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HANDELSHØJSKOLEN

An Analysis of the Norwegian Housing Cycle

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Abstract

In Norway, the house prices are very much in focus. Both the development of the house prices and speculations about future development is of high interests for Norwegians. The Norwegian housing market is interesting to investigate due to the high number of households' owning their own house in compared to other countries. The purpose of this thesis is to analyze the Norwegian housing cycle and investigate five fundamental factors that may affect the housing cycle. We look into housing constructions, the business cycle, oil price, monetary policy and households' debt. The thesis is an exploratory study where we try to answer our problem statement of "How do various macroeconomic fundamentals affect the Norwegian housing cycle?" The analysis contains an evaluation of existing research regarding the housing cycle and historical development in Norway. In addition, we use the Hodrick-Prescott filter to detect cyclical changes in the house prices and the fundamentals. We also performed a correlation analysis to discuss possible relationships. We found a relationship between the cyclical movements of the house prices and the fundamentals. Housing prices usually tend to lead the fundamentals. The most substantial correlation coefficients are between the house prices and housing constructions. Higher house prices appears to affect housing construction positively. The housing cycle also seems to be leading the business cycle. We found that oil price could affect the house prices in areas where the oil sector is operated, and possible two-way interaction between the house prices and monetary policy. Increasing key rate puts pressure on the housing prices, and additionally, higher house prices may lead to increasing key rate. House prices and debt levels seem to move together. Higher house prices stimulate increasing debt for households', which again have a positive effect on the price development. The housing cycle is complex, and the fundamentals are affecting each other. The fundamentals move together with the housing cycle, whereas monetary policy moves countercyclically. The thesis does not assess the actual effect of the fundamentals on the housing cycle, only how they move with each other. For further research, a regression model to determine the exact impact would be applicable.

Contents

Table of figures

1. Introduction

1.1 Introduction and problem statement

In Norway, the housing prices are very much in focus. Both the development of the housing prices and speculations about future development is of high interests for Norwegians. There are also constant debates about the pricing level. The debate focuses on future development, and whether fundamental factors support housing prices or heading towards a housing bubble.

The high focus on housing cycle in Norway is most likely due to the high number of Norwegians owning their own house instead of renting. Over 80 percent of households own their own home, which is very high compared to most other countries (Iversen & Skorve, 2016). Therefore, the price development is highly relevant. It is also one of the most substantial investment during a lifetime, which increases the importance of house price development.

Since the 1990s, the house prices have increased significantly. However, like the rest of the world, Norway was hit by the financial crisis in 2008, whereas the house prices started to decrease already in 2007. The Norwegian housing market shortly recovered, and the house prices again began to rise and increased until 2017. Since then, the price growth started to slow down, and we experienced a small decrease in the house prices last year.

It is interesting to analyze the potential effect different economic fundamentals that may have on the Norwegian housing cycle. There are many theories and discussions regarding which fundamental are affecting the housing cycle, and to what extent. Jacobsen and Naug (2004a) argue that housing construction and interest rate are one of the more essential factors the housing price level. Especially changes in interest rates profoundly affect the housing price level in the short-term. Jansen (2011) states that lowering the interest rates contributes to higher housing price levels. He also points out that increasing debt is driving the house price level upwards. In addition, there is evidence that changes in oil price affect the house prices (Filis & Chatziantoniou, 2013). In addition, Goodhart and Hoffman (2007) suggest that housing cycle and business cycle closely correlates. The housing cycle is also considered as a factor that is affecting the business cycle, due to the high activity within real estate market (Leamer, 2007).

Others fundamentals such as urbanization, increasing amounts of people living alone, a higher population and immigration are also discussed as drivers for the housing cycle (Larsen & Sommervoll, 2004). In addition, the increasing quality of the houses is also an essential factor. Some of the house price increases stem from the high investment for renewing existing homes: kitchen and bathrooms are upgraded and remodeled, lofts are being decorated and furnished, and garages are built (Vale, Kutluay, & Yildiz, 2013). Other factors that are contributing to increasing house prices is the view and location of a house.

Understanding some of the underlying fundamentals driving the housing prices is very relevant for the housing cycle. The housing cycle is known as a significant part of the Norwegian economy, and therefore it is beneficial to obtain a more in-depth understanding of it. Authorities might find this information useful as they can be able to forecast future development with it. The information can be used to make an impact on desired development through regulations that affect housing constructions, interests, and taxes.

We have chosen to analyze the housing cycle in Norway. Based on existing literature and data, we aim to detect whether and how fundamentals affect the housing cycle. Thus, we have chosen the following problem statement:

"How do various macroeconomic fundamentals affect the Norwegian housing cycle?"

We have evaluated previous research to find fundamentals we believe may affect the housing cycle in Norway. We chose five fundamentals to analyze: housing construction, the business cycle, oil prices, monetary policy and households' debt. We investigate the cyclical movements and look into how these correlate with the cyclical movements of the Norwegian housing cycle.

1.2 Structure of the paper

This paper contains in total ten chapters. We start by giving a short explanation of the methodology and the different data variables used. In chapter 3, we introduce general theory about housing house prices and follows with theory about cycles in chapter 4. The theory is

included to get an overview of the housing market and to support our analysis. Chapter 5 goes through the historical development in Norway to clarify the changes in the economic condition and the housing market. Chapter 6 introduces the housing cycle in Norway and the fundamentals affecting it. In chapter 7, we analyze each fundamental separately and compare the cyclical movements of the house prices to the fundamentals. Chapter 8 contains a correlation analysis. Further, we discuss our analysis in chapter 9, and the paper end with a conclusion in chapter 10.

1.3 Delimitation

It is important to emphasize delimitations for this thesis. We try to detect possible relationship and see whether housing prices tend to lead or lag the other fundamentals and do not aim to develop any new models or frameworks. Our focus is to get an in-depth understanding of the housing cycle and the fundamentals that may affect it. We aim to provide a detailed analysis of the Norwegian housing cycle, using the theories available in addition to our own analysis.

We restrict our analysis to the Norwegian market, and the main analysis focuses on the Norwegian market as a whole. Thus, we do not analyze the Norwegian housing cycle against other countries. We still use literature regarding other countries in order to get a better understanding of housing cycles in general. We use this to draw lines to the Norwegian market when appropriate. The housing market is complex and is divided into several types of housing and geographical areas. Our analysis does not specify on different parts of the market and not differentiate between different kinds of houses. However, in some parts, we include Stavanger and Oslo.

The analysis covers data from 1990 to 2017, in addition to literature regarding historical development. However, the data for some of the fundamentals are only available for a shorter timeline. The analysis contains information for houses in Norway in total, independent of location.

2. Methodology and Data

This section includes the methods and data used in this thesis. We start by discussing our methodological approach. After that, we describe the data used in the analysis. The methods regarding Hodrick-Prescot and correlation analysis is explained in separate chapters in the analysis.

2.1 Methodological approach

This thesis is an exploratory research. This type of research is used to obtain further insights into a topic and develop possible theories (Saunders, Lewis, & Thornhill, 2012; Stebbings, 2001). We aim to explore the housing cycle in Norway. Additionally, we try to develop possible assumptions about how the fundamentals affect the Norwegian housing market.

We have a pragmatic research philosophy. This philosophy is based on focused attention on the research problem, which allows freedom of all methodological choices that are most suited to the specific research. It also focuses on the importance of practical implications of the research. In addition, it helps us to address the problem most appropriately to obtain the best possible insights. Thus, we use mixed methods in this thesis. Mixed methods include elements of both qualitative and quantitative data, and is appropriate to collect the necessary data best suited to answer the research question (Creswell, 2014).

A pragmatic view gives us flexibility in the way we conduct our research. However, there are some critics towards it as well. Freedom in methodological choices allows us to determine what knowledge is useful and what is worth investigating. This may create a bias in the selection of method and implication (Feilzer, 2010). Trying to minimize this limitation, we based our research on existing literature. We chose the fundamentals to look further into based on what previous researchers have discussed and argued as influencing the housing cycles.

It is essential to obtain reliable and valid information to conduct the thesis properly. We use both qualitative and quantitative data, and this increases the validity as concepts are explained and analyzed using different types of data (Creswell, 2014). Validity in qualitative research

refers to the degree to which the data is trustworthy and accurate (Creswell & Clark, 2011). As mentioned, we chose literature from academics and other sources we trust as reliable and objective. The validity of quantitative data refers to how helpful the data is to answer the research question and whether the data measure what it intends to measure (Vogt, 2011). The information we use is data regarding the housing cycle and fundamentals that may affect it, and therefore it helps us to conduct this thesis. We analyze our quantitative data using the HP-filter and correlation analysis.

Reliability in qualitative research refers to whether other researchers would find similar findings if conducting the same research (Saunders, Lewis, & Thornhill, 2012). Threats to this might be subjective opinions regarding existing literature. It is essential that we stay objective and make sure we base our expectations and implication on what previous research argue. We have tried to be transparent in our analysis, and remain as objective as we can. Reliability of quantitative data refers to the consistency and trustworthiness of the data (Creswell & Clark, 2011). Norwegian central bank, Eiendomsverdi and Statistics Norway is considered very reliable and objective. However, Eiendomsverdi continuously updates its historical data, and some values may have been changed since we gathered our data. Therefore, we collected all data before February 20th, 2018, and may, therefore, be different if collected today. Additionally, basing arguments on more than one publication increases the reliability (Veal, 2011). Since we found same arguments in several academic papers, it is more reliable. Therefore, we focused on several papers when analyzing the different fundamentals.

2.2 Description of data material

This section contains a description and a presentation of the data material we use later in the analysis. We have divided the section into qualitative and quantitative data.

Qualitative data

The qualitative data is based on existing literature regarding the housing cycle. A literature review was also valuable when finding our research focus. In addition, it helped us find the methods possible to use for this master thesis. The literature used is mainly based on academic

journals, reports, articles from newspapers and other publications. We have spent time on both analyzing existing research and combine it with quantitative data. The advantage of using secondary data is due to its relatively easy access. It also gives useful insights into the housing cycle and other related theories. Countless articles and research regarding the housing cycle both in general and in Norway exists, which provides us with valuable insights (Saunders, Lewis, & Thornhill, 2012). However, it is important to remember that secondary data might have been used for other purposes than our field of interest. This may lead to the data being less applicable to us.

Quantitative data

The quantitative data used in this dissertation is quarterly data mainly from 1990 and 1991. We use quantitative data for house prices and the five fundamentals. We have collected the data from different sources.

For house prices, we use quarterly values from the period of 1990 to 2016. The data is obtained from Eiendomsverdi. Eiendomsverdi has data from 1985. However, we chose to start in 1990, due to too few observations from the five first years. For example, they registered only 44 houses for sales in 1985. Therefore, we began in 1990, with much higher observations and therefore assumed to be more reliable and accurate. Additionally, we use house price data for both Stavanger and Oslo when analyzing oil prices as a factor. The data is from Statistics Norway and starts in 1991.

We divide our analysis into five sections, whereas each fundamental is analyzed. We have mainly collected the data from Statistics Norway and Norwegian Central Bank. In addition, we have collected oil price data from Energy Information Administration, accessed through DataStream.

We use real values in this thesis. Therefore, we have adjusted for inflation for values given in nominal terms. These are based on the Consumer Price Index from Norwegian Central Bank. Each fundamental and the data used is further explained in separate chapters.

3. Housing theory

This chapter includes a theoretical background of the housing markets and its pricing mechanisms. We start with an introduction to the housing cycle, and drivers that may affect it. Basic microeconomics theory about pricing in the housing market is included. Further, we discuss housing purchase incentives. An overview of DiPasquale and Wheaton-model is also presented to illustrate the connection between the market for renting a house and investing, and how the housing prices are affected by supply and demand.

Housing investment is the most important investment for most households. The procurement of houses includes two incentives; for consumption purposes and investment purposes (Goodhart & Hofmann, 2007; Piazzesi & Schneider, 2016). Housing is always bought for consumption purposes. Either household buy the house to use it themselves, or it is rented out, and thus used as a consumption good by someone else. All human beings need to have a place to live, either renting or owning.

In addition, housing is always an investment as it can be seen as a capital asset that can be kept for a period and then resold (Piazzesi & Schneider, 2016). The purchase of housing is often of high value and low frequency. Houses with proper maintenance may last for several generations (Goodhart & Hofmann, 2007). The highest risk and uncertainty related to housing investment is the development of house prices (Nordvik, 1993). However, it is essential to keep in mind that even though house prices decrease, there is a value of owning a house. It gives households a place to live and is a tangible asset that can be held for a long time.

The housing cycle is unique and complicated to analyze. Houses as economic goods have many aspects. First, houses are heterogeneous. No homes are identical, even though many houses in the same area today are very similar (Piazzesi & Schneider, 2016). The quality, areal and design may be almost identical. However, other attributes such as location, view and the amount of sun are never equal. For example, two apartments in the same building at Tjuvholmen in Oslo have different qualities, such as view. One of the apartments may have a beautiful view over the ocean, while second has no view as another apartment blocks it. Even though the standard is the same and they are both in the same beautiful area of Oslo, these two apartments are

obviously valued differently. Houses can also be seen as immobile goods as it cannot be moved (Goodhart & Hofmann, 2007).

3.1 The housing cycle

Housing is a big part of the national economy, and it moves in cycles as other economic components. The house prices cannot increase forever. Housing cycles usually have a longer duration than the business cycles. In periods of house price growth, the growth tends to be more extensive than the house price corrections. Studies from 1970 to 2005 on the 18 OECD countries shows that the housing cycle has an average length of 10 years with upturns averaging 5 ½ years and downturns averaging 4 ½ years. In times of decreasing house prices, the sellers need to adjust to the market, which takes time. Thus, the house prices fall at a slower pace. One of the reasons may be that some house owners are in danger of becoming technically insolvent (Lunde, 2014).

Both the ownership of houses and rent of apartments affects the housing cycle. However, most households choose to buy their own home instead of renting. There are, however, problems related to the reason why households decide to buy. Many want to buy instead of renting because they compare the cost of owning a house to the cost of renting one. However, these two costs are very different and imply different risks. An owner carries all risks regarding house price and expenses. In principle, the tenants need to pay these risks to the proprietor (Lunde, 2014).

Speculation about the housing market is one thing that may affect the housing cycle. Gao, Sockin, and Xiong, (2016) investigate how the U.S. housing cycle reacted to speculation in the housing market over two different periods. The first period was during the boom period of 2004 to 2006 when they experienced a price increase. The second period was the bust period of 2007 to 2009 when they had a decrease in house prices. They used home buyers who purchased housing for investment purposes as a measurement of speculations, and they found a potential link between housing cycles and speculation in the housing market. Another research from the U.S. housing market suggests that speculation by investment home buyers played an essential

role in the dramatic housing price boom and bust cycles in 21 different cities (Chinco & Mayer, 2015).

It is almost impossible to predict the cyclical changes, and whether the house prices increase or decrease. Thus, it is tough to use government regulations to affect the house prices as it cannot predict the extent of the increase or decrease. However, as pointed out earlier, the house prices cannot increase forever. At the same time, the house prices cannot fall forever either. There is a long-term equilibrium price, and the house prices always go back to its long-term trend. The real house price development points toward its trend in the long run (Lunde, 2014).

3.2 Housing price theory

This section includes relevant housing price theory. Housing investment affects households' wealth, and therefore affects future consumption opportunities for many years. A higher value in housing may lead to higher financial freedom such as possibilities of higher loans and higher economic security. Therefore, the price development for housing is of high importance for households. However, households may be willing to take a higher short-term risk of changing house prices if their investment has a long-term perspective (Nordvik, 1993).

The housing market is different from other markets as short-term supply is more or less inelastic. This is important, as the housing price is mainly determined by two elements – supply and demand (André, 2010). Several other factors affect these two components and are vital to consider. Houses available for sales differ in several dimensions and standards such as location, space, quality and type of ownership. These dimensions affect the housing price.

3.2.1 Demand and supply for the housing market

Demand and supply for the housing market are essential determinants for the house price development. Lower supply and high demand put pressure on the housing prices, and vice versa. Demand consists of all potential buyers of housing, and housing supply includes all types of housing available for consumption. The housing supply is relatively stable in the short-term, due to the long time-horizon of housing construction. Therefore, housing construction affects

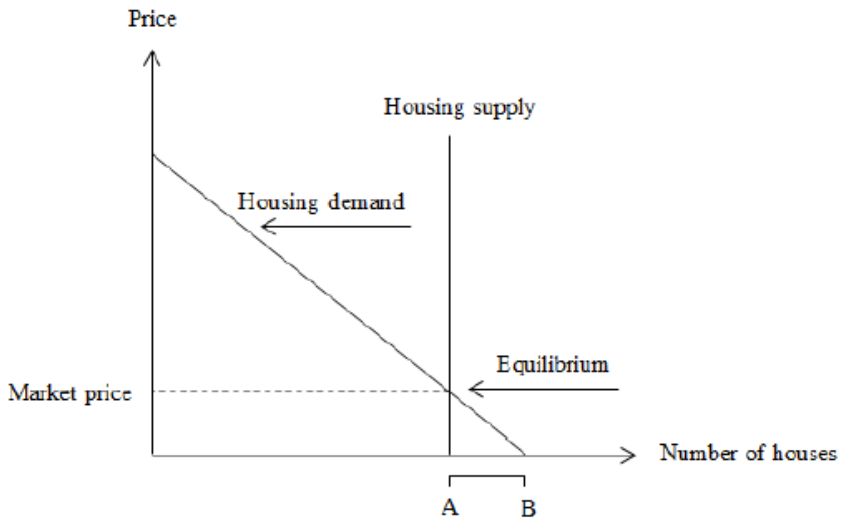
the long-term housing price development (Jacobsen & Naug, 2004a). The rest of this section gives an explanation of demand and supply of housing closer.

The demand for housing

Several factors affect demand. Demand is among other things affected by size, standard, location, and view. There are many different types of housing in Norway, from small studio apartments to honorable villas with huge gardens.

Demand can be divided into short-term and long-term demand (Kongsrud, 2000). Figure 1 shows a homogenous short-term housing market with free pricing mechanisms. This figure illustrates the short-term housing supply and the demand. It shows a perfect frictionless market, and the equilibrium price is determined where demand meets supply. Demand is declining with increasing house prices. Assuming that all household have different willingness to pay, each point on the demand curve determines the number of consumers who are willing to pay equal to the current position or at a higher price.

Figure 1 Price determination in the short term



Source: Steigum (2004)

The demand for housing seems to be dependent on several factors. Factors such as disposable income, mortgage market, unemployment, and demographics should have an impact on the housing prices and demand. The willingness to pay is among others determined by today's income and wealth as well as preferences. Different consumers value houses differently, and thus their willingness to pay is affected by this. Therefore, demand is affected by the current supply and the house price levels.

Additionally, expectation about future income and house price development affects the willingness to pay (Kongsrud, 2000). Housing construction takes time, and therefore the housing prices are mainly fluctuating around the demand in the short-term (Jacobsen & Naug, 2004a).

Demographical developments are an essential driver for the housing demand. Population growth leads to higher demand for housing and can increase the housing prices. However, this effect is most prominent in the short term. Due to this long-lasting higher demand, more housing construction lead to a higher supply, which partly offset the higher pressure on prices. In the long run, housing construction can offset this (André, 2010).

A shift in the number of households is also worth mentioning. The number of households has tended to increase more than the population growth in general due to a higher amount of divorces, an increasing number of lone-parents and a higher-aged population (André, 2010). This change in household contributes to an even more prominent increase in the housing demand. In Norway, we move towards this tendency. The higher amount of people looking for housing in the same area may put pressure on the housing prices. In a long-term perspective, the other factors have a higher effect on the house price levels (André, 2010).

The supply for housing

The supply of housing relates to the number of houses available in the market, both new constructions and existing houses on the market. In the short-term, the supply of housing is relatively stable. The short-term housing supply is defined as lasting from two to three years. Housing construction takes time due to planning, cost and government regulations (Jacobsen & Naug, 2004a).

Housing construction affects the supply of houses in the long run. Prices for existing homes is one of the factors determining how attractive it is to start constructing new houses. Higher demand increases the housing prices and thus again stimulate more housing projects. Therefore, higher housing investment has a downward pressure on the housing prices in the long run (André, 2010). The price depends on whether the demand has changed or remained at the same level. If demand has decreased, and the supply of houses has increased, it leads to downward pressure on the prices. However, the supply side is affected by some factors, including the amount of housing construction, regulations, and costs (Kongsrud, 2000).

The volume of construction depends on local conditions, costs and regulation. For example, land availability, infrastructure and transport, and building regulations. The building cost and land prices are two other important factors when evaluating housing construction projects. Whether the project is profitable also highly depends on the planned constructions. House availability and construction is essential to understanding long-term price development (André, 2010).

It is also worth mentioning that it takes time for houses and housing projects to be finalized due to regulations and construction. Regulations and taxes on the housing market can also affect the housing supply. Examples of this may be regulations that limit the ability to build certain types of housing or limits the ability to invest in houses for some consumers. The latter could be achieved by tax systems and restricting bank loan conditions and so on.

The tax systems may affect housing prices by taxing house investment and profits. The increased transaction costs make the housing market less liquid than it otherwise could be. These taxes are often included to achieve less volume of speculation in the housing market. The tax also benefits the households who purchase housing to live in instead of as an investment opportunity. An example of this is a tax on the profit of a housing sale if it is resold within a year, or a house bought for renting out. In Norway, there is regulation for residential mortgage loans, which has been tightened in fear of a pricing bubble (Regjeringen, 2016a).

Costs of construction and property also affect the housing construction. Labor, materials, fulfilling requirements and productivity are costs that are important to determining the quantity of housing construction. Cost of land highly depends on the location. Outside urban areas, the

price of the property is mainly determined by a comparison of an alternative value of the land, such as farmland.

3.2.2 Real estate as both property and asset market

To obtain a better understanding of the real estate market, we discuss the DiPasquale and Wheaton model. It is essential to keep in mind that we focus on household's housing. Still, this model is relevant as it can be used to illustrate how the housing prices are affected by supply and demand, macroeconomic factors and housing construction. In addition, it helps to see the relationship between the consumption of housing and the level of housing construction. Furthermore, this model does not differ between the demand for tenants or real estate owners.

The DiPasquale and Wheaton model were developed in 1996 to see the relation between the market for renting and investment of housing in the long run. The model cannot explain how much a given house is going to cost. However, it can help to decide whether there is balance in the market. The model is highly relevant to the understanding of housing prices and the reaction from the market when the prices are changing.

Real estate is divided into property and asset markets. The property market is for the use of space, while asset market deals with ownership of real estate. Macroeconomic changes in the market affect both markets. These macroeconomic changes might be for example changes in GDP, interest rate or demographics. The market is in equilibrium when supply and demand are equal to each other. As the real estate market is both an asset and property market, the equilibrium needs to be in place in both, before the real estate market is in equilibrium.

Real estate as property refers to housing as a consumer good. Demand determines the price of rent in the short term, and the demand is set by the price of rent and other macroeconomic factors. The price is set at the point where supply and demand are equal. When supply meets demand, we are in equilibrium in areal of the housing.

Real estate as an asset market refers to housing as an investment. The real estate price is determined by the price of rent and required return. This affects the quantity of new housing construction. The quantity of housing construction is dependent on the rental price, housing

prices and the cost of constructions. High levels of housing price indicate future profit opportunities in the real estate market, and therefore new buildings may be beneficial. The price of existing houses is compared to the cost of construction. The demand for housing construction decreases if the price of existing houses is lower than the price of housing constructions. We find equilibrium in the market when the cost of housing construction equals the cost of existing houses.

Summarizing, the connection between the two markets, property and asset market, and the final price is the cost of rent. The cost of rent and required return affects the housing prices, which determines the relationship between housing construction and existing housing. This relationship defines the current housing supply and levels of new constructions. A shift in any parameter in the model affect both the asset market and property market before ending in equilibrium again. If the demand for renting houses increase, the price of rent also increase. As the housing price is also affected by the price of rent, there is also an increase in housing prices. An increase in housing price leads to higher speculating in the market. Higher investments lead to increase in housing construction. This leads to a higher space for renting, which lowers the price due to higher supply. Thus, new constructions offset some of the effects of higher demand (DiPasqual & Wheaton, 1996).

4. Economic cycles

In this thesis, we analyze the housing cycle. Therefore, it is vital to present general theories regarding how cycles move. This chapter explains theories behind the economic cycles. The general cycle theory is discussed in the light of real business cycles. The chapter begins with what business cycles are, and present how different economic cycles move together and with the business cycle.

4.1 What is business cycles?

Economic activity and employment tend to fluctuate over time. This is called cyclical fluctuations or macroeconomic fluctuations. In periods with upturns, we have high economic activity and low unemployment. While in periods of downturns we have stagnation or decline in economic activity and higher unemployment. Cycles are not regular or predictable. Thus, the economic forecasts are often very uncertain. Extremely deep downturns are known as economic crises, and bring along large falls in stock markets and house prices (Steigum, 2004).

