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The Impact of Mortgage Regulations on Housing Prices: A case Study of Norway

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Abstract

The Ministry of Finance over the years have instituted guideline and policies in an attempt to dampen increasing housing prices and household debt. This research studies how housing prices and household debt has been affected after the 2017 mortgage regulations.
Using data from Eiendomsverdi, Statistics Norway and Norges Bank, this study finds that, there has been slower increase in household debt and housing prices after the mortgage regulations in 2017.

By using the hedonic model, this study finds that the coefficient of housing characteristics like living area, geographical location and the estate type has changed over this period, but the change has been slower than the change in the coefficients before the 2017 mortgage policy.
Also, in using the VECM, this study finds a negative relationship between house prices and household debt.

TABLE OF CONTENTS

List of Tables

List of Figures

CHAPTER ONE: INTRODUCTION

1.1 PROBLEM STATEMENT

The purpose of this study is to determine if the impact of a reduction in the amount that banks can lend to prospective houseowners will:

1. Dampen the increase in housing prices?
2. Reduce household debt?

House prices have a direct impact on homeowners and the economy as a whole. Therefore, it is of great interest to homeowners, banks and the government. According to Lindquist et al. (2017) residential mortgage makes up 95% of loans from banks and mortgage companies. Due to the importance of housing prices to household debt and the financial system as a whole, the central banks and the governments pay great attention to it in the formulation of monetary and fiscal policies.

If there is one thing that political players in Norway have agreed on post Second World War, then it is making house ownership possible for Norwegian citizens. Three-quarters of Norwegians in their lifetime own a house (SSB, 2017). This is not only as a result of political players after the Second World War, but also from History. To vote, one had to own a land or real estate under the 1814 constitution. Owning a house is one of the few things Norwegians put a high value on. It is therefore not surprising that, Norway ranks high in terms of house ownership rankings in the world (Eiendom Norge, 2018b).

Political players continually have made moves to facilitate house ownership for Norwegians. Tax incentives are put in place to make Norwegians favor house ownership to renting. And the prestige and security that comes with it makes people want to own a house rather than rent. Over the last decades, investing in one´s own house has been a good investment. House prices have increased. Tax incentives put in place to make house ownership preferred to rent include no tax on sales if the dwelling is the primary residence in the last two years. Interest payments are tax-deductible and house valuations for tax purposes are lower than the actual market values.

The Norwegian banking crisis in 1988 and the 2008 financial crisis showed the impact of shocks in housing prices on the financial system and the economy as a whole. According to

Norges Bank (2018), the Norwegian economy is highly exposed to shocks in the housing industry and the amount of household debt. It also suggests that commercial estate price increases make the financial system very vulnerable.

The Norwegian banking crisis of 1988 put a huge strain on the economy. The financial deregulation of 1984 to 1987 led to boom situation in the housing market (Moe et al., 2004). The financial deregulation made it easier for people to borrow from the banks. This led to a boom situation in the real estate industry as many people borrowed to purchase properties. Between 1988 and 1990 which was the first phase of the crisis, smaller banks collapsed (Moe et al., 2004). The 1984 crisis ended in 1993-1994. This is an example of how shocks in the housing sector affect the economy and this was an internally generated crisis. The financial crisis of 2008 is an externally generated problem that had a ripple effect on other economies of which Norway is no different.

Movements in housing prices and credit growth is an indicator of financial sector vulnerability (Anundesn & Jansen, 2011). The Norwegian government offered much liquidity to help the banks mitigate the crisis in 2008. After the crisis, there has been a housing market boom due to the cyclical nature of the housing market and in view of probably another bust in housing prices, regulators are tightening the regulations.

The government of Norway, in trying to reduce household debt and dampen increasing housing prices, has decided to regulate the amount that banks can lend prospective homeowners. Rising housing prices and household debt is an increasing concern in Norway. This is because, housing becomes expensive to new (young) entrants into the housing market. Also, increasing prices may be a bubble that will pop and lead to a financial crisis as it happened in Norwegian banking crisis in 1988. After formulating regulations in 2010, the regulations turned into law in 2015 (Ministry of Finance, 2015) and this law was further strengthened in 2017 (Ministry of Finance, 2017).

The new mortgage regulations based on the legislation instituted by the government to dampen house price increases and build-up of household debt include limitations on bank lending for housing:

1. The borrower's total debt must not exceed five times the gross annual income (debt ratio).

2. The borrower's debt servicing ability must be tested against an interest rate increase of 5 percentage points.
3. Installments shall be paid for loans with a loan-to-value ratio above 60 percent
4. For Oslo, the loan-to-value ratio for secondary housing shall not exceed 60 percent

1.2 RESEARCH QUESTIONS

1. What is the impact of the new mortgage regulations on housing prices?
2. What is the impact of after-tax mortgage rate on Housing prices?

There has been a lot of work done to access the impact of this policy. Jebsen & Tveit (2019), found that areas with high education were the most affected and that household debt was not reduced in the process. This defeats one of the purposes of this current policy. Borchgrevink & Torstensen (2018) found that, in the first year of the policy, home buyers with a high debt-to- income ratio experience lower inflation on house prices. Thus, there was sharper fall in prices in places with a debt-to-income more than five than areas with a debt-to-income less than five. They also found a decline in the number of young people buying houses and fewer house sales in Oslo. Thus, the share of home purchases for young people was lower in 2017 compared to 2016 even though there was a fall in prices in 2017.

1.3 THESIS ORGANISATION

The first chapter of the work is the introduction to the study and the general idea of the study. Chapter two is the background to the topic. Here, we look at housing demand, supply and price determination. We also consider speculative forces that drive the housing market, housing market bubbles, house price development in Norway the demographics in Norway and Household debt in Norway.

Chapter three is the theory and literature review. The theory of rational expectations and the theory of demand is the main foundation of this work. There is also a list of studies in the housing market that has been reviewed.

Chapter four presents the data sources and transformation of Data. The Data for the work was obtained from Eiendomsverdi, Statistic Norway and Norges Bank. This ensures that the data

is reliable. Two econometric models are used in this work. The first is the hedonic regression where characteristics of the house are used in determining the price of a house. The second is the vector error correction model (VECM). With this, variable like house price, household debt, after-tax mortgage rate, housing stock and household income are used to estimate the VECM.

Also, after each methodology is presented, the results and discussions are presented beneath so as to make it easier to follow the sequence of events.
The last chapter is the conclusion. This chapter presents a summary of the empirical results. It also presents the limitations to the research and the recommendations for further studies.

This research employs graphs, hedonic regressions and vector error correcting model (VECM) to add to the research of the impact of the new policy. Hedonic regression is used to show how individual characteristics of a house affect the price of the house and how price predictions have improved or changed.

CHAPTER TWO: BACKGROUND

After the financial crisis of 1988 and the global crisis of 2008; both caused by the housing market, governments and government agencies have been putting in place measures to avoid or reduce the risk of another crisis. To protect individual borrowers and maintain financial stability, Finanstisynet in 2010 introduced some guidelines to supplement those guidelines already carried out by the banks and financial institutions in Norway. This was done in order to ensure sound lending practices for residential purposes. According to Finanstilsynet (2010), Household loans account for 90 percent of hosehold loans. Household loans account for 60 percent of overall loans to the non- financial private sector.

These guidelines were transformed into a law in 2015 (Ministry of Finance,2015). The main aim was to regulate the amount banks can lend to prospective house owners. This policy came into effect on the first day of July in 2015. According to this policy, house purchase must be composed of a 15 percent equity or 85 percent of loan-to-value ratio. Also, interest payments must be composed can be approved only if the loan-to-value ratio was less than 70 percent. Also, at the time of refinancing, refinanced loans should not exceed the size of an existing mortgage. Acoording to Finansieringsvirksomhetsloven (2015), banks and financial institutions could deviate from the rules up to 10 percent of the approved value in each quarter.

The Ministry of Finance through Finanstilsynet sent out proposals for strengthening the restrictions. This was because of increasing household debt and house prices (Ministry of Finance, 2016). Vulnerability of household to a bust in housing prices was a growing concern to the Ministry of Finance. The Ministry was also concerned about a situation whereby an increase in interest rate will lead to a high number of loan defaulters.

There were a lot of concerns raised by other agencies. Real Estate Norway was concerned about a situation whereby the stricter regulations will lead to a fall in house prices. In their letter to the Ministry of Finance, they raised the issue of people not entering the housing market due to a fall in prices and hence it will lead to a fall in construction of residential houses.

The new mortgage regulation that was passed in 2017 as already stated in the introduction are:

1. The borrower's total debt must not exceed five times the gross annual income (debt ratio).

2. The borrower's debt servicing ability must be tested against an interest rate increase of 5 percentage points.
3. Installments shall be paid for loans with a loan-to-value ratio above 60 percent
4. For Oslo, the loan-to-value ratio for secondary housing shall not exceed 60 percent

2.1 IMPORTANCE OF REAL ESTATE

The impact of housing prices or the housing market on the Norwegian economy cannot be overemphasized. The 1988-1993 banking crisis and the 2007-2008 financial crisis shows how the Norwegian economy is affected by activities in the housing market (Anundesn & Jansen, 2013). Most investors are now looking into the real estate industry as an alternative form of investment.

Rubens et al. (1989) study on inflation hedges, identified residential real estate as the best hedge for inflation. Most investors are adding real estate to their portfolios in order to diversify their portfolio. According to Rubens et al. (1989), to get a very good hedge against inflation, a diversified portfolio with mixed assets and real estate is the best otion.

2.2 DEMAND

Demand for residential real estate has direct impact on the prices of real estate. The demand for real estate can be defined as the quantity of space or number of units demanded at various prices. For the law of demand, a lower quantity of space or amount of space is demanded at higher prices and the reverse is true (Kau, 1985). The is shown in the diagram below.

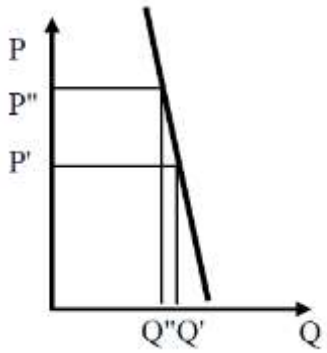

Figure 1. Law of Demand (Inelastic)

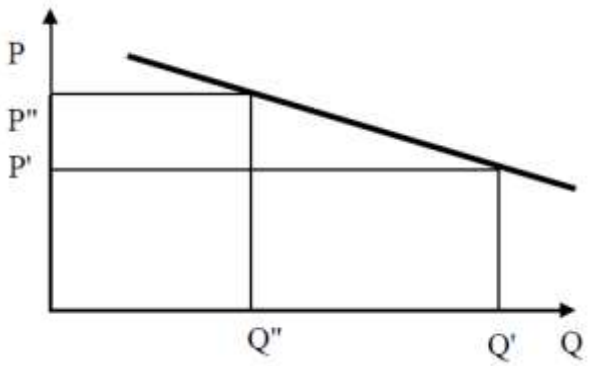

Figure 2. Law of Demand (Elastic)

Source: Hyman Source: Hyman

From figure 1, it can be seen that, as the price increased from P´to P", the quantity demanded fell from Q´to Q".But, when we contrast figure 2.2.1 with that of figure 2 which is elastic demand, we realize that, though, there is a fall in quantity concening same increase in price as it is in figure 1, there is a more significant fall in quantity.
Thus, the sensitivity of quantity demand to changes in prices, known as price elasticity, explains why there is a difference between figure 1 and figure 2

Also, it is important to note that, expectations also affect the demand for real estate. That is, if there is an increase in real estate prices today and potential homeowners think that, there will be further increase in prices in real estate in future, then though the law of demand states that less will be demanded at an increase in prices, potential homeowners in an attempt to avoid future price increases will purchase at the current prices so as to avoid future price increases.

Aside from prices, some exogenous factors also affect quantity demand and they are classified into four (Kau, 1985) but there is a fifth one.

1) Market size (population/employment)
2) Income/Wealth
3) Prices of substitutes
4) Expectations
5) Credit constraint (this can also affect the quantity demanded)

2.3 SUPPLY

Residential real estate supply refers to the quantity of space or number of units supplied at different prices at a given time (Kau, 1985). With regards to the law of supply, more is supplied at higher price and the reverse is true. Thus, the supply curve is an upward slopping curve. The diagram below shows a short-run aggregate supply curve and a long-run aggregate supply curve.

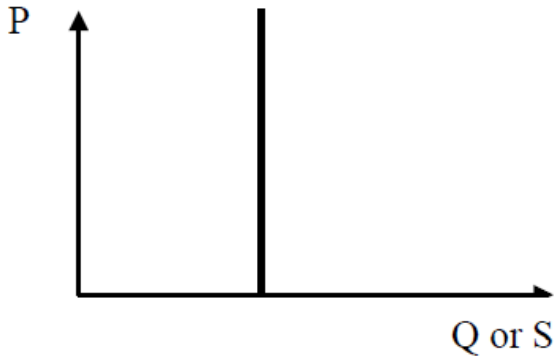

Figure 3. Short-run Aggregate Supply Curve

Source: Hyman

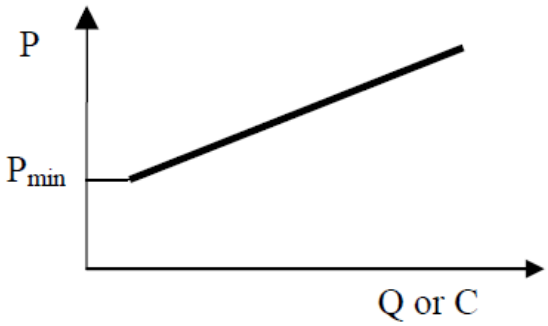

Figure 4. Long-run Aggregate Supply

Source: Hyman

The short-run aggregate supply curve represents a market´s total stock at a given time. Supply in the short run for real estate is fixed. This is the reason why it has a vertical slope in figure 3. It takes time to acquire land, plan and develop a building. This leads to a construction lag and hence explains why we have a vertical slope. It usually takes 6-12 months to put up a residential building. When planning, obtaining permits etc. are included, it will take longer.

