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The Impact of Oil Price on the Housing Market: A Case Study of Stavanger

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Foreword

We are pleased to present our master's thesis, which marks the completion of our master's degree in Business and Administration with a major in economics at the University of Stavanger Business School.

We would like to express our gratitude to our supervisor, Anders Åkerman, for his guidance and support throughout the research process.

Abstract

Our master thesis investigates the intricate relationship between the price of oil and the housing market in Stavanger. Our thesis is motivated by the impact of oil on the region's economy, and its potential impact on the housing market. Stavanger, known as the oil capital of Norway, provides a unique context for this study, making it an ideal location to explore the intricate interplay between the oil market and the housing sector.

This leads us to our research question;

How does the oil price affect the housing market in Stavanger?

To try to answer our research question, we will use quantitative research. Our data consists of 64 observations from the 1st quarter of 2006 to the 4th quarter of 2022. Variables we have included are the House Price Index, Brent Crude Oil Price, House Stock, Policy Rate, Median Income, and Unemployment Rate for Norway and Stavanger. Using a first-difference multiple linear regression analysis, we test for differences in a model including and excluding oil price as a variable and look for differences in a national average for Norway compared to Stavanger.

Our results show a statistically significant impact of oil prices on housing prices in Stavanger and Norway. Still, the oil price has a higher correlation with the house prices in Stavanger, supporting our hypothesis. Our regressions show signs of multicollinearity, and some model variables showed no significant impact on housing prices. This indicates that our model has omitted variables.

To conclude our research, we found evidence of oil impacting the housing prices in Stavanger, but further research needs to be done on the topic as our models show signs of inaccuracies.

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1.0 Introduction

The primary objective of our research is to investigate the potential influence of a change in oil prices on the housing market in Stavanger. Given that Stavanger is a major hub for the Norwegian oil industry, we also aim to compare housing prices in Stavanger with the national average to identify any disparities. This brings us to our research question;

How does the price of oil affect the housing markets in Stavanger?

The motivation behind our research is to gain a deeper understanding of the housing market in Stavanger's dependence on the oil industry. By examining comparable and analyzable data, we aim to establish a clear connection between the oil industry and the local region's growth. This study will try to provide valuable insights into the extent Stavanger relies on the oil industry for its economic development.

To begin, we will explore existing theories and research regarding the determinants of housing prices. We use quantitative data to employ a first-difference multiple linear regression model incorporating oil prices as a variable. We will test our variables for inconsistencies and irregularities to validate our analysis. Furthermore, compare our equations, including and excluding the oil variable for Stavanger and Norway.

Through this analysis, we will conclude whether oil prices significantly impact housing prices in Stavanger.

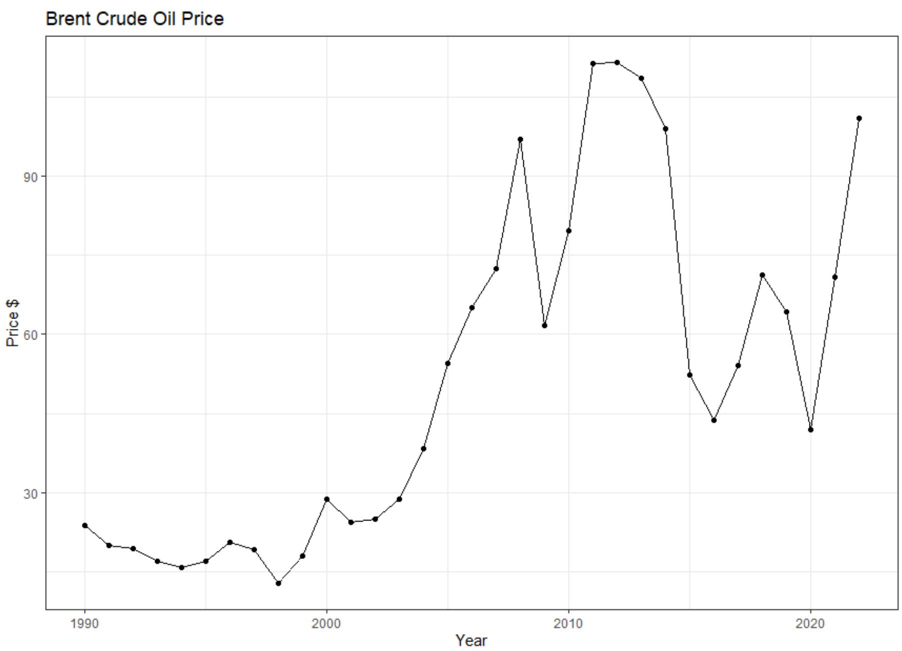
2.0 Theory

This thesis is part of a larger field of research within macroeconomics, housing markets, and resource economics. By interpreting and applying theory to the oil and housing markets, we can understand and utilize it in our regression analysis.

2.1 The Oil Market

The graph in Figure 1 shows that the oil price has fluctuated over the past decades. Simplified the oil price is a result of supply and demand. Nevertheless, there are historical events that have significantly shifted its place of equilibrium. Worth mentioning examples is the increase from 2001- which is linked to the Iraqi war, instability in the middle east, and Venezuelan oil workers' strike. Furthermore, in 2008, the downfall was associated with the financial crisis. Hamilton (2009) suggests that all major fluctuations in oil prices are related to disruptions in oil production flow caused by political events in the middle east. Contradicting Hamilton, in Kilian’s (2009) research, he found that the data for political events in the middle east frequently does not fit and has little predictive power for the change in oil price. Both Hamilton and Kilian’s research proposed measures of exogenous oil supply shocks. However, from another research from Kilian (2014), exogenous oil supply shocks only explain at most 25% of the oil price change, and shifts in demand for oil must explain the rest.

Figure 1



Compared to other commodities, the oil price is still widely considered stable, analyzed by Gong, Guan, Chen, Liu & Fu (2021). Driving factors that affect the price of oil are global demand, supply, economic conditions, geopolitical events, and governmental policies. Geopolitical events can disrupt supply long term. A recent example is the Ukrainian conflict and the trade sanctions on Russia. More short-term events can cause distributional bottlenecks from a mismatch in supply and demand, causing short-term volatility researched by Brook, Price, Sutherland, Westerlund & André (2014). Global economic conditions refer to conditions such as inflation, interest rates, and currency fluctuations. Governmental policies refer to monetary and fiscal policies limiting and enhancing oil trade.

On the supplier side, the biggest market force is The Organization of the Petroleum Exporting Countries (OPEC), which produces around 40% of the supply of crude oil and approximately 60% of petroleum traded internationally (EIA, 2023). Berk & Çam (2020) concludes that OPEC was a stabilizing factor for the oil price in an unstable time. For our research, Norway's oil production is key to understanding. Norway is Europas's largest crude oil producer and the world's third-largest exporter of natural gas (EIA, 2023). Norway produced in 2022 roughly 615 billion barrels of crude oil, illustrated in Appendix 1, which from the yearly average price, comes to approximately 62 trillion dollars. This makes petroleum the largest industry in Norway based on value creation, government revenues, investments, and export value (Norwegian Petroleum, 2023). From Hungnes, Midttun & Strøm's (2022) research, we also find there are 164 000 directly or indirectly employed in the oil industry in Norway, implying a cluster effect. Still, comparable to OPEC, Norway is a small independent competitor to the overall supply of oil and has a lesser impact on the crude oil price.

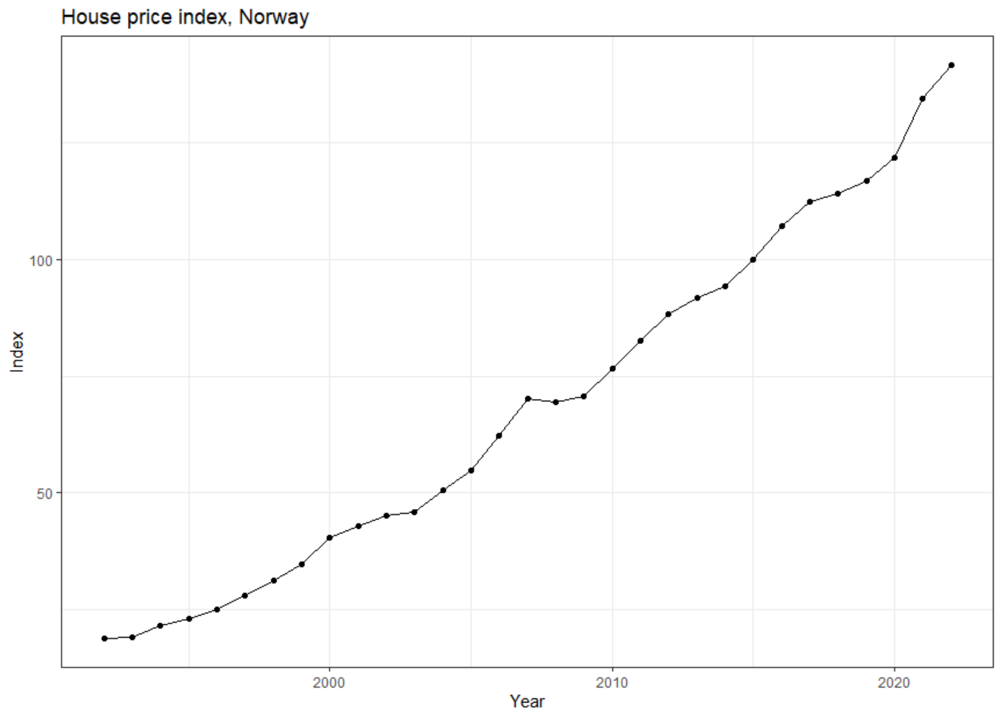
More important for our hypothesis is the factors oil price affects. From Gong et al. (2021), the oil market affects fields in economic activity, government spending, stock options, and monetary and fiscal policy. As for the impact on the housing market, Alquist, Ellwanger & Jin (2020) names crude oil as a strategic commodity whose price mechanism has become a primary concern and plays a crucial role in economic growth. As an example from Su, Huang, Qin & Umar (2021), a high oil price causes inflation, high production costs, and low real income and profits, and thus hinder economic growth. Oil plays an important role in the overall economic system (Amihud & Wohl, 2004), and it is why we chose it as an independent variable to explain our hypothesis.