The different business cycles contribute differently to the economic condition. Business cycles can be small leading to stable economic growth, whereas the next period may be much more powerful. These facts imply that it is difficult to predict when cycles turn around, and how powerful the cycle is. Therefore, it is misleading to draw similarities from natural cycles in nature or the biology to business cycles. Due to the planets movements in space, we can predict the changes between day and night, and summer and winter, and we can calculate when the next eclipse occurs. Such a form of legalism that provides the basis for predictions does not exist in the economy (Steigum, 2004).

A trademark for the business cycles in an economy is that the economic fluctuations turns out in the same direction in a big part of the economy, and goes along with significant changes in labor, unemployment, gross investment and other macroeconomic sizes. The economic activity of different countries that trade with each other often varies in line (Steigum, 2004).

Business cycles are a relatively new phenomenon that occurred in the wake of the industrial revolution in the early 1800s. Historians guess that the first modern economic crisis with high

unemployment occurred in Europe after the Napoleonic war. The earlier financial crises in agriculture and crafts communities were often caused by crop failure, plague or war. They did not lead to higher unemployment as the financial crises we know from today's industrialized countries (Steigum, 2004).

Economic fluctuations are not certain and cannot be predicted. The fluctuations have not the same period of length nor the same amplitude. Amplitude is the percentage deviation from the turning points to the trend line. Sometimes there is a long time between the turning points, all up to 10-12 years, and other times it is just a year between the turning points. In some periods small fluctuations are leading to stable growth, while the next period it can be really great fluctuations. Therefore, there are no laws in the economy that provides a basis to give exact predictions of the fluctuations. However, there is an experienced slowness in the economy that leads to persistence in the economic activity. Persistence means that if there is a boom or recession one year, there is a high probability that the economy is in the same phase the next period. If the economy is in a boom today, it is expected that the boom continues next year (Steigum, 2004).

Eugen Slutzky formulated this perspective about economic fluctuations back in 1937:

"Just as waves following each other on the sea do not repeat each other perfectly, so economic cycles never repeat earlier ones exactly either in duration or in amplitude. Nevertheless, in both cases, it is almost always possible to detect even in the multitude of individual peculiarities of the phenomena, marks of certain approximate uniformities and regularities." (Slutzky, 1937, p. 105).

In his definition, Slutzky underlines the uncertainty and point out that none of the economic fluctuations is the same.

Even earlier did Wesley Mitchell (1927) try to make a definition of the business cycles and its movements. He stated that:

"Business cycles are a species of fluctuations in the economic activities of organized communities. The adjective "business" restricts the concept to fluctuations in activities which are systematically conducted on a commercial basis. The noun "cycles" bars out fluctuations which do not recur with a measure of regularity" (Mitchell, 1927, p. 468).

He further highlights the fact that each cycle includes one wave of rising and falling or falling and increasing activity, whereas the intervals between "crises" often include two or three such waves. Business cycles are separated by their broader inclusiveness, that they do not recur annually, and by their brief time span (Mitchell, 1927).

Measurement of cyclical fluctuations is built on a division of macroeconomic time series data in a long-term trend and cyclical components (Steigum, 2004). The business cycle and other economic time series always fluctuate above and below its average trend. The cycles move either up or down, but eventually turn and move back to its trend line (Mitchell, 1929). Just like Isaac Newton's law of gravity "What goes up must come down," the economic cycles cannot rise forever and will eventually turn and fall. At the other side, a financial time series do not decrease permanently, but in the end turn and rise toward its trend line.

4.2 Leading and lagged indicators

The business cycle consists of many different economic components. Each component does not necessarily correlate with each other. Before his death, Mitchell handed over his last report on what happens during business cycles to Arthur F. Burns to complete. This resulted in the development of the Burns and Mitchel diagram. The diagram is focusing on identifying the peaks of cycles of different economic components. Two different types of research with the Burns and Mitchell diagram shows that the economic elements correlate with the business cycle, but these often reached its peak sometime before or after the business cycle. These components are called leading or lagged indicators (Burda & Wyplosz, 2009).

We follow the leading indicators with great interest because they can provide signals about close coming economic cycles. Some of the economic components coincide with the business cycle. Usually, the housing cycle coincides with the business cycle, but there are also examples of periods where the housing cycle moved independently.

If an economic component is high in a boom and low in a recession, the component moves procyclical. Labor is one example of an economic component that varies with the business cycle. This means that employment tends to be below trend in recessions, and above trend in booms. On the other side, there are components that are low in booms and high in recessions. These components fluctuate countercyclical with the business cycle. The unemployment rate is one example of an economic element that fluctuates countercyclically. The unemployment rate is below average in booms, while it is above average in recession (Steigum, 2004).

To analyze how different economic components move in relation to each other, we have three statistical properties of interest: Volatility, correlation, and persistence.

Volatility

The volatility measures how much the variable varies during cyclical fluctuations. Volatility is a statistical measure transferred from the standard deviation. High volatility means that there are considerable fluctuations in the variable.

Correlation

Correlation is a measure of the strength of a linear relationship between two variables. A correlation coefficient is a number between -1 and 1. A positive correlation means that the variables move in the same direction and is procyclical. A negative correlation says that the variables move in different directions and is countercyclical.

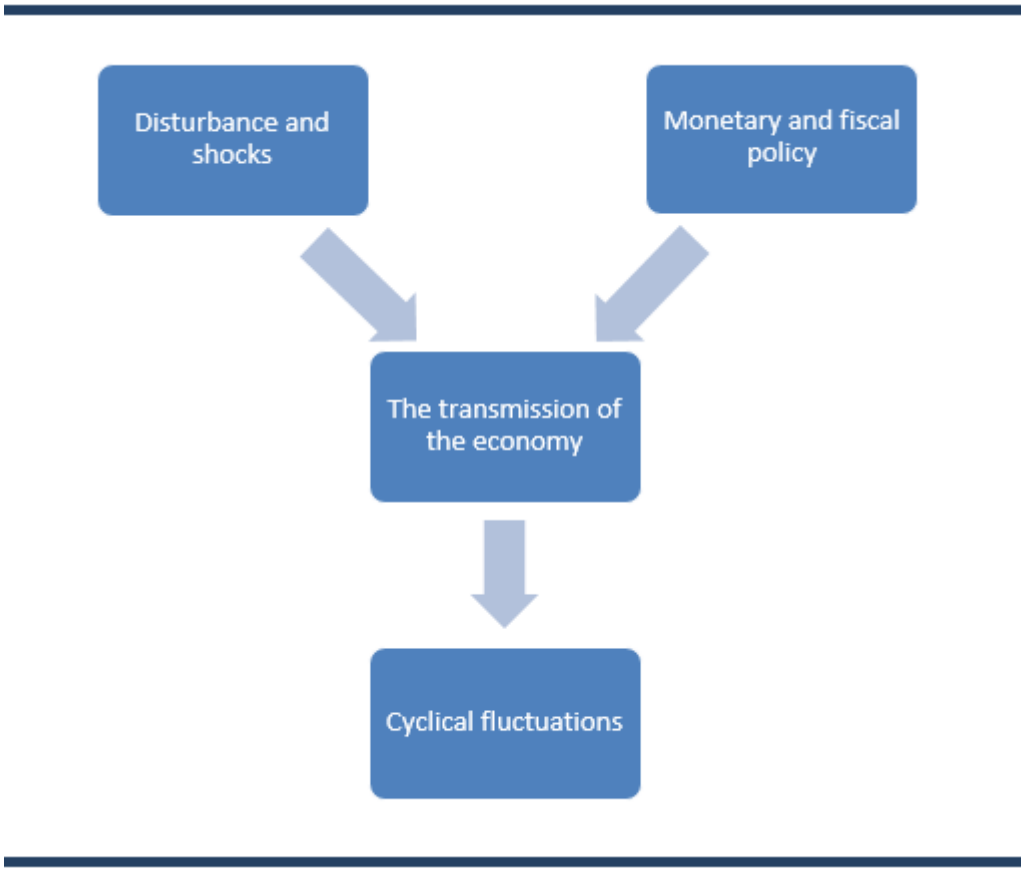
Persistence

Persistence is when one variable at time t is dependent on another variable in an earlier period (t-n) or later period (t+1). Persistence occurs due to due to inefficiency in the economy. We can measure persistence in time series by calculating correlation coefficients between one time series in period t and one time series in period $(t \pm n)$.

4.3 Business cycle theory

One question many economics have tried to answer is why there are cyclical fluctuations in the economy and what that is the main reason behind these. There have been significant disagreements around this question, which has resulted in many different business cycle theories. One reason for this is the difficulties to detect what that are the causes and what that are the effects. We know that the house prices vary somewhat with the business cycle, but we do not know if increases in the house prices do cause improvements in the business cycle (Steigum, 2004).

Figure 2 Ragnar Frisch explanation form.



Source: (Steigum, 2004)

Although disagreements around the theoretical business cycle models, the most of them are built on the same explanation form. Ragnar Frisch was the first to use this in 1933 when

analyzing a dynamic economic model with stochastic variables that started cyclical movements. Frisch believed that the economy was continuously exposed to small and large disturbances or shocks that caused the economy to fluctuate. These shocks are seen as a stochastic variable as they are not predictable. Examples can be supply and demand shocks that make an impact on the whole economy and cause cyclical fluctuations. The transmission of the economy is the structural condition in the economy that leads the shocks to cause cyclical fluctuations. The Governments' monetary and fiscal policy also affect the cyclical variations dependent on the transmission of the economy. The explanatory form presented by Frisch tells that we cannot predict future cyclical fluctuations. Future cyclical fluctuations are dependent on future shocks that we do not know the outcome of. Cyclical fluctuations are a result of coincidence (Steigum, 2004).

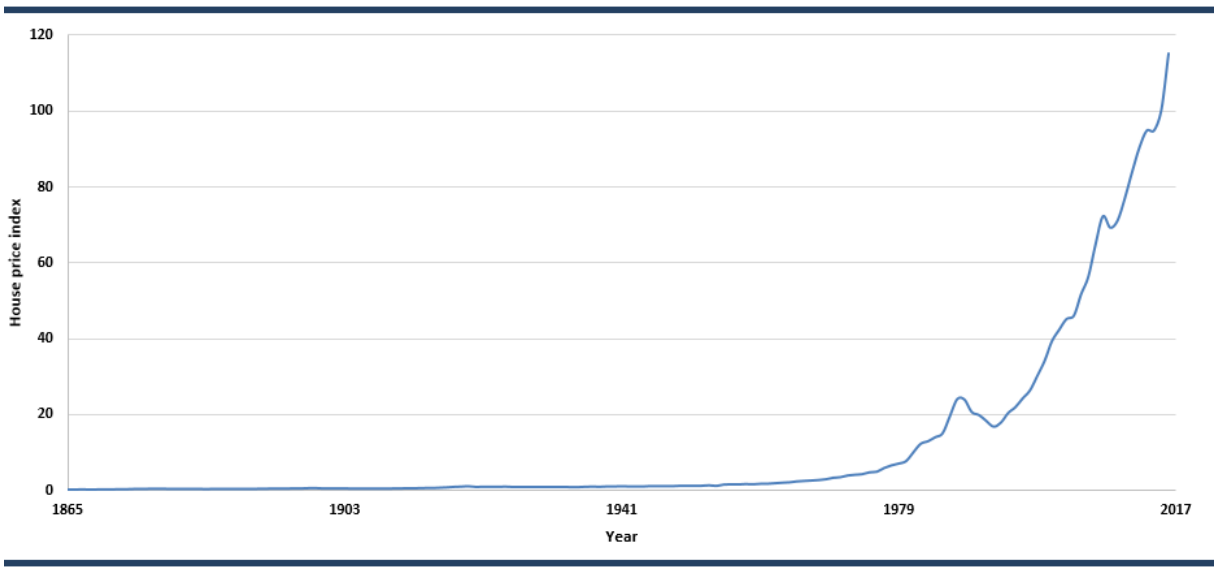
5. Historical Development in the Norwegian housing market

This chapter gives an overview of the historical development in Norway. Included, we highlight monetary policy changes, government regulations, economic conditions and other events that might have affected the historical development. An overview of these happenings and their effect on the housing cycle is valuable in the analyses as it may detect what fundamentals that have an impact on the housing prices in Norway. This section is relevant as we get a deeper understanding of the housing market, including price development and housing supply in the market.

Understanding the housing market gives us valuable insight into the factors driving the housing prices. We start by providing an overview of the historical price development in Norway. After that, we discuss housing cracks, monetary policy changes, and other events affecting the housing cycle.

First, we introduce the housing market by looking at the actual price development. In figure 3, we illustrate the nominal Norwegian house prices from 1865 until today. The house prices were relatively stable until the 1980s, from where they experienced a rapid and robust increase. The increasing house prices may be attributed due to the liberalization of the financial markets with low interest rates and extended repayment time (Sørvoll, 2011). Since then, the nominal house price development has increased significantly. It is, however, hard to see the changes in nominal prices for later years.

Figure 3 Nominal house price index 1865-2017 (2015 = 100). Measured in price per square meter.

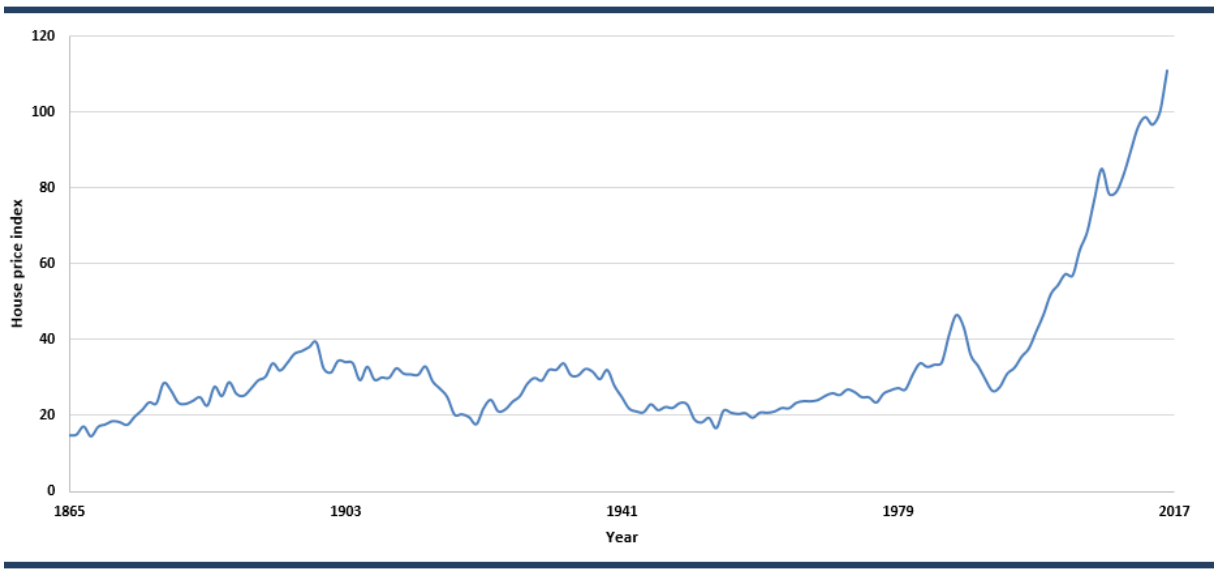


Source: Statistics Norway

It gives us more insights if we look at the real house prices. Real house prices are adjusted for inflation, which makes it possible to compare as if the prices did not change and measured the current price levels. Figure 4 illustrates the real house prices from 1865 to the beginning of 2017. As we see, the housing prices were relatively stable until around 1980s. Since then, the housing prices have increased a lot (Jansen, 2011).

However, several events before the 1980s can have made an impact on the house prices. First, a bubble burst in 1899, called Kristianiakrakket. The next crisis in the 1920s came after an economic boom. It ended in a housing crash at the end of the 1930's (Grytten, 2008). After that, there was a crash as a result of the Norwegian Banking Crisis that lasted from 1988 to 1993. Since then the housing prices have increased a lot, except a small recession in 2002 and the effect of the financial crisis 2008-2009 (Jansen, 2011). However, in 2017 the prices have decreased slightly.

Figure 4 Real house prices 1865-2017 (2015=100). Measured in price per square meter



Source: Statistics Norway

Further, we discuss the following happenings in the Norwegian economy, and how they affected the housing market:

- Kristianiakrakket
- The interwar period
- The banking crisis
- The financial crisis
- The oil recession
- Current development

5.1 Kristianiakrakket

The first economic crisis that had an impact on the Norwegian housing market was Kristianiakrakket. Kristianiakrakket was a financial bubble, and took place around 1899 and lasted until 1905 (Grytten & Hunnes, 2010).

Strong economic growth characterized the end of the 1800s. Norway's stronger financial condition increased the activity in the stock market and led to higher exports and industrial growth. A much more free housing market followed. Before this, the credit and housing market were strictly regulated (Jansen, 2011). These were revised, and Norway faced a liberalization of the financial markets. The liberalization resulted in easy access to loans.

In 1893, there was an essential monetary policy change introducing new bank legislation. This change included the abandonment of the silver standard period. The system regulated the volume of issued notes, forcing a minimum relation to the metal reserves. The abandonment of this standard was liberating the note-issuing and made the parliament able to decide excess note-issuing. This led to the expansionary monetary policy (Grytten & Hunnes, 2010).

The period from 1895 to 1899 experienced housing construction boom. The cities experienced a period of urbanization, especially in Kristiania. From 1895 to 1898, the population in Kristiania increased by 40,000 inhabitants and by 18,000 in 1899 alone. The fast increasing population in Kristiania grew the demand for housing, and the prices started to increase (Søbye, 1999). The establishment of banks also profoundly increased in this period (Gram, 2017). The money market was favorable for lenders as banks had an aggressive lending policy (Eitrheim & Erlandsen, 2005). In this period there was low interest rates, as well as money and credit expansion (Grytten & Hunnes, 2010).

The combination of easy credit access and positive return on housing investment contributed to the increasing speculation towards the housing market in Norway (Norges Bank, 2017). Housing supply eventually exceeded the demand for houses. The financial stability was gone. In June 1899, after an extended period of rising house prices, the bubble burst, and the prices fell drastically (Jansen, 2011). Banks collapsed due to the massive losses (Grytten & Hunnes, 2010). The crisis started when Christian Christophersen & Co went bankrupt, with a total debt of NOK 14 million (Søbye, 1999). The market broke down, which resulted in 10 percent of houses in Kristiania were left empty. Rental prices in some areas were set to zero to prevent depopulation.

Two significant factors drove the Kristianiakraket: monetary policy and urbanization. Changes in the monetary policy before the crash made the crisis longer (Grytten & Hunnes, 2010).

5.2 The interwar period

The Post-War depression in the 1920s ended in the next crash at the end of the 1930's (Grytten, 2008). At the beginning of 1919, Norway and other western countries experienced an economic boom. The overheated economy turned into a crash in 1929. It became the worst economic downturn in modern history. Rapidly increasing demand occurred in Norway, and imports into Norway grew to more than twice the volume of export in 1919 (Grytten & Hunnes, 2010). The market turned in 1920, and during the 1920s and until 1933 it was a substantial international downturn (Eitrheim, Klovland, & Qvigstad, 2004).

Monetary policy had a significant impact on this crisis. During World War I, Norway and many other economies abandoned the gold standard for its currency. After the war, the gold standard was back in use. The Norwegian economy ran an expansionary monetary policy to finance the cost of the war and maintain demand. The money stock increased significantly from 1914 to 1920. Additionally, the central bank rents were low, and budget deficits occurred. There was an increase in demand. However, supply decreased during the war. This led to a severe rise in consumer price inflation. The Norwegian Krone depreciated with 50 percent to gold until the autumn of 1920. The market situation was stressed, savings were low and investment high (Grytten & Hunnes, 2010).

Late 1920, the market turned around, and the recession started. As the market turned, the Norwegian central bank decided to change monetary policy and adopt a contractionary monetary policy. In 1920, the Norwegian central bank increased the interest rate and lowered money stock. The reason for this was to bring the Norwegian Krone back to its par value in gold. The Norwegian Krone appreciated rapidly, but the development was not steady, and it profoundly fluctuated (Grytten & Hunnes, 2010).

The tight monetary policy made the crisis worse for Norway and led to substantial financial problems. Investments reduced significantly along with an increasing unemployment rate. Bank losses reached new heights, and many banks went bankrupt. The housing price levels decreased for several years. Due to the seriousness of these events, the central bank paused the contractionary monetary policy in 1923 (Grytten & Hunnes, 2010; Tvedt, 2017).

The change in monetary policy in 1923 made the situation better for Norway, and the unemployment and financial losses decreased. The international economy was also better at that time. Thus, the monetary policy changes again, and a new round of contractionary policy was introduced (Grytten & Hunnes, 2010). From 1924 to 1928, the Norwegian krone regained its par value in gold, and the financial situation improved.

The years after was followed by an international economic boom. From 1930, this turned into a severe global depression (Tvedt, 2017). The recession started after a money and credit expansion over several years. This expansion resulted in an overheated economy in the US and an asset bubble collapse in 1929. The consequence of this was the most substantial global recession in the modern history (Grytten & Hunnes, 2010).

This global recession made a significant impact on Norway, however, not as severe as after the postwar depression. From the summer of 1930, Norway experienced the international economic recession that lasted until 1941. Norway was more sensitive to global economic fluctuations. Norway reached its turning point in December 1932, and thus shortly recovered (Grytten & Hunnes, 2010). However, the unemployment rate was still high until 1941.

5.3 Pre 1980 – developing the welfare state

The first decades after World War II, the political objective was to focus on housing construction. The aim was to build enough houses for most residents, to a reasonable amount of money relative to their disposable income. Low interest rates and extended repayment time helped households to invest in houses (Sørvoll, 2011). However, the regulations were more strict and regulated at this time than in the coming years (Gram, 2017). In addition, the development of the welfare state and the establishment of the petroleum industry characterized the Norwegian economy (Steigum, 2010).

Since 1950, the Norwegian macroeconomic policy had a low interest rate policy as one of the backbones in the economy. This policy predicted a credit ration beyond what was in the banks' interest. The low interest rate policy was connected to the credit policy adjustments of everything from financial institutions lending growth to placement obligations in the bond market. At the same time, the Government provided high public saving. After the development

of the petroleum industry gave large oil revenues, the tendency for socializing savings and wealth formation became stronger. Despite increasing the nominal interest rate level in the 1970s, the inflation and expectations of inflation increased significantly leading to a more negative real interest rate than in the 1960s. The taxation system was not protected against inflation, and eventually, the marginal tax rate was above 60 percent for a big part of the middle class. At the same time, the taxation rules allowed income deduction at nominal interest expenses. This led to the real interest rate after tax to be as low as -8 percent on several occasions. The economic system gave incentives to rent financing and low equity ratio, which in turn weakened the firms' solidity (Steigum, 2010).

5.4 The banking crisis in the 1980s

The next crash was a result of the Norwegian Banking Crisis and lasted from 1988 to 1993. Norway had been experiencing economic growth for an extended period. There was an international wave of market liberalization inspired by Prime Minister Margareth Thatcher in Great Britain and President Ronald Reagen in the USA. An essential goal for Thatcher and Reagen was to decrease inflation through monetary policy tightening (Steigum, 2010). This policy turned out to be difficult in Norway.

Norway followed the liberalization-wave. Early in the 1980s, the Government conducted a liberalization policy that was a clear violation of former economic policies in Norway. After the World War II, the policy was more strict and regulated. Now, consumers who previously were denied loan were able to be served by the banks (Gram, 2017). Lower interest rates were set for households to increase their investments. Real interest rate after tax was negative, creating an incentive for households to invest and not save money. Norway also deregulated its credit market, resulting in a credit boom more severe than most other countries (Grytten & Hunnes, 2010). The revocation of price regulations in the housing market made a significant impact on the turnover of housing cooperatives. Furthermore, the framework conditions for the stock and bond markets became freer. Foreigners gained access to the Norwegian stock market, and the old regulations on issues, interest rates and requirements for "placement duty" for financial institutions were reduced and eventually lifted (Steigum, 2010).

The liberalization resulted in a lending boom, and private consumption and real estate investment increased. The increasing and record high oil prices also drove the demand. The number of banks quickly increased during these times. These banks aimed at a higher market share and expanded their lending to consumers. The banks were negatively affected by the deregulation (Gram, 2017). Expansion of loans led to an increase in the money and credit levels. Housing prices also increased during this period. All this was leading to an overpricing of goods and asset bubble (Vale, 2004).

Late 1985, the oil price fell significantly. Norwegian export went from surplus to trade deficit (Grytten & Hunnes, 2010). The fall in the oil price led to pressure on the Norwegian Krone, and it was devalued in 1986 to increase competitiveness. This affected the Norwegian economy, which resulted in a crisis in the financial markets. The interest rate also rose, and before 1987, the prices rapidly increased (Vale, 2004).