For figure 4 which represents the long-run aggregate supply curve, shows the relationship between long-run prices or rent and the total number of units supplied over the long run.
After world war II, there was a surge in the housing stock in Norway. Only 15 percent of the current housing stock was built before world war II (Andersson et al. 2010). The majority of these building were put up after the second world war (WWII).

According to Andersson et al. (2010), there was a conscious government effort to increase the housing stock. As of February 2019, the building stock in Norway stood at 4.2 million of which 1,555,774 are residential buildings and 2,633,311 are non-residential buildings (Statistics Norway, 2019; Construction, Housing and Property). There are approximately 2.6 million dwellings in Norway as of April 2019 of which approximately 2.4 million are occupied (Statistics Norway, 2019; Construction, Housing and Property and family and household). From 2009 to 2019, there were approximately 561,000 dwellings added.
There has also been a shift to renovating and transforming old buildings in Norway. There has been an increase in multi-dwelling buildings in Norway especially in urban areas where there is a high density in population (Andersson et al., 2010).

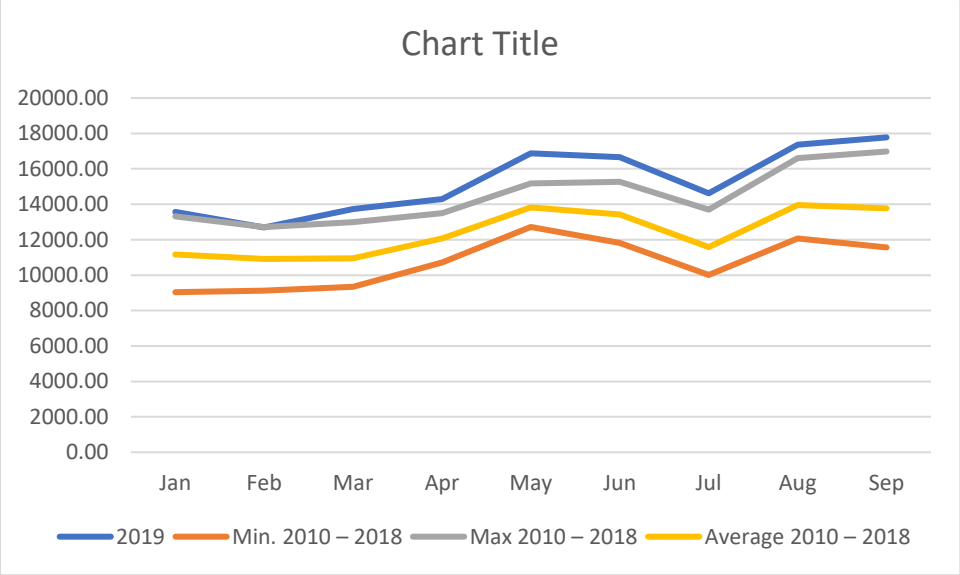

Figure 5. Unsold used Houses.

Source: Norges Bank (2019).

There is a high number of existing unsold houses. Generally, the number increased in 2019, with the number of unsold houses in 2019 higher than the average of unsold existing houses. This also goes to affect the price of houses since it will create excess supply.

2.4 PRICE DETERMINATION

Market forces of demand and supply determine the prices of real estate. Potential homeowners demand houses and the homeowners supply houses. The point where the demand by potential houseowners meet the supply from homeowners is the equilibrium market price. Hence, the law of demand and supply determines the prices of houses Hyman (1985). The diagram below explains more.

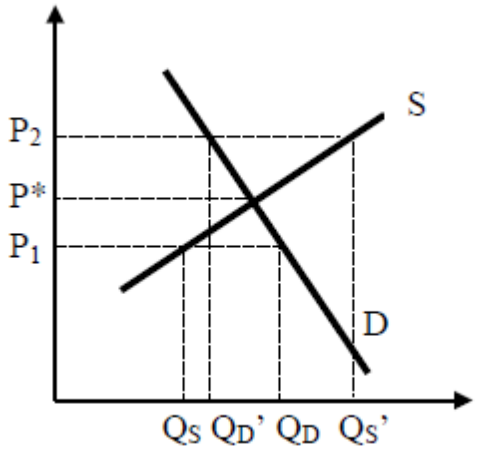

Figure 6. Price Determination.

Source: Hyman (1985)

From figure 6, at price P1, there is excess demand over supply as producers supply fewer homes because the prices of homes are low and therefore the law of supply comes in. with regards to the law of demand, more houses are demanded therefore leading to excess demand. At price P2, there is excess supply as there is a higher price. And there is less demand. But at Point P*, quantity demanded is equal to quantity supplied.

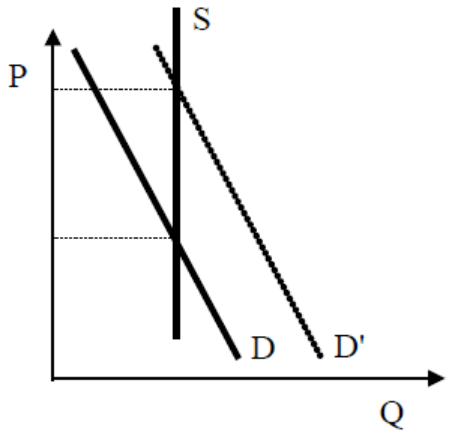

Figure 7. Short-Run Price Changes

Source Hymen.

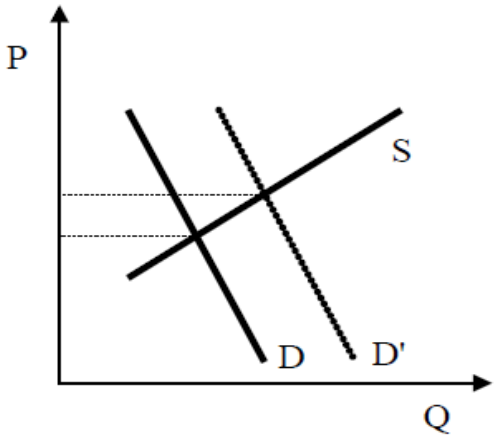

Figure 8. Long-Run Price Changes

Source Hymen.

In Figure 7, there is a fixed supply due to construction lag, thus, a shift in the demand curve leads to a sharp change in price. But in the long-run, supply adjust as developers will respond to the change in demand. Eventually, there will be a new equilibrium as can be seen in Figure 8.

2.5 SPECULATIVE FORCES DRIVING HOUSING MARKET

The financial crises of 2008 show the impact of speculation on housing prices and the economy as a whole. All other things equal, with rational expectations, consumers will demand more if they expect an increase in price in the future and demand less if they think there will be price falls in the future. Speculation is therefore an important factor driving housing prices.

Shiller (2007) in analyzing recent booms and bust, showed that, there have been different courses of price change in housing prices. He showed that economic factors like population growth, interest rates construction cost and rental rents were unable to account for the change in prices. Thus, speculative thinking, extrapolative expectations, market psychology, herd expectations and social contagion of new ideas matched up with price changes Shiller (2007).

Expectations about future price changes have a great impact on demand as discussed under 2.2. Thus, future expectations can influence the prices of houses. Case and Shiller (1988), in their study of the behavior of home buyers in boom and post boom markets, posits that, housing prices is driven by fundamental factors in a rational market. And that, investors use changes in these fundamental factors in forecasting future prices. Their results were contrary to that of the rational expectation market. It came out that previous prices rather than rational expectations affected future house prices and expectations.

Gao et al. (2016) conducted a study on the Economic Consequences of Housing Speculation. They found that, the economy was affected by Housing speculation during recession. They also found that future price expectations in the housing market is extrapolated by speculators using previous changes in housing prices.

2.6 HOUSING MARKET BUBBLES

Shiller and Case (2003) defines a bubble “as a situation in which public expectations of future price increases cause prices to be temporarily elevated”. Thus, new home buyers fear that there will be an increase in future prices and therefore, all other things being equal, will buy homes today even if prices are high so as to avoid any future increase in price. Also, homebuyers see it as an avenue to make profit from future increase in prices and therefore purchase homes

though the price is high. All this in turn affect demand since people don't see prices to fall in the future. The demand for houses therefore increases and creates a price bubble.

2.7 HOUSING MARKET IN NORWAY

The central aim of Norwegian housing after the war until today has been to make house ownership easy. The state developed a holistic approach to fight against ownership by a few. Most policies were geared towards providing individuals loans to finance home constructions. The Norwegian State Housing bank financed a million housing units from 1945-1999 (Gulbrandsen, 2004).

After the world war II, there was massive construction and as at 2010, 85% of buildings in Norway are modern. There has also been a shift from government assistance, macroeconomic governance and credit controls to a market determined approach (Andersson et al., 2010). Andersson et al. (2010) state that, the government sees the interest rate as the most important factor that affects the housing market.

HOUSE PRICE DEVELOPMENT

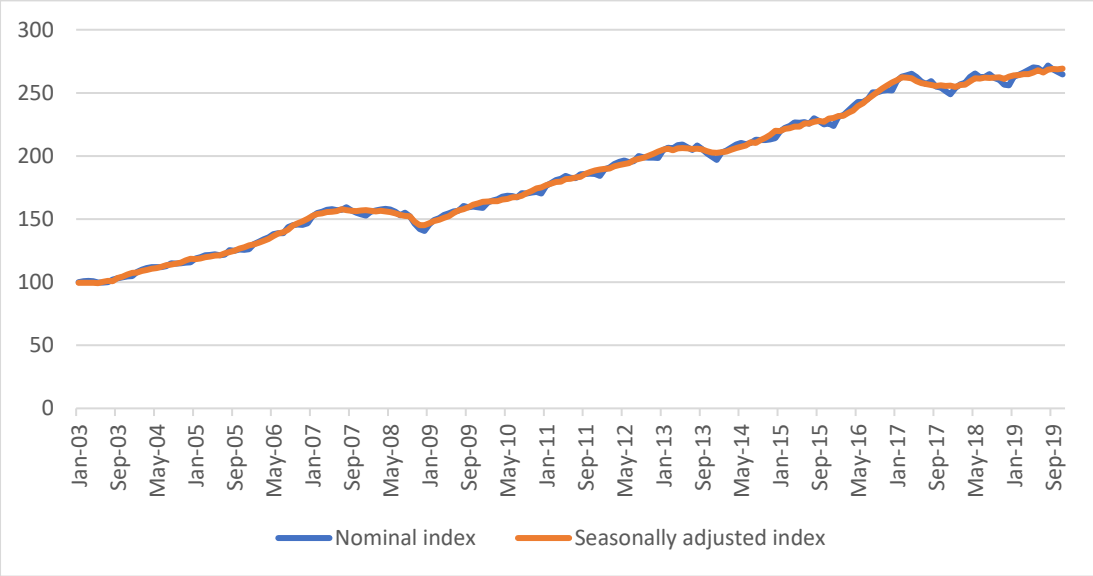

Figure 9. House Price Development Source: Eiendomsverdi

From figure 9, it can be seen that, the price fell after the policy was introduced in 2019. And then, it has been rising at a slow rate. Norwegian housing prices has been experiencing higher

growth rate over the years. House prices have a great impact on any economy in the world. Governments and head of central banks have a greater interest in the happenings in the real estate industry because of its impact to the whole economy. Boom-Bust situations in the housing market tends to cripple economies.

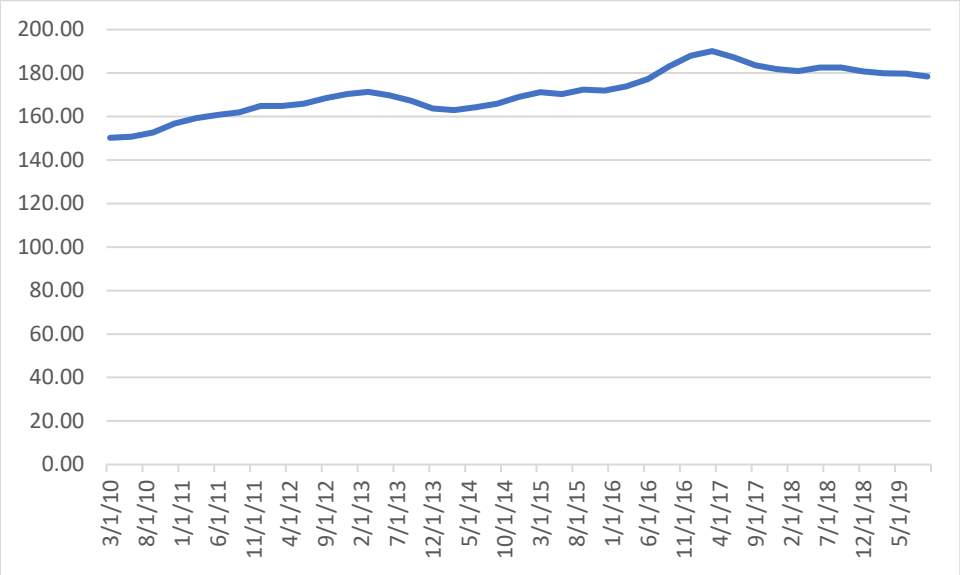

Figure 10. Ratio of House Prices to Disposable Income Index.

