slowdown in the economy.

2.0 Literature Review

There is a vast amount of research done on the development and performance of countries rich on natural resources. As mentioned earlier, we will focus on the Dutch Disease and the Resource Curse, and thus continue the work from Røed Larsen (2005).

2.1 The Theory of Resources

There are mainly two economic theories that we will focus our attention on in this thesis, the Dutch disease and the resource curse. Both concern possible consequences and challenges for a country rich on natural resources, but it is important to separate the two, given the possibility for the existence of one without the other. It could also be discussed that one of them is a result of the other. The literature is not completely certain on how to separate them from each other.

2.1.1 Dutch Disease

The term Dutch disease was first defined by the magaine *The Economist* in 1977 trying to explain the economy in the Netherlands after the findings of natural gas in 1959. The article described the reckless use of revenues from the natural gas in the North Sea, leading to high government spending, which again led to difficulties when the revenues from the resources were spent (Economist 2010). Later, the term has been widely used in economic theory, and describes what may happen to countries that are rich on natural resources, but do not have the strength, power, or knowledge to manage their revenues properly. The term describes some of the difficulties of reversing initial allocation of factors into the oil industry.

Corden and Neary (1982), and Corden (1984) discuss different aspects in an economy regarding the Dutch Disease phenomenon. Different outlines for nations are considered, such as mineral production in Australia, natural gas production in the Netherlands, or oil production in Norway, and some OPEC–countries which experience pressure on the traditional manufacturing sector. The aim is to explore the nature of the resulting pressure towards de-industrialization. A central feature in both analyses is the effect of a boom; namely the *resource movement effect* where resources are drawn from the other sectors into the booming sector because of rise in margins. This creates several adjustments, and one of them is the real exchange rate. Dependending on the amount of resources needed, and the allocation of them, the boom can create a *spending effect* where higher real income is the result. This results in extra spending on services that may give rise to prices, which again will be adjusted. This is called real appreciation (Corden and Neary 1982). Corden and Neary sees the distinction between the factor movement effects and the spending effects as key ingredients in the pursuit of understanding the analysis of the Dutch Disease, and the policy implications of natural resources development.

Røed Larsen (2006) has tried to identify the essence and similarities of different evaluations of the Dutch Disease since no clear consensus are yet established. Røed Larsen describes the Dutch disease as an economic illness that involves 1) *factor movement; 2) excess demand; 3) loss of positive externalities*. Linking the Dutch Disease to these three effects; 1) where allocation of resources (capital and labor) are placed on the activities for resource extraction; 2) aggregate demand increases as a result of resource receipts which results in a pressure on domestic currency and excess demand; 3) and loss of positive externalities in the non-oil traded sectors are formed (Røed Larsen 2006).

It is also interesting to look at the disease from a different angle. What is actually meant by “Disease”? Considering the great possibilities the oil brings, it would be unnatural not to take advantage of the situation. If you have resources waiting to be extracted into useful assets, it is clearly not economically optimal to avoid using these resources because of fear for the disease. Referring to the “disease” to explain difficulties of reversing the process might seem more natural. The problems in the Netherlands were not about building up a new sector, but being unable to reverse the process after the natural resources had been extracted.

In the Netherlands the government spending increased as a result of the new natural gas in the 1960s. When the revenues from the gas industry phased out, the government had placed the economy in a vulnerable situation. The country had become dependent on revenues from the North Sea to sustain high government spending in addition to a less competitive export sector. The process resulted in major government cuts throughout the 1980's, which set the Dutch economy back to where it was in the years prior to the finding of gas (Bjørnland 2010).

The phenomenon is linked to the exchange rate. An increase in domestic government spending may result in an increase in domestic price level. Also, when exporting natural resources to a global market, it could create pressure on the domestic currency when the revenues from the trading sector have to be converted into domestic currency, which again put pressure on the exchange rate (Barder 2006).

We can look at the definition of the real exchange rate:

$$R = \frac{NP^*}{P} \qquad (1)$$

Where, R denotes the real exchange rate, N is the nominal exchange rate, P* is the foreign price level, and P is the domestic price level. Assuming that the foreign price level is stable, a real appreciation can be a result of 2 different changes, a nominal exchange rate (N) appreciation or an increase in the domestic price level (P).

Norway is a typical candidate for the disease due to the revenues from oil extraction. If the government spend too much of the revenues on domestic consumption and investment, it may increase the pressure in the Norwegian economy, making the central bank forced to increase the interest rate to reduce price growth. This will result in a pressure on the exchange rate from foreign players. Røed Larsen (2005) argues that the oil sector may potentially crowd out important parts of the economy, and create pressure on the wage level and the real exchange rate. An increase in price on different input factors may cause the trading sector to be less competitive on the global market. If the oil sector is too attractive compared to other domestic sectors, it will probably extract resources from other sectors making them falling back in the race for new developments. This gives a direct link to loss of positive externalities.

Bjørnland (2010) is one of several economists who fear the possible development of the Dutch disease in Norway. The high use of revenues from oil extraction and increased government spending on public goods may reduce the competitiveness for the industry, and force the real exchange rate to a level that is not sustainable. The restructuring process Norway must go through may prove to be difficult due to high government spending, a low unemployment rate, and a large public sector[5]. If the public sector is inefficient and less productive it may not be sustainable without the revenues from the oil. Restructuring this sector will then become a major challenge.

Torvik (2001) presents an updated model of *learning by doing* (LBD) that presents the opportunity that a nation is able to learn, and therefore able to handle implications linked to the Dutch disease. Torvik is able to show that both the traded and non-traded sector is able to generate LBD. This is a new contribution to the existing literature and earlier models. He stresses the fact that some existing literature may be too pessimistic or too optimistic, and that the total picture depends on the exact state of the economy. He describes the situation by the following: *"(…) depending on the characteristic of the economy at hand, production and productivity in both the traded and non-traded sector can go either way (…)"(Torvik 2001, pp. 304).*

The determined wage level is important due to resource allocation. High wages in one sector will create movements of resources across sectors, and create a less competitive environment for the trading sector. To keep a sustainable wage level for all sectors in the long run, the Norwegian wage negotiation model is based on what wage level the traded sector can handle in the future. The idea is that traded sector should end their negotiation before the other sectors follow. By this, the non-traded sector will follow, and not press, the wages above the traded sector. This is the centralized wage negotiation model. The model was first formalized in 1966 as a two-sector model distinguishing between sheltered and exposed

[5]Unemployment rate on 3,5 percentage of the civilian labor force seasonally adjusted (OECD 2010)

industries (Aukrust 1977). The Norwegian Ministry of Finance gives a formal representation.[6]

$$\Delta p_K = \Delta p_k^* + \Delta v \qquad (2)$$

$$\Delta p_i = \Delta p_i^* + \Delta v \qquad (3)$$

$$\Delta w - \Delta p_k = \Delta z_k + k \qquad (4)$$

$$\Delta w - \Delta p_s = \Delta z_s \qquad (5)$$

$$\pi = \alpha \Delta p_i + (1 - \alpha)\Delta p_s \qquad (6)$$

Taking the exchange rate into consideration, equation (2) and (3) state that the price on international products should be the same across countries. Equation (4) and (5) explain the development in profitability given by wage cost share. The parameter k (eq. 3) defines the phasing in of oil revenues. Eq. (2) – (6) explains the relationship when phasing in oil revenues.

The Competitive-Sector-Model (Frontfags-modellen) will help to determine a wage level that is suitable for the macro-economic movement for the long run. The model limits the wage increase to the productivity increase in traded sector.

2.1.2 Resource Curse

Auty (1993), cited in Stevens (2003), was the first to use the term resource curse in an attempt to explain why countries rich on natural resources experience a lower growth than countries without. During the last two decades the term has been widely used and several studies have been conducted on the topic. Sachs and Warner (2001) stress the importance of research on the topic since there are many poor countries with abundant natural resources, that can still escape the curse.

6 The Norwegian Government. Accessed: 15.06.12. URL:http://www.regjeringen.no/nb/dep/fin/dok/nouer/2003/nou-2003-13/13.html?id=370375

To illustrate the existence of resource curse Sachs and Warner (2001) pointed out two observations:

- There is almost no overlap in data between countries with abundant natural resources and countries with high GDP. If natural resources stimulated to growth it should be a positive correlation between national wealth and other kinds of wealth.
- Extremely natural resource rich countries, such as Nigeria, Mexico, Venezuela, and the Oil States in the Gulf, have not experienced rapid sustainable economic growth.

Sachs and Warner (2001, figure 1, pp. 829) present a regression study that substantiates the observations, and we can see that none of the countries with abundant natural resources in 1970 grew rapidly the next 20 years. An interesting observation from the figure is that the countries with little natural wealth grew the most, except from the deviating countries Mauritius, Iceland, and Malaysia.

An accepted explanation of underlying causes for the curse of natural resources has not yet been discovered, but it is possible to use a sense of logic. Sachs and Warner (2001) present a very simplified method, which says that natural resources crowd-out activity x. Since activity x drives growth, the natural resources harm growth. The only problem is that there is no universally accepted theory of economic growth in general, and until this theory/factor is discovered we cannot give a complete answer to what explains the curse. However there are some partly accepted theories available.

Sachs and Warner (1995, 1999), cited in Sachs and Warner (2001), present the theory where x is equal to manufacturing. A positive welfare shock from the natural resource sector will enhance the demand on non-traded goods. This will not only increase the prices of non-traded goods, but also reduce the competiveness for tradable goods due to the increase in costs and wages. Furthermore, the decline in manufacturing will reduce the growth. In order to test this theory, Sachs and Warner wanted to see if it was a relationship between abundance of natural resources and the prices of non-traded goods in the resource rich countries. Due to the fact that prices seldom are divided into traded- and non-traded goods, they used the general price level in the test. The results show a significant relationship, and that natural resource rich countries had a higher price level than the ones without the natural wealth. They were also able to show empirical results which said that *"(...) resource abundance tended to render the export sector uncompetitive and that as a consequence resource abundant countries never successfully pursued export-led growth(...)"* (Sachs and Warner 2001, pp. 835)

Gylfason (2001) makes the assumption that x equals education. Since the natural resource sector has the opportunity to offer higher wages in comparison to other sectors, they tend to attract the best and the brightest. By doing so, the natural resource industry may crowd-out entrepreneurial activity or innovation since it is more lucrative to work in this sector. The author also highlights the problems of rent-seeking and corrupt politicians. Natural resource rich countries will then experience less innovation, lower entrepreneurial activity, poorer governments and lower growth.

Auty (2001) discusses the curse as mismanagement. He argues that resources do not create curses, but rather how the resources are managed. Auty (2001) argues that resource-poor countries are likely to develop a political state that pursues favorable competitive diversification. The principal features are industrialization and outward-oriented policy with low per capita income which lead to an expansion in manufacturing. He also claims that countries with abundant natural resources will engender a political state that is predatory and the governments neglect the economy and pursue rents for own gain.

Røed Larsen (2005) tests the theory which indicates that developed countries may escape the curse, and finds some interesting results. By comparing the Norwegian, Swedish and Danish GDP per capita from 1960 to 2002 he was able to find a structural break that indicated that Norway experienced a boom in growth because of the oil. This would make Norway a candidate for the resource curse. Nevertheless, Norway has managed to keep sustainable growth for more than two decades.

Røed Larsen (2005, 2006) argues that good institutions are one of the main reasons for the escape from the curse. Norway managed to keep illegal and legal rent seeking, large-scale conflicts, and political purchase of power to a minimum, due to well-developed institutions and politicians who restrained themselves. Mehlum et al. (2006) were able to find empirical evidence of institutional effect on economic performance after the extraction of the natural resource. They mention Norway as an example of how good institutions may lead to an escape from the curse. However, Sachs and Warner (1995) tested for the effect natural resource abundance has on institutions, and found little or no evidence of importance.

Another example of a country that has escaped the curse is Botswana. Botswana has 40 percent of GDP stemming from the diamond industry, but it still has one of the highest GDP growth rates in the world since 1965. Acemuglo et al. (2002), cited in Mehlum, Moene and Torvik (2006), attribute good institutions for the performance. In contrast, there are several resource rich countries with poor institutions that perform badly. Tornell and Lane (1999) explain slow growth in countries with abundant natural resources like Nigeria, Venezuela, and Mexico with weak institutions that invite rent grabbing.

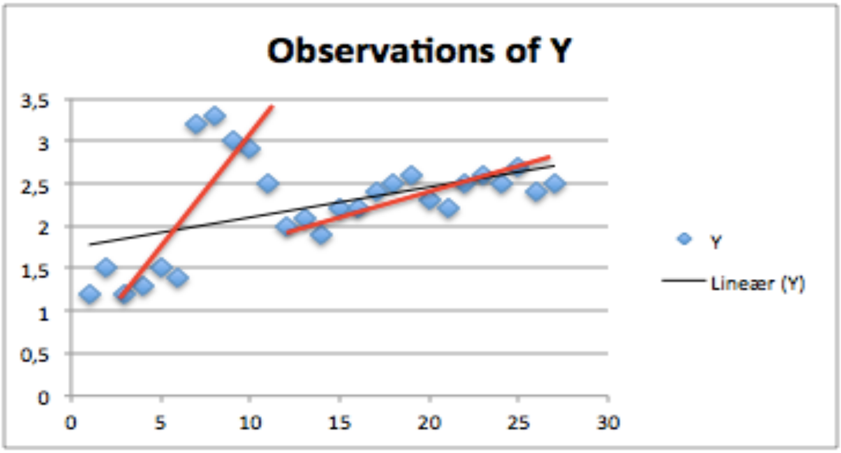
2.1.3 Combining the theories

Both of the theories share the same origin: natural resource abundance and the economic challenges after extraction of the wealth. Amongst several, researchers like Stevens, Gylfason, Sachs, and Warner combine the two theories. Gylfason (2001) argues that the Dutch Disease is one of four channels of transmission into poor economic growth, and highlights overvaluation of the national currency as a common symptom. Stevens (2003) comment on the effect the Dutch disease has on the manufacturing sector and the movement of working capital to the resource sector. Manufacturing is often seen as one of the most important drivers for economic growth, and shrinkage in this sector may lead to signs of a curse. He also argues that Dutch disease may be one of the reasons causing the resource curse. Sachs and Warner (1999) argued that countries with abundant natural resources tended to have a larger service sector and smaller manufacturing sector than the resource-poor countries as a result of Dutch disease effects. So if manufacturing is the x factor which drives growth, it is reasonable to believe that the Dutch disease effect, which squeezes this sector, is one of the reasons for the bad performance in resource rich countries.