After 1987, the house prices decreased drastically. The beginning of the crisis was the risk of failure for small banks. During 1988-1990, many banks were in danger of failing, and several small banks failed. Norwegian authorities also intervened in many cases to prevent the banks from closing. From 1988 to 1990 the difficulties banks where experiencing were mainly local. However, 1991 was the worst year, whereas two of Norway's largest banks lost all their capital or experienced high financial difficulties. GDP and production decreased as well as investment. The confidence in the Norwegian economy also fell drastically. Banks tightened their mortgage restrictions, and the interest rate increased. The increasing interest rate tightened the households borrowing opportunities, which also negatively affected the demand for housing. The housing prices then decreased dramatically, and Norway entered a new recession that lasted until 1993 (Vale, 2004).

The restructuring of the economic system and credit liberalization through the 1980s led to what we can call a "boom-bust cycle." First, there was a "lending boom" in Norway, replaced by asset price drop and the most substantial economic downturn since the interwar period. The economic downturn in 1988-1989 was replaced by an extended period of low economic growth and increasing unemployment (Steigum, 2010).

In consequence of these years of monetary expansion and after that contraction, most western countries experienced financial crises. The financial crisis was relatively strong in Norway.

Housing prices fell, consumers could not pay their bills, and bankruptcies and unemployment reached new heights. The Norwegian Central bank took over most of the more significant commercial banks to avoid a total financial collapse (Grytten, 2008). The 1991-1992 bank crisis took the Government by surprise. However, Norway came through the bank crisis better than their neighbor countries Sweden and Finland. This was due to the increase in oil revenues following higher recovery rate. The overall GDP growth was more significant than the growth in mainland Norway. It is worth noting that also mainland Norway had high economic growth after 1993 (Steigum, 2010).

A market-based credit and finance system had been established, and a satisfactory tax system was created. In addition, monetary policy was no longer linked to a fixed exchange rate. Throughout the 1990s, there was a high focus on income policy corporation in the economic policy. This co-operation system led to steady and tentative wage growth, and a gradual reduction in the high unemployment rate that had been (Steigum, 2010).

5.5 The years before the financial crisis

The economic downturn that had been for the last years led to a lower price- and cost growth in Norway than in their trading partners. The improved cost competitiveness resulted in an apparent positive development for Norwegian competitive activities. Investments in the petroleum industry started to increase significantly in 1991 and gradually made the fiscal policy more expansive. An international interest rate decline contributed to a sharp decrease in the Norwegian money market rates in 1993, which contributed to an increase in growth. There was substantial growth in Norwegian export markets from 1994 to 2000, and growth in exports was a significant factor in the development of the Norwegian economy. Toward the end of the recovery, the petroleum investments rose after a few weak years in 1997 and 1998 (Eika, 2008).

The growth in the Norwegian economy slowed down through 1998. Norway was affected by the disorder in international capital markets in connection with the so-called Asia crisis. Stock and exchange rates were massively reduced in several Southeast Asian countries, contributing to a relatively short period to weaker growth in the Norwegian export markets and a drop in oil prices. Norway was desired to defend the Norwegian Krone exchange rate, and this resulted in

that the Norwegian key rate more than doubled itself through the summer of 1998. During 1999, the key rate then dropped considerably, leading to the continued rapid expansion of the economy for a few more years (Eika, 2008).

In the autumn of 2000, oil prices were over 30 dollars per barrel. Although the oil prices were high, investment in the petroleum sector gave no growth impulses to the economy. Oil investments began to fall already in 1999 and continued to decline through 2002. The persistent fall in oil investment and the competition problems for Norwegian companies caused a downturn in the economy. The bottom was reached early in 2003. The following spring, the unemployment had almost doubled itself the last four to five years. Demand from the households nevertheless remained high, which largely prevented a more severe downturn. The main reason for the demand to stay high was partly due to increasing imports from low-cost countries such as China. This resulted in a relatively high wage growth, which in turn caused people's earnings to increase (Eika, 2008).

The international stock market fell in the wake of the IT bubble burst. This contributed to a market fall in GDP growth in the OECD area between 2001 and 2003. Due to the extended period of high growth in Norway at the same time, Norwegian wages increased much more than salaries at our trading partners. Based on this, the Norwegian Central Bank raised the key rate in the spring of 2002 due to fear of increasing inflation. Abroad, interest rates were lowered. This lead to a strengthening of the Norwegian Krone. Norway's competitiveness weakened considerably, both from developments in wages and from the strengthened Krone. As there was an international economic downturn at the time, Norwegian business exposed to competition struggled. Norway experienced a fall in exports in 2002 and 2003 (Eika, 2008).

5.6 The financial crisis in 2008-2009

After the banking crisis and up to 2008, Norway and the world economy experienced economic growth and increasing housing prices. This resulted in speculation of the housing market in several countries. The increased investment in housing led to higher prices and profit for investors, leading to housing bubbles. A pricing bubble occurs when fundamental factors can not explain the housing prices. In the event of the financial crisis, the housing construction

almost entirely stopped, and the housing prices experienced a sharp drop in prices (Helleiner, 2011). Later both the housing construction and prices have increased in Norway. GDP, a standard indicator of a business cycle, also increased. Norway has been at the top of the GDP list in Europe for several years.

The next drop in the housing prices was related to the Financial Crisis in 2008-2009. This was the worst global financial crash since the 1920s. The financial crisis in 2008 was a result of a banking crisis in the U.S. with bank liquidity shortage (Billington, 2015). The mortgage crisis gave ripple effect to the rest of the world economy (The Economist, 2013).

The effect on the Norwegian economy was smaller than most other economies. As a small and open economy, the low impact of the financial crisis was surprising (Grytten & Hunnes, 2010). More specifically, it did not affect the housing prices as much as in the other OECD countries. The housing prices still decreased in Norway, and it changed the Norwegian economy.

The reason why Norway did not suffer that much was due to among other things the Norwegian financial systems. Since the banking crisis, the Financial Surveillance Authorities have followed the Norwegian banks carefully, such as regulation and surveillance. This made it impossible to end up in the same situation as the US banks. Additionally, the interest rate was for a long time kept low, and prior taxation on houses was removed (Juel, 2011). In 2008, the Norwegian Central Bank decreased the key rate by 0.5 percentage points, after several years of increasing its target rate (Norges Bank, 2008). There was also high security for employees in more risky sectors. In addition, household's income continues to grow. Norway also had a robust national banking system (Midthjell, 2010). The fact that Norway was not as exposed to the financial securities that came in trouble, also reduced Norwegian exposure (Juel, 2011).

The housing prices had a substantial increase before the financial crisis. However, as The Norwegian Central Bank increased the key rate in the second part of 2007, the housing prices started to fall. The construction market also slowed down. Even though the pricing level was decreasing, the effect of the financial crisis that began in 2008, steepened the housing prices even further (Juel, 2011).

The Government and the Norwegian Central Bank made several initiatives to reduce the effect of the financial crisis. Arguably, the experiences from the banking crisis in the 1980s were

helpful. The reduction of the impact of the crisis may be due to the expansionary monetary and fiscal policy. Among other things, many of the initiatives by The Norwegian Central Bank was to increase the liquidity of the banks, such as longer time horizon of loans to banks, and also introduced less strict demands for banks to obtain loans (Norges Bank, 2009). The bottom was in 2008, and the market shortly recovered.

5.7 The development in recent years

Today, the Norwegian economy appears to be a success. According to Statistics Norway, Norway had the fourth highest GDP in 2016 among the OECD countries. Since the financial crisis, the housing prices have had an increasing trend. However, since the financial crisis, some events have occurred that appears to have affected the housing cycle.

The oil prices dropped in 2014 and profoundly affected Norway. This significantly changed the GDP as the oil export is the most important industry for Norway. Before 2014, Norwegian economy was very successful due to among other things the high investment in the oil sector. After the oil price decrease, Norwegian GDP decreased (Ryggvik & Smith-Solbakken, 2018). Even though Norwegian GDP started to fall, the housing prices still increased. However, in cities where the oil sector was one of the most important industries, such as Stavanger, the housing prices started to fall. Looking at Norway as a whole, the increasing growth prices continued until 2017. The Norwegian currency was weakened in 2014, just as the oil prices fell. The weak currency was positive for the Norwegian economy due to more export. Therefore, the overall Norwegian economy benefited from his. However, due to increasing activities in other sectors, this reduced the effect of less activity in the oil sector (Telle, 2017).

The key rate has the last years been at record low levels, and today it is set at 0.5 percent, which it has been since the beginning of 2016. However, this turned in 2017. The prices experienced less growth and were then followed by falling prices later in 2017. The decrease has been most prominent in Oslo (Telle, 2017). The falling house prices continued in 2018, and January 2018 gave a weaker result than what is normal for January. Since 2003, this month has always had an increasing housing price development (Dreyer, 2018).

The Norwegian economy is now growing after years of smaller growth (Telle, 2017). However, the house price levels did not continue on the same path. Much of this can be argued as being based on the new and more strict government regulation, valid from 1st of January 2015. The new regulation included more strict supervision towards the level of debt. The drivers of this were to contribute to more sustainable developments in the mortgage market (Regjeringen, 2016b). This makes it harder to get a loan, which may seem to slow the market down (Olsen, Baynes, & Saltvedt, 2018).

6. The Norwegian housing cycle

This chapter contains the introduction of the Norwegian housing market. We start by introducing the fundamentals affecting the housing cycle. Thereafter, different types of housing and the historical development in house prices are discussed. Housing prices for Stavanger and Oslo are also included. We further analyze these in the chapter containing oil prices as a factor. Moreover, we compare the development of housing prices in Norway to other OECD countries.

Further, we explain the methods we use to detect cyclical changes. To detect cyclical changes we use the Hodrick-Prescott filter. We present the cyclical changes for housing prices in Norway, Stavanger, and Oslo. Moreover, we present the different fundamentals that may affect the housing cycle.

This chapter is an introduction to chapter 7, whereas the analysis of the Norwegian housing market continues, and each fundamental is analyzed in separate sub-chapters.

6.1 Fundamentals of the housing cycle

As we pointed out in the introduction, several fundamental factors may affect the housing cycle. It can be difficult to point out exactly which fundamentals are changing the cycle and how, and one cannot adequately predict future development. Fundamentals of the housing cycle are also highly discussed, both internationally and specifically for Norway. Each fundamental we have chosen to focus on is presented below. However, several other fundamentals are also essential, and some of them are included in this section.

There are many debates regarding fundamentals that may affect the housing cycle. Jacobsen and Naug (2004a) point out that interest rate, housing construction, unemployment and households' income is essential fundamentals affecting the housing prices. Demographics may also be affecting the house prices positively in the long run (André, 2010). In addition, household disposable income seems to have a positive effect on the house price development. It also contributes to economic freedom to invest in houses and increase their ability to take up loans. A study by Miles and Pillonca (2008) found that increasing real income contributed to

increasing house prices. These findings were especially prominent in Norway and a few other countries. Higher income increases each consumers' purchasing power and demand for housing. Expectations about personal wealth and house price development also have a long run effect on the housing prices (André, 2010; Jacobsen & Naug, 2004b).

Lower unemployment has shown to support the house prices positively in several countries. Lower unemployment contributed to expectations about higher wealth in the society and less uncertain household wealth and income. This can also affect credit access, and the household may get lower limits for loans. The loan limits may have an adverse effect on the housing prices (André, 2010; Jacobsen & Naug, 2004b).

Housing construction is an essential part of the housing cycle. Leamer (2007) points out the importance of construction for the housing cycle. He argues that the housing cycle is, in fact, a volume cycle. Goodhart and Hofmann (2007) argue that increasing house prices lead to higher housing construction. It is also important to keep in mind the raising quality of houses in recent time. The rising level of quality and comfort in houses raises its value. Household invests more in refurbishing and maintenance of their homes, and basement and unused areas of the houses are often refurbished.

Leamer (2007) argue that housing prices significantly affect the business cycle. He assessed the relationship between the business cycle and housing in his paper "Housing IS the Business Cycle." An essential aspect of Leamers' arguments is that the two factors not only correlate, but the housing prices determine much of the business cycle. Goodhart and Hofmann (2007) support this and argue that housing prices and economic cycles closely correlates. Increasing house prices profoundly affects the housing cycle because, among other things, new housing construction is more invested in.

Anundsen and Jansen (2013) argue that monetary policy influences the housing cycle. Interest rates have an indirect influence on housing prices. The Norwegian central bank sets the key rate, which impacts the interest rates set by banks, affecting the households' loans and mortgages (Larsen, 2018). The level of the interest rate is also critical and changing key rate affects households' possibilities of taking a loan. Most households are depending on the ability to get a loan to finance it. Interest rates affect households' disposable income, which makes it easier to obtain a loan from banks, and repay it. The higher loan households can get, the higher

degree of freedom they have in their purchasing decisions (Jacobsen & Naug, 2004a). The ability to increase their loan is also contributing to rising house prices. If the interest rate falls, the mortgage loan is cheaper. A higher purchasing power implicates higher demand for houses, which again influence a higher housing price (André, 2010).

The effect on oil price towards housing cycle is very much discussed. The economic condition for Norway is profoundly affected by the oil prices. Park and Ratti (2009) claim that Norway, as a net exporter of oil, experience a positive impact on house price levels if oil prices increase. Some argue that in general, rising oil prices negatively affect housing cycles (Antonakakis & Gupta, 2016; Breitenfellner, Cuaresma, & Mayer, 2015). A study made by Killings, Egly and Escobar (2017) argue that housing prices are much more affected for a net oil-exporting country, such as Norway. However, Cappelen, Eika, and Prestmo (2014) debate that Norway is more robust towards a fall in the oil prices today than before. Therefore, oil price fluctuation may not affect the housing prices that much.

Households' debt levels are also essential to consider. Anundsen and Jansen (2013) debate that housing prices and debt are highly correlated. Increasing house prices tends to have a positive effect on household debt levels. Higher housing prices result in higher credit growth, which again spurs housing price growth and so on (Anundsen & Jansen, 2013). Favara and Imbs (2015) argue that credit increase positively affect demand for houses, and thus the housing prices. Goodhart and Hofmann (2007) debate that there is a relationship between bank lending and housing prices. They point out that this two-way causality may be as prices rise, the demand for household borrowing increase, which again results in higher house prices.

We have chosen to look further into housing constructions, the business cycle, oil price, monetary policy and households' debt levels. For the rest of the thesis, we discuss and analyze these five different fundamentals separately to see whether and how they affect the housing cycle.

6.2 Psychological fundamentals affecting the Housing Market

Theory regarding behavior finance concerns how psychology plays a vital role in humans' decision-making. Behavior finance highlight that consumers do not always make rational

decisions (Ackert & Deaves, 2010). The decisions regarding investment of housing relate to more than only economic fundamentals. To purchase a house is a massive investment, and it is essential for households to buy houses they believe are worth the price. Consumers affect each other, and the market efficiency disappears. Therefore, expectations about the future are highly relevant in the housing cycle.

Vale, Kutluay, and Yildiz (2013) argue that psychological factors such as expectations to the Norwegian economy and housing have an actual effect on the housing price development. These expectations come from both banks and other households. Mayer and Sinai (2007) claim that psychology along with rational fundamentals matters in the housing market. Psychological factors impact consumers' behavior and thus the effect on house price movements.

Shiller (1990) debates that expectations about the future development profoundly affect consumers purchasing behavior. Expectations for the future may relate to income, interest rates, growth in population and the relationship between future supply and demand. Jacobsen and Naug (2004a) have also included expectations as an exogenous variable for their house price model, indicating that expectations in the housing market are essential to consider.

The housing cycle cannot be fully explained by fundamental factors (Vale, Kutluay, & Yildiz, 2013). Expectations about future development may also have a significant impact on house price development. Both expectations about future price development and the economy affect the housing cycle. Anundsen and Jansen (2013) together with Jacobsen and Naug (2004 a) argue that the expectations for the housing prices are an essential determinant of the housing price development. Speculations may be about both increases and decreases in price. Households and other investors speculate in the housing market and evaluate whether or not investing in housing at a specific period is a good investment. When selling or buying a home, the owners usually have some expectations about availability in the markets or the housing prices in the neighborhood (Anundsen & Jansen, 2013).

Expectations about the house price development may have a significant effect on the actual growth. If analysts or experts state that the "bottom is reached" for the housing prices, this house price level does not have a long-lasting duration. The house prices start to increase rapidly. As the house prices rise, more houses are sold and bought. As households' believe that the house prices increase, they are willing to buy a new house before they have sold their

existing home. This again spurs the house price development, as demand grows more than supply (Lunde, 2014).

Expectations regarding the housing price development may also result in a housing bubble (Vale, Kutluay, & Yildiz, 2013). A housing bubble occurs when the housing prices are set above its fundamental value, and occur due to unreasonable expectations for increasing house prices in the future. These expectations are not supported by fundamental factors (Shiller, 1990). High house prices relative to rent prices may be an indication of a housing bubble. The gap between the fundamental value and the price levels may burst.

It is vital to evaluate the housing cycle and the house price development in light of the psychological fundamentals. This is not analyzed in detail. However, expectations and irrational decisions are included if appropriate.

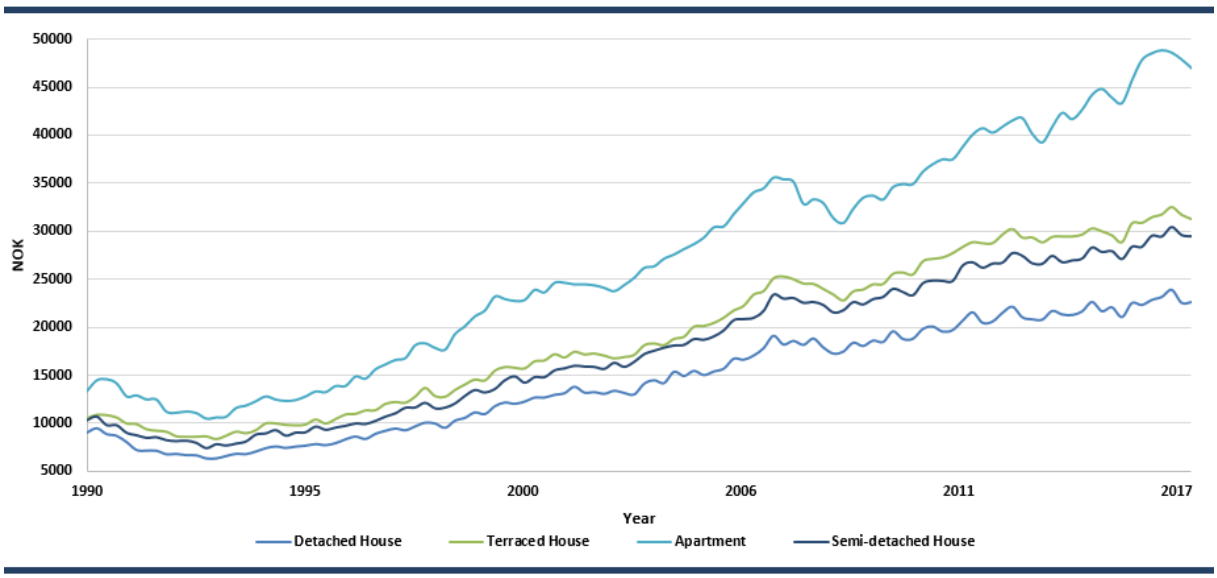
6.3 House prices in Norway

As describes in chapter 5, the housing prices have increased significantly since the 1980s. In this thesis, we use the house price levels as the measure for housing cycle when analyzing the fundamental factors.

Eiendomsverdi distinguishes between four types of residential buildings in their database. The four types are detached houses, semi-detached houses, terraced house, and apartments. In figure 5, we see the development of house prices per square meters for all four types since 1990. It shows the small price decrease in housing prices the recent year. The figure contains fewer years than figure 3 in chapter 5, and therefore it is easier to see the changes in house prices.

As the four different types of houses are priced differently, it is necessary to define them. A detached house is a type of house that is not connected to other houses and is a free-standing residential building. A detached house is usually a home for only one single family. A semi-detached house is a single-family house built as one of a pair that shares one common wall. Often each house's layout is a mirror image of the other. A terraced house is a house with more residential homes attached to each other in a row. Last, an apartment is a self-contained housing unit that occupies only a part of a building, generally on a single level.

Figure 5 Real house prices in Norway for the four different housing types



Source: Eiendomsverdi

The different types of housing have different square meter price. However, the price development follows more or less the same pattern. There are various reasons for why there are different square meter prices. We see that detached houses have had the lowest square meter price through the period. However, the prices of detached houses are often higher than the other types of houses, due to the larger size and residential lot. Therefore, the square meter prices tend to be lower, as when the total square meters increase, the square meter prices decrease.

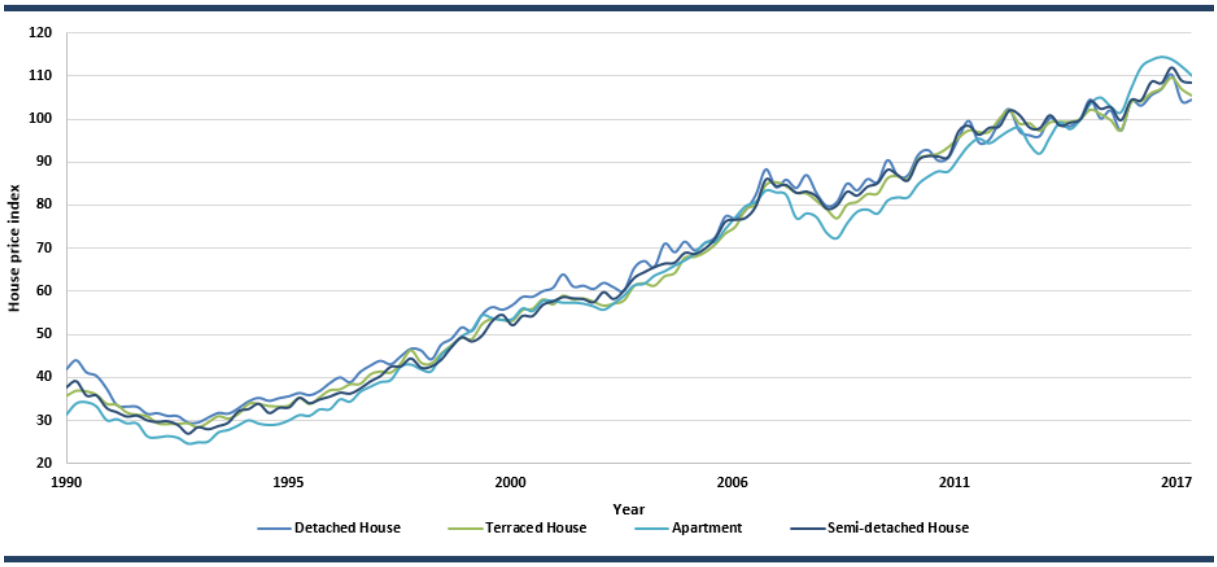
When it comes to location, it is more expensive to buy houses in larger cities than more urban areas and smaller towns in Norway. Especially Oslo has had much higher housing prices than rest of the country. The majority of housing types found in Oslo is apartments. Apartments are more prominent in the city center, and detached houses, semi-detached houses, and terraced houses are located in areas outside the city center or in the countryside.

As seen from figure 5, apartments have a much higher square meter price than the other three forms of housing types. This higher square meter price might be due to the high housing prices in the larger cities and that apartments usually have fewer square meters than the other housing types. We also see that the prices of terraced and semi-detached houses have been close to each

other over the whole period. The difference between those two types of homes are small, and thus the minor price differences seem reasonable.

However, in this paper, we do not want to investigate further the actual level of prices, but rather the cyclical changes in them. We see that the different house types have many of the same cyclical changes. The cyclical changes are even more visible when we transform the four different house prices over to indexes. This has been done in figure 6 with 2015 as index year, and we see that the four house prices move close and have many of the same characteristics.

