The War in Ukraine´s Effect on Norwegian GDP

By Elina Risanger and Ine Heen Aaness

Bachelor thesis in Economics
Supervisor: Gorm Kipperberg
2024

University of Stavanger Business School
Bachelor in economics and business
administration (B-ØKAD)

Universitetet i Stavanger

HANDELSHØGSKOLEN VED UIS

BACHELOROPPGAVE

STUDIUM:	OPPGAVEN ER SKREVET INNEN FØLGENDE TEMATISKE RETNING:
Økonomi og Administrasjon	Samfunnsøkonomi
	ER OPPGAVEN KONFIDENSIELL? Nei

TITTEL:

Krigen i Ukraina sin Effekt på Norsk BNP

ENGELSK TITTEL:

The War in Ukraine's Effect on the Norwegian GDP

FORFATTERE:		VEILEDER:
Kandidatnr:	Navn:	Gorm Kipperberg
1637…………………	Elina Risanger……………………….	
1547…………………	Ine Heen Aaness…………………….	

Foreword

This bachelor's thesis is written in the context of a three-year bachelor program in Economics and Business Administration coming to an end. The study program is by the Business School of the University of Stavanger. The supervisor for this thesis is Gorm Kipperberg, a professor at the University of Stavanger. The process of this thesis has been challenging and time-consuming, but simultaneously filled with deeper understanding, insightful discussions, and new perspectives. One of the main motivators in choosing a theme and research question was to choose something interesting that could be discussed enthusiastically with people along the road, and that goal was achieved. The work has given us useful insight on current themes and given us the opportunity to integrate the knowledge from various subjects from the course of study.

Gorm Kipperberg has been an engaged and motivating supervisor. In addition to thanking Gorm Kipperberg for guidance, we would like to thank Torfinn Harding for taking the time to discuss the thesis and provide valuable expertise.

Abstract

This bachelor's thesis investigates the impact of the war in Ukraine on Norway's GDP, focusing mainly on the relationship between the price and exported volume of natural gas and GDP. In addition to the main research question in the thesis, there is also a sub-research question along with hypotheses to lead the analysis and contribute to reaching a conclusion. Regression analyses were conducted on two datasets representing different periods between 1980 and 2023. The results indicate a significant effect of both natural gas prices and exported volume of natural gas on the Norwegian GDP also after the Russian invasion of Ukraine. While the price of natural gas experienced a notable increase compared to exported volume, there is no clear evidence for a strengthened or weakened relationship between natural gas prices and the Norwegian GDP as a result of the war. The research integrates findings from regression analyses, hypothesis testing, and the AS-AD model, discussing how increased natural gas prices, triggered by market mechanisms during the war, contributed to growth in Norway's GDP. Factors such as demand shocks due to European sanctions on Russia, Russian supply shortfall, and the markets uncertainty played pivotal roles.

Summary

Denne bacheloroppgaven undersøker virkningen krigen i Ukraina har hatt på Norges BNP, med hovedfokus på forholdet mellom prisen og eksportert volum av naturgass, og BNP. I tillegg til hovedproblemstillingen i oppgaven, er det en underproblemstilling sammen med hypoteser for å lede analysen og bidra til en konklusjon. Regresjonsanalyser ble utført på to datasett som representerer ulike tidsperioder mellom 1980 og 2023. Resultatene indikerer en betydelig effekt på både prisen på naturgass og eksportert volum av naturgass på Norges BNP også etter den russiske invasjonen av Ukraina. Mens prisen på naturgass opplever en bemerkelsesverdig økning sammenlignet med eksportvolumet, er det ingen tydelige bevis for et forsterket eller svekket forhold mellom naturgasspriser og Norges BNP som et resultat av krigen. Forskningen integrerer funn fra regresjonsanalyser, hypotesetesting og AS-AD-modellen, og diskuterer hvordan økte naturgasspriser, utløst av markedsmekanismer under krigen, bidro til vekst i Norges BNP. Faktorer som etterspørselssjokk som følge av europeiske sanksjoner mot Russland, Russisk tilbudssvikt og markedets usikkerhet spilte avgjørende roller.

Table of Contents

Figure Overview

Tables Overview

Equation Overview

1.0 Introduction

On February 24th 2022, Russia initiated an invasion of Ukraine. This military action was swiftly condemned by the European Union (EU) and other European nations, leading to several sanctions on Russia (Iversen, 2024). As a response to these sanctions, President Putin leveraged Russian energy resources as a weapon. For a considerable period, Russia had been a significant supplier of natural gas to the EU, accounting for 40% of the region's gas imports in 2021 (European Council, 2024). Germany, in particular, heavily relied on Russian gas, which constituted over 50% of the nation's natural gas consumption (Bundesnetzagentur, 2023). Throughout 2022 Putin threatened to shut down the export of natural gas to Germany. In June 2022 the Nord Stream 1 capacity was limited to 40% and in early September Putin made the decision to close the Nord Stream 1 pipeline to Germany indefinitely. A fear of a supply shortage for the upcoming winter led the EU to seek alternative sources to meet its natural gas requirements (Kuzemko et al, 2022, p.1; Tertre et al, 2023). The US emerged as a crucial alternative supplier and in 2023 they made up almost 20% of the natural gas imports to the EU. Norway has been a longstanding major supplier of natural gas to continental Europe, and after the reduction of imports from Russia Norway has become the largest natural gas supplier for Europe accounting for 30% of the imports (European Council, 2024).

After the invasion of Ukraine, the Norwegian GDP experienced a significant boost. Although the volume of the GDP showed a conservative increase of 3%, the value of the GDP witnessed a remarkable surge of 28.2% from 2021 to 2022 (SSB, 2024a). When examining the GDP by dividing it into the regular GDP and the mainland GDP, a noticeable disparity in growth rates becomes apparent. While the value of the GDP soared by 28.2%, the mainland GDP only experienced a 6% increase (SSB, 2024a). This distinction serves to highlight how most of the changes in the GDP can be attributed to industries that lie outside the scope of the mainland GDP, which is the petroleum industry as well as shipping. These numbers indicate that it is the prices related to the petroleum industry or the shipping industry that are the cause of the increase in Norway’s GDP in 2022.

The TTF Dutch price of natural gas, the standard used in most of Europe, has exhibited a prolonged period of low and stable prices, experiencing a moderate increase from 2020 to 2021 (Investing.com, 2024). However, in 2022 a remarkable surge occurred, as TTF prices skyrocketed. Specifically, between February and August of that year, the price of natural gas witnessed an astonishing growth of 143%. This significant fluctuation in gas prices aligns closely with the timeline of events surrounding the invasion of Ukraine in February 2022 and the following closure of the Nord Stream 1 pipeline in September (Kuzemko et al., 2022, p. 1). Nonetheless, this sudden shock in prices in the natural gas market was subsequently reversed, with prices returning to levels below the average recorded in 2021 by the end of the year 2023.

This thesis aims to investigate the relationship between Norway's GDP and the invasion of Ukraine, with a focus on the price and exported volume of natural gas. Looking into whether the boom in the Norwegian economy can be attributed to the war in Ukraine or if it primarily stems from the pre-existing economic landscape in Norway. Thus, the research question is the following.

How has the war in Ukraine affected Norway's GDP?

In addition to the main research question, the thesis will also include a sub-research question to narrow down on the effects of the gas prices which is stated below.

Has the war in Ukraine altered the relationship between the price of natural gas and the value of the Norwegian GDP?

To determine if there is a causational relationship between the two independent variables price of natural gas and volume of natural gas, and the Y variable GDP, the four following hypotheses are introduced and will be tested in the regression analysis.

$$H_0^P: The\ price\ of\ natural\ gas\ has\ no\ positive\ effect\ on\ Norway's\ GDP$$

$$H_A^P: The\ price\ of\ natural\ gas\ has\ a\ positive\ effect\ on\ Norway's\ GDP$$

$$H_0^V: The\ exported\ volume\ of\ natural\ gas\ has\ no\ positive\ effect\ on\ \ Norway's\ GDP$$

$$H_A^V: The\ exported\ volume\ of\ natural\ gas\ has\ a\ positive\ effect\ on\ Norway's\ GDP$$

Throughout the analysis, significant economic models will be employed to explain the underlying mechanisms of the Norwegian economy and the prices of natural gas. By utilizing these models, this study seeks to provide a comprehensive understanding of the economic consequences incurred by Norway as a result of the conflict in Ukraine. AI (artificial intelligence) has been a useful tool throughout this thesis and has contributed to a smoother and more effective process as well as assistance with R studio. AI and Grammarly has also been used to optimize grammar and readability in this chapter and throughout the thesis. The discussion will address components from the analysis in light of external research, in relations to Norwegian exports and European imports, to justify the importance of natural gas in this thesis. The discussion will also give additional insights to the effect prices has on the inflation in the Norwegian economy. Lastly, the ethical dilemma of the term war profiteer as well as suggestions for future research will be examined.

2.0 Background

2.1 Norwegian Gas Export History

"The Norwegian Oil Adventure" is said to have started in 1969 when one of Norway's biggest oil fields was found. The production of oil from this field, known as "Ekofisk", began in 1971 (Energidepartementet, 2021). The first big pipelines were built in the 1970s and 1977 was the first year Norway produced and exported natural gas (SSB, 2024b). Norpipe was the first pipeline to other countries, from Ekofisk, Norway to Emden in Germany, built in 1977. The export of both oil and gas has later increased, resulting in Norway building 8800 kilometres of pipelines to Germany, Belgium, France and Great Britain (Gassco, 2024; Norsk Petroleum, 2024a).

2.2 International Deals

2.2.1 EEA

A significant determinant in this context is the agreements Norway has with the EU. Even though Norway is not a part of the EU, they have several agreements, and some shared policies and laws. One of these, is the European Economic Area (EEA) agreement, which among other things gives the people and businesses of Norway access to the free flow of goods, services, people, and capital within the EEA countries. The EEA countries consist of the 27 EU members, Iceland, Liechtenstein, and Norway (Utenriksdepartementet, 2021).

2.2.2 ACER

The Agency for the Cooperation of Energy (ACER) is an agreement adopted on the 13th of July 2009. In short terms, the agreement is about making the regulation of electricity and natural gas easier for EEA countries. It contributed to coordination and cooperation between the countries by being an authority the national regulators can turn to for counselling, monitoring, and support (EØS-notatbasen, 2024). This means that Norway is a part of the European energy cooperation.

2.3 Examples from Other Conflicts

This chapter contains examples from conflicts in which a non-belligerent country possesses and trades one or more resources that have been sought after during the conflict. The impact of these resource transactions on the non-belligerent country's GDP will be discussed. Table 2.1, below, summarizes the information in this chapter. It shows that a country has profited from resources traded in times of conflict, what it has done to the exporter's GDP, and how the Norwegian GDP has been affected in the specific timeframe. Some information is left out in the last two rows because, at the time of writing, the conflicts are still ongoing.

Table 2.1 Overview of other conflicts, resources and effects.

Important resource	Conflict	Resource holder	Effect on GDP	Norwegian GDP per capita	Research
Gold	WW1	Switzerland	Decrease	First increase, then decrease	1
Goods	WW1	Sweden	First increase, then decrease	First increase, then decrease	2
Gold/munitions	WW2	Switzerland	Decrease	Decrease	3
Iron rod, other goods	WW2	Sweden	Varying	Decrease	4
Oil	Gulf war (1990-1991)	U.S.	First increase, then decrease	Increase	5
Oil	Iraq war (2003)	U.S.	Increase	Increase	6
Oil	2023-	-	-	-	7
Oil/shipping	2023-	-	-	-	8

Note. (1) Stuart, 2022, p. 3; SSB, n.d.a. (2) Sveriges Riksbank, 2018, p. 258-260; SSB, n.d.a. (3) James, 2016, p. 219; Stuart 2022, p. 3; SSB, n.d.a. (4) Edvinsson, 2014, p. 155; James, 2016, p. 213; SSB, n.d.a.; Sveriges Riksbank, 2018, p. 311; U.S. Embassy Stockholm, 2016. (5) Estrada et al, 2020, p. 3; Han & Wang, 1998; SSB, n.d.a.; Sun, 2022; Jaffe & Elass, 2015, p. 121; Noguera-Santaella, 2016, p. 302-303. (6) Noguera-Santaella, 2016, p. 302-303; SSB, n.d.a.; Sun, 2022. (7) Ambrose, 2023; Stacey & Johnson, 2023. (8) Agnolucci & Temaj, 2024; Partington, 2024; Kozul-Wright, 2024.

2.3.1 First World War (1914-1918)

Throughout the First and Second World Wars, both Switzerland and Sweden were formally neutral. Despite their neutral status, they engaged in trade with countries on both sides of the conflicts (Häggqvist, 2019, p. 3-4). During the First World War, Switzerland traded gold. Even though they capitalized from trading with countries at war and the prices doubled during the war, they ended up with a growing public debt. This was due to increased nominal wages and costs associated with war. As table 2.1 shows, the Swiss GDP declined during the First World War (Stuart, 2022, p. 3).

The demand for many Swedish goods, such as food and gear for soldiers, grew during the First World War. By trading with countries at war, the Swedish export rates went up by 50%, measured in volume, from 1910 to 1915 and deflated to some extent afterward. Despite the decline in exports, the prices continued to rise. From 1910 to 1918 the prices went up 300%. The reason why the Swedish economy was stimulated was the external demand (Sveriges Riksbank, 2018, p. 258-260). During the first two years of World War One, the Swedish GDP experienced an increase of 4.74%, but registered a downturn of 5.66% by the end of the war (Häggqvist, 2019, p. 2-3).

2.3.2 Second World War (1939-1945)

During the Second World War Switzerland traded gold and exported other goods, including ammunition, detonators, and weapons. This led to an increase in prices. However, the growth rate in the GDP was negative, but not as much as in other European countries. The Swiss GDP increaed after both wars ended, due to the trade that had been conducted with gold (James, 2016, p. 217-219; Stuart, 2022, p. 3).

Sweden had a transit agreement with Germany during the Second World War and traded various goods, including iron ore, machines and tools, timber, shipping, real estate, steel, ball-bearing, and other raw materials. Approximately 60% of the iron ore imported to Germany came from Sweden. Swedish iron ore exports grew by 4% of total Swedish exports during the war compared to before. In 1943 Sweden reduced their export to Germany after deals with the United States and Great Britain (Sveriges Riksbank, 2018, p. 311; U.S. Embassy, Stockholm, 2016). Sweden and Switzerland traded with Germany and other countries at war to keep their economies floating, and to secure food and energy for their residents (James, 2016, p. 213). While trading with Germany between 1938 and 1943, the Swedish GDP was varying, from 3.75% in 1938, down to negative 9.94% in 1940, and up to 4.17% in 1943. And in 1945 it was down to 2.27% (Edvinsson, 2014, p. 155).

2.3.3 Gulf War (1990-1991)

In the complex arena of international relations, the dynamics of oil and gas prices play a pivotal role, often becoming catalysts for conflict or strategic manoeuvres by nations aiming to enhance their economic and geopolitical standing. Between 1973 and 2012 between one-fourth and half of wars were oil-related (Jaffe & Elass, 2015, p. 121). Research seems to agree when it comes to the global oil prices increasing during the Gulf War when Iraq invaded Kuwait in 1990 (Noguera-Santaella, 2016, p. 302). However, they disagree on whether the war is the cause of the increase in global oil prices or not. Han and Wang (1998) and Sun (2022) argue that the increased world oil prices were due to the invasion (p. 104; p. 168). Estrada et al. (2020) claims that the global oil prices rose after the invasion in 1990, but not enough to have a noticeable effect on global oil prices. In addition, the prices grew steadily from 1988, that is, before the war (p. 3). In wars like the Gulf War, supply and prices of oil, are crucial factors in the reason for conflict. War disrupts the extraction of oil, might harm oil facilities, and creates uncertainty in the market (Noguera-Santaella, 2016, p. 303; Sun, 2022, p. 167-169). This makes oil an important asset different from other resources when it comes to increased prices and demand. The U.S. GDP grew by 5% at the start but later decreased to a negative 1% (Sun, 2022, p. 169).

2.3.4 Iraq War (2003)

There are some disagreements among researchers on when the Iraq War, also known as the Second Gulf War, or the US-Iraq War, ended. It started in 2003 when the United States attacked Iraq. One source says it ended in 2010 (Sun, 2022, p. 168), while another distinguishes between the Iraq War from March to April 2003, and the U.S. occupation of Iraq from May 2003 to December 2011 (Noguera-Santaella, 2016, p. 302). Because of the big differences in time, the focus of differences in oil prices will be on 2003. Before the Iraq War, the oil markets were generally strong (Sun, 2022, p. 169). Research points to different reasons like other geopolitical aspects when discussing the increasing oil prices in and surrounding 2003 (Noguera-Santaella, 2016, p. 303). U.S. GDP grew by 4% at the start of the war and later decreased to 1% (Sun, 2022, p. 169).