2.2 Structural Breaks

To search for either economic improvement or retardation we will try to identify structural breaks in our key variables. The idea is to check if there is a sudden shift in the time series. In other words, we will examine if the fit of the regression will improve by splitting up the sample.

Figure 1.4.1 illustrates a break around 12 on the x-axis. Where the red line 0 – 12 and 12 – 27 creates a better modeling than the back line alone.



Hansen (2001) provides the structural break technique and theory we will apply in our thesis. He discusses structural change in the simplest dynamic model, the first-order autoregression:

$$y_t = \alpha + \rho y_{t-1} + e_t$$
$$Ee_t^2 = \sigma^2$$

In an ordinary stationary time series the different parameters, α, ρ and σ^2, will be constant over time. But if we experience a change in one of the parameters at some point during the period, we call it a structural break. The breakdate is the date where the change occurs. Hu further discusses different methods to identify a structural break and Chow is attributed one of the most classical tests for structural change. He splits the sample into two sub periods, estimate the residual sum of squares for each period, and then estimates the two periods fit against the fit for a full period using a classical F distribution. However, when using the chow test there are some limitations. If the break date is unknown, the researcher needs to either pick an arbitrary candidate, or pick a break date based on the data. It is then possible to reject the null, stating there is a break in the time series, when it in fact are other dates that could have proven to be a break. Hansen (2001) further presents Quandt's statistics, which states that we need to treat the breakdate as unknown, test all the candidates using the Chow test, and choose the date where the test is the largest.

3.0 Data, PPP theory, and Empirical Technique

We will now present a brief overview of data collection and important methodology used to extract our data.

3.1 Collection of data

Our first part of data are collected from Bureau of Labor Statistics (BLS) which is a statistical agency located in the United States. We have collected data for GDP per capita (PPP US 2010 dollars) and average annual hours worked per employed worker for Norway, Sweden and Denmark from their database (BLS 2012).

According to BLS (2012), gross domestic product for each country is obtained from national statistical sources. Since each country might have different ways of collecting, analyzing, and measuring data there might be some statistical differences that could interfere with the final interpretation. We will in our analysis look exclusively at the numbers from Norway, Sweden and Denmark. We assume that these three countries have no significant differences in methodology or guidelines and therefore conclude that possible differences are minimal.

The key problem when comparing GDP per Capita is that all data are delivered in local national currency. Therefore, the problem about unit value must be handled. BLS therefore converts these units into a common unit for all countries. The method behind the operations is the principle of purchasing power parities (PPP), an economic theory or technique to determine the relative value of a currency. PPP's translate different rates that allow output in different currency units to be expressed in a common unit of value, where living cost in each country is incorporated. We believe that using data adjusted for PPP will improve the quality in our research. BLS (2012) argues that not adjusting numbers for PPP may create false interpretations and may create over- or underestimation.

More formally, we can look at equation (7) to describe the steps for PPP.

$$S = \frac{P_1}{P_2} \qquad (7)$$

Where S is the purchasing power parity ratio, P_1 is the price in a specific country/currency (Norway, Sweden or Denmark) and P_2 is the price in a different country/currency (United State). For each given country a ratio (S) is computed. This ratio consist of a numerator (P_1) of the monetary units needed to purchase a common basket of goods and in the denominator (P_2) the monetary units needed to purchase the basket in the United States. This ratio is then used to compute an international equivalent of a countries gross domestic product (Røed Larsen, 2005).

We have chosen to use total GDP instead of mainland GDP for Norway. We believe that there is difficult to separate the different sectors and that there will always be some indirect relations within the data. We observe that SSB make a clear distinction, delivering data for total GDP and GDP mainland, but have chosen to use the data from BLS without this distinction. Therefore, our data may be affected by changes in oil prices and production volume.

Our second part of data are collected from the Organization for Economic Co-operation and Development (OECD), which is an international organization consisting of a broad number of developed countries. We have focused on labor productivity, which is defined as GDP per hour worked, PPP US 2005 dollars, for Norway, Sweden and Denmark. In contrast to our GDP per capita numbers, we were only able to collect data from 1970 to 2011. Therefore, in our analysis, we will not be able to document a possible early break. We have collected data from their database (OECD 2012).

Our third part of data is collected from national statistical agencies in Norway, Sweden and Denmark, respectively: Statistisk Sentralbyrå (2012), Statistika

Centralbyrån (2012), and Danmarks Statistik (2012). We have here collected data for sickness absence. Since these time series are too short, we will not be able to document possible breaks, but rather use the interpretations as an additional contribution.

Our fourth part of data is collected from World Intellectual Property Organization (WIPO). Their mission is to illustrate innovation and creativity for all countries. We have here collected data of registered patents for Norway, Sweden and Denmark (WIPO 2012).

3.2 Emperical Framework

In our attempt to continue and extend on Røed Larsen´s research, we find it useful to use the same theoretical framework as he described in his paper Røed Larsen (2005). We will use the same methodology on several variables, but for simplicity we will present the procedure using GDP per capita.

We denote by y_t the GDP per capita in Norway in year *t*, x_t the GDP per capita in Denmark in year *t* and z_t represent the GDP per capita in Sweden in year *t*. In order to achieve the relative performance of Norway vs. Denmark and Norway vs. Sweden in year *t* we denote the difference in GDP per capita to be $Y_1^t = y_t - x_t$ and $Y_2^t = y_t - z_t$. If Norway has a lower GDP per capita the difference is negative, and if it is higher the difference is positive.

More important, and the core of our thesis, is the search for structural breaks in the relative time series. As Røed Larsen (2005), we also limit our search to two: one of acceleration and one of deceleration. We further operate with two theories. First, a non-oil-related acceleration where the difference in Y_1^t and Y_2^t follows a linear progression through the full period. This may have started before the oil discovery. Second, a sudden oil-related relative acceleration followed by a curse-related relative deceleration. In the latter, the time series will not follow a linear progression and there will be one or several breakpoints.

We follow the same models and notations as Røed Larsen (2005). Our null hypothesis is a first-order autoregressive linear development with no structural break in the time series of differences between Norway and its neighbors, presented in equations (8)-(10):

$$Y_i^t = \propto_i + \beta_i t + e_i^t, i \in \{1,2\}, t \in T, \quad (8)$$

$$e_i^t = \emptyset_i e_i^{t-1} + \varepsilon_i^t, i \in \{1,2\}, t \in T, \quad (9)$$

$$\varepsilon_i^t = IN(0, \sigma_i^2), i \in \{1,2\}, t \in T, \quad (10)$$

where $\propto$ and β represent the structure of the governing trend mechanism for the relative differences, *i* refers to the two differences and *t* represent the years within the full period T. The e is a notation for the error term, and has a first-order autoregressive process in which ε is identically and normally distributed with zero mean and a constant variance σ^2. The autoregressive parameter is denoted by ϕ. Under the null hypothesis the process is said to be difference stationary, consisting of a deterministic time trend and a difference-stationary process which the white noise is provided by the stationary error term ε. In this model, there will be no structural change with an oil discovery.

The alternative model, H_1, where an oil discovery may lead to acceleration, deceleration, or both, we may experience both a level effect and a pace effect. A level effect would affect the intercept, and the pace effect would be observable in the slope. Equation (11)-(13) have included these possibilities and one break:

$$Y_i^t = \propto_i + \beta_i t + u_{1i}^t, when\ t < b$$

$$\text{and } Y_i^t = (\alpha_i + k_i) + (\beta_i + \lambda_i)t + u_{2i}^t, \quad (11)$$

$$when\ t \geq b,\ \ i \in \{1,2\}, t \in T$$

$$u_{ki}^t = \phi_{ki}^t u_{ki}^{t-1} + \varepsilon_{ki}^t, i, k \in \{1,2\}, t \in T \quad (12)$$

$$\varepsilon_{ki}^t = IN(0, \sigma_i^2), i \in \{1,2\}, t \in T \quad (13)$$

where k_i captures the level effect, λ_i the pace effect, k denotes the period before and after the breakpoint year *b*. Subscript *i* refers to the two kinds of country differences: Norway vs. Denmark or Norway vs. Sweden. The error terms *u* are identically and independently distributed with zero mean and constant variance.

We will further compare the models (8)-(10) and (11)-(13) using structural break analysis as described in Hansen (2001). We will break up the full period *T* into two sub periods, one before the breakpoint year *b* and one after (e.g. 1960-1973 and 1974-2010), and vary the candidate breakpoint years from 1965 to 2005. If one linear trend governs the full period, as stated in the null hypothesis, there is nothing to gain in explained variation and increased fit in splitting the sample into two periods. If the null is false, there is much to gain to split the sample into two periods, and according to Hansen (2001) the year with the highest computed F-value will be the break year.

In addition to test the full period, 1960-2010, we will also split our sample into smaller periods and test for breakpoints. This is done to separate a possible acceleration and deceleration break, and minimize the disturbance to each other. It is the possible deceleration break in the late 90s, which Røed Larsen (2005) managed to see the beginning of, that will be most interesting for us. If we manage to find a break in the late 90s we may have seen the beginning of a possible curse in Norway.

In order to compare the one-period with the two-period regression we use the F-test. The F-test uses the difference in the sum of squared residuals, $(SSR_r - SSR_u)$, to examine which one is the best fit. The difference will always be positive, as the fit will not be worse after including more variables. The F-ratio is given by

$$F = \left(\frac{SSR_r - SSR_u}{r}\right)/(SSR_u/(n-K)) \qquad (14)$$

where RSS denotes the sum of squared residuals, the subscript R and U represent restricted and unrestricted, r the number of linear restrictions, n the number of observations and K the number of parameters in the unrestricted case. r will be equal to 3 since the null hypothesis entails restricting the intercept, slope and autoregressive factor to be equal for the both sub-periods. In the unrestricted case both different level and slopes are allowed, reflecting the oils possible slope and level effect, and the autoregressive factor is allowed to change. The K is then equal to 6.

3.2 Different variables

We will use the theoretical framework described above to test for structural breaks in several variables, not only GDP per capita. The reason for doing this is to check if we are able to find breaks in other indicators to substantiate our conclusion. This, and updated numbers on GDP per capita, is what will separate us from the empirical part of Røed Larsen (2005).

3.2.1 GDP per capita

Our main focus will be on the parameter GDP per capita. In addition to being the variable which is used in Røed Larsen (2005), it is also a well-known indicator of the performance for a country. We believe there are few pitfalls in the collection and estimation of data. The sample we will use is from 1960 to 2010. We think the extra 7 years, compared to Røed Larsen (2005), will be important in analyzing the possible break in the late 90s. We will also perform a test of robustness on the data set by using the first year in our sample, 1960, as an index year, and divide the data from the next periods on this year.

3.2.2 Average annual Hours Worked per Employed worker

Average annual hours worked per employed person is also collected from BLS, but we do not have data from before 1970. This will restrain us from testing for a structural break in the beginning of the 70s, but we will still be able to test for the last period. We use this variable as an indicator of the work ethics, and the difference in necessity to work. If we are able to find a deceleration in GDP per capita in the late 90s, and a corresponding reduction in relative difference between Norway and its neighbors in hours worked per employed person, we may argue stronger for a possible curse.

3.2.3 GDP per working hour

GDP per working hour is collected from OECD as an indicator of labor productivity. The sample is from 1970 to 2010, which again restrains us from testing for a structural break in the beginning of the 70s, but still gives us the opportunity to test for a break in the late 90s. It is interesting to test labor productivity since the curse may lead to an overall slowdown in the economy.

3.2.4 Other Variables

In addition to the three variables described above, we will also perform structural analysis on "Employment as a Percentage of Population" and "Approved Patents per Capita". Employment as a percentage of population is collected from BLS and the sample is from 1960 to 2010. Approved patents per capita were collected from Norway, Sweden, and Denmark's statistical agencies and from WIPO.

We strongly wanted to test a time series with "sickness absence" for structural break, but this proved to be difficult. Once again we contacted the different statistical agencies, but there were no, or little, comparable data from before year 2000.

3.3 Challenges in Statistics

3.3.1 Serial correlation

It is important to check for serial correlation when working with OLS –estimation since OLS-based procedures are invalid when the disturbances are correlated (Murray 2006). The main idea is to check whether or not the OLS-residuals are correlated with each other[7]. If the residuals are in fact correlated, we can reject the hypothesis stating serial uncorrelation among the residuals, e.g. autocorrelated (Durbin and Watson, 1950, 1951, 1971). In summary, the test describes whether we are able to find statistical evidence for positive or negative autocorrelation for the error terms.

[7] This can be done by performing a Durbin – Watson test (DW-test) in Eviews.

We performed the Durbin-Watson test on all our time series, and were able to establish the presence of an AR-1 process. Figure A.3.3.1.1 and A.3.3.1.2 (appendix) shows the Eviews outputs for the difference between Norwegian and Danish GDP per capita when an AR-1 process is not considered, and when it is taken into account. The former give us the Durbin-Watson value 0.213. This is well below the critical value of 1.50, and we cannot reject the null hypothesis stating no positive autocorrelation. When we consider the AR-a process we obtain the Durbin-Watson stat of 1.591.

To confirm our findings, we may also observe that the Akaike info criterion and the Schwarz criterion have lower values when the AR-1 process is taken into account. This indicates a better fit for the model adjusted for the AR-1 process.

3.3.2 Cointegration test

It is possible to consider the potential for structural breaks by performing a cointegration test[8]. We will therefore look at real GDP for Norway compared to Sweden and Denmark. We know that these time series are considered non-stationary. Engle and Granger (1987) pointed out that there could be a possibility for a linear relationship between two or more non- stationary time series. In other words, there may be a possibility that the two non-stationary time series have a stationary relationship in the long run, e. g. the time series are said to be cointegrated. If this is the case, there will be no point in searching for structural breaks since changes in the time series will always end up in parity.

When testing for cointegration in Eviews we cannot find any evidence for linear relationship in the time series. Therefore, we conclude that the possibility for one or several structural breaks is present in our time series that may help us in explaining the non-stationarity between the variables.

4.0 Empirical findings

An empirical pattern emerges when the structural break technique is applied to data. We were able to find, as Røed Larsen (2005), a relative acceleration in GDP

[8] One method to determine if two or more time series are products of cointegration is to use the Engle and Granger test in Eviews.