Figure 6 Real house price index for the four different housing types (2015=100)



Source: Eiendomsverdi

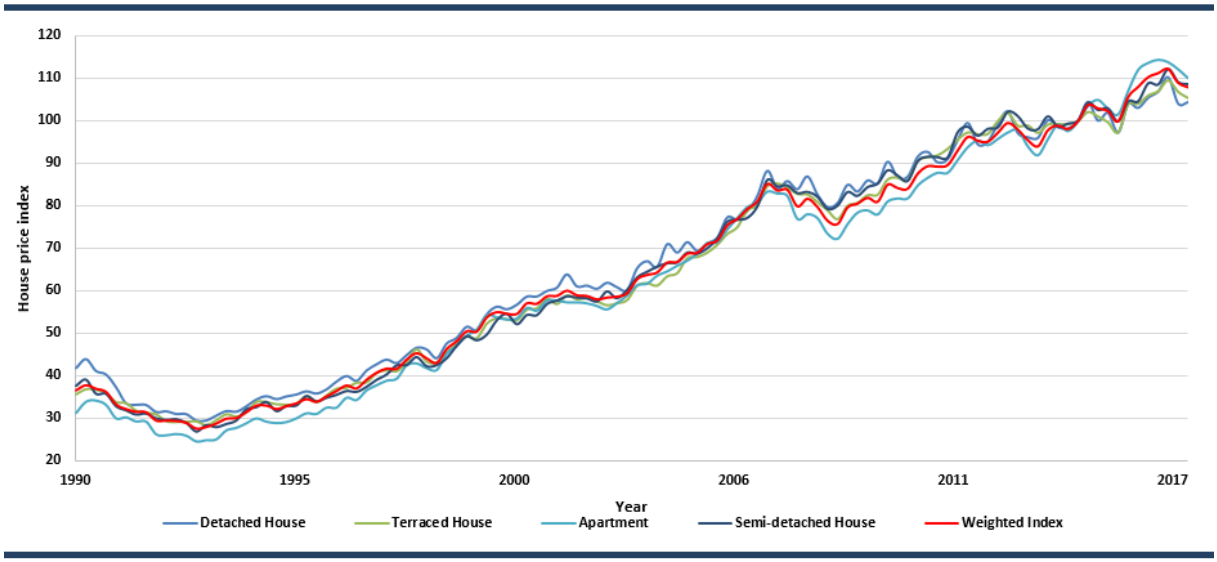
Since the house prices for the different types of houses moves very similarly, there is no point looking at the cyclical movements for all four housing types. Thus, we have chosen to use an average house price. This makes the analysis much more straightforward and easy to see cyclical changes in relations to the factors.

Eiendomsverdi has quarterly information regarding the number of houses sold for each type of houses. Thus, we can calculate one weighted average square meter price from all four types

(see Appendix 1). The weighted average house price index is presented with the other house price indexes in figure 7.

The red line indicates the weighted average house price index. We see that it has the same movements as the four other house price indexes and lies between them. In the further analysis, the weighted average square meter price is used to discuss the Norwegian housing cycle.

Figure 7 Average weighted house price index.



Source: Eiendomsverdi

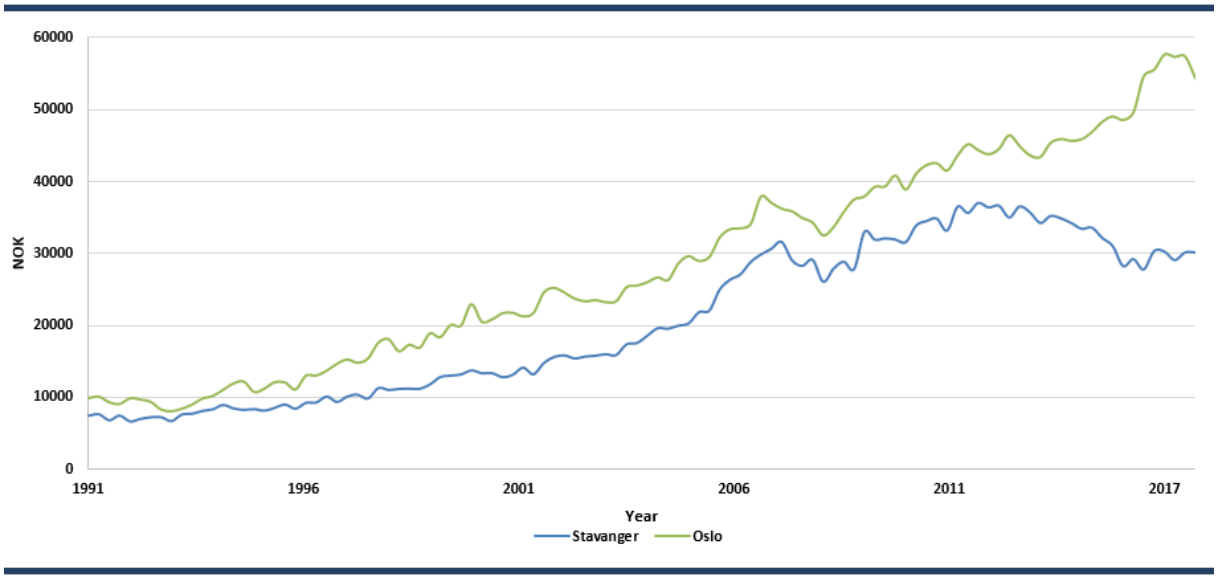
6.3.1 House prices in Oslo and Stavanger

Since we use oil prices as one of the factors that might affect the housing cycle in Norway, it is interesting to look at a specific area in Norway that is profoundly influenced by the oil industry. When the search for oil in the North Sea started, the American oil prospectors were looking for a base area. The political environment in Stavanger had a significant influence on local business peoples, and they were very willing to set the conditions for the foreign oil companies with base areas, homes, schools and so on. Thus, Stavanger was established as a base town before the first commercial find of oil was made in 1969. The city was ready to take the role as Norway's oil

capital when the first oil production started in 1971. Since then, Stavanger has had the highest ever density of oil workers in the country (Gjerde, 2015).

Since Stavanger is known as the oil capital of Norway, we want to look at oil price change to the house prices in Stavanger. It is interesting to see if a change in oil price has a different effect on Stavanger than Norway as a whole. We look at the house prices of Oslo against oil to see if there is any difference between Stavanger and Oslo. This is interesting as Oslo is less oil-dependent than Stavanger. Figure 8 shows the real house prices per square meter for Stavanger and Oslo since 1991. We see that the prices in the two cities have had the same development until late 2012. Form this point, the prices in Stavanger started to decrease while prices in Oslo kept increasing.

Figure 8 Real house prices in Stavanger and Oslo



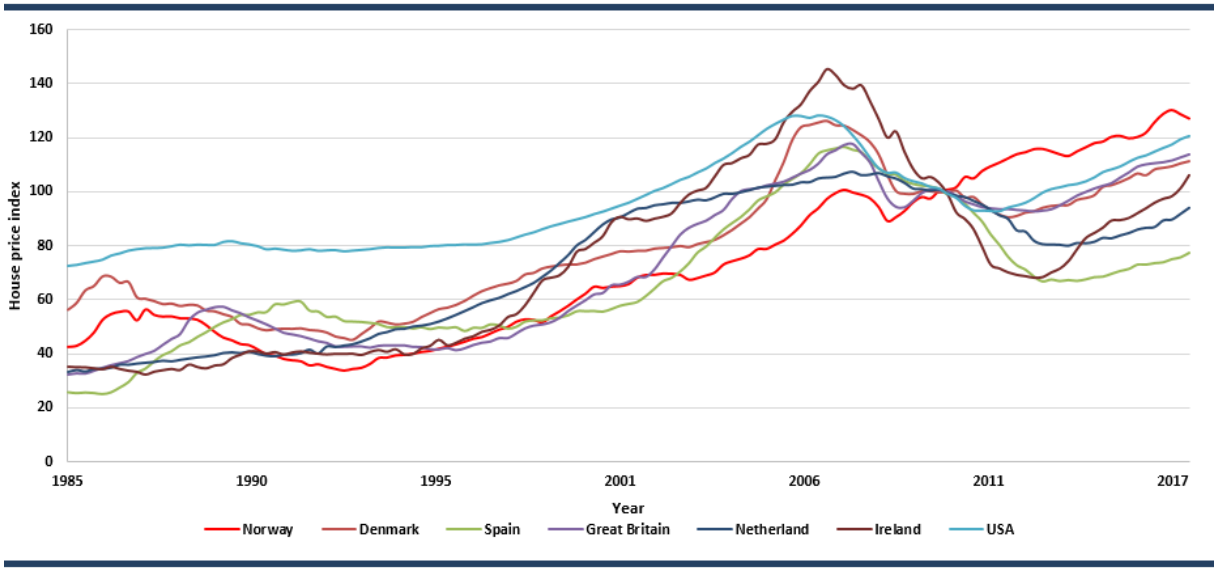
Source: Statistics Norway

6.4 House prices in Norway vs. OECD-countries

Among other OECD countries, Norway was one of the countries with the most substantial increase in house prices until the peaks in 2006-2007. Ireland, Netherland, Denmark, Great Britain and Spain were other countries experiencing a sharp rise in house prices. However, the

Norwegian house prices reacted differently to the financial crisis than the other did. Figure 9 shows the development of Norwegian house prices and the six OECD-countries with the most significant price reduction since the top in 2006-2007 (Lunde, 2014). Five of the six countries with most considerable price reduction were among those with the most substantial increase until the top points before the crisis.

Figure 9 Changes in real house prices from 1985 to 2017 for Norway and six other OECD-countries



Source: OECD

From figure 9, we see that the Norwegian house prices did not suffer the same loss as the other six OECD countries did. We see that the Norwegian house prices turned around and started to increase again after the fall several years before the house prices in the other countries. Norway is today the only country from the seven countries that have a higher real house price today than at the peak before the financial crisis. This makes it extra exciting to investigate the Norwegian housing cycle further.

6.5 Hodrick-Prescott filter

To analyze the Norwegian housing market, we want to detect the cyclical changes in the housing prices and the different fundamentals. We subtract the trend form our data to identify the cyclical variations. The cyclical changes are used to compare the cyclical movements in the housing prices to the different fundamentals.

We look at cycles in the housing market to an estimated long-term trend. Robert J. Hodrick and Edward C. Prescott introduced the HP-filter in 1981. This method can be used for decomposing observed variables into trend and cycle (Hamilton, 2017). The purpose of the HP-filter is to be able to represent a time-series with smooth curves. This is achieved by removing the cyclical component. This representation of this data is more sensitive to long-term fluctuations than short-term. Using this method, we can detect the long-term trend for historical time series. The approach aims to find the level of potential production (y_t) that minimizes the deviation from actual production and potential production. Additionally, the method takes into account the limitation of the maximal growth in potential production may vary. The HP-filter separates a time series into a trend component τ_t and a cyclical component C_t. The model is presented in the following equation:

$$Y_t = C_t + \tau_t$$

Where Y_t is the time series, C_t is the cyclical component and τ_t is the trend component. To identify the trend component, the following equation is expressed:

$$\min = \sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$$

$$t = 1, \dots, T$$

The first part of the equation consists of the squared sum of deviation between actual values and the trend. The second part of the equation composes of the squared sum of changes in trend. Both parts of the equation are squared, meaning that we get an equal weight of positive and negative values.

The second part of the equation is weighted with the smoothing parameter lambda. Lambda is an exogenous variable and is not determined in the model. It has a positive value and decides

how considerable variation that is allowed in the trend (Hodrick & Prescott, 1997). A higher lambda value gives a higher difference between actual values and trend as a trend is not allowed to vary that much. With a higher value of lambda and closer to infinity, the trend is more linear with constant growth. The lower the lambda value, the higher variation in trend is allowed. If lambda is zero, the trend component is equal to the original time series (Bjørnland, Brubakk, & Jore, 2004).

To be able to use the HP-filter for us we installed it as an ad-inn to Microsoft Excel. See Appendix 2-8 for calculations of the HP-trend in the house prices and the fundamental factors. We use real values for all factors and housing prices and finds the HP-trend for all values. To detect the cycles, we subtract the real values by HP-values. In order to analyze this, we illustrate the cyclical movements for all fundamentals against the housing prices.

Further, we use a lambda value of 1600. Hodrick and Prescott in 1981 argued that this lambda value be well suited for quarterly data, and today is known as the international standard (Bjørnland, Brubakk, & Jore, 2004). Kydland and Prescott (1990) also suggested a lambda value of 1600 for quarterly data.

6.5.1 Critics of Hodrick-Prescott filter

Although the HP-filter is a standard method to estimate such a long-term trend component, there are some critiques towards this method.

Endpoint problems are one of the drawbacks of using the HP-filter. Observed values determine the trend in the HP-filter before and after the specific values. To estimate the trend for a given period in the time series, the HP-filter uses observed values for both future and previous values (Bjørnland, Brubakk, & Jore, 2004). Thus, the filter is not complete, and there is a change from duplex to a unilateral filter (Benedictow & Johansen, 2005). The trend at the beginning and end of the time series is more affected by the fluctuations in the actual values than for the rest of the period. We do not have data after 2017, and thus the trend in most recent years depends on the actual housing prices and other values instead of the future prices or values. The higher the lambda value, the higher the endpoint problems is. To dampen the adverse effect of this, one

may use prognosis for future values (Bjørnland, Brubakk, & Jore, 2004). As this is not the focus of our thesis, we do not focus on prognoses for future values.

Choice of lambda is another problem associated with the HP-filter. Lambda values are exogenous and decided outside the model. The decision of lambda significantly affects the trend and is therefore very critical. As the decision of lambda affects the trend, it is possible to manipulate, which is a significant weakness of this method. However, there are some suggested benchmarks when using the lambda values (Bjørnland, Brubakk, & Jore, 2004).

6.6 Cyclical changes in the housing prices

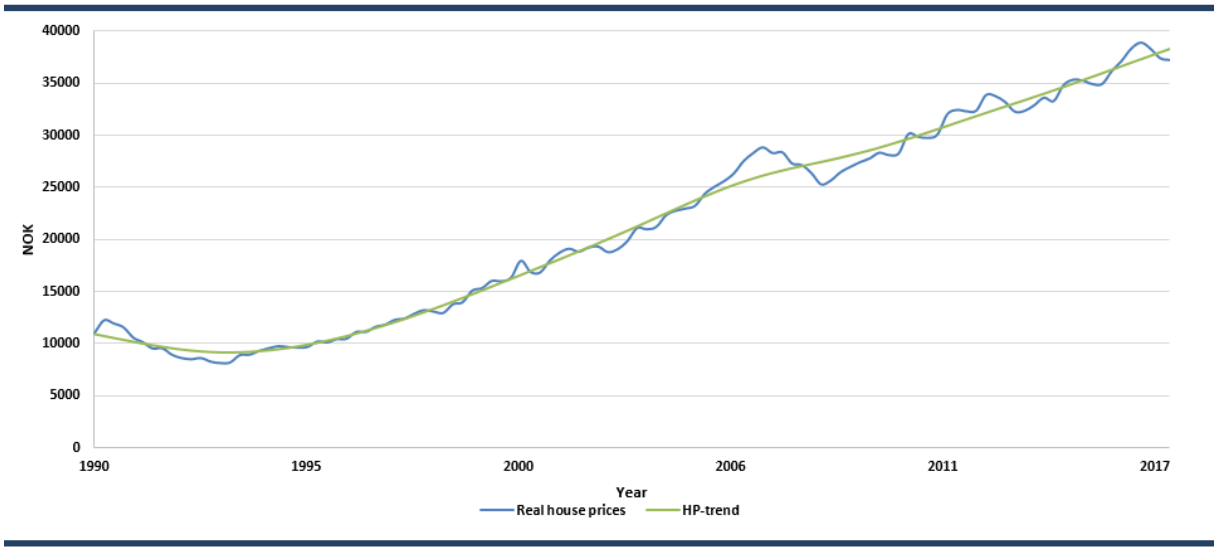
The housing price development has been discussed previously in this thesis. Booms and busts have affected the Norwegian housing market. Including the cycle impact of housing prices helps us get a better understanding of the movements.

6.6.1 The housing prices with a trend line

Figure 10 shows the real house prices per square meter and its trend line. The trend line is calculated with the HP-filter and a lambda value of 1600. The real house prices have an increasing trend. Between 1995 and 2000, the real house prices are close to the trend line. We see that when the real house prices deviate from the trend, it always tend to turn and move back to the trend.

When the house prices are above the trend, the house prices seem overvalued. In the more extended run, the house prices eventually move back to the trend. The housing prices are in balance around its trend. If the house prices do not go back to its equilibrium, the housing market may end up in a housing bubble (Vale, Kutluay, & Yildiz, 2013). Due to economic and other shocks in the market, the house prices deviate from its trend. In a well-functioning market economy, the house prices adjust and reach its equilibrium price level.

Figure 10 Real house prices and HP-Trend

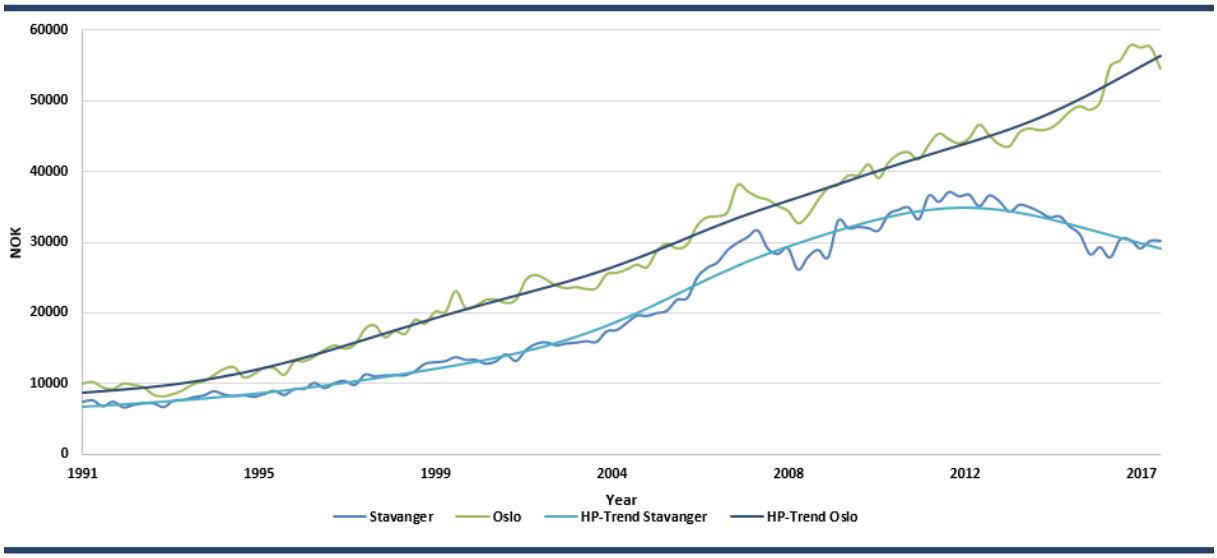


Source: Eiendomsverdi, own calculation using HP-filter

The trendline for housing prices in Stavanger and Oslo

Figure 11 shows the real house prices for Stavanger and Oslo and the two trend lines. The trend line for house prices in Oslo looks similar to the one for whole Norway. However, the trend line for house prices in Stavanger deviates from the two other. We see that the trend for Stavanger was similar to the other until around 2011. However, after this, it started to turn. While the trend for Oslo has been increasing, the trend for Stavanger have been decreasing the last years.

Figure 11 Real house prices in Stavanger and Oslo, and HP-Trend



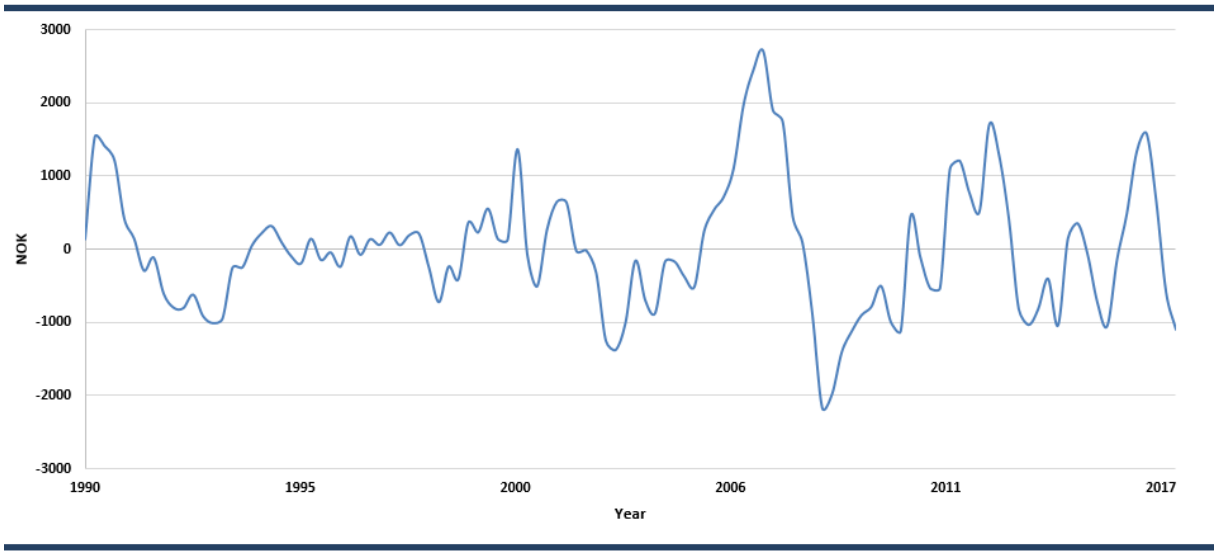
Source: Statistics Norway, own calculations using HP-filter

6.6.2 Cyclical changes house prices

If we remove the HP-trend from the real house prices, we get the cyclical changes of real house prices. In figure 12, we see the cyclical movements of real house prices per square meter for the Norwegian housing prices. Some of the tops and bottoms are higher than the other, for example, the top in 2007 and the bottom in 2008. This was due to the financial crisis occurring in Norway at that time. As previously discussed, the housing market shortly recovered, and the housing prices increase significantly. After the financial crisis, the cyclical changes are much more volatile. It is interesting to notice that before the downturn, the prices were considerably higher than its trend and were increasing rapidly.

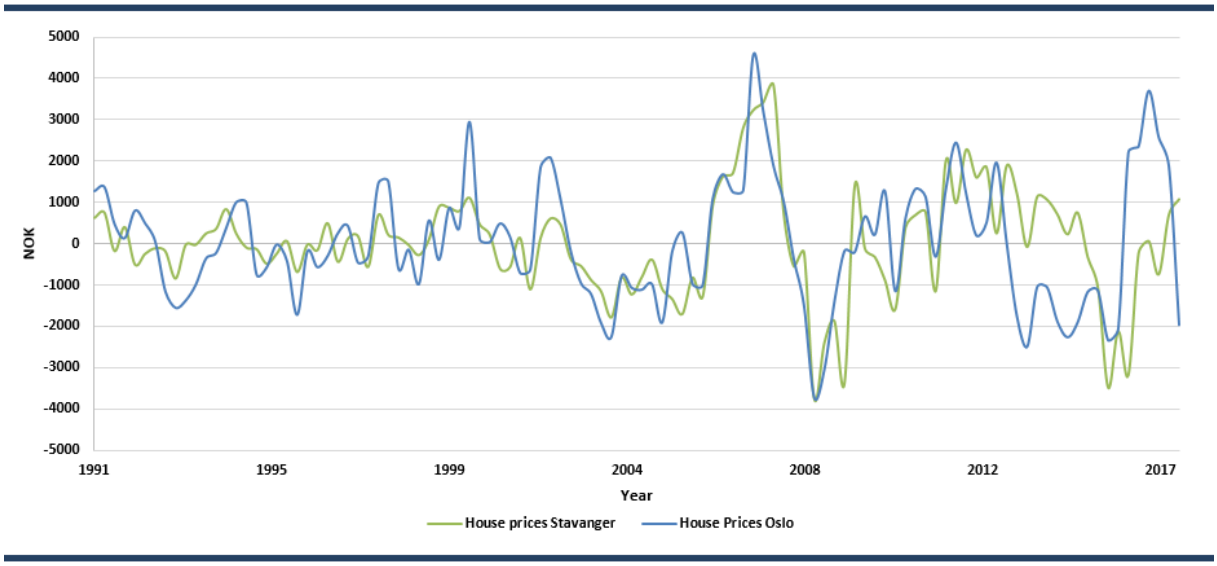
We use the cyclical changes of real house prices to compare with the cyclical changes of our five fundamentals. In this way, we see how the housing cycle moves with the other fundamentals.

Figure 12 Cyclical movements of house prices



Source: Eiendomsverdi, own calculations using HP-filter

Figure 13 Cyclical movements of house prices in Stavanger and Oslo



Source: Eiendomsverdi, own calculations using HP-filter

Figure 13 shows the cyclical movements of house prices in Stavanger and Oslo. We see that the two cyclical changes have had the same pattern until around 2012. We do also understand that Oslo has stronger positive shocks than Stavanger has, with higher deviation from its trend

line. The cyclical changes of house prices in Oslo and Stavanger are used against cyclical changes of oil price to see if we can detect a stronger relationship between house prices and oil prices in Stavanger than in Oslo.

7. Analysis of the fundamentals affecting the Norwegian housing cycle

This chapter tries to analyze the fundamentals that have a possible impact on the Norwegian housing cycle. We have previously argued that we believe that some of the fundamentals that affect the Norwegian housing cycle: housing construction, business cycle, oil prices, monetary policy and households' debt. These are analyzed in separate subchapters. In this part, we use the HP-filter to examine possible relationships, in addition to existing literature.

7.1 Housing constructions and its effect on the housing cycle

Housing construction is an essential part of the housing cycle. The most direct impact of fluctuations in house price to economic activity is via residential investment. An increase in house price raises the value of housing construction relative to the construction cost. The newly constructed house becomes a positive investment when house prices are higher than the construction cost (Goodhart & Hofmann, 2007).

The changing housing prices in a market illustrate the relationship between supply and demand. However, the housing supply is more or less given in the short run. Both housing construction and approval of construction is a long process and takes time (Goodhart & Hofmann, 2007).