2.2 The Housing Market

Represented in our House Price Index graph for Norway, Figure 2, the housing market has steadily increased, close to linear. The consistency and low variance are explained by the following; “When bad news occurs in the housing market during the previous period, the conditional variance of price returns in the current period decreases. Thus, housing prices exhibit a more stable reaction to bad news.” (Tsai, 2013, s. 412). Tsai used the loss aversion behavior of traders to explain this phenomenon and inferred that downward housing price rigidity could result in an asymmetric relationship between macroeconomic variables and housing prices.

The only negative year for our housing price index is in 2008, which is related to the global financial crisis. One of the catalysts for the financial crisis was the housing price bubble in the United States of America (USA). Mcdonald and Stokes (2013) found in their findings that the interest rate policy of the United States Federal Reserve, which pushed down the federal funds rate and kept it artificially low, was a cause of the housing price bubble. Other factors widely agreed to be a result of the housing price bubble is the increase in subprime mortgages with adjustable interest rates and mortgage-backed securities.

Figure 2



Comparing Norway and the USA, the financial crisis affected Norway significantly less, with the USA's unemployment rate doubling from 5 to 10% (FRED, 2023) during the crisis, and Norway had an increase from 2,6 to 4% (SSB, 2023). This can be explained by differences in monetary and fiscal policy. As demonstrated by Stein (1995), higher debt significantly increases the volatility in the housing market.

The housing market is complex, where multiple factors play a part in setting the market price for previously used housing. Factors could often be intercorrelated as when one increases, it indirectly impacts other factors.

We look at several different previous works in this field to determine which factors are important to include in our work. In Engle, Lilien, & Watson's (1985) work, they find factors such as inflation, nominal interest rate, and tax policy as the most important factors in determining prices in the used housing market. They also consider rental inflation as an important factor. Another study finds that the price of land has played an essential part in the long-run trends for house prices (Knoll, Schularick, & Steger, 2017). In comparison, Jacobsen & Naug (2004) finds that variables such as housing stock, policy rate, unemployment rate, income, and lending policy have explanatory value regarding housing prices.

A study by Lipscomb (2003) investigated the impact of airports and local infrastructure on housing prices in small cities in the USA. The results of the work show that the effects of noise and being in close proximity to MARTA services or schools are negligible on the selling price of houses. It also suggests that the value of having a local airport to the housing market outweighs the negatives, such as increased noise pollution. Wen, Xiao, Hui, & Zhang's (2018) work finds that educational opportunities also affect housing prices in China. They find that the quality of primary and junior high schools and local universities significantly affects housing prices. Wu, Yu, & Wang. (2018) finds that water resources positively affect the growth in housing prices.

Case & Mayer (1996) investigated which factors had an impact on the housing market. They found that sectoral employment, demographics, and supply shifts had effects on the prices. Another conclusion they came to is that low-priced houses had less variance compared to high-priced homes in the real estate cycle. Another study showed that poorer neighborhoods bordering richer neighborhoods had higher appreciation in house value compared to poorer neighborhoods that did not have these neighboring areas (Guerrieri, Hartley & Hurst, 2013). Another factor in the housing market is neighborhoods. Jarocinski & Smets (2008) found that housing demand shock and monetary policies in the US significantly affect house prices and housing investment.

Another study investigates previous work regarding consumers' willingness to pay for housing regarding environmental goods such as air quality, water quality, and toxic sites. They find that most work in the field of air quality has a statistically insignificant coefficient on housing prices. The factor of water quality has a consistently correct sign for the coefficient with statistical significance to housing price. The distance to toxic sites is also mainly with the correct signs and has statistically significant coefficients, while the dollar value to distance varies quite a bit (Boyle & Kiel, 2001).

This brings us to the next part, where we will explain the variables we find most important and will be used in our work. As seen above, the significance of the various independent variables is debated. The most common factors that have an impact are housing stock, demographics, unemployment rate, and the governing policy rate.

2.2.1 Housing Stock

The variable of housing stock plays a part in understanding why prices fluctuate. The variable is the supply of housing in the market. However, this variable changes slowly as it takes time to raise new housing. This results in shocks only having a long-term impact on investments.

When prices for housing increase, this would, by the law of supply, increase investments in new buildings, and if supply increases too much, the result would be cheaper housing. New housing has an effect on used housing, as most people tend to sell their previously owned residence when moving to a newly built residence. Should the housing stock not increase as much as demand, the result would be an increase in the price of both used and new housing, and vice versa. The variable is, therefore, a complex variable that changes slowly over time, with different effects on price.

2.2.2 Demographics

We have several variables, such as income, age, and family size, which impact the housing market differently. We have labeled these as the demographics of the population. They all play a part in making the market's price, such as the age factor often impacts which type of housing one is looking for. Younger and older citizens more often buy apartments, while people in their 30s with a family might need to upgrade from apartments to houses. Both age and family size impacts demand in the market. Income affects both location and size of one purchase as it is one factor that determines how much money people can borrow. Holly & Jones (1997) finds in their work that income is the single most important determinant of real house prices. We have chosen to use the variable median income in our work to represent demographics in our model.

2.2.3 Unemployment Rate

The following variable we focus on is the unemployment rate, which determines people's ability to purchase homes. Employment is key for people's ability to repay loans and ability to acquire loans. When the unemployment rate is high, many households may face financial difficulties and struggles to pay for everyday goods and sometimes even their mortgage. Thus, some people must sell their homes and move to cheaper, more affordable housing. Therefore, when the unemployment rate is low, demand for housing should increase as more people have a stable income. Should the opposite occur, demand for housing will decrease as people do not have the stable income required to acquire housing and pay mortgages. Therefore, fluctuations in the labor market have significant effects on the housing market, making it an important variable for the demand for housing and pricing.

2.2.4 Policy Rate

Policy rate is the rate banks pay to borrow money from the governing central bank, which in turn affects the rates banks will lend to households and businesses. When the policy rate is low, mortgages become more affordable and easier to obtain, and vice versa, should the policy rate increase. When the policy rate is low, the demand for housing will increase, and subsequently, prices will increase. Should the policy rate increase, the interest rates on mortgages would increase, thus, resulting in more expensive mortgages decreasing the affordability for people and reducing the demand for housing. The policy rate also affects developers' and builders' decisions to what extent they invest in new housing. When borrowing money costs lower, they have a higher incentive to invest and resell their project since the demand would be higher.

The central bank adjusts the policy rate as a tool in its monetary policy. They can use this tool to either help a struggling economy by lowering the policy rate, making it cheaper to borrow money, and therefore making it cheaper for businesses, investors, and individuals to invest. The central bank also increases the policy rate if there is an economy with too much purchasing power and inflation is rising. Increasing the policy rate ultimately reduces purchasing power and slows down an economy that is growing too fast.

2.2.5 Other factors

We have focused our attention on the key factors mentioned above. We find these as key indicators for housing prices. However, we acknowledge that there are more factors impacting the housing market. There is the presence of secondary markets and cluster effects in the industry, but we find that these are encompassed within the broader economic variables we discuss. Other factors we considered are population, quality of infrastructure, material costs for building, and house-specific variables such as bedrooms, floors, acreage, and build year. We find that these variables are, as mentioned, encompassed on a larger scale in our other variables, and therefore, we do not isolate and analyze these elements in our approach.

3.0 Method

To answer the research question, we have chosen to use a quantitative method. As such, we use pre-existing statistical data and manipulate it to fit our time frame. Based on previous research, we have decided to use an altered version of Jacobsens & Naug's (2004) multiple linear regression formula to check if any of the suggested variables in the theory part can be proven to affect the prices in the housing market. This is a least square regression method with the goal of minimizing the offsets of residuals. We use this method to predict how the independent variables respond to a one-unit increase in the dependent variable.

3.1 Regression model:

This chapter reviews our regression formula based on the variables we chose to explain our model. To answer our question, we use a first-difference multiple linear regression model. In our work, we have quarterly changes in HPI (housing price index) as the dependent variable. This is because we want to explore whether our other variables increase or decrease when HPI increases. The explanatory variables in our formula are the quarterly changes in the policy rate, labeled R, unemployment rate, labeled UR, housing stock, income, and price of Brent crude oil.

We first want to test our model to see how it responds without the price of Brent crude oil. We, therefore, first gain a formula with all aforementioned variables except the price of Brent crude oil.

Formula 1

$$\Delta HPI = \beta_0 + \beta_1 \Delta R + \beta_2 \Delta UR + \beta_3 \Delta Housing\ stock + \beta_4 \Delta Income$$

We use Formula 1 on both Stavanger and Norway separately, with variables such as R and housing stock being national numbers, equal to both locations. While other variables depend on whether we investigate Stavanger or Norway, for Stavanger, these are labeled income Stavanger, UR Stavanger, and HPI Stavanger. For Norway, it is the same variable labeled as Norway. For simplicity, we write these variables in the formula as the name of the variable without the location behind it.