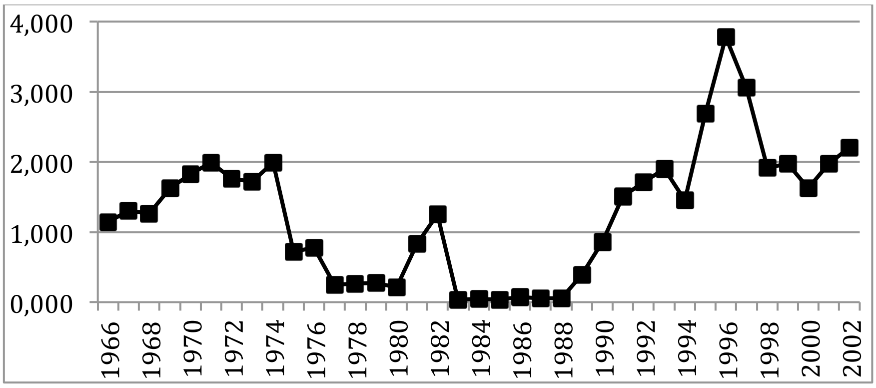
per capita for Norway compared to its neighbors in the beginning of the 70s. In the next two decades there were no structural break indicating a relative slowdown, but we managed to get a quite interesting result in the late 90s. Røed Larsen (2005) did catch an intriguing slowdown in the late 90s, but our research give a quite strong (highest F-ratio) break, indicating a severe relative slowdown in Norwegian GDP.

4.1 GDP per capita

Figure 4.1.1 shows the computed F-ratios for structural break in the relative difference between Norwegian and Danish GDP per capita. This figure shows that despite the overall impression of higher growth in Norway compared to Denmark, there is a clear change in pace in the late 90s. According to Hansen (2001), the year with the highest computed F-value is where the break should be, and in our case we observe the highest F-value to be 3.787 in 1996. The critical value for the F-distribution within the 95 percentile is 2,816, thus we can reject the null hypothesis vs. the alternative[9]. The peak in 1996 indicates that splitting the sample into a period from 1960 to 1995 and one from 1996 to 2010 greatly enhances the fit of the model, compared to retaining the full period from 1960 to 2010. We can also see a possible break in the beginning of the 70s. Thus, we have chosen to split the full sample into two sub periods, the first from 1960 to 1984 and the second from 1975 to 2010, and test for a break within these periods. The reason for doing this is to separate the possible breaks in order to minimize disturbance. (Further calculations in appendix A.4.1.1)

[9] For situations with several significant break points years, we will according to Hansen (2001) choose the year with highest F-ration.

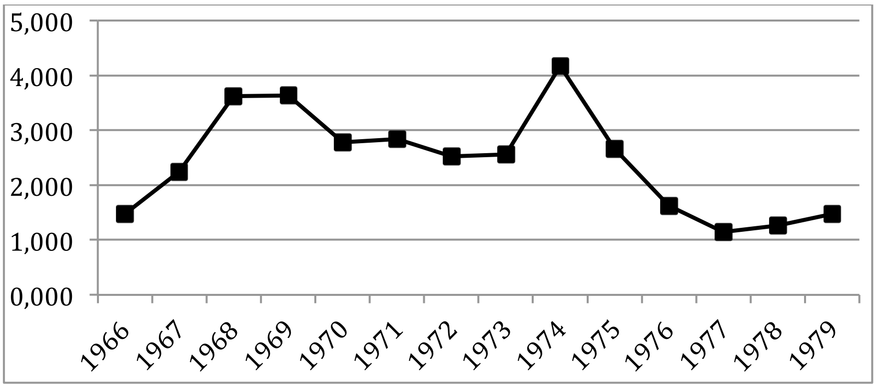
Fig. 4.1.1 F-Value, Structural Break Test, Diff. in GDP-adj. per Capita between Norway and Denmark. Full period 1960 – 2010, Candidate Years 1966 - 2002



Critical Value; $F_{(,5,3,44)}$ *= 2,816*
Source: Original data from BLS, own calculations.

Figure 4.1.2 illustrates the computed F-values for the sub period 1960 to 1984. We observe a peak in 1974 with the F-value of 4.166, which is the same break date as in Røed Larsen (2005). The graph indicates several high F-values, but we have experienced the same pattern using different tests. By the theory from Hansen (2001), and the fact that we confirm the same pattern and year as Røed Larsen (2005), we believe that the structural break in 1974 is correct.

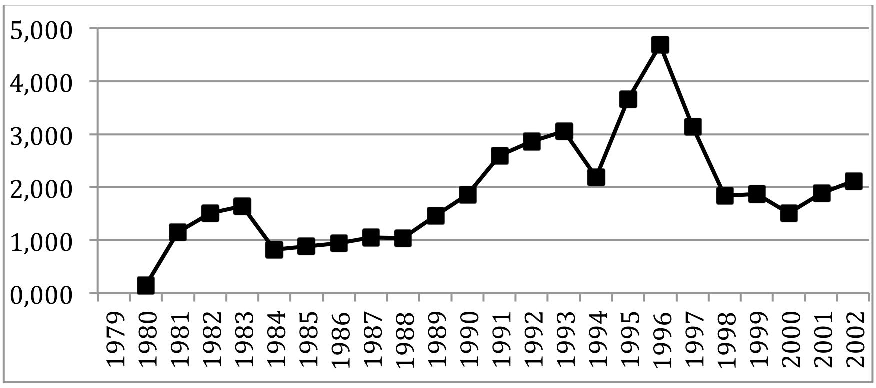
Fig. 4.1.2 F-Value, Structural Break Test, Diff. in GDP-adj. per Capita between Norway and Denmark. Partial period 1960 – 1984, Candidate Years 1966 - 1979



Critical Value; $F_{(,5,3,17)}$*=3,197*
Source: Original data from BLS, own calculations

In figure 4.1.3 we observe the computed F-values for the second sub period, 1975 to 2010. We searched for a break in the candidate years from 1980 to 2002 and successfully found one in 1996 with the F-value of 4.691. Once again, our result is in concordance with Røed Larsen (2005), and we are quite confident of the presence of a relative deceleration in the late 90s.

Fig. 4.1.3 F-Value, Structural Break Test, Diff. in GDP-PPP-adj. per Capita between Norway and Denmark. Partial period 1975 – 2010, Candidate years 1979 - 2001



Critical Value; $F_{(,5,3,28)}=2,947$
Source: Original data from BLS, own calculations

We used the same technique on the relative difference between the Norwegian and Swedish GDP per capita as well, and we were able to find a relative acceleration in the beginning of the 1970s and a relative deceleration in the late 1990s. We split the full period into two sub periods and managed to find a break in 1976 with an F-value of 3.907 and in 1997 with an F-value of 8,234. Even though we did not get the break in the same year for the two control countries, the results are quite similar and both tests indicate a relative acceleration in the 1970's and a relative deceleration in the 1990's. The break dates are almost the same as in Røed Larsen (2005), and it only separated a few years between the results from Denmark and those from Sweden. The fact that we did get a clear break in the late 1990's substantiates the theory presented by Røed Larsen (2005). The graphs and further information on the relative difference between Norwegian and Swedish GDP per capita are available in the appendix, A.4.1.4 and A.4.1.5.

In addition to split the full period into two sub periods we performed one further test for robustness. We used the same data as in the relative difference between the Norwegian and Danish GDP per capita, but denoted 1960 as an index year by dividing all the following years on 1960, and performed the same break point technique as earlier. When testing the full period from 1960 to 2010, we managed to obtain the same pattern, and the results indicated a break in 1974 and in 1996. We further split the sample into two sub periods, and the test showed a peak and an F-value of 4.290 in 1974 and 4.473 and 1996 (appendix A.4.1.6 and A.4.1.7). We performed the same analysis for the difference between Norway and Sweden and did find the same result as the former GDP per capita test. The break dates were the same as above, one in 1976 and one in 1997 (appendix A.4.1.8 and A.4.1.9).

4.2 Average Annual Hours Worked per Employed Person

We performed the same structural break technique to the data set on average annual hours worked per employed person. The data available were from 1980 and 2010 so we focused solely on the possible break in the late 1990's. When we tested the relative difference between Norway and Denmark our results indicated a break in 2002 with an F-value of 5,306 (appendix A.4.2.1). The same test was performed on the data for the difference between Norway and Sweden. We found a clear break in 1994 with an F-value of 7.943 (appendix A.4.2.2). These results do not support our theory of a relative slowdown in the Norwegian performance. In appendix A.4.2.3 we observe that this was a rather positive adjustment from Norway illustrated by the differences between Norway vs. Denmark and Norway vs. Sweden. This will obviously *not* substantiate our previous results, but we still want to include this in our thesis, since we observe a clear change in the late 1990's in the graph.

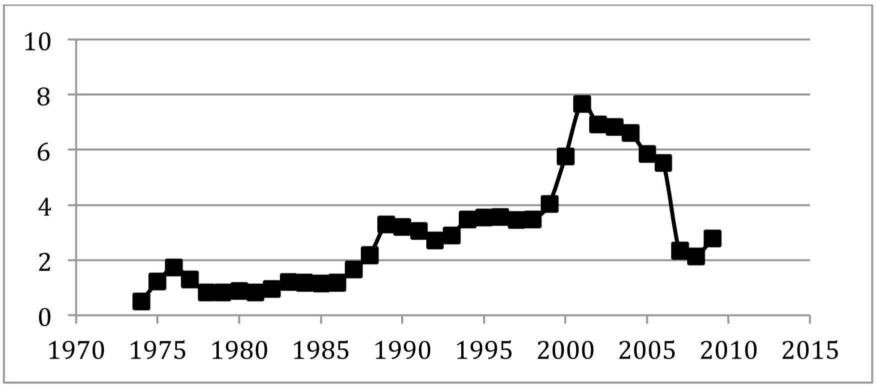
The results from our structural break analysis on Average Annual Hours Worked per Employed Person did not substantiate our previous findings. Nevertheless, we think it is interesting to observe the differences in the light of the GDP per capita performance. While Norway had a relative acceleration in GDP per capita compared to its neighbors from 1970 to 1995, Norway also experienced a relative slowdown in average hours worked. We will come back to this in section five.

4.3 GDP per Hour Worked

We wanted to test a variable that could give us some indication of the relative productivity level between Norway and the control group Sweden and Denmark, and a relative slowdown in the productivity level in Norway would certainly support our theory. We performed the same structural break analysis as described earlier, having a full period from 1970 to 2010 and with candidate years from 1974 to 2009 (appendix A.4.3.1 for illustration of Norway vs. Denmark).

Our result indicates a break in the relative performance between Norway and both Sweden and Denmark in 2001, with an F-value of 7.67 for the former and 13.901 for the latter. We experienced high F-values on both tests, but supported by the theory presented in Hansen (2001) we may argue for a structural break in 2001. Since the break occurred in the same year in both cases, we argue that this shows a strong indication of a slowdown in the Norwegian productivity level, and not an increase in the productivity level for one of the countries in the control groups.

Figure 4.3.1 F-Value, Structural Break Test, Diff. in GDP-PPP-adj. per Hour Worked between Norway and Sweden, Full period 1970 – 2010, Candidate Obs. 1974 – 2009



Critical Value; $F_{(,5,3,33)}$*=2,892*
Source: Original data from OECD, own calculations

4.4 Other Variables

Employment as a percentage of population operates as an additional indicator of a possible slowdown in the Norwegian economy. Did Norway experience a relative slowdown in the employment rate compared to its neighbors? Figure A.4.4.1 (appendix A.4.4.1) illustrates the relative differences between Norway and Denmark, and Norway and Sweden in the employment rate. We observe that Norway caught up with the control countries during the 1980's, and exceeded them in the beginning of the 1990's. The structural break analysis shows a peak in the F-distribution in 1982 with a value of 6.957 for Denmark, and in 1992 with the value of 6,666 for Sweden (appendix A.4.4.2 and A.4.4.3). The break for Denmark occurs when there is a relative slowdown in the catch up from Norway, but we will not linger with this, instead we focus on the overall impression of a higher employment rate in Norway vs. its neighbors. This raises questions such as: Why does Norway have a higher employment rate than its fairly equal neighbors? Do Norway have a artificially low unemployment rate because of the large public sector? We believe these are interesting questions, but leave this topic open for further research.

We wanted to test one additional variable for structural breaks, namely patents per capita. We thought this variable could be a good indicator of entrepreneurship and innovation, but the time series proved to be too noisy and we did not discover any results of interest. Illustration of difference between total patents per capita for Norway and Denmark see appendix (A.4.4.4).

5.0 Discussion and Perspective

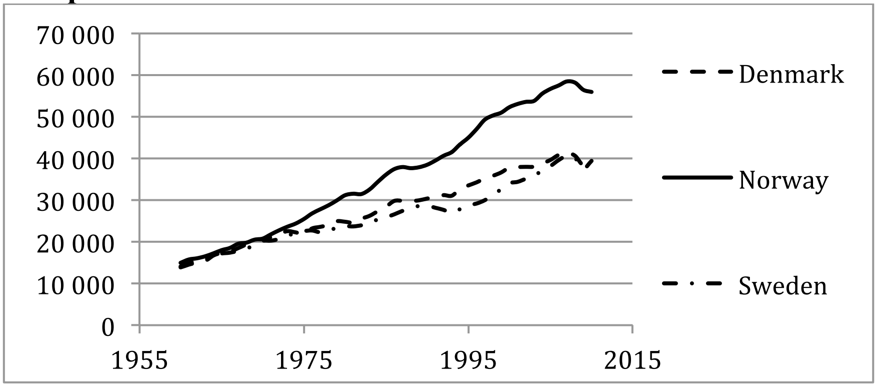
There are several movements, events, and circumstances that may affect our conclusion when interpreting the findings. Since we explain patterns in the Norwegian economy using Sweden and Denmark as yardsticks there will always be something to comment. We will therefore establish an overview of concerns that we believe is of interest for our findings.

5.1 Production

Our key indicator on production is GDP per capita which measures the total output for a given nation divided on its population. In broad lines, it says something about the economic development for a nation.

Figure 5.1.1 illustrates the movement in GDP per capita for the three Scandinavian countries. They all increase in time, but with some differences in development. We know that Norway discovered oil in 1969 and there is reasonable to believe that this is the main reason for the acceleration early in the 1970s.