In the long run, new houses affect the housing supply. The housing supply relates to what is available on the market. In the Nordic markets, demand exceeds supply, which is a part of the increase in housing prices (Tunström, 2016). As new homes are constructed and available for sales, there is a shift in the supply of housing in the market. This shift in supply may affect the housing prices (Jacobsen & Naug, 2004a). This also relates to macroeconomic theory, such as DiPasquale and Wheaton model, whereas the supply increases. If demand does not follow, the housing prices are affected.

7.1.1 Existing literature

Leamer (2007) points out the importance of construction for the housing cycle and argues that the housing cycle is, in fact, a volume cycle. If a decline in demand occurs, the volume is adjusted and not necessarily the prices. A decrease in construction results in fewer jobs in construction, finance and real estate, which again affects the economy.

An analysis made by Statistics Norway further points out that the housing construction in Norway tends to have a tight relationship to the general economic cycle. As the Norwegian financial condition increases so does the construction activity as well. Telle (2017) reasons that the increasing housing construction in recent years has been an essential and positive contributor to the Norwegian economy during the recent market downturn. Higher housing constructions lead to higher employment and higher activity in the real estate market. This increasing activity also contributes to GDP growth (Case & Quigley, 2008).

Spiegel (2001) argues that the effect of house prices for new housing also depends on the economy. He claims that during economic growth periods and increasing house prices, the price levels differ less than usual between homes in new condition, versus those in a dilapidated condition.

Housing developers tend to analyze the current state of the economy before deciding whether to start new housing projects (Spiegel, 2001). Goodhart and Hofmann (2007) claim that increasing house prices lead to higher housing construction. Jacobsen and Naug (2004a) support this, and debates that an increase in house prices in Norway leads to profitable construction projects, and thus lead to a higher amount of housing construction. The house prices have been increasing the last years in Norway, implying that housing is a scarce and attractive resource.

Cost of construction is similarly a vital part of the housing cycle and housing construction (Rosenthal, 1999). Higher construction costs affect the possibilities of housing construction. Hort (1998) argues that construction costs are an essential factor for house price development. Zahirovich-Herbert and Gibler (2014) find that the cost of new houses inside a built-up metropolitan area is often higher than suburban areas. These areas tend to have lower land prices and fewer restrictions. If construction costs increases, there is most likely be a slowdown in construction until the costs fall to lower levels (Rosenthal, 1999).

There are high regulations in each city and countries regarding the volume of construction allowed, location and shape of the housing construction (Gyourko & Molloy, 2014). Therefore, Housing construction cannot increase immediately as the house price increase.

The level of housing construction is also strongly dependent on state support measures. In Norway, state institutions exist to help financing housing construction and help households' buy their first residential (Tunström, 2016). In addition, house construction restrictions may also affect the house price development. There are several restrictions in Norway (Statistics Norway, 2018). Gyourko and Molloy (2014) say that regulation for the housing construction tends to have a positive effect on the house price development. They may prevent a housing construction boom due to increasing house prices, and can, therefore, regulate some of the growth in house prices.

The higher quality of new houses may also be an essential driver of house prices. Housing constructions should also have a direct impact on the housing prices in other ways than increasing supply. As newer houses have a higher quality and comfort, this raises the value of the home (Goodhart & Hofmann, 2007).

Ooi, Le, and Lee (2014) debate that due to the higher quality of new buildings, the prices for new houses increases. Additionally, they argue that the house price increase does not only occur in the pre-sale market. The housing prices have a positive effect also on the secondary market. This positive effect means that the first-time buyer recoups the extra cost of buying newly constructed houses with higher quality if they sell in the secondary market.

The effect of new houses and the price development can also depend on the existing houses. Constructions of new homes in established neighborhoods may contribute to increasing housing prices for the existing houses in the area. If one high-quality house is placed near other dwellings with relatively lower quality, these existing houses become more attractive. However, this happens if the new houses are more significant than the existing ones. If the new houses are similar in size with the existing ones, the house prices for the existing houses suffer, as the homes would be comparable. In this case, it is not driving housing prices up, as supply increases while demand remains at the same level. In addition, this relationship is only prominent when the new houses are placed nearby, and the effect declines as the distance increase (Zahirovich-Herbert & Gibler, 2014).

Housing constructions could also be an indication of the future expectations in the market. Low construction activity in one period may be based on the expectations of weak housing demand in the following period. On the opposite side, a high number of new houses indicate that there it is expected to be an increase in demand.

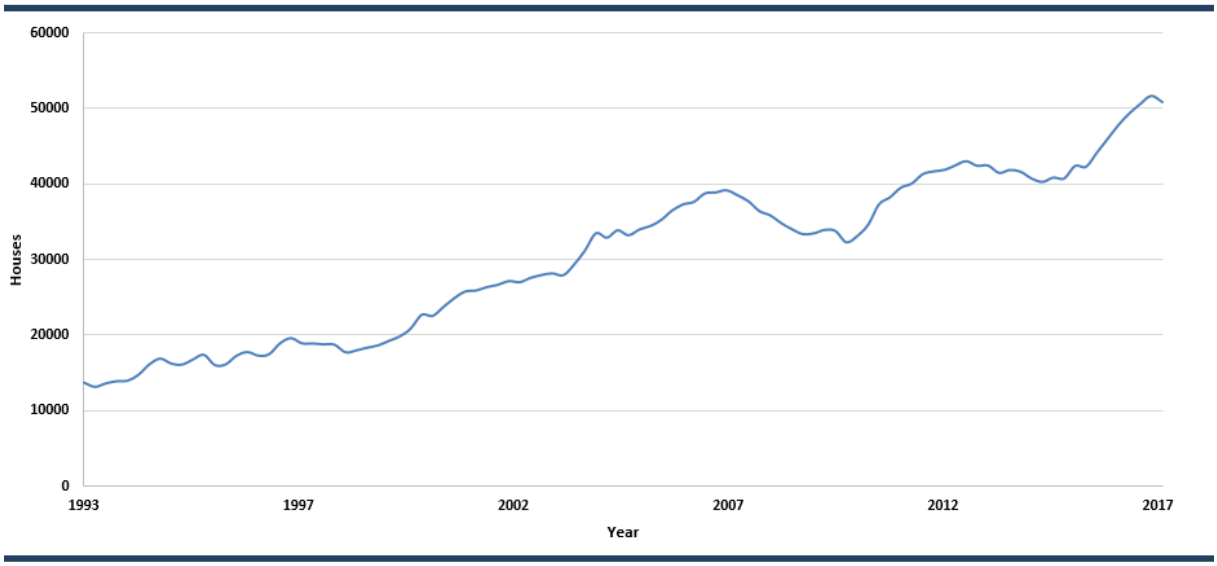
The Expected effect of construction on the Norwegian housing cycle

Based on existing literature, we expect to see a correlation between housing prices and housing constructions. In addition to increasing the housing supply, new houses also raise the quality of homes and contribute to higher values. We also expect that housing prices most often lead construction levels. Most importantly, we believe that housing construction is a vital fundamental for the housing cycle. The prices determine the level of construction. However, the construction significantly affects the economy. As Leamer (2007) points out, the housing cycle is a volume cycle. Higher construction leads to more jobs in construction, finance and real estate market, which benefit the business cycle. Thus, we expect that housing prices lead construction, which again affects the business cycle.

7.1.2 Housing construction data

To measure housing construction in Norway, we have used data on total residential houses under construction, downloaded from Statistics Norway. Statistics Norway defines houses under construction as houses that are reported initiated, but not finished. If some houses are registered as under construction over a more extended period, Statistics Norway investigates whether the construction has stopped or whether there is any intention to complete the house. Already started housing construction that will not be completed is removed from the statistics. In this variable, we have covered all the active housing construction in Norway for each quarter. Houses under construction are in monthly figures from January 1993. We have converted the variable over to quarterly data using an equally weighted average. Figure 14 shows the quarterly number of houses under construction.

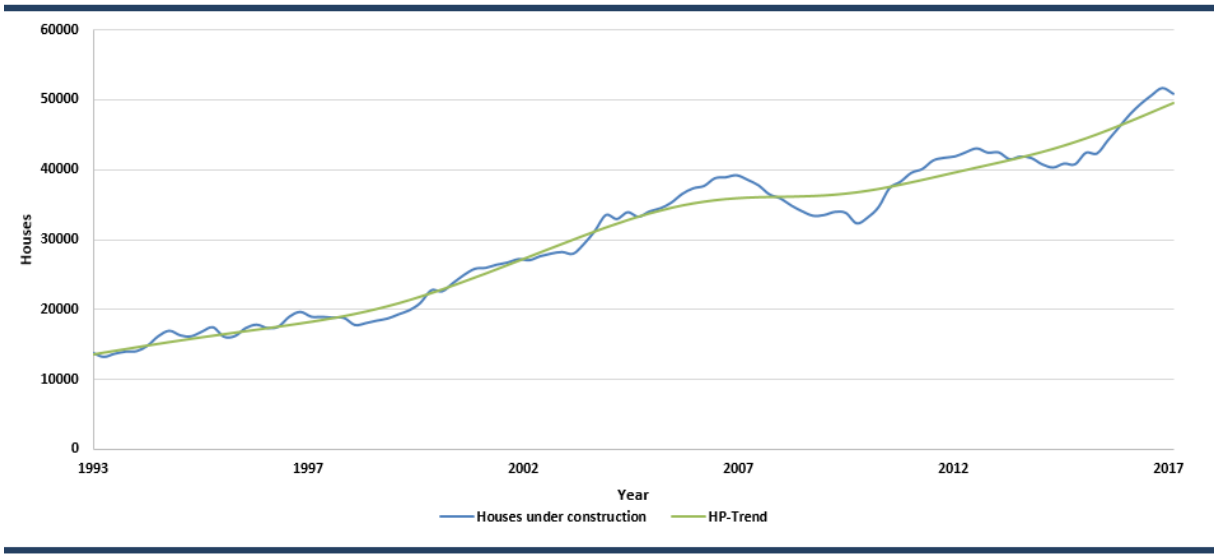
Figure 14 Quarterly houses under construction from 1993 to 2017



Source: Statistics Norway

In figure 15, we show the number of houses under construction from 1993 to 2017 with its trend line. The trend line is calculated with the HP-filter and a lambda value of 1600. We see that there is an increasing trend for houses under construction and that housing construction fluctuates above or below the trend. The top point in front of the financial crisis is followed by a downturn from 2008 to 2011. After the financial crisis, the deviations from the trend line is more significant than it was before. In addition, the booms and recessions have a longer duration than before the crisis.

Figure 15 Houses under construction and HP-trend from 1993 to 2017



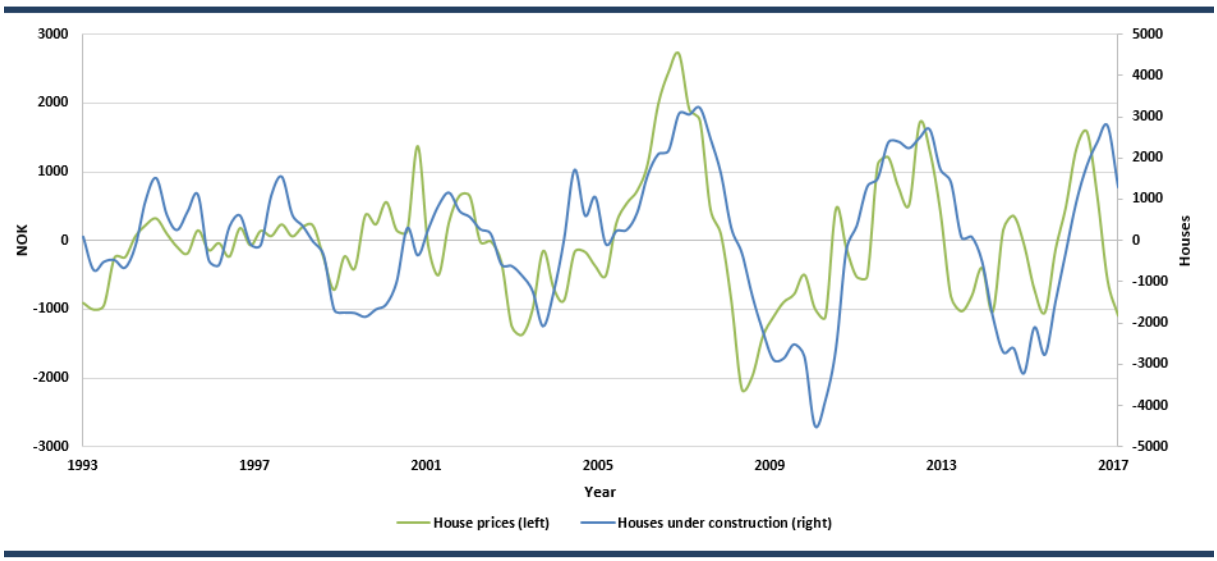
Source: Statistics Norway, own calculations using HP-filter

7.1.3 Housing construction and the housing cycle

We remove the trend line for the actual values of houses under construction to find the cyclical movements. This is illustrated against the cyclical changes of real house prices in figure 16. We see that there is some relationship between the two variables, and it seems like the house prices lead houses under construction, as expected. Higher house prices lead to possibilities of profitable projects for housing construction.

This tendency can be located in several periods from the figure. For example, when the house prices in 1999 started to increase and reached its top point in 2001, houses under construction began to rise in 2000 and peaked in late 2001. In the buildup before the financial crisis, the house prices peaked in Q2 2007, while the houses under construction peaked in Q4 2007. The house prices decreased until Q4 2008 before it again started to increase, while houses under construction fell all the way to Q3 2010 before it turned. From 2013 to the end of 2017, we also can see that the house prices change first and the houses under construction then follow. These periods are a clear indication that these factors correlate, and that real house prices lead the houses under construction. It looks like the mechanisms in the construction markets needs time to react when the house prices change.

Figure 16 Cyclical changes of houses under construction and house prices



Source: Statistics Norway and Eiendomsverdi, own calculations using HP-filter

In periods of uncertain or falling prices, real estate investors may tend to wait or cancel projects in fear of negative returns. Due to regulations, some projects are established a long time before the construction is started. Thus, even though house prices decrease, the level of construction may not fall immediately. This tendency might be seen during the financial crisis, whereas the housing construction seems to be lag the house prices more than before. At the same time, it takes time to start real estate projects, and thus investors may not completely follow the changing prices.

7.2 Business cycle and its effect on the housing cycle

Housing is a significant part of the economy, and it moves in cycles as the other economic component. Thus, we want to look at how the Norwegian housing cycle relates to the Norwegian business cycle.

The economy follows a cyclical pattern. Business cycles include fluctuations of economic growth over time. The economy may experience both recession and high economic growth. An economic boom may lead to rising housing prices, wage growth, and low unemployment.

Investors and households are optimistic and become more eager to borrow (Kindleberger & Aliber, 2005: Minsky, 1982). If the economy overheats, as financial stability is lost, and a recession may occur (Amadeo, 2017).

7.2.1 Existing Literature

There have been several discussions about the relationships between the housing cycle and the business cycle. However, which of the fundamentals driving the other is debated. Xu (2017) argue that there exists a complex and interdependent relationship between growth in GDP and the housing prices. She finds that GDP growth influences both building values and bank credit. This stimulates investment needs, and thus positively affecting the house prices. Furthermore, the real estate industry boom also significantly impact the development of the national economy.

Leamer (2007) argue that housing prices profoundly affect the business cycle. He assessed the relationship between the business cycle and housing in his paper "Housing IS the Business Cycle." This was based on observing ten recessions in the U.S. since the Second World War and was able to locate problems in the housing market and the declining housing construction right before eight of these recessions. He tried to show the importance of housing for the business cycle. Furthermore, he found that the recovery started earlier in the housing constructions than the rest of the economy. Thus, the first item in the economy to soften and the first to turn back up is the residential investment.

An essential aspect of Leamer's arguments is that the two factors not only correlate, however, that housing prices determine much of the business cycle. The business cycle is very dependent on the housing cycle, and he argues that the housing cycle is a volume cycle. He also explains that this relationship is most prominent in recession. If demand falls, households do not want to sell, due to the slower market. The falling demand does not necessarily lead to lower prices. However, it leads to fewer sales and less construction. Fewer sales and lower constructions lead to fewer jobs related to construction, finance and real estate brokerages (Leamer, 2007).

Goodhart and Hofmann (2007) point out that changes in real house prices tend to lead the business cycle. Jabobsen and Naug (2004a) debates that the two variables not only correlate,

but it is also the changing housing prices that affect the activity in an economy and therefore the economic condition. Thus, it affects the operation of construction. Higher activity in construction contributes to many jobs and higher activity in the real estate market. Telle (2017) argues that the increasing housing construction in recent years has been an essential and positive contributor to the Norwegian economy during the previous market downturn.

Decreasing house prices affect the economy. If housing prices decrease, there is significantly less activity in the housing market. This lower activity includes lower levels of housing construction and general operation in the real estate market, which influences brokers, lenders and other people involved in the process of housing investment. A slower real estate market has an adverse effect on the GDP (Case & Quigley, 2008).

However, the close correlation between housing prices and economic cycle appears to be less reliable over the last couple of years. Goodhart and Hofmann (2007) point out that the real housing price levels have been increasing despite economic downturn for several countries.

Two studies from China have investigated the interaction between housing investment and economic growth. Hongyu, Park, and Siqi (2002) argue that housing investment has a stronger short-term effect on economic growth than non-housing investment. They also found that housing investment has a long-term impact on economic growth, while economic growth has a long-term impact on both housing and non-housing investment. Their findings are supported by Chen and Zhu (2008) which finds that there is a relationship between housing investment and GDP in both short run and long run.

The expected effect for the Norwegian housing cycle

Based on the existing literature, we expect that there is a close relationship between the business cycle and the housing cycle in Norway. We believe that there is a two-way relationship between housing prices and the business cycle. However, housing leads the business cycle in most cases.

As the housing prices changes, the amount of housing construction and real estate activity in the market is affected. This has a significant impact on the employment and GDP for Norway.

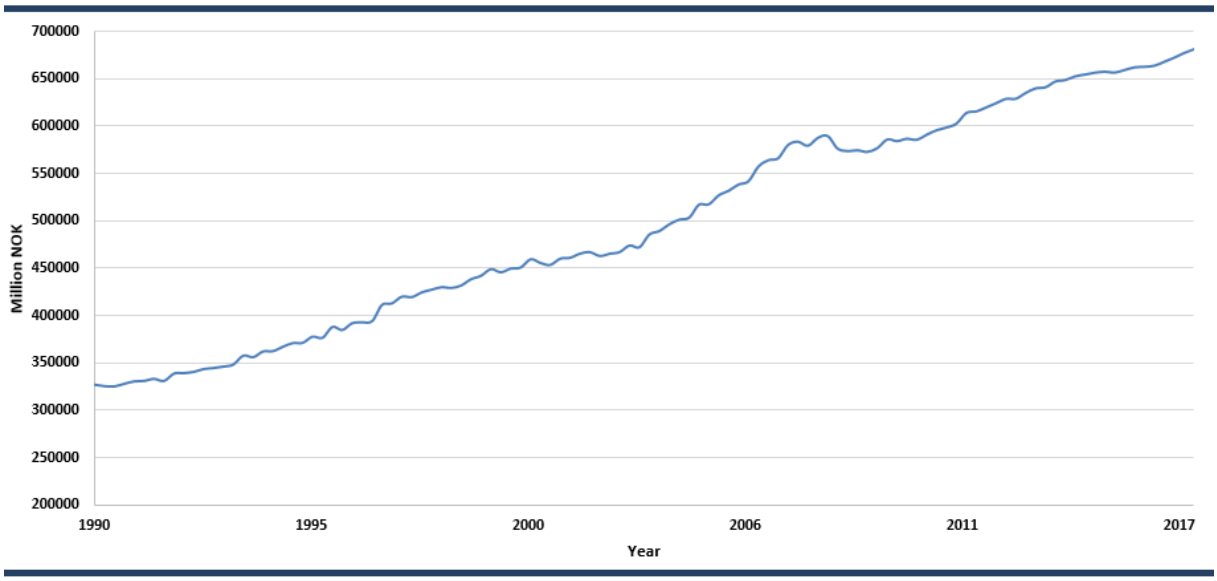
Thus, we expect that the housing prices affect the Norwegian business cycle through construction and real estate activity.

7.2.2 Business cycle data

We use Gross Domestic Product (GDP) as a measure of the business cycle in Norway. Statistic Norway defines GDP as the total value of goods and services produced one year, less the total value of products and services used during this production. GDP is an indicator of overall value added in a country, and also an expression for gross income generated from domestic production.

Due to the significant impact of the oil industry on the Norwegian economy, it is normal to look at the value of GDP Mainland Norway. GDP Mainland Norway is production from all sectors in Norway except oil and gas extraction, pipeline transport and foreign shipping. As we analyze oil prices as a separate fundamental for the housing cycle, we have selected to use GDP Mainland Norway as our measure for the Business Cycle. Real GDP Mainland Norway from Statistics Norway is measured in 2015 prices. Figure 17 illustrates the development in real GDP Mainland Norway from 1985 to 2017.

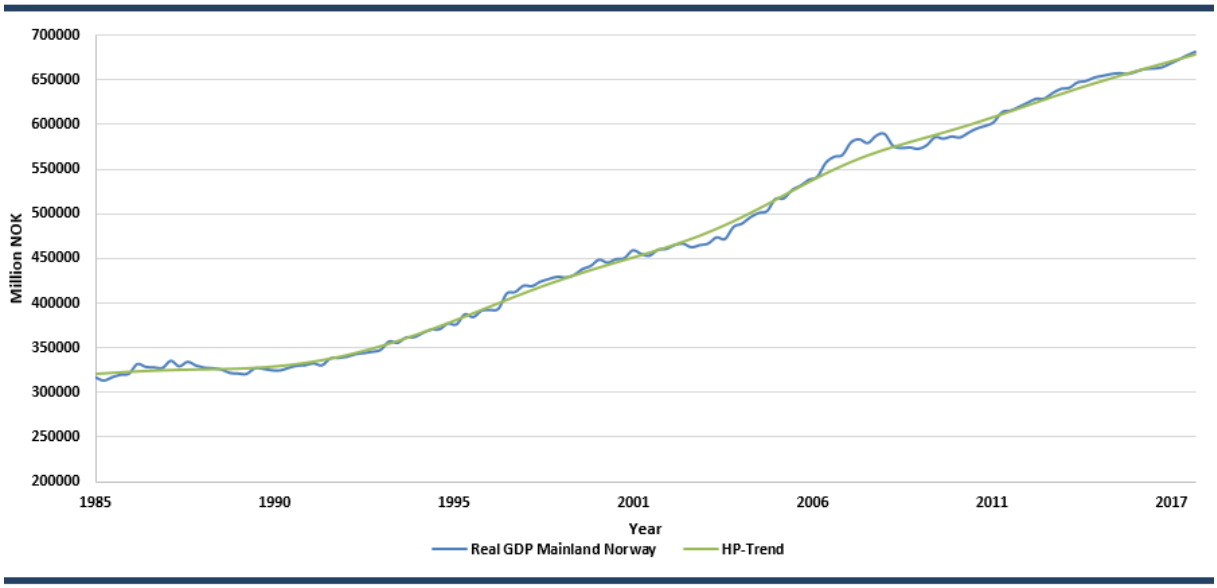
Figure 17 Real GDP Mainland Norway from 1990 to 2017



Source: Statistics Norway

The trend line of real GDP mainland Norway is visualized in figure 18. Booms and busts are hard to detect from this figure. Before 1990, there was a boom in the economy from 1986 to 1988. This was followed by a recession with the banking crises. We can also clearly see that there was a boom in the economy from 2006 to mid-2008. However, the economy shifted with the financial crisis, which caused a prolonged recession until early 2012. Since 2012, there has been a small boom and a minor recession, but these have not been as powerful as the ones closer to the financial crisis. One needs to keep in mind that the figure only shows the real GDP of mainland Norway. Since the Norwegian economy is highly sensitive to oil, real total GDP would show stronger fluctuations.