2.3.5 Recent Conflicts (2023 -)

More recent examples of what happens to oil prices in times of conflict are during the Hamas-Israel conflict. The oil prices increased after Hamas attacked Israel on October 7th, 2023 (Ambrose, 2023). A part of the reason why the price spiked was the fear of the conflict escalating to petroleum supplier countries. However, the fear settled, and the price of oil was low already a month after the attack (Stacey & Johnson, 2023). Also, during the attacks on shipping in the Red Sea and the counterstrikes from the US, starting in November 2023, the price of oil experienced an upturn (Partington, 2024). It is hard to pinpoint one specific shock to the oil price in the conflict surrounding the Red Sea due to multiple attacks and events. There are many things that affect the prices of oil, there by supply, multiple conflicts, and uncertainty about the market, but the oil prices have been mostly steady (Agnolucci & Temaj, 2024; Kozul-Wright, 2024).

3.0 Theory

The theoretical framework of this thesis is constructed by a combination of fundamental and widely recognized concepts from microeconomics and macroeconomics. In the upcoming chapter, these theories will be presented and linked to the research question, thereby establishing a solid groundwork for the remainder of the report.

3.1 Microeconomics: Supply and Demand

Perhaps one of the most known economic concepts are the supply and demand curves, also known as the market equilibrium. To keep it short, the market equilibrium is where the demand curve, how much the market wants of one good, and the supply curve, how much the suplliers want to sell, meets. As shown in Figure 3.1 the y-axis is price and along the x-axis there is quantity (Riis & Moen, 2021, p. 25).

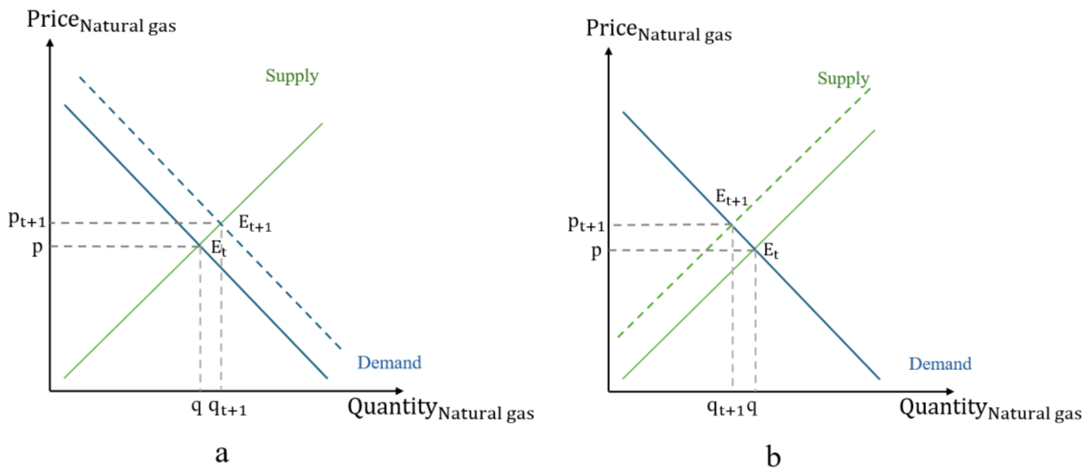

Figure 3.1 Supply and demand curve. Figure 3.1a illustrates a positive shift in the demand curve, while Figure 3.1b depicts a negative shift in the supply curve.

If the demand increases the demand curve will have a positive shift, and the market equilibrium will rise. As a result, the price of the good will also rise as shown in Figure 3.1a. When a big supplier of natural gas is cut from the market, as illustrated in Figure 4.1b, the other suppliers experience a demand shock. In times of war, this could be because of damaged, or hijacked, petroleum facilities, sanctions against suppliers, or other inter-political causes. This would lead to increased prices of natural gas.

3.2 Macroeconomics: GDP

The following explanations about macroeconomic theories in chapter 3.2 and 3.3 are based on the book “Macroeconomics” by Charles I. Jones, 5th edition, from 2021. GDP, which stands for gross domestic product, serves as a crucial economic indicator for measuring the overall economic performance of a country, both in the present and throughout history. It includes the total value of all goods and services produced within a country over a specific period, with the exception of goods and services used in the production process (Jones, 2021, s. 19).

Equation 3.1

$$GDP = C + I + G + (EX - IM)$$

Equation 3.1 depicts the GDP equation and shows how the GDP is the sum of the consumption, investment spending, and government spending in the economy as well as the collective export after subtracting the imports.

3.2.1 Total GDP vs. GDP Per Capita

When conducting comparisons of GDP, whether across countries or over time within a single country, it is often important to distinguish between total GDP and GDP per capita. This differentiation is crucial as population growth significantly influences GDP and can lead to misleading interpretations if not properly considered. However, the relevance of accounting for population growth is predominantly when comparing long-term GDP, while it may be less significant in short-term assessments as the population is not likely to experience a significant change over a very short period. Moreover, GDP per capita is very significant in comparison to the GDP of different countries that exhibit considerable gaps in population size. For instance, a country like China, with a considerably larger population, will inherently have a considerably higher total GDP compared to a smaller nation such as Ireland with a much smaller population. Yet, when population differences are taken into account, one will get a more accurate portrayal of each country's economic situation (Jones, 2021, p. 55).

3.2.2 Nominal GDP vs. Real GDP

An additional crucial distinction in GDP measurement is the differentiation between nominal GDP and real GDP. Nominal GDP refers to GDP calculations that do not adjust for changes in quantities of goods and services or prices. In contrast, real GDP accounts for these changes by removing the influence of both the volume and prices of goods and services (Jones, 2021, p.

29-30). Essentially, nominal GDP can be regarded as the result of multiplying the real GDP by the price level in the economy.

3.2.3 Short-term GDP vs. Long-term GDP

In macroeconomics, it is crucial to distinguish between short-term and long-term GDP. Long-term GDP, also referred to as long-term output, represents the potential output of an economy in the long run while accounting for inflation over that period (Jones, 2021, p. 244). Potential output is the level of output an economy can achieve when all inputs are utilized at their sustainable levels. However, due to various fluctuations and shocks in the economy, the actual output often deviates from the potential output. The actual output is the current level of output in the economy, considering the current inflation (Jones, 2021, p. 244). To illustrate these concepts, the short-term output, denoted as $\tilde{Y}$ and the long-term output, denoted as $\bar{Y}$ are often presented together. This provides a way to visualize different economic shocks and their impact on short-term output. Figure 3.2 is an example of such an illustration. When the actual output falls below the potential output, it indicates that the economy is in a recession. On the other hand, if the actual output surpasses the potential output, it suggests that the economy is experiencing a boom (Jones, 2021, p. 245).

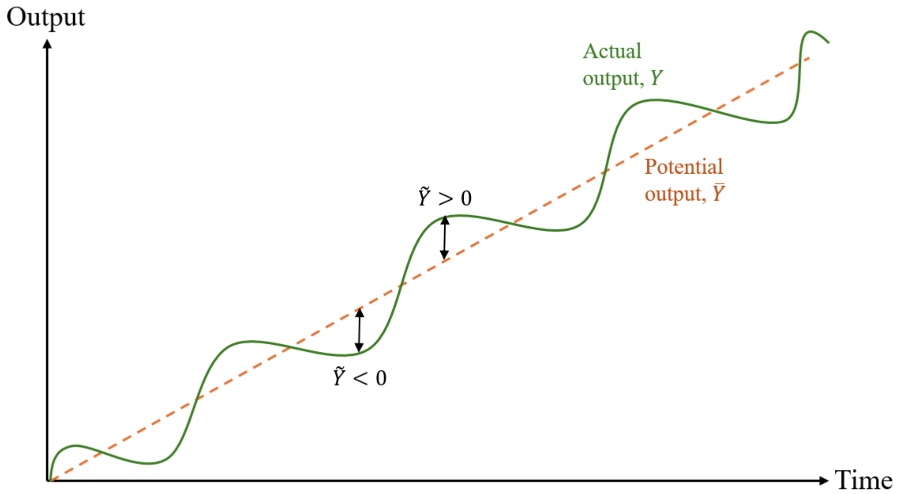

Figure 3.2 Economic fluctuations and short-run output

3.2.4 GDP vs. Mainland GDP

The petroleum industry is of great importance in the Norwegian economy and contributes significantly to the country's GDP. Due to the size of the Norwegian petroleum industry, Norway also calculates a GDP that solely focuses on the mainland economy in order to get a more accurate representation of the underlying domestic economy. This mainland GDP encompasses all sectors of the economy except for oil and gas extraction, pipeline transportation, and international shipping (SSB, 2021).

3.3 Macroeconomics: AS-AD

The AS-AD framework is a macroeconomic model and consists of the aggregate supply (AS) curve and the aggregate demand (AD) curve. The model is used to explain changes in the economy in the short term (Jones, 2021, p. 361-362).

3.3.1 Aggregate Supply

To gain a better understanding of the AS-AD model, it is necessary to examine the components of the model. The aggregate supply curve will from here on be referenced to as the AS-curve. The AS-curve is also known as the Phillips curve, which includes the current rate of inflation to the short-run output. In other words, it shows how the prices set by a company, or output, affect inflation (Jones, 2021, p. 327, 360-361). The AS-curve is an upward-sloping curve with inflation on the y-axis and output on the x-axis as is illustrated in Figure 3.3.

Equation 3.2

$$\pi_t = \pi_{t-1} + \bar{v}\tilde{Y}_t + \bar{o}$$

Equation 3.2 explains the AS-curve and shows how the inflation equals the expected inflation plus the product of the short-run output and the variable $\bar{v}$ that represents how sensitive inflation is to demand conditions plus shocks in the inflation.

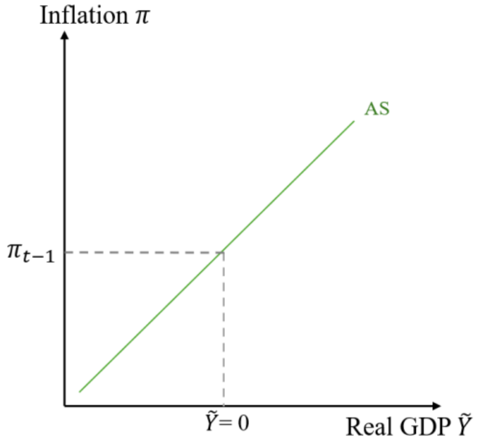

Figure 3.3 AS-curve

3.3.2 Aggregate Demand

The second component of the AS-AD framework is the aggregate demand (AD) curve. The AD-curve consists of IS-curve and the Policy rule. The IS-curve describes how the interest rate affects economic activity in the short run (Jones, 2021, p. 287). A high interest rate results in lower investments, which results in less output. A momentary policy rule is a set of guidelines that dictate how to react to particular economic scenarios as they unfold. The Policy Rule used in the AD-curve, sets a real interest rate from the current inflation and the target level of inflation. With inflation on the y-axis and output on the x-axis as shown in Figure 3.4, the AD-curve is a downward-sloping curve that describes how the central banks consider the current inflation when setting the interest rate, and thereby affects the short-run output (Jones, 2021, p. 357-358).

Equation 3.3

$$\tilde{Y}_t = \bar{a} - \bar{b}\bar{m}(\pi_t - \bar{\pi})$$

Equation 3.3 depicts how the short run output is equal to the aggregate demand shock minus the product of how sensitive the investment is to changes in the interest rates, how aggressive monetary policy responds to inflation and lastly the difference between the current inflation and the inflation target.

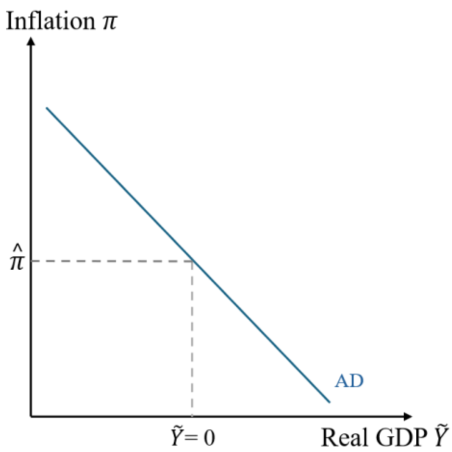

Figure 3.4 AD-curve

3.3.3 Demand Shock

The AS-AD framework is among other things used to analyse the dynamics of the economy in relation to different macroeconomic events, such as shocks. Figure 3.5 shows the different shifts in the AS-AD framework during a demand shock. Shocks in the aggregate demand curve can greatly impact the short-term output. A positive shock in the aggregate demand curve is an increase in the parameter $\bar{a}$ from the aggregate demand equation. In this case a shock in $\bar{a}$ creates an outward shift for the AD curve and an increase in the short-run output. Higher demand for goods results in higher prices in the market which in turn leads to an increase in inflation. The economy will now be in point B in Figure 3.5 (Jones, 2021, p. 369). As inflation now is above the expected inflation π_{t-1} the firms in the market expect the inflation to rise even further in the future and the AS curve will shift upward to point C. The short-run output in point C is equal to zero, thus the inflation will again be stable but at a higher rate of inflation than the target inflation of the central bank (Jones, 2021, p. 370). Shocks in the economy are always temporary, and when the aggregate demand shock eventually ends the AD curve will shift down to point D. In point D the output is below zero, hence the shift from C to D is a negative shock. As the inflation is pushed down, the expected inflation is decreased and the AS curve will over time move down on the AD curve until it reaches the steady state in point A (Jones, 2021, p. 371).

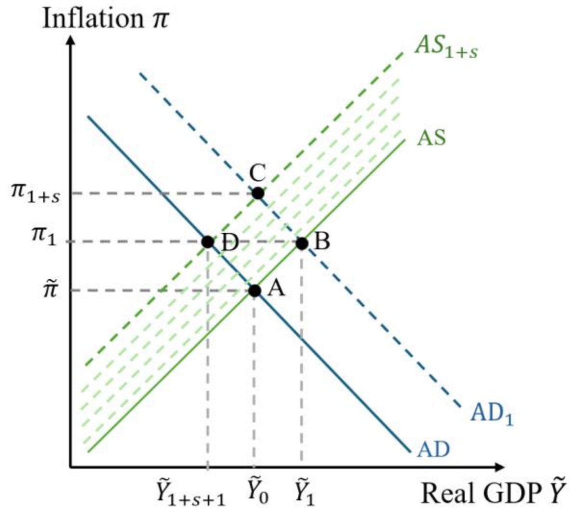

Figure 3.5 A demand shock in the AS-AD framework

4.0 Method

This chapter will explain the data basis, the method and research design used to answer the research question, sub-research question, and the hypotheses, as well as the principles behind and execution of linear regression. Lastly, there will be a paragraph regarding the use of AI.

4.1 Data Basis

4.1.1 Collecting Data

Given the research question, the most fitting research method is the quantitative method, using time series data. This includes datasets over a period of time. The quantitative secondary data needed for the following regression analysis are collected from Statistisk sentralbyrå (SSB), Investing.com, NorskPetroleum.no, and Norges Bank. Collecting the data has been mostly a straightforward process, however, there have been some issues regarding some of the variables. This will be further elaborated in the following chapters. Since the collected data is official data, available to the public, there are no concerns when it comes to privacy or secrecy.

4.1.2 Time Period

As this report seeks to investigate the impact of the war in Ukraine on the Norwegian GDP, the year in which the war broke out, 2022, will be essential. In order to accurately assess the relationship between the Norwegian GDP and the war with the following changes in natural gas prices, it is vital to analyse data from a time period preceding the war. This makes it possible to determine if the fluctuations in Norway's GDP are a consequence of the war or if they are a result of pre-existing economic trends.

As mentioned in the introduction, the growth of the petroleum industry had the biggest impact on Norway's GDP in 2022. It is also clear that although the export of oil has seen an increase in the last few years, the increase in the value of gas export is by far the biggest contributing factor to the growth of the petroleum industry from 2021 and forward. In order to get a detailed picture of the relationship between the gas prices and the Norwegian GDP the time period of the complete dataset begins in 1980, one of the first years of Norwegian gas export, and ends in 2023. Because of the financial crisis in 2008, the first dataset covers 1980Q1 to 2007Q4. The financial crisis is excluded because these were deviation years and would interfere with the results.