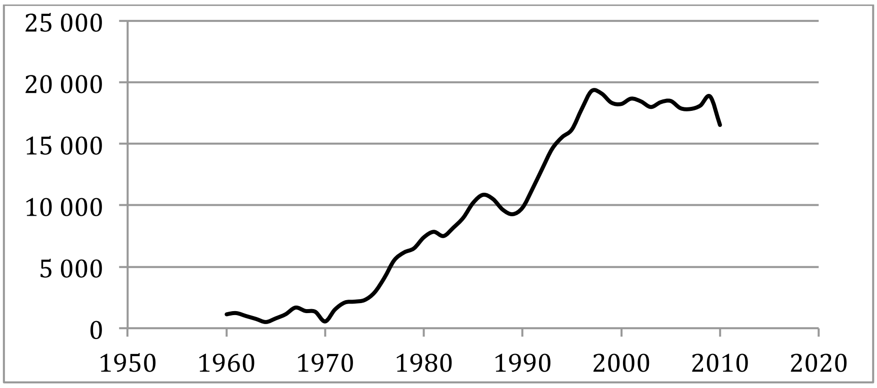
Figure 5.1.1 Obs. GDP-PPP-adj. per Capita. Norway, Sweden, and Denmark. Full period 1960 – 2010



Source: Original data from BLS, own illustrations

Figure 5.1.2 illustrates the difference in GDP per capita between Norway and Sweden, and the break in the 70s and the on in the late 90s are well illustrated in the graph. Still, it is difficult to give an exact explanation for the breaks. The break in the late 90s may be a result of either an economic deceleration for Norway, an economic acceleration for Sweden, or both. According to Davis and Henrekson (2006), the Swedish economy experienced a turning point around 1993 -1994 after several decades with low economic growth, and a long period with economic contraction was followed by a period with high economic growth. Thus, the break in the late 90s might therefore be explained by a Swedish acceleration rather than a Norwegian deceleration.

Figure 5.1.2 Obs. GDP-PPP-adj. per capita. Diff. between Norway and Sweden. Full Period 1960 - 2010



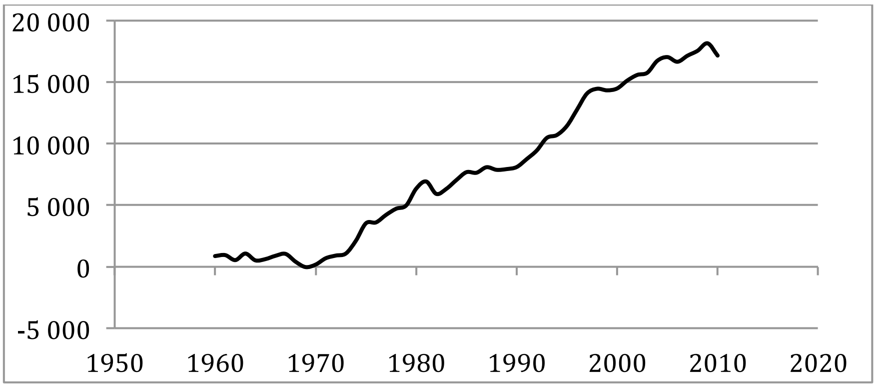
Source: Original data from BLS, own illustration

Banking crises have occurred frequently both among developing and developed countries. Demirgüc-Kunt and Detragiache (1998) were able to prove that banking crises and slow GDP growth are positively correlated. Both Norway and Sweden experienced banking crises around the 1990s, but with a more severe crisis in

Sweden compared to Norway (Moe, Solheim, and Vale, 2004). In the time period between 1990 to 1993 Sweden experienced accumulated losses of nearly 17 percent of total lending capital (Englund, 1999). As an economic consequence Moe, Solheim, and Vale (2004) argue that due to the lack of credit crunches during the period, it did not have a significant impact on the real economy. They suggest that the downturn may be due to economic shocks not related to the banking crisis.

Our analysis on GDP per capita for Norway and Denmark suggests a break in 1974 and 1996. This describes an economic acceleration in the late 70s and a potential economic slowdown in the 1990's. The break in the 1990's is not as clear as the comparison with Sweden, see figure 5.1.3.

Figure 5.1.3 Obs. GDP-PPP-adj. per Capita. Diff. between Norway and Denmark. Full Period 1960 - 2010



Source: Original data from BLS, own illustration

To minimize the possibilities of drawing conclusions too quickly, about a possible slowdown we have used both Denmark and Sweden as control countries, and not just one of them. It is important to keep in mind that Denmark does export oil and is considered an important supplier of oil to certain countries. However, they only have a fraction of the North Sea rights compared to Norway (M. Höök, B. Söderbergh, K. Aleklett, 2009). This depresses Denmark's status as a control point. There have also been several restructuring processes among the Scandinavian countries, and both Sweden and Denmark might have over- or under- performed compared to Norway within our time aspect. All together this highlights the value of using two control countries rather than one (Røed Larsen, 2005).

The relationship between oil price movements and macro economy has been discussed among researchers. Lardic and Mignon (2005) investigated the long-term relationship between oil prices and GDP for a selection of European countries in the period from 1970 to 2003. With respect to four different tests[10] they were able to find clear evidence of cointegrated relationship between oil prices and GDP in Norway. Eika and Magnussen (2000) pointed out the fact that Norway should gain from a high oil prices. They argue that the overall outcome is not that obvious because of the fact that Norway is dependent upon trade with other non-oil exporting countries. Solheim (2008) discusses the impact of increased oil prices on the Norwegian economy. He exemplifies this by saying that with an increase in oil prices, it will lead to a rise in the national wealth, but that the activity level will decrease at the same time. In sum, he was able to find a positive relationship. In his study, 27 percent of the businesses claim to have direct deliveries to the oil industry, and if the oil prices suddenly drop back to the 2003 level the total turnover is reported to decrease with 3 percent. This exemplifies the sensibility of an oil price change for the Norwegian economy. The study also documents a negative relationship between increased oil price and the development in export of traditional goods. This results in stronger real exchange rate, reduced foreign demand, and resource allocation to sectors trading with the oil sector. Economic sensibility to oil price changes, increased real exchange rate, and resource allocation movement are all possible indications of a potential Dutch disease in the Norwegian economy. It is important to mention that a significant drop in oil prices in the long run may create the same effect as a non-existing oil extraction situation. Norway may find itself in a situation not only dependent on extracting oil, but also dependent on a situation with high oil prices. In A.5.1.1 we can see the illustration of oil and gas export as a fraction of total export. From the non-existing level in 1970 the oil export has developed with a significant share. The peak came in 1996, with a fraction of almost 60 percent of total export. The high level has been reduced to approximately 40 percent in 2011.

According to our findings and discussion it is reasonable to believe that the break in the 1970's is a result of a significant acceleration of the Norwegian economy caused by the oil findings. The break in the 90s is more difficult to connect to a

[10] Augmented Dickey-Fuller, Phillips-Perron, Shin and Johansen tests

certain event in the Norwegian economy. There are strong arguments for a relative slowdown during this period, but at the same time, our findings may be explained by an under-performance for our control points during the period. We will not conclude neither one, but rather linger to a possible slow down in the Norwegian economy in the 90s.

5.2 Productivity

One of the areas we want to investigate further is the development in productivity. Krugman (1997) explained productivity as:

*”Productivity isn´t everything, but in the long run it is almost everything. A country´s ability to improve its standard of living over time depends almost entirely on its ability to raise it output per worker”. (*Krugman 1997. pp. 11)

A clear measure of productivity can be difficult to obtain due to the economic complexity. Hagelund (2009) argues that productivity development are affected by education within the population, size and quality of the real capital, research and development, infrastructure, production and use of information technology, possibilities for trade, ownership, turnarounds in private and public sectors, institutions, welfare systems, wage differences, age composition in the population, the degree of competition, and macroeconomic circumstances.

One way to measure productivity is to look at GDP per employed person. Another way is to look at GDP per hour worked. In the latter, some of the pitfalls may be avoided. If the share of female workers increases, it might result in a decrease in productivity per employed person. This can be explained by part time jobs, less working hours because of childcare, and other obligations. According to a SSB (2012)[11], 47 percent of employed females have part time work. This illustrates our point, and GDP per working hours will adjust for the possibility of different working hours per employed person. Another obstacle when measuring productivity is the degree of invested capital. Extra capital may increase the productivity level (a farmer gets a new tractor), even if the real productivity level

[11] SSB Accessed:20.06.12
URL:www.ssb.no/arbeid

did not increase (his productivity level will increase due to new equipment). The solution is to measure total factor productivity (TFP). This is production that is not affected by capital (Hagelund, 2009). Changes in TFP can be a result of new technology, logistics, effectiveness of assets, and changes in the organizations. According to Hagelund (2009) we can calculate TFP by the model, using the same notations;

$$Y_t = A_t K_t^{(1-\alpha)} L_t^{\alpha} \qquad (15)$$

Where Y denotes gross product, K denotes capital services, L denotes labor measured in hours worked, α denotes wages paid in the share of value added, and A denotes changes in output not attributable to primary inputs (TFP).

In order to separate increased labor productivity, capital intensity, and total factor productivity (TFP) we can develop a second equation from our first (1).

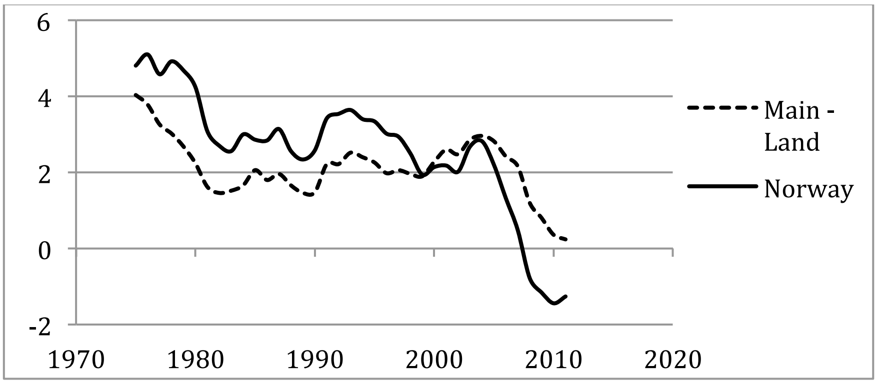
$$g_Y - g_L = (1-\alpha)(g_K - g_L) + g_{TFP} \qquad (16)$$

Where $g_Y - g_L$ denotes increased labor productivity and $(1-\alpha)(g_K - g_L)$ denotes the increased contribution of capital intensity. g_{TFP} denotes increased TFP. This model will help explaining the contribution of capital to labor productivity.

To illustrate the actuality of the topic, Simensen and Holte[12] wrote an article about the decrease in productivity and the consequences this might entail for Norway. They illustrated the decrease in annual growth in working productivity per hour from 1975 to 2011. We have reproduced their graph, figure 5.2.1, with a five-year smoothing average[13], providing clear evidence of a slowdown.

[12] Partners in McKinsey & Company who wrote an article in Dagens Næringsliv. 07.08.12
[13] Since the percentage change are extremely volatile, we use five years smoothing to easier interpret the data

Figure 5.2.1 Obs. of Working Productivity per Hour. Norway - mainland and Norway - total. Percentage change. Five year smoothing. Full period 1975 – 2011.

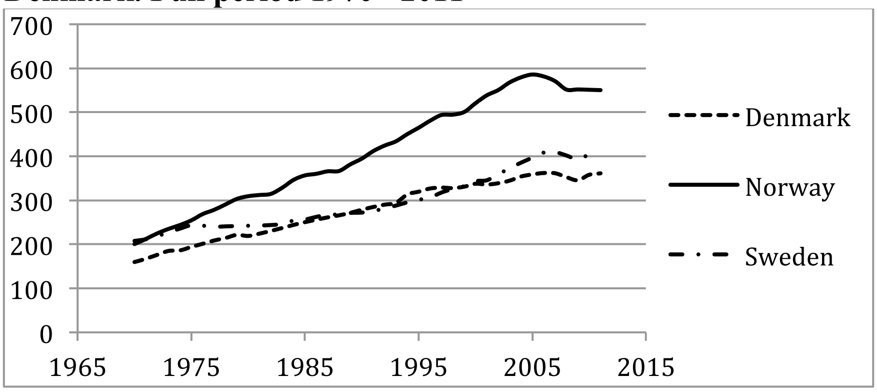


Source: Original data from SSB, own illustration

When considering their findings there are particularly three factors to comment. Does the picture illustrate the actual situation when they only look at Norway without any control points, is it possible to separate Norway such that mainland does not include indirect oil revenues, and does circumventing TFP have a significant consequence? We believe that their findings do count for something, but is too narrow for a discussion of a significant slowdown in Norwegian productivity.

Figure 5.2.2 illustrates the development in GDP per working hour in Norway, Sweden and Denmark. It is reasonable to believe that something occurred in 1970s and the late 1990s. To investigate this further we have used the same structural break technique as earlier. The data is available from 1970 to 2011, and it follows that we may only test for one break. Both for Norway vs. Sweden and Norway vs. Denmark achieved the highest f-ratio in year 2001.

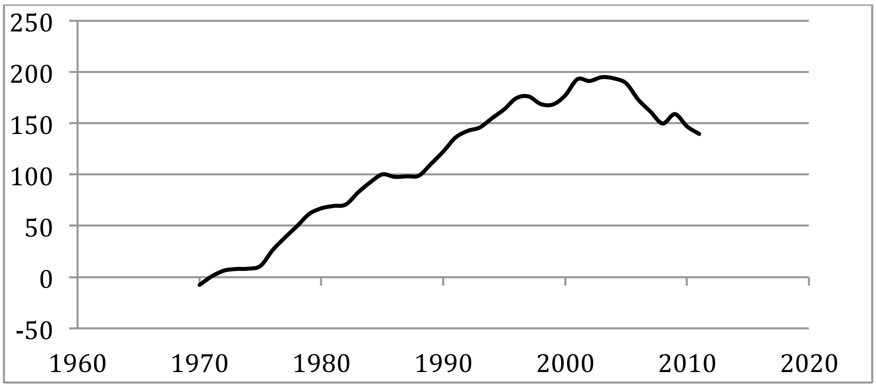
Figure 5.2.2 Obs. GDP-PPP-adj. per Working Hour. Norway, Sweden, and Denmark. Full period 1970 - 2011



Source: Original data from OECD, own illustration

From figure 5.2.3 we can observe that Norway has increased their productivity compared to Sweden from the 70s until the millennium. Then something happened which changed the graph dramatically.