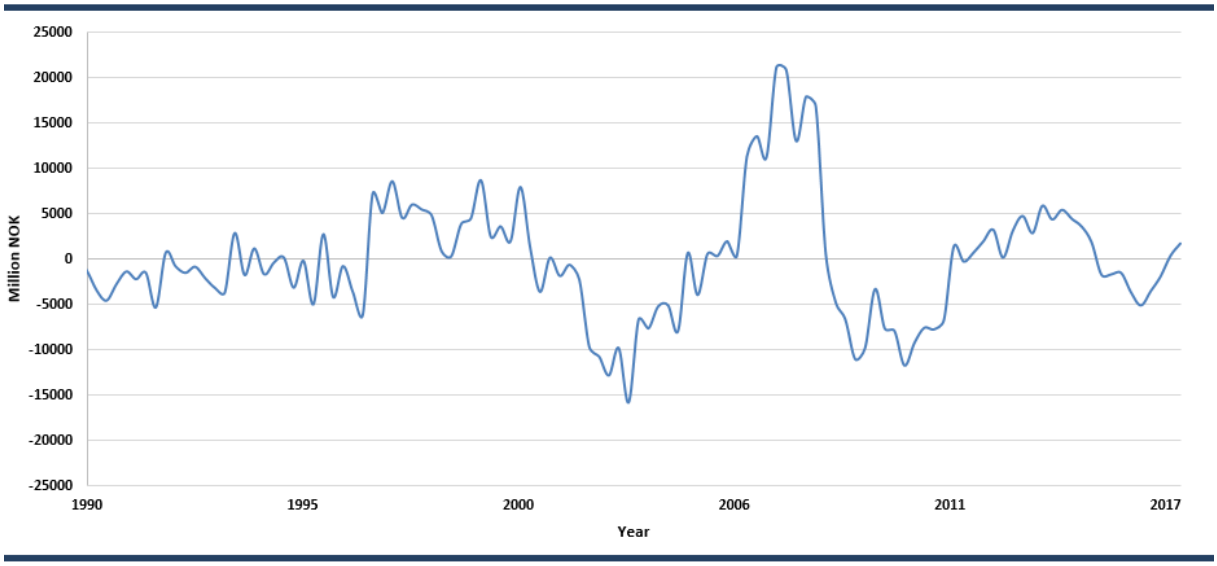
Figure 18 Real GDP Mainland Norway and HP-Trend



Source: Statistics Norway and Eiendomsverdi, own calculations using HP-filter

To look at the cyclical movements of real GDP mainland Norway, we subtract the HP-trend from the actual values. Figure 19 shows the cyclical changes of GDP mainland Norway. It is easier to detect the booms and recessions here. The cycle is positive in booms and negative in recessions. Here we see the impact of the financial crisis in 2008.

Figure 19 Cyclical movements of GDP Mainland Norway



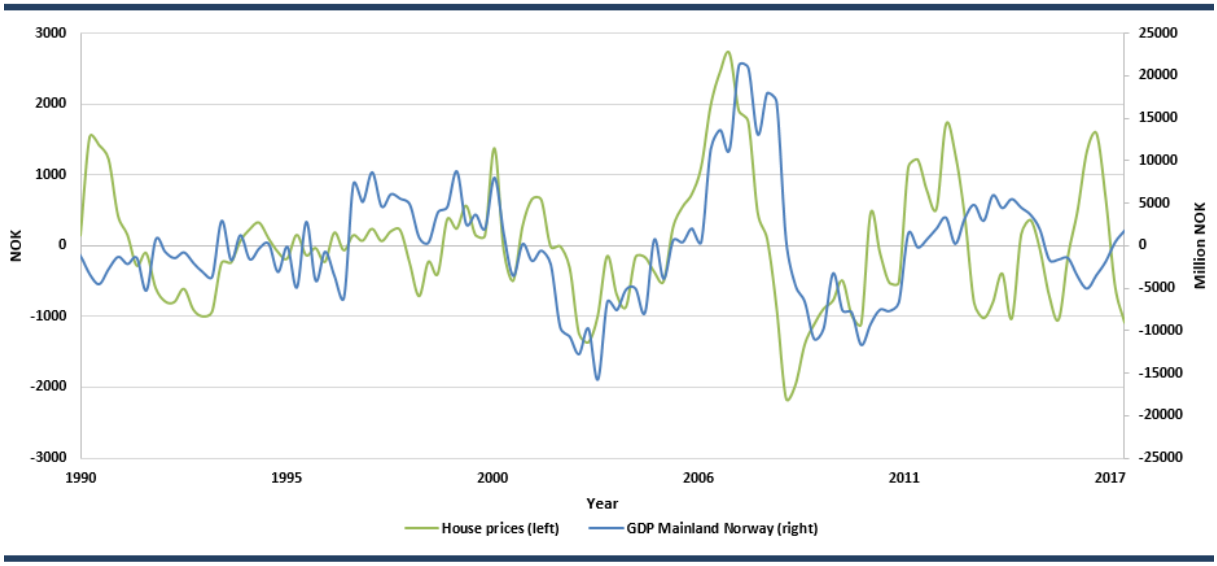
Source: Statistics Norway, own calculation using HP-filter

7.2.3 The business cycle and the housing cycle

In figure 20, we have the cyclical movements of GDP mainland Norway and house prices from 1990 to 2017. We see that the two cycles start with a different pattern. From 1990 to around 2000, the two cycles seem to be countercyclical. When housing prices move up, GDP mainland Norway moves down, and vice versa. However, this pattern change by 2000 and they changed more procyclical from that point until 2014. It looks like there have been slightly more countercyclical movements from 2014 until today.

From 1990 until around 2000, it is difficult to detect if the housing prices or the business cycle is leading. From 2003, it seems like the housing prices lead the business cycle, as we expected. This tendency is especially visible around the financial crisis in 2008 and the recovery of the economy.

Figure 20 Cyclical movements of real GDP Mainland Norway and real house prices



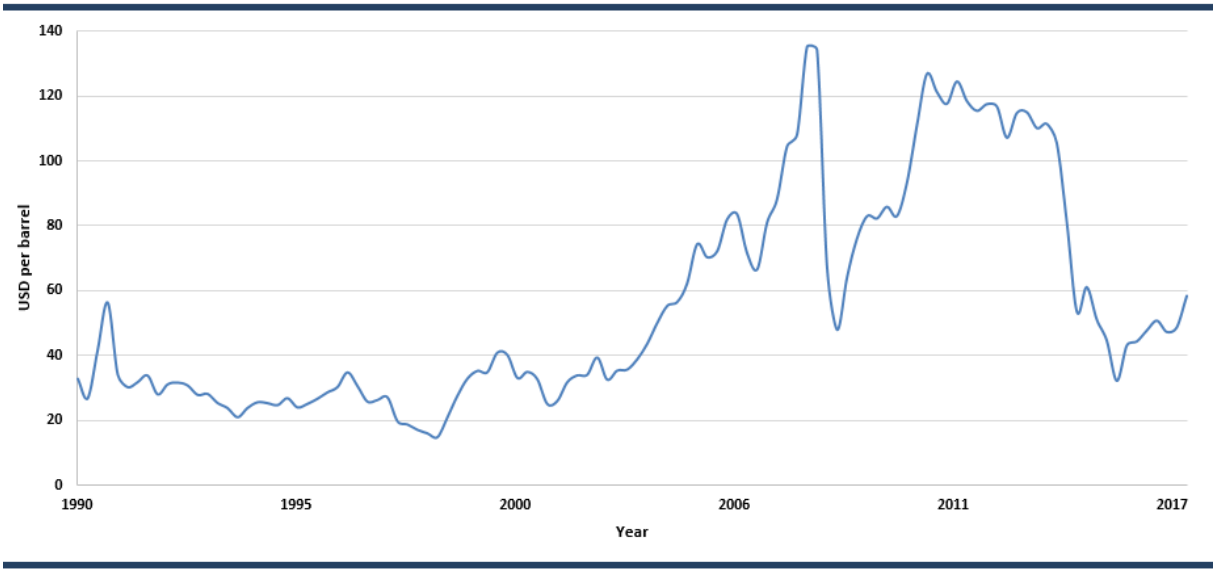
Source: Statistics Norway and Eiendomsverdi, own calculations using HP-filter

7.3 Oil prices and its effect on the housing cycle

The oil industry has been an essential sector for Norway since the 1970s. The impact of the petroleum is significant and contributes to GDP and employment in the whole country, both direct and indirect (Blomgren, et al., 2015). Extraction of oil and gas has been Norway's most profitable industry over the years and has provided many jobs, and is an essential source of tax revenues for the state. The increasing wealth due to the petroleum sectors has also been affecting other industries (Fjose, Grünfeld, & Blomgren, 2012).

The oil prices have fluctuated over the years and started at a much lower value than today. Falling oil prices is not new. In late 1985, a significant fall in the oil price occurred. Along with the banking crisis, Norway experienced a significant recession, which lasted until 1993. Just like the GDP and employment, the oil price fell drastically (Cappelen, Eika, & Prestmo, 2014).

Figure 21 Real Crude Oil – Brent Spot FOB



Source: Energy Information Administration, United States

From 2000-2014 Norway experienced high economic growth. The Norwegian economy was profoundly affected by the oil boom during the same period, and the oil prices significantly increased. However, the oil prices also fell during the financial crisis. As seen in figure 21, the oil prices made a fast recovery. In 2014, the oil prices turned and dropped drastically. The activity within the sector experienced a significant drop, leading to lower economic growth in Norway and less employment. The business cycle was therefore significantly affected by this whereas the GDP has decreased. This turn also affected the housing prices (Nordbø & Stensland, 2015). The oil prices have somewhat increased, but not to the same levels before the fall of 2014.

It is interesting to analyze how changing oil prices affect the Norwegian housing cycle. Next section covers existing literature towards how oil prices affect the housing cycle. Furthermore, we use collected data to evaluate whether we support academics arguments.

7.3.1 Existing literature

There are high amounts of research regarding the effect of oil price changes. Evaluating this gives us a better understanding of the importance of the oil prices, and especially towards Norway. We argue in chapter 7.2 that GDP and business cycles affect the housing cycle. Therefore, we also use literature regarding the effect of oil prices on business cycles. The Norwegian economy is highly dependent on the oil industry and is consequently sensitive towards the changes in the oil price. A reduction in the oil price leads to lower economic activity. Thus, the employment level also decreases (Cappelen, Eika, & Prestmo, 2014).

The effect on oil price towards housing cycle is highly discussed. Some argue that in general, increasing oil prices negatively affect housing cycles. A study by Antonakakis and Gupta (2016) in the U.S. explained that the oil prices and the housing market have a consistent negative correlation over time. Breitenfellner, Cuaresma, and Mayer (2015) analyzed 18 OECD countries. Their findings point towards that increasing energy prices raises the probability of housing price corrections. They highlight the adverse effect on personal income by increasing oil prices, which reduces the demand for housing. Additionally, they point out that some countries tighten their monetary policy due to the inflationary effect of the increased oil prices. This also has a negative impact on the real estate market.

A shortcoming from the literature above might be the homogeneous analysis of the countries. The effect of oil price shock may be different whether it is net oil-exporting or net oil-importing country. Thus, the impact on real estate market can be significantly different (Filis & Chatziantoniou, 2013; Killins, Egly, & Escobari, 2017; Park & Ratti, 2008).

For net oil-importing countries, changes in oil prices may affect the housing prices negatively (Filis & Chatziantoniou, 2013). On the contrary, the oil exporting countries obtain a positive impact on the stock market for increasing oil prices. A research made by Park and Ratti (2009) for the U.S. and 13 European countries supports this argument. Whether the oil price increase gives a negative or positive effect on the housing prices depends on whether the countries are net oil exporters or net oil importers.

Killings, Egly and Escobar (2017) studied the impact of the oil shock in Canada and the U.S. They argue that the direct relationship between oil prices and housing prices are much stronger

in Canada, a net oil exporter, than the U.S., a net oil importer. This finding is valuable for us, as we can draw lines towards Canada's reaction to changing oil prices since Norway is also a net exporter of oil. In addition, Canada is a small open economy like Norway.

As Norway is a net oil exporter, previous literature suggests that an oil price increase have a positive real estate effect. Due to the high importance of oil activity in Norway, fluctuating oil prices profoundly affect the Norwegian economy. However, Cappelen, Eika, and Prestmo (2014) argue that Norway is more robust towards a fall in the oil prices today than before. In 1990, the Norwegian Government established the Government Pension Fund Global, to obtain a robust economic buffer. It intends to secure the long-term revenues from the petroleum sector. The aim is to get a diversified portfolio, by investing in international equities, securities and real estate (Norges Bank, 2017). In addition, Norway has become more flexible and has other industries to rely on as well. However, it is reasonable to believe that a decreasing oil price is still affecting the Norwegian economy (Cappelen, Eika, & Prestmo, 2014).

If the prices fall, it affects the Norwegian economy primarily by lowering investment in the petroleum due to weaker revenues. It may also affect the exchange rate, international economy, households' expectations and Norwegian stock prices. Lower revenues from the petroleum sector result in less investment in new projects and oil fields. The Government also experience lower revenues due to lower tax income by the petroleum sector. In the short run, the weakened currency ease the effect of falling oil prices due to international contracts. Additionally, a weaker currency leads to higher export for Norway, which benefits the Norwegian economy (Cappelen, Eika, & Prestmo, 2014).

Changing oil prices may affect the Norwegian housing cycle. Lowering oil prices leads to less investment and activity. The least profitable oil fields might stop and not be reinvested in (Cappelen, Eika, & Prestmo, 2014). This affects the housing cycle. Brun (2013) argue that the fall in oil prices affects the housing prices. However, this does not occur immediately. The highest effect on housing prices happens after around six years.

It is reasonable to believe that there are differences in the effect of changing oil prices depending on the cities in Norway. Oslo and Stavanger grew at much higher rates when the oil prices increased before 2014, whereas the prices dropped more in Stavanger than rest of the country.

The housing prices in Oslo continued to grow after the oil price decrease. This shows that different countries are differently affected by oil prices (Anundsen & Eitrheim, 2016).

The Expected effect for the Norwegian housing cycle

The oil sector is an essential contributor to the Norwegian economy. We expect a positive correlation between the oil price levels and the housing prices in Norway. Norway is a net oil exporter, and increasing oil prices have a positive effect on the house price development. We also expect that Oslo is less dependent on the oil prices than Stavanger. Stavanger is supposed to be more affected as the oil industry is the most important industry in Stavanger. In 2014, after the oil price fall, Stavanger was the city in Norway were the unemployment increased most rapidly (NAV, 2016).

7.3.2 Data for oil price

This section includes historical oil price data to be able to analyze how oil prices affect the Norwegian housing market. We investigate oil price levels to real price development. Crude oil brent spot historical prices are found from Energy Information Administration through DataStream. The data is given in nominal values, and we have divided the levels with CPI to obtain real oil prices. The data shows values from 1990 to 2017.

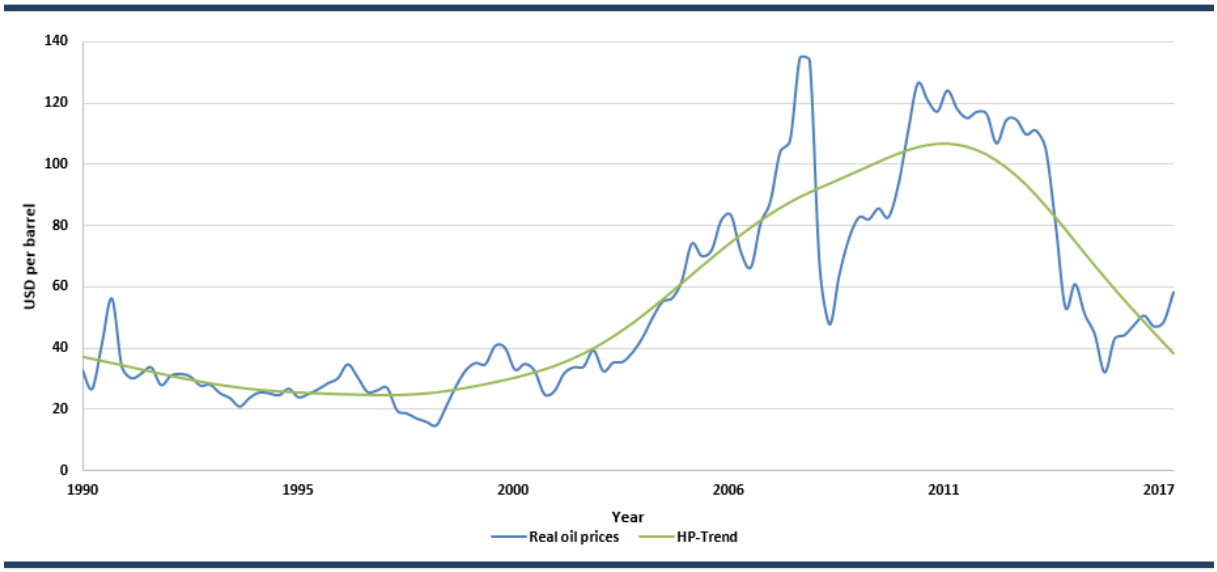
We have included housing prices from Stavanger and Oslo. The reason for this is that the oil sector is a significant industry for Stavanger, and therefore the housing cycle there might be different from other cities in Norway. Thus, analyzing the effect towards Stavanger gives a more in-depth understanding of how the oil price affects the housing cycle. Oslo, Norway's' capital, is less dependent on oil, whereas much other industries and factors affect Oslo more than other cities. Together with an analysis of data for oil prices and housing cycle in Norway, we are better equipped to evaluate the effect of oil prices.

As we saw in figure 20, the oil prices have been fluctuating a lot. Since 1990, the oil prices have increased 77.5 percent. This development contrasts with the last ten years, whereas the oil prices have decreased by 44 percent. The highest average oil price level was in 2008, third

quarter, whereas the oil prices were at 135.1 dollars per barrel. At this time, the housing prices where decreasing. The decrease in house prices started in 2007 and declined through 2008. It recovered shortly after, and the housing prices began to increase in 2009, one year after the highest oil price value. However, in the first quarter of 2009, the oil prices dropped and averaged at 48 dollars per barrel, indicating that the period with the highest oil price level where during a drop in housing prices. However, the increasing oil prices might have contributed to the recovery of the housing prices.

Figure 22 shows the development of oil prices to its estimated trend. It highly fluctuates from quarter to quarter. The oil prices increased rapidly from 2000 to 2013. However, it fell at the end of 2008 and beginning of 2009. Since the oil price fall in 2014, the prices have had a decreasing trend.

Figure 22 Real oil price and HP-Trend



Source: Energy Information Administration, own calculations using HP-filter

7.3.3 Oil price and the housing cycle

This section analyses the cyclical changes in oil prices to the housing cycle, measured in housing prices. Literature suggests that increasing oil prices for net-exporting economies have

a positive effect on the housing cycle. Figure 23 illustrates the cyclical movements of oil prices and housing prices since 1990. Looking at the figure, we see that the two cycles start in the same increasing pattern and somehow follow each other. Before and after 2008, oil prices and housing prices seem to correlate. Housing prices look to lead the oil prices. However, due to the fluctuating levels, it is hard to conclude based on this.

In addition, we see that the financial crisis points out. It is interesting to notice that the housing prices peaks before oil prices, before both drops. This tendency indicates a correlation between the two variables. Yet, it does not fully support the literature that oil prices affect the housing cycle. However, they move in the same direction, and one may argue that these two factors correlate.

Figure 23 Cyclical movements of real oil price and real house prices

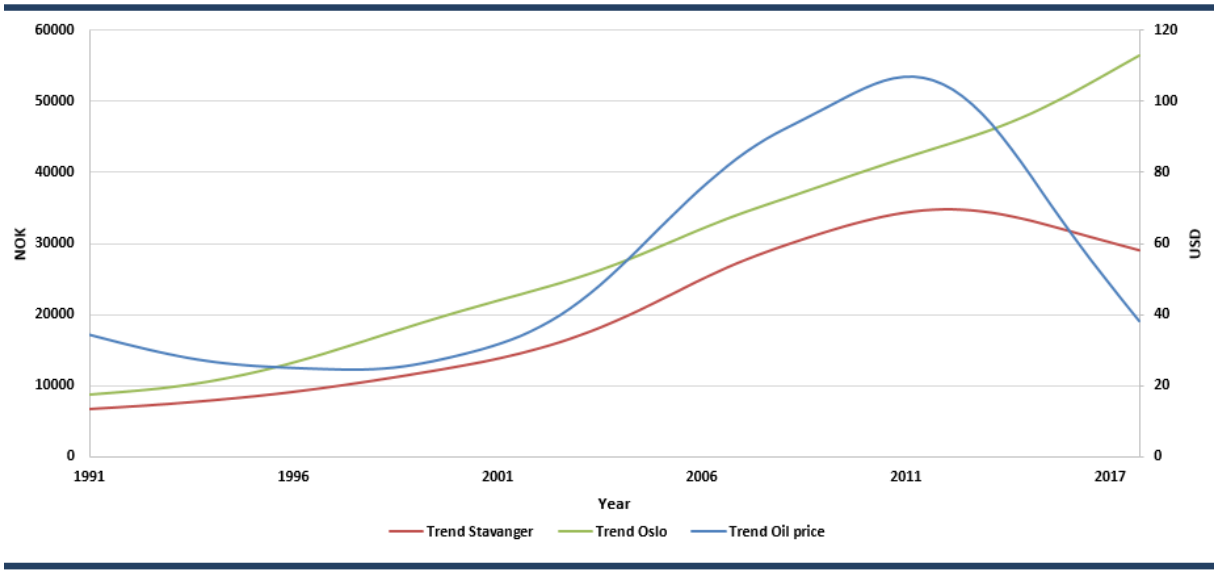
Source: Energy Information Administration and Eiendomsverdi, own calculations using HP-filter

Oil prices and housing prices in Stavanger and Oslo

Earlier in chapter 6, we looked at the housing prices in Stavanger and Oslo up against each other. We observed that both Oslo and Stavanger had the same development in housing prices from 1991 until around 2012, but then something happened. The house prices in Stavanger suddenly started to decrease, while the prices in Oslo kept increasing. Similarly, did we observe a change in the trend of the oil price at the same time in figure 22.

Figure 24 illustrates the trend line of housing prices in Stavanger and Oslo together with the trend line of the oil price. The trend line of oil price and housing prices went from increasing to decreasing almost at the same point, while the trend of the prices in Oslo seems to be unaffected. This underlines the statement that the housing prices in Stavanger were affected by the fall in oil price that occurred.

Figure 24 Trend line of oil price and housing prices in Stavanger and Oslo



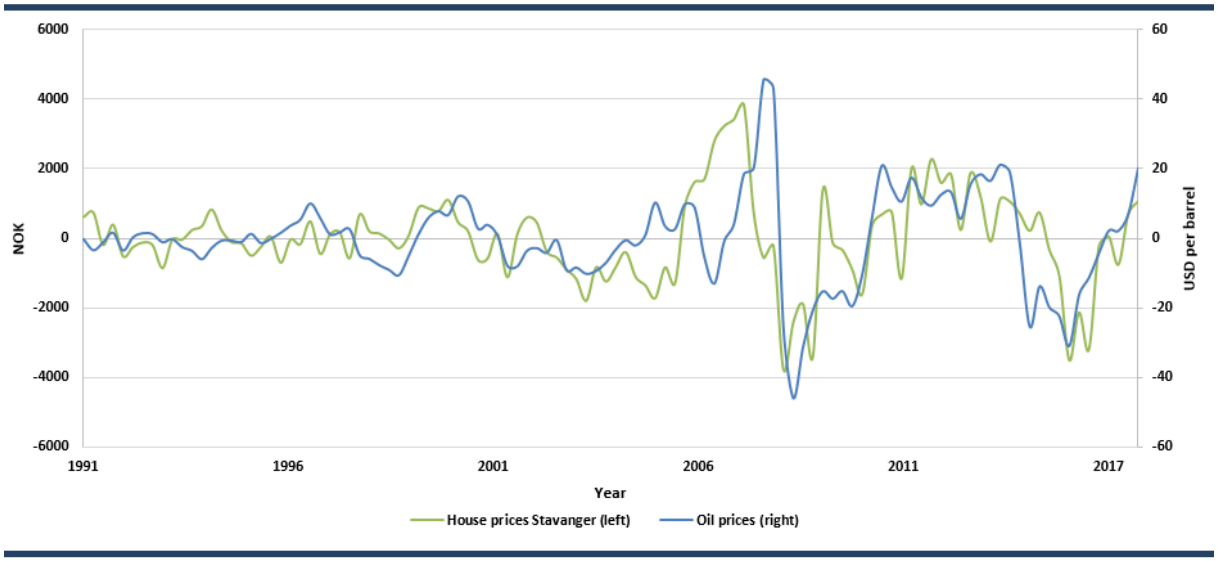
Source: Energy Information Administration and Statistics Norway

However, even though the trend lines follow each other, there is still cyclical fluctuations that are necessary to investigate further. Figure 25 illustrates the cyclical movements of real oil prices and real house price in Stavanger since 1990. The real house prices in Stavanger seems a bit more affected by the changing oil prices, whereas the cyclical changes seem to be closer

to each other than the housing market for whole Norway. Oil prices and housing prices in Norway seem to follow each other over the entire period.

The financial crisis also points out here. We see a tendency of the same pattern in increasing oil prices such as in 2008. The house price levels in Stavanger had the most substantial growth in oil prices from 2006 to 2007, whereas the real house price levels rose by 13 percent. During that time, the average real oil price level was at 75 dollars per barrel. This price level is much above the average oil price level in this period at 55.5 dollars per barrel.

