SCHOOL OF ECONOMICS AND MANAGEMENT

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Understanding the Norwegian Petroleum Industry: How does Oil explain Norwegian Public Expenditure and Social Spending? How vulnerable is it to shocks?

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Abstract- There are few people who deny that Norway's social welfare was achieved after Oil Discoveries. But there is concern about the sustainability of the Norwegian economy regarding the volatility of the Oil market. This study provides a quantitative analysis of the relationship between Central Government Expenditure and Oil exports plus vulnerabilities measured by Gold to Oil ratio, Exchange Rate Volatility and Export to Import ratio. The aim of the study is to see if Norway has achieved independence from Oil in its Social Public Spending and for that reason after testing for cointegration, a VEC analysis is performed, in order to observe the impulse response functions of the variables of interests to shocks in their vulnerabilities. The results show that the country had a strong dependency from Oil between 1978-1996 but then managed to became resilient to such shocks plus those in Oil and financial markets and Balance of Payments.

Keywords: Norway, Social Public Spending, Oil Exports, VEC, Impulse Response, External vulnerabilities

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Table of Contents

List of Tables

List of Figures

1. INTRODUCTION

At the beginning of the 19th Century, Norway was an agrarian economy in which less than 10% of the total population lived in urban areas (Minde & Ramstad, 2011, pp. 1). Arable land was scarce and weather was cold, which limited and constrained its economic growth and opportunities, as in pre-industrial economies land and labour were the main economic factors. In fact, Malthus (1799) in his journey to Norway observed that most peasants were struggling to subsist and merchants were concerned about possible increases in import prices. These facts, coupled with the difficulties to cultivate, make him conclude that any economic improvement (e.g. better harvest) would led to an increase in population that will eventually offset such economic increase reaching thus previous levels of economic outcomes, the so-called *Malthusian Trap* (Malthus, 1803). It is also important to notice that these agricultural constraints and harsh living conditions strengthened the need for imports, making Norway extremely dependent on international trade. In fact, this dependency also made the country extremely sensitive to international shocks as it was seen during the *Continental Blockade* between 1805-1814 when Norway's CPI levels increased by more than 50% (Statistics Norway & Eirtheim et al., 2004). In short, before industrialization, Norway was a relatively poor country with low growth opportunities and high dependency on trade.

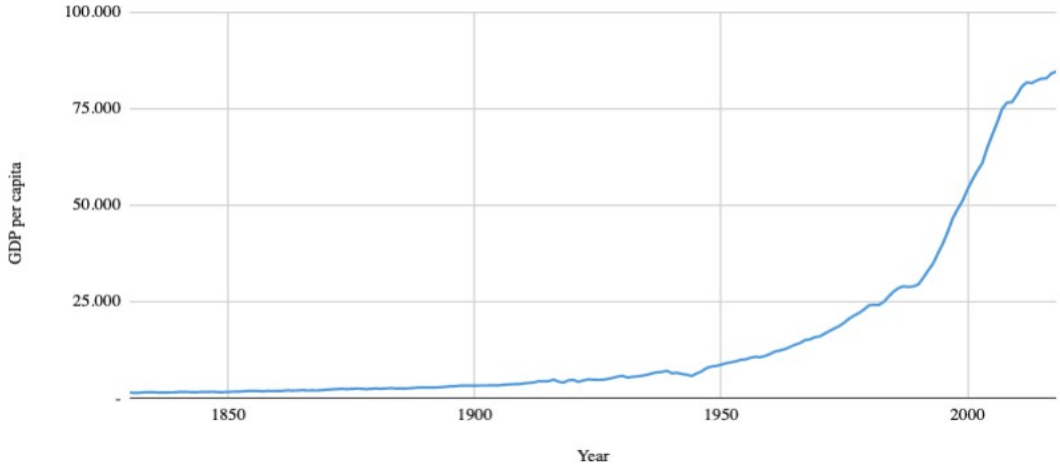
However, nowadays it has reached high levels of welfare and development, being positioned among the nations with highest values of HDI and GDP per capita, suggesting significant improvements in living conditions and economic performance with respect the 19th Century. What has motivated this event?

It is true that Industrialization played an important role by increasing agricultural productivity by 150% during the last half of the 19th Century and reducing its labour share in Agriculture by less than 40% in 1910 (Minde & Ramstad, 2011, pp. 1). Moreover, Klemp & Møller (2016) provide evidence that investment in infrastructure and technological change managed to achieve higher growth rates in economic outcomes with respect population growth, escaping thus from the *Malthusian Trap* and ensuring some economic growth opportunities. However, in Figure 1, it can be observed that Norway's GDP per capita although having a steadily increasing trend, the change is only noticeable after 1950 and becomes sharper around 1980. This fact suggests that despite some economic achievements gained during early Industrialization, they were still not enough to reach high growth rates or at least not at early stages. Why?

As it was mentioned before, Norway's climate conditions and scarcity of land coupled with

relative low levels of population (Drake, 1969) made the economy not only dependent on trade but also small. Taking these statements into consideration, then perhaps the reason why Norway didn't achieve high levels of growth in economic outcomes is because its domestic markets weren't big enough to incentivize a fully manufacturing transition or because its limited endowments of resources made the country unable to strengthen the export industry. Following the theories of Rosenstein-Rodan (1943), Rostow (1959) and Gerschenkron (1977), the main reason for Norway's slow growth was mainly due to the lack of resources, incentives and commercialisation as well as its high dependency on trade imports that prevented a take-off or *Big Push*. This fact has been corroborated by Lieberman (1970, pp. 160): "The available data fail to show a Rostow-like industrial take-off … in the nineteenth century in Norway". That being the case, what has motivated the accelerated economic growth between 1950-1980?

Figure 1: Norway's GDP per capita (constant prices 2011)



Source: Own elaboration based on Maddison Project Database

After WWII, Norway was forced to restructure its economy in order to deal with the destruction caused during the war. The lack of a stable and strong currency forced the country to be part of the Marshall Plan and join the Bretton-Woods system which, as in many European countries, provided the necessary resources to reconstruct its economy and achieve growth rate levels never seen before, it was the *European Golden Era of Economic Growth.* However, the peak in growth rates did not occur until 1969 when Norway discovered Oil deposits at the North Sea which led to the establishment and nationalization of this new industry, *Statoil.* Following the premises discussed above then Oil, as a natural resource with high Demand since the energy transition from Coal to Internal Combustion Engines, might have provided enough incentives for an industrial take-off capable of stimulating economic growth rates. Some economists like Larsen (2005; 2006), Al-mulali (2010) and Ryggvik (2010) have found evidence of Oil as the main driver of its economic

prosperity and living standards but there are caveats to be observed.

One of the main caveats is the "Curse of Natural Resources" which states that raw materials tend to incentivize the rise of extractive institutions and hinder growth (Sokoloff & Engerman, 2000) being Oil a specially notorious case (Brooks, 2022; Tsui, 2010). Nevertheless, Norway seems to be an anomalous case as its levels of GDP per capita have been following a sharp increasing trend since the creation of Statoil and there has been lot of spending in social outcomes like education and health, suggesting a possible increase not only in economic growth but also in living standards.

On the other hand, this can be a potential issue for the Norwegian economy, as being dependent on depletable resources with high sensitivity to international shocks (as it was observed during the "Oil Crisis" and COVID-19) might have a significant negative effect in the economy. In fact the Governor of Norges Bank declared: "We cannot expect the strong growth in national income we have seen in recent years to continue. Norway is not immune to … external shocks" (Olsen, 2014, pp. 10). Knowing these facts, this study address the following questions:

How does Oil influence Norway's Social Spending? What are its main vulnerabilities? How sensitive is it to shocks?

The structure of the thesis is organized as follows: Section 2 provides a Literature Review on the foundation of Statoil and its relationship to Public and Social Spending as well as their dynamics and trends throughout the period of time analyzed, 1978-2020; Section 3 provides a detailed description of the possible vulnerabilities for the Oil industry among reviews from scholars as a way to identify the main mechanisms of such vulnerabilities in Norway's economy; Section 4 describes the data used and the empirical specifications which will consist in time series regressions through VAR and VEC models; Section 5 presents the Results of the estimations; Section 6 points out the main limitations of the model and its implications; Section 7 concludes.

2. NORWAY'S PUBLIC EXPENDITURE

2.1- Background: The creation of Statoil and its aim

Before analyzing the relationship between Oil and Public Spending, it is necessary to first deepen on the historical background of Norway during the 1970s in order to acquire the basic insights needed for the analysis.

In the 1960s, after having declared sovereignty over the North Sea, Norway moved by entrepreneurial spirit began a set of explorations in search for natural resources over the area. Initially, explorations were carried out in a liberal and flexible way, imposing little restrictions for international oil companies who took a major role in this venture, but after the discovery of the large deposits of oil in 1969, the government shifted to a more restrictive approach. In 1971, the *Norwegian Labour Party* (ruling party at that time) seized this opportunity to nationalize the industry and get an independent administration, it was the birth of *Statoil.*

The main aim of this new industry was to ensure the welfare of the Norwegian population through the revenues obtained due to the extraction of petroleum and to decrease the external dependency of Norway:

... a petroleum policy should be developed with a view to exploiting the natural resources... in a way which benefits the whole community, the committee would concur that this means:

1. *That national management and control must be secured over all operations on the Norwegian continental shelf.*
2. *That petroleum discoveries are exploited in a way which minimizes Norway's dependence on others for crude oil supplies.*
3. *That new industrial activities should be developed on the basis of petroleum*

   ....
6. *That petroleum from the Norwegian continental shelf must, as a main rule, be landed in Norway with the exception of individual cases where national policy concerns call for a different solution.*
7. *That the state becomes involved at all appropriate levels, and contributes to a coordination of national interests in the Norwegian petroleum industry as well as the creation of an integrated Norwegian petroleum community which sets its sights both nationally and internationally.*
8. *That a state oil company be established to take care of the state's commercial interests and to maintain suitable collaboration with domestic and international petroleum interests* (Stortingsmelding, 1971)

As it was mentioned before, the Oil industry was capable of fostering economic growth. However, in the 1990s, the Government started to be concerned about the sustainability of petroleum industry and its implications on the population, and thus the *Government Pension Fund* was created. The mechanism of this new fund consisted in investing the surplus revenues of Oil industry in foreign shares and bonds in order to diversify the risk and achieve some financial security at national levels. One of these mechanisms is the *Handlingsregelen* (set in 2001), a withdrawal rule that stipulates that the national budget must not have a deficit larger than 3% (Henriksen, 2012) emphasizing once again the concern of the Norwegian Government for the welfare of its citizens.

2.2- Oil exports and Public Expenditure: Trends, dynamics and implications

Now that we know that purpose for which Statoil was created, it is time to deepen into the relationship between the petroleum industry and Public Spending in order to determine the link of causality between these two factors.

There are different approaches to explain this phenomenon. Most macroeconomic models state that Government budget constraint is determined purely by taxes in a closed economy and by taxes and financial and economic assets (e.g. bonds) in an open economy. It is true that tax revenues are usually the main source of revenues for Public Spending and following the establishment of *Government Pension Fund,* it is reasonable to expect significant contributions from financial assets.

However, the aim of this section is to analyze the relationship between Norway's oil industry and Public Spending, therefore focusing on fiscal revenue and economic assets is insufficient, it is required to first understand the mechanisms and the dynamics of the petroleum industry.

In order to perform such analysis and determine the link of causation between these two factors, let's begin by understanding the channels by which the Norwegian Government obtain revenues from the petroleum industry. As it was mentioned before, the State has a strong participation in the Oil industry and as such, the two main mechanisms are fiscal revenues (taxes to firms and producers) and direct ownership through the sale of fees and licenses for extraction or exploration of petroleum to foreign companies (take in mind that most of the discoveries were performed by foreign firms)

Fiscal revenues obtained through the petroleum sector are taxed on firms rather than Households. Initially, there were three different type of taxes: the Corporate Income Tax (CIT) that is levied on the profits of all firms; the Special Petroleum Tax (SPT) imposed just on oil related businesses; and Royalties on sales revenues (Lund, 2014, pp. 50). Over time, royalties have been

eventually withdrawn in favor of CIT and SPT, which have the aim to incentivize the production of firms and regulate the petroleum sector respectively (Bjerkholt et al., 1990, pp. 26). Nowadays, CIT is set on 28% and SPT on 50%, making a total share of 78% for the fiscal revenues out of the total revenues in the sector (Holden, S., 2013, pp. 872). Despite the high share of taxation in the industry, this fiscal system has been perceived as transparent, safe and stable, providing enough incentives to other economic agents to compensate for this apparent drawback, even the IMF (2012, pp. 24) proclaims: "Norway has perhaps the closest to a pure rent tax … for its North Sea oil and a system also noted for its stability"

Regarding the second channel, it was in 1972, after claiming full sovereignty of Oil reserves, that Statoil was created and was fully nationalized (100% of its ownership was in hands of the State), and its revenues were obtained through the sale of licenses. However, in the 1980s, the increase in Oil revenues were so high that the Government decided to relinquish part of Statoil ownership. In 1985, a new portfolio with direct control from the state was created, the *State's Direct Financial Interest* (SDFI), which held more than 50% of the ownership of licenses plus full participation in the production and decision processes including the management of costs and revenues. Currently the Government is in possession of about two thirds of Statoil after its partial privatization in 2001, which coupled with the revenues obtained through SDFI suppose a considerable amount of additional incomes for the Government.

Taking these facts into consideration and knowing that the Petroleum industry is no different from other production industries in the sense that it requires labour, capital, technology and investment for its process of production, two things can be noticed. The first thing is that the State is the major player in this industry and as such, it is the one with the highest bargaining power and the one who gets the highest share of its benefits. The second is that through state participation and taxation (at high levels), Norway's Government plays both an active and a passive role not only in the matter of revenues but also in the production process. Therefore, it can be assumed that the the State behaves not purely as a public entity but also as a producer in this market.