The Norwegian gas export follows the Dutch TTF (Title Transfer Facility) gas prices, which serve as a reference price from the TTF trading market. The TTF, established in 2003, has become one of the most prominent gas exchanges in Europe (Gasunie Transport Services, 2024). However, during the process of collecting data for the datasets, finding historical data of the TTF gas prices before 2010Q2 turned out to be difficult. To maintain consistency within the datasets, the timeframe was divided into two distinct periods, the years preceding 2010 except the years of the financial crisis, in Dataset 1, and the years thereafter in Dataset 2.

4.1.3 Periodization

The periodization of the two datasets that are the foundation of the regression analysis is quarterly. A quarterly breakdown of the values offers a detailed view, making it possible to identify patterns that may occur within specific quarters of the year. Splitting the data into quarters rather than yearly creates four times the number of points in the regression analysis, making it stronger and more accurate.

While monthly values could potentially give an even stronger result, it was not possible as GDP per month in Norway was only available from 2016 forward. Despite efforts to acquire earlier monthly data from SSB, it was confirmed that such data is not available. However, to ensure the most precision in depicting GDP and other significant variables during the crucial years surrounding the war, most of the figures in the rest of the thesis will be based on monthly values. This will make it possible to pinpoint the changes in the variables after key events in the conflict.

4.1.4 Reliability and Validity

High reliability and validity are crucial for allowing researchers to draw conclusions about the phenomena that are studied. When it comes to reliability it is important that a measure is consistent, stable, and precise (Thrane, 2022, p. 47). By having the time periods introduced above, the model is “trained” and tested before using it on the time period that will answer the research question. This will help establish a stable relationship and strengthen reliability.

The secondary data is collected from credible sources. Statistisk sentralbyrå, Norsk Petroleum and Norges Bank all underlie the Norwegian state and follow official laws for statistics and operation (Norges Bank, 2020; Norsk Petroleum, 2024b; SSB, n.d.b), and Investing.com is one of the most acknowledged financial platforms in the world (SimilarWeb, 2024). None of the variables are based on factors that cannot be measured and there are no questions of definition in the data, which supports the datasets validity.

According to Kleiven (2008) there are four types of validity: construct validity, statistical validity, internal validity, and external validity (p. 223). Construct validity refers to the degree the indicator measures the theoretical construct or concept it is intended to measure. In this research, it signifies whether the model effectively answers the research question or not. Statistical validity is about covariation between variables (Kleiven, 2008, p. 223-224). During the regression analysis the variables will be tested for significance. Internal validity is about whether the changes observed in the dependent variable are actually caused by the independent variable being studied, or not (Kleiven, 2008, p. 227). This is what the regression analysis seeks to answer. By clarifying if the price of natural gas has caused the increase in Norway's GDP or not, it will be possible to answer the research question and determine the effect of the Russian invasion of Ukraine on the Norwegian economy. Lastly there is external validity, which refers to the extent to which the findings of a study can be generalized (Kleiven, 2008, p. 229). The findings in this study can be generalized to be relevant outside of times of conflict, however the situation Norway finds itself in is not relevant for many other countries.

4.2 Regression Analysis

4.2.1 Multiple Linear Regression

Linear regression is a statistical method used to model the relationship between a dependent variable and one or more independent variables. There are two main types: simple linear regression and multiple linear regression. This thesis utilizes multiple linear regression. Multiple linear regression includes multiple independent or predictor variables and allows for the consideration of multiple factors simultaneously (Rodríguez del Águila & Benítez-Parejo, 2011, p. 160-163). The purpose of multiple regression is to explain the variation in the dependent variable using multiple predictor variables and to understand the unique contributions of each predictor variable (Thrane, 2022, p. 62). In Equation 4.1 the Y represents the dependent variable, α represents the intercept with the y-axis. Xr represents the explanatory variables, and βr represents the regression coefficient or slope (Ubøe, 2017, p. 263).

Equation 4.1

$$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_r x_r$$

4.2.2 Variables

As the research question is "How has the war in Ukraine affected Norway's GDP", the regression analysis seeks to determine if there is a correlation between the dependent variable GDP and the relevant independent variables. With the theories previously introduced in mind, there is reason to believe there will be a strong connection between the price of natural gas and Norway's nominal GDP. From here on, when referring to GDP, it is nominal GDP.

The sub-research question, "Has the war in Ukraine altered the relationship between the price of natural gas and the value of the Norwegian GDP", will be answered by incorporating dummy variables in the regression analysis and analysing the output. This will be further elaborated later in this chapter.

The dataset representing the time period from 2010 until 2023 contains the TTF Dutch gas prices which are given in euros. This introduces a possible complication which is the exchange rate of NOK/EUR. As the gas is sold in euros which are then converted to Norwegian kroner, the exchange rate goes hand in hand with the value of the exported natural gas which again is directly linked to the value of the GDP. To make sure that the changes in the GDP throughout the datasets are not rooted in fluctuations in the exchange rate, each quarterly price in euros is converted to NOK by multiplying with the corresponding quarterly average exchange rate. Seeing that there was no available data on gas prices for the period representing the years from 1980 until 2007, the prices given in this dataset are estimated using the value of natural gas export divided by the volume of natural gas export.

The regression is not just important to determine a correlation between the GDP and gas prices, but also an essential part of assuring that other variables are not the primary driving force behind the increase in GDP. As the volume of exported natural gas is directly linked to the size of the GDP it is important to confirm that the increase in Norway's GDP in 2022 was not just a result of an increase in the exported volume alone. Thus, the exported volume of natural gas is the second variable in the regression equation. There were difficulties when collecting data of exported volume of natural gas, and as a result the numbers of exported volume was calculated by multiplying numbers of produced volume of natural gas with 0.95, as Norway exports approximately 95% of all natural gas production (Norsk Petroleum, n.d.).

Inflation rate and consumer price index, CPI, are key macroeconomic indicators that reflect the overall health and performance of an economy (Jones, 2021, p. 244). Because of this, CPI is included in the dataset with the purpose of clarifying whether the increase in GDP is a result of underlying macroeconomic measurements rather than the price of natural gas.

When analysing data with variables that exhibit growth over time, it is often advantageous to employ a logarithmic transformation. While the relationship between two variables may appear linear as they both increase over time, it could be non-linear. By applying the logarithm to these variables, it becomes easier to identify and interpret non-linear relationships. As GDP tends to exhibit exponential growth, it is especially important to perform a logarithmic transformation of the variables in order to get a reliable result from the regression analysis (Benoit, 2011, p. 2). An addition, using logarithm on the variables makes it possible to interpret the betas as elasticities.

An important assumption in linear regression analysis called homoscedasticity states that the variation in the residuals stays constant. Meaning the difference between the predicted values and the observed values will remain unchanged. However certain variables can have a relationship with the outcome variable which leads to the variance changing, and there will be a case of heteroscedasticity. Using the logarithm of the variables makes the variance more stable in all the values of the variable, and it will contribute to maintain homoscedasticity and reliable results (Rodríguez del Águila & Benítez-Parejo, 2011, p. 169-170).

Therefore, the main regression equation in the regression analysis in this report is Equation 4.2 as seen below.

Equation 4.2

$$\log GDP = \alpha + \beta_1 * \log Price\ of\ natural\ gas + \beta_2 * \log Exported\ volume\ of\ natural\ gas + \beta_3 * \log CPI$$

The hypothesis for the regression analysis is formulated from the variables introduced above, as well as the research question, the and are as following.

Equation 4.3

$$H_0^P : x_1\ has\ no\ significant\ positive\ effect\ on\ Y$$

Equation 4.4

$$H_A^P: x_1 \; has \; a \; significant \; positive \; effect \; on \; Y$$

Equation 4.5

$$H_0^V: x_2 \; has \; no \; significant \; positive \; effect \; on \; Y$$

Equation 4.6

$$H_A^V: x_2 \; has \; a \; significant \; positive \; effect \; on \; Y$$

In addition to the main regression equation, there will also be an equation including dummy variables for Dataset 2 representing the period between 2010 and 2023. Dummy variables are categorical variables that seek to discover effects in the dependent variable Y in the presence of or in the absence of one or more categories. In the presence of the category, the dummy variable will be 1 and in the absence it will be 0 (Hardy, 1993, p. 5). In this regression analysis the “category” is the war in Ukraine, and the years within the war have a value of 1, and all years before the invasion have a value of 0. The first dummy represents the Log Price of natural gas in the years after the invasion and the second dummy variable represents Log Exported volume of natural gas after the invasion. The dummy variables will clarify any changes in the relationship between Log GDP and Log Prices of natural gas, or Log GDP and Log Exported volume of natural gas following the war and contribute to answering the sub-research question. Thus, the second regression equation is the following Equation 4.7.

Equation 4.7

$$\begin{aligned} \log GDP = \alpha + \beta_1 * \log Price \; of \; natural \; gas + \beta_2 \\ * \log Exported \; volume \; of \; natural \; gas + \beta_3 * \log Price \; Dummy + \beta_4 \\ * \log Volume \; Dummy + \beta_5 * \log CPI \end{aligned}$$

To answer the sub-research question two additional hypotheses are introduced to the regression analysis representing the period 2010 to 2023. The two additional hypothesis, Equation 4.8 and 4.9, highlights the difference between the relationship between Log Price of natural gas and Log GDP, and Log Exported volume of natural gas and Log GDP.

Equation 4.8

$$H_0^D: x_3 \; has \; no \; significant \; effect \; on \; Y$$

Equation 4.9

$$H_A^D: x_3 \; has \; a \; significant \; effetct \; on \; Y$$

4.2.3 Execution of Regression Analysis

Excel was used to set up the datasets and prepare them for analysis in R Studio. This process included adapting values as mentioned in 4.2.2 and organizing the datasets to enhance their usability. In this bachelor's thesis, the methodology utilized for analysis was multiple linear regression, conducted within R Studio. The Stargazer package (Hlavac, 2018) was utilized to present the regression results in a structured and comprehensive manner. In addition, a vif test was used to measure multicollinearity and the alpha function was used to measure reliability.

4.2.4 Statistics and Diagnostics

The key statistics obtained from the regression analysis that will be the focus of the analysis will be explained below.

1. R-squared – The explanatory power is a measurement that indicates the proportion of the variation in Y that can be explained by the inclusion of the control variables. The greater the R squared, the better the fit (Ubøe, 2017, p. 264).

2. Adjusted R-squared – R squared adjusted for the number of predictor variables in the regression model and includes a penalty for including irrelevant variables. This is used to compare models.

3. P-value – Represents the probability of observing a deviation equal to or greater than the one observed, assuming that the null hypothesis is true. If the p-value is less than or equal to the significant level, then the null hypothesis is rejected (Ubøe, 2017, p. 178-179).

4. Significance – The significance level of a hypothesis test is denoted by α, representing the maximum probability of a false positive (Ubøe, 2017, p. 183). In other words, to what degree a finding is true, and not just a coincidence. When using Stargazer there will be the following degrees of significance:

- 0.01 ‘***’
- 0.05 ‘**’
- 0.1 ‘*’

In addition to the statistics mentioned above, diagnostics will be an important part of a thorough analysis as it helps control the validity and quality of the model. A very important statistical diagnostics is testing for multicollinearity. In a multiple linear regression analysis, the explanatory variables should be independent to avoid collinearity. When predictor variables in a regression are correlated or dependent it can lead to unstable numerical results and problems with the interpretation of the coefficients (Ubøe, 2017, p. 266). There is no specific vif value as a cutoff point, but the higher the value, the more severe the multicollinearity. Although, it is a general rule that a vif value over ten indicates a very extreme case of multicollinearity (Kavlakoglu & Murel, 2023).

A good method to measure the reliability of a dataset is using the alpha function in R Studio to find Cronbach's alpha. Cronbach’s alpha is used to indicate the reliability of the internal consistency in the data, which looks at the homogeneity of the variables. Homogeneity means to which degree the different variables in the data measure the same concept. Usually, 0.70 is used as a cutoff point of what is considered reliable, with all values equal to or above 0.70 being considered acceptable (Tavakol & Dennick, 2011, p. 54).

4.3 AI

AI (Artificial intelligence) has been used as a tool during the work with this bachelor's thesis. More specifically as a tool for reformulating, finding synonyms, and translating. The University of Stavanger has developed various chatbots that are available for students. The chatbot for “R programming” has been helpful during the execution of the regression analysis. An example of how the “R programming” chatbot has been used can be seen in Picture 1.

Figure 4.1 Screenshot from UiS's "R programming" chatbot

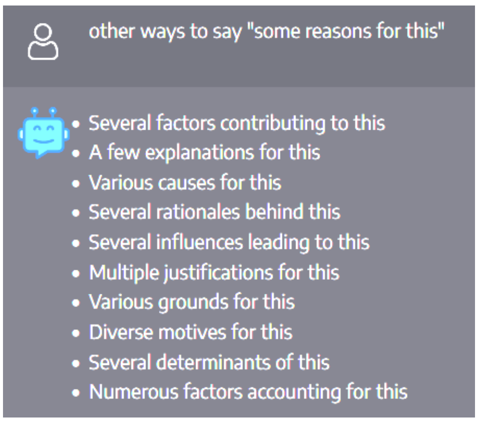

Figure 4.2 Screenshot from UiS's "Chat GPT-3.5. chatbot”

5.0 Analysis

Distinctions exist between high explanatory power and causality, with the latter being essential in statistical analysis for comprehending and identifying causal relationships between variables. Regression analysis alone does not provide evidence of causality (Ubøe, 2017, p. 265). Thus, the following chapter will answer the hypotheses by analysing and interpreting the results from the regression analysis. Subchapter 5.4 will utilize the previously presented theory to explain the mechanisms in the natural gas market as well as the Norwegian economy in the light of the Russian invasion of Ukraine in an attempt to give a comprehensive answer to the research question.

5.1 Descriptive Analysis

In the context of time series analysis, descriptive statistics such as minimum, maximum, and mean may not provide a comprehensive understanding of the underlying patterns and dynamics. Instead, visualizations that depict the changes in the data over time are often more insightful and useful. This chapter presents Figures 5.1-5.6, which are examples of such visualizations that illustrate important variables in the regression analysis. These figures highlight significant events during the war, including the invasion, the reduction in Nord Stream 1, and the subsequent shutdown of Nord Stream 1. Incorporating these figures throughout the analysis will help creating a clearer understanding of the changes in the economy in light of the theoretic foundation of this thesis.

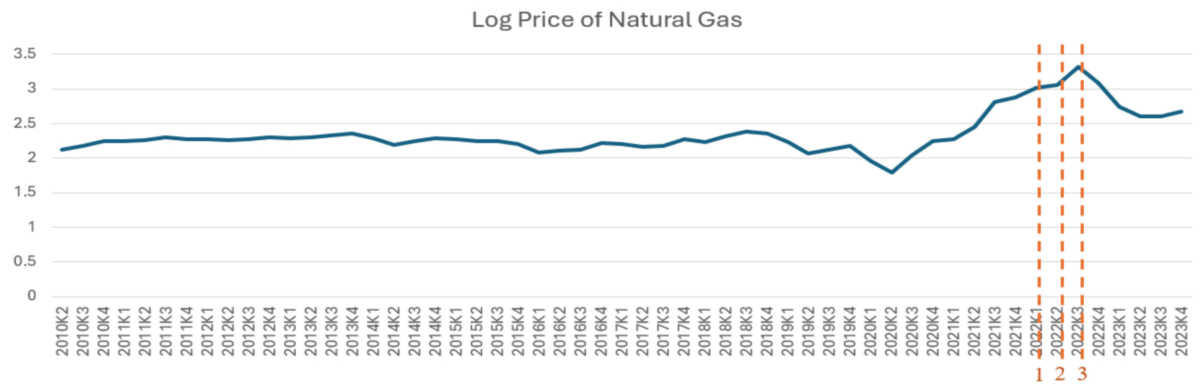

Figure 5.1 Logarithmic function of the price of natural gas, in quarterly values from 2010 to 2023, marked with important events in the conflict. 1 marks the invasion, 2 marks Nord Stream 1 being reduced to 40% capacity, and 3 marks the shutdown of Nord Stream 1. Data collected from investing.com (investing.com, 2024).