Source: Norges Bank (2019)

Figure 10 represents the ratio of house prices to disposable income. It can be seen that, after the second policy, the ratio of prices to disposable income has been falling. The above graph is known as the house price indicator. From the graph, it has been falling ever since the policy was introduced.

2.8 DEMOGRAPHICS

A change in the age structure of a population helps us to understand changes in household debt Finocchairo et al. (2011)**.** Age has an impact on the income levels of individuals. Changes in population or the structure of the population affects housing prices. Norway has a pretty youthful population. With the majority of citizens falling between the ages of 20-66 years.

In 2019, there was a total of 137,409 gross internal migration and gross 24, 893 immigration in Norway. As the population of a country increases, so is the demand for houses. This leads

to an increase in housing prices. The reverse is also true. There is a huge difference between the price of houses in Oslo and the prices of houses in the other part of the country. Generally, prices in urban areas are higher than in the rural areas.

Most people move to the bigger cities from the smaller cities. There are also movement to smaller cities but the gap between those moving to the bigger city and those moving to the smaller cities is very wide. This is the reason why places like Oslo, Bergen, Trondheim and Stavanger generally have a higher price than the other part of the country.

Thus, some areas of the country of the country are seeing a decline in population, whereas population is growing in and around the biggest cities. Housing is cheap in these areas of the country that people are moving from or are not settling in, whereas prices are increasing in Oslo and other urban cities.

HOUSEHOLD DEBT IN NORWAY

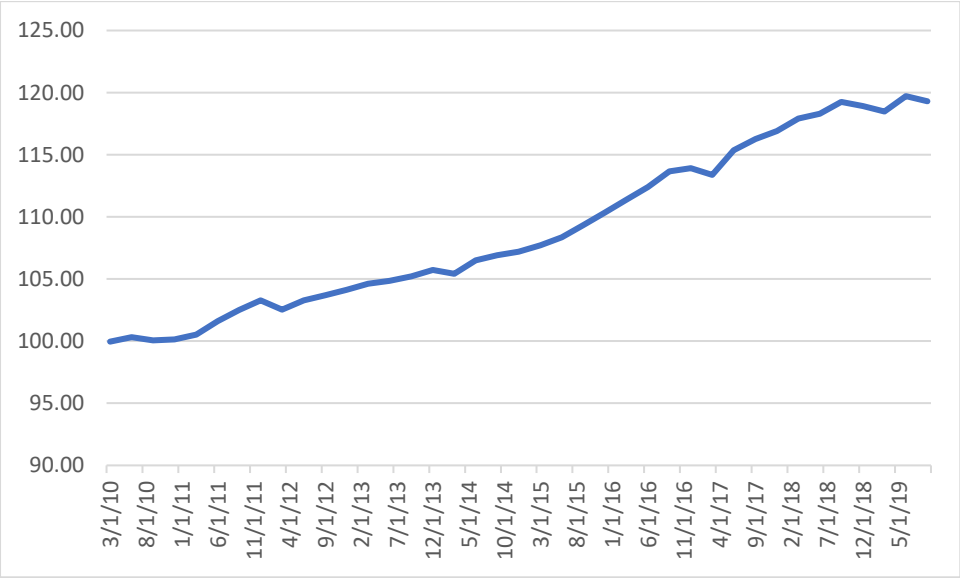

Figure 11. Household Debt Index Source: Norges Bank (2019)

Norway has one of the highest household debts in the world. Increasing household debt is a concern to many governments and the Norwegian economy is no different. Increasing household debt. The lowest level of the rate of growth of household debt in 20 years was recorded in early 2019 (Norges Bank, 2019). This was not only due to the policy change, but it also played a part in the fall in the growth rate.

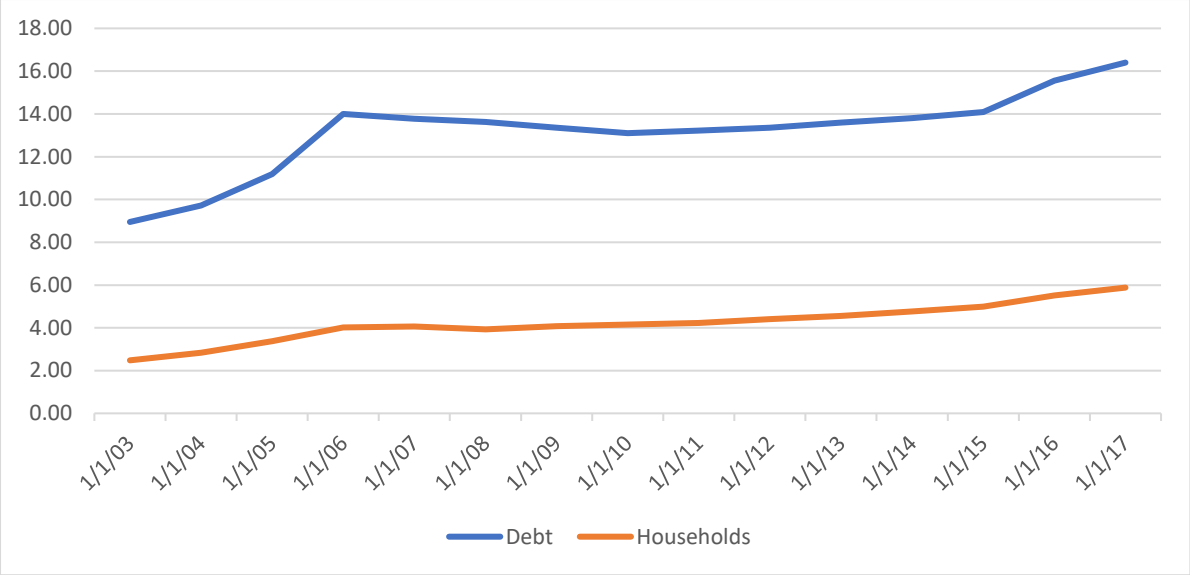

Figure 12. Share of Households with DTI above Five and the Share of Debt held by these Households. Source: Norges Bank (2019)

Figure 12 shows the share households with a debt-to-income (DTI) above five and the share of debt these households hold. Slower household debt growth rate reduces the vulnerability of an economy. Growing household debt is not good in terms of a fall in prices.

CHAPTER THREE: THEORY AND LITERATURE REVIEW

3.1 INTRODUCTION

This chapter reviews comprehensively both the theoretical and empirical literature on the theory of rational expectations and theory of demand. To start with, theory of rational expectation and the theory of demand are defined. Also, some studies that were built on these theories are also presented. Again, the empirical literature reviews of some studies are presented to throw more light on the topic.

With regards to theory, the theory of rational expectation and the theory of housing demand will be used in this research. Mishkin (2004) defines the theory of rational expectations as an optimal forecast using all available information. Thus, the outcome of an event depends on what people expect will happen Wang et al. (2018).

There has been a lot of works in the housing market that is based on rational expectations. Ren et al. (2012) in their study of house price bubbles in China found that in the presence of bubbles, house prices generates negative returns. Under rational expectations, if the decision to purchase a house is based on a person's preference and aspirations and it ignores future financial gains, then it is irrational (Case and Shiller (2004).

The demand for residential real estate can be defined as the quantity of space or number of units demanded at various prices Kau (1985). Demand is one of the major factors that affect the price of a product. Factors that affect the demand for residential real estate includes, population, household income, expectations of changes in future price and credit constraints.

There has been a lot of literature relevant to the impact of regulations on household debt and dampening price. Below is a review of some selected literature that is relevant for this study.

3.2 CREDIT SUPPLY AND HOUSING PRICES

Adelino et al. (2012) in their work on credit supply and house prices: evidence from market segmentation found that the value of a house increases when it is easy to finance or its easier to meet loan requirements. They posited that; most homebuyers choose loan-to-value ratio as

their financing option. Adelino et al. (2012) found other financing options as more expensive than the loan-to-value ratio They also found significant deviations from the 80 percent norm of loan requirements. This implies that, a significant number of people didn't meet the 80 percent loan to value ratio requirement.

Favara & Imbs (2012) in their paper, credit supply and the price of housing, used branching deregulation in the United States of America as instruments for credit found that, loose credit requirements explain house price change in an instrumental variable situation. They also found that, areas with elastic supply of houses are not so much affected when banks expand credit supply.

3.3 DETERMINANTS OF HOUSING PRICES

Anundesn & Jansen (2013) in analyzing the self-reinforcing effects between housing prices and credit, find that, interest rates affects housing prices through the credit source. According to the authors, the expectation of future household income and the Norwegian economy affects housing prices. The authors go on to state that, the inclusion of the housing supply side to the model decrease the effect.

Xu and Tang (2004) used cointegration and error correction method in their study of the determinants of house prices in the UK. They found that GDP, unemployment rate, credit and construction cost have a positive impact on housing prices in the UK. According to Xu and Tang (2014), house prices in the short run are affected by construction cost, credit, interest rates and disposable income.

Borowiecki (2009) used a VAR model to study the determinants of house prices in Switzerland. The results reveal a positive relation between population and housing prices. There is also a positive relation between house price and construction cost. The results further reveal a negative relation between the interest rate and house prices in Switzerland.

3.4 INTERACTIONS BETWEEN HOUSHOLD DEBT AND HOUSING PRICES

Turk (2015) examines housing price and household debt interactions in Sweden. Turk uses a three-equation model to explore the connection between housing prices and household debt. Turk finds out that, in the long run, housing prices contribute more to household debt though there is an impact of household borrowing on housing prices in the short run.

Lindquist et al. (2017) posit that high household debt will make households increase savings and reduce consumption when there is a fall in housing prices or an increase in interest rate. The authors assert that high household debt and an increase in secondary home ownership exposes banks to high credit risk.

3.5 IMPACT OF REGULATIONS ON HOUSING PRICES AND HOUSHOLD DEBT

Igan and Kang (2011) investigate whether loan-to-value and debt-to-income policies actually work. The authors found that loan-to-value and debt-to-income leads to a decline in increasing housing price and transaction activity. These limits, according to the authors, affect the expectations of prospective homeowners.

Borchgrevink and Torstensen (2018) examine the impact of residential mortgage loans. The authors found a relationship between house prices and the debt-to-income ratio. According to the authors, areas with homebuyers having a high debt-to-income ratios had lower house price increases.

CHAPTER FOUR: EMPIRICAL METHOD AND RESULTS

4.1 INTRODUCTION

This chapter presents the conceptual framework and the econometric method used. It also specifies the various models to be used and the variables are described. And then, data sources and reliability of data are also presented. Finally, the results from the estimated models are presented.

4.2 DATA

This empirical research will employ the property transaction database from Eiendomsverdi. Both nominal and real housing prices will be used for the analysis. Eiendomsverdi AS, a private firm, was founded in 2000 to gather data from official records and realtors. Eiendomsverdi employs automated valuation methods for estimating housing prices for real estate agents, surveyors, banks, financial institutions, and real estate developers.

The data are in two forms; microdata (individual transactions) from Oslo, Bergen, Trondheim, Stavanger, and Tromsø and house prices on index-level. Also, data on nominal interest rate, consumer price index (CPI) and inflation rate are obtained from Norges bank. Data on household income, housing stock and household debt are obtained from Statistics Norway.
For this research, it is important to employ both micro and macro data. This makes it easier to evaluate both the micro factors (housing characteristics) and the macro factors (fundamentals) that determine the price of a house.

With regards to microdata, data is obtained from Eindomsverdi on household sales in Bergen, Trondheim, Tromsø, Stavanger, and Oslo. These are the five biggest cities in Norway. It makes it possible to perform a hedonic model to determine how the individual characteristics of a house contributes to its price. This data contains the sales date, sales price, common debt, living area, estate type, floor, area code, city district, council name, build year, ownership type and the average age of the owner. The data is from the 2nd of January 2003 to the 17th of December 2019.

Table 1. Summary Statistics of Daily Housing Prices.

VARIABLE	OBS	MEAN	STD. DEV	MIN	MAX
BERGEN	**38,397**	**3185678**	**1546179**	**15404**	**2.51 + 07**
OSLO	**117,670**	**4227661**	**2623303**	**10000**	**7.11e + 07**
STAVANGER	**16,552**	**3588050**	**1796202**	**120000**	**2.35e + 07**
TRONDHEIM	**32,556**	**3204513**	**1538965**	**32**	**1.93e + 07**
TROMSØ	**9,896**	**3346671**	**1,702590**	**55000**	**2.30e + 07**

Data Source: Eiendomsverdi

Table 1 presents a summary statistic of the data from Bergen, Oslo, Stavanger, Trondheim and Tromsø. The mean, standard deviation, minimum and maximum values of each of the cities are presented in the data.

Table 2. Summary Statistics of Housing Characteristics.