Figure 25 Cyclical movements of oil price and house prices in Stavanger



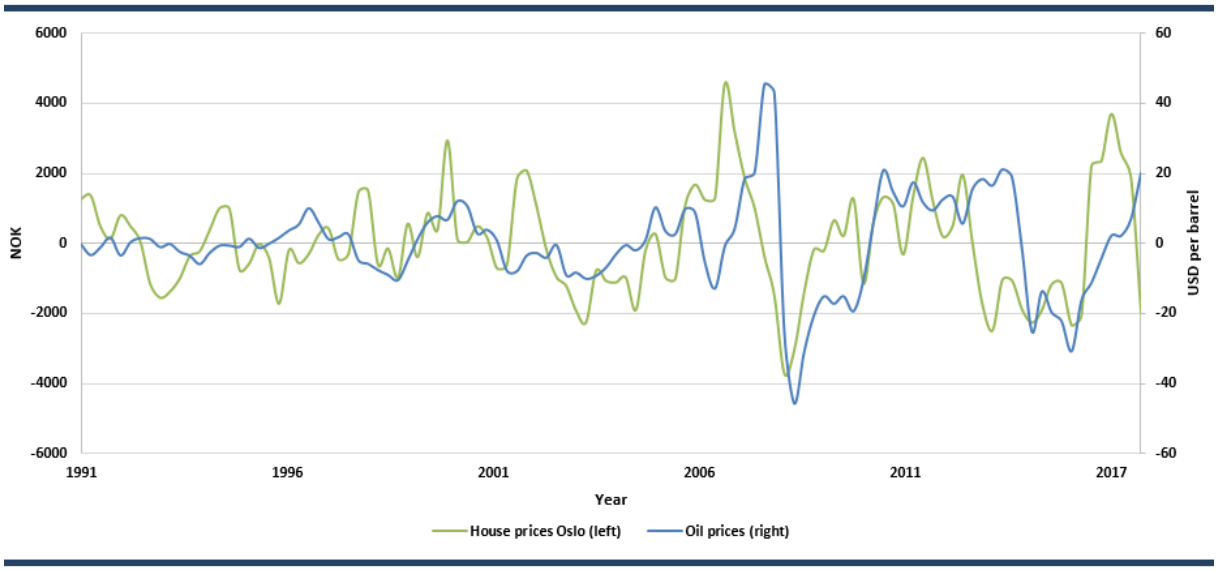
Source: Energy Information Administration and Statistics Norway, own calculations using HP-filter

After the financial crisis, the two factors highly follow each other. However, we can point out that the housing prices seem to lag the oil prices. Between 2015 and 2017, the real housing prices in Stavanger decreased by 3 percent, while oil prices increased. However, the years before that, since 2014, the oil prices were declining. The house prices fell shortly after. This might indicate that the housing cycle in Stavanger was affected by the decreasing oil prices. In addition, lower employment in Stavanger after the oil price decrease may have also contributed to decreasing house prices (NAV, 2016).

Figure 26 illustrates the cyclical movements of oil prices and housing prices in Oslo. The oil sector is less critical in Oslo than in Stavanger, and we expect a smaller correlation for this housing market. However, it is essential to keep in mind the great importance of the oil sector for the whole country.

Oil prices do not seem like the primary driver for the house price increase. The cyclical movement of Oslo deviates more from the oil prices than cyclical movements of Stavanger. Between 1992 and 1993 is the period where the housing prices in Oslo decreased the most. At that time, the oil prices averaged at 30 dollars per barrel. The highest house price increase in Oslo was in the third quarter of 1994, and the oil priced averaged at 25 dollars per barrel. The oil price level where lower at the time when the housing prices increased the most in Oslo compared to when the housing market slowed down.

Figure 26 Cyclical movements of oil prices and house prices in Oslo



Source: Energy Information Administration and Statistics Norway

However, the two factors seem somehow correlated. From 1991 to 1998, the relationship between them seems to be weak, with lower cyclical levels of house prices in times with higher cyclical levels of oil prices, and vice versa. However, after the financial crisis, they seem to be

more correlated. This relationship changes in 2013, where the oil prices increased, and the housing prices had decreased. After the decline in oil price, the housing market in Oslo experienced a boom with rising prices, indicating that the housing market in Oslo is not that dependent on the oil price development.

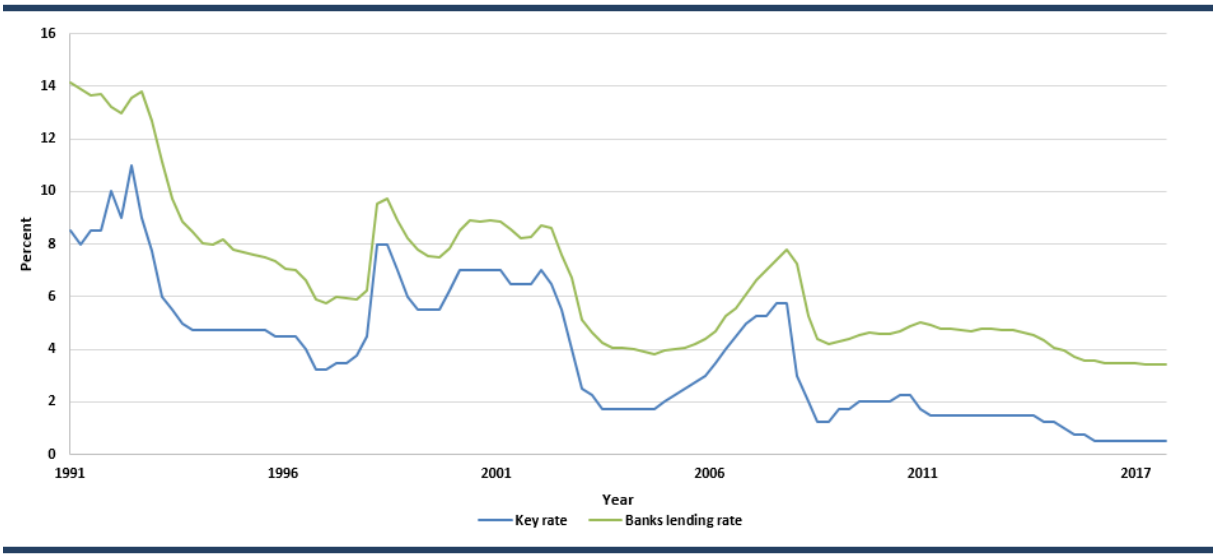
It gives valuable insight to compare observations from Stavanger to Oslo. The oil prices were at its lowest first quarter of 1999 at 15 dollars per barrel. From 1998-1999, the house prices rose both in Stavanger and Oslo. One year after the low oil price, the prices in Stavanger fell from start 2000 to start 2001 by 3 percent. The prices rose by 8 percent during the same period in Oslo. After this, housing prices in both Stavanger and Oslo the price rose again.

7.4 Monetary policy and its effect on the housing cycle

Monetary policy includes the actions of the Norwegian Central bank and regulations affecting quantitative easing, money supply, and interest rates. In this chapter, we analyze the effect of monetary policy towards the Norwegian housing cycle. We discuss previous literature and research to obtain more in-depth insight into monetary policy. Additionally, we use data to be able to understand the existing literature and the Norwegian housing market.

The data that we use is the Norwegian key rate and average lending rate from Norwegian banks as our measure for monetary policy. The key rate is the interest rate Norwegian Central Bank gives other banks on deposits. Therefore, the key rate indicates where the minimum lending rate banks in Norway is set. The average lending rate from bank measures all loans given by banks in Norway.

Figure 27 Nominal Key rate and average bank lending rate in percent



Source: Norwegian Central Bank and Statistics Norway

As seen in Figure 27, both the key rate and lending rate by banks have been fluctuating a lot over the last decades. Today, the key rate is at a record low level at 0.5 percent, which it has been since 2016. A decrease leads to a lower average lending rate from banks. This makes it more beneficial for the household to borrow money for housing. It is interesting to analyze how changing monetary policy affects the housing cycle in Norway. We argued in chapter 7.2 that business cycle and the state of the economy is a factor that has affected the house prices in Norway before. Therefore, literature concerning monetary policy and its effect towards the business cycle is also included. Next section covers existing literature towards monetary policy and its impact on the housing market.

7.4.1 Existing literature

Expansion in credit, such as easier access to lower interest rates may affect the house prices. Most research argues that monetary policy does affect the house prices. Credit increase increases demand for houses, and house prices thus increase (Favara & Imbs, 2015). The relationship between the housing prices and monetary policy may seem prominent on a general

basis. Zhu, Betzinger, and Sebastian (2017) state that a one-time monetary-easing shock has a significantly positive effect on house prices.

A cross-country study from the US also supports this. Cerutti, Dagher, and Dell'Ariccia, (2017) analyzed the relationship between credit access and house price booms with a sample of more than 50 countries. They argue that credit and house price booms are closely linked. There is also research on the central bank's actions in changing house prices, and studies that claim that banks react to changes in house prices (Finocchiaro & Heideken, 2013).

This relationship seems prominent in Norway too. Research from the Norwegian housing market that supports these arguments. Jacobsen and Naug (2004a) argue that interest rate is one of the most prominent fundamental explaining the housing prices in Norway. They further say that the house price corrections happen shortly after changes in the interest rate. Anundsen and Jansen (2013) state that interest rates have an indirect influence on housing prices. They have analyzed different financial crises in Norway since the independence from Denmark in 1814 and based on their analysis they argue that the monetary policy affects the booms and bursts in the market. This was pointed out in for example the crash of Kristiania in 1899-1905 where the period before the crash included an expanding monetary policy and credits (Grytten & Hunnes, 2010).

Arguably, monetary policy affects expectations and operating conditions for private banks and thus affects the housing cycle. The Norwegian central bank sets the key rate, which influences the lending rates decided by banks. This affects the households' wealth, loans and mortgages. Many Norwegian households have variable mortgages rate, and therefore changing interest rates is very pronounced and quickly affecting the housing prices. Larsen (2018) argues that the reason why house prices are immediately affected is also based on the physiological aspects. The operating conditions take time to change. However, the psychological factor based on the changing interest rate is affecting immediately after the change.

In 2008, the key rate was lowered in Norway. Larsen (2018) studied the effect of this monetary policy change. The crash in 2008 was not as severe in Norway, and the house prices did not decrease as much as other countries. Monetary policy may have played an essential role in this housing market recovery.

However, not all research agrees on the role of monetary policy in housing cycles. Glaeser, Gottlieb, and Gyourko (2010) studied the housing price increase in the U.S. from 1996 to 2006. They found that interest rates were affecting the house price increase, however to a much less extent and cannot explain more than one-fifth of the rise during that period. Additionally, Tenreyro and Thaiwaites (2016) argue that monetary policy have different effects whether the economy is in a recession or expansion. Their study in the U.S. housing market explains that the impact of monetary policy is less powerful to the economy in downturns.

The Expected effect for the Norwegian housing cycle

Based on the existing literature, we expect that there are a correlation and link between monetary policy and the housing cycle. We expect a negative relationship between the house prices and both the key rate and average lending rates by banks. Key rate changes can be used as a house price correction. Even though not all research agrees on this, most literature does. Studies regarding Norway also give us good reason to expect connections between housing cycle and monetary policy.

7.4.2 Monetary policy data

To analyze monetary policy and its effect on the housing cycle, we have included the key rate and the average lending rates from banks. The key rate is given from the Norwegian Central Bank, and the average lending rate is downloaded from Statistics Norway. Both rates are presented in quarterly numbers from 1991 to 2017. To better detect the effect of monetary policy towards the Norwegian housing cycle, we analyze the different measures for monetary policy towards the house prices in Norway.

Since 1991 to end of 2017, the key rate and average lending rate has decreased significantly. As discussed in the literature review above, some argue that monetary policy plays a vital role in the housing cycle. Larsen (2018) claims that the lowering key rate in 2008 was a relevant factor for the Norwegian housing market, and contributed to a less severe house price fall. The key rate was lowered in the fourth quarter of 2008 from 5.75 percent to 3 percent.

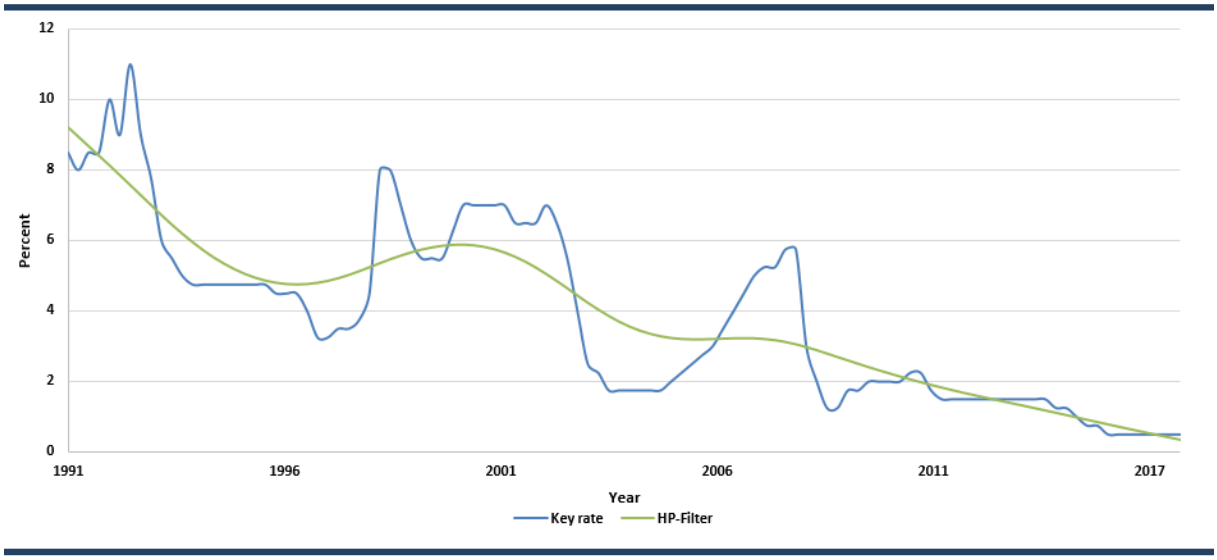
With few fluctuations, the key rate has had a decreasing trend, and since 2016 the key rate has reached historic low levels of 0.5 percent. During the same time, the average lending rate was 4.4 percent, and since the first quarter of 2015, the average lending rate has not been higher than 4 percent. The house prices have increased since the fourth quarter of 2008, indicating that the house prices in Norway did not suffer much from the financial crisis. The changes in monetary policy may have caused this (Larsen 2008).

The key rate was at its highest in the third quarter of 1992 at 11 percent. At that time the average lending rate was 13.57 percent and the year after it was 13.78, thus increasing after the key rate increased. The house prices decreased 7 percent after one year. However, the prices started to rise again, and from the third quarter of 1993 to the third quarter of 1994, the house prices increased by 17 percent. This house price increase was followed by a decrease in the key rate. This correction might indicate that house prices are rapidly affected by the key rate.

As written above, the key rate and the average lending rate from banks have been fluctuating a lot. Naturally, they highly follow each other. Due to the similarity between the fluctuations of key rate and average lending rate that we observe in figure 75, we only analyze the cycle of the key rate.

Figure 28 shows the development of key rate and the calculated HP-trend. Key rate has had a decreasing trend over the period. The figure shows that the value profoundly deviates from its trend line. We see that the key rate tends to stay at the same level over a more extended period.

Figure 28 Norwegian Key rate and HP-Trend



Source Norwegian Central Bank, own calculations using HP-filter

7.4.3 Monetary policy and the housing cycle

This section analyses the cyclical changes in key rate about the housing cycle, measured in the house prices.

In figure 29, we have the cyclical movements of key rate and house prices from 1991 to 2017. Looking at the figure, one can see that the two cycles start with a different pattern and seem countercyclical. From 1992 to early 1994, the two cycles are countercyclical, where key rates move up while housing prices decrease. Until 2007, both housing prices and key rates move upwards, and after the financial crisis, the key rates and housing prices run in the same pattern again.

The literature argues that interest rate affect the housing prices, and we can point out a few events to support these arguments. The fourth quarter of 1998 the key rate increased, whereas the house prices had a sharp drop in the first quarter 1999. However, between 2004 and 2007, both housing prices and positive cyclical movements, indicating that they do not necessarily move countercyclically at all times. Prices started to fall in 2007, and so did the key rate in 2008. The housing prices began to increase and recovered.

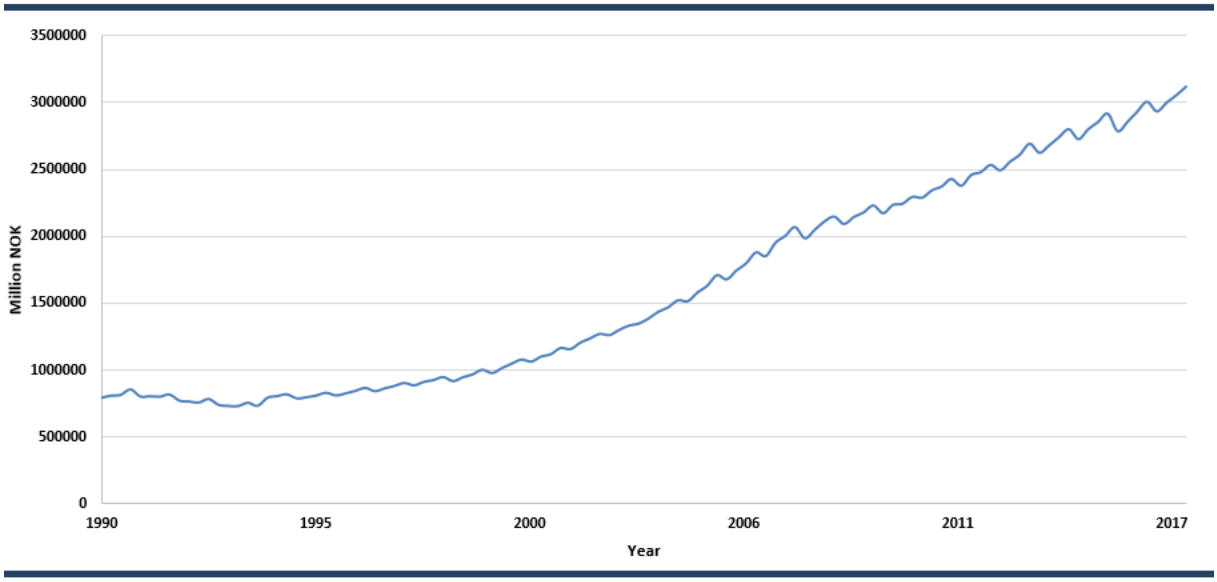
Figure 29 Cyclical movements of Key rate and house prices

Source: Norwegian Central Bank and Eiendomsverdi, own calculations using HP-filter

7.5 Household debt and its effect on the housing cycle

The most significant investment for a household is most often their residential investment. Housing is mainly financed through loans from banks. Household debt has increased over the years, and it is interesting to analyze its effect towards the housing cycle. Together with Denmark, Norway has the highest level of debt for households in the Nordic (Røstadsand, 2017). The Norwegian households have a high debt level that has been increasing over time.

Figure 30 Real households' debt



Source: Norwegian Central Bank

Figure 30 illustrates the household debt development in Norway since 1990. This development shows that the debt has been continuously increasing over the period, and it is interesting to analyze how this affects the housing cycle in Norway. To investigate this, we use literature regarding the effect of household debt in general and in Norway, along with the HP-analysis. In this way, we are better equipped to evaluate the impact of households' debt on the Norwegian housing cycle.

The Norwegian Government is afraid of too large households' debt levels. The house prices have increased 11 percent more than per capita disposable income since 2008. Thus, house price decreases may harm Norwegian households, and after that, the Norwegian economy. In order to prevent this, the Government has tightened their mortgage rules with much higher restrictions on loans and debt levels. An example of this is that the capital requirement has increased for the past couple of years, reducing consumer risk if decreasing house prices. However, this may make it more difficult for younger people to buy their first home (Hægeland & Olsen, 2016).

7.5.1 Existing literature

Most households need to take a loan to be able to finance their house. Research regarding the effect of household debt helps us get a better understanding of how it is affecting the housing cycle. The level of debt for households often correlates with the households' age. Younger families tend to have higher debt levels (Hægeland & Olsen, 2016). The amount of each repayment for a loan by banks is usually low. If the housing prices increase, each household increases their wealth. Thus, they are financially able to obtain a higher loan than their current mortgage (Jacobsen & Naug, 2004b).

The effect of debt levels is very different depending on the economic condition. In a boom phase, the additional debt acts as an economic stimulus and contributes to an economic boom (Minsky, 1982). Investors and households are optimistic and become more eager to borrow. Credit supply increases and the economy is boosting (Kindleberger & Aliber, 2005). However, as lending rate increases, so do the risk. Changing credit supplies may affect the financial stability of an economy. The financial system becomes more fragile as debt levels increases. The higher levels of debt may cause or contribute to the bust after the boom. The high debt level may trigger an even more severe economic downturn (Minsky, 1982).

Debt may provide economic stimulus, but only in the short term. Cynamon and Fazzari (2008) argue that even though credit expansion provides economic stimulus, it may also raise the probability of financial instability, followed by an economic downturn. The study was based on data from the US in the period from the 1980s to early 2000s.

There is a risk associated with decreasing house prices when financing through debt. The household might become technically insolvent, as debt is higher than the value of the house. Most creditors do not let households sell if they cannot repay all outstanding debt. Technically insolvency is probably one of the worst consequences of falling house prices. However, the problems associated with high debt and technically insolvency is not a big issue as long as the housing prices rise (Lunde, 2014).

The house price levels are much higher today than before. Therefore, there is a risk of a crash or significantly falling house prices. The development of housing prices is also difficult to predict. Knowing the risk is therefore very important when taking a loan, and even when

deciding how much equity one wants or have the ability to invest in housing to avoid the insolvency.

Debt levels and housing prices seem to follow each other. Goodhart and Hofmann (2007) studied 16 countries and excessed the relationship between bank lending and housing prices. They stated that there is an integrating long run relationship between property prices and credit booms. They found that there is a significant two-way causality between housing prices and bank lending. Further, they point out that this two-way causality may be as prices rise, the demand for household borrowing increase, which again results in higher house prices.

Cerutti, Dagher, and Dell'Ariccia (2017) analyzed the relationship between credit access and house price booms with a sample of more than 50 countries. They argue that credit and house price booms are closely linked. Country-specific researchers also support this view. Oikarinen (2009) made a study from Finland and claims that there is a two-way interaction between housing prices and household borrowing since the financial liberation in the late 1980s. This relationship is contributing to the boom and bust cycle, and the fragility of the economy increases by debt.

The relationship between debt and house prices has been seen in Malaysia as well. Rahman & Masih (2014) argue that rising households' debt is due to increasing house prices. They also say that changing landing rate may affect household debt, which again influences the housing prices.

A Swedish housing market study by Turk (2015) supports the view of a two-way interaction between housing prices and households debt. She argues that since the financial liberation from the mid-1980s, the growth in house prices and households' debt have moved together. The study is comparable to Norway as the financial liberation occurred in Norway at the same time. Further, Turk states that the debt-to-disposable income in Sweden is comparable to Norway.

For Norway, house prices may seem to have a positive correlation to households' debt levels. Anundsen and Jansen (2013) investigate the relationship between housing prices and the households' debt in Norway. They found a two-way interaction between house prices and credit in the long run. This relationship implies that higher housing prices result in higher credit growth, which again spurs house price growth. They argue that growing housing prices follows

expansion in real household debt and credit growth. An increasing house price raises the value of the housing capital. This increases households' wealth in addition to a higher amount each household may loan by banks. Thus, the demand for credit increases. This again spurs housing price growth. Therefore, they state that each factor positively affects the other (Anundsen & Jansen, 2013).

Increasing house prices often leads to households' taking up a higher loan. Jacobsen and Naug (2004b) argue that increasing house prices tends to have a positive impact on the households' debt. Households tend to increase their borrowing as the price of their house increases. House owners may take a higher loan as they have higher wealth security in their home. They further argue that the debt level and housing prices in Norway have followed each other since 2002. An increase in housing prices contributes to a growing debt for an extended period.

When analyzing debt, it is essential to include the interest rate. Interest rates are indirectly influencing housing prices through debt (Anundsen & Jansen, 2013). Interest rates affect the households' amount of maximum loan possible. It also determines the amount household pay in interests to the credit holder, which also affects households' possibility for housing investment. Changing interest rates are of major importance for households' debt level. A higher interest rate, as discussed in chapter 7.4, changes the households' ability to take a loan. However, it also affects their wealth when they repay back the loan. A rising interest rate results in more strict conditions during repayment of loans. Risk of debt also arises when or if the interest rate increases. This might be damaging if the household is not able to finance the raising payback rate, and a household can be forced to sell their homes.

There have been developments in the mortgage market over the last decade as an extension of loan terms and flexible payments schedules, and there are many different ways of financing a loan. If the interest rate falls, the repayment of a specific loan decreases. However, this positively affects the demand for other investments for most households, and their total loan may be higher. Yet, increasing possibilities of investing in houses based on the mortgage market have a positive effect on the housing prices (André, 2010).