However, we are not only interested in the pure model, and we want to investigate whether or not there is a link between the price of oil and housing in Stavanger with our other variables, using Norway as a benchmark for our results. We add another part to the same regression from Formula 1 to do this. The variable we add is the price of Brent crude oil. The same logic above regarding the location for the variables, Stavanger and Norway, applies to the following formula.

Formula 2

$$\Delta HPI = \beta_0 + \beta_1 \Delta R + \beta_2 \Delta UR + \beta_3 \Delta Housing\ stock + \beta_4 \Delta Income + \beta_5 \Delta Oil$$

With Formula 2 we want to investigate our research question, and this is where our formula diverges the most from the house price model from Jacobsen and Naug (2004)

With these two formulas we then run several multiple linear regression using R as our statistical language model. We conduct a total of four regressions, two for Stavanger and two for Norway, with both our formulas. One weakness of these formulas is that they are initially made for looking at a country rather than individual cities. There might also be other variables than those we have in the formulas with explanatory value to our dependent variable.

The results from these multiple linear regressions give us coefficients on each explanatory variable with their relationship to our dependent variable, HPI. We will first compare the regression results from Formula 1 without oil as a variable with both our locations and investigate the pure model. These coefficients give us information on how much the dependent variable increases or decreases should the explanatory variable increase by one percentage point. We also look at the significance level of each variable in regards to the 10%, 5%, and 1% to check if they are statistically significant regarding their explanatory power.

Afterward, we do the same with our regressions with the oil variable added. Here we are most interested in whether or not the price of oil will give us a statistically significant result for Stavanger and, if so, how it would be for Norway. We will also see if the new variable changes anything for our other variables.

3.2 Correlation

Based on our theory and variables, we suspect that there is a natural correlation between some of our variables. For instance, it makes sense that should oil prices fall significantly, layoffs would follow in the sector, reducing household income if a person in the said household were laid off. This could have a butterfly effect on the entire housing market should one variable change much. A natural correlation we predict is that several of our variables capture the market effect. For instance, when there is global economic growth, we expect to see variables such as policy rate, unemployment rate, and oil price change with it.

We will create a correlation matrix to investigate if our variables are correlated. We make two matrices to answer this, as we are not interested in how Stavanger's variables correlate with Norway's. With these two, we hope to gain more insight into our data and whether we should worry about this.

3.3 Model Diagnostics

To validate our hypothesis, we will perform diagnostics on our model to check if our model includes any errors or biases we should be concerned with.

Firstly we will test our regression model for multicollinearity. If our model contains multicollinearity through a high variance inflation factor, it can invalidate the explanatory value of our variables and skew the results.

Secondly, we will check if our observations are similar to what the model estimates the observations to be using normality tests. This includes the Kolmogorov-Smirnov, Shapiro-Wilk, Cramer-von Mises, and Anderson-Darling tests. From these, we can see if, purely by chance, we would observe a difference by comparing the observed distribution of residuals with the normal distribution. We test for normality because if the residuals are not normally distributed, the dependent variable or at least one of the explanatory variables may have the wrong functional form, or our model is missing important variables, resulting in a model deficiency.

The next test is for residuals regarding heteroskedasticity. We check using the Breuch-Pagan test to see if the variance is not equal through the range of measured values. Heteroskedasticity could result in an invalid analysis since our regression model assumes homoscedasticity. Checking our model for heteroskedasticity is important because it could show us an inefficient regression model, which can give us bizarre and unstable future predictions later on.

Lastly, we will test for outliers to look for abnormal observations that could affect our regression outcome. We can see potential outliers using Cook’s D chart and consider if they need to be modified to improve our regression's validity.

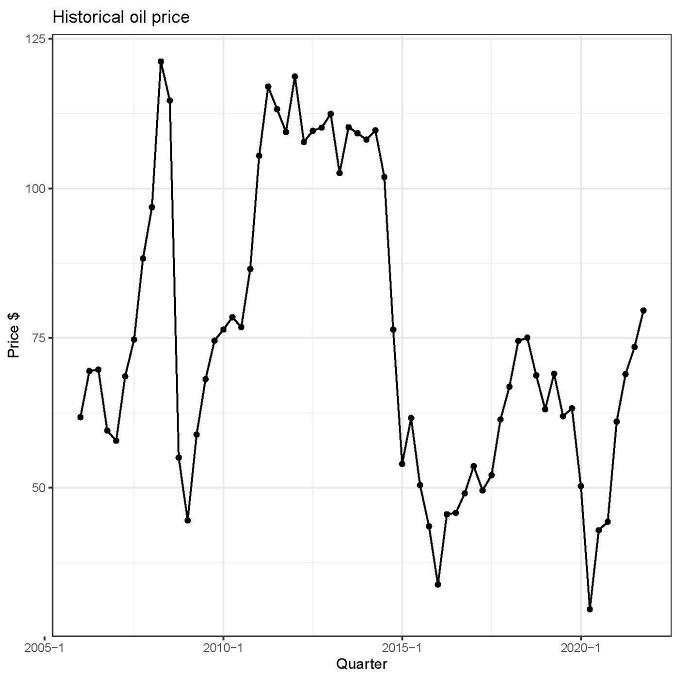
4.0 Data

To answer our research question, we need data on our variables. The data we have collected is secondary data from different governmental institutions, which would make the data reliable regarding our work, as the same data is used in policy processes.

4.1 Data Source

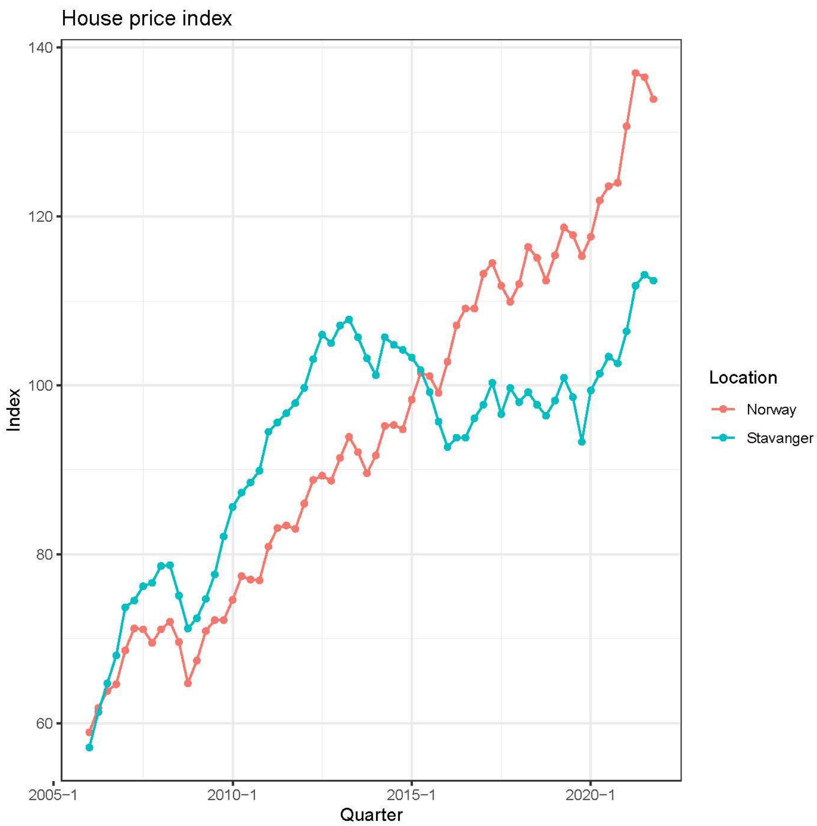
Most of the data we have collected are from Norwegian governmental sites, except the price for Brent crude oil, which is collected from FRED (2023), one of the most comprehensive databases in the world. We collected daily oil prices measured in USD from January 2006 to December of 2021 and then turned these into quarterly averages. When looking at Figure 3, during our time frame, there is a noticeable fluctuation in oil prices. From the highest observation before the recession of 2008, the oil price crashed and did not recover until the period from 2011 to 2014 before plummeting again in 2015 and early 2016. After these events, it started to stabilize again, with prices between 50 and 75 USD, before the corona pandemic appeared with much uncertainty and shut down a large part of the economy on short notice in late 2019 and early 2020. Since then, it has steadily increased to our end of data in December of 2021.