VARIABLE	OBS	MEAN	STD. DEV	MIN	MAX
SALES P. (NOK 1000)	**215,071**	**3796995**	**2271278**	**32**	**7.11e + 07**
LIVING AREA (M^2)	**215,071**	**83.09829**	**47.39175**	**0**	**1117**

Data Source: Eiendomsverdi

From the above, a total of 215,071 micro data of housing prices or sales in the five regions were employed. Table 2 provides information on the means, standard deviations, the minimum and maximum of the sales price and living area (space)

Concerning the macro data, I obtained both the nominal and real house price index of Norway from 2003, January to 2019, November. This helps in finding how the interest rate, credit, and disposable income affects housing prices.

Table 1. Summary Statistics of Real and Nominal Housing Prices.

VARIABLE	OBS	MEAN	STD. DEV.	MIN	MAX
NOM. HOUSING PRICES	203	185.2982	51.60213	99.67	271.66
REAL HOUSING PRICES	203	185.2805	51.57256	99.23	269.2

Data Source: Eiendomsverdi

4.3 TRANSFORMATION OF DATA

With the microdata, the sales price will be added to common debt to become the new sales price. This is because the common debt is assumed to be part of the total cost of the house. However, some houses do not have common debt. To make the data easy to work with, all houses that where not apartments (houses without floors), will be left as blank. That is, instead of leaving it as null, I deleted the null and left it blank. So that, it will be possible to analyze all house sales.

For the macro data, they will be converted into logarithmic form. This will make it easier to work with. To ensure data quality, the data is obtained from reliable sources here in Norway. Eiendomsverdi is a respectable institution. This ensures that data on house prices are reliable. Also, Statistics Norway is a trusted source for data and research to government institutions and the General public Norway. This makes the data obtained reliable and suitable for research.

There will be a measurement bias if the wrong data is used for the research. Hence, the reason for obtaining data from reliable sources. Thus, this data is consistent and unambiguous. This makes it easier to process and analyze.

4.4 EMPIRICAL METHODS, RESULTS AND DISCUSSIONS

Table 4. Number of House Sales per Year, 2015-2019.

YEAR	OSLO	VIKEN M/OSLO	TROMSØ	STAVANGER M/OMEGN	TRONDHEIM	BERGEN
2015	**20127**	**39830**	**1490**	**3958**	**5160**	**6382**
2016	**18611**	**37972**	**1613**	**3602**	**5067**	**6247**
2017	**18052**	**37911**	**1497**	**3985**	**5115**	**6147**
2018	**18854**	**39817**	**1615**	**4270**	**5216**	**6193**
2019	**20253**	**41205**	**1586**	**4541**	**5281**	**6185**

Data Source: Eiendomsverdi

Table 4 represents the number of houses sold from 2015 to 2019. It can be seen that the policy affected demand for houses since some individuals didn't qualify for mortgage loans. So, it can be seen that, the number of houses transactions decreased from 2015 to 2017. But places like Oslo, Viken M/Oslo, Tromsø , Stavanger and Trondheim experienced an increase in the number of houses sold for 2018 to 2019. Bergen had an increase the number of houses sold in 2016 and then it fell again in 2018. It has been a up and down situation in Bergen.

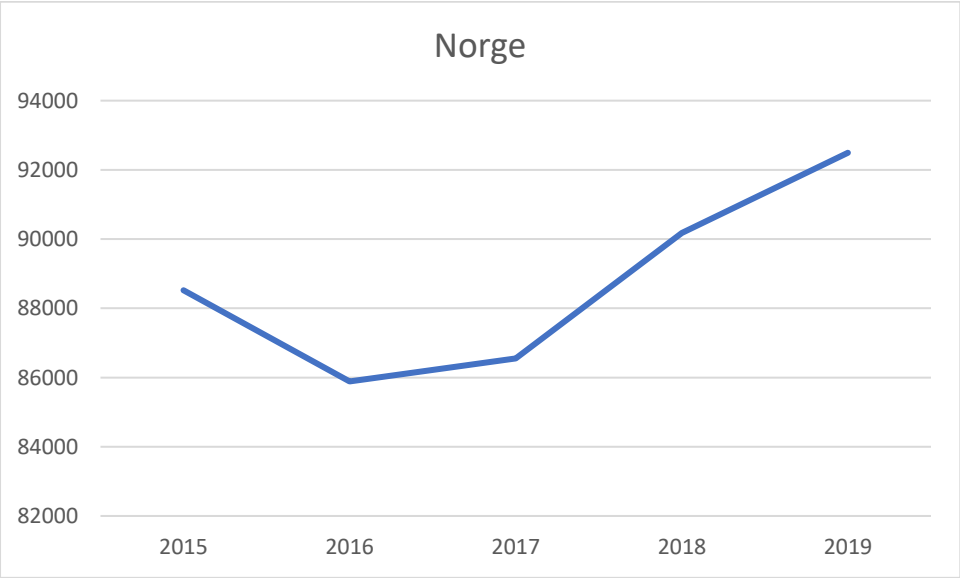

Figure 13. Number of houses sold in Norway.

Source: Eiendomsverdi

The graph above represent the number of houses sold in Norway from 2015 to 2019. It can be seen that, the number of houses sold fell in 2016 and grew slightly in 2017 after the first policy. But the number of houses sold increased in 2018 and 2019.

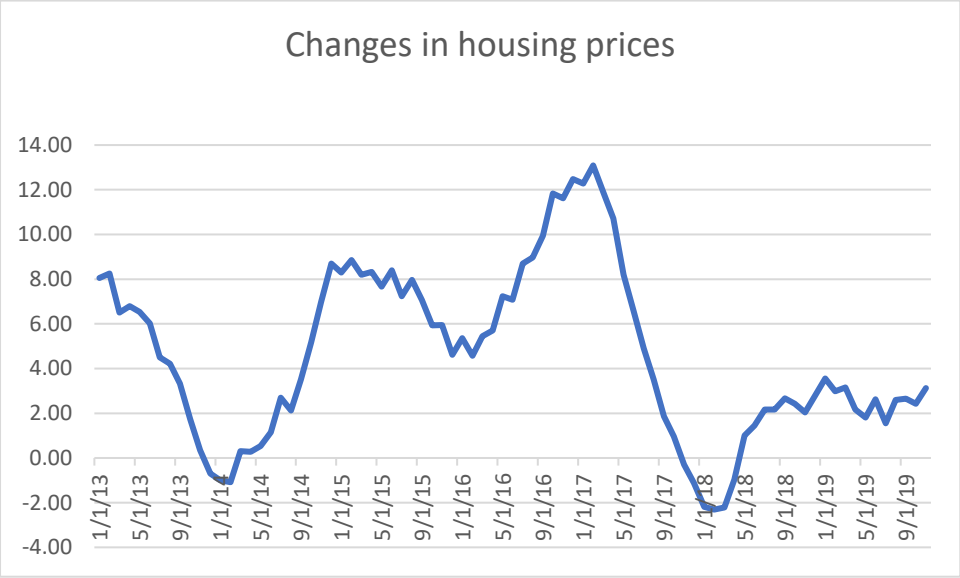

Figure 14. House Price Growth Rate.

Source: Norges Bank (2019)

From the graph above, it can be seen that, there has been a slower growth in house price after the second policy. It can be seen that increase in house prices fell to negative 1% in the second quarter of 2014 and started increasing again. And then fell after the first policy intervention on the mortgage market. And then it started rising again the second 1st quarter of 2016. After the second policy intervention, it can be seen that house price growth has been hovering below 4% from 2018 through to the third quarter of 2019.

To provide a detail picture, the results of the hedonic model further goes to show how there has been changes in the effect of some selected housing characteristics on the price of the house after the policy intervention.

4.4.1 OIL PRICES AND HOUSING PRICES

The Norwegian economy is very reliant on oil and oil related activities. Since oil is one of the major drivers of the economy, a fall in the price of oil have a high impact on the Norwegian economy. Household income of people in the oil industry and the country as a whole is affected when oil prices fall. From the VECM results in table 10, though not significant, there is a negative relation between house prices and household income. The elasticity of household income with respect to house price is -1.285% A 1% rise in household leads to a fall in house price by -1.285%.

Figure 15 Spot Oil prices in US Dollars

From figure 23, it can be seen that in 2008-2009 there was oil price fall to a little below $40. Between 2014 to 2016, the was also oil price falls. And these affected the Norwegian economy severly. According to Finanstisynet, (2016), oil price falls in this period led to a negative impact on the profits and the finances of business in the oil-related sector. This in turn affects household income and hence affects house prices also.

4.4.2 HEDONIC MODEL

The Hedonic model framework by Rosen (1974) will be emulated in this work. Housing characteristics affect the value of a house. These characteristics include the location of the house, structure, environmental characteristics Freeman III (1979b). Based on this, the price of the house can be formulated as

$$Ph_i = Ph(Si_1, \dots, Si_j, \dots, Ni_1, \dots, Ni_k, \dots, Qi_1, \dots, Qi_m) \dots\dots\dots\dots\dots (1)$$

Where Ph_i is the price of the house, and S_j,N_k, and Q_m represent the location, structure, and the environment.

This research will focus on using the log-linear specification of the hedonic model in estimating the price of the house. In this specification, both the dependent is in the log form and explanatory variables are in the linear form. This makes it easy to interpret results and also generates linearity in the parameters which is one of the assumptions of the ordinary least squares method. Thus, the log-linear of this hedonic model is;

$$lnP = \alpha + \sum \beta z_{.} + \varepsilon \text{ ..... (2)}$$

where;

P denotes the price of the house

α is the intercept

$\beta_{.}$ Represents a percentage change in housing price if there is a percentage change in the characteristic.

z is the characteristics of the house.

ε is the random error term.

In estimating the hedonic model, this research will focus on modeling the hedonic regression using structural characteristics. That is, the research will estimate the implicit price of some structural components of a house. This is because, a change in policy will affect housing prices and since the data and the nature of the policy makes it difficult to capture the impact of the policy, housing price here is used as an explanatory variable. Most variables in the model will be treated as dummy variables and will be given 1 if the variable is present and 0 if the variable is non-existent.

4.4.3 HEDONIC REGRESSION

From equation 4 the hedonic regression for this research thus is;

$$LnP = a + \sum \beta z + MUi + \varepsilon \quad \text{..... (3)}$$

Where Z includes the living area (LA) and estate type (EST). Living area is divided into three parts; small living area (less than 45 square meters), medium living area (greater than 45 square meters but less than or equal to 85 square meters) and large living area (an area greater than 86 square meters). Also, there are four types of estates being considered here.They are Leilighet, Rekkehus, Enebolig and Tomannsbolig.

MU is the municipality (council name) and

ε is the error term. Variables that affect housing prices other than the ones above

Table 5. Variables used in the Analysis

VARIABLES	TYPE OF VARIABLE	UNIT OF MEASUREMENT
Sales Price (P)	Dependent variable	log
Council Name (PL)	Independent variable	Dummy (1=Oslo, 2= Stavanger, 3= Bergen, 4= Trondheim and 5= Tromsø)
Living Area (LA)	Independent variable	Dummy (1= small living area, 2= medium living area and 3= large living area)
Estate Type	Independent variable	Dummy (1= Leilighet, = Enebolig, 3= Rekkehus, 4= Tomannsbolig)

From the table above, sales price represents the price of the house and it's the independent variable. We make dummies of the independent variables and the categories are in the brackets in the table above (under unit of measurements).

The hedonic model helps to find evidence of a change or improvement in price prediction after the introduction of the 2017 mortgage policy.

Table 6. Results of Hedonic Model

Variables	**2017**	**2018**	**2019**
lnP-dependent			

M. Living Area	**0.3472513*** **(0.0060092)**	**0. 3180673*** **(0. 0061971)**	**0.3329817*** **(0.0061812)**
L. Living Area	**0.7552572*** **(0.0069087)**	**0. 7346271*** **(0. 0070916)**	**0.7495559*** **(0.0070998)**
Rekkehus	**0.0354262*** **(0.0060092)**	**0. 0520244*** **(0. 0083707)**	**0.0327565*** **(0.0084276)**
Enebolig	**0.4432906*** **(0.0069087)**	**0. 448133*** **(0. 0076511)**	**0.461775** **(0.0077952)**
Tomannsbolig	**0.2456084*** **(0. .0083115)**	**0. 2505974*** **(0. 008819)**	**0.258451*** **(0.0088009)**
BERGEN	**-0.4620383*** **(0 .0074857)**	**-0. 4624789*** **(0. 0051163)**	**-0.5076268*** **(0.005259)**
TRONDHEIM	**-0.4236541*** **(0 .0087333)**	**-0. 4222968*** **(0. 005372)**	**-0.4653336*** **(0.0055006)**
STAVANGER	**-0.5297906*** **(0.0049569)**	**-0. 5492663*** **(0. 0074154)**	**-0.6009125*** **(0.0074395)**
TROMSØ	**-0.4766287*** **(0.0053036)**	**-0. 4833412*** **(0. 0087892)**	**-0.4721633*** **(0.0092768)**
Cons	**14.80638*** **(0.0072925)**	**14.83066*** **(0.0057956)**	**14.86521*** **(0.0057634)**
	R-Squared= 0.5596 **Observations= 30,346**	**R-Squared= 0.5450** **Observations=31,302**	**R-Squared=0.5503** **Observations=32,523**

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From the table above, the price of a Leilighet with a small living area had a slower increase in price from 2017 to 2019. In 2019, it had a 14.8% increase in prices, 14.83% in 2018 and the

14.86% increase in 2019. This therefore shows that, after the policy, though house prices grew, it grew at a slower rate compared to the growth rates from 14.6% in 2015 to 14.8% in 2016. The results for this can be found in the appendix.