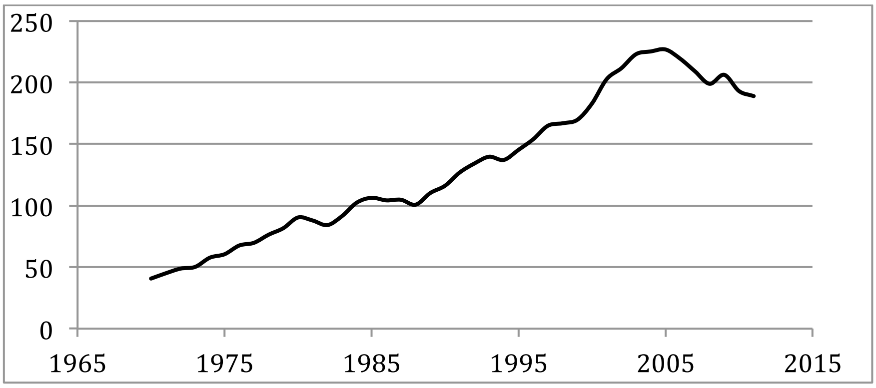
Figure 5.2.3 Obs. GDP-PPP-adj. per Working Hour. Diff. between Norway and Sweden. Full Period 1970 - 2011



Source: Original data from OECD, own illustration

The same pattern can be recognized looking at the comparison of difference between Norway and Denmark (figure 5.2.4).

Figure 5.2.4 Obs. GDP-PPP-adj. per Working Hour. Diff. between Norway and Denmark. Full Period 1970 - 2011



Source: Original data from OECD, own illustration

What is the reason for this possible slowdown of Norwegian productivity around the millennium? It can be argued that Norway was over-performing, and the break is just a natural catch-up for its Scandinavian neighbors. Another reason can be the possible emergence of an attitude towards working less within the Norwegian population. If the latter is the answer, the break is a good indication for a possible build-up of a potential resource curse.

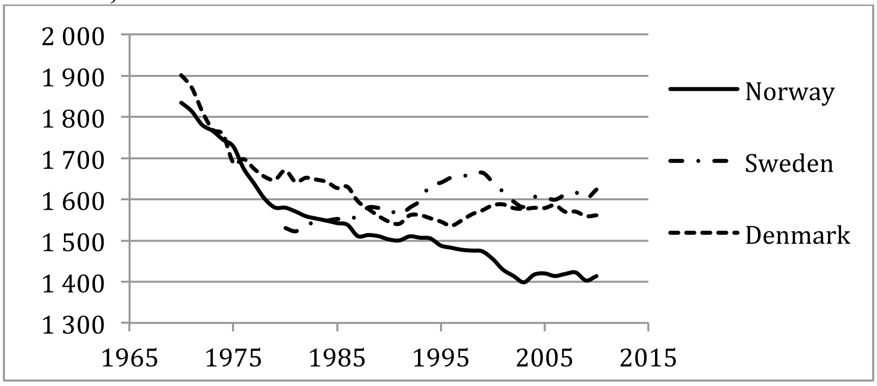
To supplement our discussion on productivity we will highlight some notes from Hagelund (2009) that observes the productivity level taking TFP into consideration. There is clear evidence of a decrease in productivity per working hour since the top level in 2000. He explains this by reduced capital intensity, economic upturn created needs for more marginal capital that may not be fully effective, high employment and increased needs for highly qualified workers, and the economic retardation in 2007 which hit Norwegian businesses instantly. In his report an overview is presented to illustrate the movements in productivity. This is decomposed into capital intensity and TFP. Until the 1980s the high level of capital intensity explained the high level of productivity. Around the year 1990 the level of capital intensity decreased, but the productivity level sustained due to high TFP. This is explained by tax-reform in 1992. The productivity level increased close to the millenium, mostly explained by increased capital intensity (Hagelund, 2009).

Considering the observations of Hagelund (2009), the argument to rejecting the theory of a break as a natural adjustment has become more valid. The high productivity level in Norway around 2000 is carried by capital intensity, not TFP. Combined with our findings about a structural break in GDP per Capita in the 1990's, we believe that our indicator for productivity support the idea of a relative slowdown during this period. Thus, we are more confident of the potential build-up of a possible resource curse during the period from the late 90s to the early 2000.

5.3 Work Ethics

We have computed data for annual average hour worked per employed worker to examine work ethics. Figure 5.3.1 illustrates the difference between Norway against Sweden and Denmark. Here it shows that Norway has moved from a top level in 1970s to a bottom level today.

Figure 5.3.1 Obs. Annual Average Hour Worker per Worker. Norway, Sweden, and Denmark. Full Period 1970[14] - 2009



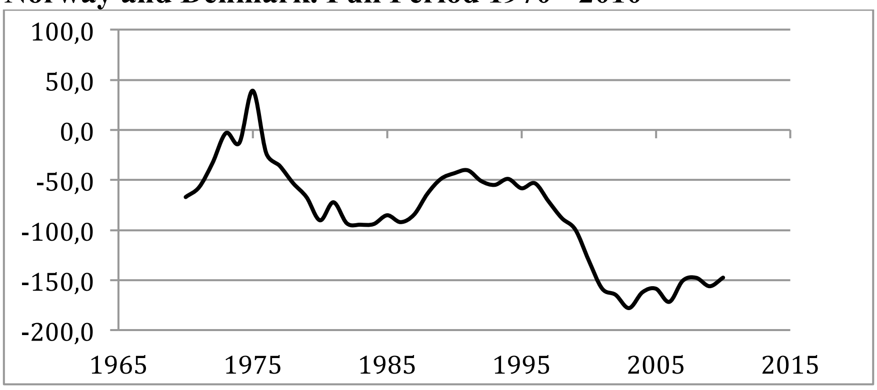
Source: Original data from BLS, own illustrations

We believe that this extreme drop from 1970 to 2009 can be explained as a natural movement adjusting the high productivity level in Norway, but we will still like to analyze this further in order to fulfill our structural break analysis on this variable.

In a broader comparison, figure A.5.2.1 (appendix) shows that Greece is ranked as the top country within the EU, while Norway ranked below the average of the Euro-area, just above Germany and the Netherlands.

Figure 5.3.2 and 5.3.3 illustrates the differences between Norway compared Denmark and Sweden. Both graphs illustrate a decrease in average annual hours worked per employed person in Norway compared to the control countries.

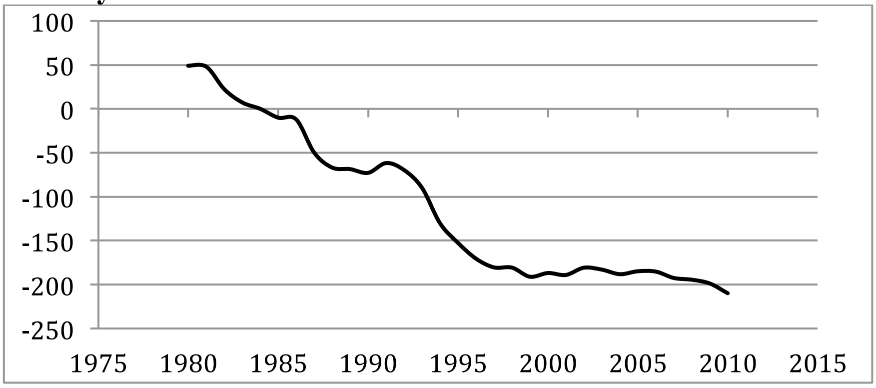
Figure 5.3.2 Obs. Annual Average Hours Worked per Worker. Diff. between Norway and Denmark. Full Period 1970 - 2010



Source: Original data from BLS, own illustrations

[14] Only available data for Sweden from 1980 - 2009

Figure 5.3.3 Obs. Annual Average Hours Worked per Worker. Diff. between Norway and Denmark. Full Period 1980 - 2010



Source: Original data from BLS, own illustrations

There are large differences in Scandinavia when it comes to main industry and export. Norway is in a position with high general level of productivity on hours worked. This can explain why Norwegians work less than many of their European neighbors. Sweden and Denmark are considered less productive compared to Norway. Related to this, they need to work more hours in order to maintain the same production level.

According to Ueberfeldt (2005) there has been a large decline in working time per employed person from 1870 to 2000 for advanced industrialized countries[15]. He reports the percentage change to be -46 percent for hours worked per population older than 15 years of age, and -41 percent for hours worked per working person. He further argues that one of the main reasons for these findings is development in technology.

As mentioned, our break years in this variable did not support the theory of a possible slowdown in the Norwegian economy. The break years explains a catch up, rather than a setback, for average working hours. We therefore believe that a high productivity level in Norway may explain our findings.

5.4 Other Variables

Unfortunately, we were not able to search for structural breaks in time series for patents or sickness absence. Still, we feel that these measurements would have given valuable contributions in our discussion about a potential slowdown. We

[15] Includes 15 countries, among them Norway, Sweden and Denmark

will therefore discuss the topics in general, without empirical documentation of structural breaks.

Ihleback, Brage and Eriksen (2007) claim that Norway had an increase of 65 percent in sickness absence days from 1996 to 2003. The number of disability pensioners has increased by 26 percent in the same period. These numbers indicate a disturbing trend in Norway. However, SSB (2012) argues that the total amount of sickness absence in percent of man-days has been, with some fluctuations, the same from 2000 to 2012 (6.9 percent). Denmark has had an increase from 7.36 to 7.98 in days of sickness absence from 2003 to 2010 (Statistics Denmark 2012), and in Sweden we may observe a steady development. From the collected data we can observe a slight increase of sickness absence in Denmark, but in general there is little or no fluctuations in the respective countries. Unfortunately, we cannot perform any structural break analysis without more data.

According to Wilhelmsen (2011) the long-term trend in innovation for Norway is seen to be weakly negative. By international comparison, Norway is placed at the third level and defined as a “moderate innovator”. Denmark and Sweden are at the top level in the survey defined as “leading innovators”. The importance of innovations can be explained by Schumpeter (1934) who exemplifies the value of both product and process innovation as a possibility to operate in a monopolistic market. In this situation other enterprises will have to innovate/imitate in order to follow the progression. This push and pull situation may create high economic growth within and after the period with high innovation frequency.

Wilhelmsen (2011) presents high innovation cost, lack of funding, problems maintaining or recruit qualified employees, and demand uncertainty as different factors that are considered as obstacles for innovation activities in the Norwegian business sector.

An OECD survey (2010) [16] presents data of business enterprise expenditures on R&D as a percentage of GDP, and figure A.5.4.1 (appendix) illustrates the comparison of Norway, Sweden, Denmark, and OECD. Compared to Sweden and Denmark, Norway has had a negative development, using less on R&D in 2008 compared to 1998. Norway is also well below the OECD average. The survey also presents data of direct and indirect government funding of business R&D and tax incentives for R&D as a percentage of GDP (appendix A.5.4.2). It shows that the Norwegian government allocates more resources to R&D than its Scandinavian neighbors in total. In contrast to Wilhelmsen (2011), the lack of funding from the Norwegian government does not show in the data from OECD.

5.5 Discussion in Perspective - Escaping the curse for two decades

The theory on resource curse say that countries rich on natural resources will experience a slower growth than the countries without (Sachs and Warner 2001). Nevertheless, Norway had a relative acceleration in GDP per capita compared to Sweden and Denmark for over two decades after the discovery of oil. How did they do that?

Several researchers like Røed Larsen (2006), Stevens (2003) and Auty (2001) are drawn against a theory which says that good institutions are the reason. Before the discussion on what effect institutions have had on the Norwegian performance continues, we think it is important to define the term "institution". There are several definitions available, but we will follow the same as North (1981):

"*(…) a set of rules, compliance procedures, and moral and ethical behavioral norms designed to constrain the behavior of individuals in the interest of maximizing the wealth or utility of principals(…)*" North (1981, pp. 201-202)

This is a wide definition which encompasses formal political institutions (e.g. constitutional laws), economic institutions (e.g. Central Bank), and informal institutions (e.g. norms, values).

[16] Article written by OECD, Measuring Innovation: A new perspective – online version 2010. Accessed 05.07.12 URL: www.oecd.org/site/innovationstrategy/measuringinnovationanewperspective-onlineversion.htm

Stevens (2003) presents six possible ways to avoid natural resources turning into a curse. We believe good institutions can explain five of these:

- Leave it the ground
- Diversification
- Revenue sterilization
- Stabilization and Oil funds
- Investment policy
- Political reforms needed to carry out the corrective politics

Norway did obviously not leave the oil in the ground. We consider this “solution” as a response to the theory that says the resources harm growth, and not a serious option.

Diversification is more relevant for explaining the Norwegian escape. A reduction in the dominance of the oil sector has been an important goal for the government. Røed Larsen (2006) explains several policies that Norway executed to avoid a full-blown Dutch disease, and not to crowd out tradable sector. He highlights the importance of the centralized wage formation system where both parties, employer and employee, are encouraged to follow a wage increase ceiling, which are equal to the productivity increase in the manufacturing sector. Furthermore, he focuses on the exercise of fiscal discipline. Norway repaid foreign debts when possible, established a petroleum fund, and used resource rents to counteract recessions. Lastly, they built up and educated domestic expertise in the field of oil extraction. It was invested in education and R&D, which lead to a rise in human capital.

Revenue sterilization, stabilization and oil funds, and investment policy are more or less linked together. As discussed in part one of our thesis, the Norwegian government early understood the possible wealth and some of the challenges the findings of oil could bring. After the debt was repaid, the Government Pension Fund – Global was established and restrictions to the use of revenues from the natural resources were set.

The last of Stevens (2003) six points is the presence of political reforms that carry out the proper politics. The presence of democracy is mentioned as a necessity, which Norway certainly has, followed by avoidance from rent seeking and corruption. Røed Larsen (2006) argues that formal political and informal institutions prevented the latter. He does not seek to establish the presence of norms, but rather confirms that they averted the quest for effortless reward and reduced the frequency of conflicts. A strong judicial system is mentioned as the reason for little illegal rent seeking and arguably on of the most important factors in the theory which suggests that developed countries are less likely to catch the curse. Transparency, media scrutiny and institutions did minimize the legal rent seeking. The government was able to secure the revenues from the oil extraction through high taxes on revenues, government ownership in oil companies and the soil from which oil is extracted (Røed Larsen, 2006).