Figure 3



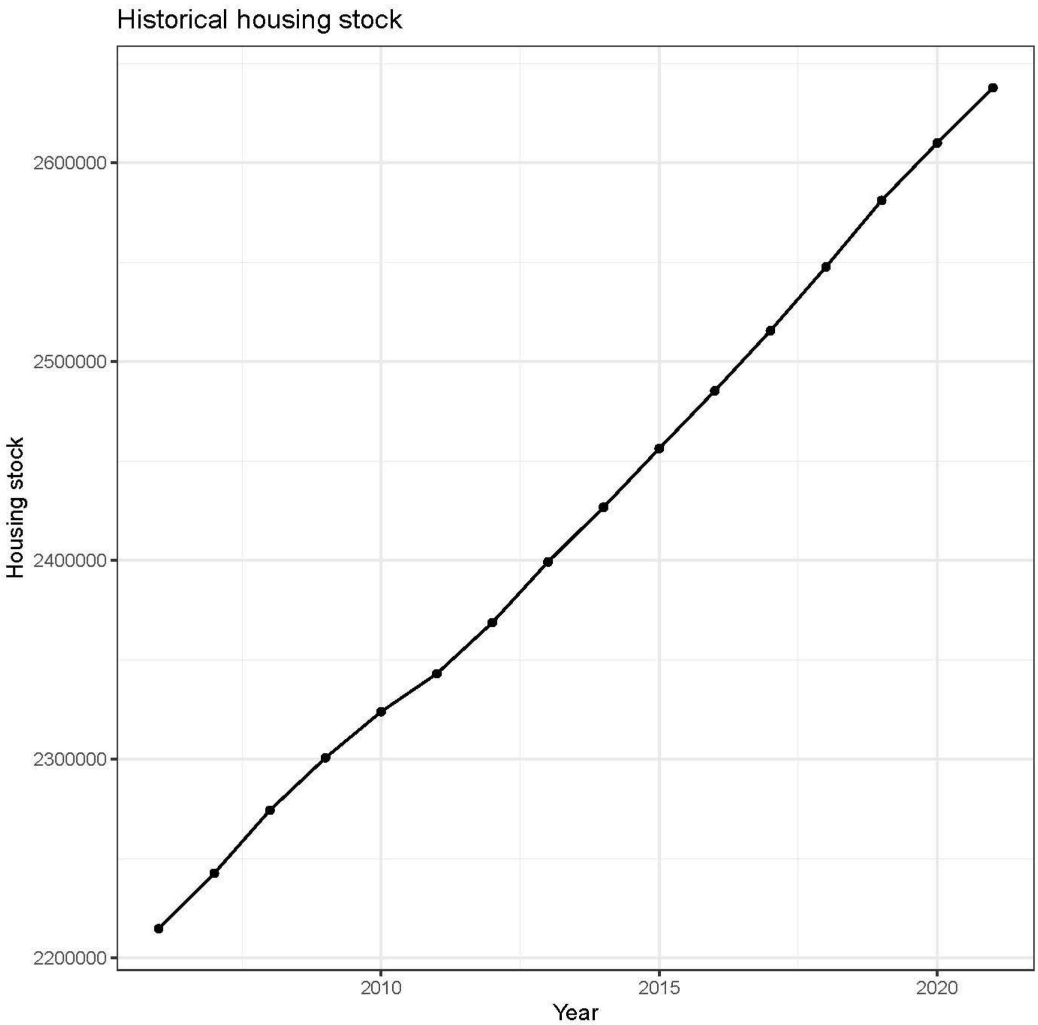
The data for the house price index (See Figure 4), Price for existing dwellings, by type of building and region (2015=100), are retrieved from Statistics Norway, a governmental statistics collection agency, which tracks population, economy and society statistics in Norway (SSB, 2023). We have used data for both Norway and Stavanger to do our analysis. The data is reported in quarterly observations over the years 1992 to the first quarter of 2023. However, due to the limited data collection in the region of Stavanger, there were no observations before 2005. Looking at the graph in Figure 4 below, we see that the price increased more in Stavanger from the beginning of our time series to the first quarter of 2015. Afterward, the national average began to increase in price at a steeper rate than Stavanger, who experienced a decrease in housing values. Stavanger needed a few years to recover from the "oil crisis" of 2014, where many companies laid off staff. Resulting in the demand for housing decreasing and, ultimately, the price of housing (Wig, 2021).

Figure 4



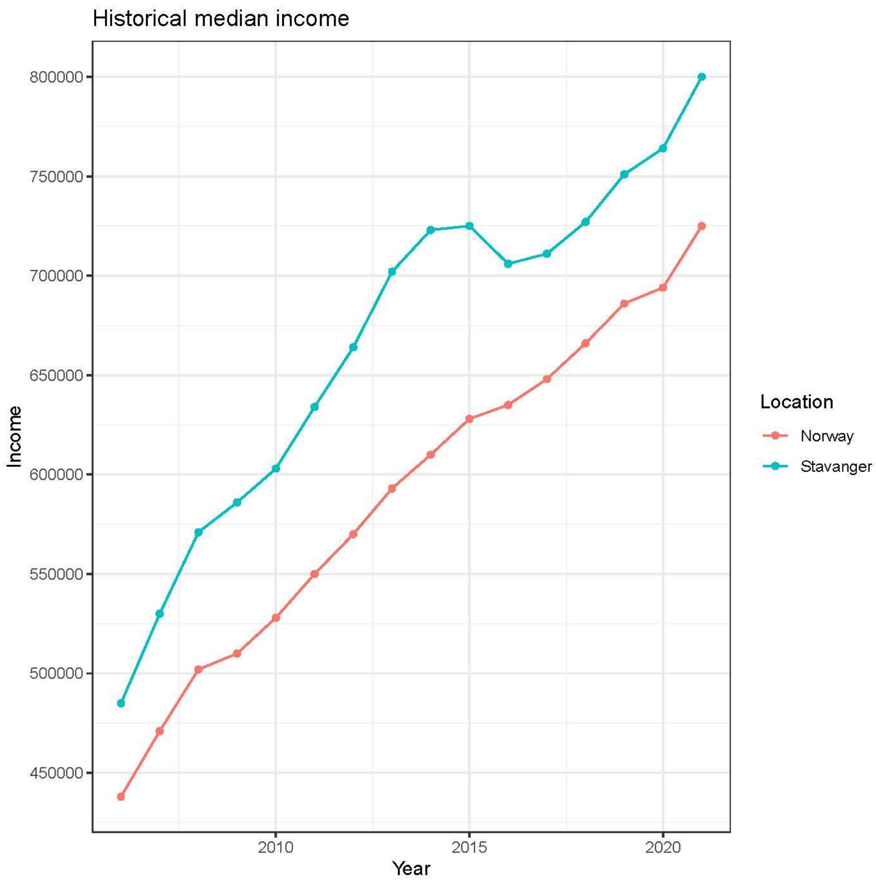
Statistics Norway has a dataset on the housing stock in Norway (See Figure 5), where the data is from 2006 to 2023. However, the dataset only contains yearly observations from this period. In contrast, most of our dataset is being reported quarterly or monthly. However, as seen in Figure 5, the housing stock increases steadily and almost by the same amount each year. Therefore, this is a very stable variable that has not historically experienced extreme shocks in our time frame.

Figure 5



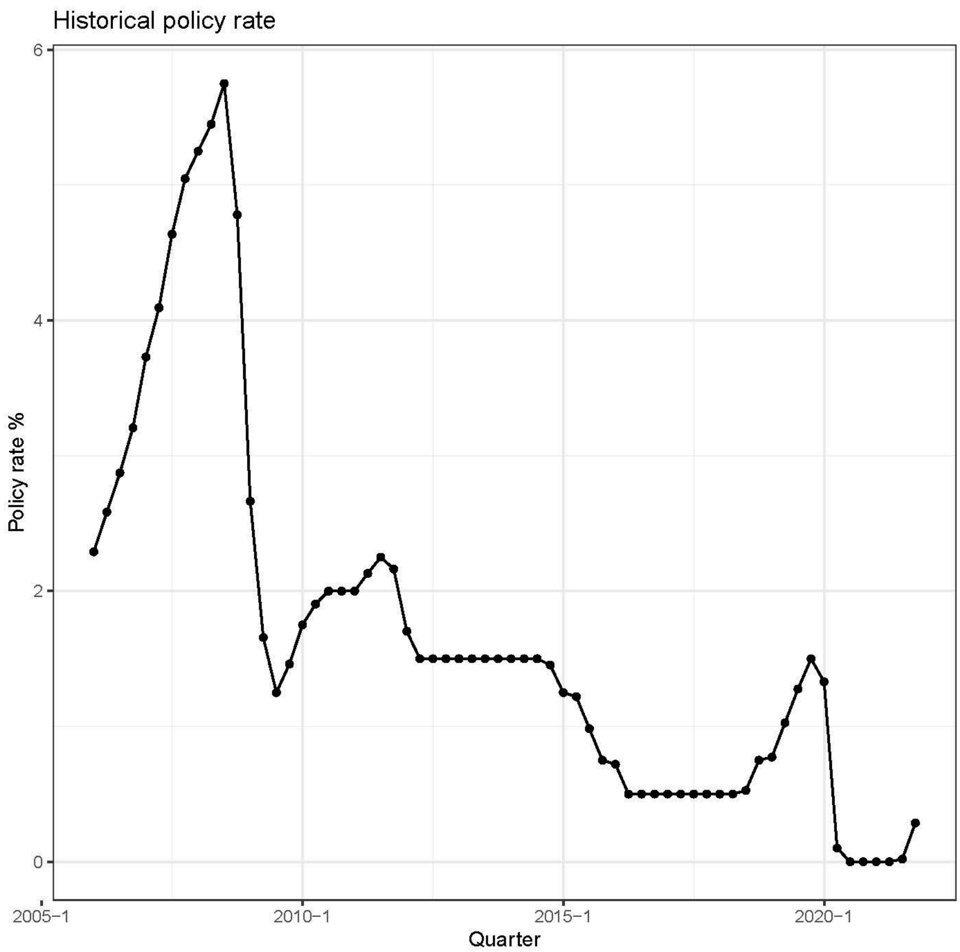
The variable median income given as NOK is also retrieved from Statistics Norway ranging from 2005 to 2021, with yearly observations (See Figure 6). For this data, we also have two locations, one for Stavanger and one for Norway. Stavanger has a higher median income in every yearly observation when compared to Norway. Given that Stavanger is the oil capital of Norway, we assume that a large part of this is due to the oil businesses and related industries, such as manufacturing and service businesses specifically focused on the oil industry. A large population works directly or indirectly in companies that are involved with oil. Another interesting observation when compared to the oil price is that when the price of oil started to go down in late 2014 and 2015, the median income was also affected in Stavanger, as we saw by the movement from 2015 to 2016, while there was still an increase in Norway. This could suggest that Stavanger is more dependent on oil and indicates that a large population works directly or indirectly in the industry.