Living Area is significant in the pricing of houses. We see that as the living area increases there is a surge in the housing prices. From the table …. above, medium living area had 34.7% higher prices than small living Area. This decreased to 31.8 in 2018 and then increased to 33.3 in 2019. Also, we see that there are 75.5% higher prices houses with large living area relative to the houses with small living area. Comparing these figures with that of 2015 and 2016, a period before this current policy, it can be seen that, though there are increases in prices, the increase has been slower. This can be seen from the fall in the relative prices of medium and large living areas to small living areas.

The city also is significant to determining housing prices. Oslo is the reference dummy in this case. Generally, house prices have been rising but at a slower rate. The results show how the prices in the other cities have been behaving compared to prices in Oslo where the policy is more binding due to the extra regulation for Oslo only. Houses located in Stavanger increased but were 53%,545 and 60% less than prices in Oslo in 2017,2018 and 2019 respectively. Houses in Bergen also increased but were 46.2%,46.2% less than prices of a similar house in Oslo in 2017,2018 and 2019 respectively. Also, prices of similar houses in Trondheim were 42%,42% and 46% less than prices in Oslo in 2017,2018 and 2019 respectively. Houses in Tromsø exhibited 47.6%,48% and 47.2% less than prices of a similar house in Oslo in 2017,2018 and 2019 respectively.

4.4.4 STATIONARITY

According to Stock and Watson (2015), "A time series y_t is stationary if it´s probability distribution does not change over time. That is, if the joint distribution of $(y_{t+1,}y_{t+2} \dots y_{t+T})$ does not depend on time, otherwise y_t is said to be nonstationary. Stationarity requires the future to like the past, at least in the probability sense".

A stationary process must have a constant mean, constant variance, constant autocovariance structure, periodic functions and be without trends. Ignoring stationarity may lead to inaccurate results or what is termed as the spurious regression problem. To avoid the spurious regression problem, we can model the series in first difference. Cointegration is another way of avoiding spurious regression.

The Augmented Dickey-Fuller test is used to test for stationarity. We reject the null hypothesis if the Augmented DF statistic is less than the Augmented DF critical. If we reject the null hypothesis, it means that, that there is no unit root. If we fail to reject the null hypothesis, it means that there is a presence of unit root.

To start with, all variables but After-tax mortgage rate were linearized by taking logarithms of them. This makes the data easy to work with. After this, all the variables were plotted to get a virtual picture of what they look like in terms of trends, breaks etc. All the variables exhibit features of a trend.

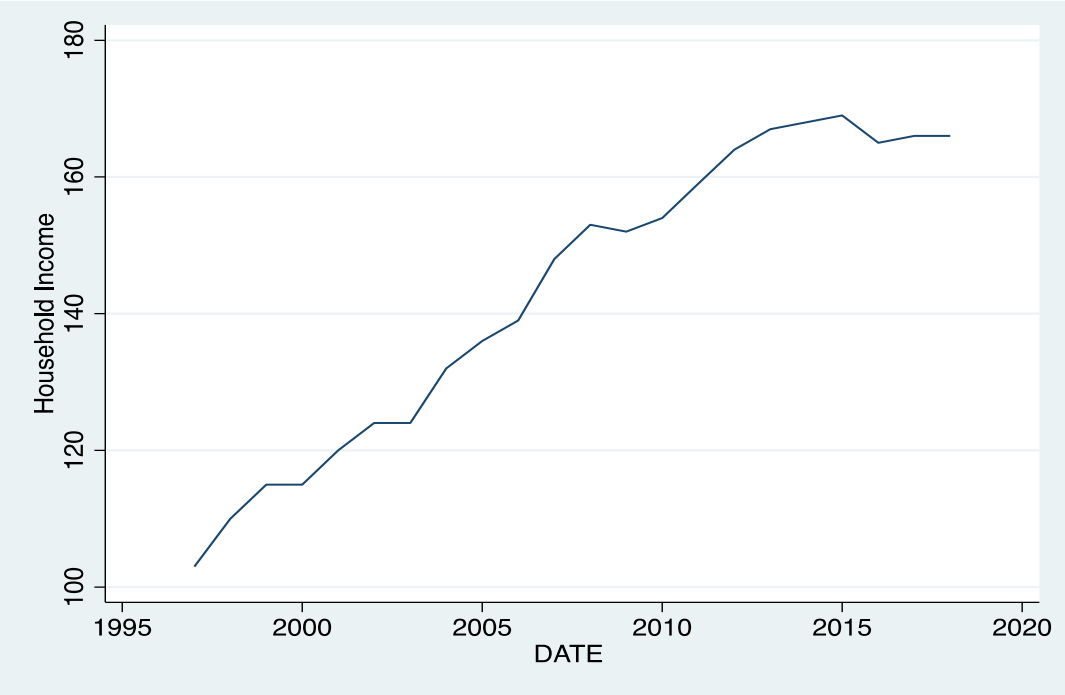

Figure 16. Household Income (Yearly Average in Norwegian Krones)

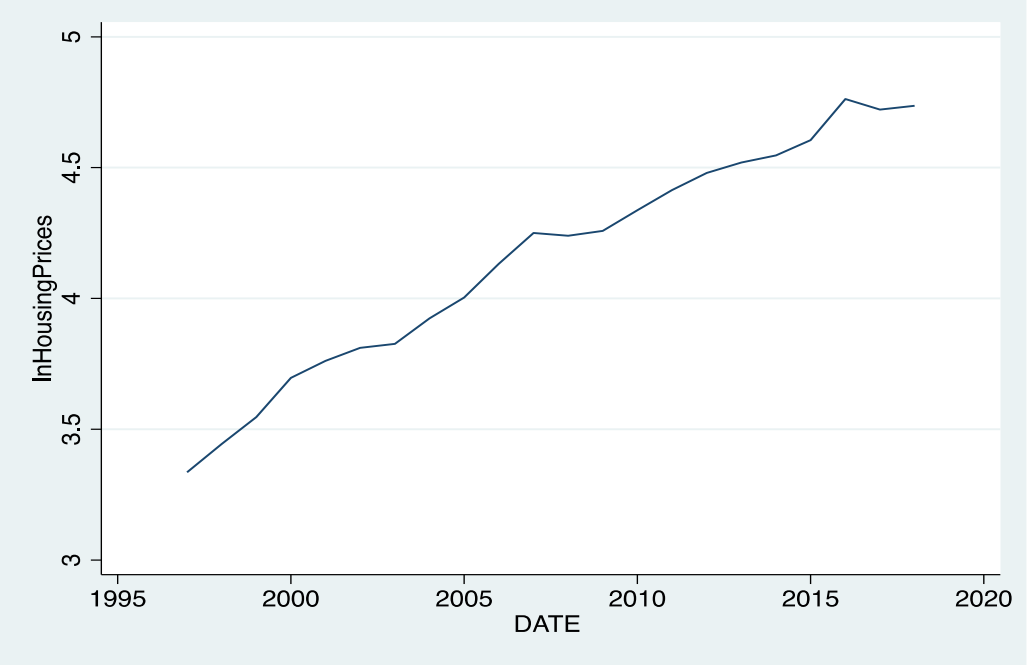

Figure 17. House Price (In Norwegian Krones)

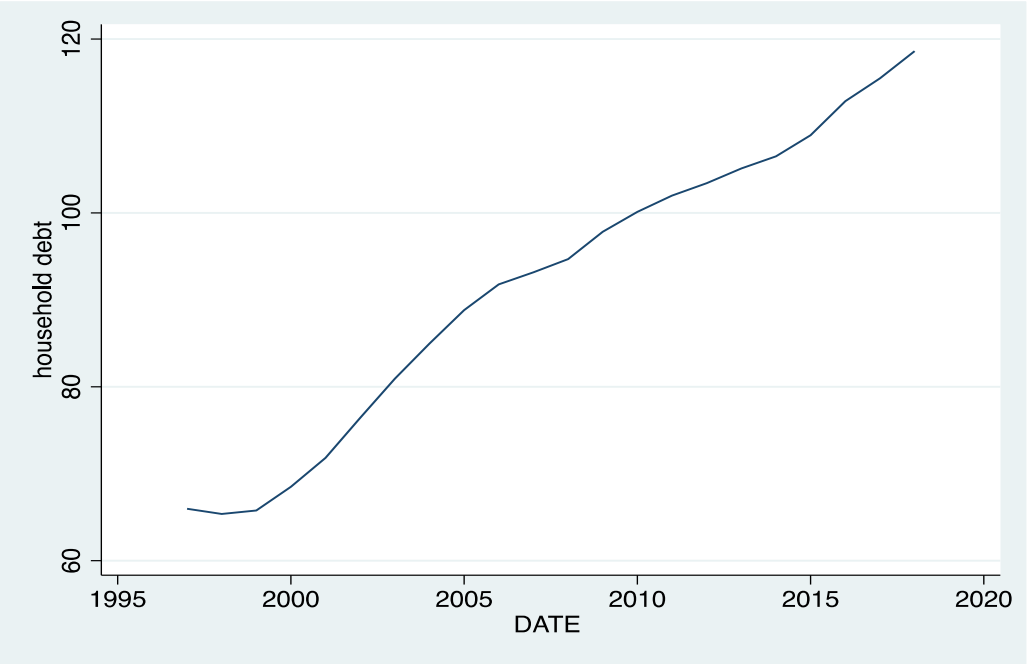

Figure 18. Household Debt (Yearly Average in Norwegian Krones)

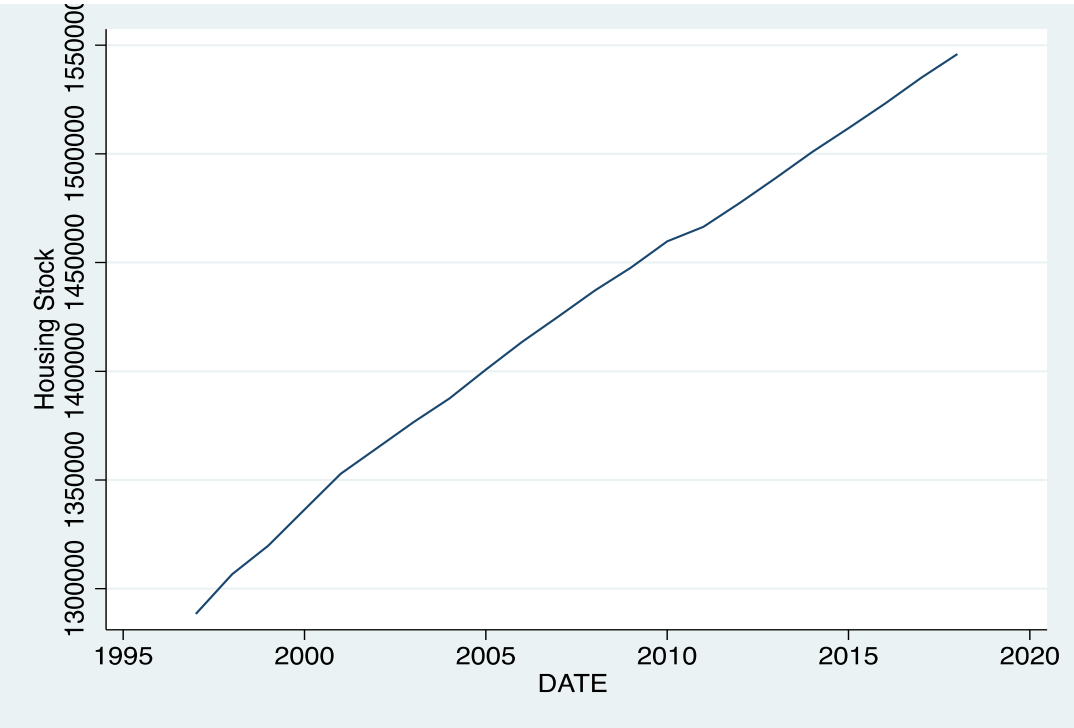

Figure 19. Housing Stock (Yearly) in Millions

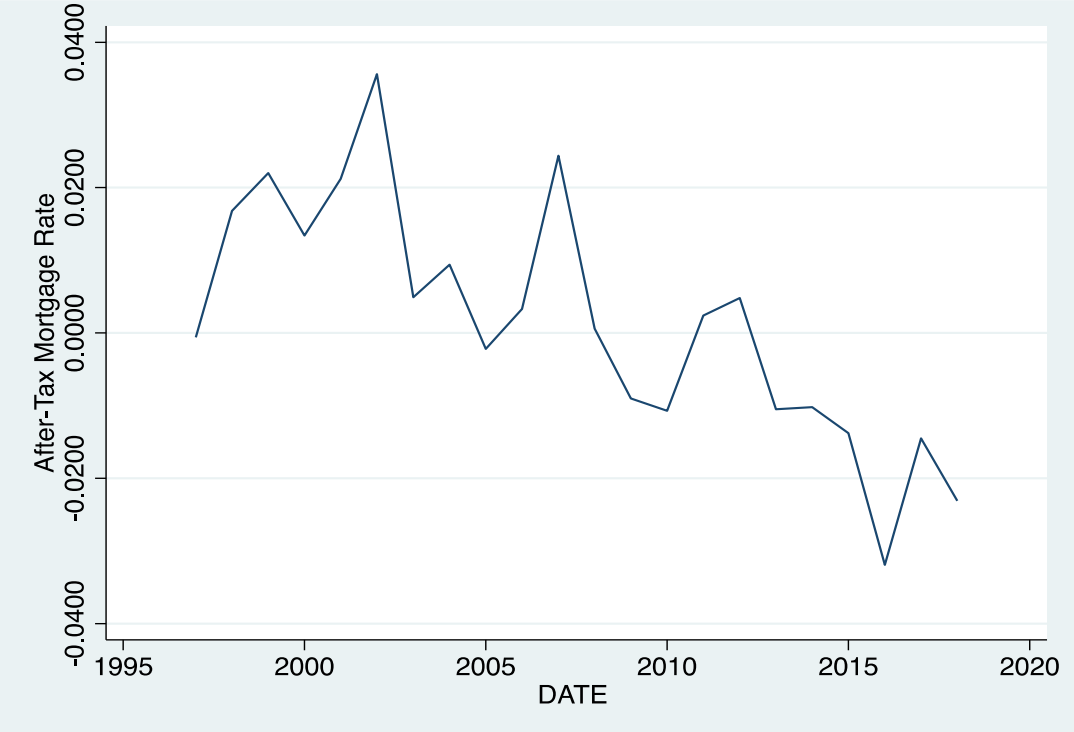

Figure 20. After-Tax Mortgage Rate Trend (Yearly Average in Percentages)

Then, to determine the optimal lag for each variable in the stationarity test, the Akaike information criterion (AIC) suggested two lags for all the variables except average housing prices. AIC helps in testing if the model fits the data well to avoid over-fitting it. Four lags were determined for the average housing prices.