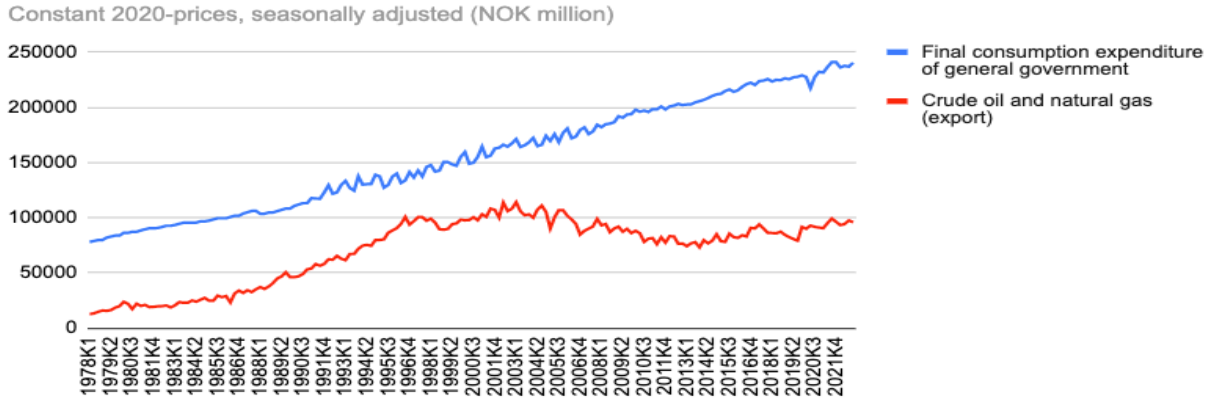
Assuming the veracity of the statement and knowing that Norway is a small economy with a high dependency in international trade, plus the fact that Oil is mostly used as a tradable-export good, we can think that Oil exports will play a significant role in explaining Public Spending. Figure 2 strengthens this assumption, as it shows a steadily increasing trend both in Final Public Expenditure and in exports of Crude Oil and Natural Gas that seem to go in parallel although in smaller magnitude. However, it can be observed that after 2003, Oil and Natural Gas exports are reaching a plateau while Final Public Expenditure keeps having a steadily increasing trend,

suggesting two things. The first is that oil industry might have diminishing returns to scale and as such the production levels may have already reached its peak, an assumption that is strengthened by the fact that Norway has not experienced new noticeable oil discoveries in recent years (Holden, S., 2013, pp. 871) and even the discoveries of 2010 and 2013 seem to have had little impact in the export sector. The second thing is that if Oil exports have already reached their production limit and Public Spending is apparently unaffected, it is probably due to some other sources of revenues that make up for this loss like investment in foreign bonds and capital assets through the *Government Pension Fund,* considered the World's biggest sovereign fund.

Knowing these two facts, a question arises: How big is the role of Oil exports in Norway's economy? In Figure 3, it can be observed that despite some decline in the value of Oil exports (specially during COVID-19 that accounted for a minimum of around 15% of total value of export goods), they still hold an important share and role in the export sector reaching a maximum of almost 50% of the total value of export goods in 2000. Besides, in 2013 it was estimated that Oil represented 30% of public revenues, 29% of total investment and 52% of total exports (Norwegian Petroleum Directorate, 2013). Moreover in Table 1 (in the Appendix) it appears that the share of Public Spending over GDP moves in parallel with Oil revenues in the decades of 1972-1980, 1981-1990, 1991-2000 and 2001-2010 (specially during 1981-1990) where the increase in Oil revenues is followed by a higher share of Government Expenditure over GDP and vice versa (but in the last decade this trend doesn't hold).

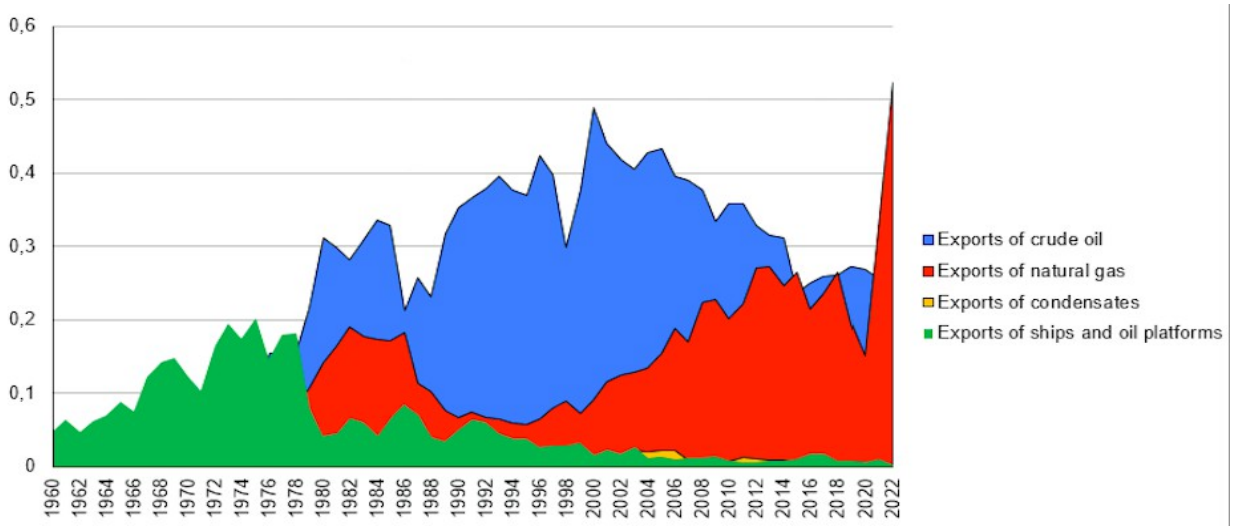
In other words, despite evidence of a increasing gap between Oil exports and Public Spending in recent years, it is undeniable the importance of the oil industry in the Norwegian Economy and as such it is reasonable to think that unexpected events or shocks might have a significant effect in the Public Sector.

Figure 2: Final Public Consumption expenditure & Crude Oil and Natural Gas Exports



Source: Own elaboration based on Statistics Norway

Figure 3: Share of Exports of goods (% of value of total exports of goods)



Source: Own elaboration based on Statistics Norway

3. SHOCKS, VULNERABILITIES AND ITS IMPLICATIONS

3.1- Overview and mechanisms

Now that the theoretical relationship between the petroleum industry and the Public Sector has been addressed, it is time to deepen into the possible factors that might influence or trigger unexpected events or anomalies in the Oil Sector and by proxy in Public Expenditure. In other words, the main constraints and vulnerabilities of the Oil industry.

To address this matter, it is required to first know what does vulnerability mean. "Vulnerability" is a very broad and abstract concept, but most of the economists that have deepened into the concept of vulnerability seem to agree that it is the incapacity to cope with unexpected events that may hinder or constraint the growth opportunities for a country or its citizens. Some economists like Chambers (1989) have classified it in two sides: *internal vulnerabilities* and *external vulnerabilities:*

> Vulnerability has thus two sides: an external side of risks, shocks and stress to which an individual or household is subject; and an internal side which is defencelessness, meaning a lack of of means to cope without damaging loss (Chambers, 1989, pp. 1)

Therefore, it is sensible to think that countries with a small open economy will be the ones with the highest vulnerability due to their lack of economic and geopolitical power to influence the global market and its fluctuations. Following the Portfolio Theory, then the most efficient way to cope with the risk is due to diversification (Megginson, 1996, pp. 325), that way if an industry suffers from an external shock, the effect may be alleviated by gains from a different industry with a negative correlation with the former[1]. In other words, specialization in economies with a strong dependence in trade, will increase the risk and its vulnerability.

In the case of Norway, it has been previously discussed how the Oil industry still plays a big role in external trade and the economy as a whole. Therefore, Norway will be more sensitive to external vulnerabilities, specially in the Oil market. But, how and in which way do shocks may affect and determine Norway's economy?

To answer this question, a set of factors have been selected and will be discussed in detail next. These factors are: Oil prices in the global economy and the capacity to influence them (bargaining power); the remaining two have been selected following the theories of Abeles & Valdecantos (2016) that correspond to vulnerabilities in financial (proxied by fluctuations in exchange rates) and real (fluctuations in Terms of Trade and Trade Balance) terms.

3.2- External shocks and vulnerabilities

3.2.1 Oil prices and bargaining power

In order to understand the reason why Oil prices are one if not the most important source of vulnerability for Oil-exporting and Oil-importing countries, it is necessary to first know the Oil market, specially the supply and demand, and which role they play in the global market.

Oil is a major source of energy and as such, it is an indispensable good for economic and social development. The results in Table 2 strengthen this statement as it can be observed that despite significant decreases over time, Oil still explains more than 30% of World's primary electricity, and some countries like United States and Saudi Arabia show rates higher than 36% and 60% respectively. Moreover, Oil is often exported through shipping and pipelines, and it requires fewer workers for its extraction than other natural resources like coal (Kander et al., 20 , pp. 265) therefore it has a higher degree of flexibility and efficiency in production and transport, making

1 That means that for a portfolio with a set of different assets, if there is a negative shock that affects one asset, then another asset with a negative correlation with respect the former asset will experience a positive effect and the negative effect of the shock will be alleviated to some extent.

easier to overcome geographical distances and foster international trade. In fact, in 2005 around 60% of the global Oil supply was traded in the global market (BP, 2006), suggesting thus a high level of globalization in the oil market and a possible profitable industry for economies intensive in trade.

Table 2: Share of primary energy from Oil, 1970-2020 (in %)

Region	1970	1985	2000	2015	2020
World	46,53	39,93	38,90	33,36	30,95
European Union	50,92	39,54	41,35	36,54	35,47
Africa	48,64	45,05	44,28	43,52	38,33
Asia	50,78	40,93	40,45	30,15	28,04
Middle East	84,61	73,65	59,03	48,46	42,89
North America	46,02	42,79	40,95	38,63	36,29
Saudi Arabia	94,16	75,53	64,55	67,08	61,61
USA	44,91	42,31	40,14	38,41	36,73
OECD	49,76	42,64	41,83	38,05	35,76

Source: Own elaboration based on BP Statistical Review of World Energy

Assuming the veracity of such assumptions, then it can be expected for the global demand of Oil to be close to inelastic given the high dependency of Oil as a source of energy. The supply on the other hand is determined almost entirely by Oil reserves, meaning that the size of an Oil industry within a country will be closely linked to its endowments of natural resources. For instance in 2006, the OPEC had around 75% of the total World reserves of Oil and produced 41.7% of global production of petroleum (Gupta, 2007, pp. 1195) Under normal circumstances and following the assumptions of economic models like Cournot or Stackelberg, the prices would be determined by the technological and efficiency rate of the producers[2]. Nevertheless, the global Oil industry is an industry notorious for providing large and stable economic rents (given in part by the inflexibility of the demand and the few number of big players and organizations within the market) and as such the main concern of the economic agents involved is how these rents are distributed. These distribution is only possible due to the exchange between host nations and Oil exporters as the bargaining power of each party will determine both the outcome and the revenues of the transaction (Vivoda, 2017) Indeed, the high level of dependency of petroleum for Oil-importing countries and the potential revenues for the exporters has wide implications for the rest of society, specially for governments who may use it as a political and bargaining tool. In other words it has geopolitical implications for the World economy as stressed by authors like Liu et al. (2019) and from historical examples like the Oil Crisis, the War of Iraq or COVID-19. Knowing these facts, the next question is: Which role

2 That way firms with higher efficiency rates will have lower marginal costs and as such they could set lower prices than less efficient firms having the whole demand for themselves for example. In other words, these producers have the advantage of having lower costs of production.

does Norway play in the international oil market? How big is its bargaining power?

At first sight, one would expect for Norway to have little geopolitical and bargaining power within the Oil market since it is a small open economy. Nevertheless, the size of its petroleum reserves and its technology has made the country capable of being among the twelve biggest Oil producers in the World (in gross terms) and among the biggest five in per capita terms. Therefore, it can be assumed that perhaps the country may have a certain level of bargaining power within the industry that might be helpful to achieve a certain level of resilience regarding Oil prices. However, a study carried out by Bjørnland & Thorsrud (2014) found that the a fall in oil prices only affects Norway in a significant way if the shock has implications for the global economy (both for demand and supply)[3]

That way, in order to measure the sensitivity of Norway's economy to oil prices, it is required to also include the bargaining and geopolitical power of all players involved at a global level.

3.2.2 Exchange rate volatility

Without a doubt, Exchange rate is one of the most important instruments for international macroeconomics within a country as it reflects the price of a domestic currency in terms of a foreign currency. And as such, it has important implications in explaining the relationship between domestic and foreign prices and therefore the *Balance of Payments* and volume of trade. Changes in the exchange rate are commonly defined as "Exchange rate volatility" and it has important and significant effects for an open economy. For instance a rise in the real exchange rate for a country will rise the prices of such country with respect foreign prices and incentivize imports relative to exports and vice versa. However, the exchange rate is related with a large number of economic factors and international trade movements that may affect the magnitude of its change over time. Given the fact that small economies tend to have little economic and bargaining power to offset most of the trade flows, then trade-intensive and small economies may be vulnerable to exogenous shocks that have an impact in the magnitude of "Exchange range volatility". Is this the case with Norway? To answer this question, it is required to know how the international monetary system works and may cause macroeconomic instability through anomalies in the changes in the exchange rate, and how these anomalies may affect the export performance and if it applies to Norway.

3 If the fall in the international oil price happens because of an increase in the global supply of Oil then the effect is minimum but if the shock affects both the global supply and demand then it can decrease Norway's GDP by more than 2%

The fall of Bretton-Woods in 1971 led to a transition towards a free-floating exchange rate with free flow of capital and independent monetary policy which raised concerns among economists and policymakers about potential economic instability. Some neoclassical economists like Pigou (1927) and Keynes (1936) emphasized how economic fluctuations are driven by the expectations of economic agents, and as such unexpected events in economic fluctuations with little mechanisms and regulation may trigger anomalous responses from these agents causing economic disequilibrium. This premise is supported by Ethier (1973) who proclaims that uncertainty in exchange rate fluctuations may reduce trade volume due to the negative expectations for the revenues of the economic agents, disincentivizing further operations in investment and trade. To offset this vulnerability most countries have chosen either to peg their currencies to another currency with a higher backing that is used as a reference (usually the USD[4]) or adopt another currency shared among several countries (being the Eurozone the most common example) maintaining their exchange rate fixed to some extent. In fact, Ilzetski et al. (2019, pp. 605) found that "anchorless currencies" (those that don't shadow or are pegged to other currencies) are often the ones with the highest an more persistent volatility. At the same time, Ilzetzki et al. (2017) estimate that around 80% of all countries are under such system of "limited flexibility" in exchange rates and others even state: "The gains to exchange rate flexibility are worse than you think" (Gopinath, 2017, pp. 3). Once again, it is observed the risk-aversion of economic agents towards free-floating exchange rate regimes that may increase the uncertainty. Knowing this, the next question is: How does exchange rate volatility may affect the Oil industry and Norway's economy?