In addition to Stevens' (2003) six points, Røed Larsen (2006) argues that Norway has avoided large-scale conflicts after the discovery of its oil riches. A common understanding from unions, coalitions and the average people *not* to exploit the new riches kept for instance labor conflicts relatively small and rare. Moreover, there were no ruling elite in Norway which could channel the wealth into a few, private ends.

The results in our empirical chapter indicate an escape from the curse for more than two decades in Norway. Stevens (2003) presented six ways to avoid the curse, and it seems like Norway managed to fulfill most of them. We think good institutions were the reason for this. Both Acemoglu, Johnsen and Robinson (2001) and Rodrik, Subramanian and Trebbi (2004) argue that good institutions have a positive impact on economic growth. Institutions did perhaps not cause the rise in the Norwegian economy, but we argue that their presence was of utmost importance.

6.0 Conclusion

In this thesis we set out to research whether Norway has experienced a relative economic slowdown compared to its neighbors Sweden and Denmark. Røed Larsen (2005) used structural break analysis to show a relative acceleration in GDP per capita for Norway in the mid 1970's, and related this to the discovery of oil. He also found indications of a relative slowdown in the late 1990's, and related this to the economic theories on resource curse and Dutch disease. Had we seen the beginning of a lurking curse in Norway? We continued the work done by Røed Larsen (2005) with updated data, and, to some degree, extended the research to include other economic variables.

We encountered some difficulties when collecting data. It was especially the lack of data on sickness absence that disappointed us. A comprehensive increase in the sickness absence in Norway from 1996 to 2003 has been proven, and we thought a structural break analysis on the relative development in Norway compared to the neighbors would have been of utmost interest. Nevertheless, we obtained interesting results in other economic variables.

We performed the same structural break technique as Røed Larsen (2005) on the relative differences between Norway and Denmark, and Norway and Sweden in the following time series: GDP per capita, average annual hours worked per employed person, GDP per working hours, and employment as a percentage of population.

The key variable in our thesis is GDP per capita. We were able to confirm Røed Larsen's findings (2005) with a structural break in mid 1970's and the late 1990's. The results differed to some extent on the latter. Where Røed Larsen (2005) discovered an indication of a break, we observed a significant structural break in the time series. Our results indicate that the break in the late 1990's is more severe than the break in the 1970's. In addition to performing the same test as Røed Larsen on GDP per capita, we also performed a test of robustness. We used the first year in our data, 1960, as an index year, and divided all the following periods on index year. The results confirmed our previous findings with a break in the mid 1970's and one in the late 1990's.

It proved difficult to substantiate our theory of a relative slowdown in the Norwegian economy with structural break analysis on the other variables. The only breaks of interest were in the time series comparing the Norwegian and Swedish, and the Norwegian and Danish GDP per working hours, with a break closely after the millennium. This break indicated a relative slowdown in GDP per working hours for Norway compared to its neighbors. However, we were able to see interesting trends in the other variables. Norway begun the period with a relative lead on both Sweden and Denmark in the time series with data on annual average hours worked per employed person, but ended up below. The data on employment as a percentage of population illustrated the relative differences between the Scandinavian countries, and Norway ended up with a higher employment rate than its neighbors.

We further discussed the findings in the context of our research question and the two economic theories: The resource curse and the Dutch disease. We argued that events such as the Swedish reform in 1993 and the oil price might have affected the results, and that the best argument against our findings were the possible underperformance in the control countries during the time period. With regards to the findings in the variable average annual hours worked per employed person, we claim that it may be due a reduction in the need for work. It may also mean that Norwegians are more productive than its neighbors, which is closely linked to the variable GDP per working hours.

It is difficult to determine whether Norway had a relative economic slowdown compared to its Scandinavian neighbors, but we believe our findings indicate a lurking catch up from Sweden and Denmark. We think it is to early in the process to conclude the presence on either a resource curse or a Dutch disease, even if it is tempting to label the development in the Norwegian economy.

References

Acemoglu, D., Johnsen, S and Robinson, J. A. 2002. “An African success: Botswana”, Analytic Development Narratives, Princeton University Press.

Acemoglu, Daron, Simon Johnson and James Robinson 2001. ”The Colonial Origins of Comparative Development: An Empirical Investigation” The American Economic Review, 91 (5): 1369-1401

Aukrust, Odd 1977. “Inflasjon I en åpen økonomi: En norsk modell”, Statistisk Sentralbyrå, Nr. 96

Auty, Richard M. 2001. “The political economy of resource-driven growth”. European Economic Review, 45: 839 – 846

Barder, Owen 2006. “A policymaker’s guide to Dutch Disease”. Center for Global Development, Working paper No. 91.

Barro, Robert J., and David B. Gordon. 1983b: “A positive theory of monetary policy in a natural rate model”. Journal Of political economy, 91 (4): 589 – 610.

Bjørnland, Hilde C. 2010 ”En Mutert og Alvorlig Hollandsksyke” Dagens Næringliv. Published: 10.03.10. Accessed: 03.05.12 URL: *http://www.dn.no/forsiden/politikkSamfunn/article1855947.ece*

Calvo, Guillermo. 1978. “On the time Consistency of optimal Policy in a monetary Economy”. Econometrica, 46 (6): 1411 – 1428

Corden W. Max. 1984. “Booming Sector and Dutch Disease Economics: Survey and Consolidation”. Oxford Economic Papers, 63 (3): 359 – 380

Corden, W. Max and J. Peter Neary. 1982. “Booming Sector and De-Industrialization in a Small Open Economy”. The Economic Journal, 92 (368): 825 – 848

Davis, Steven J. and Henrekson, Magnus. 2006. “Economic performance and Work Activity in Sweden after the crises of the early 1990s”. National Bureau of economic research, NBER Working Paper. No. 12768

Demirgüc-Kunt, A., and Detragiache, E. 1998, “Financial Liberalization and Financial Fragility”, International Monetary Fund, Working Paper 98/83.

Durbin, J. and Watson, G.S. 1971 “Testing for serial correlation in least squares regression, II.” Biometrika, 58 (1): 1-19

Durbin, J., and Watson, G. S. 1950 "Testing for Serial Correlation in Least Squares Regression, I." Biometrika, 37: 409–428.

Durbin, J., and Watson, G. S. 1951 "Testing for Serial Correlation in Least Squares Regression, II." Biometrika, 38: 159–179.

Dwyer, Gerald P. Jr. 1983 “Rules and Discretions in Monetary Policy“ The Federal Reserve Bank of St. Louise, Review /may/june 3 - 13

Economist. 2010. ”Its only natural” The Economist

Eika, Torbjørn., Magnussen, Knut A. 2000. “Did Norway gain from the 1979 – 1985 oil price shock?” Economic modeling, 17 (1): 107 – 137

Englund, Peter 1999, “The Swedish Banking Crisis: Roots and Consequences”, Oxford Review of Economic Policy, 15 (3): 80 – 97

Gjedrem, Svein. 2010. ”Konjukturer, kriser og statsfinanser – kan staten bære sine forpliktelser?” Norges Bank

Gylfason, Thorvaldur. 2001. *“*Natural resources, education, and economic development*”*. European Economic Review, 45: 847 – 859

Hagelund, Kåre. 2009. “Produktivitetsutviklingen I Norge 1948 -2008”, Norges Bank, Penger og Kreditt, 37 (2): 4-15

Hansen, Bruce E. 2001. *"*The New Econometrics of Structural Change: Dating Breaks in U.S. Labor Productivity*"*. Journal of Economic Perspective, 15 (4): 117 – 129

Ihlebaek, Camilla., Soren, Brage., and Eriksen, R. Hege. 2007. "Health complaints and Sickness Absence in Norway 1996 – 2003". Occupational Medicine 57: 43 - 49

Krugman, Paul R. 1997*: The age of diminished Expectations",* 3rd. Edition: Business and Economics. pp 11

Kydland, Finn E., and Edward C. Prescott. 1977. "Rules rather than Discretion: The inconsistency of optimal plans". Journal of political Economy, 85 (3): 473 - 491

Lardic, Sandrine and Mignon, Valèrie. 2005 "The impact of oil prices on GDP in European Countries: An empirical investigation based on asymmetric cointegration". Energy Policy 34 (18): 3910 – 3915

M. Höök, B. Söderbergh, and K. Aleklett. 2009 "Future Danish oil and Gas Export", Global Energy Systems, 34 (11): 1826 – 1834

Mehlum, H., K. Moene, and R. Torvik. 2006. "Institutions and the Resource Curse*." The Economic Journal, 116 (508): 1-20.

Mikesell, Raymond F. 1997. *"*Explaining the resource curse, with special reference to mineral-exporting countries*"*. Department of Economics, 23 (4): 191 – 199

Moe, Thorvald G., Solheim, Jon A., and Vale, Bent. 2004. "The Norwegian Banking Crisis",. Norges Banks Skriftserie / Occasional Papers,. No. 33

Murray, P. Michael 2006. *Econometrics – A modern introduction.* International Edition: Daryl Fox

North, D. C. 1981. Structure and Change in Economic History. New York: Norton and Co.

Rodrik, Dani., Subramanian, Arvind and Trebbi, Francesco. 2004. “Institutions Rule: The primacy of Institutions Over Geography and Integration in Economic Development*”,* Journal of Economic Growth 9: 131-165

Røed Larsen, Erling. 2005. “Are rich countries immune to the resource curse? Evidence from Norway’s management of its oil riches*”*. Research Department, Statistics Norway, Resource policy 30, 75 – 86

Røed Larsen, Erling. 2006. *“*Escaping the Resource Curse and the Dutch Disease? – When and Why Norway caught up with and Forged Ahead of its Neighbors*”*. American Journal of Economics, 65 (3): 605 - 640

Sachs, J.D., and Warner, A.M., 1995 revised 1997, 1999. “Natural resource abundance and economic growth”. National Bureau of Economic Research Working paper NO 5398, Cambridge, MA.

Sachs, J.D., and Warner, A.M., 1999. The big push, natural resource booms and growth. Journal of development economics 59, 42-76

Sachs, Jeffrey D. and Andrew M. Warner. 2001. *“*The curse of natural resources*”*. Center for International Development, 45 (4-6): 827 – 838

Schumpeter, J. A. 1934. “The theory of economic Development”, trans. Harvard Economic Studies, 46

Solheim, Haakon. 2008. “Virkninger av økt oljepris på norks økonomi”. Norges Bank Pengepolitikk, Nr. 2/Juni 2008

Stevens, P. 2003. “Resource Impact: Curse or Blessing?” A Literature Survey.” Journal of Energy Literature 9(1): 3-42

Tornell, A., and P.R. Lane. 1999. "The voracity effect. "American Economic Review: 22-46.

Torvik, Ragnar. 2001. "Learning by doing and the Dutch Disease", European Economic Review 45, 285 – 306

Ueberfeldt, Alexander. 2005. "Working Time over the 20th Century", Bank of Canada, Working Paper 06-18

Wilhelmsen, Lars. 2011. "Innovasjon i norsk næringsliv 2006-2008". Statistisk sentralbyrå – Norway, Rapporter 32/2011

Bureau of Labor Statistics (2012). International Labor Comparison. 1960 – 2010 US department of Labor. URL:http:/www.bls.fls

Organisation for Economic Co-operation and Development (2012). International Comparison. 1970 – 2011. URL: http://www.oecd.org/statistics/

Statistisk Sentralbyrå (2012). Statistics Norway.
URL:http://statbank.ssb.no/statistikkbanken/

Denmark Statstik (2012). Statistics Denmark URL:http://www.statistikbanken.dk/

Statistiska Centralbyrån (2012). Statistics Sweden
URL:http://www.scb.se/Pages/List____250612.aspx

World Intelectual Property Organisation (2012). Innovation and Creativity. URL: http://www.wipo.int/portal/index.html.en

NHO 2010. "Oljepengen brukes feil" Økonomisk Overblikk 2010/1
"The Confederation of Norwegian Enterprise. Published: 04.03.12 Accessed: 25.04.12*:* URL: http://www.nho.no/oekonomisk-politikk-og-analyser/oljepengene-brukes-feil-article21772-86.html
published 09.09.10. Accessed: 14.04.12 URL: www.economist.com/node/16964094

Appendix

This appendix will fill inn results and findings that are referred to as appendix for further information in the main paper. This overview will follow the same set of chapters, connecting both together.

A.3.3.1.1 Eviews output, the difference between Norwegian and Danish GDP per capita, period 1960-2010, not taken the AR-1 process into account.

Dependent Variable: N_D
Method: Least Squares
Date: 09/02/12 Time: 14:21
Sample: 1960 2010
Included observations: 51

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2161.750	331.0496	-6.529988	0.0000
@TREND	400.6188	11.41098	35.10818	0.0000

R-squared	0.961766	Mean dependent var	7853.720
Adjusted R-squared	0.960986	S.D. dependent var	6072.852
S.E. of regression	1199.511	Akaike info criterion	17.05564
Sum squared resid	70502487	Schwarz criterion	17.13140
Log likelihood	-432.9189	Hannan-Quinn criter.	17.08459
F-statistic	1232.584	Durbin-Watson stat	0.213146
Prob(F-statistic)	0.000000		

A.3.3.1.2 Eviews output, the difference between Norwegian and Danish GDP per capita, period 1960-2010, taken the AR-1 process into account.