The reason why I determined the number of lags individually was to avoid a situation whereby I lose degrees of freedom statistically insignificant coefficients and multicollinearity. Also, few lags may lead to a specification error. Therefore, it was necessary to use the AIC to determine the number of lags for the stationarity test.

The Augmented Dickey-Fuller test was initiated to test for stationarity for all the variables. Table 7. All the variables except household debt and housing stock, were non-stationary at level but stationary after first difference. Household debt and housing stock were stationary at level. Therefore, the next step is to perform the cointegration test

Table 7. Stationarity Test

VARIABLE	**TEST STAT(LEVELS)**	**5% CRITICAL**	**TEST STAT (1^{ST} DUFFERENCE)**	**5% CRITICAL**
LnHousingStcok	**-2.001**	**-3.600**	**-4.028**	**-3.600**
LnHouseholddebt	**-3.732**	**-3.600**		**-3.600**
lnHouseholdIncome	**0.094**	**-3.600**	**-4.326**	**-3.600**
LnHousingPrices	**-1.078**	**-3.600**	**-3.979**	**-3.600**
AfterTaxMortgage	**-4.199**	**-3.600**		**-3.600**

4.4.5 COINTEGRATION

Time series data are said to be cointegrated if they have a long-run relationship. There are two popular methods of testing for cointegration. These are the Engle-Granger method and the Johansen test. This research will use the Johansen test for cointegration.

In 1988, Johansen extended the work of Engle and Granger (1987) to make room for the existence of more than one cointegrating relationship in cases where there is more than one explanatory variable. Therefore, he came out with the maximum likelihood estimator to help

address some of the limitations of the Engle-Granger method. If cointegration exists in the dataset, the next step will be to perform a vector error correcting model.

From the results for the stationarity test, it is therefore plausible to go ahead with the cointegration test. If there is no cointegrating equations in the model, then VECM cannot be estimated. We will rather estimate VAR. The Johansen tests for cointegration was conducted. From the trace statistic, it revealed that there were two cointegrating vectors in this model. This is consistent with the results of (Anundsen and Jansen, 2013) showing that there is cointegration between housing prices and the other variables.

4.4.4.1 RESULTS OF THE JOHANSEN TEST FOR COINTEGRATION

Table 8. Johansen Cointegration Test: Trace Statistic

MAXIMUM RANK	Parms	LL	eigenvalue	Trace statistic	5% critical
0	35	377.78542	.	133.7870	77.74
1	44	366.67079	0.94434	76.0163	54.64
2	51	387.27746	0.87263	34.8029	34.55
3	56	397.86497	0.65311	13.6279*	18.17
4	59	403.61808	0.43747	2.1217	3.74
5	60	404.67893	0.10065		

Table 9. Johansen Cointegration Test: Maximum Statistic

MAXIMUM RANK	Parms	LL	eigenvalue	Max statistic	5% critical
0	35	-131.75735	.	57.7707	36.41
1	44	-104.84518	0.93220	41.2133	30.33
2	51	-85.936296	0.84906	21.1750	23.78
3	56	-75.385637	0.65183	11.5062	16.87
4	59	-70.135543	0.40845	2.1217	3.74
5	60	-69.192747	0.08997		

Number of observations is 20 with 2 lags. The sample spans from 1999 to 2018. The trace statistic and the maximum statistic can be used to determine the number of cointegrating equations. The trace statistic will be used to determine the number of cointegrating variables Johansen (1988) and Anundsen and Jansen (2013). From the table, the trace statistic on table. it is established that there are three cointegrating equations.

Since there are three cointegrating vectors confirming the presence of cointegration, the next step is to estimate a VECM model.

4.4.6 VECTOR ERROR CORRECTION MODEL

The vector error correction method used by Anundesn & Jansen (2013) will be replicated in this model. It helps by using a single framework to study the long-run determinants and short-run dynamics of housing prices. In the short-run, house prices tend to be cyclical, but the fundamentals help to develop equilibrium in the long-run Riksbank (2011). The vector error correction method will help to look at the impact of macroeconomic variables on housing prices and household debt. This was not possible with the hedonic regression. The vector error correction model helps in teasing out the dynamic adjustment from the short-run to the long-run.

The vector error correction method thus will help to find out how restrictions in the mortgage market in Norway will affect the housing market in Norway. Thus, the relationship between credit supply and housing prices. The presence of cointegration, therefore, forms the basis of constructing a vector correction model. The cointegration term is known as the error correction term. This is because the deviation from the long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

The VECM process involves,

1. Specifying and estimating a VAR model for the integrated multivariate time series.
2. Calculate likelihood ratio tests to determine the number of cointegration relations.
3. Estimate VECM.

The mortgage policy introduced was uniform across Norway. This makes estimating the policy impact difficult. Also, since the period after the implementation of the policy is short, it´s difficult also to look at the long-term impact of the policy. House prices and household debt

are used as explanatory variables to tease out the impact of the mortgage policy. An impact of this policy if and only if there is, will be captured in these variables. The policy will affect the demand for houses and hence housing prices. Also, since housing prices constitute about 80 percent of household debt, household debt also captures the effect of the policy.

VECM treats all the variables as endogenous variables. That is, since there are five variables, VECM will estimate five equations. But since this research is interested in two main variables; housing prices and household debt, the research only considers two equations. This is formulated in equations 4 and 5.

$$\ln Hp = \propto + \Sigma_{i=1}^{K-1} B_i \Delta lnHp_{t-1} + \Sigma_{j=1}^{k-1} \emptyset \Delta Y_{t-j} + \Sigma_{m=1}^{k-1} \psi_m \Delta D_{t-m} + \Sigma_{u=1}^{k-1} \varphi_u \Delta R_{t-u} + \lambda_1 ECT_{t-1} + U_{1t} \quad \ldots\ldots\ldots\ldots (4)$$

$$\ln D = \propto + \Sigma_{i=1}^{K-1} B_i \Delta lnD_{t-1} + \Sigma_{j=1}^{k-1} \emptyset \Delta Y_{t-j} + \Sigma_{m=1}^{k-1} \psi_m \Delta Hp_{t-m} + \Sigma_{u=1}^{k-1} \varphi_u \Delta R_{t-u} + \lambda_2 ECT_{t-1} + U_{2t} \ldots\ldots\ldots\ldots\ldots (5)$$

Where;

Hp is House Price

Y is Household income

D is household debt

R is the after-tax mortgage rate

ECT is the error correction term and

U is the stochastic error term or impulses.

From equation 4 and 5, dependent variable is regressed on its previous lag and the independent variables. There is also an error correcting term (ECT). ECT explains how the previous periods deviation from the LR equilibrium (which is error) influences the SR movement in the dependent variable. Lambda, coefficient of the error correcting term, measures the speed of adjustment. Thus, it measures the speed at which the dependent variables return to equilibrium after changes in the independent variable. To ensure convergence to LR equilibrium, it must come with a negative sign.

In order to implement VECM, certain conditions have to be met. The series must be stationary. It can be observed from table that the series are stationary. The optimal lag was also determined using the AIC. The Johansen test for cointegration was performed to determine the presence of cointegration. Table 6 provides the results of the cointegration test.

The data sample covers from 1997 to 2019. housing prices and are aggregated to get a yearly average. From above, stationarity test was conducted, and they were stationary after first difference. This made it prudent to perform the Johansen test to determine whether there is cointegration and the number of cointegration equations that exist. There was two cointegrating equations. Since there is there is cointegration, we go ahead to estimate VECM.

To begin, VAR model is estimated in real housing prices, real household debt, real after-tax rate and the housing stock. To get the order of VAR, this research employs the Akaike Information Criterion. From AIC, the VAR model should include four lags. We are just concerned with two equations; housing prices and household debt.

Table 10. VECM Results

VARIABLES	**D_lnHouseholddebt**	**D_lnHousingPrices**
Error correction term	**-0.426*** **	**0.947**
	(0.0898)	**(0.7556)**
LD.lnHouseholddebt	**0.515*** **	**-0.739**
	(0.104)	**(0.877)**
LD.lnHousingPrices	**-0.119*** **	**0.034**
	(0.0329)	**(0.277)**
LD.lnHouseholdIncome	**0.311** **	**-1.285**
	(0.125)	**(1.0489)**
LD.lnHousingStock	**-2.726***	**2.3678**
	(1.452)	**(12.2136)**
LD.AfterTaxMortgageRate	**-0.0353**	**-0.0003**
	(0.136)	**(1.1437)**
_trend	**-0.00301*** **	**-0.002**
	(0.000729)	**(0.006)**
Constant	**0.0768*** **	**0.1025**
	(0.0227)	**(0.1905)**
Observations	**20**	**20**

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The error correction term, household debt, housing prices, the trend and the constant are significant at 1% significance level. Household income is significant at 5% and housing stock is significant at 10%.

In this study, we trace the effectiveness of housing policy through housing prices. As stated in the previous section, it is difficult to measure the effectiveness of the policy partly because the policy has only been in place for a few years and also because, the policy is uniform across Norway except for the fifth one which states that "for Oslo, the loan-to-value ratio for secondary housing shall not exceed 60 percent".

To do this, we find out how housing prices affect household debt. From the estimation results, there is significant negative adjustment term at the 1% level. This implies that the speed of adjustment (-0.426) is not explosive and thus there is a long run convergence. Thus, the adjustment toward equilibrium is not rapid. The adjustment term measures the rate at which housing prices returns to equilibrium after changes in the independent variables. The speed of adjustment suggests that, previous year´s error (deviation from long-run equilibrium) are corrected for within the current year at a convergence speed of 42.6%.

The short run elasticity of Housing Prices with respect to Household Debt is -0.119 which is significant at the 5% significance level. This implies that, a 1% rise in housing prices will lead to a 0.119% drop in household debt. This result can be interpreted as that as government implement housing policy that is observed through housing prices, individuals reduce their demand for housing as prices become expensive, all things being equal. Due to this, Household debt has been growing at a slower rate.

There's a significant positive relation between household income and household debt. As household income rises, the demand for housing increases. The elasticity of household income with respect to household debt is 0.311%. Thus, a 1% rise in household income increases household debt by 0.311%.

Also, there is a negative significant relation between housing stock and household debt. As housing stock increases, household debt falls. The elasticity of housing stock with respect to household debt is -2.726% A 1% rise in housing stock leads to a fall in household debt by -2.726%.