A study carried out by Arezki et al. (2016) provided evidence that discoveries of big reserves of oil and natural gas rise the expectations of the economic agents for additional revenues, increasing the investment rates in consequence at the initial periods which are later translated into significant increases of economic output. Knowing that investment (specially Foreign Direct Investment) is necessary for a successful management of oil revenues and that high levels of Exchange rate volatility tend to discourage investment, it is reasonable to think that exchange rate volatility suppose an important vulnerability for Norway which is intensive in Oil. Moreover, Olufayo & Babafemi (2014) found evidence that floating exchange rates induce economic instability within a country but it has bigger and sharper effects in Oil-intensive sectors (specially those that are highly intensive). Figures 4 and 5 in the Appendix[5] strengthen this assumption as they

4 Nowadays the U. S. Dollar remains the dominant currency in international transactions like international debt insurance, international loans, foreign exchange turnover, global payment and foreign exchange reserves (Gourinchas, Rey & Sauzet, 2019, pp. 4-5)

5 In both cases, the U. S. Dollar has been used as a benchmark of financial stability because it is the currency with the highest use in the global economy and the one with the highest baching from all anchor currencies and therefore the more stable.

show (both in absolute and relative terms) that the outliers (anomalies) in both graphs correspond to 1985, 2008, 2014-2016 and 2019[6] which coincide with financial crisis and sharp declines in oil prices (specially in 1985 and 2014-2016).

In Table 3, it can be observed that the net inflows of FDI (as percentage of GDP) for Norway are on average similar to OECD, the EU and Eurozone, suggesting some degree of dependence for Foreign Direct Investment and for capital inflows. Besides, it can be observed once again that the highest decreases or negative outcomes of net inflows correspond to financial crises and the fall of Oil prices previously mentioned. In that case, the previous statement of how unexpected shocks in exchange rate vulnerability may affect the levels of FDI and oil industry in consequence is strengthened. Knowing these facts, then it can be said that for understanding the financial vulnerabilities of the Oil industry for Norway it is of utmost importance to measure and take into account the "Exchange Rate Volatility" and its shocks.

Table 3: Foreign Direct Investment, net inflows (% of GDP)

Year	OECD members	North America	Euro area	European Union	Middle East & North Africa	United Kingdom	United States	Germany	Norway
1975	0,382	0,306	0,420	0,409	1,393	1,373	0,137	0,141	0,668
1980	0,565	0,720	0,357	0,342	-0,397	1,792	0,586	-0,020	0,093
1984	0,464	0,704	0,403	0,384	1,156	-0,075	0,625	0,081	-0,286
1985	0,344	0,231	0,420	0,408	0,333	1,119	0,222	0,073	-0,648
1990	1,124	1,214	1,043	1,007	0,375	3,784	1,195	0,144	0,836
2000	4,757	3,796	8,573	8,739	1,165	9,851	3,406	12,732	4,866
2005	3,157	1,181	6,015	6,140	4,469	9,928	1,092	2,102	3,256
2006	4,063	2,395	7,313	7,172	5,691	7,515	2,160	2,920	3,437
2007	5,373	2,932	9,950	10,031	5,584	6,774	2,395	1,484	6,187
2008	3,548	2,519	4,641	5,083	4,032	8,646	2,309	0,827	4,452
2009	1,763	1,147	3,386	3,244	3,290	0,602	1,113	1,662	2,236
2014	1,911	1,632	2,849	2,764	1,046	1,921	1,435	0,501	0,651
2015	3,538	2,890	6,737	6,030	1,271	1,545	2,809	1,859	1,885
2016	3,878	2,514	4,950	5,203	1,543	12,032	2,537	1,865	-5,062
2019	1,614	1,572	1,494	2,254	1,800	0,693	1,472	1,844	4,033
2020	0,958	0,792	0,350	1,757	2,064	4,898	0,707	3,671	-1,133
2021	1,898	2,027	1,493	2,198	2,290	0,189	1,923	1,729	2,942

Source: World Bank, World Bank Development Indicators: https://databank.worldbank.org/source/world-development-indicators

3.2.3 Trade balance and Terms of Trade

So far, it has been analyzed the possible factors that may influence the vulnerabilities of the Oil sector in the Norwegian economy in nominal and financial terms. Important as they may be, there are still caveats to be observed. In fact, the neoclassical models clearly differentiate between nominal and real variables and assume that nominal variables like money are only used as a transaction and therefore in the long run, nominal variables will not influence real variables (Becker

6 To measure the volatility in the exchange rate, a ratio between NOK currency and U. S. Dollar has been performed as Dollar is the most demanded and used currency in global financial market and as such the perfect example to see deviations from anchor currencies

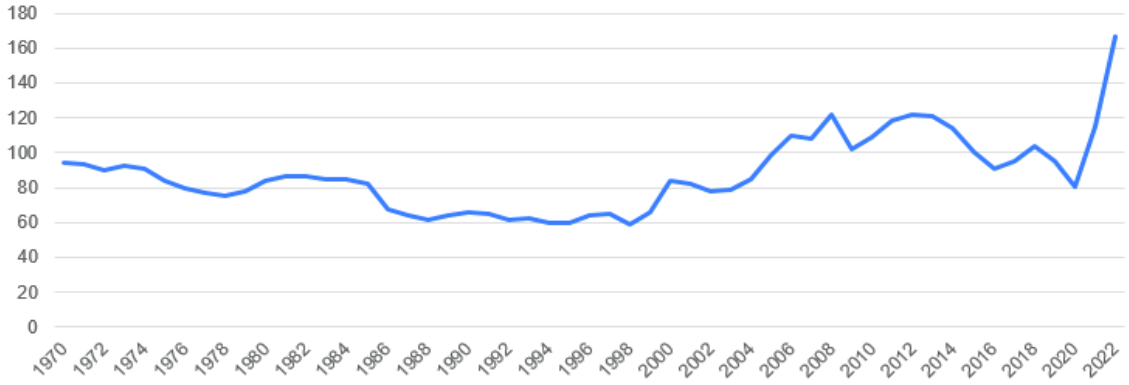
& Baumol, 1952) like goods or services, *the Classical Dichotomy*. Although there is an open debate regarding the veracity of such Dichotomy, it is undeniable that just focusing on nominal and financial factors is insufficient and thus this part of the study will take a look at vulnerabilities that may affect real economic factors within the Oil industry and the economy as a whole.

As it was mentioned before, external vulnerabilities are strongly linked with trade specialization, being the Oil sector one of the most important industries in Norway. Moreover, it was previously mentioned that the Oil market is mostly globalized and as such it is expected to be more exposed (as well as Norway's Public Spending) to shocks and dynamics in the international market. That being the case, the next question is which factors may explain these dynamics and the possible subsequent perturbation in Norway Oil industry and Public Spending, and for that reason the dynamics of Terms of Trade and Trade Balance will be discussed as well.

According to Charnakovi & Dolado (2014), Terms of Trade may affect small open economies in several ways. One effect may be that a rise in the price of exports relative to imports increases then the relative value of exports to imports will increase in consequence, translating into higher levels of foreign assets and an appreciation in the real exchange rate. Another effect, would be the "spending effect" which consists in an increase in consumption, investment and Government Expenditure (GDP as a whole) as a consequence of a rise in the domestic demand due to an increase in the Terms of Trade. This "spending effect" may occur due to the fact that an increase in Terms of Trade incentivize the export sector and thus increase the Trade Balance. In that case, unexpected events might cause economic instability. In fact, in Figure 7 it can be observed that the fall of Oil prices occurred in 1985 and 2014-2016 although not as sharp as the financial crisis of 2008 and the COVID crisis of 2019 (and the massive increase since 2021[7]) they are more persistent over time. Furthermore, in Figure 9 it is seen how the annual change in the share of Trade Balance to GDP coincide with the dynamics in Terms of Trade being specially noticeable during the periods mentioned before (except for 2014-2016) with variations of -6.18, -7,83, and -5,71 percentage points respectively. This fact emphasized how the dynamics of the Terms of Trade can explain the volume of trade for Norway and their levels of public expenditure given the fact that since 1971 to 2021 the average share of Trade balance to GDP has been around 70%, implying a high dependency in trade. That being the case, how and in which magnitude do these dynamics in the Trade Balance and Terms of Trade can affect the petroleum industry?

7 This increase is caused by the high increase in the price of natural gas due to the conflict between Russia and Ukraine that persist today

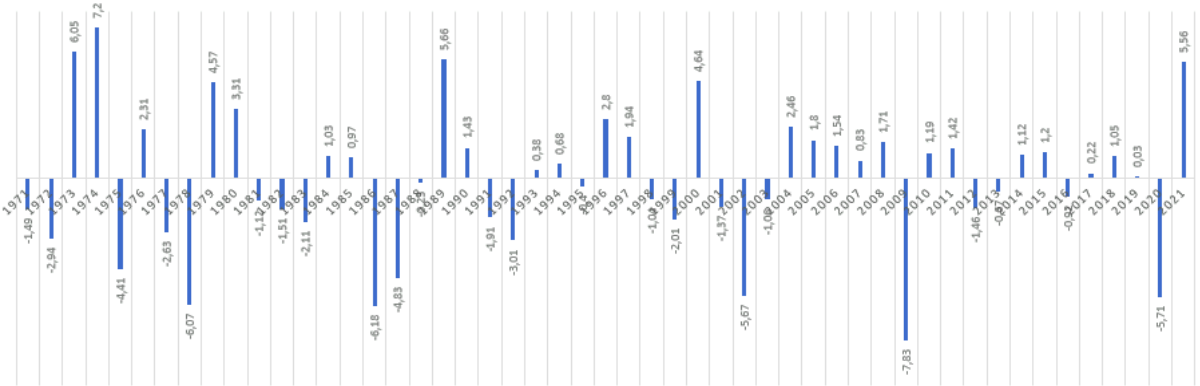
Figure 7: Norway Terms of Trade 1970-2022



Source: OECD (2023). DOI: 10.1787/7722246c-en

As it was stated before, Oil is needed for energy and electricity consumption making the demand close to inelastic. Nevertheless, more than 60% of the total oil barrels are globally traded (as it was mentioned before) which implies that global shocks (e.g financial crises) can cause economic disruptions and reduce consumption and trade as well as a significant fall in oil exports and revenues. In fact some authors like Ambler et al. (1995) and Costello & Praschnik (1993) have found evidence of how intermediate inputs (e.g. raw material like Crude Oil) play a significant role in explaining international outputs and business cycles. Other authors like Backus & Crucini (2000) even found that variations in the Terms of Trade for major industrialized countries were mainly caused by shocks in oil prices. Taking these findings into account, it can be assumed that for Norway, a small economy intensive in Oil exports, unexpected variations in the Oil prices will affect negatively the Terms of Trade and these in turn the Trade Balance which will reduce Oil exports and Government Revenues. In other words, Norway as a small economy is still very vulnerable to global shocks and it rises important concerns for Norwegian welfare and Public Spending

FIGURE 9: TRADE TO GDP (ANNUAL GROWTH) 1971-2021



Source: World Bank, World Bank Development Indicators: **https://databank.worldbank.org/source/world-development-indicators**

3.2- Hypothesis

Knowing the importance of Oil for the Norwegian economy and its wide implications to most aspects of society like social, geographical and political factors, it is expected to find evidence that the value of Oil exports will have a positive impact for the Government revenues from Oil and therefore for Public Spending. After assessing the potential vulnerabilities of the petroleum industry in the global market, being Norway an economy highly intensive in trade, it is expected for shocks in the Balance of Trade to be the factor with the most direct effect on Oil exports and therefore Government Expenditure. By taking a look at the Terms of Trade it is expected for these shocks to have a negative effect in both variables. It is reasonable to assume that shocks in the price of Oil in the global market will be the one with the highest impact, both in magnitude and significance, so shocks that rise the international price of oil will translate into higher gains of trade and therefore higher value of Oil exports and levels of Public Spending, and vice versa. As for shocks in the real Exchange Rate Volatility, they will most likely have a negative effect for the Trade Balance and Oil exports and by proxy for levels of Government Expenditure.

Nevertheless, this study does not focus on Public Expenditure as a whole but rather on the fraction of Government Expenditure that is destined to Social welfare and therefore there may be some limitations to previous statements as it is not only a matter of revenues but also about institutions. However, a study carried out by Pazouki & Zhu (2022) found evidence that Oil volatility induces higher Public Spending in democratic countries and since the beginning, the aim of Statoil was to ensure the welfare of the Norwegian population, so it is reasonable to expect for Substitution Effect to dominate over Income Effect in Norway's Public Sector[8] and observe some resilience in consequence. Moreover, Oil production has been stagnating in recent decades so there is every reason to await a decrease in the impact of oil shocks over time specially since 1997 when the *Government Pension Fund* was created.

8 If the Government receives less income from one of the most important industries in the economy (and also one in which the Public Sector acts as the main player) then it is reasonable to think that they will shift its focus towards another industry in order to offset this fall. If there is an increase in oil revenues then the demand for oil will be higher and the Government will have more incentives to seize this opportunity and increase its revenues and participation.

4. DATA AND RESEARCH METHODOLOGY

4.1- Data description and model assumptions

The aim of this study is to see how and in which magnitude does the Oil sector explain Government Expenditure in social welfare (e.g health and education) subject to external shock and vulnerabilities as described in Section 3. For that reason, a set of variables have selected in order to serve as a proxy for such factors. Table 4 provides a brief description of the variables used as well as their label and source. The database is quarterly and covers the period from January 1978 (1978Q1) to October 2022 (2022Q4) having a total of 180 observations per variable.

Social Public Spending is the main variable of interest and it is proxied by dividing the amount of money spent by the Norwegian Central Government in the civilian aspect and the total amount of Final Public Expenditure of the Central Government. Total Government Expenditure is composed by the Spending from the Central Government and local governments. But the study will only focus on the amount of Social Public Spending carried on by the Central Government for two reasons. The first one is for a matter of simplicity as the Central Government is the main actor in the Public Sector and its main activities correspond to ensure the welfare and stability of its citizens and economy as a whole, foreign affairs like diplomacy and external trade and national defense. Local governments on the other hand, have a more restrictive approach that is just limited to their own regions and municipalities, therefore by focusing only in Central Government Spending will provide a general picture of the role of the State in the economy and make the approach simpler. The second reason is to make the causal link between the Oil sector and Public Spending clearer as it is the Central Bank the one with the highest participation in the industry and the one that receives most of its revenues while local governments are mostly financed by taxes issued on citizens and firms.

The second most important variable is *Oil Exports* that correspond to the total value of Crude Oil barrels sold overseas plus Natural Gas. Since this study tries to estimate the relationship between the petroleum industry and Government Expenditure, it is imperative to look at the production of Oil in Norway. And by including the value of exports of Crude Oil will not only provide insights about the possible Oil revenues but also about the intensity of Oil in Norway's external trade and its production, broadening the scope of the study and getting a more general picture of Norway's economy. Nevertheless, Natural Gas plays a fundamental role in the share of Norwegian exports (Figure 3) and thus focusing only on Oil may bias the estimations and limit the perspective of the study so they will be included.