Dependent Variable: N_D
Method: Least Squares
Date: 09/02/12 Time: 14:15
Sample (adjusted): 1961 2010
Included observations: 50 after adjustments
Convergence achieved after 4 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3655.521	1158.299	-3.155938	0.0028
@TREND	435.7996	31.86464	13.67659	0.0000
AR(1)	0.829553	0.061351	13.52144	0.0000

R-squared	0.993103	Mean dependent var	7993.286
Adjusted R-squared	0.992809	S.D. dependent var	6051.321
S.E. of regression	513.1433	Akaike info criterion	15.37711
Sum squared resid	12375854	Schwarz criterion	15.49183
Log likelihood	-381.4278	Hannan-Quinn criter.	15.42080
F-statistic	3383.633	Durbin-Watson stat	1.590945
Prob(F-statistic)	0.000000		
Inverted AR Roots	.83		

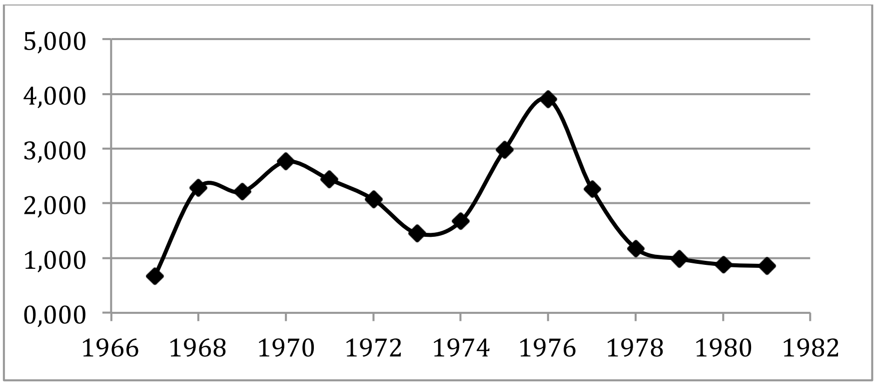
A.4.1.1 RSSr, RSSu, and F-value calculations. GDP-PPP-adj. per Capita. Diff. between Norway and Denmark. Full Period 1960 – 2010

To calculate our different F-values we have used the formula for F-values. The table below exemplifies the different values obtained in order to find the F-value. We will only illustrate this once due to the amount of space needed for all calculations. For the future findings we will only present the F- values by a graph, documenting the key value obtained in order to determine a break year.

Full period: 1960 - 2010

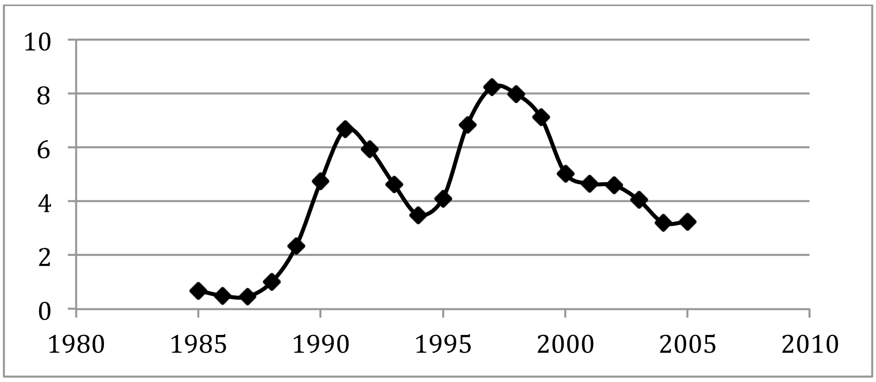
	Norway vs. Denmark		RSSr	12375854	
Year	Period	RSSu1	Period	RSSu2	F - Value
1966	1960 - 1965	82171,1	1966 - 2010	11397246,0	1,145
1967	1960 - 1966	143131,7	1967 - 2010	11223737,0	1,302
1968	1960 - 1967	290756,9	1968 - 2010	11108772,0	1,256
1969	1960 - 1968	344175,6	1969 - 2010	10793820,0	1,630
1970	1960 - 1969	762767,9	1970 - 2010	10244160,0	1,824
1971	1960 - 1970	775464,4	1971 - 2010	10119179,0	1,994
1972	1960 - 1971	939560,3	1972 - 2010	10105118,0	1,768
1973	1960 - 1972	1155168,0	1973 - 2010	9925223,0	1,715
1974	1960 - 1973	1299711,0	1974 - 2010	9594836,0	1,994
1975	1960 - 1974	2245785,0	1975 - 2010	9547780,0	0,724
1976	1960 - 1975	2854851,0	1976 - 2010	8898108,0	0,777
1977	1960 - 1976	3368414,0	1977 - 2010	8807330,0	0,241
1978	1960 - 1977	3372800,0	1978 - 2010	8783119,0	0,265
1979	1960 - 1978	3377792,0	1979 - 2010	8773216,0	0,271
1980	1960 - 1979	3446352,0	1980 - 2010	8758270,0	0,206
1981	1960 - 1980	3975451,0	1981 - 2010	7734844,0	0,834
1982	1960 - 1981	3997818,0	1982 - 2010	7405688,0	1,251
1983	1960 - 1982	6118706,0	1983 - 2010	6227893,0	0,035
1984	1960 - 1983	6120029,0	1984 - 2010	6220018,0	0,043
1985	1960 - 1984	6178456,0	1985 - 2010	6168244,0	0,035
1986	1960 - 1985	6207554,0	1986 - 2010	6110412,0	0,069
1987	1960 - 1986	6418229,0	1987 - 2010	5915274,0	0,050
1988	1960 - 1987	6418269,0	1988 - 2010	5910953,0	0,055
1989	1960 - 1988	6795658,0	1989 - 2010	5256054,0	0,394
1990	1960 - 1989	6940400,0	1990 - 2010	4752861,0	0,856
1991	1960 - 1990	7024622,0	1991 - 2010	4198113,0	1,507
1992	1960 - 1991	7050299,0	1992 - 2010	4034904,0	1,708
1993	1960 - 1992	7104691,0	1993 - 2010	3850182,0	1,902
1994	1960 - 1993	7421317,0	1994 - 2010	3836008,0	1,457
1995	1960 - 1994	7440520,0	1995 - 2010	3019218,0	2,687
1996	1960 - 1995	7543399,0	1996 - 2010	2292829,0	3,787
1997	1960 - 1996	8288860,0	1997 - 2010	1950402,0	3,060
1998	1960 - 1997	8999464,0	1998 - 2010	1946426,0	1,916
1999	1960 - 1998	9006332,0	1999 - 2010	1900153,0	1,976
2000	1960 - 1999	9299054,0	2000 - 2010	1840467,0	1,628
2001	1960 - 2000	9369459,0	2001 - 2010	1536258,0	1,977
2002	1960 - 2001	9402264,0	2002 - 2010	1359630,0	2,200
2003	1960 - 2002	9402421,0	2003 - 2010	1209803,0	2,437
2004	1960 - 2003	9467734,0	2004 - 2010	762819,0	3,076
2005	1960 - 2004	9701493,0	2005 - 2010	714353,2	2,760
2006	1960 - 2005	9721327,0	2006 - 2010	539203,9	3,024
2007	1960 - 2006	10347502,0	2007 - 2010	71338,1	2,755
2008	1960 - 2007	10347533,0	2008 - 2010	0	
	1960 - 2008		2009 - 2010	NA	

A.4.1.4 F-Value, Structural Break Test, GDP-PPP-adj. per Capita. Diff. between Norway and Sweden. Partial Period 1960 – 1984, Candidate Year 1966 - 2002



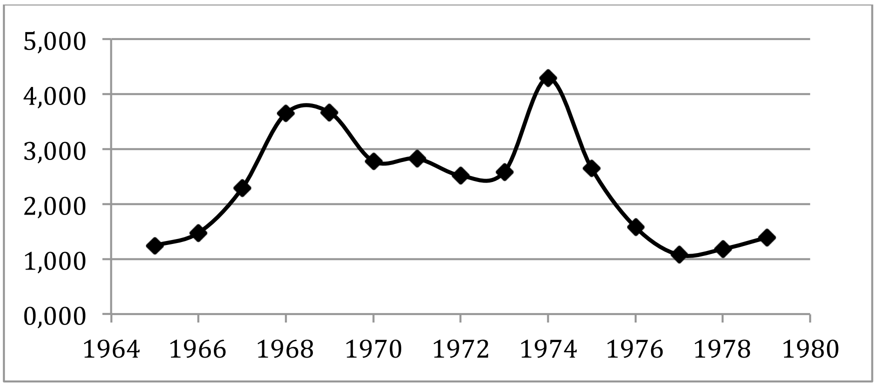
Critical Value; $F_{(,5,3,18)}$*=3,160*
Source: Original data from BLS, own calculations

A.4.1.5 F-Value, Structural Break Test, GDP-PPP-adj. per Capita. Diff. between Norway and Sweden. Partial Period 1978 – 2010, Candidate Year 1985 - 2005



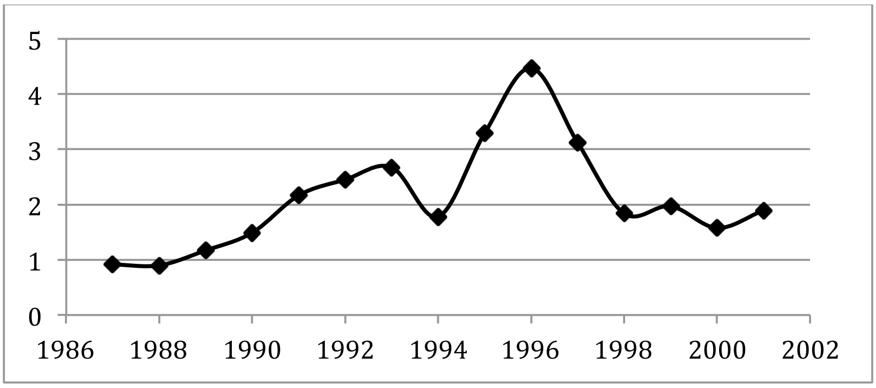
Critical Value; $F_{(,5,3,26)}$*=2,975*
Source: Original data from BLS, own calculations

A.4.1.6 F-Value, Structural Break Test, GDP-PPP-adj. per Capita. Diff. between Norway and Denmark. Index Year 1960. Partial Period 1960 – 1984, Candidate Year 1966 - 2002



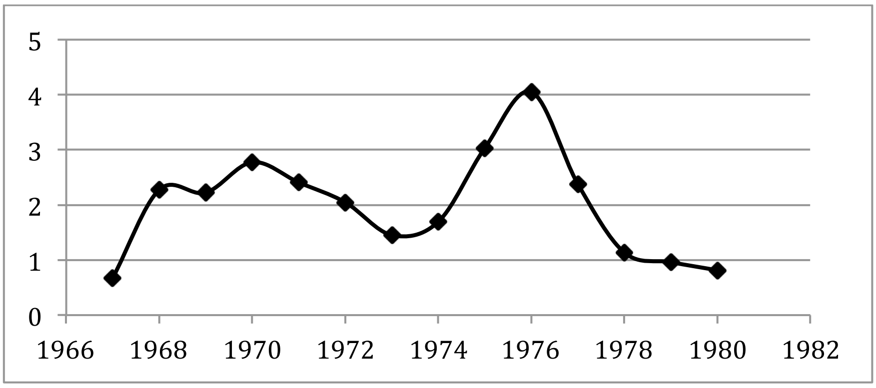
Critical Value; $F_{(,5,3,18)}$*=3,160*
Source: Original data from BLS, own calculations

A.4.1.7 F-Value, Structural Break Test, GDP-PPP-adj. per Capita. Diff. between Norway and Denmark. Index Year 1960. Partial Period 1975 – 2010, Candidate Year 1987 – 2001.



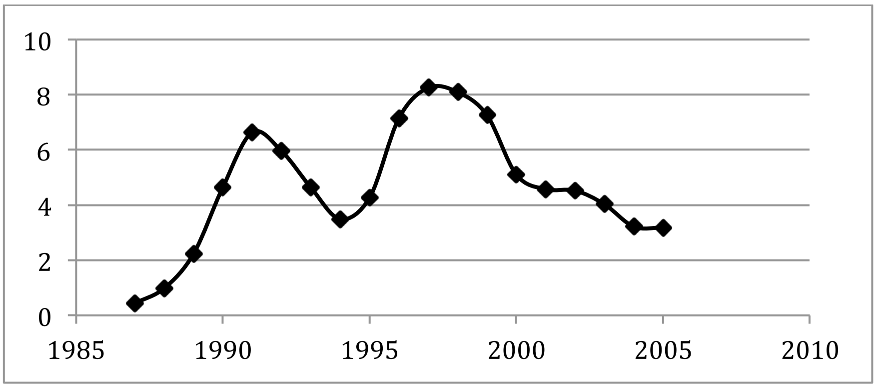
Critical Value; $F_{(,5,3,29)}=2{,}934$
Source: Original data from BLS, own calculations

A.4.1.8 F-Value, Structural Break Test, GDP-PPP-adj. per Capita. Diff. between Norway and Sweden. Index Year 1960. Partial Period 1960 – 1984, Candidate Year 1967 – 1980.



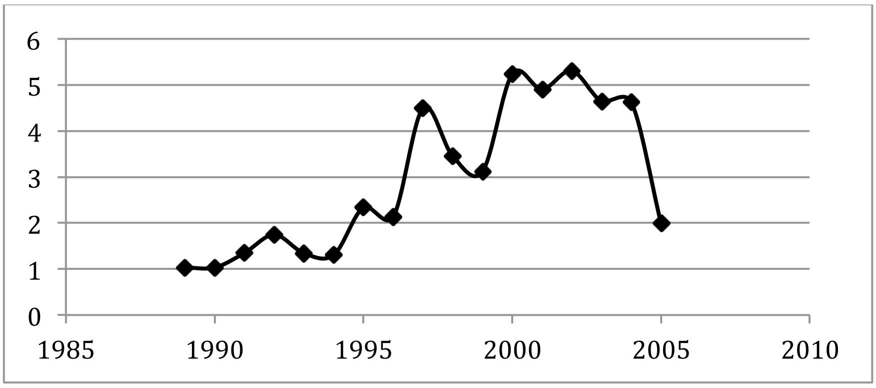
Critical Value; $F_{(,5,3,18)}=3{,}160$
Source: Original data from BLS, own calculations

A.4.1.9 F-Value, Structural Break Test, GDP-PPP-adj. per Capita. Diff. between Norway and Sweden. Index Year 1960. Partial Period 1978 – 2010, Candidate Year 1987 – 2005.