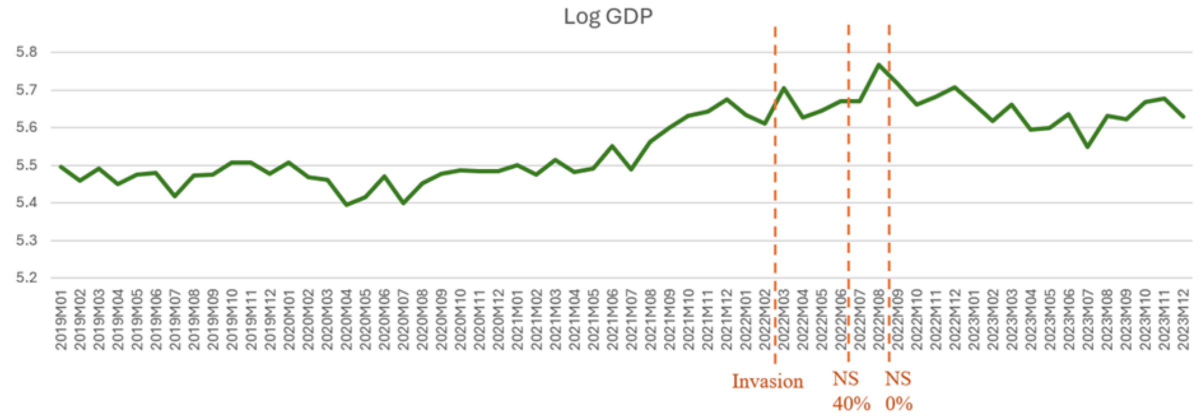

Figure 5.2 Logarithmic function of the GDP, in monthly values from 2019 to 2023, marked with important events in the conflict. Data collected from SSB (SSB, 2024c).

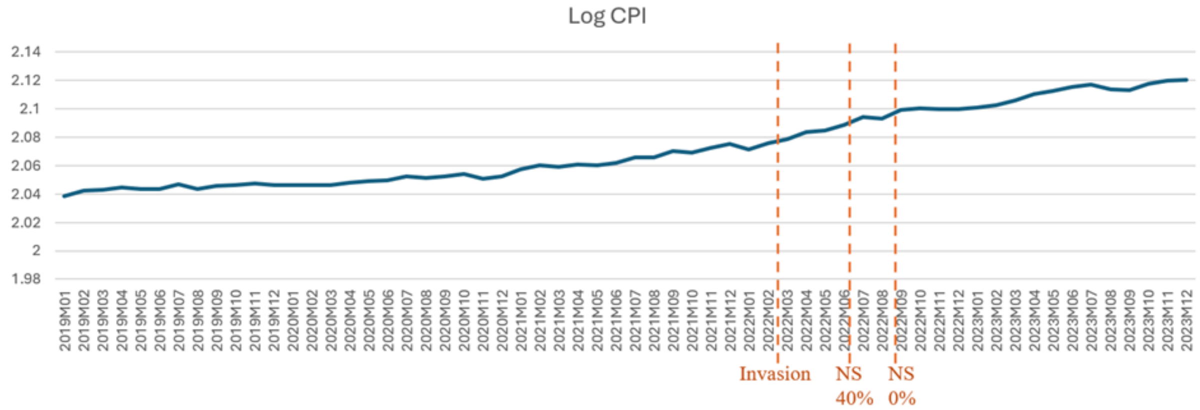

Figure 5.3 Logarithmic function of the CPI, in monthly values from 2019 to 2023, marked with important events in the conflict. Data collected from SSB (SSB, 2024d).

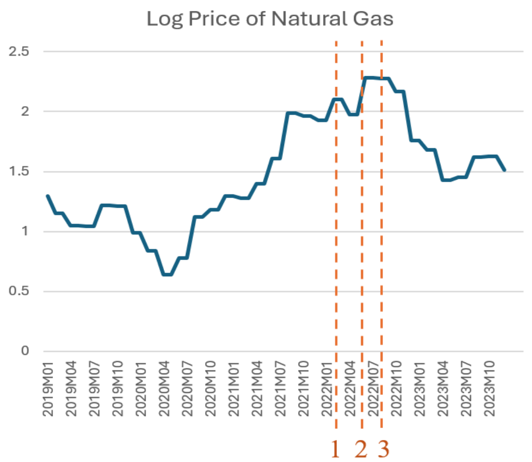

Figure 5.4 Logarithmic function of the price of natural gas, in monthly values from 2019 to 2023, marked with important events in the conflict. 1 mark the invasion, 2 marks Nord Stream 1 being reduced to 40% capacity, and 3 marks the shutdown of Nord Stream 1. Data collected from investing.com (investing.com, 2024).

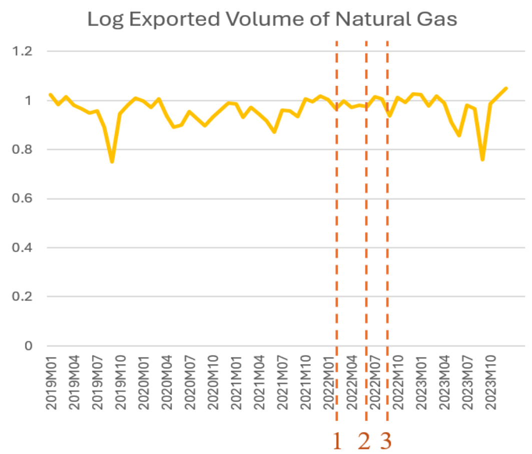

Figure 5.5 Logarithmic function of the exported volume of natural gas, in monthly values from 2019 to 2023, marked with important events in the conflict. 1 mark the invasion, 2 marks Nord Stream 1 being reduced to 40% capacity, and 3 marks the shutdown of Nord Stream 1. Data collected from Norsk Petroleum (Norsk Petroleum, 2024c).

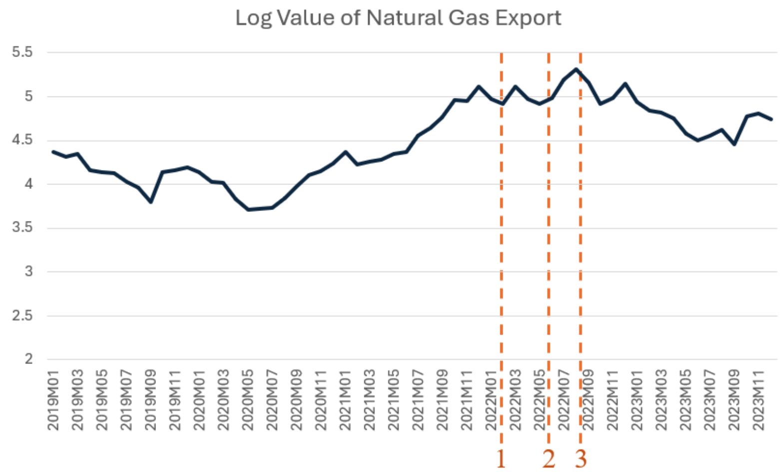

Figure 5.6 Logarithmic function of the value of Norwegian natural gas exports in monthly values from 2019 to 2023, marked with important events in the conflict. 1 mark the invasion, 2 marks Nord Stream 1 being reduced to 40% capacity, and 3 marks the shutdown of Nord Stream 1. Data collected from SSB (SSB, 2024e).

5.2 Regression Analysis

This chapter will be based on the regression statistics from the regression analysis of Dataset 1 and Dataset 2, depicted in the Appendix as A.1 and A.2. Regression statistics are crucial for providing a concise summary of data and understanding its key characteristics and trends. The most significant findings from the regression analysis conducted by using Stargazer in R Studio have been collected in Tables 5.1 and 5.2 below.

Table 5.1 Regression statistic from the regression analysis of Dataset 1, with and without log CPI

	1980-2007	
	Without log CPI	**With log CPI**
Coefficients:		
(Intercept)	-1.42045 ***	0.2781 **
Log Price	-0.13706	0.16363 ***
Log Volume	1.03339 ***	0.31863 ***
Log CPI		1.34603 ***
R-squared	0.7557	0.9874
Adjusted R-squared	0.7513	0.987
P-value	2.20E-16	2.20E-16

Table 5.2 Regression statistics from the regression analysis of Dataset 2, with and without log CPI

2010-2023		
	Without log CPI	**With log CPI**
Coefficients:		
(Intercept)	1.95673 **	1.546605 ***
Log Price	0.14925 ***	0.13424 ***
Log Price Dummy	-0.06122	0.024589
Log Volume	0.48675 ***	0.203239 ***
Log Volume Dummy	0.03742	-0.008932
Log CPI		1.268985 ***
R-squared	0.8411	0.9777
Adjusted R-squared	0.8284	0.9755
P-value	2.20E-16	2.20E-16

5.2.1 The Explanatory Power of the Models

Table 5.1 depicts the results from the regression analysis comparing the datasets with and without the control variable log CPI. In the first period spanning the years from 1980 to 2007, the regression analysis without the control variable log CPI the R-squared is 0.7557 and the adjusted R-squared is 0.7513 which indicates that the model explains over 75% of the variance without including irrelevant variables. However, when including log CPI in the regression, the R-squared made a big jump to 0.9874 with the corresponding adjusted R-squared 0.987. This implies that the regression containing log CPI explains almost all the variance in the model without including irrelevant variables. In this case, it appears to be a better fit to include the CPI in the analysis. The same can be said for the second period from 2010 to 2023. In the regression without the log CPI, the R-squared is very high, at 0.8411, and there is little difference from the adjusted R-squared which is 0.8284. The regression with log CPI is even higher, explaining 97.77% of the variance in the model, and there is an even smaller difference between the multiple and the adjusted R-squared at 97.55%. This discovery implies that all the models are strong, but the models that include the logarithmic CPI are the strongest, thus it is the results containing the CPI that will be used throughout the analysis chapter of the thesis.

5.2.2 Tests

In addition to using the adjusted R-squared as an indication of a strong and reliable model, other tests were used to confirm the validity of the models. The first test controls for multicollinearity with a vif command in R Studio. Table 5.3 illustrates the vif values of the regression model representing 1980 until 2007. All the values are below 10, with a good margin, thus indicating low multicollinearity, and therefore the model is still considered as strong.

Table 5.3 Vif values for the variables in the regression model from Dataset 1

Log Price	Log Volume	Log CPI
1.584715	3.150488	2.311842

Table 5.4 shows the vif values for the regression model of the period from 2010 until 2023. The values corresponding to Log Price, Log Volume, and Log CPI are within the acceptable range and do not affect the validity of the model. The vif values for the dummy variables on the other hand are very large, reaching an astonishing 173 and 161, suggesting a high level of multicollinearity in the model. However, the dummy variables are directly related to the price and volume variables, so a high multicollinearity in these variables is to be expected. Because of this, the high vif values will not be of any relevance and the model remains valid.

Table 5.4 Vif values for the variables in the regression model from Dataset 2

Log Price	Log Price Dummy	Log Volume	Log Volume Dummy	Log CPI
3.533217	173.504168	1.329694	161.333277	2.555324

The second test used to verify the model was a reliability test using the alpha function in R Studio to find Cronbach's alpha. The result from this test is shown in Table 5.5. The raw alpha value of the dataset representing 1980-2007 is 0.86 which indicates a good internal consistency in the data. The last dataset on the other hand, has a much lower raw alpha value, a value that is not considered as acceptable in regards to reliability and validity of the dataset. However, this dataset includes the two dummy variables Log Price Dummy and Log Volume Dummy. As the dummy variables are equal to zero until the last eight quarters of the time period, there is a clear difference between what the dummy variables measure compared to the other variables, and how they relate to the underlying concept of the GDP. Because of this, it might not be so unexpected that the raw alpha to the second dataset appears to be unreliable. Considering the likelihood that the dummy variables affected the reliability test results, and the other test and analysis discussed previously in chapter 4, there is enough evidence to support both the datasets having good reliability and validity.

Table 5.5 Cronbach's raw alpha value for Dataset 1 and Dataset 2

1980-2007	**2010-2023**
0.86	0.60

5.2.3 The Effect of Log Price of Natural Gas on Y

Table 5.6 depicts the estimate of and the corresponding p-value of x_1 for the two different regression analyses previously conducted. The estimate for β_1 is relatively consistent throughout the two different periods, staying at 0.1636% between 1980 and 2007, and slightly decreasing to 0.1342% between 2010 and 2023. This can be directly interpreted as the elasticity of price, and an increase of 1% in x_1 gives a corresponding increase of 0.1342% in Y. While the effect of x_1, the variable represented by β_1, appears to be smaller than the effect of x_2, as indicated by β_2, it still demonstrates a noticeable relationship with the dependent variable Y. It is worth noting that as the price of natural gas in the dataset representing 1980-2007 is estimated, there is a possibility that β_1 in the first period could be affected by other factors.

Table 5.6 Coefficients, estimate and p-value, of x_1 from the regression analysis

Log Price		
	Estimate	Pr(> |t|)
1980-2007	0.16363	6.96E-12 ***
2010-2023	0.13424	9.88E-14 ***

The presence of a significant relationship between the price of natural gas and the GDP is reinforced by the p-value, which remains substantially below the predetermined threshold of 0.05% in both regression models. This lower p-value signifies a strong level of statistical significance and supports the notion of a meaningful relationship between the two variables. Consequently, the null hypothesis is rejected, and the alternative hypothesis, stating that the price of natural gas has a significant positive effect on the GDP, is accepted.

5.2.4 The Effect of Log Exported Volume of Natural Gas on Y

In order to assess the impact of the beta coefficient corresponding to x_2 on the dependent variable Y, it is crucial to examine the coefficient estimates and p-values obtained from the regression analysis. Table 5.7 presents these values for the independent variable Log Volume. During the first period from 1980 to 2007, the estimated coefficient β_2 was found to be positive, measuring 0.31863. This positive estimate suggests that a 1% increase in the variable x_2 leads to a corresponding increase of 0.31863% in the dependent variable Y. Therefore, in this period, the exported volume of natural gas has a significant positive effect on the GDP. However, in the second period, there is a notable reduction in the estimated value of β_2, which decreases to 0.203239%. This decrease indicates that the effect of the volume of exported gas on the GDP is less pronounced compared to the initial period.

Table 5.7 Coefficients, estimate and p-value, of x_2 from the regression analysis

Log Volume		
	Estimate	Pr(> |t|)
1980-2007	0.31863	< 2.00E-16 ***
2010-2023	0.203239	7.57E-06 ***

Despite the decrease in the effects of β_2 from the first period to the second, it remains evident that the exported volume of natural gas (x_2) exerts a substantial influence on the dependent variable Y, GDP. This observation supports the existence of a clear positive correlation between these two variables. Additionally, it is noteworthy that the p-value associated with β_2 in both regression analyses falls comfortably within the desired level of significance. By being below the predetermined cutoff point of 0.05%, the null hypothesis H_0^V is rejected, and the alternative hypothesis H_A^V is accepted. In other words, the regression analysis confirms the alternative hypothesis that the exported volume of natural gas has a significant positive effect on the GDP.

5.2.5 Has the War in Ukraine Affected the Relationship between Y and Prices of Natural Gas?

When attempting to address the sub-research question, the significance of the dummy variables becomes evident. The dummy variable associated with x_1 serves to illustrate the changes in the connection between the dependent variable Y and the independent variable x_1 after the occurrence of the Russian invasion of Ukraine. As seen in Table 5.8, which portrays the estimated coefficient and p-value of the β_3, it is evident that the p-value of the dummy variable, 0.351, surpasses the significance threshold of 0.05% by a considerable margin. Consequently, this suggests that there are no substantial changes in the relationship between the price of natural gas and the GDP as an outcome of the war. In other words, there is a significant relationship between the GDP and the price of natural gas as determined in chapter 5.2.3, but there have not occurred any significant changes in this relationship due to the war in Ukraine.

Table 5.8 Coefficients, estimate and p-value, for x_3 from the regression analysis

Log Price Dummy	
Estimate	Pr(> |t|)
0.024589	0.351

The Log Volume dummy also has a very high p-value as seen in Table 5.9. Similar to the dummy representing price, the Log Volume dummy shows that there are no significant changes in the relationship between the volume of exported natural gas and the GDP. The relationship between the volume of exports and GDP is, to be more precise, the same in the years following the invasion as the years before.

Table 5.9 Coefficients, estimate and p-value, for x_4 from the regression analysis

Log Volume Dummy	
Estimate	Pr(> |t|)
-0.008932	0.414

5.4 The Effects of the War in Ukraine

While the regression analysis uncovered a strong positive correlation between the variables Log Price of natural gas and Log Exported volume of natural gas with Log GDP, additional analysis is essential to determine a causational relationship. This chapter seeks to confirm such a causational relationship using the theoretic framework from chapter 3.0 alongside the figures presented in chapter 5.1.

5.4.1 Why Did the Gas Prices Increase?

The surge in natural gas prices can be attributed to one of the fundamental principles of economics: supply and demand. In June 2022, when Russia reduced the capacity of the Nord Stream 1 pipeline to 40%, it caused a significant shortage of Russian gas in the European Union (Kuzemko et al, 2022, p.1; Tertre et al, 2023). Consequently, the EU had to urgently explore alternative sources to meet its natural gas requirements. This sudden surge in demand for natural gas created an upward pressure on prices, which aligns with the theory of supply and demand and is shown in Figure 3.1.