In order to find a proper estimator capable of measuring international Oil price levels, it is necessary for the estimator to be representative[9], to be measured in units that take into account purchasing power and not to be biased by inflation rates. The importance of Crude Oil in the economy is undeniable, probably being the most traded raw material in the World, and yet its price levels are slightly higher than its marginal costs as a consequence of competition within the market, lobbying and geopolitical differences between Oil producers and consumers (Šimáková, 2011, pp. 652) making difficult to predict the flows of its price levels. This statement has been supported by historical facts of several Oil Crises that showed how unexpected movements in the price of Oil affect the inflation rate and shifts the monetary policy. On the other hand, Gold is a non-consumption good and is demanded by Central Banks as reserves to keep the stability of their respective currencies, and by investors to have safe assets. Taking these facts into consideration, then it can be assumed that these two goods will have a positive relationship as an increase in Oil prices will also increase its revenues in Oil-exporting countries. This in turn will also increase the demand for Gold given that a significant amount of portfolio assets is composed of Gold and the need for central governments of Oil-exporting nations to safeguard their assets (Šimáková, 2011; Hunt, 2006, Furlong et al., 1996). That way, *Gold/Oil* will not only reflect fluctuations of Oil prices from a global perspective and into PPP levels[10] but also its influence over international economies in geopolitical and economic power plus solving the potential issue of inflation as stated by Nath (2013, pp.): "Gold Oil price ratio is a measure that is not biased by inflation factor[11]"

To proxy for "Real Exchange Rate volatility" the model will use the interaction term between the Norwegian Kroner and U. S. Dollar and the inflation growth rate of Norway:

$$\Delta ExchangeRate = \frac{NOK_t}{USD_t} \times \frac{CPI_t}{CPI_{t-1}}$$

Volatility implies changes in a certain variable or trend over time with respect previous periods of time or a certain period or factor/variable used as a benchmark. When talking about Exchange rate, then the U. S. Dollar is without a doubt the best benchmark possible as it is the most used and demanded currency in the global economy both in transactions, financial assets and as an anchor currency. Besides, most if not all the transactions of crude Oil are paid in U. S. Dollars since the OPEC officially agreed to sell exclusively in dollars, so changes in the value of NOK with respect

9 It must englobe a wide variety of countries with high levels of bargaining power and market power in the international Oil industry and the global economy and not just a specific region.

10 Gold is a good with intrisic value and as such it is backed up by actual value and not just trust (like credit or fiduciary money) and besides it is used internationally by all nations regardless of their currency and it is not subject to inflation movements so it is reasonable to think to think of Gold as a common measure of PPP

11 In fact the author found that there is little variation in the value of Gold/Oil as in the 1970s an ounce of gold could buy 16 barrels of Oil and 309 months later 15.72 barrels (Nath, 2013)

USD may also reflect gains of trade in the Oil market for Norway. However, to have more consistent and accurate estimations it is required to take into account purchasing power and for that reason it is included the inflation growth rate of Norway calculated through its CPI.

Finally, to proxy vulnerabilities in real terms, a ratio between the total value of exports (goods) and total value of imports (goods) will be used. Usually, it would be measured through Terms of Trade because it reflects possible gains from trade, as it was explained before, but unfortunately there is no data for a quarterly frequency. Moreover, Terms of Trade just reflect price levels of exports and imports and as such it ignores the volume of trade, total gains and the state of the Balance of Payments (either if the economy is in deficit or surplus). For that reason, this ratio is going to be used as it will provide a wider and broader perspective both for Norway's Balance of Payments and for volume and gains from trade.

Table 4: Variable Description

Variable	Label	Description	Source
Social Public Expenditure	Soc_Spend	Fraction of the total amount of Government Expenditure spent on civilian use at constant 2020 prices	Statistics Norway
Oil Exports	Oil_exp	Total value of Crude Oil and Natural Gas exports (in million NOK) at constant 2020 prices, seasonally adjusted	Statistics Norway
Gold to Oil ratio	Gold_Oil	Value of ounces of gold in terms of an oil barrel	London Bullion Market Association & U.S Energy Information Administration
Exchange Rate Volatility	real_NOK_USD	Interaction term between the value of Norwegian Kroner to one USD and the inflation growth rate	Board of Governors of the Federal Reserve System (US) & Organization for Economic Co-operation and Developmen
Balance of Payments	Exp_Imp	Total value of Export goods divided by the Total value of Import goods for Norway	Organization for Economic Co-operation and Development

4.2- Research methodology: VAR analysis

Given the number of variables included in the analysis and the interrelations between them, it is imperative to estimate not only the effect of international shocks on these variables but also their dynamics. VAR analysis is a useful tool for that purpose. Vector Autoregresions (VAR) were introduced by Christopher Sims in 1980, which compared to *univariate autoregressions,* that are explained by one variable and its lagged values in a single equation, VAR measures a set of variables and take into account their dynamic behavior between them (Stock & Watson, 2001)

providing a more detailed and complex approach. VAR models are specially useful in the presence of simultaneity and interrelation in the long run between variables.

VAR specifications are composed by a number *c* of variables, each of them following a linear function of their own number of *q* lags and the error term (Lütkepohk, 2004). In a simple version, the equations for two endogenous variables will follow:

$$x_t = \theta_{x0} + \theta_{xx1}x_{t-1} + ... + \theta_{xxq}x_{t-q} + \theta_{xw1}w_{t-1} + ... + \theta_{xwq}w_{t-q} + \epsilon_t^x \quad (1)$$

$$w_t = \theta_{w0} + \theta_{ww1}w_{t-1} + ... + \theta_{wwq}w_{t-q} + \theta_{wx1}x_{t-1} + ... + \theta_{wxq}x_{t-q} + \epsilon_t^w \quad (2)$$

In this case, the variables *x* and *w* are endogenous and as such unexpected shocks[12] will affect the variable in question but also the remaining variable since both of them interact each other. This shock effect also has implications for future periods of time through the lags of the two different variables in their respective equations. For simplification, let's take a look at its matrix form:

$$Y_t = A_0 + \sum_{j=1}^{c} A_j Y_{t-j} + \epsilon_t \quad (3)$$

where Y_t represents the vector of variables, A_j the coefficients that link past and present values for the endogenous variables included and ϵ_t the vector of innovations/shocks in each variable.

In order to understand shocks, it is required to understand the error term. For simplicity, it is assumed that the covariance matrix of ϵ_t is diagonal, in other words that the error terms of the innovations of the different variables are not correlated between them. The reason is because the correlation between variables is collected by the presence of each of such variables in the structural model (Novales, 2011, pp. 5) and therefore the correlation between the different variables would be explained by the contemporaneous effect (present value) of each variable over the others.

Assuming that there are no problems of endogeneity (variables are correlated with the error term) then the endogenous variables would be a function of the predetermined variables and as such it would be possible to perform consistent estimations through OLS because the covariance between the error term and the rest of the variables in each lag would be zero: $Cov(\epsilon_t \mid Y_t ; Y_{t-1} ; ... ; Y_{t-c}) = 0$

Nevertheless, these assumptions only hold in the reduced form of theVAR and this poses an important drawback for the analysis as the reduced form don't capture all the parameters in the structural form. In that case is necessary to recover all the numeric values for all parameters in the structural form from the reduced for of the VAR (Novales, 2011, pp. 12), this procedure is called *VAR identification.* More precisely, *VAR identification* consists in obtaining structural innovations (shocks) through VAR residuals and therefore find numeric values for the matrix of the error term.

12 Shocks correspond to changes in the error term which represents innovations (in other words significant variations) in each variable as they are not correlated to past values

In order to carry out such identification, the Cholesky decomposition will be used as it allows to obtain a transformed model with structural innovations not correlated with the variables unitary variances:

$$\begin{aligned} u_{1t} &= \epsilon_{1t} \\ u_{2t} &= \epsilon_{2t} - \hat{\pi}_{12} u_{1t} \\ u_{3t} &= \epsilon_{3t} - \hat{\pi}_{13} u_{1t} - \hat{\pi}_{23} u_{2t} \\ &\dots \\ u_{kt} &= \epsilon_{kt} - \hat{\pi}_{1k} u_{1t} - \hat{\pi}_{2k} u_{2t} - \dots - \hat{\pi}_{k-1} u_{k-1,k} \end{aligned} \tag{4}$$

That way, the first innovation u_{1t} is equal to ϵ_{1t} while the second includes the error term for that period plus the residuals of the OLS equations obtained in the previous period, and so on. Since the residuals of the OLS regressions are not correlated with the variables (assuming no endogeneity), then the innovations will be no correlated between them. Besides, this procedure takes into account the order for he variables since it gives different relevance and weight to each of the transformed error terms. Therefore, the first variable will not respond to contemporaneous shocks (shock in the current period) but the next variable will be able to respond to such shocks for the first variable bit not for the next variables and so on. In that case, by including contemporaneous shocks, the problem of correlation between residuals of different variables will be solved to an extent and the estimations will be more stable and consistent.

Given the fact that Norway is a small open economy intensive in trade and that a significant share of its exports consist in Oil and Natural gas then it is possible that the residuals of the variables *Oil-exp, Exp_Imp* and *Oil_Gold* might be correlated. For that reason, Social Public Spending and Exchange rate Volatility are the first variables ordered in the model respectively so that they may not be affected by the contemporaneous of the next variables. This assumption is reasonable given the fact that the Norwegian Welfare State system stand up for an economy capable of ensuring the well-being of its citizens and therefore will most likely put most of its resources into civilian use, and since Norway has pegged its currency and diversified most of its financial assets, it is expected for its Exchange Rate Volatility to be less sensitive to movements in real assets and Oil.

Regarding the remaining variables, the order will consist in Oil to Gold ratio, Oil exports and Export to Imports ratio. Taken into account the fact that the price of Oil in the global market is beyond Norway's geopolitical power to achieve significant changes the this variable will be put before the remaining two. And since Oil Exports constitute a share of the total amount of exports then the last variable will be Exports to Imports ratio. The main idea behind the order selection of these three variables is that they depend both on the economic performance of the country and on

international trade movements given them a high degree of flexibility and variability, making them capable to respond contemporaneously to the rest of the variables.

Nevertheless, regardless of the sensibility behind the assumptions, correlation doesn't imply causality and it is precisely for that reason that the causal link between variables must be established. One of the main tools used in that matter is the *Granger Causality* which performs a set of hypothesis contrast tests on wether the effect of a specific variable over another have a causal effect on such variable by examining their past values[13] (Lütkepohl, 2004). However, the main econometric tool will be the Accumulated Impulse Response Functions which measure the the sum of each variable reaction to a shock/innovation of a specific variable across different periods of time and therefore will be the main measures of the effect and resilience of such variables to different shocks or vulnerabilities. Finally, the model will also take into account the Variance Decomposition to find out the magnitude of the different shocks attributable to specific shocks.

4.3- Cointegration and VEC models

One of the main features of most econometric models is to deal with equilibrium relationships, and to achieve that they usually make use of different statistical analyses. One of the most commonly used, specially for time series analysis, is stationarity (Dolado, Jenkinson &Sosvilla-Rivero, 1990) for which the unconditional mean and standard deviation is constant over time. Despite the importance of Stationarity in time series analysis, the required conditions for it to hold are rarely seen in real life, specially for the ones with propensity to grow (as they would have a trend) since they most like have a unit root as it is often the case with stocks, interest rates or yield curves. To solve these issues, most economists like Box & Jenkins (1970) or Hodrick & Prscott (1997) have argued that the transformation of non-stationary variables or the decomposition of their cycles[14] can achieve Stationarity. However, some economists like Sargan (1964) and Davidson et al. (1978) have criticized this methodology (specially differentiation between variables) as it does not reflect information in the long-run and might cause spurious correlation[15]. Considering the implications this issue might have for dynamic time series estimations, Engle & Granger (1987) tried to solve this problem by formalising the idea of variables sharing a common trend or relationship in the

13 More precisely, it asks wether the past values of a variable are significant in predicting values of a different variable, having taken into account the effects fo the previous values of the latter variable on itself.

14 The so-called Hodrick-Prescott filter cosists in estimating a trend for the variable in question and then look into the deviations of the values of such variable with respect the trend to isolate the cycle. It has been empirically proven that in most of the times, these cycles have a zero unconditional mean over time fulfilling the condition for stationarity.

15 It means that 2 or more variables might be causally linked to unobserved/inuncluded variables and therefore the estimations will be biased in the long-run.

long-run, the so-called *Cointegration.*

The model implemented only takes into account the supply side of the Oil industry in Norway (since the country is a petroleum exporter) and as such it ignores factors that might proxy for the demand of Oil. This in turn poses a problem as prices and exports are partially influenced by the Demand and not only by the Supply, therefore this simultaneity that is not observed might generate a spurious correlation. In other words, the risk of having Cointegration is high.

If that happens and the variables are cointegrated, then a new model that takes into account this cointegration will be used, the Vector Error Correction (VEC) model:

$$\Delta y_t = \beta_{y0} + \beta_{y1}\Delta y_{t-1} + \ldots + \beta_{yp}\Delta y_{y-p} + \gamma_{y1}\Delta x_{t-1} + \ldots + \gamma_{yp}\Delta x_{t-p} - \lambda_y(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + u_t^y \quad (5)$$

$$\Delta x_t = \beta_{x0} + \beta_{x1}\Delta y_{t-1} + \ldots + \beta_{xp}\Delta y_{x-p} + \gamma_{x1}\Delta x_{t-1} + \ldots + \gamma_{xp}\Delta x_{t-p} - \lambda_x(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + u_t^x \quad (6)$$

where $y_t = \alpha_0 + \alpha_1 x_t$ represents the long-run relationship of cointegration between two variables (in the simple form of just two variables) and the coefficients λ_y and λ_x the deviations from the equilibrium in the long-run. When having more than two cointegrated variables, it is required to generalize the procedure (Lütkepohl, 2004)

To sum up, VEC models solve for the problem of cointegration by measuring their growth rates and then including the common long-run trend they follow as a way to capture both the effects in the long and short-run (that VAR ignores in case of cointegration). However, since Vector Error Correction Models are created through a matrix of cointegrated equations in the long run (and therefore it has unit roots), it is possible that some of them may not converge to zero and instead the effect will continue to increase. In that case, it is required to make a distinction between shocks that persist over time until a new equilibrium has been reached, *Permanent Shocks,* and those which after some time come back to previous equilibrium levels, *Transitory Shocks*.