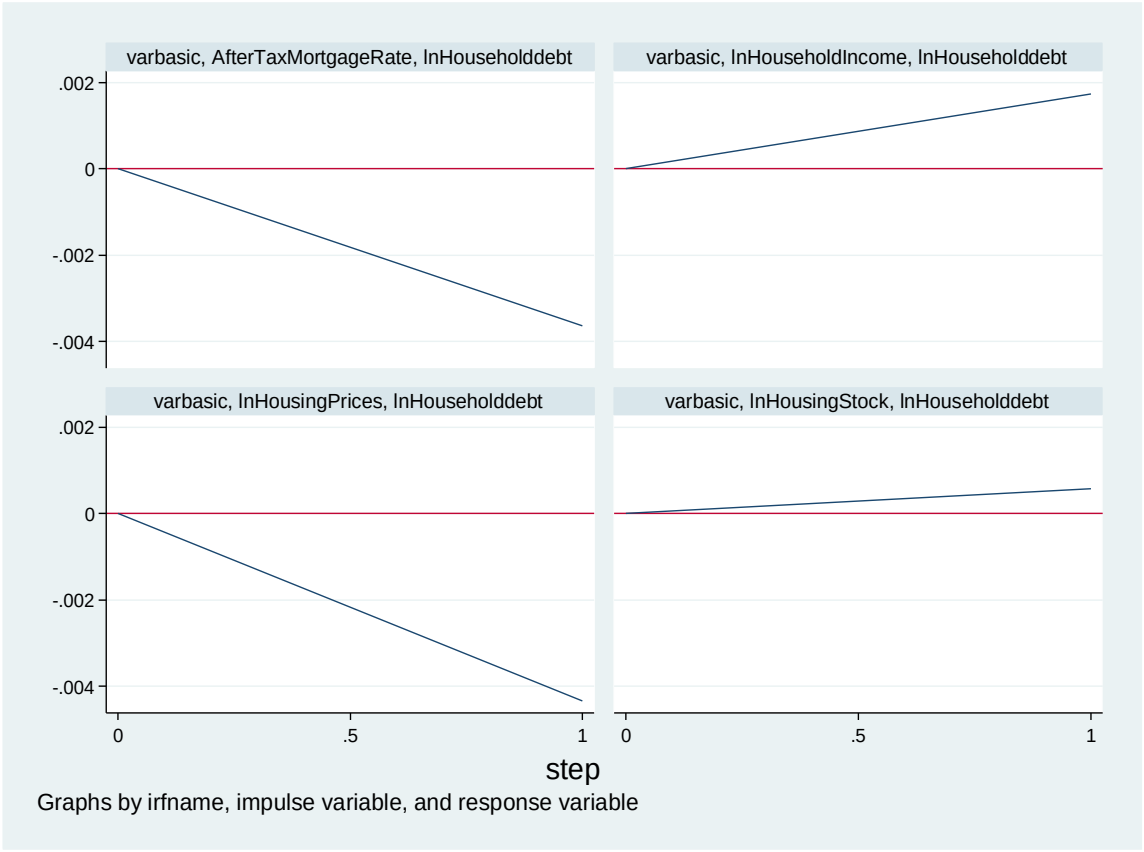

Figure 21. IRF Graph. The red line is the impulse variable and the blue represents the response functions of lnHouseholddebt.

To further understand how household debt responds to exogenous shocks, I conduct an impulse response analysis. An impulse response function provides the time profile of the effect of an external change that occurs at a given time on the expected values of variables in a dynamic system. I construct the function under the assumption of a one standard deviation shock from regressors.

The results from the IRF graph above reaffirms the relationship between household debt and housing prices. As can be observed from graph 18, household debt responds negatively to a one standard deviation shock (a positive shock) in housing prices. Thus, household debt (bottom left) reduces after a positive shock in housing prices occur and hence a negative relationship between household debt and housing prices.

The test for model stability shows that the model is stable since VECM imposes 4-unit moduli.

4.4.7 INTEREST RATE AND HOUSE PRICES

From the VECM results in the appendix, there is an insignificant negative relationship between house price and the after-tax mortgage rate. The significance level confirms that by Anundesn & Jansen (2013), but they find the relationship to be ambiguous. According to Anundesn & Jansen (2013), the effect of interest rate is captured through loans and household income. The result, though not significant, confirms the relationship between house price and interest rate found by Wang et al. (2018) in their study "Is the Australian housing market in a bubble".

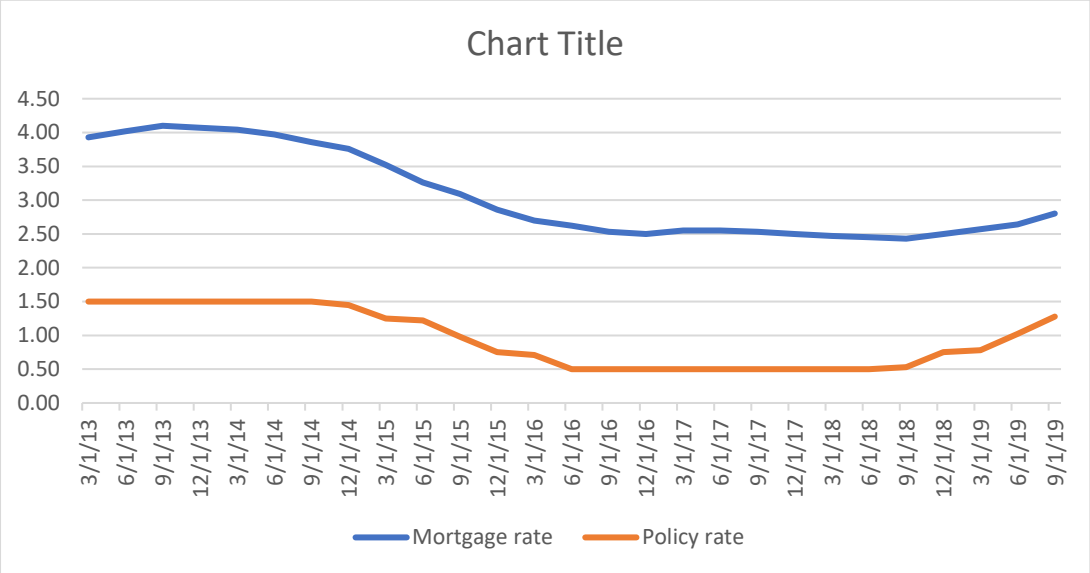

Figure 22. *Mortgage Rate and Policy Rate*.

The diagram above represents the mortgage rate and policy rate in Norway from the first quarter of 2003 to the third quarter of 2019.

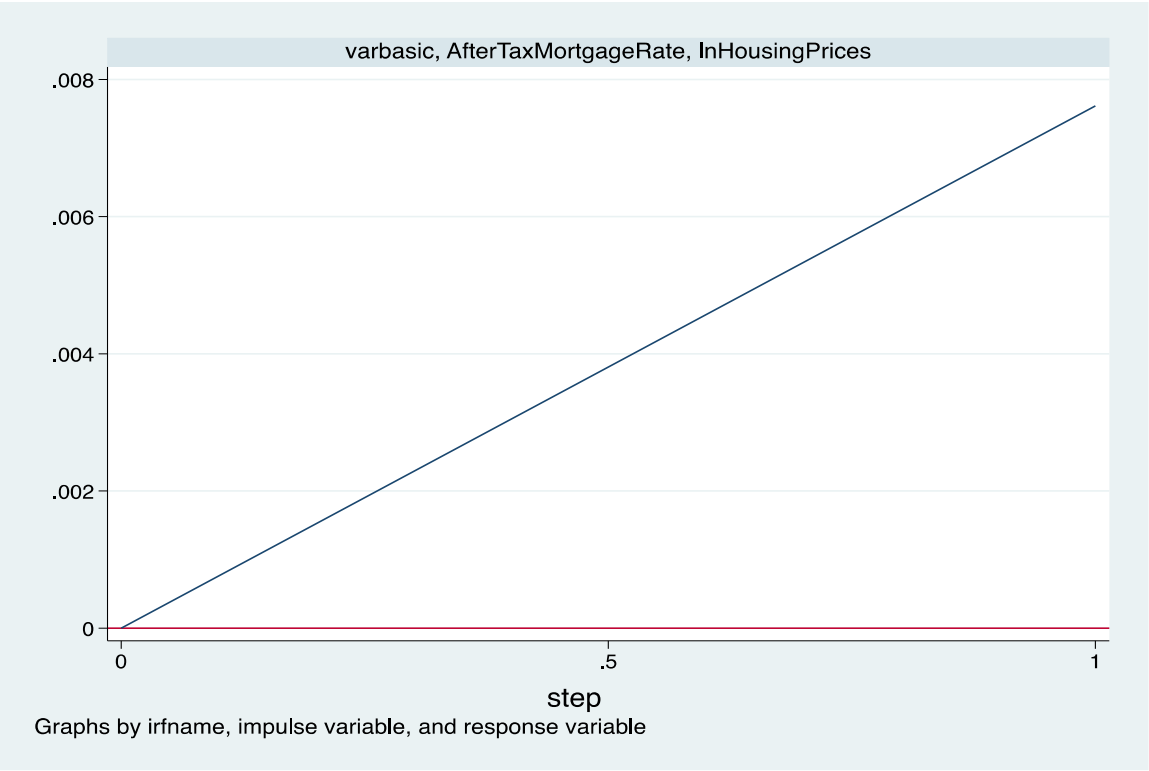

Figure 23. IRF Graph of After-tax Mortgage Rate and House Price

The IRF graph exhibit the adjustment or time path of the variables explained in the VAR model above when there is a shock to one of the variables. The response of house price to a shock in the after-tax mortgage rate in the IRF graph reaffirms the relationship from the VECM results. As after-tax mortgage rate falls, it is easier for households to access mortgage loans and then purchase homes. This pushes the demand for homes and hence leads to an increase in price.

CHAPTER FIVE: CONCLUSION

5.1 INTRODUCTION

This chapter provides a summary and conclusion of this study. It provides some recommendations and also talks about the limitation of the study and the areas where further studies can be undertaken.

5.2 SUMMARY

In an attempt to analyse the effect of the effect of the 2017 Mortgage regulation introduced by the Norwegian government to strengthen the guidelines introduced in 2010 that transformed into law in 2015, this research employs data from Eiendomsverdi, Statistics Norway and Norges Bank. The research also employs econometric tools like hedonic regressions and the vector error correction model to help analyse the impact of the policy.

From the results, it is found that, though housing prices have been increasing after the policy intervention, the rate of growth have been slower. The rate of growth has been hovering below 4% from 2018 through to the third quarter of 2019. The rate of growth of housing prices experienced a significant fall after the introduction of the 2017 policy. At the start of the second quarter annual increase in Housing prices was hovering above 12%. This fell substantially and ever since, has been hovering below 4%.

Thus, after the policy was introduced, there was a great shock to housing prices. This shock led to the substantial fall in housing prices in 2017 and the policy has been able to keep house price growth hovering below 4%.

Also, the price of a Leilighet with a small living area in Oslo had 14.8% in 2016 (a year before the 2017 mortgage regulation) and had a 14.86% change in 2019 (years on after the policy change). This shows a slower growth in house prices. Considering the fact that it had 0.2% increase from 2015 to 2016 and 0.06% change from 2017 to 2019.

Also, prices of Enebolig was the most expensive followed by Tomannsbolig, Rekkehus and Leilighet respectively. That is, the type of estate also had a strong bearing on the price of a house. Prices also depended on the size of the living area and the name of the council. Oslo has higher prices than all the other regions.

From the results, there is a negative relationship between house prices and household debt. As housing prices increase, household debt fall. This is because, people reduce their demand for houses. This is because, the number of people who are able to access mortgage is impacted by the new laws put in place. This makes it difficult for people to qualify for mortgage loans and thereby leading to a fall in the growth rate of household debt. That is, the additions to the household debt falls, all other things being equal.

Tracing the effect of the policy by using house prices as explanatory variable, a 1% rise the price of houses will lead to 0.119% drop in household debt. That is the reason why the growth rate of household debt has decreased. This because, the slower increases in house prices affect the household debt.

With the data available, this research has managed to analyse the impact of the 2017 mortgage regulations. But there are some limitations to this research. This research with the data didn't analyse the impact of each of the regulations on housing prices and household debt. For example, what is the impact of DTI ratio on housing prices. That is, if the share of household with a DTI ratio greater than five has a different impact than those of households with a DTI ratio less than five.

Again, due to lack of enough data, VECM does not give a clear impact of the policy on household debt. But it helps to tease out the impact of the policy using house prices as an explanatory variable.

Despite these challenges, this research goes to add to other works in this field on the impact of the policy on housing prices and household debt. It also re-echoes the determinants of house prices and household debt.

5.3 RECOMMENDATION

To conclude, this research can provide different outcome in some years to come. This is because, to assess the impact of the policy, there must be enough years after the policy to know whether the policy can withstand the test of time. Also, enough data on debt and the DTI ratio might also lead to more revealing impacts of the policy on house prices and household debt.

REFERENCES

Adelino, M. et al. (2012) Credit Supply and House Prices: Evidence from Mortgage Market Segmentation. *NBER Working Paper Series*. [Online] n/a. [online]. Available from: http://search.proquest.com/docview/1687842216/.

Andersson, R. et al. (2010). Immigration, housing and segregation in the Nordic welfare states. Retrieved from https://helda.helsinki.fi/bitstream/handle/10138/25849/julkaisuc2.pdf

K Anundsen, A. & S Jansen, E. (2011) Self-reinforcing effects between housing prices and credit: Evidence from Norway. *IDEAS Working Paper Series from RePEc*. [online]. Available from: http://search.proquest.com/docview/1698482060/.

Anundsen, A. K. & Jansen, E. S. (2013) Self-reinforcing effects between housing prices and credit. *Journal of Housing Economics*. [Online] 22 (3), 192–212.

Borchgrevink, H., & Torstensen, K. N. (2018). Analyses of Effects of the Residential Mortgage Loan Regulation. Available from: https://static.norges-bank.no/contentassets/7dbc1421917c43a7a8a3f67e5f072d37/economic_commentaries_1-18.pdf?v=06/19/2018101557&ft=.pdf

Case, K. E. & Shiller, R. J. (1988) *The Behavior of Home Buyers in Boom and Post-Boom Markets*. Markets New England Economic Review, 29-46.