To visually represent the price dynamics of natural gas between 2010 and 2023, Figure 5.1 demonstrates the logarithmic function of the price of natural gas, marked with important events in the invasion. “1” indicates the Russian invasion, “2” marks when Nord Stream 1 capacity was reduced, and “3” is the complete shutdown of the Nord Stream 1 pipeline. The rapid growth in prices of natural gas began at the end of 2021 due to a sudden increase in demand that came after the reopening of the world after the partial shutdown during the COVID-19 pandemic (SSB, 2022, p. 16). The demand for goods and services increased, and as a result, the demand for power followed. However, as the Figure 5.1 illustrates, the biggest jump in gas prices came in 2022 after the Russian invasion of Ukraine. The most extreme growth in prices was seen after the reduction in Nord Stream 1 capacity in June, and there was a continuous upward trend in prices until September of the same year when the Nord Stream 1 pipeline was indefinitely shut down.

This supports the claim that disruptions in supply, such as the reduction in pipeline capacity, can have a significant impact on the market price of natural gas. In addition, it supports the statement that the Russian invasion of Ukraine has directly played a hand in the landscape of the natural gas market.

5.4.2 How has Norway’s GDP been Affected?

The AS-AD model is a highly valuable tool for explaining the relationship between supply, demand, output, and inflation within the economy. Subsequently, this chapter will leverage the AS-AD model to demonstrate the implications of the Russian invasion of Ukraine on Norway's GDP.

As discussed in the last chapter, the reduction in natural gas exports through the Nord Stream 1 pipeline by Russia in June 2022 resulted in increased demand for natural gas from other suppliers in the market. Norway, being a major supplier of gas to the EU, experienced a rise in output as a result. This situation aligns with the theory that a positive shift in the aggregate demand curve leads to an increase in output and inflation in the economy as shown in Figure 5.7 below. To give an additional illustration of these changes, Figure 5.2 presents a logarithmic GDP graph with key events marked, such as the beginning of the invasion in February, the reduction of Nord Stream 1 capacity to 40% in June, and the complete shutdown of Nord Stream 1 in September. From April to August 2022, there was a significant increase in GDP, particularly between July and August. Similarly, Figure 5.3 is a logarithmic CPI graph depicting the same time period and significant events. Although the change in Log CPI in Figure 5.3 is not as extreme as the changes in Log GDP in Figure 5.2, there is still a notable increase in the growth rate from January 2022 to September of the same year. These figures indicate that a demand shock occurred, and the resulting changes in the economy align with the expected outcomes based on the theoretical background of demand shocks.

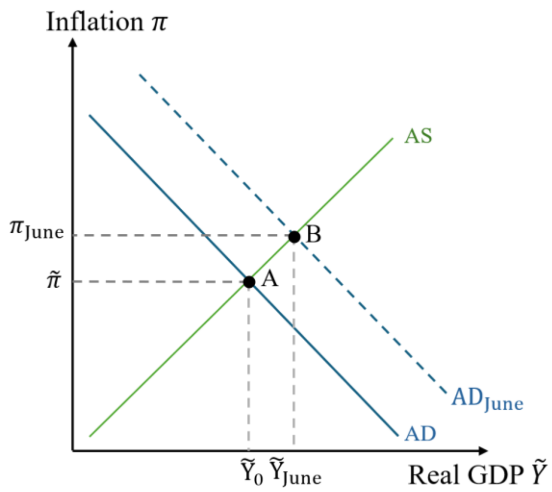

Figure 5.7 AS-AD framework with the positive shock in the AD-curve following the reduction of Nord Stream 1 in June 2022.

It is worth noting that inflation began to increase rapidly already at the end of 2020. This rise can be attributed to a sudden surge in demand in the overall economy as the society in Norway reopened after the COVID-19 pandemic, coupled with historically low interest rates (SSB, 2022, p. 16). It is important to highlight that this inflationary trend started years before the Russian invasion of Ukraine, however, the extreme spike in natural gas prices during 2022 has played a significant role in driving up inflation. The reduction in exports through the Nord Stream 1 pipeline, combined with the subsequent shutdown, caused a shock in the natural gas market, leading to increased prices. These high natural gas prices have contributed to the overall inflationary pressures observed throughout 2022.

According to the AS-AD model, following the initial demand shock, the supply side of the market begins to adjust to the increased demand and higher level of inflation. When inflation exceeds the target level, the central bank typically responds by increasing the policy rate, and this increase in interest rates encourages suppliers to adapt to the changes in the economy. As a result of these adjustments, the market eventually returns to the original level of short-term output but is still accompanied by a high level of inflation. Figure 5.2 illustrates a similar reduction in output in the months following the record-high GDP observed in August 2022.

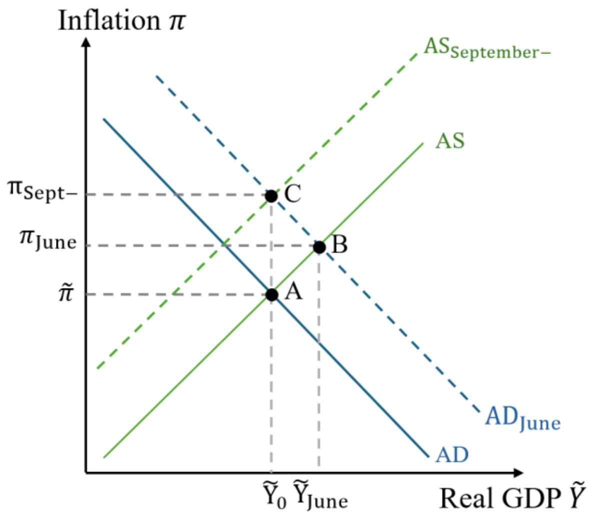

Figure 5.8 AS-AD framework with the positive shock in the AD-curve after the reduction of Nord Stream 1 in June 2022 and the following shift in the AS-curve from September 2022.

According to theoretical principles, when the market stabilizes following a demand shock, the demand will eventually decrease. In the case of gas prices, they experienced a significant decline after August 2022, as depicted in Figure 5.4, and by the middle of 2023, prices had almost returned to a normal level. This reduction in prices signifies a notable decrease in demand pressure by the end of summer 2022, based on theory stating that the relationship between prices and volume is influenced by supply and demand dynamics. Figure 5.8 illustrates the AS curve shifting and settling in the new equilibrium in point C where the output is back to a pre-war level.

Considering the decline in GDP and the price of natural gas, it would be reasonable to expect a similar reduction in the volume of natural gas exports. Surprisingly, the actual data on natural gas exports does not clearly exhibit this pattern. Although there was a substantial decrease in the exported volume throughout most of 2023, the winter period transitioning into 2024 witnessed an even larger level of natural gas exports compared to 2022. This trend is illustrated in Figure 5.5. The combined effect of an increased interest rate following the inflation surge after the initial shock and the expected decrease in demand will result in a decrease in the inflation rate. While inflation has significantly decreased since 2022, it has not yet returned to the pre-2020 levels. This observation indicates that the economy has not yet stabilized back to its steady state short-run output.

The limited decrease in the volume of exported natural gas can be primarily attributed to Norway keeping its position as the largest gas exporter to the EU. It is reasonable to assume that Norway will continue to maintain this position in the near future. Consequently, the aggregate demand in the market for Norwegian gas is likely to remain stable at a level slightly below and more maintainable than what was experienced in 2022 for an extended period.

The relatively stable nature of Norwegian gas exports despite a decline in GDP suggests that the surge in output observed throughout 2022 was primarily driven by changes in the price of natural gas. This observation strengthens the notion of a significant causal relationship between GDP and the price of natural gas. This relationship is further substantiated by comparing the changes in the exported volume of natural gas with the value of natural gas exports. There is a clear discrepancy between the value of Norwegian gas exports, depicted in Figure 5.6, and the volume of the export, illustrated in Figure 5.5. In 2022, there was a substantial increase in the value of gas exports, whereas the increase in volume was relatively more conservative. This disparity highlights the influence of price fluctuations on the overall value of gas exports. In other words, the surge in value of natural gas export can be primarily attributed to the rise in gas prices, rather than a proportional increase in the actual volume of gas exported.

Through analysing the results from the regression analysis there has been established a positive correlation between the price of natural gas and the GDP and the exported volume of natural gas and the GDP. However, there has been no evidence that these relationships changed after the Russian invasion of Ukraine. By using the AS-AD framework to delve deeper into the mechanisms in the economic landscape, it appears to be primarily the price of natural gas that has led to an increase in the Norwegian GDP in 2022. This increase in price can be attributed to the demand shock that occurred after Russia partially withdrew from the natural gas market after the invasion. In simpler words, this analysis has confirmed that the war in Ukraine has led to an increased GDP in Norway through supply and demand mechanisms in the market of natural gas. Thus, there is a causational relationship between the price of natural gas, the war in Ukraine and Norway's GDP.

5.4.3 How Much has Norway Profited from the War?

While it has now been confirmed that the war in Ukraine caused a demand shock in the market for Norwegian natural gas that in turn resulted to an increase in Norway's GDP, this chapter will attempt to predict how much Norway profited from the war in 2022. The following estimation equation will be used to predict the GDP with the price of natural gas from before the war and the price after the growth in 2022 (Ubøe, 2017, p. 250).

Equation 5.1

$$\hat{Y} = \hat{\alpha} + \hat{\beta}_1 x_1$$

In Equation 5.1 $\hat{Y}$ represents the estimated Y using the estimated α, the estimated β and the known explanatory variable x. When predicting what the GDP would have been if there was no increase in the price $\hat{\alpha}$ is estimated by taking the average of Log GDP form 2010Q2 to 2020Q4. While it is not possible to know how the price of natural gas would change in 2022 if the war in Ukraine never happened, it is possible to estimate on the basis of the historic data. As seen in Figure 5.1, the price of natural gas has stayed stable from 2010 until the middle of 2021. Thus, x_1 was estimated by finding the mean of Log Price from 2010Q2 to 2020Q4. $\hat{\beta}_1$ is given in the regression analysis of Dataset 2. The estimated quarterly GDP for 2022 in the case of stable prices of natural gas is 1 479 681 in million NOK witch equals to a yearly GDP of 5 918 722 million NOK.

To predict the GDP with the changes in price that did occur in 2022 the x_1 was estimated using the average of Log Price in the four quarters of 2022, while $\hat{\alpha}$ and $\hat{\beta}$ remain the same. This model predicted that the quarterly GDP in 2022 was 1 908 278 million NOK with the yearly GDP of 7 633 111 million NOK. The difference of these two predictions is 1 714 388 million NOK which indicates a profit of 1 714 billion NOK in the year of 2022, while SSB reports a profit of over 1 500 billion NOK in 2022 (SSB, 2023, s.26). However, due to the simplicity of the model, as it isolates the price of natural gas and the GDP, a deviation from the actual numbers is not unexpected. Still, the answer was relatively close to reality, and clearly demonstrates that Norway profited greatly from the consequences of the Russian invasion of Ukraine.

6.0 Discussion

This chapter will discuss the results in light of the research question and external research and statistics. Topics that will be discussed are what Norwegian export consists of, the role of natural gas exports, the relationship between geopolitical events and petroleum prices as well as the term "war profiteer". In addition, limitations of this analysis and suggested future research will be addressed.

6.1 Components of Norwegian Export

As presented in Chapter 3.2.4 the Norwegian GDP is presented in two different approaches: the mainland GDP and the total GDP. Figure 6.1 shows the relationship between Norwegian mainland GDP and the total GDP, given in seasonally adjusted current prices in million NOK. The total GDP, the blue line, shows greater variations starting from COVID-19. However, the mainland GDP, illustrated with the red line, shows normal growth, apart from a decrease during COVID-19. The big difference between the variations in the total GDP and the mainland GDP is what motivated this thesis; to delve further into the underlying economic and geopolitical mechanisms surrounding the GDP.

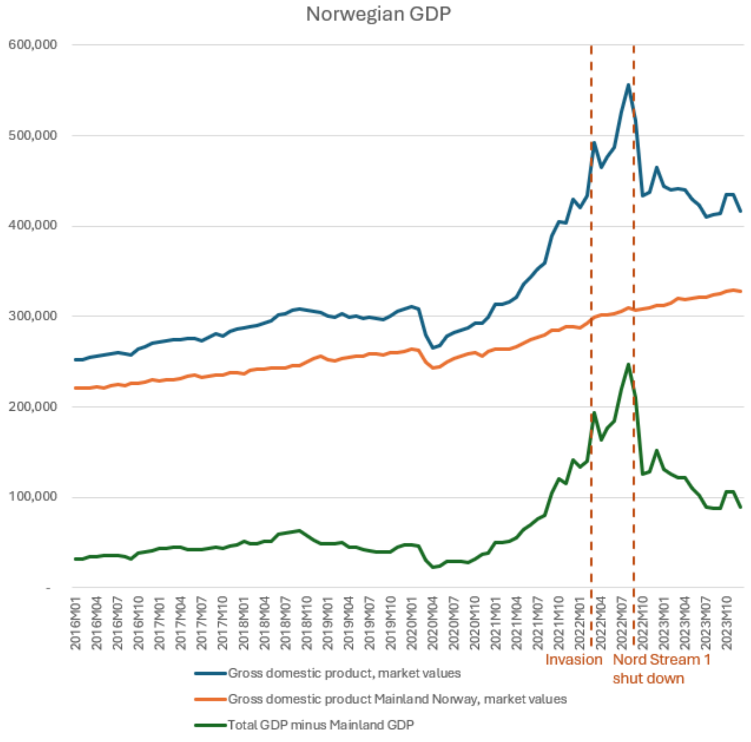

Figure 6.1 Norwegian GDP in monthly values from 2016 to 2023, split into total GDP, mainland GDP and the total subtracted the mainland. Data collected from SSB (SSB, 2024c).

According to the NHO (2023), Norwegian exports exhibited stability from 2022 to 2023, in terms of the exported volume. On the other hand, the value of the exports almost doubled. Oil and gas exports went from being 65% of the total Norwegian export in 2021, to 73% in 2022. Norwegian exports reached record numbers both in 2021 and 2022 (Basso et al., 2023, p.13). In light of this, the value of the exports, and thereby also the GDP started before the Russian invasion of Ukraine. Figure 6.2 represents the biggest categories of exported goods, as well as the export of weapons, from Norway in 2021 and 2022, denoted in billions NOK.

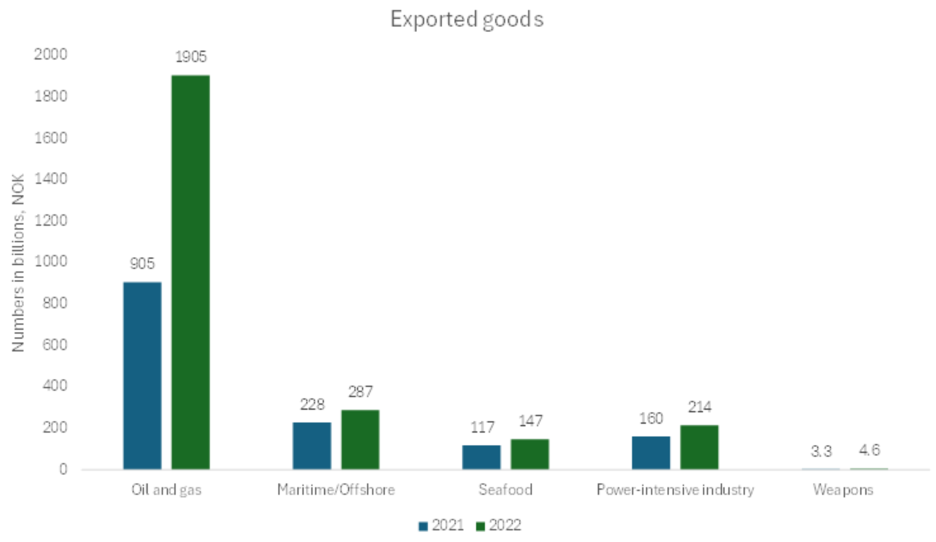

Figure 6.2 Biggest categories of Norwegian exports, and weapon exports, in 2021 and 2022. (Basso et al., 2023, p. 18; Basso, Hernes & Erraia, 2022, p. 15;Mysen, 2023; Gruben, Fossanger & Husø, 2022; Rørhus & Mysen, 2023).