5. RESULTS

5.1- Full sample: 1978-2021

As it was mentioned before, VAR models are used to describe both the effects of innovations/shocks and the dynamic interrelationships between stationary variables. Therefore, the first step in the analysis will be to determine if the levels of the database used are stationary. In Figure 10 in the Appendix, it can be observed that except for a few outliers, the variables *real_NOK_USD* and *Gold_Oil* show little variations over time and it doesn't appear that they are following a trend implying that they might be stationary. Indeed, the Dickey-Fuller Unit Root test show p-values 0 and 0.0053 respectively rejecting the Null Hypothesis of the variables having a unit root. On the other hand, the rest of the variables are clearly following a trend[16] (specially *Soc-Spend* and *Oil_exp*) and therefore they will have to be transformed in order to achieve stationarity. For this purpose, first differences have been applied (denoted by letter *d*) and in Figure 11 (in the Appendix) it can be seen that we have got rid of the trend and achieved stationarity for all variables.

The next step is check the validity of the VAR, and to do that we will start by selecting the optimal number of lags to eliminate the residual correlation and achieve stability for the model. Following Akaike information criterion, the number of lags selected is 4. In this specification, the results of the LM test for residual autocorrelation report a p-value of 0.051 so although at a 10% confidence level the estimates are against no residual autocorrelation, it applies at a 5% and 1% levels. In Figure 12 (i) (Appendix), it appears that none of the roots are outside the circumference meaning that the model is stable (after the dependent variable suffers from a shock, the effect will eventually come back to equilibrium) and coupled with the fact that there is no residual autocorrelation at 5%, it can be said that the model is valid.

However, when performing the Johansen Cointegration test under the assumptions that the dynamics in the short run and cointegrating relationships include a constant, the results indicate that there are at least five cointegrated equations. That being the case, VEC specifications should be implemented so that the Cointegrated interrelationship between the variables is taken into account. The validity of the VEC model is confirmed as all roots are inside the circumference[17] and there is no serial autocorrelation at 5% in the LM autocorrelation test.

16 P-values of 0.8445, 0.3781 and 0,3856 of the Dickey-Fuller test for Social Public Expenditure, Oil Exports and Exports to Imports ratio respectively.

17 One is very close ot the borderline (value of almost 1) but it is still inside the circumference confirming its stability

Table 5: Granger Causality Tests – VEC (1978Q1-2022Q4)

Regressor	Dependent Variable				
	d_soc_spend	real_nok_usd	gold_oil	d_oil_exp	d_exp_imp
d_soc_spend	x	0,0225**	0,485	0,871	0,0403**
real_nok_usd	0,533	x	0,524	0,000***	0,447
gold_oil	0,916	0,613	x	0,50	0,795
d_oil_exp	0,752	0,594	0,757	x	0,961
d_exp_imp	0,295	0,249	0,302	0,20	x
All	0,667	0,082*	0,422	0,0002***	0,440

Note :* if p <0.1, ** if p<0.05 and *** if p<0.01; the variables with a "d" at the beginning are the variables that were transformed through first differences in order to to get rid of their unit roots and achieve stationarity.

Table 5 presents the results of the Granger Causality tests, showing the p-values associated to the null-hypothesis of lags of "Regressors" not having a causal effect in the "Dependent variable" against the alternative hypothesis of having a causal effect. It appears that Social Public Spending influence in the Real Exchange Rate Volatility and Trade Balance at a 5% significance level. And Real Exchange Rate Volatility helps to predict Oil and Natural gas exports. As expected none of the variables are significant enough to predict the Gold to Oil ratio given the fact that Norway is a small economy with little geopolitical and bargaining power in the international economy. Unexpectedly, none of the variables included, help to predict Social Public Spending suggesting some level of inelasticity and resilience to external shocks. In order to assess the veracity of this statement let's assess the magnitude and persistence of the shocks.

As stated before, the aim of the project is to analyze the effects of shocks in the different endogenous variables. The effect of shock/innovation is calculated through AIRFs using the Cholesky Decomposition for one standard deviation during 30 periods. The impulse responses include the confidence intervals and standard errors calculated by using the Bootstrap method (red lines).

We will start taking a look at the AIRFs of Oil and Natural gas exports and the International Price of Oil on the Social Public Expenditure of Norway. Figure 13 and 14 present the results of the responses of Social Public Spending to shocks in Oil Exports and Gold/Oil respectively. As expected in both cases the effect is negative. However, the impact of the shock of Oil Exports has a small magnitude and even after 10 year the effect is barely noticeable and continues to converge to

zero. On the other hand, the shock of the ratio of Gold to Oil (global measure of the International price of Oil, geopolitical power and global economic stability) has a noticeable and permanent effect in the fraction of Norway's Public Spending into civilian use with a steep and decreasing effect that increases with each period. Perhaps these results show that the Norwegian economy is oriented to the export services and financial assets rather than on goods and natural resources, specially since the establishment of the *Norwegian Government Pension Fund.* Nevertheless, the results of the AIRF of Social Public Expenditure to Gold /Oil might reflect the vulnerabilities of the Norwegian economy to the dynamics in the Global economy, specially given the fact that the geopolitical and economic power of Norway is too low to have any influence in the international market or offset most of its effects.

Although the results of Figure 13 are unexpected, they are consistent with the policy of the Norges Bank which consists in saving money in prosperous periods of time and increase the spending during crises or unexpected events as stated:

There is broad political consensus on how the fund should be managed ... Budget surpluses are transferred to the fund, while deficits are covered with money from the fund. In other words, the authorities can spend more in hard times and less in good times (Norges Bank Investment Management, 2023)

In that case, Income Effect dominates over the Substitution Effect and ensures some degree of economic stability over time and resilience to international shocks in the Oil industry. Besides, Norway's Oil Fund has a very diversified portfolio with around 11549 investments in 69 countries including Equities, Fixed Income, Real State and Renewable energy infrastructure (Norges Bank Investment Management, 2023) which following the Portfolio Theory, it will diversify and decrease the risk and allow the country to achieve some resilience from shocks in the global price of Oil and trade flows.

Figure 13: Response of Social Public Spending to a shock in Oil Exports

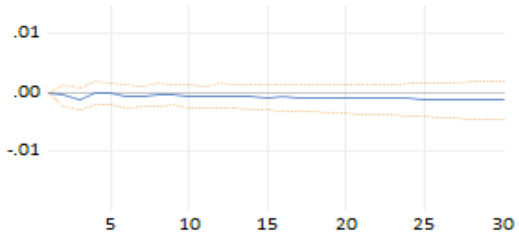
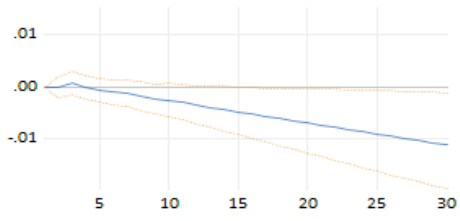


Figure 14: Response of Social Public Spending to a shock in Gold/Oil



Now that the effects of Oil exports and Gold/Oil have been analyzed, it is time to observe the implications of the financial vulnerabilities both in the Social Expenditure and Oil and Natural Gas exports. As we can see in Figure 15 and Table 6, the effect of a shock in the Exchange Rate Volatility has a negative impact although extremely small (in fact imperceptible) over time and it is also temporary as it eventually converges to zero. Table 5, shows that Social Spending has a causal effect in Exchange Rate Volatility and Figure 17 show that although the effect is positive, it is also temporal and quickly becomes zero. These facts strengthens the previous assumption that Income dominate the Substitution Effect in Norway Public Spending so that in times of a financial crisis (2008 crisis appears as a peak in the graphs) the State can mitigate this issue to an extent and fasten the return to previous levels and/or that the highly diversified portfolio of its Sovereign Fund might offset financial shocks with returns from different investments.

The effects of a shock in Exchange Rate Volatility in Oil and Natural gas exports however have a steeper, negative and more persistent effect (in fact permanent as observed in Figure 16) confirming the hypothesis that changes in the real exchange rate (with respect U. S. Dollar) may translate into loses in the value of Oil exports and disentivize more production. On the other hand, shocks in Oil exports have a positive and permanent effect in the Exchange Rate Volatility.

Figure 15: Response of Social Public Spending to a shock in Exchange Rate Volatility

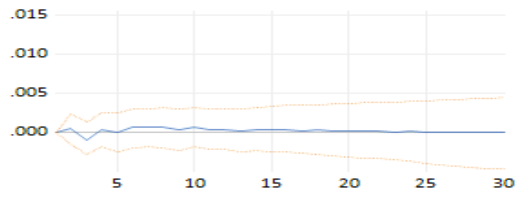


Figure 16: Response of Oil Exports to a shock in Exchange Rate Volatility

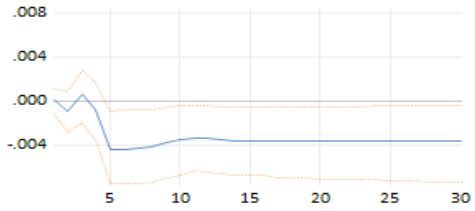


Figure 17: Response of Exchange Rate Volatility to a shock in Social Public Spending

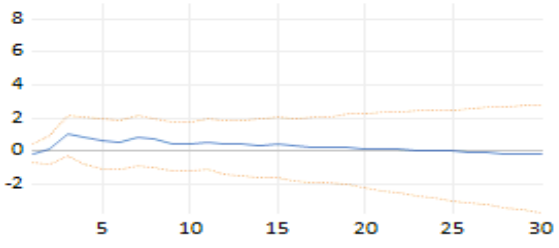
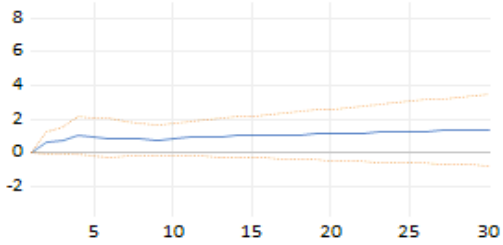


Figure 18: Response of Exchange Rate Volatility to a shock in Oil Exports



Finally, let's test the last hypothesis and see the impact of the price of Oil and Exchange Rate Volatility in the Balance of Payments, and the effect of the latter in Oil exports and Social Spending. Contrary to what was expected, shocks in the Exchange Rate Volatility have little and short-time effect in the Balance of Payments while shocks in the ratio Gold to Oil have a persistent and positive steep effect. This results suggest that Norway's policies may have achieved some degree of financial stability when dealing with deficits, specially with *Handlingsregelen,* but the country is still sensitive to big international shocks that may affect the composition of its external economy.

Regarding Social Spending, the shock show a positive and temporary impact in the short-run and a negative and persistent effect in the long-run suggesting that the Norwegian Public Sector is not prepared to sustain long periods of persistent deficits or they will be forced to reduce their Spending in civilian spending. As for Oil exports, the hypothesis hold and show that shocks in the ratio of Exports to Imports have a negative and persistent effect through time which is expected from an industry export-intensive.

Figure 19: Response of Balance of Payments to a shock in the Exchange Rate Volatility

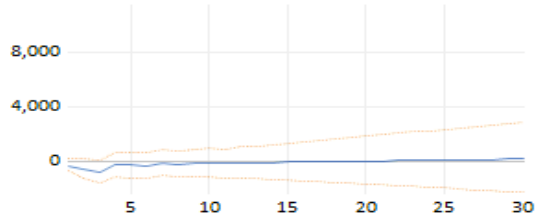


Figure 20: Response of Balance of Payments to a shock in Gold/Oil

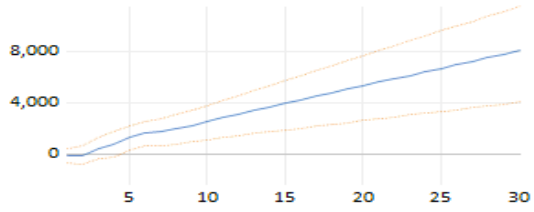


Figure 21: Response of Social Public Spending to a shock in the Balance of Payments

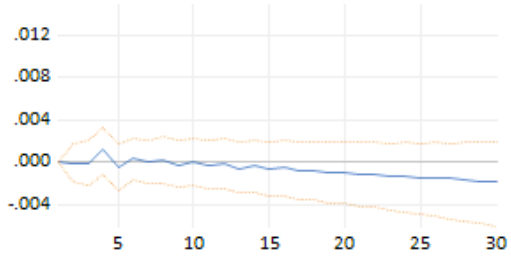


Figure 22: Response of Oil Exports to a shock in the Balance of Payments

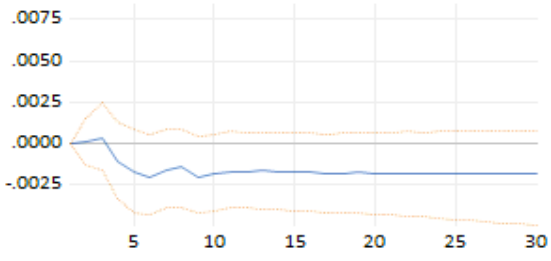


Table 6: Accumulated Impulse Response Function after 30 periods

Impulses	Responses				
	d_soc_spend	real_nok_usd	gold_oil	d_oil_exp	d_exp_imp
d_soc_spend	0,00951	-0,186	-12,1	0,000495	-349,7
real_nok_usd	$-8{,}48\times10^{5}$	4,61	4,55	-0,00356	157,2
gold_oil	-0,0112	8,09	101,3	-0.0072	8090,7
d_oil_exp	-0,00132	1,4	7,79	0,00493	1080,0
d_exp_imp	-0,00175	2,38	18,9	-0,00185	3920,4

To sum up, the results have provided evidence of little support to the main hypothesis that shocks in Oil and Natural gas exports have a significant impact and magnitude in Social Expenditure. In fact after 30 periods, as observed in Table 7, the variance of Social Public Expenditure is explained by a proportion of 93,34% by itself and among the remaining proportion, Oil Exports only explain 0,75%. This degree of inelasticity regarding the share of Public Spending destined to social welfare is consistent with the hypothesis of efficiency and compensation.

The former hypothesis states that in the presence of a highly globalized economy, Governments will try to attract mobile capital by increasing the spending in education, R&D and infrastructure (Tanzi, 2000). The latter instead argues that the increase in spending is caused as a way to compensate economic agents for being more exposed to external shocks (Ruggie, 1983; Rodrick, 1998). Following a study carried out by Gemmel et al. (2008) where they concluded that compensation hypothesis dominates the efficiency one for a sample of OECD countries (included Norway). These findings coupled with Norway's aim of ensuring the welfare of its citizens and achieve sustainability and its cautious policies regarding the use of its assets, suggests that this effect might explain the reason behind this inelasticity.