Figure 6



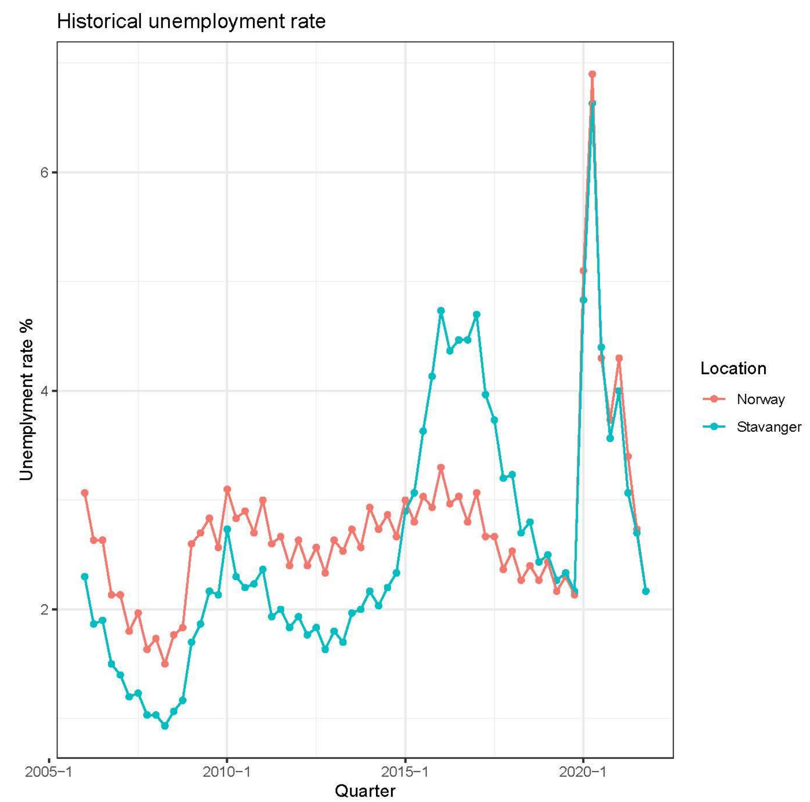
The policy rate is retrieved from Norges Bank, the Norwegian central bank, which is also the governing institution for the policy rate. The data is available in yearly, monthly, and daily numbers, so we collected the monthly data on the policy rate for our work ranging from January of 2000 to March of 2023. We then make quarterly averages of the individual months. Figure 7 shows a graph of the policy rate from our time frame. In these observations, the policy rate has been relatively stable in Norway from mid-2009 to 2021 and has almost exclusively been below 2%. However, before 2008 and the recession, the government increased the interest rate to nearly 6%. This was done in an effort to reduce purchasing power amongst the population.

Figure 7



NAV (2023), the governmental labor and welfare organization, collects more detailed information on the labor market than Statistics Norway, which is why we have chosen to use their data for the unemployment rate in Norway and Stavanger (See Figure 8). The data available is monthly numbers from 2004 to 2021, given in the total number or as a percentage of the workforce. We decided to use the unemployment rate as it would be more indicative of the percentage change in unemployment rather than a total number with little to no context without numbers for the total workforce. Viewing our observations of the UR in Figure 8, we find some interesting trends in Norway and Stavanger. The first we observe is that the unemployment rate was particularly low prior to the recession in 2008, especially in Stavanger, before increasing in the following few years. It was stable in the following five years, with minor fluctuations in Stavanger and Norway. However, after the oil prices were reduced, as mentioned earlier in 2014, unemployment was higher in Stavanger the following year compared to the rest of Norway. While early 2020, it was the highest we observed in our time frame due to the corona pandemic when companies were forced to lay off employees due to the uncertainty of how they would operate in society on lockdown.

Figure 8



We have used the software environment R in our work. Here we first cleaned the data to simple data frames of each variable with time and observation. We then removed observations not within our scope of work and within our time frame merging all data frames into one clear and concise data frame. After this is done, we have 64 remaining observations from 9 variables. With the data for all variables collected, we then create a descriptive table to get a quick overview of the data and whether or not the data has any obvious outliers that can skew the results. Following this, we create the dataset of 63 observations with the difference between each quarter. Afterward, we started doing our work as described in the method.

4.2 Data Liabilities

We also find some liabilities in some of the data we have used. For instance, the two variables of income and housing stock only have yearly observations. We have turned these into equal quarterly observations for a given year. For income, this would have the effect that it misses seasonal dependent income, even though in Norway, the rule of thumb is that when getting a mortgage is five times yearly income, so it is the yearly income that affects the size of the loan and thus people's purchasing power. When we have divided this into four equal sizes, the numbers remain the same throughout the year, and therefore we will have less variation in our observations. The same goes for housing stock, but the changes throughout the year would be small, as seen in Figure 5 since it takes time to raise new buildings. Therefore, we find these variables as a minor liability for our data. Quarterly data can capture more shock effects in the market and how our variables react to a shock. It is important because a variable such as oil price fluctuates over a year. We also find some liabilities in the number of years available for our research, as we have used 2006 to 2021. While we would optimally have more years, variables such as housing stock only have numbers available after 2006 and the median income after 2021, which is why we have to limit our sample size of the other variables.

4.3 Descriptives

The descriptives of our data give us valuable insight into the distribution of our observations of variables. As seen in Table 1, we get an insight into our observations' mean, min, and max of our observations. This is interesting as we get the insight if the highs and lows are outliers compared to the average. For instance for the policy rate, the mean is much closer to the min point, suggesting that the policy rate has usually been low for our period. The same goes for the unemployment rate for both Stavanger and Norway. HPI, both for Stavanger and Norway, the mean is more centered between the min and max points. This makes sense as the prices usually steadily increase and rarely decrease. The price for Brent crude oil has a large difference between the min and max point, but the mean of the variables is close to what is considered the average price of oil, so neither min nor max has skewed that too much. Regarding the last two variables we presented in the table, housing stock and income, we do not want to spend too much time interpreting their descriptives given that these are yearly numbers made quarterly and have many equal observations.

Table 1 (Hlavac, 2022)

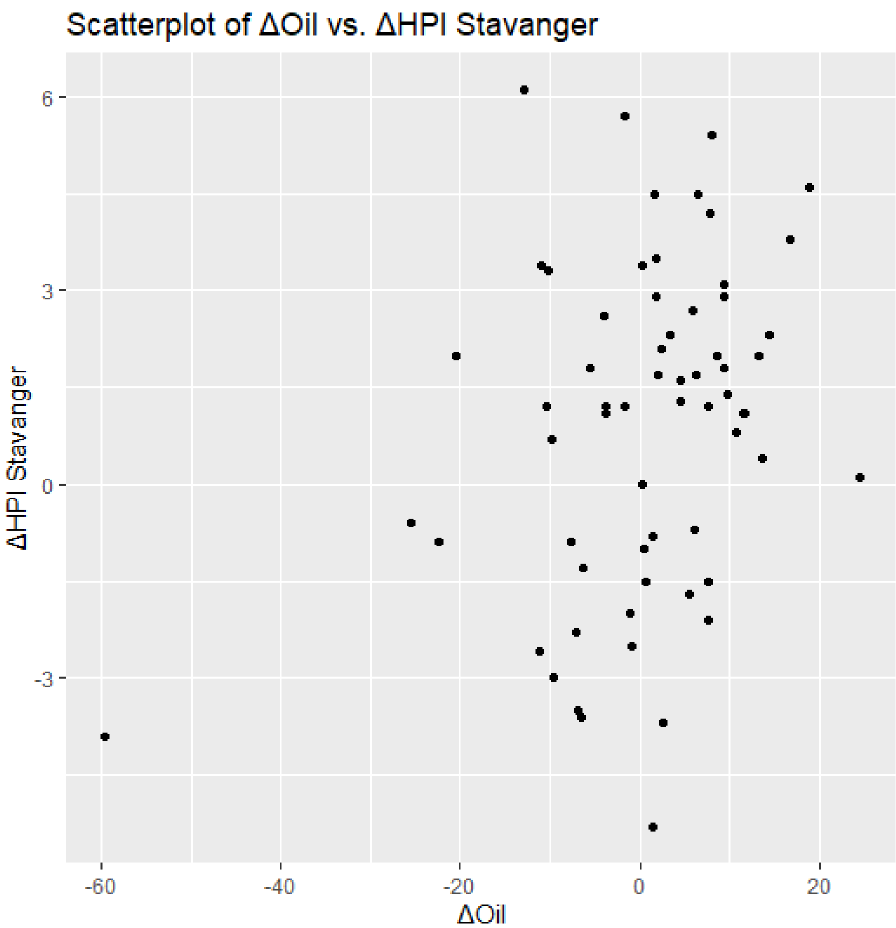
Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Max
R	64	1.689	1.427	0.000	5.750
UR Norway	64	2.736	0.805	1.500	6.900
UR Stavanger	64	2.572	1.153	0.933	6.633
HPI Norway	64	94.508	21.280	58.900	137.000
HPI Stavanger	64	93.055	13.407	57.100	113.100
Brent crude oil price	64	75.275	24.850	29.699	121.204
Housing stock	64	605,129.200	32,601.560	553,692.500	659,459.500
Income Norway	64	147,718.800	20,751.340	109,500	181,250
Income Stavanger	64	166,906.200	21,984.280	121,250	200,000

4.4 Scatter Plot of HPI Stavanger and Oil Price

This section will compare the individual first-difference observations of HPI Stavanger and Brent crude oil. We want to check if there is a trend or intuitive connection between an increase in the price of Oil and the HPI. Figure 9 shows that when the change in HPI is negative or zero, the oil price usually decreases or has a marginal increase. The marginal increase is always below 10$. However, when we check the largest increase in HPI, we see that oil decreases in value for this period. However, we find that the majority of our observations for both HPI Stavanger and Oil are either positive or negative at the same time, which further intrigues us to our analysis to check if there is a significant correlation between them or if it is a false impression.