All five categories in Figure 6.2 experienced an increase from 2021 to 2022. Oil and gas, which is the biggest Norwegian export, was also the category that experienced the biggest increase as it more than doubled. The value of Norwegian natural gas exports in August 2022 was 14 times higher than the monthly average in 2019 (SSB, 2023, p. 9). Maritime and offshore, seafood, and power-intensive industries are seen as big and important industries and exports for Norway, and salmon is often described as the "new oil". As seen in Figure 6.2 these are big industries, however not nearly as dominating as oil and gas. These industries did contribute to the increase in Norway's GDP in 2022, but the contribution was far smaller thus irrelevant to the research question.

The weapons industry is an industry that is often discussed, both in media and in politics, and this subject got even more attention after the Russian invasion of Ukraine. This category includes weapons, bombs, grenades, torpedoes, mines, rockets, and more (Mysen, 2023), but to keep it simple it will be referred to as weapons. The biggest importers of Norwegian weapons, outside of NATO, are Ukraine and Qatar. Qatar is by far the biggest, almost doubling the amount of exports to Ukraine in 2022 (Mysen, 2023). Even though the export of weapons has increased, the value of this export is extremely small compared to the rest of Norway's exports, and thereby not a big contributor to the GDP.

6.2 EU´s Import of Natural Gas

There have been three waves of sanctions against Russia from Western countries. One in 2014 after the Russian annexation of Crimea, the next one in 2017 after Russia interfered with the US presidential election, and the last wave in 2022 when Russia invaded Ukraine. After these events, the EU maintained a dependency on Russian natural gas (Kuzemko et al., 2022, p. 1; Mamonov & Pestova, 2023, p. 2-3).

According to numbers from Eurostat (2024a, 2024b), portrayed in Table 6.1 below, almost every country exporting natural gas to the EU has increased its sales in 2022 when Russian gas was no longer wanted in the EU. Four of the countries that export the most are not members of the EU: Algeria, Norway, Russia, and USA. In 2022 these four countries comprised 74% of all natural gas that the EU imported, and in 2021 the number was even higher at 88%. Table 6.1 contains the amount of exported natural gas from 2018 until 2022 from some of the biggest and most important natural gas suppliers to the EU. Even though Russia's exports to the EU decreased by 44.84% from 2021 to 2022, the total amount of gas imported by the EU increased by 8.31% in the same period (Eurostat, 2024a, 2024b). The table also highlights how important Norwegian natural gas is for the EU, as it makes up 30.52% of all imports. To put it differently, the table shows how important the EU is as a consumer of Norwegian natural gas.

Table 6.1 Natural gas import to the EU by provider country (Eurostat, 2024a, 2024b)

	2018	2019	2020	2021	2022	Percentage of total import 2022	Percentage change from 2021-2022
Algeria	41766.409	30670.471	28995.371	42817.164	40712.116	10.04 %	-4.92 %
Belgium	1343.100	4402.300	3423.500	2848.000	8468.400	2.09 %	**197.35 %**
France	3587.606	9084.743	8095.622	5348.050	14767.394	3.64 %	**176.13 %**
Italy	390.504	325.440	315.560	1543.496	4613.955	1.14 %	**198.93 %**
Netherlands	24842.355	24171.446	16664.643	16812.144	17851.042	4.40 %	**6.18 %**
Norway	120086.430	113582.306	110921.730	113449.687	123744.135	30.51 %	**9.07 %**
Russia	146644.477	160933.981	149582.008	154082.005	84997.379	20.95 %	-44.84 %
Spain	3247.000	1124.000	1171.000	3020.731	6054.542	1.49 %	**100.43 %**
United Kingdom	5189.850	6102.754	7227.656	5521.858	12480.395	3.08 %	**126.02 %**
United States	2158.602	12345.540	15388.673	19697.117	50998.954	12.57 %	**158.92 %**
Total import natural gas EU 27	**362339.237**	**405427.706**	**362008.090**	**374502.517**	**405619.876**		**8.31 %**

6.3 Economics of War for International Markets

Norway's role in the European energy market and the effect it has on Norway has now been discussed. The following subchapter will discuss the effect that geopolitical events have on the international markets. As seen in Chapter 2.3, wars do not only affect the countries that are actively in the conflict. Likewise, is the case for the cost of conflict as well. There are several factors contributing to this, one of them being supply shocks, and thereby the effect on international markets. The closer geographically a country is to the conflict, the more severe the consequences tend to be. Another effect war can have on neighbouring countries is migration (Federle et al., 2024, p. 3; Gordon & Recio, 2019, p. 267). As shown in Figure 5.1, the price of natural gas increased after Russia invaded Ukraine and after important events in the months that followed.

War and the price of petroleum products are often said to have a causal relationship (Barsky & Kilian, 2004, p. 115; Blomberg et al., 2009, p. 431; Kilian, 2014, p. 133). As most of the research on economics surrounding war is based on oil prices, the following discussion will be based on the prices of oil instead of natural gas. Not all the research agrees that this causal relationship is true in all cases. Kilian (2009) argues that during certain conflicts in the Middle East, oil prices were driven up by increased uncertainty for the future supply which in turn caused precautionary demand for oil, rather than an actual supply disruption (p. 1054).

In another article, Zhang et al. (2009) points to the effect of a prepared market. In situations where uncertainty exists before the outbreak of war, the market appears to be more resilient in handling the shock. However, when a shock occurs unexpectedly, its effects tend to persist for a longer period of time (p. 776). Similar to what happened to the price of natural gas after the Russian invasion of Ukraine, the prices of crude oil had an upward surge at the start of both the Gulf War and the Iraq War (Zhang et al., 2009, p. 776). At the time of writing, the war in Ukraine has not ended, therefore a comparison with the Gulf War and Iraq War is not possible. After the Gulf War and the Iraq War, the prices of crude oil returned to pre-war levels (Zhang et al., 2009, p. 776). Noguera-Santella (2016, p. 306-308) argues that geopolitical events happening before 2000 tend to affect the mean of oil prices, while between 2000 and 2016, when the study was done, no geopolitical event affected the mean of oil prices. The oil markets today appear to exhibit greater resilience against unexpected impacts of contemporary geopolitical events than what was seen previously (p. 306-308).

The situation in the European energy market was pressured before the Russian invasion of Ukraine. The export of oil and gas is crucial for the Russian economy, and as the EU started a green transition and phasing out oil and gas, Putin is said to have bribed Europe into keeping Russian gas. Russia wanted to build another pipeline to Germany, Nord Stream 2, however, the EU has voted against it. Since 2015 this pipeline has been a topic for debate amongst Russia, the EU, and the US (Francis, 2021; Russel, 2021, p. 3-5; Troianovski et al., 2021). During the summer of 2021 Russian exporters of natural gas did not increase their exports, which was surprising from the EU´s perspective considering the rising gas prices (Gran et al., 2023, p. 18). Because of this unexpected move from Russia, it could be argued that this was, at the time, an unknown preliminary stage of the conflict the world was about to see. Before the invasion, there were accusations against Russia and Putin for using energy as a political weapon, thereby reducing the supply which resulted in rising prices, and then again making the EU more dependent on Russian gas (Francis, 2021; Troianovski et al., 2021).

The Russian supply withholds resulted in European gas storage facilities having very low fillings levels going into the winter of 2021/22. In addition to this, the EU was in the process of phasing out coal- and nuclear power and transitioning to renewable energy. Hydro and nuclear energy output was lower than usual, and the Norwegian water reservoirs had low filling levels. These factors contributed to a strained supply situation and record-high power prices in Europe during the winter 2021/22. The effect of this was higher consumption of natural gas compared to electricity (Gran et al., 2023, p. 5, 18: SSB, 2022, p. 10, 76; Tertre et al., 2023).

Looney (2003) describes a crisis model where oil prices generally increase before a crisis, stay high during the crisis, and decrease after (p. 4). As shown in Figure 5.1 the price of natural gas also increased prior to the invasion. After the invasion and the capacity of Nord Stream 1 was reduced to 40% the prices were extremely high but decreased to some extent after the shutdown of Nord Stream 1. In late 2022 the market corrected itself and renewable energy sources could keep up with the energy demand, resulting in reduced prices for natural gas (Tertre et al., 2023). In addition to this, there was mild weather, which reduced the need for heating, and better storage for energy. This made Europe less dependent on Russian gas (SSB, 2023, p. 3). During 2023 prices of natural gas were back to the price level seen in 2021. This can be related to what Zhang et al. (2009) discussed about the market´s absorbance of the shock (p. 776). The European market for natural gas had then been able to absorb the shock, and the prices normalized. To summarize some of the discussion above, the duration of the increased prices of natural gas is dependent on how prepared the market was. According to Stacey & Johnson (2023) the market was better prepared for a shock as Hamas attacked Israel, and therefore more absorbent to the shock than it was as Russia invaded Ukraine.

6.4 Gas Prices´ Effect on Inflation

In the AS-AD model utilized in this thesis, inflation is on the y-axis, therefore it is relevant to discuss the effect gas prices have on inflation. The inflation in Europe and Norway saw an increase in growth already in 2021, which follows the financial recovery from COVID-19. One of the reasons for the rise in inflation in Norway was the price of electricity which rose as a result of foreign electricity prices. Another reason was pandemic-related difficulties with production and the related bottlenecks. After Russia invaded Ukraine in February 2022, the inflation in Europe and Norway continued to rise. Norway experienced a growth in prices bigger than recorded over an extended period. There were several factors contributing to this increase: the prices of raw materials, electricity prices, and the increasing prices of natural gas. The mainland prices also experienced bigger growth, however not as much as prices for natural gas (SSB, 2022, p. 3; SSB, 2023, p. 37, 59, 61).

The more a country is trading with a belligerent country, the more their inflation tends to rise. This is one of the causes of why many European countries experienced a higher rate of inflation than Norway in recent years. Exchange rates are also connected to the policy rates and the inflation. The Norwegian NOK strengthened in 2021 but weakened in 2022, which is a leading cause for the increase in prices of Norwegian imports in 2022 (Saunders et al., 2022, p. 304; SSB, 2022, p. 6; SSB, 2023, p. 60).

In order to contain the rising inflation, the Norwegian central bank, Norges Bank, increased the policy rate. The policy rate is a tool for reducing the economic growth of an economy by reducing the flow of money. If the policy rate is lowered too soon it can cause a quick increase in prices, in part due to a weakened NOK, which in turn will make it more expensive for Norway to import. This could lead to the inflation rates rising again (Norges Bank, n.d.a). Thus, the flow of money from high prices of natural gas counteracts the central bank’s monetary policy and contributes to the inflationary pressure. A consequence could be high interest rates for a longer period of time than expected.

6.5 War Profiteer

There are several different definitions of the term “war profiteer”, however, they all seem to agree that a war profiteer is someone who makes profits from war. The Oxford International Encyclopedia of Peace describes “War Profiteering” as: “War profiteering occurs when private and public entities jointly support a system in which war and military spending becomes highly profitable, regardless of the public's interest. …” (Young, 2010, “War Profiteering”).

Norway has been accused of being a war profiteer after Russia invaded Ukraine on February 24th, 2022. Already the next day, Ola H. Grytten (2022) wrote in the NHH Bulletin that Norway could become a war profiteer and that after just a few hours the prices of gas rose by 30%. Grytten then points to several common economic consequences based on historical wars, like a disturbance in the financial markets, increased inflation, increased prices of energy in an already pressured market, increased interest rates, and a strong dollar compared to the NOK (Grytten, 2022). All these features are seen in Norway’s economy in the aftermath of the invasion.

In an article from Forskning.no, written by Bård Amundsen (2022) about a discussion during the economic festival KÅKÅnomics in Stavanger 2022, there are multiple takes on the term “War Profiteer”. There were several participants in the discussion, where Kalle Moene said that Norway has become an involuntary war profiteer. Jon Hustad stated that the EU has itself to blame for having to pay a spot price for natural gas as the EU did not extend its agreement with Norway about having a fixed price. Torfinn Harding argues that shocks in the economy happen all the time, both for the better and worse and that there are different reasons to help Ukraine other than giving all the revenue from exported gas due to increased gas prices (Amundsen, 2022).

6.6 Limitations and Suggested Future Research

As most research, this thesis also has some limitations. Among these limitations are the estimation of the prices of natural gas prior to 2007. In Dataset 1 the prices are estimated from total value and exported volume. This may give somewhat inaccurate numbers compared to Dataset 2 with the TTF prices, as it is likely that more elements than actual natural gas is included in the value of natural gas exports. Another limitation is the simplicity of the model used in the regression analysis. There could have been added more control variables or included monthly values. As the research question relates to the GDP with all its components, and this thesis focuses on exports, it overlooks changes in the other components such as consumption and government spending. Including the other components in the analysis could have given a more accurate answer to the research question.

During this bachelor's thesis, several intriguing topics have emerged that deserve further exploration as separate research initiatives. One such topic is delving deeper into the previous chapter on war profiteering, which includes examining the definition of the term and determining culpability. Another compelling issue pertains to the prioritization between energy security and sustainability for Europeans. Can energy security be ensured for a large population while simultaneously relying on renewable energy sources? Additionally, it would be interesting to investigate how the conflict in Ukraine has adversely affected economies outside the Western world. Specifically, analysing the reduced energy access experienced by these countries due to Europe's ability to pay higher prices and its subsequent impact on food prices (Hansen, 2023; Liadze et al., 2022). Lastly, it is interesting to examine whether the EU and the European energy market should have been better prepared for Russia's potential invasion of Ukraine and the subsequent consequences. Can the EU be held accountable for any shortcomings in this regard?

7.0 Conclusion

The research question this thesis has sought to answer is “How has the war in Ukraine affected Norway's GDP?”, with the following sub-research question “Has the war in Ukraine altered the relationship between the price of natural gas and the value of Norwegian GDP?”. To guide the analysis and assist with answering these research questions there have been three sets of hypotheses. One regarding whether or not the price of natural gas has affected Norway’s GDP. The second is about whether the exported volume of natural gas has affected Norway's GDP. Lastly, the third is about the relationship between the price of natural gas and the GDP, and if it changed after the invasion of Ukraine.

The hypotheses have been answered through regression analysis of two datasets, one from 1980Q1 to 2007Q4, and the other from 2010Q2 to 2023Q4. As a result of the regression analysis, both of the null hypotheses were rejected based on the p-value and significance level of the respective coefficients. Both the price of natural gas and the exported volume of natural gas were documented to have had a significant impact on the Norwegian GDP both before and after the Russian invasion of Ukraine.

The sub-research question was answered by looking at the p-value of Log Price dummy variable. There is no clear evidence in this model for a change in the relationship between the price of natural gas and the Norwegian GDP as a result of the war in Ukraine. In other words, the price of natural gas does not have a stronger or weaker effect on the GDP equation after the beginning of the war than before the conflict.

In addition to answering the hypotheses and research questions, the model was used to estimate profit by predicting what the GDP would have been if the war in Ukraine had not taken place. The model from this thesis predicted a yearly GDP of 5 918 billion NOK in the case of no war and stable prices of natural gas, whereas the predicted GDP including the increase in prices was 7 633 billion NOK. This indicates a profit of 1 714 billion NOK in 2022, while SSB reports a profit of approximately 1 500 billion. As the model isolates the effect of the prices of natural gas and the GDP the deviation from the real profit is not unexpected, and both the model and SSB highlights how Norway has gained on the war.

The research question is answered on the grounds of multiple different factors, primarily the results from the regression analysis, the results from hypothesis testing, and the AS-AD model.

In addition, the results are discussed in light of research from similar cases. This analysis and discussion conclude that the boom in the Norwegian GDP was a result of the spike in prices of natural gas, which again was caused by mechanisms in the market for natural gas after the outbreak of the war in Ukraine. A demand shock, from Norway's point of view, occurred due to European sanctions against Russia, and their answer to shut down a significant portion of the supply of natural gas to Europe. This demand shock brought an increase in the price of natural gas, CPI, and policy rate with it. Another discussed cause for the increase in the price of natural gas is the uncertainty it created in the market and the precautionary mindset that follows a fear of a supply shortfall. In addition, to what degree the market is prepared for the incoming shock also affects how well it is handled.

The model created in this thesis has been tested for explanatory power, multicollinearity, reliability, and the significance of the variables. Thus, strengthening the model. However, there are, as always, some limitations to the model. The focus of this thesis has been on the export component of the GDP equation, with the focus on the price of natural gas due to it dominating Norwegian exports, especially in 2022. While the regression analysis controlled for price, volume, and CPI, there could potentially be other factors in the market that affected the relationship between the GDP and the prices of natural gas. Furthermore, the war had a big impact on the economy both in Norway as well as in Europe and has most likely affected all the different components of the GDP equation. Because of this, even though the thesis has given a good understanding of the changes in GDP in relation to exports, it does not give a full-picture answer to the total effect the war had on the entirety of the Norwegian GDP.