Regarding the rest of the variables, it is observed once again how Norway is incapable of significantly affecting the global economy, as the variance of Gold/Oil is explained by 94,1% by itself, and how despite its decisions to keep a high share of expenditure in social welfare its economy is still dependent from external events. In Table 7, it can be observed that although most of the variance of Exchange Rate Volatility and Balance of Payments are explained by their own values, Gold/Oil still explains more than 10% of its variance. And in the case of Oil Exports, the ratio of Gold to Oil is even bigger as it explain 40% suggesting thus a significant and important dependence external trade and of external vulnerabilities.

Table 7: Variance Decomposition from VEC after 30 periods

	d_soc_spend	real_nok_usd	gold_oil	d_oil_exp	d_exp_imp
d_soc_spend	93,34	5,01	1,43	5,08	6,33
real_nok_usd	1,68	78,49	0,38	14,04	3,16
gold_oil	1,96	10,62	94,1	40,00	11,96
d_oil_exp	0,75	2,26	0,62	38,47	3,47
d_exp_imp	2,26	3,62	3,48	2,41	75,07
Total	100	100	100	100	100

5.2- Before and after "Government Pension Fund": 1978-1996 & 1997-2022

Previously, it has been observed the inelasticity of the fraction of Government Expenditure in social aspects and a clear independence from Oil. However, as shown in Figure 2, the situation might be different before and after 1997, as it is the time when the Sovereign Fund was put in action and when the production of Oil started to plummet. In fact, it can be observed how the trend of Oil Exports is practically linear before 1997 and then it appears that the production becomes constant as it has reached a plateau. In that case, then perhaps this independence from Oil has been reached only after the creation of the Sovereign Fund and not before. In order to assess the veracity of this statement and its implications in the short and long-run, the sample will be restricted to 1978Q1-1996Q4 and 1997Q1-2022Q4 respectively and a time series specification will be done for the two sub-samples.

As it was done before, the first step is to make sure that the variables used in the model are stationary. Figure 23 show a set of graphs for the original time series variables in both sub-samples and Figure 24 their transformations after confirming their stationarity through Durwin-Watson unit root test and applying first differences (denoted by "d") to those variables with a unit root. Once stationarity has been confirmed, the next step is to test if there is Cointegration by applying the Johansen-Cointegration test which provides evidence in favor for at least five equations, meaning that VEC models should be used in both sub-samples.

Using Akaike information criterion for both specification, the optimal number of lags is 2 and 3 respectively. The order of the variables is the same as before and its validity is confirmed as the p-values associated to the null-hypothesis of the LM test of no autcorrelation in the residuals are 0,8656 and 0,1465 and the inverse roots of the AR Characteristic Polynomial are within the circumference (Figure 25)

When testing for Granger Causality, it can be seen that contrary to the previous specification, the fraction of Public Expenditure destined to social outcomes is more sensitive to shocks, specially during the first Sub-Sample where all variables except Exchange Rate volatility have a significant effect. It is interesting to notice though, that during the first subsample, Oil Exports and Gold/Oil are the most significant variables in the test but in the second they stop being significant and in turn Exchange Rate Volatility becomes significant suggesting an emergent service and financial transition with respect Oil. In the case of the petroleum industry, it appears that in both subsamples the Export to Import ratio has a significant effect and in the second subsample Exchange Rate Volatility becomes significant suggesting a higher financial vulnerability in the industry and a higher sensitivity to gains of trade[18]. With respect Exports/Imports and Exchange Rate Volatility, it is observed that although they appear to be inelastic to the shocks of the rest of the variables during 1978-1996, after 1997 the effect of the rest of the factors become significant specially Gold/Oil which might reflect external vulnerabilities as a consequence of a higher integration in the global market. In short, it is likely that after 1997 the country experienced a higher integration in the global market and some independence from Oil in its Social Spending which is reasonable given the establishment of the *Government Pension Fund.*

Table 8: Granger Causality Tests – VEC (Comparison)

Regressor	Dependent Variable				
	d_soc_spend	real_nok_usd	gold_oil	d_oil_exp	d_exp_imp
d_soc_spend					
Sub-Sample: 1978-1996	x	0,804	0,215	0,77	0,44
Sub-Sample: 1997-2022	x	0,0567*	0,706	0,166	0,0267**
real_nok_usd					
Sub-Sample: 1978-1996	0,816	x	0,871	0,650	0,711
Sub-Sample: 1997-2022	0,0965*	x	0,658	0,0002***	0,0006***
gold_oil					
Sub-Sample: 1978-1996	0,0002***	0,0871*	x	0,940	0,706
Sub-Sample: 1997-2022	0,801	0,0057***	x	0,187	0,0274**
d_oil_exp					
Sub-Sample: 1978-1996	0,0004***	0,135	0,447	x	0,936
Sub-Sample: 1997-2022	0,155	0,0073***	0,446	x	0,213
d_exp_imp					
Sub-Sample: 1978-1996	0,0023***	0,511	0,0878*	0,0335**	x
Sub-Sample: 1997-2022	0,0587*	0,0176**	0,224	0,026**	x
All					
Sub-Sample: 1978-1996	0,0002***	0,348	0,246	0,360	0,172
Sub-Sample: 1997-2022	0,0178**	0,0014***	0,702	0,0027***	0,0064***

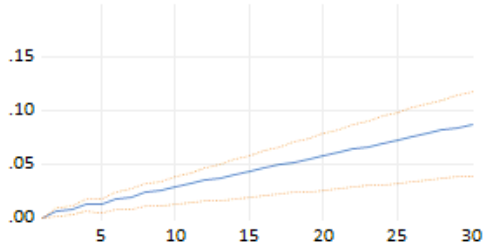
Note :* if p <0.1, ** if p<0.05 and *** if p<0.01; the variables with a "d" at the beginning are the variables that were transformed through first differences in order to to get rid of their unit roots and achieve stationarity.

18 Taking into account the last wave of Globalization and the dollarization of international Oil sells, then lower Terms of Trade, higher deficits and appreciation of NOK with respect USD can disentivize the production of Oil.

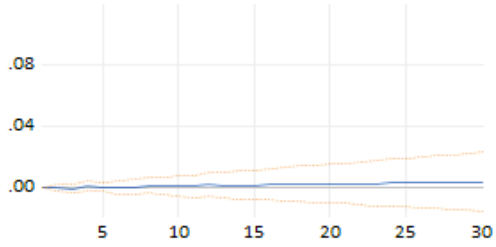
Now that Granger Causality has been addressed, it is time to compare the magnitude and persistence of shocks in the different variables across the two Sub-samples, starting with the AIRF of Social Public Spending to a shock in Oil Exports. Results in Figure 26 provide an interesting contrast as in the first subsample the response to a shock is permanent and with a noticeable magnitude and positive effect, while in the second the effect of the shock is transitory and with no significant effect. It is interesting to take a look at the graphs of *Soc_Spend* and *Oil_Exp* in the Original Time Series for the full sample (Figure 10) it can be observed that they follow a similar pattern as they both have a steadily increasing trend that eventually reach a plateau. In that case, the permanent shock shown in Figure 26 (i) might reflect how the emerging market of Oil incentivized more Social Expenditure as the Central Government had higher levels of income to spare with constant revenues (as the trend is linear). Nevertheless, in 2003 (when Social Spending in Figure 10 experienced the highest variation) when the War of Iraq began[19] and the global economy started to show signs of stagnation, the Norges Bank increased the Social Expenditure in the face of this uncertainty and made use of its Sovereign Fund to offset this drawback explaining thus why Figure 26 (ii) show such a short and small impact in Social Spending. At the same time, it was at the beginning of the 21th Century when Norway's Oil production started to stagnate (Figure 2) so the fact that Figure 26 (ii) shows little magnitude of the shock might reflect how the role of Oil in the economy has decreased confirming the main hypothesis in Section 3.

Figure 26: Response of Social Public Spending to a shock in Oil exports (Comparison)

(i) 1978Q1-1996Q4



(ii) 1997Q1-2022Q4



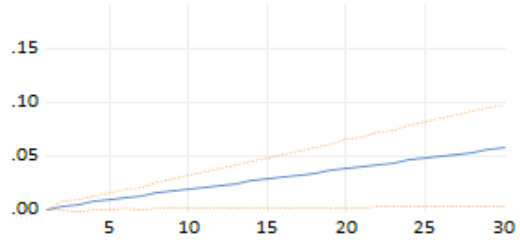
When analyzing the effects of shocks of the International Price of Oil, proxied by Gold/Oil, in Social Public Expenditure and Oil Exports, two things can be noticed. The first one is that for Social Spending, between 1978 and 1996, the AIRF show a significant positive and permanent shock while in the other subsample the impact is transitory and barely noticeable. This could reflect a possible transition in the Public Sector towards an Oil-resilient economy perhaps motivated by the

19 The gobal supply of Oil during this time started to show sharp decreases in its levels due to the uncertainty of the consequences of the War of Iraq and the strike of Oil producers in Venezuela, exerting thus a significant pressure on the price levels of Oil and by proxy the production of petroleum that became stagnated (Gjedrem, 2003)

restrictive policy implemented by the Norges Bank and by *Government Pension Fund.* The second thing is that Oil Exports experience a negative permanent and noticeable shock in both samples probably reflecting how the industry is still sensitive to external shock within the Oil Market and its incapacity to offset such shocks. In short, permanent shock in Social spending during the first subsample might reflect the incapacity of the variable to offset the innovation if the situation remains unchanged while a temporary shock in the second subsample might show that resilience have been achieved, indicating once more how the Public Sector have managed to reduce its dependency form Oil and offset external shocks both within the industry and the global market.

Figure 27: Response of Social Public Spending to a shock in Gold/Oil (Comparison)

(i) 1978Q1-1996Q4



(ii) 1997Q1-2022Q4

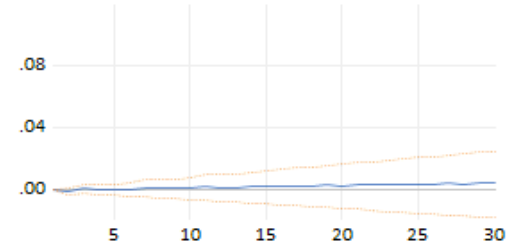
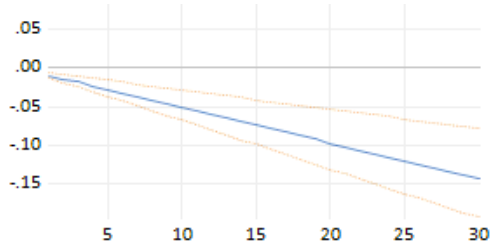
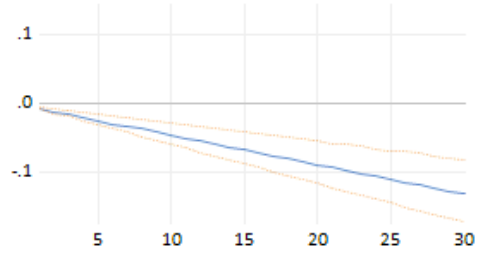


Figure 28: Response of Oil Exports to a shock in Gold/Oil (Comparison)

(i) 1978Q1-1996Q4



(ii) 1997Q1-2022Q4

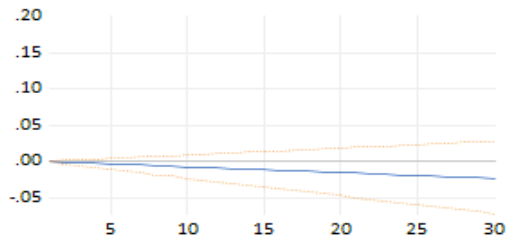


Now that the effects of the shocks in the international price of Oil have been discussed, it is time to analyze the effects of financial vulnerability in Social Spending and Oil Exports. It is interesting to see that although Table 8 provide evidence Exchange Rate Volatility has a causal effect on these two variables in second subsample and it appears that the impact of the shock in Social Spending although little is persistent over time while Oil Exports only between 1978-1996. These negative and persistent effects over time in Social Public Expenditure may imply how deviations from anchor currency may affect the expectations of the economic agents forcing the State to cut Spending although in small magnitude. Knowing that Norway's Sovereign Fund constitutes a wide portfolio is reasonable to expect that financial vulnerabilities would have important implications in

the Fund and in Public Spending by proxy. As for the petroleum industry, during the time of expansions (1978-1996) clearly deviations form the anchor currency will likely translate into trade losses but after reaching the plateau and acquiring a firm position within the global market the effect of the shock might stop being significant.

Figure 29: Response of Social Public Spending to a shock in Exchange Rate Volatility (Comparison)

(i) 1978Q1-1996Q4



(ii) 1997Q1-2022Q4

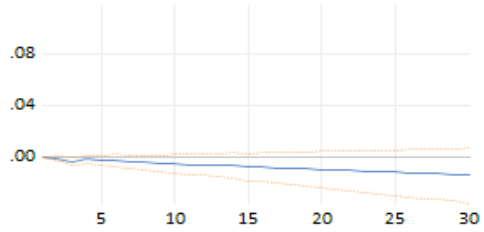
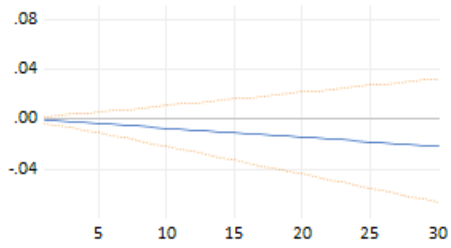
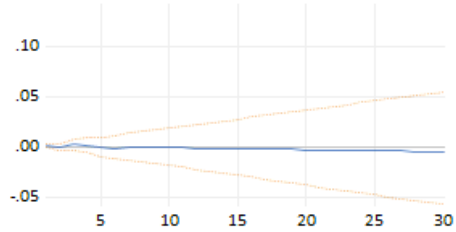


Figure 30: Response of Oil Exports to a shock in Exchange Rate Volatility (Comparison)

(ii) 1978Q1-1996Q4



(ii) 1997Q1-2022Q4

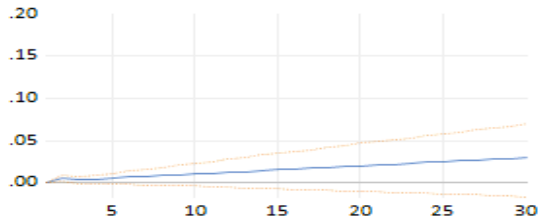


Finally, let's compare the AIRFs of Social Spending and Oil Exports to shocks in the Balance of Payments in the two different periods of time. In Figure 31, it is observed that in the first subsample a shock in the Balance of Payments has a positive and persistent effect in Social Spending while in the other subsample the effect is negative, temporary and of small magnitude. This clear difference between periods might explain how the fraction of Public Expenditure destined to civilian use has stabilized over time and reached some degree of resilience from external vulnerability in real terms. This is consistent with the fact that the 20th Century has seen many cases of economic instability in the international economy suggesting that perhaps Norway has made use of its savings to compensate the ones affected by it, keeping thus its economic status. On the other hand, between 1978-1996, the country experienced constant economic growth rates (interrupted only during the crisis of 1988) allowing the country to allocate more resources into social welfare. As for Oil Exports, Figure 32 shows that during the first period of time the impact of the shock is negative, small and transitory while during the second period it's positive, significant and persistent. This

may reflect how the petroleum industry is still dependent from external flows and how persistent periods of economic instability in the international market (Financial Crisis of 2008, War of Iraq or COVID-19) may incentivize or disentivize the production of Oil.