Eiendom Norge. (2018). Boligprisutvikling i Norge etter beregning av boligprisindeks. Retrieved from http://eiendomnorge.no/boligprisstatistikken/

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. Econometrica: journal of the Econometric Society, 251-276.

Finocchiaro, D., Nilsson, C., Nyberg, D., & Soultanaeva, A. (2011). Household indebtedness, house prices and the macroeconomy: a review of the literature. sveriges riksbank economic review, 1, 6-28.

Finansforetaksloven. (2016). Forskrift om krav til nye utlån med pant i bolig (boliglånsforskriften). Available from https://www.regjeringen.no/no/dokumenter/forskrift-om-krav-til-nye-utlan-med-pant-i-bolig-boliglansforskriften/id2523973/.

Finanstilsynet. (2010). Banks`s Adjustment to Finanstilsynet`s Guidelines on Home Mortgage loans. Retrieved from https://www.finanstilsynet.no/en/news-archive/press-releases/2010/banks-adjustment-to-finanstilsynets-guidelines-on-home-mortgage-loans/

Gao, Z. et al. (2019) *Economic Consequences of Housing Speculation*. Cambridge, Mass., USA: National Bureau of Economic Research. [online]. Available from: http://www.nber.org/papers/w26457.pdf.

Gulbrandsen, L. (2004). Home ownership and social inequality in Norway. Home ownership and social inequality in comparative perspective, 166-186.

Hyman, D. N. (1985). Economics

Igan, D., & Kang, H. (2011). Do loan-to-value and debt-to-income limits work? Evidence from Korea. IMF Working Papers, 1-34.

Johansen, S. (1988). Statistical analysis of cointegration vectors. Journal of economic dynamics and control, 12(2-3), 231-254.

Kau, J. B., Sirmans, C. F. (1985). Real Estate.

Lindquist, K.-G., Solheim, H., & Vatne, B. H. (2017). Household Debt and Links to the Housing Market-Consequences for Financial Stability.

Ministry of Finance. (2015). Forskriftsfester fleksible krav til boliglån. Accessed 22.05.2019 from https://www.regjeringen.no/no/aktuelt/forskriftsfester-fleksible-krav-til-boliglan/id2417372/

Mishkin, F. S. (2004). The economics of money, banking, and financial markets. 7th ed., USA: Columbia University, 849.

Moe, T. G., Solheim, J. A. and Vale, B. (2004). The Norwegian Banking Crisis. Norges Banks Skriftserie/Occasional Papers No. 33 https://static.norges-bank.no/contentassets/ed5dd397dce345338046a22c7e07f959/hele_heftet.pdf?v=03/09/2017122240&ft=.pdf

Norges Bank. (2019) Monetary Policy Report with Financial stability Assessment. Accessed from:https://www.norges-bank.no/en/news-events/news-publications/Reports/Monetary-Policy-Report-with-financial-stability-assessment/2019/mpr-419/

Regulations on Requirements for new mortgages (Mortgage Loan Regulations) https://lovdata.no/dokument/SF/forskrift/2019-11-15-1517

Riksbank, S. (2011). The Riksbank's inquiry into the risks in the Swedish housing market. Stockholm, April. Available from: http://archive.riksbank.se/Upload/Rapporter/2011/RUTH/RUTH%20eng.pdf

Rosen, S. (1974). Hedonic prices and implicit markets: product differentiation in pure competition. Journal of political economy, 82(1), 34-55.

Rubens, J., Bond, M., & Webb, J. (1989). The inflation-hedging effectiveness of real estate. Journal of Real Estate Research, 4(2), 45-55.

Shiller, R. (2007) Understanding Recent Trends in House Prices and Home Ownership. *IDEAS Working Paper Series from RePEc*. [online]. Available from: http://search.proquest.com/docview/1698242804/.

Stock, J. H. & Watson, M. W. 2015. *Introduction to econometrics*.

Turk, R. A. (2015) Housing price and household debt interactions in Sweden. (European Department)(Report). *IMF Working Papers*.

Xu, L. and Tang, B., 2014. On the determinants of UK house prices. *International Journal of Economics and Research*, *5*(2), pp.57-64.

APPENDIX A

REGRESSION WITH LIVING AREA AS A CONTINUOUS VARIABLE

Source	SS	df	MS	Number of obs	=	215,071
				F(1, 215069)	>	99999.00
Model	22753.859	1	22753.859	Prob > F	=	0.0000
Residual	30259.9079	215,069	.140698603	R-squared	=	0.4292
				Adj R-squared	=	0.4292
Total	53013.767	215,070	.246495406	Root MSE	=	.3751

lnHP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LivingArea	.0068633	.0000171	402.14	0.000	.0068299	.0068968
_cons	14.44929	.0016327	8850.20	0.000	14.44609	14.45249

YEAR 2015 HEDONIC REGRESSION

Source	SS	df	MS	Number of obs	=	31,263
				F(9, 31253)	=	4073.47
Model	3742.22884	9	415.803204	Prob > F	=	0.0000
Residual	3190.18117	31,253	.102075998	R-squared	=	0.5398
				Adj R-squared	=	0.5397
Total	6932.41001	31,262	.221751968	Root MSE	=	.31949

lnHp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
EST						
Rekkehus	-.0186025	.0084766	-2.19	0.028	-.035217	-.001988
Enebolig	.3606414	.0076796	46.96	0.000	.3455889	.3756938
Enebolig	.1707553	.008816	19.37	0.000	.1534755	.1880351
LA						
Medium Living Area	.338654	.0051423	65.86	0.000	.3285749	.3487331
Large Living Area	.802874	.0064775	123.95	0.000	.790178	.8155701
PL						
BERGEN	-.2733235	.0049507	-55.21	0.000	-.2830271	-.26362
TRONDHEIM	-.2954903	.0053055	-55.69	0.000	-.3058894	-.2850912
STAVANGER	-.2774482	.0073939	-37.52	0.000	-.2919406	-.2629558
TROMSØ	-.3553456	.0090157	-39.41	0.000	-.3730167	-.3376744
_cons	14.62195	.0046625	3136.06	0.000	14.61281	14.63109

YEAR 2016 HEDONIC REGRESSION

Source	SS	df	MS	Number of obs	=	30,231
				F(9, 30221)	=	4242.01
Model	3699.02994	9	411.003327	Prob > F	=	0.0000
Residual	2928.07776	30,221	.096888844	R-squared	=	0.5582
				Adj R-squared	=	0.5580
Total	6627.1077	30,230	.219222881	Root MSE	=	.31127

lnHp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
EST						
Rekkehus	-.0372828	.0084329	-4.42	0.000	-.0538117	-.0207539
Enebolig	.3737604	.007653	48.84	0.000	.3587603	.3887605
Enebolig	.182235	.0088348	20.63	0.000	.1649184	.1995516
LA						
Medium Living Area	.3132035	.0051647	60.64	0.000	.3030806	.3233265
Large Living Area	.7558709	.0065365	115.64	0.000	.7430591	.7686827
PL						
BERGEN	-.4186807	.0048599	-86.15	0.000	-.4282063	-.4091551
TRONDHEIM	-.3959472	.0052507	-75.41	0.000	-.4062388	-.3856556
STAVANGER	-.5083381	.007507	-67.72	0.000	-.523052	-.4936241
TROMSØ	-.4431333	.0084061	-52.72	0.000	-.4596096	-.426657
_cons	14.80054	.0046986	3150.02	0.000	14.79133	14.80975

VECM RESULTS

Sample: 1999 - 2018 — Number of obs = 20

AIC = -32.26708

Log likelihood = 366.6708 — HQIC = -31.83945

Det(Sigma_ml) = 8.19e-23 — SBIC = -30.07647

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_lnHouseholdd~t	8	.006505	0.9775	520.5967	0.0000
D_lnHousingPri~s	8	.054713	0.7344	33.18294	0.0001
D_lnHouseholdI~e	8	.021157	0.7078	29.06604	0.0003
D_lnHousingStock	8	.001382	0.9844	758.3162	0.0000
D_AfterTaxMort~e	8	.013512	0.4130	8.441916	0.3915

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_lnHouseholddebt						
_ce1						
L1.	-.426371	.0898349	-4.75	0.000	-.6024442	-.2502978
lnHouseholddebt						
LD.	.5148663	.104283	4.94	0.000	.3104755	.7192571
lnHousingPrices						
LD.	-.1189754	.0329455	-3.61	0.000	-.1835473	-.0544035
lnHouseholdIncome						
LD.	.3113096	.1247017	2.50	0.013	.0668989	.5557204
lnHousingStock						
LD.	-2.726497	1.452066	-1.88	0.060	-5.572494	.1194997
AfterTaxMortgageRate						
LD.	-.0352515	.1359696	-0.26	0.795	-.301747	.2312441
_trend	-.0030127	.0007291	-4.13	0.000	-.0044418	-.0015837
_cons	.0767554	.0226515	3.39	0.001	.0323593	.1211514
D_lnHousingPrices						
_ce1						
L1.	.9472539	.7556191	1.25	0.210	-.5337323	2.42824
lnHouseholddebt						
LD.	-.7392382	.8771444	-0.84	0.399	-2.45841	.9799333
lnHousingPrices						
LD.	.0339876	.2771107	0.12	0.902	-.5091394	.5771146
lnHouseholdIncome						
LD.	-1.284788	1.04889	-1.22	0.221	-3.340574	.7709994
lnHousingStock						
LD.	2.36777	12.21361	0.19	0.846	-21.57047	26.30601
AfterTaxMortgageRate						
LD.	-.0002793	1.143667	-0.00	1.000	-2.241826	2.241267
_trend	-.0019951	.0061329	-0.33	0.745	-.0140154	.0100252
_cons	.1025191	.190526	0.54	0.591	-.270905	.4759432
D_lnHouseholdIncome						
_ce1						
L1.	.5117605	.2921896	1.75	0.080	-.0609206	1.084442
lnHouseholddebt						
LD.	.2562812	.3391821	0.76	0.450	-.4085035	.921066
lnHousingPrices						
LD.	.1664046	.1071557	1.55	0.120	-.0436166	.3764259
lnHouseholdIncome						
LD.	-.4368427	.4055943	-1.08	0.281	-1.231793	.3581075
lnHousingStock						
LD.	4.764041	4.72287	1.01	0.313	-4.492614	14.0207
AfterTaxMortgageRate						
LD.	.091554	.4422436	0.21	0.836	-.7752275	.9583355
_trend	.0011143	.0023715	0.47	0.638	-.0035338	.0057625
_cons	-.0471707	.0736743	-0.64	0.522	-.1915697	.0972283
D_lnHousingStock						
_ce1						
L1.	-.0189555	.0190889	-0.99	0.321	-.0563691	.018458
lnHouseholddebt						
LD.	-.0227451	.022159	-1.03	0.305	-.0661759	.0206856
lnHousingPrices						
LD.	.0046269	.0070005	0.66	0.509	-.0090939	.0183477
lnHouseholdIncome						
LD.	-.0049335	.0264977	-0.19	0.852	-.0568681	.047001
lnHousingStock						
LD.	-.2011221	.3085477	-0.65	0.515	-.8058644	.4036202
AfterTaxMortgageRate						
LD.	.0052758	.028892	0.18	0.855	-.0513515	.0619031
_trend	-.0003444	.0001549	-2.22	0.026	-.0006481	-.0000408
_cons	.0144491	.0048132	3.00	0.003	.0050155	.0238828
D_AfterTaxMortgageRate						
_ce1						
L1.	.0522331	.1866121	0.28	0.780	-.31352	.4179862
lnHouseholddebt						
LD.	-.0290781	.2166247	-0.13	0.893	-.4536548	.3954985
lnHousingPrices						
LD.	.0963387	.0684369	1.41	0.159	-.0377951	.2304725
lnHouseholdIncome						
LD.	-.2350909	.2590401	-0.91	0.364	-.7428001	.2726183
lnHousingStock						
LD.	3.024849	3.016345	1.00	0.316	-2.88708	8.936777
AfterTaxMortgageRate						
LD.	-.2032136	.2824468	-0.72	0.472	-.7567991	.3503719
_trend	.0005455	.0015146	0.36	0.719	-.0024231	.0035141
_cons	-.0352218	.0470534	-0.75	0.454	-.1274448	.0570012

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	4	302.4598	0.0000

Identification: beta is exactly identified

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1						
lnHouseholddebt	1	.	.	.	.	.
lnHousingPrices	-.2756974	.0668383	-4.12	0.000	-.4066981	-.1446968
lnHouseholdIncome	.2469537	.1049348	2.35	0.019	.0412854	.4526221
lnHousingStock	-5.693186	1.269595	-4.48	0.000	-8.181547	-3.204825
AfterTaxMortgageRate	1.410552	.3158263	4.47	0.000	.7915435	2.02956
_trend	.0283706	.	.	.	.	.
_cons	75.82857	.	.	.	.	.

STABILITY TEST

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
.6335443 + .4637641*i*	.785147
.6335443 - .4637641*i*	.785147
-.1762609 + .3526446*i*	.394241
-.1762609 - .3526446*i*	.394241
-.2932209 + .1274551*i*	.319724
-.2932209 - .1274551*i*	.319724

The VECM specification imposes 4 unit moduli.

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