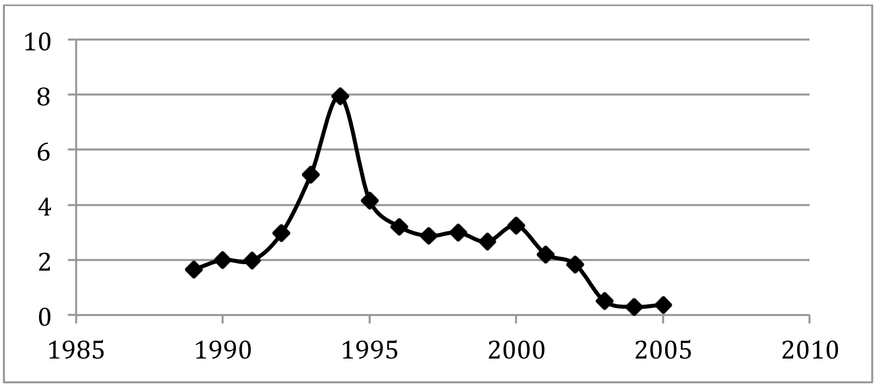
Critical Value; $F_{(,5,3,26)}=2{,}991$
Source: Original data from BLS, own calculations

A.4.2.1 F-Value, Structural Break Test, Average Annual Hours Worked per Employed Person. Diff. between Norway and Denmark. Full Period 1980 – 2010. Candidate Year 1989 - 2005



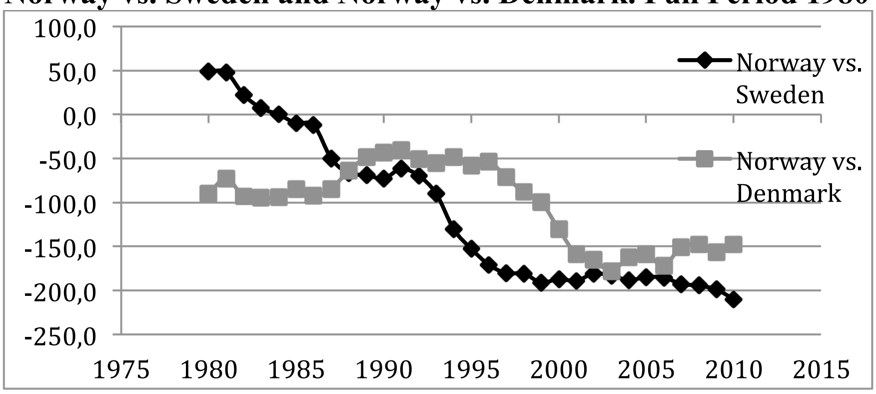
Critical Value; $F_{(,5,3,24)}=3{,}009$
Source: Original data from BLS, own calculations

A.4.2.2 F-Value, Structural Break Test, Average Annual Hours Worked per Employed Person. Diff. between Norway and Sweden. Full Period 1980 – 2010. Candidate Year 1989 – 2005.



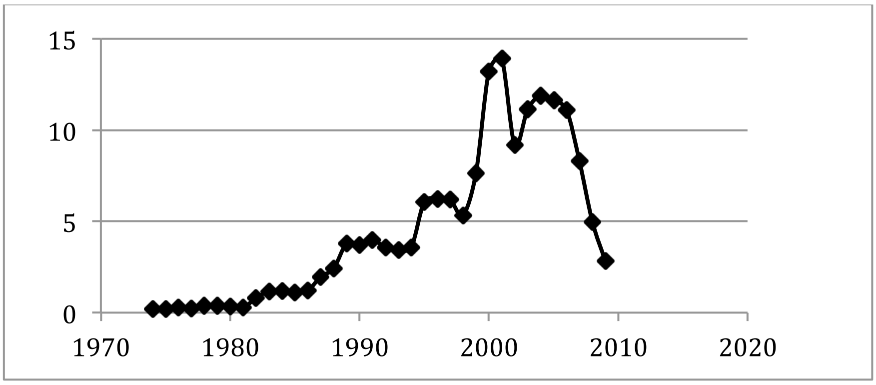
Critical Value; $F_{(,5,3,24)}=3{,}009$
Source: Original data from BLS, own calculations

A.4.2.3 Obs. Avereage Annual Hour Worked per Employed Person. Diff. Norway vs. Sweden and Norway vs. Denmark. Full Period 1980 - 2010



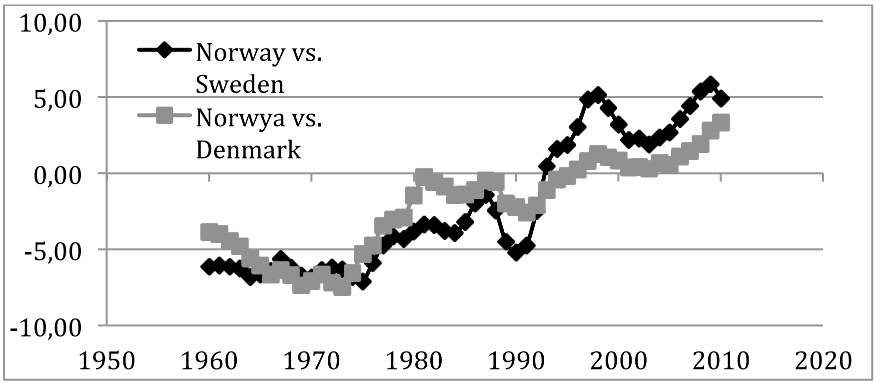
Source: Original data from BLS, own illustrations

A.4.3.1 F-Value, Structural Break Test, GDP-PPP-adj. per Hour Worked. Diff. between Norway and Denmark. Full Period 1970 – 2010. Candidate Year 1974 - 2009.



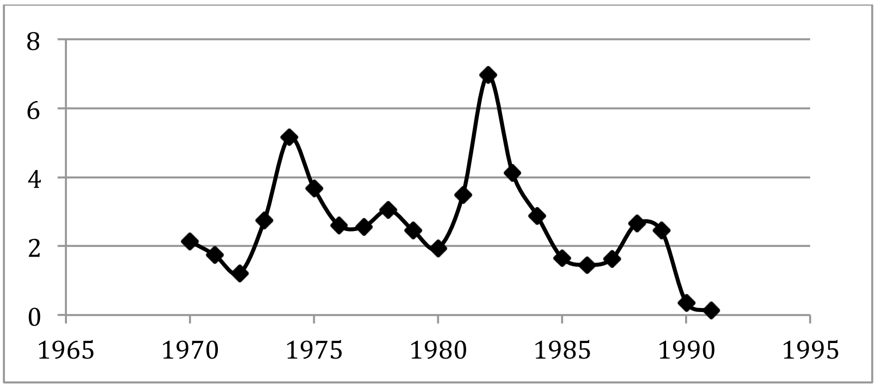
Critical Value; $F_{(,5,3,34)}$*=2,883*
Source: Original data from OECD, own calculations

A.4.4.1 Obs. Employment as a Percentage of Population. Diff. between Norway and Sweden and between Norway and Denmark. Full Period 1960 – 2010.



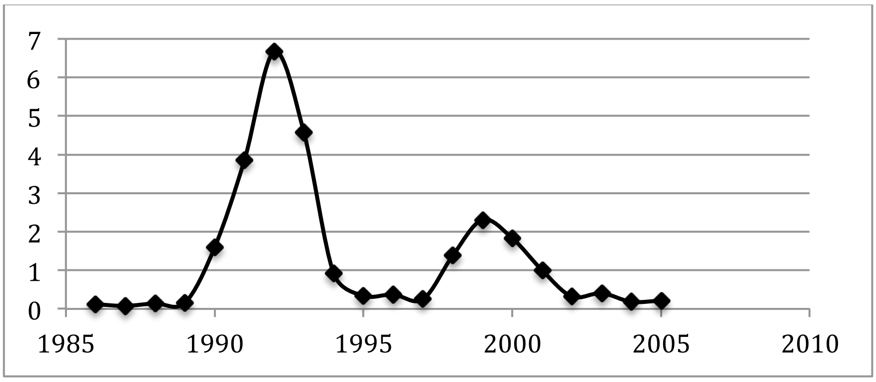
Source: Original data from BLS, own illustrations

A.4.4.2 F-Value, Structural Break Test, Employement as a percentage of population. Diff. Between Norway and Denmark. Full Period 1960 – 2010. Candidate Year 1970 - 1991



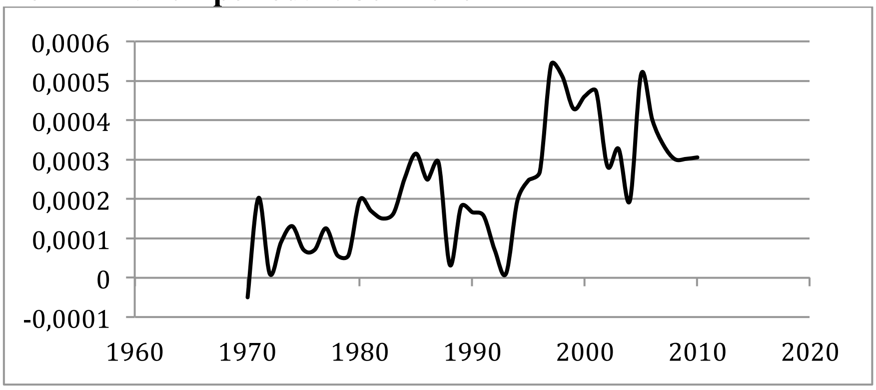
Critical Value; $F_{(,5,3,44)}$*=2,816*
Source: Original data from BLS, own calculations

A.4.4.3 F-Value, Structural Break Test, Employement as a percentage of population. Diff. Between Norway and Sweden. Full Period 1960 – 2010. Candidate Year 1986 - 2005



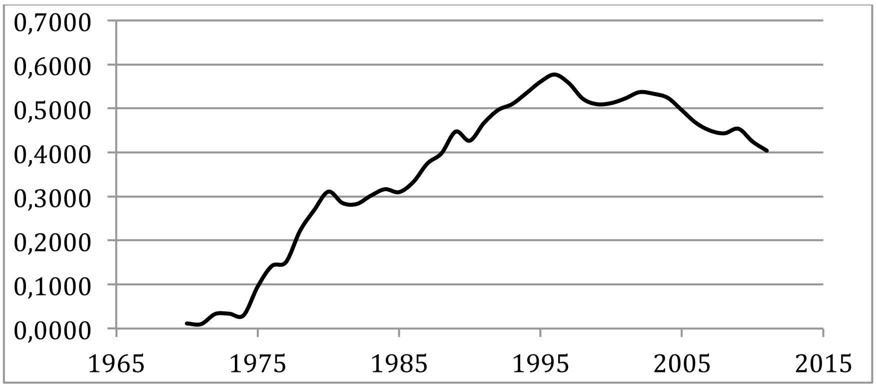
Critical Value; $F_{(,5,3,44)}=2{,}816$
Source: Original data from OECD, own calculations

Fig. A.4.4.4 Obs. Total Patents per Capita. Diff. between Norway and Denmark. Full period: 1970 - 2010



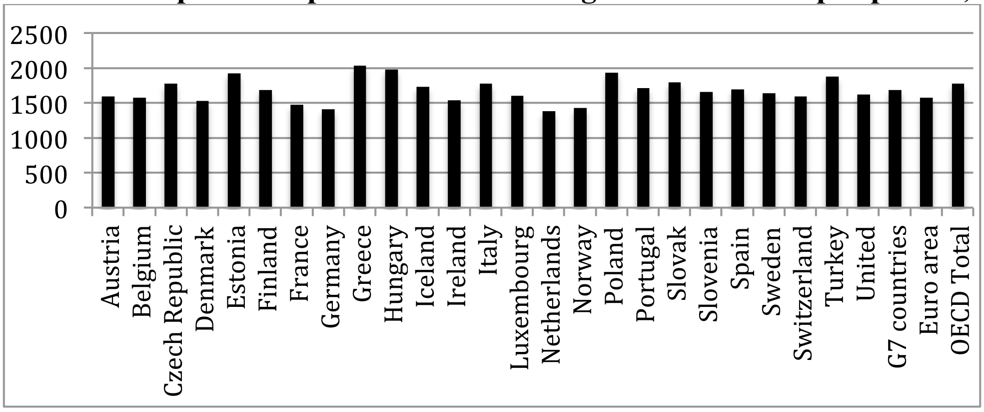
Source: Original data from WIPO, own calculations

A.5.1.1 Oil & Gas export as a fraction of total export. Norway, Full period. 1970 - 2011



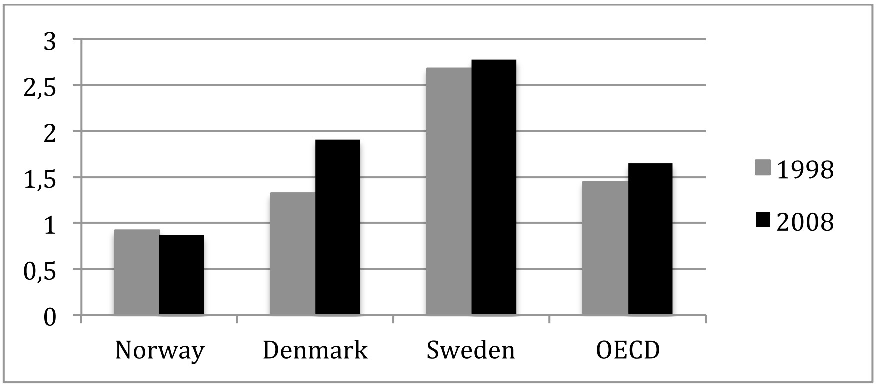
Source: Original data from SBB, own illustrations

A.5.3.1 European comparison. Obs. Average hours worked per person, 2010.



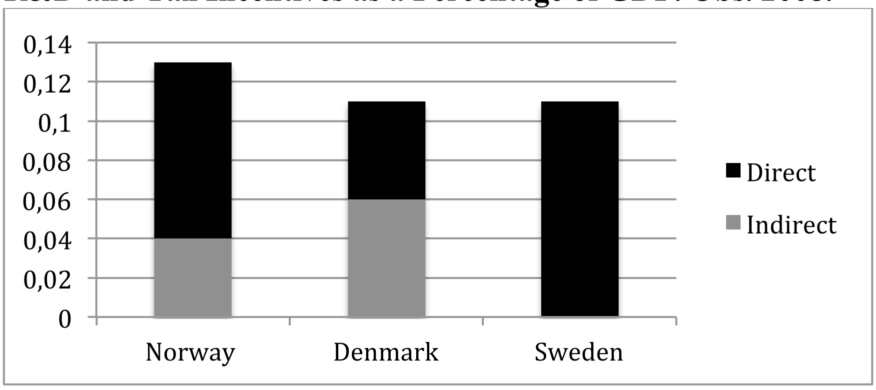
Source: Original data from OECD, own illustrations

A.5.4.1 Comparison of Enterprise Expenditures on R&D as a Percentage of of GDP. Obs. 1998 and 2008



Source: Original data from OECD, own illustrations

A.5.4.2 Comparison of Direct and Indirect Government Funding of Business R&D and Tax Incentives as a Percentage of GDP. Obs. 2008.



Source: Original data from OECD, own illustration