Figure 31: Response of Social Public Spending to a shock in Balance of Payments (Comparison)

(i) 1978Q1-1996Q4



(ii) 1997Q1-2022Q4

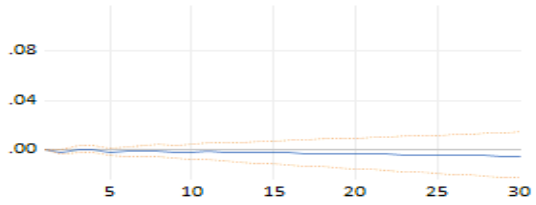
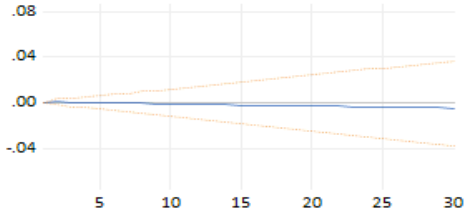


Figure 32: Response of Oil Exports to a shock in Balance of Payments (Comparison)

(ii) 1978Q1-1996Q4



(ii) 1997Q1-2022Q4

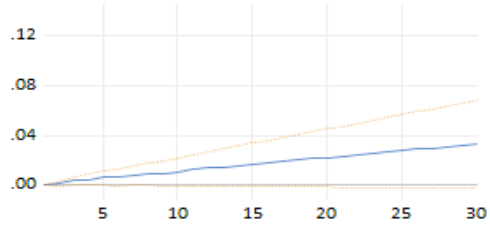


Table 9: Accumulated Impulse Response Function after 30 periods (Comparison)

Impulses	Responses				
	d_soc_spend	real_nok_usd	gold_oil	d_oil_exp	d_exp_imp
d_soc_spend					
Sub-Sample: 1978-1996	0,146	-1,81	18,4	-0,0235	-0,314
Sub-Sample: 1997-2022	0,0917	3,26	-10,8	0,0372	4083
real_nok_usd					
Sub-Sample: 1978-1996	-0,0231	29,1	4,26	-0,0217	29,1
Sub-Sample: 1997-2022	-0,0143	54,8	-20,7	-0,00483	13620
gold_oil					
Sub-Sample: 1978-1996	0,0576	0,589	38,6	-0,144	-1,20
Sub-Sample: 1997-2022	0,00431	-23,1	70,0	-0,131	1432
d_oil_exp					
Sub-Sample: 1978-1996	0,0873	-0,913	-6,01	0,0621	-0,545
Sub-Sample: 1997-2022	0,00365	0,804	1,71	0,109	32155
d_exp_imp					
Sub-Sample: 1978-1996	0,0298	0,787	3,89	-0,00455	2,00
Sub-Sample: 1997-2022	0,0917	27,6	8,55	0,0331	34477

To sum up, this comparison has provided evidence of how Oil before the establishment of the *Government Pension Fund* played a high and significant role in explaining the share of Public Expenditure in social outcomes but after the establishment of the Sovereign Fund, the Norwegian State achieved resilience from Oil. This statement is strengthen in Table 10 where in the first subsample, 65,28% of Social Spending variance is explained by itself and 19,82% by Oil Exports, clearly a significant dependence from Oil an Natural gas but in the second subsample, 88,22% of the variance is determined by its own values. With respect the Oil Sector, Table 10 shows that the industry was and continues to be sensitive to movements in the international price of Oil, as Gold/Oil explains 80,14% and 51,56% respectively reflecting the lack of sufficient bargaining power of Norway in the market (despite an improvement in the second period).

As for the rest of the variables, the most notable results are in the Exchange Rate Volatility where 98,76% of its variance was explained by its own values in 1978-1996 but then changes to 70% probably as a result of a higher participation rate in the international financial market and economy after the decision to invest their surpluses in foreign financial assets. As expected, Gold/Oil variance is very little influenced by the rest of the variables during the two periods confirming once again the incapacity of Norway to play a big role in the international economy. Finally, the Exports to Imports ratio show some signs of external dependence as in the first subsample, 24,56% of its variance was explained by Gold/Oil and although such effect is offset in the next subsample, Oil Exports determine 35,6% of it during that time, meaning that the petroleum industry still plays an important role in the foreign sector.

Table 10: Variance Decomposition from VEC after 30 periods (Comparison)

	d_soc_spend	real_nok_usd	gold_oil	d_oil_exp	d_exp_imp
d_soc_spend					
Sub-Sample: 1978-1996	65,28	0,47	17,35	2,56	1,87
Sub-Sample: 1997-2022	88,22	1,67	2,24	5,23	2,89
real_nok_usd					
Sub-Sample: 1978-1996	1,29	98,76	0,97	1,83	0,45
Sub-Sample: 1997-2022	4,23	70	7,65	1,69	7,81
gold_oil					
Sub-Sample: 1978-1996	8,42	0,17	78,04	80,14	24,56
Sub-Sample: 1997-2022	1,8	11,45	88,18	51,65	0,67
d_oil_exp					
Sub-Sample: 1978-1996	19,82	0,44	2	14,43	5,11
Sub-Sample: 1997-2022	2,36	0,21	0,49	37,77	35,6
d_exp_imp					
Sub-Sample: 1978-1996	5,19	0,15	1,65	1,04	68,01
Sub-Sample: 1997-2022	3,39	17	1,43	3,65	53,03
All	100	100	100	100	100

6. ANALYSIS, DISCUSSION AND LIMITATIONS

This study has established two important features for the Public Sector of Norway that may be of interest for nations intensive in Oil exports and production. The first one is that over the whole period of time analyzed that covers from 1978 to 2022, it is observed a Budget Rigidity in Social Expenditure, specially with respect Oil Exports. The second is that when making a comparison between the periods before and after the creation of the Sovereign Fund, it is observed that before 1997 (when the Pension Fund was established) the relationship between Oil and Social Spending was positive and significant, and later Government Expenditure in civilian use became inelastic. Besides, it is also observed how despite this rigidity the effects of shocks in the Exchange Rate Volatility have a higher impact in the Balance of Payments suggesting a higher level of financial integration of Norway in the international market.

At first sight, these findings seem to provide evidence in favor of Norway having achieved independence form Oil in the Public Sector and financial stability. When talking about Oil-exporting economies, it is important to look not only the revenues obtained from its extraction but also to Government Spending (since the industry is closely related to geopolitical interests as mentioned in Section 3) to evaluate their economic performance and social welfare. As it was stated before, Oil is a very globalized market with high competence and number of players and it is perhaps for this reason that it is notorious for its volatility and consequences, specially in Oil-exporting economies. That being the case, Public Spending and fiscal policies are usually the main measures to deal with this issue, and it is no wonder that authors like Bouchanor & Al-Zeaud (2012) have found evidence of oil-exporting countries trying to reduce its dependence from petroleum. Knowing these facts, then it is reasonable to think that for an Oil-exporting country to stop being dependent from Oil and achieve satisfactory levels of welfare (e.g in the form of Public Spending in social outcomes) and distribution of resources, it is imperative to have a proper set of institutions.

Pazouki & Zhu (2022) found empirical evidence that Oil-exporting and democratic countries in times of Oil volatility they increase Government Expenditure. Throughout this study, it has been found that the results for Norway are consistent with such findings, specially in 2003 and in the 1980s when the country experienced the highest volatility and uncertainty in the price of Oil. It is also important to take into account that since the establishment of the *Government Pension Fund,* the Norwegian Government has transferred its Oil revenues into such fund providing the nation with a tool capable of increasing Social Spending and limiting the harmful effects of economic fluctuations into socioeconomic outcomes. In 2016, it was estimated that 40% of total Government

Expenditure was used for Social Protection, 11% in Education, 17% in Health and the rest in Economic affairs, military use and others (OECD and Eurostat, 2016). Taking these facts and the two features mentioned above into consideration plus the set of goals stipulated during the creation of Statoil, it can be assumed that indeed Norway's institutional quality and clear aim to be independent from Oil has helped the country to achieve this aim and escape the "Curse of Natural Resources"

Nevertheless, this approach has important limitations that need to be pointed out for a proper and more accurate discussion and future work. The first and most important aspect is that the empirical approach only provides evidence of Norway's budget rigidity after 1997 but no measure of institutional quality of the Sovereign Fund has been included and as such only hypothesis can be done in this aspect.

Second, the model used only takes into account Social Public Spending from the Central Bank as a way to make a clearer and more direct link of causation between the petroleum industry and Government Expenditure. Even though this assumption sounds reasonable, it limits the scope the analysis and narrows the perspective of the study.

Third, when talking about vulnerabilities in the petroleum sector, only the supply side has been taken into account. Although the effect of the supply side plays a major role in Oil-exporting countries, flows in Oil market are simultaneously determined by both the demand and the supply, so by ignoring one of those effects it may cause some bias in the estimations.

Finally, another factor not included in the empirical analysis is the diversity of trade and partners. As it was mentioned before, one of the most common vulnerabilities in small economies intensive in trade is specialization which means that an economy that is not diversified is more sensitive to shocks as they are very unlikely to offset the impact of external shocks. That being the case, it would be relevant to include the number of trading partners for Norway over the period of time analyzed or another measure of its trade complexity.

In other words, the results warrant some caution and further studies in this area should focus their attention in understanding why Norway has became independent from Oil. More precisely in the diversity and profitability of the returns of the shares and equities of the *Government Pension Fund* which is the institution with the highest probability of explaining this phenomenon.

7. CONCLUSIONS

It is undeniable the importance that Oil has played in the economic performance and social welfare of Norway. After 1978, Norway experienced a constant (almost linear) production and export of Oil and Natural Gas allowing the Central Bank to spend more money into social outcomes and proving it with a stable rate of economic growth. However, since its proclamation in 1974, the Norwegian Government made clear that Oil was only to be used to ensure the welfare of the Norwegian population in a way that will not make the nation extremely dependent on trade. This in turn allowed the Government to accumulate enough wealth to make significant investments into civilian use and increase its economic performance.

Nevertheless, the beginning of the 21st was marked by economic instability (War of Iraq in 2003 and financial crisis of 2008), uncertainty and concern among investors about the next economic inflows in the international economy. These events coupled with the plateau reached by the petroleum industry called for measures and made clear the need to stop dependency from Oil and Natural Gas. This study has shown that Norway has been successful in this aim and there is indeed a significant level of resilience and inflexibility for Social Public Expenditure for vulnerabilities in the Oil market, the international price of Oil, international financial market and in the Balance of Payments.

Nevertheless, the causes for this resilience have not been addressed and future studies in this topic should focus their attention in determine such factors. That being the case, there are interesting facts in this matter like Norway's institutional quality, financial integration and above all the *Government Pension Fund*. Therefore, this thesis suggests to future researchers to analyze the relationship and impact of the returns of the Sovereign Fund both for Government Expenditure and Investment and thus grasp accurately and consistently if Wealth Sovereign Funds motivated by a clear aim to ensure social welfare are successful for Oil-exporting countries in need for resilience from Oil.

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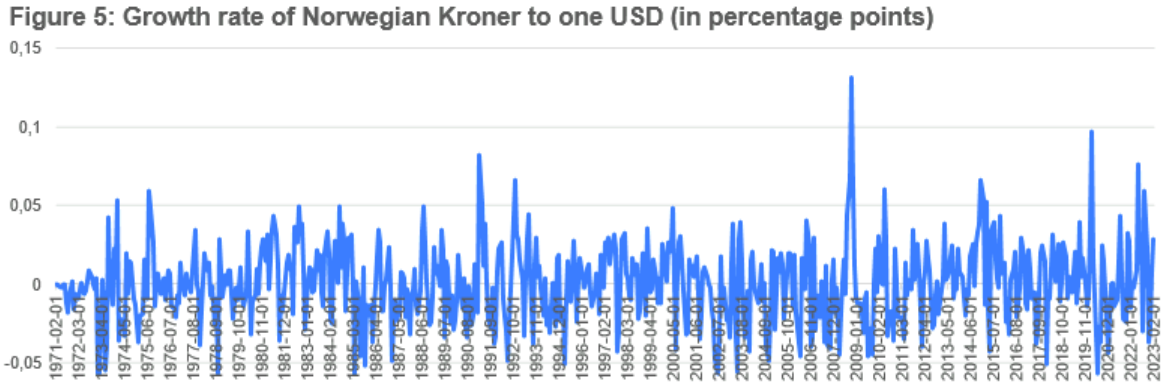
APPENDIX

Table 1: Final Government Expenditure and Oil revenues – Average per decade

	1971-1980	1981-1990	1991-2000	2001-2010	2011-2020
Final Government Expenditure (% GDP)	18,3	19,19	20,91	20,28	23,04
Oil Revenues (% GDP)	1,47	4,05	5,07	7,84	5,04