Figure 9



5.0 Results

In this part, we present the results of our work. We start by presenting our regressions, providing oversight of the most important results. Afterward, we check the correlation to understand if there are any underlying issues with our data. Then we present our findings from our diagnostics, including different tests we used on the regression data.

5.1 Regression

5.1.1 Regression Stavanger - Formula 1

Firstly, we start by looking at our regression output from Formula 1, the house price model, more specifically for Stavanger (Table 2).

Table 2 (Hlavac, 2022)

Regression Stavanger

	Dependent variable:
	\`Δ HPI Stavanger\`
\`Δ R\`	0.263
	(0.823)
\`Δ UR Stavanger\`	0.049
	(0.607)
\`Δ Housing stock\`	-0.0001
	(0.0002)
\`Δ Income Stavanger\`	0.0004^{**}
	(0.0002)
Constant	0.631^{*}
	(0.368)
Observations	63
R^2	0.134
Adjusted R^2	0.074
Residual Std. Error	2.498 (df = 58)
F Statistic	2.248^{*} (df = 4; 58)
Note:	*p<0.1; **p<0.05; ***p<0.01

At first glance, we look at whether or not the model as a whole has the ability to predict the outcome of the dependent variable. As seen from Table 2, the R-Squared value for the house price model with our explanatory variables and dependent variable for Stavanger has a value of 0.134. The R-Squared is a measure that ranges from 0 to 1, with a higher number indicating that the explanatory variables have higher explanatory power and explains more of the variations in our dependent variable. Given our low R-Squared value, we suspect that we have some omitted variables that have explanatory power regarding the house price index in Stavanger.

When looking at our variables and their signs in front of the coefficients, we have assumed in advance that the policy rate should be negative. We would intuitively assume that should loans become more expensive with an increase in R and more scarce, the result would be cheaper housing in the market, as demand would decrease. We also assume that UR and housing stock are negative while income should be positive. Housing stock should be negative because an increase in new housing would decrease the value of older existing housing as supply would increase. UR should also be negative with an increase in HPI since we intuitively assume that should UR increase, the demand for housing would decrease, resulting in a lower house price index and vice versa. In our regression, we find surprisingly that R and UR are positive since we expect an increase in these to provide a decrease in demand and price. However, neither of these have statistically significant coefficients. The last two variables, Income and Housing stock, have the expected signs for their coefficient, yet only Income has a statistically significant effect at the 0.05 level. The coefficient for Income is 0.0004, which is relatively small but indicates a link between the income increase and the house price index. The reason for only one statistically significant variable could be that the model is intended to be used in the macro scale for countries rather than cities, with much more intricate variables to consider.

5.1.2 Regression Norway - Formula 2

Secondly, we will look at our regular HPI model for Norway (Table 3, see next page). The model for Norway has an R-Squared value of 0.231, which we still consider a low value, giving the same indications as previously. When investigating the sign in front of the coefficient, we find that R and UR are negative, as expected. While the signs for the coefficient for Housing stock and Income are positive, the only surprise is that Housing stock deviates from our expectations. However, none of our explanatory variables have statistically significant p-values, which means we cannot state that our variables explain the changes in the house price index nationally. One reason might be that house prices usually change slowly over time, and changes resulting from our variables increasing or decreasing, such as UR and R, could first be noticed some quarters later.

When comparing the two regressions based on Formula 1, the R-Squared is better in the second regression (Table 3), with an increase of almost 0.1. This would indicate that the second model has a higher explanatory power. However, when investigating it, we find that no variables have statistically significant values, which decreases the validity of their explanatory power. There are also differences in the coefficient signs, with the second regression being more in line with our previous assumptions. The only variable with the same sign is Income, which is only statistically significant in the first model (Table 2).

Table 3 (Hlavac, 2022)

Regression Norway

	Dependent variable:
	\`Δ HPI Norway\`
\`Δ R\`	-0.780
	(0.746)
\`Δ UR Norway\`	-0.310
	(0.522)
\`Δ Housing stock\`	0.0002
	(0.0002)
\`Δ Income Norway\`	0.0003
	(0.0003)
Constant	0.524
	(0.329)
Observations	63
R^2	0.231
Adjusted R^2	0.178
Residual Std. Error	2.203 (df = 58)
F Statistic	4.363^{***} (df = 4; 58)
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

5.1.3 Regression Stavanger - Formula 2

The third regression (Table 4, see next page) we did was for Stavanger with Formula 2. As previously, we first looked into the R-Squared. In this model, the value equals 0.199, still a low number, giving the same indications as previously. In this model based on Formula 2, we expect our sign for the coefficient to align with our assumptions made earlier. At the same time, the new variable we assume is positive for both Stavanger and Norway.

We find that the signs for the coefficients are as expected for Brent crude oil price and Income, which is positive and negative for R and Housing stock. More surprising is the fact that UR has a positive coefficient. We also get two statistically significant variables at the second level of 0.05: Income and Brent crude oil price. The coefficient for Brent crude oil price is 0.061. This indicates that should the price of Brent crude oil increase by one unit, the house price index for Stavanger would increase by 0.061. The fact that we find this statistically significant strengthens our hypothesis that oil impacts the housing market in Stavanger. The other significant variable, Income, has a coefficient of 0.0003, which indicates that it has a small impact on Stavanger's housing index. While we also would assume that this number should be low since an increase in only one unit in income is rare, the increase in income is usually a percentage of today's income. An increase in income would likely compound the coefficient of 0.0003 multiple times over, and the real change in HPI would be larger than what the coefficient tells us.

Comparing the two regressions for Stavanger (Table 2 & Table 4), the R-Squared increases from 0.134 to 0.199, indicating that the new variable of oil gives the model more explanatory power and predictive power. Another interesting point when comparing the regression is that the Policy rate goes from a positive coefficient to a negative one, which we expected from our theory. The variable of Income decreases from 0.0004 to 0.0003 in the second model but remains at the same statistically significant value of 0.05. We find that the second model has more explanatory value in regard to the house price index for Stavanger, based on the change from Formula 1 to Formula 2.

Table 4 (Hlavac, 2022)

Regression Stavanger	
	Dependent variable:
	`Δ HPI Stavanger`
`Δ R`	-0.224
	(0.830)
`Δ UR Stavanger`	0.390
	(0.610)
`Δ Housing stock`	-0.0001
	(0.0002)
`Δ Income Stavanger`	0.0003**
	(0.0002)
`Δ Brent crude oil price`	0.061**
	(0.029)
Constant	0.648*
	(0.357)
Observations	63
R^2	0.199
Adjusted R^2	0.129
Residual Std. Error	2.424 (df = 57)
F Statistic	2.833** (df = 5; 57)
Note:	*p<0.1; **p<0.05; ***p<0.01

5.1.4 HPI Norway Oil

The fourth and final regression model we have is for Norway with Brent crude oil prices as a new variable (Table 5, see next page). In this regression model, we get an R-Squared of 0.341, which would be categorized as a moderate value, indicating the model has some predictive power. Firstly we find by looking at the coefficient that policy rate, Income, and Brent crude oil have the expected signs, subsequently negative, positive, and positive. In contrast, Housing stock and UR have positive signs, which we did not expect. The only variables statistically significant are the R and Oil. The policy rate is within the significant level of 0.1, and Brent crude oil price is within the 0.01 level, which indicates that the relationship between Oil and HPI is unlikely due to chance. Their respective coefficients are R -1.341, and Brent crude oil price is at 0.073. This indicates that one unit increase in the Policy rate decreases the house price index by 1.341. Vice versa, should the Policy rate decrease by one unit, the HPI would increase by 1.341. This finding is in line with our expectations from the theory that more expensive mortgages would result in lower prices due to reduced demand. A one-unit change in Oil price would result in an increase in HPI by 0.073. The remaining variables are not statistically significant; therefore, we cannot state that they have a significant impact on the HPI on a national basis.

Firstly we want to compare the fourth regression with our second regression from Table 3. With the new variable added, the R-squared increases from a low value to a moderate one, indicating that the fourth regression has a more explanatory value. One key difference in the regressions is that the UR changes from a negative coefficient in Table 3 to a positive one in Table 5. In comparison, the remaining explanatory variables have the same positive and negative signs in front of the different coefficients. Another interesting part is that when adding the variable of oil, R goes from not being statistically significant to being significant at the 0.1 level, and the coefficient decreases from -0.780 to -1.341. This indicates that the variable Brent crude oil price has some effect on the house price index in Norway and helps explain how other variables interact with HPI.

Table 5 (Hlavac, 2022)

Regression Norway

	Dependent variable:
	\`Δ HPI Norway\`
\`Δ R\`	-1.341^{*}
	(0.721)
\`Δ UR Norway\`	0.041
	(0.501)
\`Δ Housing stock\`	0.0002
	(0.0002)
\`Δ Income Norway\`	0.0002
	(0.0003)
\`Δ Brent crude oil price\`	0.073^{***}
	(0.024)
Constant	0.551^{*}
	(0.308)
Observations	63
R^2	0.341
Adjusted R^2	0.283
Residual Std. Error	2.058 (df = 57)
F Statistic	5.886^{***} (df = 5; 57)
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Secondly, we compare the fourth regression from Table 5 with the third regression from Table 4. Here both regressions are based on Formula 2, where we will look at similarities and differences between these. The R-Squared is lower in the third regression at 0.199, while it is 0.341 in the fourth regression, indicating that our model fits better with the national data. A difference in the models is that Housing stock has a negative coefficient in the third regression, as we expected, while in the fourth, it is positive. The variables UR, Income, and Brent crude oil price have positive coefficients in both models. In contrast, R has negative coefficients in both regressions.