8.0 References

Agnolucci, P. & Temaj, K. (2024, January 4). Oil prices remain volatile amid uncertainty arising from geopolitical conflict. *World Bank Blogs.* https://blogs.worldbank.org/en/opendata/oil-prices-remain-volatile-amid-uncertainty-arising-geopolitical-conflict

Ambrose, J. (2023, October 20). Why oil prices are rising amid the Israel-Hamas war. T*he Guardian.* https://www.theguardian.com/business/2023/oct/20/oil-prices-israel-hamas-war

Amundsen, B. (2022, November 3). Bør Norge gi fra seg tusen milliarder kroner av profitten vår på Ukraina-krigen? *Forskning.no* https://www.forskning.no/finans-krig-ukraina/bor-norge-gi-fra-seg-tusen-milliarder-kroner-av-profitten-var-pa-ukraina-krigen/2101505

Barsky, R. B. & Kilian, L. (2004). Oil and the Macroeconomy Since the 1970s. *Journal of Economic Perspectives. 18*(4), 115-134. DOI: 10.1257/0895330042632708

Basso, M.N., Hernes, S. Erraia, J. (2022). *Eksportmeldingen 2022* (Menon-publikasjon, 89/2022). Retrieved from https://www.menon.no/wp-content/uploads/2022-89-Eksportmeldingen-2022.pdf

Basso, M. N, Hernes, S., Jacobsen, E., Aslesen, S., Wahl, E. S. & Erraia, J. (2023). *Eksportmeldingen 2023* (Menon-publikasjon, 79/2023). Retrieved from https://www.nho.no/contentassets/b7945dd871a14d639946bc1a5d929f35/menon-eksportmeldingen-2023-med-fylkesvedlegg.pdf

Benoit, K. (2011) Linear Regression Models with Logarithmic Transformations. *Methodology Institute.* https://kenbenoit.net/assets/courses/me104/logmodels2.pdf

Blomberg, B., Hess, G. & Jackson J. H. (2009). Terrorism and The Returns on Oil. *Economics & Politics. 21*(3), 359-451. https://doi.org/10.1111/j.1468-0343.2009.00357.x

Bundesnetzagentur. (2023, June 1). *Bundesnetzagentur publishes gas supply figures for 2022.* Bundesnetzagentur. https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/EN/2023/20230105_RueckblickGas2022.html

Edvinsson, R. (2014). 4. The Gross Domestic Product of Sweden within present borders, 1620-2012. In R. Edvinsson, T. Jacobson & D. Waldenström (Ed.), *Historical Monetary and Financial Statistics for Sweden, Volume II.* (pp. 101-182). Ekerlids förlag. https://www.riksbank.se/globalassets/media/forskning/monetar-statistik/volym2/chapter4_-volume2_140613.pdf

Energidepartementet. (2021, October 12). *Norsk oljehistorie på 5 minutter.* Regjeringen. https://www.regjeringen.no/no/tema/energi/olje-og-gass/norsk-oljehistorie-pa-5-minutter/id440538/

Estrada, M. A. R., Park, D., Tahir, M. & Khan, A. (2020). Simulations of US-Iran war and its impact on global oil price behavior. *Borsa Istanbul Review. 20*(1), 1-12. https://doi.org/10.1016/j.bir.2019.11.002

European Council. (2024, March 21). *Where does the EU's gas come from?* European Council Council of the European Union. https://www.consilium.europa.eu/en/infographics/eu-gas-supply/

Eurostat. (2024a). *Exports of natural gas by partner country* [Statistics]. https://doi.org/10.2908/NRG_TE_GAS

Eurostat. (2024b). *Imports of natural gas by partner country* [Statistics]. https://doi.org/10.2908/NRG_TI_GAS

EØS-notatbasen. (2024, January 2). *Europeisk Energiregulatorbyrå (ACER).* Regjeringen. https://www.regjeringen.no/no/sub/eos-notatbasen/notatene/2007/okt/europeisk-energiregulatorbyra-acer/id2434792/

Federle, J., Meier, A., Müller, G. J., Mutschler, W. & Schularick, M. (2024). *Policy Brief: The Price of War.* (No. 171). Kiel Institute for the World Economy. https://www.ifw-kiel.de/fileadmin/Dateiverwaltung/IfW-Publications/fis-import/85518865-6c69-495b-8103-644e4469c43e-KPB171.pdf

Francis, D. (2021, September 15). *Vladimir Putin accused of weaponizing Russian gas.* Atlantic Council. https://www.atlanticcouncil.org/blogs/ukrainealert/vladimir-putin-accused-of-weaponizing-russian-gas/

Gassco. (2024). *Norpipe.* Gassco. https://gassco.eu/rorledningsnettverk/norpipe/

Gasunie Transport Services. (2024). *TTF.* Gasunie Transport Services. https://www.gasunietransportservices.nl/en/about-gts/gas-transport/ttf

Gordon, A. J. G. & Recio, L. A. H. (2019). External Effects of the War in Ukraine: The Impact on the Price of Oil in the Short-term. *International Journal of Energy Economics and Policy. 9*(2), 267-276. https://doi.org/10.32479/ijeep.7380

Gran, R.I, Taule, H., Hansen, P. V., Hagen, L., Hilland, J., Lie, M. H., Bjella, K., Sundsbø, S., Lillelien, N. & Hansen, N. (2023). *Balansekunst* (Report from Strømprisutvalget to the Norwegian oil- and energy minister, Terje Aasland). Retrieved from https://www.regjeringen.no/contentassets/10f00b5fc453430a867deea8b9d1f355/stromprisutvalgets-rapport.pdf

Gruben, M.H., Fossanger, K. & Husø, J. (2022, January 17). *Tidenes største handelsoverskudd i 2021.* Statistisk sentralbyrå. https://www.ssb.no/utenriksokonomi/utenrikshandel/statistikk/utenrikshandel-med-varer/artikler/tidenes-storste-handelsoverskudd-i-2021

Grytten, O.H. (2022, February 25). Norge kan bli krigsprofitør. *NHH Bulletin*. https://www.nhh.no/nhh-bulletin/artikkelarkiv/2022/februar/norge-kan-bli-krigsprofitor/

Häggqvist, H. (2019). Wartime and Post-war Economies (Sweden). *International Encyclopedia of the First World War.* 10.15463/ie1418.11402

Han, J.C.Y. & Wang, S.W. (1998) Political cost and earnings management of oil companies during the 1990 Persian Gulf Crisis. *The accounting review. 73*(1), 103-117. http://ezproxy.uis.no/login?url=https://www.proquest.com/scholarly-journals/political-costs-earnings-management-oil-companies/docview/218574250/se-2?accountid=136945

Hansen, H. (2023, February 27). I Sør-Afrika har strømmangelen utløst nasjonal krisetilstand. *Fri Fagbevegelse.* https://frifagbevegelse.no/nettverk/i-sorafrika-har-strommangel-utlost-nasjonal-krisetilstand-6.469.940769.767536e954

Hardy, M. A. (1993) *Regression with dummy variables.* (Issue 93). Sage Publications. https://books.google.no/books?hl=no&lr=&id=EzLffJlYISEC&oi=fnd&pg=PP7&dq=dummy+variable+regression+&ots=RblUfWveOD&sig=84RK1r5dA3JwPbsrw5LP23vkW8A&redir_esc=y#v=onepage&q&f=false

Hlavac, M. (2018). stargazer: Well-Formatted Regression and Summary Statistics Tables (Version 5.2.3) [Software]. Retrieved from https://CRAN.R-project.org/package=stargazer

Investing.com. (2024). *Natural Gas TTF Quarterly Futures Historical Data* [Statistics]. https://www.investing.com/commodities/natural-gas-ttf-quarterly-futures-historical-data

Iversen, J. (2024, February 26). *Ukraina*. FN-sambandet. https://fn.no/konflikter/ukraina#2022:RusslandinvadererUkraina%3Cbr%3E-7

Jaffe, A. M. & Elass, J. (2015). War and the oil price cycle. *Journal of International Affairs, 69*(1), 121-VIII. https://www.proquest.com/docview/1762334765?sourcetype=Scholarly%20Journals

James, H. (2012). Switzerland and Sweden in the Second World War. In C. Buchheim & M. Boldorf (Eds.), *Europäische Volkswirtschaften unter deutscher Hegemonie: 1938-1945* (Vol. 77, pp. 211-228). De Gruyter Oldenbourg. https://doi.org/10.1515/9783110446685-013

Jones, C.I. (2021). *Macroeconomics.* (5th edition). W. W. Norton & Company

Kavlakoglu, E. & Murel, J. (2023, November 21). *What Is Multicollinearity?* IBM. https://www.ibm.com/topics/multicollinearity

Kilian, L. (2009). Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market. *The American Economic Review*. *99*(3), 1053-1069. https://www.jstor.org/stable/25592494

Kilian, L. (2014). Oil Price Shocks: Causes and Consequences. *Annual Review of Resource Economics. 6*(1), 133-154. https://www.annualreviews.org/docserver/fulltext/resource/6/1/annurev-resource-083013-114701.pdf?expires=1713788785&id=id&accname=ar-154959&checksum=D9AF6F8EA3C6A411C733DBE9F8C895A2

Kleiven, T. A. (2008). Validity and validation in qualitative and quantitative research. *Nordisk Pedagogik. 28*(3), 219-233. https://www.idunn.no/doi/full/10.18261/ISSN1891-5949-2008-03-05

Kozul-Wright, A. (2024, January 12). *Oil prices steady despite Middle East tensions, but risks are rising.* Aljazeera. https://www.aljazeera.com/economy/2024/1/12/oil-prices-steady-despite-middle-east-tensions-but-risks-are-rising

Kuzemko, C., Blondeel, M., Dupont, C. & Brisbois, M. C. (2022). Russia´s war on Ukraine, European energy policy responses & implications for sustainable transformations. *Energy Research & Social Science*. *93*(1), 1-8. https://doi.org/10.1016/j.erss.2022.102842

Liadze, I., Macchiarelli, C., Mortier-Lee, P. & Juanino, P. S. (2022). Economic cost of the Russia-Ukraine war. *The World Economy*. *46*(4), 874-886. https://doi.org/10.1111/twec.13336

Looney, R. (2003). Oil Prices and the Iraq War: Market Interpretations of Military Developments. *Strategic Insights*. *2*(4), 1-9. https://www.researchgate.net/publication/235127288_Oil_Prices_and_the_Iraq_War_Market_Interpretations_of_Military_Developments

Mamonov, M. & Pestova, A. (2023) The Price of War: Macroeconomic and Cross-Sectional Effects of Sanctions on Russia. (n.p.). 1-67 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4190655

Mysen, S. (2023, March 2) *Historisk høy våpeneksport i 2022.* Statistisk sentralbyrå. https://www.ssb.no/utenriksokonomi/utenrikshandel/statistikk/utenrikshandel-med-varer/artikler/historisk-hoy-vapeneksport-i-2022

NHO. (2023, June 29). *Rekordhøye eksportinntekter i 2022 – men lav vekst og fortsatt oljeavhengighet.* Næringslivets Hovedorganisasjon. https://www.nho.no/tema/eos-og-internasjonal-handel/artikler/rekordhoye-eksportinntekter-i-2022--men-lav-vekst-og-fortsatt-oljeavhengighet/

Noguera-Santaella, J. (2016). Geopolitics and the oil price. *Economic Modelling*. *52*(B), 301-309. https://doi.org/10.1016/j.econmod.2015.08.018

Norges Bank. (n.d.a) *Kort fortalt: Styringsrenten.* Norges Bank. https://www.norges-bank.no/kort-forklart/styringsrenten/

Norges Bank. (n.d.b). *Valutakurser*. [Statistics]. https://www.norges-bank.no/tema/Statistikk/Valutakurser/?tab=currency&id=EUR

Norges Bank. (2020, January 2). *Våre samfunnsoppdrag.* Norges Bank. https://www.norges-bank.no/tema/Om-Norges-Bank/samfunnsoppdrag/

Norsk Petroleum. (n.d.). *Produksjon og eksport.* Norsk Petroleum. https://www.norskpetroleum.no/produksjon-og-eksport/

Norsk Petroleum. (2024a, January 2). *Rørtransportsystemet.* Norsk Petroleum. https://www.norskpetroleum.no/produksjon-og-eksport/rortransportsystemet/

Norsk Petroleum. (2024b, January 2). *Statlig organisering av virksomheten.* Norsk Petroleum. https://www.norskpetroleum.no/rammeverk/rammeverkstatlig-organisering-av-petroleumsvirksomheten/

Norsk Petroleum. (2024c, March 8). *Historisk produksjon.* Norsk Petroleum. https://www.norskpetroleum.no/fakta/historisk-produksjon/

Partington, R. (2024, January 12). *Oil prices hit $80 a barrel as fears grow over Red Sea disruption to trade.* The Guardian. https://www.theguardian.com/business/2024/jan/12/oil-prices-fears-grow-over-red-sea-disruption-to-trade-yemen

Rodríguez del Águila, M.M. & Benítez-Parejo, N. (2011). Simple linear and multivariate regression models. *Allergologia et Immunopathologia. 39*(3), 159-173. https://doi.org/10.1016/j.aller.2011.02.001

Russel, M. (2021). *The Nord Stream 2 pipeline* (PE. 690.705 - July 2021). Retrieved from https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/690705/EPRS_BRI(2021)690705_EN.pdf

Rørhus, J. O. & Mysen, S. (2023, January 18) *Skyhøye gasspriser ga historisk høy eksport i 2022.* Statistisk Sentralbyrå. https://www.ssb.no/utenriksokonomi/utenrikshandel/statistikk/utenrikshandel-med-varer/artikler/skyhoye-gasspriser-ga-historisk-hoy-eksport-i-2022

Saunders, A., Cornett, M. M. & Erhemjamts, O. (2022) *Financial Markets and Institutions.* (Eighth edition). McGraw Hill

SimilarWeb (2024, April 1). Top Websites Ranking. *SimilarWeb.* https://www.similarweb.com/top-websites/finance/investing/

SSB. (n.d.a). *Bruttonasjonalprodukt, Faste 2005-priser. Millioner kroner, pr. innbygger og årlig endring. 1865-2011* [Statistics]. https://www.ssb.no/a/histstat/aarbok/ht-0901-bnp.html

SSB. (n.d.b). Samfunnsoppdrag og rolle. *Statistisk sentralbyrå.* https://www.ssb.no/omssb/ssbs-virksomhet/samfunnsoppdrag-og-rolle

SSB. (2021, November 5). *Hva er egentlig BNP?.* Statistisk sentralbyrå. https://www.ssb.no/nasjonalregnskap-og-konjunkturer/nasjonalregnskap/statistikk/nasjonalregnskap/artikler/hva-er-egentlig-bnp.

SSB. (2022, March 29). *Økonomiske analyser* (1/2022). https://www.ssb.no/nasjonalregnskap-og-konjunkturer/okonomiske-analyser/okonomiske-analyser-1-2022/_/attachment/inline/3628d7e9-f7c5-4508-adbc-32db442cd815:a1e317718cc3df256b2eb40e8228223167ba743e/OA2022-1-utsyn.pdf

SSB. (2023, March 27). *Økonomiske analyser* (1/2023). https://www.ssb.no/nasjonalregnskap-og-konjunkturer/konjunkturer/statistikk/konjunkturtendensene/artikler/norsk-okonomi-er-ved-et-vendepunkt/_/attachment/inline/d50f893d-4b39-4bb4-8837-68f8c5ee505c:bc475223e4e77cbe71cf247b701a44415e77a8ebc/OA2023-1_KT10mars2023.pdf

SSB. (2024a). *09189: Makroøkonomiske hovedstørrelser 1970-2023* [Statistics]. https://www.ssb.no/statbank/table/09189

SSB. (2024b). *08800: Utenrikshandel med varer, hovedtall (mill. kr), 1960-2023* [Statistics]. https://www.ssb.no/statbank/table/08800/tableViewLayout1/

SSB. (2024c). *11721: Final expenditure and gross domestic product, by macroeconomic indicator, month and contents* [Statistics]. https://www.ssb.no/en/statbank/table/11721/tableViewLayout1/

SSB. (2024d). *03013: Konsumprisindeks, etter konsumgruppe (2015=100) 1979M01-2024M03* [Statistics]. https://www.ssb.no/statbank/table/03013

SSB. (2024e). *08792: Utenrikshandel med varer, hovedtall (mill. kr) 1980M01-2024M03* [Statistics]. https://www.ssb.no/statbank/table/08792

SSB. (2024f). *09190: Makroøkonomiske hovedstørrelser. Ujustert og sesongjustert 1978K1-2023K4* [Statistics]. https://www.ssb.no/statbank/table/09190

Stacey, S. & Johnson, I. (2023, November 7). *Oil prices gives up gains since start of Israel-Hamas war.* Financial Times. https://www.ft.com/content/e3c84540-e6d5-4ae9-a0be-a88bb9453838

Stuart, R. (2022). 160 Years of aggregate supply and demand in Switzerland. *Swiss Journal of Economics and Statistics*, *158*(17), 1-17. https://doi.org/10.1186/s41937-022-00096-2

Sun, Y. (2022) The Impacts of Wars on Oil Prices. *Advances on Social Science, Education and Humanities Research. 670*(1), 167-170 10.2991/assehr.k.220704.031

Sveriges Riksbank (2018). From the first to the second world war. *Riksbank*, 255-321. https://www.riksbank.se/globalassets/media/riksbanken-350-ar/tidslinjen/fran-varldskrig-till-varldskrig/255-321-from-the-first-war-to-the-second_eng.pdf

Tavakol, M. & Dennick, R. (2011). Making sense of Cronbach´s alpha. *International Journal of Medical Education. 2,* 53-55. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4205511/pdf/ijme-2-53.pdf

Tertre, M. G., Martinez, I. & Rábago, M. R. (2023, July 20) *Reasons behind the 2022 energy price increases and prospects for next year.* Voxeu. https://cepr.org/voxeu/columns/reasons-behind-2022-energy-price-increases-and-prospects-next-year

Thrane, C. (2022) *Kvantitativ metode: En praktisk tilnærming.* 4th edition. Cappelen Damm Akademisk.