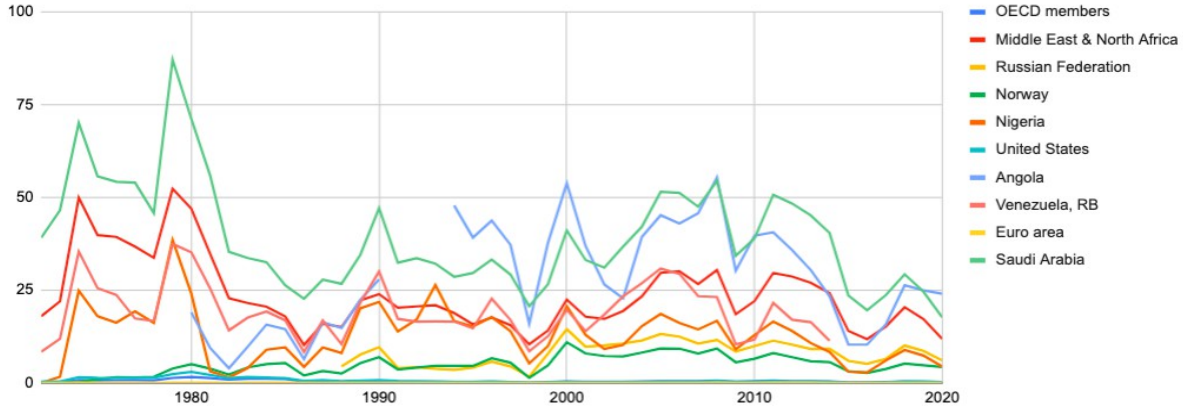
Source: World Bank, World Bank Development Indicators: **https://databank.worldbank.org/source/world-development-indicators** and Norwegian Petroleum Directorate

Source: Board of Governors of the Federal Reserve System (US)



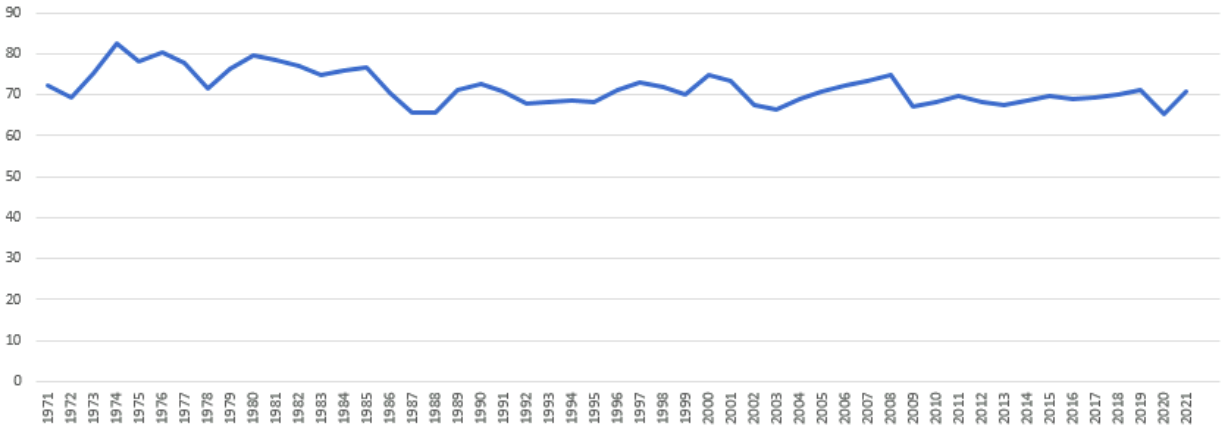
Source: Board of Governors of the Federal Reserve System (US)

Figure 6: Oil Rents (% GDP)



Source: World Bank, World Bank Development Indicators: **https://databank.worldbank.org/source/world-development-indicators**

Figure 8: Norway Trade Balance (% of GDP)



Source: World Bank, World Bank Development Indicators: **https://databank.worldbank.org/source/world-development-indicators**

Figure 10: Original Time Series (Full-sample)

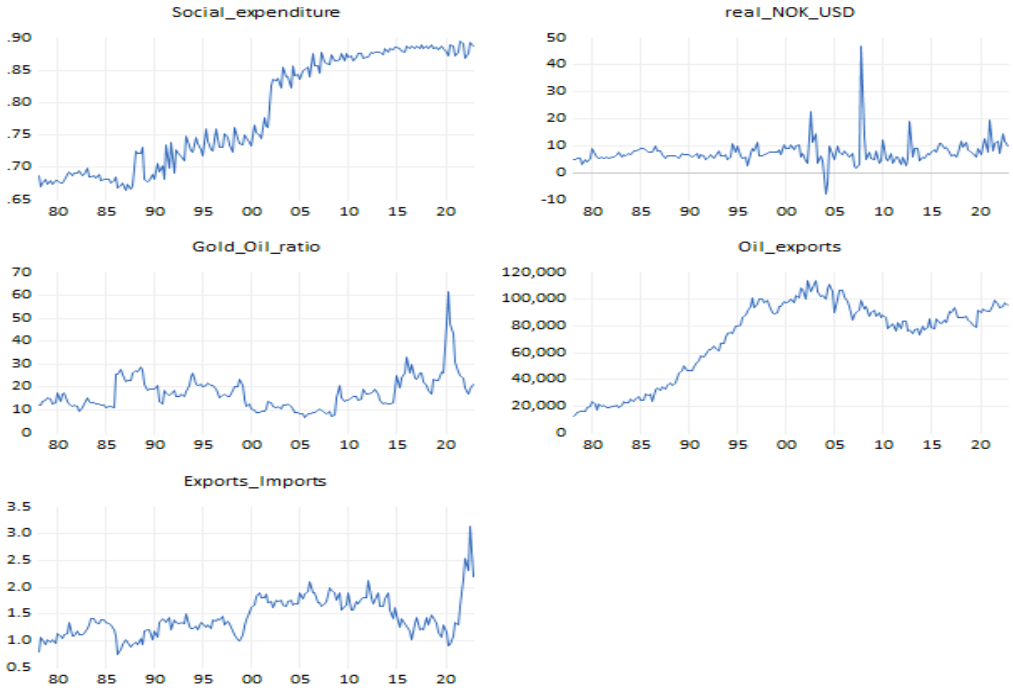


Figure 11: Transformed Time Series (Full-sample)

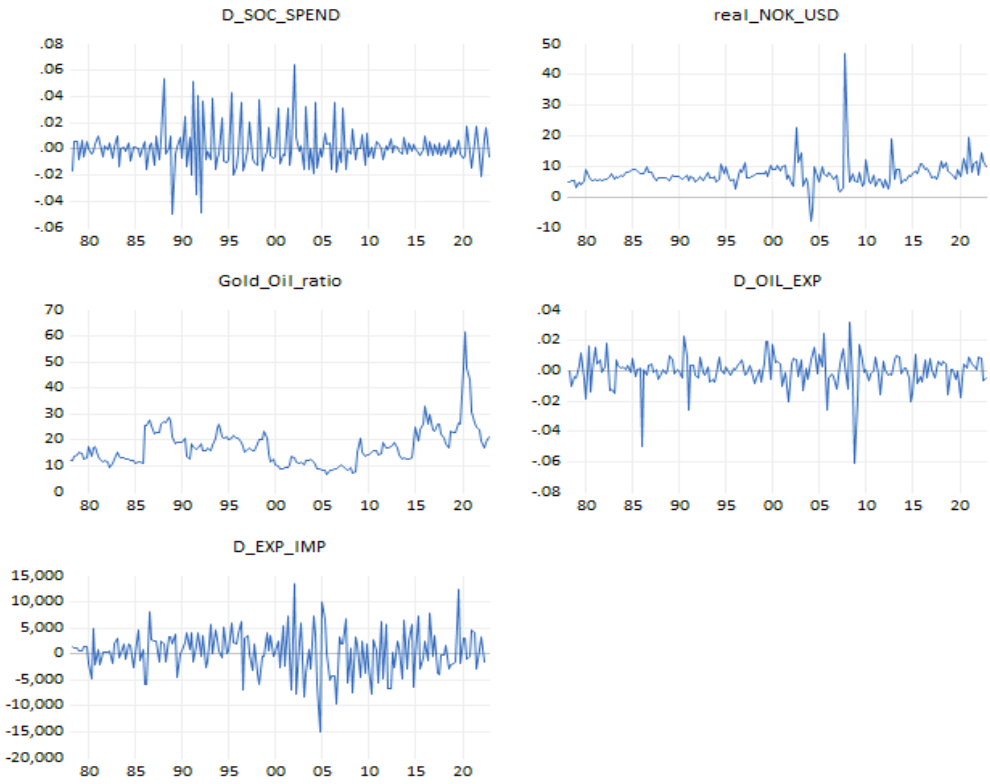
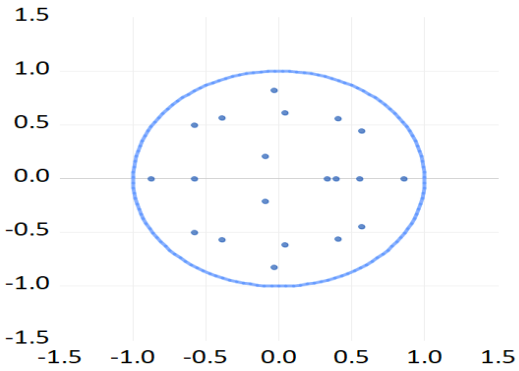
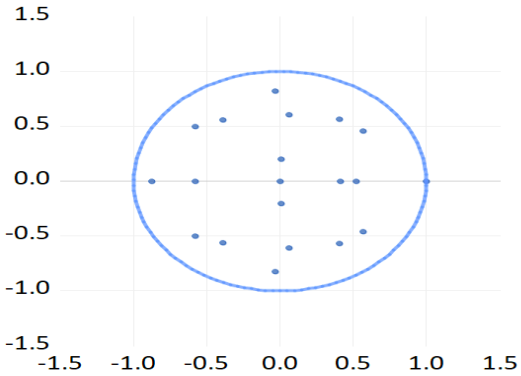


Figure 12: Inverse Roots of AR Characteristic Polynomial (Full-sample)

(i) VAR specification 1978Q1-2022Q4



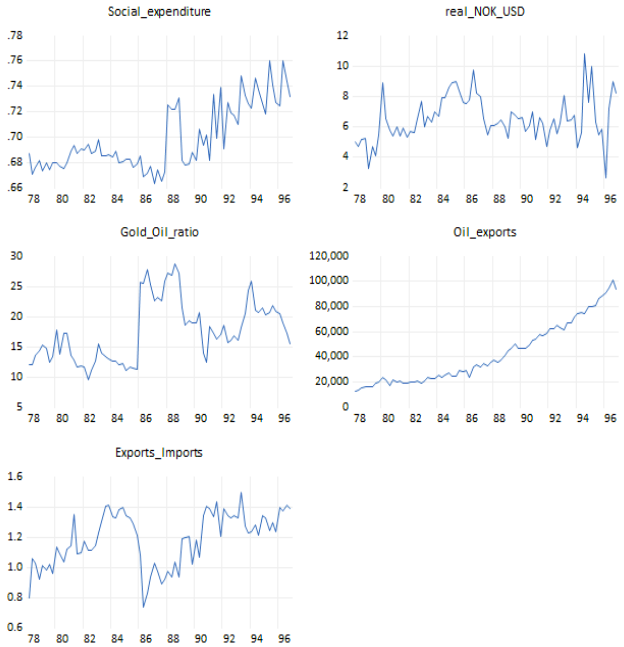
(ii) VEC specification 1978Q1-2022Q4



(ii)

Figure 23: Original Time Series (Comparison)

(i) Sub-Sample: 1978Q1 to 1996Q4



(ii) Sub-Sample: 1997Q1 to 2022Q4

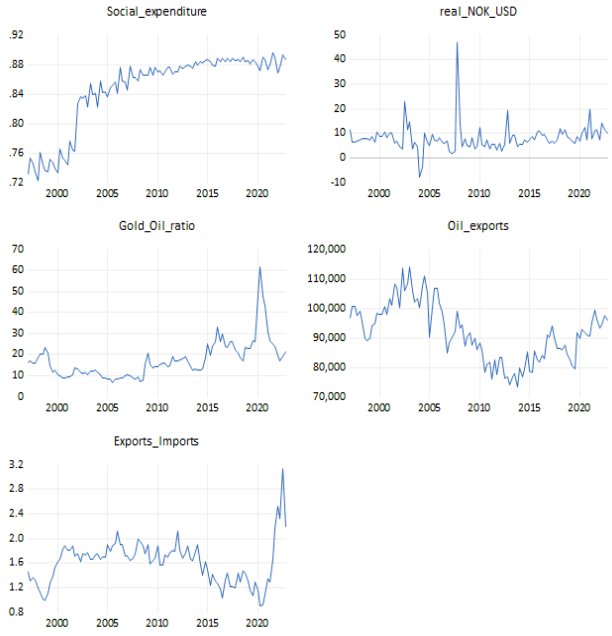


Figure 24: Transformed Time Series (Comparison)

(i) Sub-Sample: 1978Q1 to 1996Q4

(ii) Sub-Sample: 1997Q1 to 2022Q4

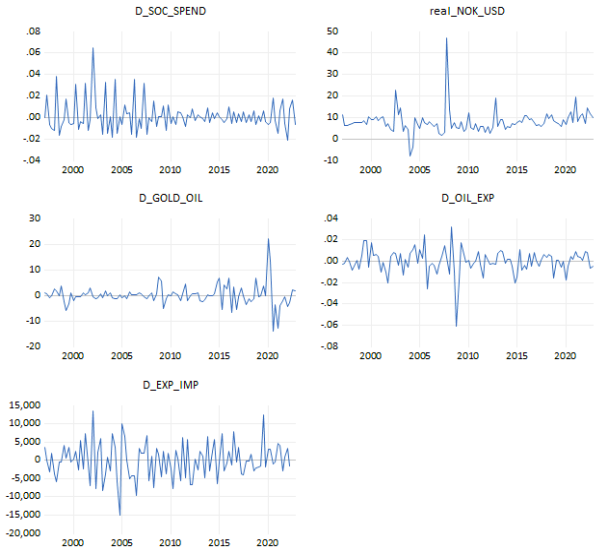
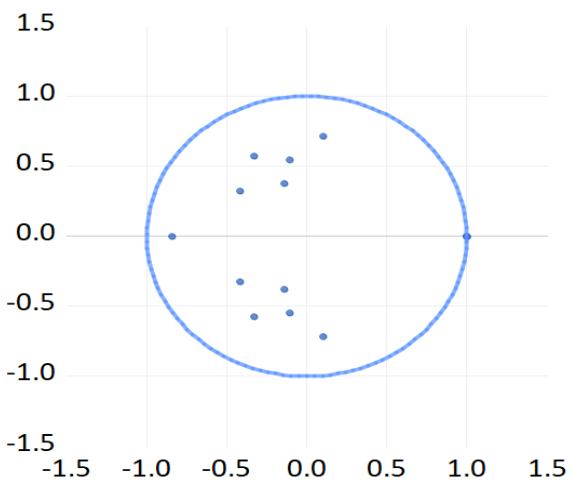


Figure 25: Inverse Roots of AR Characteristic Polynomial (Comparison)

(i) Sub-Sample: 1978Q1 to 1996Q4



(ii) Sub-Sample: 1997Q1 to 2022Q4