However, in regard to which variables have statistically significant values, there are some differences. In the third regression for Stavanger, Income is statistically significant at the 0.05 value but is not significant in Norway. In the fourth regression, the Policy rate is significant at the 0.1 value in Norway and is not significant in Stavanger. Similarly, in both regressions Brent crude oil price is statistically significant at the 0.05 and 0.01 levels. In the third regression for Stavanger, the variable is the least significant at 0.05, while for Norway, it is at the 0.01 value. The fact that the policy rate is only statistically significant at the national level when oil is added indicates that a combination of both oil and policy rates has an effect on the house price index in Norway. For Stavanger, Oil price and Income impact the house price index the most. Our interpretation of these results is that even though oil affects both locations, the policy rate only affects the national level. Due to this fact, we assume that oil plays a larger role in the local HPI for Stavanger.

Based on these four regressions, we have found that our model has some flaws regarding the variables and their explanatory value. We find that Formula 1 is not a very good model on either the national or local level; while it has one significant variable on the local level, we would have expected more on both target locations. When we add oil to our formula, we find that more of the changes in HPI can be explained, and the variable increases the validity of our model.

5.2 Correlation

Next, we will look at correlation matrices. As we mentioned, we would assume some correlation between our variables. We have created a correlation matrix for our variables for Stavanger and Norway. The correlation tables give us an insight into how the variables interact with each other.

In the correlation table for Stavanger's variables, we are most interested in whether or not the price of oil has an effect on UR, HPI, and Income. As seen from Table 6, the price of Brent crude oil has a positive correlation with HPI at 0.32, a small correlation. The relationship between Oil and the Unemployment rate is negative, as we expected for Stavanger, at a correlation of -0.34. We find this expected as, should oil increase in price, we would assume that oil companies and the connected sector would need to hire more people to take advantage of these higher prices. The fact that Income and Oil prices are also positively correlated at 0.17 indicates that when the price of oil increases, the median income in Stavanger also increases.

Another surprise is that when HPI increases, the Unemployment rate also increases, given the small positive correlation of 0.01, while we expect HPI and Income to have a positive correlation of 0.34. We find it surprising that HPI Stavanger is positively correlated with the Policy rate, albeit a small value at 0.06. As we have stated earlier, should the policy rate increase, we expect a decrease in the HPI due to a fall in demand and housing prices.

Table 6 (Hlavac, 2022)

Correlation Table Stavanger

	Δ R	Δ UR Stavanger	Δ HPI Stavanger	Δ Housing stock	Δ Income Stavanger	Δ Brent crude oil price
Δ R	1* * *	-0.33* *	0.06	-0.12	0	0.36* *
Δ UR Stavanger	-0.33* *	1* * *	0.01	0.38* *	0.17	-0.34* *
Δ HPI Stavanger	0.06	0.01	1* * *	0.17	0.34* *	0.32*
Δ Housing stock	-0.12	0.38* *	0.17	1* * *	0.73	-0.02
Δ Income Stavanger	0	0.17	0.34* *	0.73	1* * *	0.17
Δ Brent crude oil price	0.36* *	-0.34* *	0.32*	-0.02	0.17	1* * *

For the correlation matrix for Norway (Table 7), we will see how Oil price correlates with the same variables as before, HPI, median Income Norway, and Unemployment rate Norway. In this instance, Oil price correlates positively with HPI Norway at 0.29, similar to Stavanger. The Brent crude oil price correlates negatively with UR, at -0.31, similar to Stavanger. Income has a positive correlation of 0.1. Oil also has a positive correlation with the Policy rate of 0.36, which is equal in both Table 6 and Table 7.

Next, we check the variable HPI Norway and the correlation this has with R, UR Norway, and Income Norway. The relationship between the Policy rate and HPI is a negative correlation of -0.12, which is in line with what we expected. When looking at the variable HPI, it correlated positively with both the Unemployment rate and the median income in Norway, at 0.14 and 0.45, where the correlation with the unemployment rate is surprising.

Table 7 (Hlavac, 2022)

Correlation Table Norway

	Δ R	Δ UR Norway	Δ HPI Norway	Δ Housing stock	Δ Income Norway	Δ Brent crude oil price
Δ R	1* * *	-0.31*	-0.12	-0.12	0.03	0.36* *
Δ UR Norway	-0.31*	1* * *	0.14	0.44* * *	0.3*	-0.31*
Δ HPI Norway	-0.12	0.14	1* * *	0.45* * *	0.45* * *	0.29*
Δ Housing stock	-0.12	0.44* * *	0.45* * *	1* * *	0.9	-0.02
Δ Income Norway	0.03	0.3*	0.45* * *	0.9	1* * *	0.1
Δ Brent crude oil price	0.36* *	-0.31*	0.29*	-0.02	0.1	1* * *

5.3 Model Diagnostics

5.3.1 Multicollinearity

Testing for multicollinearity, we use a VIF-test, which gives us a variance inflation factor. The result shows if there is an intercorrelation between our variables that can skew the results of our model. If the variance inflation factor is below one, they are not correlated; between one and five indicates a moderate correlation and five and above shows a high correlation between variables.

For our multicollinearity test for Stavanger (Table 8), Brent crude oil price has a low multicollinearity with a VIF result of 1.309. The same goes for the Unemployment rate at 1.417 and the Policy rate at 1.217. Some multicollinearity is expected from our model. Nevertheless, the variables Income Stavanger and Housing stock shows a moderate variance inflation factor. As mentioned earlier in the data, Housing stock and Income suffer from yearly data being transformed to quarterly, which might be the reason for the moderate multicollinearity. High multicollinearity can undermine a variable's statistical significance and indicate a high standard error of their regression coefficients.

Table 8

Multicollinearity Stavanger

	VIF
\`Δ R\`	1.217
\`Δ UR Stavanger\`	1.417
\`Δ Housing stock\`	2.523
\`Δ Income Stavanger\`	2.311
\`Δ Brent crude oil price\`	1.309

For our test on multicollinearity for Norway (Appendix 2), the VIF results are quite similar, with Brent crude oil, Policy rate, and the Unemployment rate still having signs of some multicollinearity. Brent crude oil price at 1.256, Policy rate at 1.272, and Unemployment rate at 1.480. However, in our test for multicollinearity for Norway, the variables Housing stock and Income showed high multicollinearity at 6.480 and 5.914. The high multicollinearity can be a reason for concern, but we expect them to correlate with each other because of the quarterly data issue mentioned earlier.

An evident difference is Brent crude oil price having a small increase in multicollinearity, which indicates that the oil price covaries with other important economic variables more in Stavanger than in Norway.

5.3.2 Normality Test

Comparing the observed distribution of residuals with a normal distribution, we can find a p-value, and if it is purely by chance, we observe a difference. The null hypothesis is that the data follows a normal distribution. If the p-value is lower than 0.05, we can reject the null hypothesis of normality and conclude with the alternative hypothesis that the data does not follow a normal distribution. In our normality test for Stavanger (Table 9), the Kolmogorov-Smirnov, Shapiro-Wilk, and Anderson-Darling tests of normality for Stavanger have a p-value above 0.05 respectively, at 0.977, 0.965 and 0.934. This indicates that our model is consistent with normal distribution, and the deviation from a normal distribution is not more than expected from chance alone.

Table 9

Normality test Stavanger

	Statistic	P-value
Kolmogorov-Smirnov	0.058	0.977
Shapiro-Wilk	0.992	0.965
Cramer-von Mises	3.226	0.000
Anderson-Darling	0.167	0.934

This shows that there is no significant deviation from a normal distribution and no evidence that our data do not follow a normal distribution.

Interestingly, the Cramer-von Mises normality test shows a p-value less than 0.05 which indicates evidence of our deviations in the data to be statistically significant. Solutions to this can be to transform the data to a more correct distribution, or the presence of one or a few outliers might be causing the normality test to fail. Later we will run a test on outliers and look for irregularities. Nonetheless, because the other tests are not significant, there is a reason to believe no action is needed, and we can conclude that our model, in all likelihood, follows a normal distribution. For our normality test for Norway (Appendix 3), the p-values for Kolmogorov-Smirnov, Shapiro-Wilk, and Anderson-Darling tests are, respectively, 0.909, 0.286, and 0.403. Similar to the normality test for Stavanger, there is no evidence that our data does not follow a normal distribution.

5.3.3 Heteroskedasticity

Our model assumes homoskedasticity, which is why we test if this is the case for our data. The Breuch-Pagan test gives a p-value, and if it is lower than 0.05, we cannot reject the hypothesis of the Breuch-Pagan test that the variance is constant and indicates heteroskedasticity (See Table 10). Vice versa, should the p-value be larger, then it indicates homoskedasticity, and the variance is not constant.

Our model for Stavanger (Table 10) gives a p-value of 0.060, indicating that the variance is not constant, and our model shows homoskedasticity. Our model being homoskedastic supports our model's explanatory value and decreases scenarios of biased or skewed results.