Troianovski, A., Erlanger, S. & Reed, S. (2021, October 13). *As Europe Faces a Cold Winter, Putin Seizes on the Leverage From Russia´s Gas Output.* The New York Times. https://www.nytimes.com/2021/10/07/world/europe/putin-russia-natural-gas-europe.html

Ubøe, J. (2017). *Introductory Statistics for Business and Economics; Theory, Exercises and Solutions.* Springer Nature.

U.S. Embassy, Stockholm, Sweden (2016, August 15). *RG 84: Sweden.* National Archives. https://www.archives.gov/research/holocaust/finding-aid/civilian/rg-84-sweden.html

Utenriksdepartementet (2021, December 6). *Hva EØS-avtalen omfatter.* Regjeringen. https://www.regjeringen.no/no/tema/europapolitikk/eos1/hva-avtalen-omfatter/id685024/

Riis, C. & Moen, E. R. (2021). *Moderne mikroøkonomi.* (4th edition). Gyldendal.

Young, N. J. (2010) War Profiteering. In *The Oxford International Encyclopedia of Peace.* Retrieved 10th April 2024 from https://www.oxfordreference.com/display/10.1093/acref/9780195334685.001.0001/acref-9780195334685-e-756?rskey=RyRJPt&result=754

Zhang, X., Yu, L., Wang, S. & Lai, K.K. (2009). Estimating the impact of extreme events on crude oil price: An EMD-based event analysis method. *Energy Economics*. *31*(5), 768-778. https://doi.org/10.1016/j.eneco.2009.04.003

Appendix

A.1 Dataset 1, 1980-2007

Quarter	Log_GDP	Log_Price	Log_Volume	Log_CPI
1980Q1	4.88691353	2.66642149	6.834637771	1.4372219
1980Q2	4.89468151	2.70836358	6.766144063	1.45229767
1980Q3	4.8979678	2.76886957	6.694276568	1.46587834
1980Q4	4.92260091	2.79080448	6.793639825	1.47567119
1981Q1	4.94228095	2.80225853	6.828067628	1.49692965
1981Q2	4.95815759	2.82932017	6.765182875	1.50920252
1981Q3	4.96474976	2.86689917	6.670037857	1.52113808
1981Q4	4.97515138	2.92114691	6.811005513	1.52633928
1982Q1	4.98845193	2.94670933	6.850003736	1.54571936
1982Q2	4.99158931	2.95362079	6.743084991	1.55469102
1982Q3	5.00942115	3.01549417	6.608065223	1.56584782
1982Q4	5.02805858	3.00431006	6.784776854	1.57403127
1983Q1	5.03079396	2.99959265	6.8035229	1.5862121
1983Q2	5.04361767	3.00960982	6.710880249	1.59254684
1983Q3	5.05333587	3.01103979	6.647257858	1.59842571
1983Q4	5.0743629	3.03437033	6.812461425	1.60458602
1984Q1	5.08572573	3.02000804	6.857823855	1.61278386
1984Q2	5.0855724	3.01564554	6.786169628	1.61978876
1984Q3	5.10962241	3.04549532	6.642390209	1.6242821
1984Q4	5.12766189	3.05299873	6.842313291	1.62974929
1985Q1	5.13243901	3.05488468	6.880672967	1.6368221
1985Q2	5.12234369	3.06923382	6.803039026	1.6441102
1985Q3	5.15556679	3.10180226	6.663568219	1.6486852
1985Q4	5.17935356	3.06899954	6.800466875	1.65353409
1986Q1	5.15285073	3.05073703	6.856459278	1.66118144
1986Q2	5.1455227	3.02678154	6.689138274	1.66962676
1986Q3	5.15660366	2.98719143	6.751747604	1.68214508
1986Q4	5.19452822	2.91375983	6.849143694	1.69019608
1987Q1	5.1881238	2.85767554	6.879676153	1.70243054
1987Q2	5.18928252	2.76851538	6.817058142	1.70983508
1987Q3	5.19622594	2.74437928	6.695111309	1.71516736
1987Q4	5.22767336	2.76565848	6.883384159	1.72126088
1988Q1	5.21926484	2.78628996	6.883026916	1.73212559
1988Q2	5.21293831	2.76076597	6.818560231	1.73930858
1988Q3	5.21232879	2.7028796	6.74798509	1.74298683
1988Q4	5.23570768	2.6983689	6.850757024	1.7466342
1989Q1	5.22998372	2.72519957	6.878053093	1.75204845
1989Q2	5.2480714	2.6888234	6.812235864	1.75916402
1989Q3	5.24516707	2.70045603	6.771129029	1.76217822
1989Q4	5.26932377	2.73870073	6.866604314	1.76492298
1990Q1	5.25889577	2.76894162	6.854514429	1.77060658
1990Q2	5.24944785	2.79186047	6.706587931	1.77548909
1990Q3	5.26816126	2.747551	6.727247822	1.77839246
1990Q4	5.31245241	2.74001148	6.821328459	1.78414161
1991Q1	5.28494256	2.85593098	6.823678593	1.78722425
1991Q2	5.29349735	2.88158371	6.790975913	1.79169065
1991Q3	5.29149983	2.77768158	6.633095651	1.79332465
1991Q4	5.31205247	2.80604776	6.821932231	1.79518459
1992Q1	5.30685375	2.78993271	6.823697726	1.79726754

1992Q2	5.29396109	2.75546302	6.773838981	1.80208926
1992Q3	5.30327816	2.76366898	6.7646048	1.80322944
1992Q4	5.32753057	2.7734851	6.786899827	1.80482068
1993Q1	5.31621575	2.79826861	6.794241241	1.80843605
1993Q2	5.31319629	2.82165989	6.718794722	1.8124677
1993Q3	5.3312187	2.76808369	6.701738328	1.8124677
1993Q4	5.35832325	2.78465155	6.849523319	1.81335856
1994Q1	5.33202215	2.78382268	6.832127368	1.8138033
1994Q2	5.34398137	2.74866664	6.795401401	1.81668311
1994Q3	5.34753882	2.70675545	6.70905228	1.81910503
1994Q4	5.37849056	2.74530959	6.86598877	1.82085799
1995Q1	5.3773864	2.76491481	6.85323792	1.82520967
1995Q2	5.36845982	2.75248488	6.804179383	1.82823011
1995Q3	5.37676122	2.7669821	6.769954926	1.82908925
1995Q4	5.40312224	2.75779046	6.847083306	1.83016079
1996Q1	5.40832308	2.75437237	6.914944511	1.82908925
1996Q2	5.4001199	2.74388414	6.881531214	1.83250891
1996Q3	5.4218539	2.79244806	6.944903633	1.8350561
1996Q4	5.45211472	2.78321896	7.036851071	1.8377988
1997Q1	5.43191513	2.84190716	7.035291354	1.84219305
1997Q2	5.4538013	2.84194213	6.941961449	1.84406277
1997Q3	5.45234927	2.81850214	6.960661285	1.84489118
1997Q4	5.48189246	2.81769709	7.081630861	1.84736698
1998Q1	5.45657857	2.84296885	7.05278509	1.85146219
1998Q2	5.45435391	2.84917344	6.978518852	1.85369821
1998Q3	5.45989134	2.78169194	6.945116743	1.85471079
1998Q4	5.48363579	2.7711677	7.092095662	1.8573325
1999Q1	5.4658303	2.72044353	7.091801167	1.86113598
1999Q2	5.47692578	2.73016315	7.027308801	1.86431327
1999Q3	5.50535215	2.77347308	6.987476872	1.86352112
1999Q4	5.54918602	2.75442363	7.124786972	1.86884029
2000Q1	5.56167489	2.92903506	7.145561988	1.87351435
2000Q2	5.55515856	2.92766686	6.998160717	1.87679498
2000Q3	5.57770545	3.06826725	6.946505227	1.87813865
2000Q4	5.61003382	3.07185229	7.162133193	1.88214491
2001Q1	5.59897644	3.11349065	7.098430437	1.88855389
2001Q2	5.59037364	3.07117948	7.038635217	1.89357684
2001Q3	5.58509961	3.05828688	7.095192609	1.88911487
2001Q4	5.59712343	3.0580615	7.187796491	1.89079348
2002Q1	5.57627914	2.98448203	7.198018217	1.89302159
2002Q2	5.59405648	2.94900333	7.185365054	1.89560669
2002Q3	5.58643989	2.92586746	7.105379381	1.89523833
2002Q4	5.6113345	3.0305856	7.266408472	1.90036713
2003Q1	5.61278386	2.9570096	7.287267523	1.91257629
2003Q2	5.58724837	2.94990807	7.163199294	1.90525605
2003Q3	5.60531367	2.96381909	7.17451519	1.90345175
2003Q4	5.62787565	2.94413478	7.310244089	1.90561601
2004Q1	5.63956318	2.99585022	7.334604143	1.90633504
2004Q2	5.63334219	2.95091276	7.249280877	1.90884232
2004Q3	5.64585537	3.00219228	7.154266007	1.9086637

2004Q4	5.68099688	3.01382336	7.33685099	1.91097995
2005Q1	5.66982713	3.0810945	7.338712607	1.9106244
2005Q2	5.68940121	3.06061349	7.286989707	1.91539984
2005Q3	5.69718923	3.0623777	7.259800231	1.91627844
2005Q4	5.7343445	3.18005599	7.346063495	1.91890364
2006Q1	5.74206258	3.27291558	7.357837645	1.92029729
2006Q2	5.73138567	3.20963105	7.28728477	1.92565581
2006Q3	5.73926768	3.20967007	7.28713508	1.92582757
2006Q4	5.76741711	3.26067108	7.355888451	1.92941893
2007Q1	5.75554329	3.22125448	7.342309662	1.92462383
2007Q2	5.75379364	3.15907603	7.302932424	1.92702799
2007Q3	5.76042022	3.15252199	7.27213101	1.92651394
2007Q4	5.81113043	3.23170929	7.39793472	1.93533929

(SSB, 2024f; SSB, 2024e; Norsk Petroleum, 2024c; SSB, 2024d)

A.2 Dataset 2, 2010-2023

Quarter	Log_GDP	Log_Price	Log_Price_Dummy	Log_Volume	Log_Volume_Dummy	Log_CPI
2010K2	5.80481387	2.12642765	0	7.395609284	0	1.9653585
2010K3	5.79798246	2.17331347	0	7.266508436	0	1.9622114
2010K4	5.84454179	2.24048874	0	7.460016761	0	1.9664546
2011K1	5.84169726	2.24967271	0	7.457340544	0	1.9687942
2011K2	5.8322016	2.25566917	0	7.279959438	0	1.9715851
2011K3	5.83787682	2.29384125	0	7.331617554	0	1.9686386
2011K4	5.87356065	2.26873086	0	7.431791328	0	1.9700368
2012K1	5.88383796	2.2660531	0	7.494334647	0	1.9723571
2012K2	5.86408488	2.26106634	0	7.405820057	0	1.9732818
2012K3	5.85365137	2.27400033	0	7.35971486	0	1.9701919
2012K4	5.88793615	2.30000767	0	7.4686791	0	1.9752786
2013K1	5.87668942	2.29177723	0	7.439862851	0	1.9777236
2013K2	5.88300467	2.30165607	0	7.399639471	0	1.9816676
2013K3	5.87875554	2.32170438	0	7.363805501	0	1.9830246
2013K4	5.91236396	2.35757641	0	7.440386158	0	1.985127
2014K1	5.90390569	2.28521037	0	7.447161889	0	1.9867717
2014K2	5.88954652	2.18540772	0	7.363156466	0	1.9897464
2014K3	5.88505518	2.25095982	0	7.340359187	0	1.9922589
2014K4	5.91242241	2.29174667	0	7.475910692	0	1.9938769
2015K1	5.89429723	2.27612702	0	7.471113084	0	1.9951963
2015K2	5.89457855	2.24166291	0	7.371659518	0	1.9992756
2015K3	5.88481801	2.25051296	0	7.433634895	0	2.0008677
2015K4	5.90020485	2.19891881	0	7.489910532	0	2.0046079
2016K1	5.87742318	2.07587943	0	7.494996904	0	2.0087421
2016K2	5.89365082	2.10921262	0	7.428006116	0	2.0141003
2016K3	5.87404789	2.11907517	0	7.346688539	0	2.0178677
2016K4	5.9195451	2.22348071	0	7.486551693	0	2.0198084
2017K1	5.92425809	2.2042508	0	7.493808282	0	2.0198084
2017K2	5.90881089	2.16035258	0	7.430789553	0	2.0231152
2017K3	5.90010374	2.18204554	0	7.461985496	0	2.0243488
2017K4	5.94350391	2.27033317	0	7.495808856	0	2.0255789
2018K1	5.93871031	2.23502325	0	7.485145303	0	2.0284357
2018K2	5.94712039	2.31647452	0	7.436433398	0	2.0334238
2018K3	5.94028134	2.38082893	0	7.451402849	0	2.0383552
2018K4	5.97832161	2.35796691	0	7.476277158	0	2.0399426
2019K1	5.95983671	2.22651252	0	7.507438749	0	2.0412611
2019K2	5.94581559	2.06317869	0	7.465037599	0	2.043886
2019K3	5.93353588	2.12044759	0	7.374498711	0	2.0454534
2019K4	5.97518679	2.17533826	0	7.478435841	0	2.0468852
2020K1	5.95688893	1.94927615	0	7.492565388	0	2.046235
2020K2	5.90578509	1.78957407	0	7.409504397	0	2.0488301
2020K3	5.92104731	2.03603951	0	7.426259607	0	2.0521807
2020K4	5.96252181	2.23873231	0	7.460694804	0	2.0524374
2021K1	5.97433112	2.27064908	0	7.463680416	0	2.0589319
2021K2	5.98621396	2.44597912	0	7.411927424	0	2.0609495
2021K3	6.0295599	2.81302953	2.813029527	7.450148762	7.450148762	2.0670709
2021K4	6.12779555	2.87907671	2.879076707	7.506244973	7.506244973	2.0721273
2022K1	6.1296435	3.01014762	3.010147624	7.489766518	7.489766518	2.0751819
2022K2	6.12516788	3.05274339	3.052743391	7.475341668	7.475341668	2.0855284

2022K3	6.1980525	3.31764528	3.317645285	7.486650503	7.486650503	2.0954018
2022K4	6.1609173	3.07872873	3.078728734	7.509839527	7.509839527	2.1000257
2023K1	6.12511578	2.74510375	2.745103752	7.506628944	7.506628944	2.1030051
2023K2	6.08776439	2.60010013	2.600100133	7.422058892	7.422058892	2.1128283
2023K3	6.0800403	2.60218218	2.60218218	7.412648421	7.412648421	2.114611
2023K4	6.13622354	2.67724601	2.677246006	7.518060128	7.518060128	2.1192559

(SSB, 2024f; Investing.com, 2024; Norges Bank. n.d.b.; Norsk Petroleum, 2024c; SSB, 2024d)