Table 10

Heteroskedasticity test Stavanger

	Test Statistics	DF	P-value
Breuch Pagan	13.55167	7	0.0597546

For our test on heteroskedasticity for Norway (Appendix 4), the Breuch-Pagans test gives us a p-value of 0.493. Both our models conclude with no evidence of heteroskedasticity and support the validity of our model.

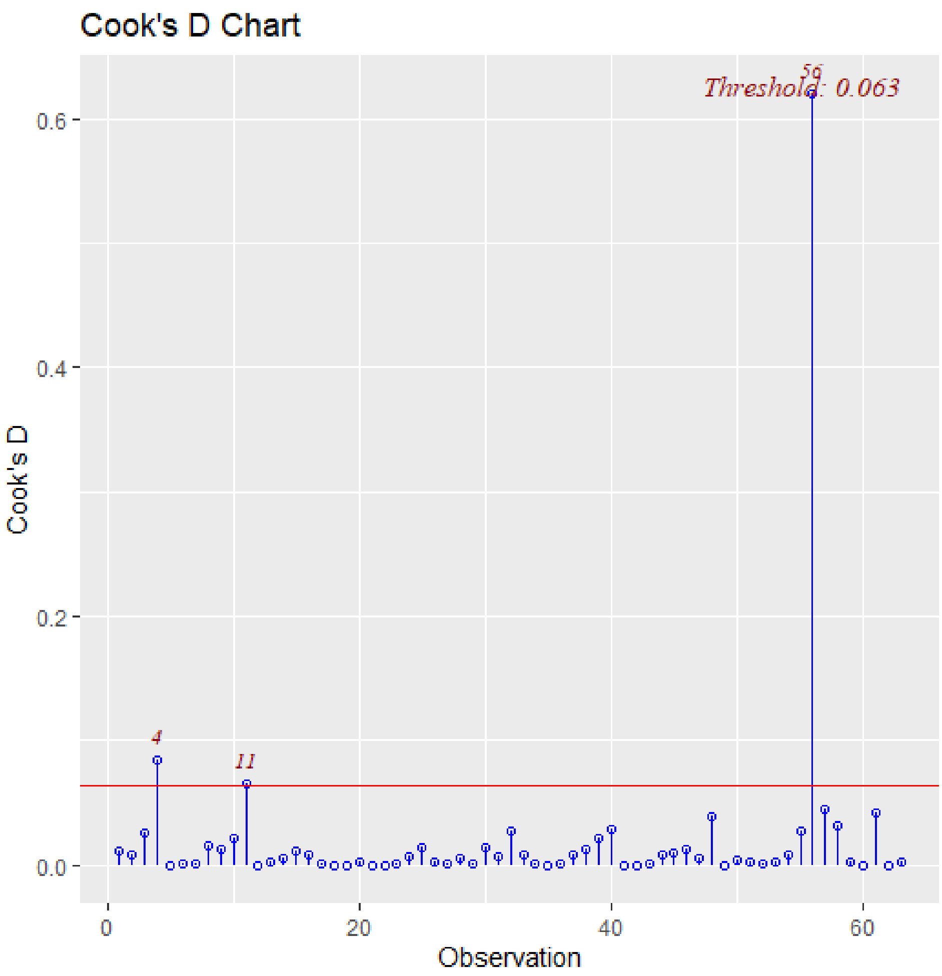
5.3.4 Test for Outliers

Using Cook's D chart for a test on outliers for our first-difference regression model (Figure 10, see next page), we find three extreme observations, 4, 11, and 56 which translate into changes in the 1st quarter of 2007, the 4th quarter of 2008, and the 1st quarter of 2020. In the 1st quarter of 2007, the policy rate increased by 0.52, the unemployment rate decreased by 0.1, and the HPI increased by 5.7. In the 4th quarter of 2008, oil prices fell from 114 to 55 dollars, and the policy rate decreased by one percentage point. In the 1st quarter of 2020, the HPI increased by 6.1, and the unemployment rate increased by 2.67. We would assume house prices would decrease when the unemployment rate increases, which might explain the outlier. To explain the outliers, looking at macroeconomic events for the dates outlier 4 and 11 coincides with the global financial crisis. Furthermore, outlier 56 coincides with the coronavirus pandemic. The outliers reduce the predictability of our model, and we interpret them as coming from shocks in the market. Nonetheless, our goal is to have an explanatory model, not have high predictability, and removing the outliers removes the effects of shocks and how our variables correspond to them. Thus, since our outliers can be linked to historical shocks in the market and not something random and invalid, we choose to retain the outliers.

Our test for outliers, Norway (Appendix 5), has five outliers, 11, 12, 40, 57, and 60. The outliers represent the 4th quarter of 2008, the 1st quarter of 2009, the 1st quarter of 2016, the 2nd quarter of 2020, and the 1st quarter of 2021, respectively. Outlier 11 had a change in the oil price, which decreased by 59 dollars, and the policy rate decreased by one percentage point. In outlier 12 Policy rate decreased by 2.1 percentage points, and UR increased by 0.76 in a quarterly year. Outlier 57 had a change in the Policy rate by 1.2 percentage points, and UR increased by 1.8 in a quarterly year. Outlier 60 Unemployment rate increased by 0.56.

Figure 10

Test for outliers, Stavanger



These quarterly outliers are still within the scope of where we predicted outliers could be with the financial crisis and the corona pandemic. The exception is outlier 40, in the 1st quarter of 2016, which has a moderate change in all variables but no extreme change.

6.0 Conclusion

To conclude our research question, “Does oil price have a significant impact on the housing prices in Stavanger?”, we have analyzed the theory and made a first-difference regression model for housing market prices, including oil price as an explanatory variable.

Our data analysis and results for Formula 1 had some flaws regarding the variables. They provided our model with a low explanatory variable, and only for Stavanger did we get a statistically significant variable. Both models indicated that some key variables explaining changes to HPI were omitted from our work. In Formula 2, we added oil as an explanatory variable and saw a noticeable increase in explanatory and predictive power for both Norway and Stavanger.

We are more interested in the Formula 2 regressions due to the inclusion of the oil price variable. When analyzing the results, we find that oil significantly impacts both Norway and Stavanger; the only other significant variables were Income in Stavanger and the Policy rate in Norway. From this, we conclude that even though Oil price impacts both Norway and Stavanger, it may seem that the housing market in Stavanger is more dependent on oil than Norway. Due to the policy rate being significant in Norway, we expect changes in Oil prices to have a larger effect on HPI in Stavanger.

Our tests furthermore validate our regression results, Oil price does show a significant impact on the housing market in Stavanger, but we do find some test results which might be of concern. Some variables in our model show moderate multicollinearity, which indicates some standard error in their regression coefficients. Although we find evidence of Oil price having a significant impact on the housing market in Stavanger, we can not conclude with certainty that we get a statistically significant effect from Oil price due to other variables in our model not being significant.

This furthermore opens up for more research on the topic with more accurate models for the housing market on a local level. Future research can include more variables affecting local house markets than national ones, such as infrastructure, educational opportunities, water quality, public transport, pollution, and neighborhoods. Other variables could be house specifics, such as floors, size, and bedrooms.

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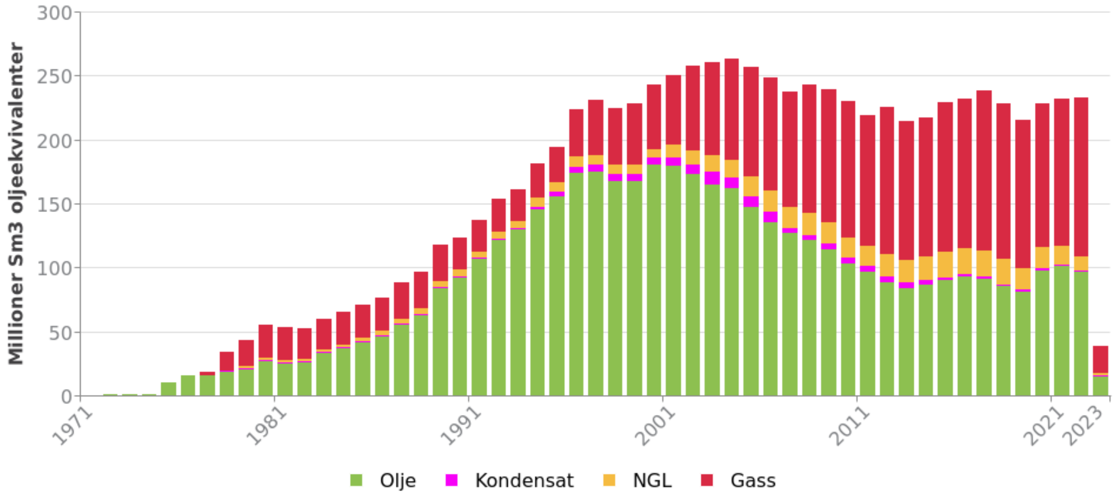
Appendix

Appendix 1

Historical Oil Production Norway



Source: (Norwegian Petroleum, 2023)

Appendix 2

Multicollinearity Norway

	VIF
\`Δ R\`	1.272
\`Δ UR Norway\`	1.480
\`Δ Housing stock\`	6.480
\`Δ Income Norway\`	5.914
\`Δ Brent crude oil price\`	1.256

Appendix 3

Normality test Norway

	Statistic	P-value
Kolmogorov-Smirnov	0.069	0.909
Shapiro-Wilk	0.977	0.286
Cramer-von Mises	4.925	0.000
Anderson-Darling	0.375	0.403

Appendix 4

Heteroskedasticity test Norway

	Test Statistics	DF	P-value
Breuch Pagan	6.404744	7	0.4933618

Appendix 5

Test for outliers, Norway