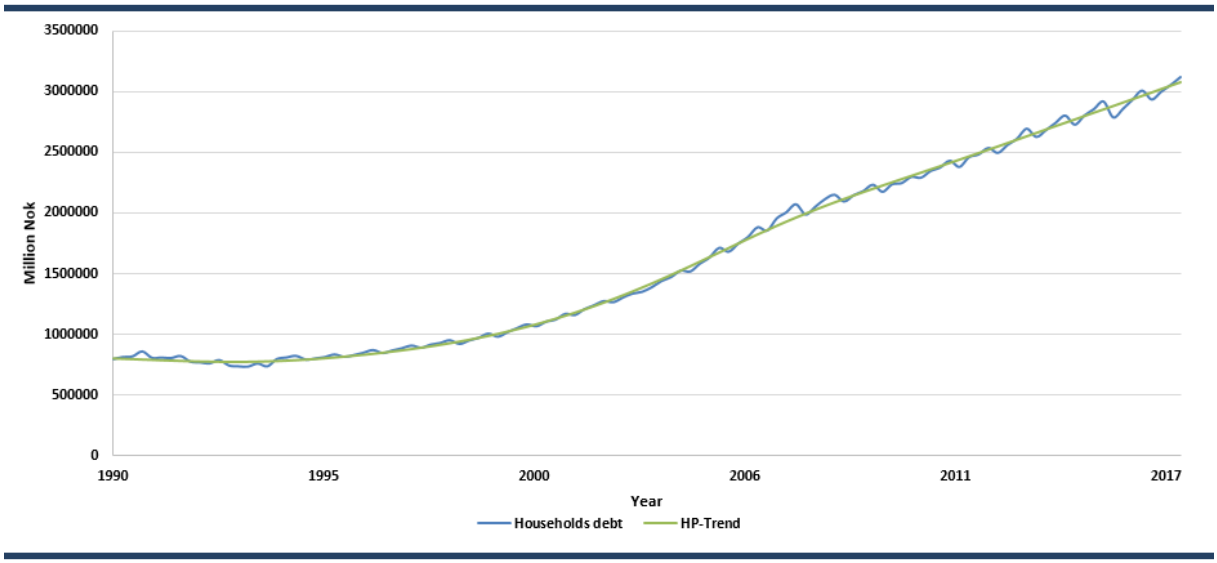
The Expected effect for the Norwegian housing cycle

Based on existing literature, we are expecting a relationship between housing prices and debt levels. Both housing levels and debt levels might affect each other, and thus we expect a positive relationship between these. Higher prices drive households' debt upwards, which again drives housing prices. As higher house prices increase households' value of existing houses, this increases the maximum loan they may take.

7.5.2 Data for household debt

To analyze the effect of household debt towards the housing cycle, we use data from the Norwegian Central Bank to find households' debt. The data are quarterly and given in nominal values. We divided the nominal values CPI to detect the real households' debt. The debt values contain amounts of households' debt in total, not per inhabitant or household. The development of households is also changing, as there is a higher level of divorces and singles investing in their own house today.

Figure 31 Real households' debt



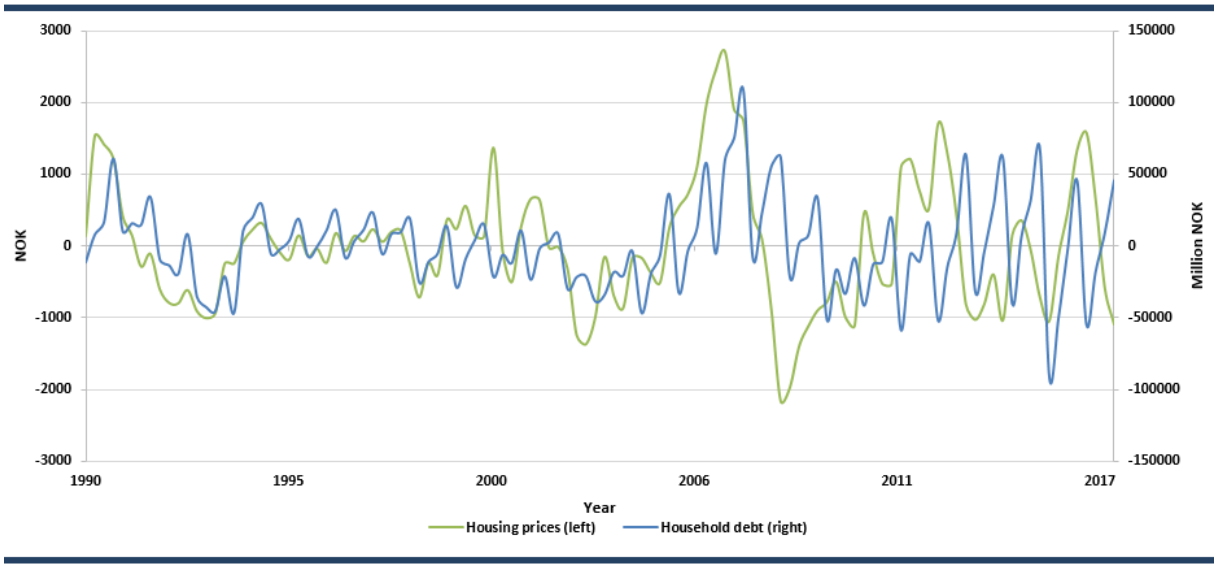
Source: Norwegian Central Bank, own calculations using HP-filter

Figure 31 illustrates the real households' debt development since 1990, with its HP-trend. Households' debt levels in Norway have had a clear increasing trend. It is almost three times larger today than it was in 1990. The last ten years, from late 2007 to late 2017, the debt have doubled itself. The yearly change in debt levels was highest between 2003 and 2004, whereas it increased by 13 percent.

7.5.3 Household debt levels and the housing cycle

To be able to understand how debt levels are affecting the Norwegian housing cycle, we look at the cycle movements of the two factors against each other. Figure 32 shows the cycle movements of real households' debt and housing prices from 1990 to 2017. We see a close relationship between the cyclical movements in the two factors, especially from 1990 to the middle of 2007. This makes sense because higher housing prices lead to a need for higher mortgages, which increase the total household debt.

Figure 32 Cyclical movements of households' debt and house prices



Source: Norwegian Central Bank and Eiendomsverdi, own calculations using HP-filter

Despite the close relationship between the two cycles in the first part of our dataset, we can locate a change in the movements beginning in the middle of 2007, right before the financial crisis in 2008. While the housing prices dropped significantly with the financial crisis, household's debt had a much smaller drop and still reminded above the trend line. The housing prices started to increase again while the household's debt began to decrease. This led to a change from a procyclical relationship to a countercyclical relationship. It looks like households debt moves simultaneously as the housing prices. When buying a house, one usually take up the mortgage at the same time. When selling a house, the mortgage is repaid or refinanced. This leads to movements in the household's debt cycle simultaneously as in the housing cycle.

8. Correlation analysis

In this chapter, we calculate cross-correlation between the housing cycle and the different fundamentals. We estimate the correlation for both lagged and leading fundamentals to see if the cyclical changes in housing prices have a stronger relationship with cyclical changes in the fundamentals for different periods. The correlation analysis is used together with the previous review of the fundamentals.

8.1 Correlation

Maximum linear covariation is obtained whenever the observation pairs are in line with a nonzero slope. The correlation coefficient measures the amount of linear covariation. This tells if the values of the variables move in the same direction. If we get a correlation coefficient close to -1, it shows that the variables are close to a maximal negative covariation. On the other side, a correlation coefficient close to 1 indicates that the variables are close to a maximal positive covariation (Ubøe, 2017). The correlation coefficient can be defined as:

$$R_{XY} = \frac{S_{XY}}{S_X \cdot S_Y}$$

Where:

R_{XY} = The correlation coefficient

S_{XY} = The sample covariance

S_X = The Sample standard deviation for variable X

S_Y = The sample standard deviation for variable Y

The sample standard deviation shows the spread around the mean value. Large standard deviation means significant differences between the values, while low standard deviation indicates that the values are similar. The sample covariance is used to measure how the two variables correspond. Positive covariance implies that they move in the same direction, while negative covariance implies that they move in opposite directions (Ubøe, 2017).

We look at the correlation between the cyclical movements of housing prices and the cyclical movements of the fundamentals. In this way, we see the strength and direction of the linear relationship between the cycles. We want to determine whether the housing cycle is procyclical or countercyclical to the other variables. If we get a positive value, it is an indication of procyclical relationship. This relationship means that that the variables increases or decreases together. A negative value shows that they move countercyclical, which means that one variable increase while the other variable decrease. Further, we want to investigate the correlation of lagged and leading correlations to see if the housing prices lead or lag the fundamentals.

In addition, we look at the level of significance of the correlation coefficients. The significance level is the probability of a false positive and indicates the probability to observe the estimated t-value more substantial than the critical value if the null hypothesis is correct. Significance levels show how likely a pattern in the data is due to a chance. If the coefficient is significant, is there a low probability that this is a result of coincidences (Ubøe, 2017). The level of significance is indicated with a star behind the correlation coefficients in the different tables. The stars show when the t-value is more substantial, in absolute value than the critical value of 10 percent (*), 5 percent (**) and 1 percent (***) levels. No stars indicate that the coefficient is not statistically significant. The t-statistic formula is defined as:

$$t^* = \frac{r*\sqrt{n-2}}{\sqrt{1-r^2}}$$

Where

r = the correlation coefficient

n = the number of observations

Since the significance level indicates the probability of our analysis to be a result of coincidence, the number of observations plays a big part when checking for the significance of correlation coefficients. The more observations we have, the lower is the probability of our result to be due to a coincidence. In addition, a high correlation indicates a high likelihood of a linear relationship between the two variables. To begin with, we have 108 pairs of observations, in our dataset. This means that every correlation coefficients above 0.26 are statistically significant at a 1 percent level (See Appendix 9) (vom Saal, 2004).

8.2 The correlation coefficients

In this paper, we have selected to look at the correlation between housing prices and our chosen fundamentals (housing construction, GDP, oil price, monetary policy and households' debt). We present three tables with correlation coefficients. The first table is the correlation coefficients of housing prices to the five fundamentals. The second table is the correlation coefficients for housing prices in Stavanger and Oslo against Oil, as we have discussed the importance of the oil industry in Stavanger. Last, we present the correlation coefficients for the housing prices in Stavanger and Oslo against the oil price for the last six years.

It is important to highlight that the correlation coefficients do not explain whether the fundamentals affect the housing cycle or the other way. However, a correlation analysis helps us to see how they move with each other and give an indication of whether the housing cycle or the factors lead the other.

8.2.1 Correlation coefficients between house prices and the fundamentals

Table 1 shows the correlation coefficients between the cyclical movements of housing prices and each of the variables selected for this paper. Altogether, we see 54 estimated correlations in the table. Correlations between the two variables in the same period can we see in the fifth row. The correlation coefficients in row one to four (t+1 to t+4) indicate correlations when the house prices lead the fundamentals. The coefficients in row six to nine (t-1 to t-4) indicate correlations when the fundamentals lead the house prices. The different period indicates

quarters. We see that 42 of the 54 coefficients are positive, and 12 are negative. All of the negative correlations are located when the fundamentals lead the housing prices. For the period when the variables are in the same period, or the housing prices lead the fundamentals, we only have positive coefficients.

Table 1: Correlation coefficients between house prices and all variables. With quarterly lag or lead on the variables

Period (Quarter)	*Housing construction*	*Mainland GDP*	*Oil price*	*Key rate*	*Lending rate*	*Households Debt*
$\boldsymbol{House\ price_t, var_{t+4}}$	0.461***	0.494***	0.388***	0.484***	0.530***	0.247***
$\boldsymbol{House\ price_t, var_{t+3}}$	0.611***	0.552***	0.431***	0.521***	0.502***	0.349***
$\boldsymbol{House\ price_t, var_{t+2}}$	0.684***	0.549***	0.433***	0.480***	0.405***	0.442***
$\boldsymbol{House\ price_t, var_{t+1}}$	0.678***	0.514***	0.405***	0.379***	0.247***	0.361***
$\boldsymbol{House\ price_t, var_t}$	0.578***	0.440***	0.283***	0.204**	0.037	0.194***
$\boldsymbol{House\ price_t, var_{t-1}}$	0.431***	0.273***	0.108	0.010	-0.154	0.097
$\boldsymbol{House\ price_t, var_{t-2}}$	0.256***	0.133	0.012	-0.145	-0.282***	0.066
$\boldsymbol{House\ price_t, var_{t-3}}$	0.094	0.024	-0.006	-0.226**	-0.335***	-0.084
$\boldsymbol{House\ price_t, var_{t-4}}$	-0.050	-0.080	0.015	-0.276***	-0.343***	-0.255

Own calculations.

Housing construction

We see that the highest correlation is between housing prices and housing construction. All the coefficients from t-2 to t+4 are positive, indicating that houses under construction move procyclical with the house prices in Norway. The most substantial coefficients are from t+1 to t+3, with all values over 0.60. This indicates that house prices lead the houses under construction. However, we see that the two first periods where houses under construction lead the house prices also have positive and moderate correlations. Therefore, there may be a relationship between the two variables when houses under construction are leading. The

relationship between house prices and houses under construction is thus ambiguous. The correlation analysis indicates that the house price can have an impact on the future housing construction. On the other side, it suggests that housing construction affects future house prices. It is reasonable to assume that housing construction and house prices have an influence on each other.

Business cycle

For the business cycle, we see that eight of the nine calculated correlations between house prices and GDP is positive. This correlation indicates that GDP is procyclical with the house prices. The relationship is most definitely in period t+3 for the variable with a correlation of 0.552. Looking at table 1, we see that the correlation between housing prices and GDP is higher in period t to t+4, and get lower and close to uncorrelated in period t-1 to t-4. This relationship indicates that housing prices lead the GDP.

Oil prices

For the oil price, we see that the relationship with housing prices is sort of the same as GDP and the housing prices. The main difference from GDP is that oil price has the highest correlation with house prices in period t+2. This indicates that housing prices also leads the oil price. However, this is discussed more closely later. We see that the correlations are low and close to uncorrelated in period t-1 to 1-4. This relationship is an indication that there is no leading effect of oil price on the house prices.

Monetary policy

We have used two variables as a measure of monetary policy, the key rate, and the banks' lending rate. Both rates have a similar relationship with the house prices. Seven of the total 18 correlations coefficients are negative, and all of this is between period t-1 and t-4. In these periods is there a countercyclical relationship between the variables and the rates are leading the house prices. Increasing key rate and the lending rate seems to have a negative effect on the house prices. However, from period t to t+4, the correlation values are positive. Key rate has its highest positive correlation with housing prices in period t+3 with 0.521, while banks'

lending rate has its highest correlation in period t+4 with 0.530. It looks like there is a procyclical relationship between the variables and house prices, where house prices lead the rates. As house prices increased, the key rate and average lending rate tends to grow as well.

The correlation coefficients indicate is that when there is a decrease in the key rate or lending rate, house prices increase some periods after. In addition, when there is an increase in the house prices, the key rate and lending rate follow and increase. Then when the rates rise, the house prices decrease. This leads to a decrease in the rates once again.

Households' debt

Households' debt has pretty much the same relationship with housing prices as GDP and the oil prices. The highest correlation between households' debt and house prices in period t+2, which indicates that housing prices also leads the households' debt. Higher house prices seem to be followed by increasing households' debt. We see that the correlations are lower and close to uncorrelated in period t-1 to 1-4. Thus, we cannot locate a leading effect of households' debt on housing prices with the correlation analysis.

8.2.3 How Oslo and Stavanger correlates with oil price

Table 2 shows how the housing prices in Oslo and Stavanger correlates with the oil price between 1991 and 2017. For Oslo, we see that three of the nine coefficients are negative. These are the coefficients of period t-2 to t-4. For Stavanger, we only find positive correlation coefficients. The periods where housing prices lead the variables are all positively correlated.

Table 2: Correlation coefficients between oil price and house prices in Stavanger and Oslo. With quarterly lag and lead on the oil price

Period (Quarter)	House prices Stavanger	House prices Oslo
$\boldsymbol{House\ price_t, Oil\ Price_{t+4}}$	0.281***	0.476***
$\boldsymbol{House\ price_t, Oil\ Price_{t+3}}$	0.396***	0.473***
$\boldsymbol{House\ price_t, Oil\ Price_{t+2}}$	0.404***	0.452***
$\boldsymbol{House\ price_t, Oil\ Price_{t+1}}$	0.429***	0.404***
$\boldsymbol{House\ price_t, Oil\ Price_t}$	0.481***	0.245***
$\boldsymbol{House\ price_t, Oil\ Price_{t-1}}$	0.291***	0.023
$\boldsymbol{House\ price_t, Oil\ Price_{t-2}}$	0.188*	-0.193**
$\boldsymbol{House\ price_t, Oil\ Price_{t-3}}$	0.133	-0.236**
$\boldsymbol{House\ price_t, Oil\ Price_{t-4}}$	0.075	-0.210**

Own calculations

For Oslo, we have a negative correlation with the oil price in the periods where oil price leads the house prices, and a positive correlation in the periods when house prices lead the oil prices. The most substantial correlation is in period t+4, with a coefficient of 0.476. This relationship may be an indication that the housing prices in Oslo move upwards or downwards before the oil prices move upwards or downward. The negative correlation between oil prices leading house prices is weaker, indicating that the oil prices does not positively affect the housing prices in Oslo.

For Stavanger, all the correlations between house prices and oil price are positive. This indicates that there is a procyclical relationship between the two variables. The most substantial correlation is in the current period t, with a coefficient of 0.481. The positive correlation when the variables are in the same period indicates that they move simultaneously. In addition, we see a relationship in the periods when the house prices lead the oil price.

Both these results are surprising, as we expected that oil prices would lead house price developments. Most importantly, we expected that it oil price would lead the house prices in Stavanger.

However, as we remember from chapter 7.3, oil prices had a significant drop in 2014. Around this time, the house prices in Stavanger also turned and started to decrease. Therefore, it is interesting to make a new correlation analysis, looking at data from Q1 2011 to Q4 2017. This was made to see if we here can locate a different relationship between house prices and oil price. The correlations between the house prices and oil price from 2011 to 2017 are presented in table 3.

Table 3: Correlation coefficients between the oil price and house prices in Stavanger and Oslo from 2011 to 2017. With quarterly lag and lead on the oil price

Period (quarter)	*House prices Stavanger*	*House prices Oslo*
$\boldsymbol{House\ price_t, Oil\ Price_{t+4}}$	0.109	0.750***
$\boldsymbol{House\ price_t, Oil\ Price_{t+3}}$	0.196	0.634***
$\boldsymbol{House\ price_t, Oil\ Price_{t+2}}$	0.256	0.517***
$\boldsymbol{House\ price_t, Oil\ Price_{t+1}}$	0.437**	0.416**
$\boldsymbol{House\ price_t, Oil\ Price_t}$	0.688***	0.257
$\boldsymbol{House\ price_t, Oil\ Price_{t-1}}$	0.649***	0.138
$\boldsymbol{House\ price_t, Oil\ Price_{t-2}}$	0.709***	-0.118
$\boldsymbol{House\ price_t, Oil\ Price_{t-3}}$	0.715***	-0.273
$\boldsymbol{House\ price_t, Oil\ Price_{t-4}}$	0.635**	-0.370**

Own calculations

Table 3 shows some interesting results for Stavanger. The relationship between house prices in Oslo and the oil price looks much as it did in table 2, and is not further commented.

For Stavanger, the relationship between house prices and the oil price has changed a lot from table 2. We can now see that the most substantial correlation coefficients are in the periods when oil price leads the house prices. This indicates that during this period, house prices seem to move after changes in oil price levels between 2011 and 2017. This result coincides better with what we expected before doing the analysis.

While Oslo seems to move before the oil price, house prices Stavanger move after. However, this can be explained by the dynamics of the economy. Until the drop in 2014, oil price followed much of the changes in GDP. In the same period, the house prices in Stavanger had the same development as house prices in Oslo and the rest of the country. Therefore, in this part, the house prices in Stavanger were moving before the oil price, ad it did for the whole country. However, when the oil price dropped in 2014, the house prices in Stavanger followed shortly after, indicating that the oil price leads the house prices in Stavanger. This suggests that oil prices as a fundamental factor for the housing cycle have a different effect depending on cities and the importance of the oil industry is in that area.

9. Discussion

In this chapter, we discuss the housing cycle in relation to the literature and the analysis. We attempt to make a link between the theories for the house price mechanisms, historical developments regarding events that may have affected the housing cycle, and our own analysis of how the five fundamentals have moved in relation to the housing cycle.

The housing cycle is complex, and the different fundamentals need to be discussed together. First, the fundamental factors are discussed separately before we round up the chapter with a discussion of how the five fundamentals stand together and how this may cause movements in the housing cycle.

Housing construction

Housing construction is an essential part of the housing cycle and effects the long-term supply. We expected higher construction when house prices increased. Additionally, if we follow the view of Leamer (2007), indicating the housing cycle is a volume cycle, we should expect that the housing construction and house prices have an impact on each other. Increasing house prices seems to raise the value of housing construction relative to the construction cost. Thus, new buildings become profitable (Goodhart & Hofmann, 2007). Newly constructed houses should also affect the house prices positively since new houses have higher quality than old houses. In addition, housing construction increases the supply and may pressure the prices if demand does not follow.

During a recession, or decline in demand, the housing construction is adjusted. A decrease in housing construction results in fewer jobs in construction, finance, and real estate. In this way, housing construction is an essential fundamental for the housing cycle (Leamer, 2007).

In chapter 7, we looked at cyclical movements, and housing construction seems to have a procyclical relationship to the housing prices. From the cyclical changes, the house prices appeared to lead the housing construction. This observation was also supported by our correlation analysis. We found high correlation values between the cyclical changes when the

housing prices were leading the housing constructions. In addition, construction also seems to be leading house prices. Houses under construction are the fundamental that has the highest correlation value with the house prices. This relationship indicates that housing prices and housing construction follow each other. When house price either decrease or increase, the levels of housing construction adjusts rather rapidly after. Thus, housing construction seems to be a vital part of the housing cycle.

Business cycle

The housing market is a significant part of the economy. Housing activity such as construction and other real estate activity affects the Norwegian economy (Jacobsen & Naug, 2004a). Especially the housing construction is positively impacting the economy in Norway. As higher house prices mainly drive construction, the development in house prices is essential. Higher house prices imply that future constructions may be a good investment, and this should affect the economy (Goodhart & Hofmann, 2007). Changing house prices also leads to speculation in the real estate market, which contributes to increasing activity. Leamer (2007) argues that the housing cycle not only affecting the business cycle, but the housing cycle does also lead the business cycle. Higher housing prices indicate higher activity within the construction, finance, and brokerage, which significantly influences the business cycle. Thus, we expected that housing cycle would be vital for the business cycle.

In the HP-analysis, we observed a procyclical relationship where it looked like the house prices were leading the business cycle. We found the same relationship in our correlation analysis. The most substantial correlations occurred when the house prices were leading the business cycle by three quarters. On the other side, the correlation coefficients got weaker and close to uncorrelated when the business cycle leads the house prices.

As all economic activity, the changes in the housing cycle have an impact on the changes in the business cycle. Our findings coincide with what previous literature. Thus, it is reasonable to suggest that changes in house prices affect the business cycle as the change in house prices affect the households' general economy.

Oil prices

The oil industry is essential for Norway, and changes in oil price do affect the Norwegian economy somehow. Brun (2013) debates that a decrease in the oil price decreases the housing prices over time.

In chapter 7, we were looking at the cyclical movements of oil price in relation to the house prices. When we observed Norway as a whole, we could see that the cyclical movements of the oil price seem to move in the same direction, with the housing prices moving before oil prices. The same relationship was revealed in the correlation analysis. These results were surprising as we expected that the house prices would follow the oil prices. However, the oil prices do affect not only the oil industry but also has an impact on the whole Norwegian economy. Thus, we might argue that the correlation values become higher over time due to the increase in GDP caused by the oil prices.

We further analyzed Oslo and Stavanger separately. The cities are expected to be affected in different ways, as Stavanger is more dependent on the oil sector. Oslo and Stavanger experienced increasing house prices before the oil price fall in 2014. After that, the housing prices decreased in Stavanger, whereas in Oslo they continued to increase.

The relationship between house prices in Oslo and the oil price looks similar as the effect for whole Norway. The correlation coefficients are highest for the period where the house prices lead the oil price and are weak or close to uncorrelated when oil price leads the house prices.

For Stavanger, we observed a slightly different relationship between the cyclical movements of house prices and the oil price. Until late 2013, it looked like the house prices of Stavanger were leading the oil price, as seen from the analysis of whole Norway. Conversely, this turned around with the oil price drop in 2014, and the house prices seem now to be following the oil price. We expected to find that the oil price was leading the house prices, due to the high importance of the oil industry in Stavanger. However, we found that the correlation coefficients were highest when the variables moved at the same time or the house prices were leading. It is, however, worth mentioning that the correlation values are higher for Stavanger than both Oslo and whole Norway.

Due to the high effect of the oil price decrease in 2014, we wanted to investigate the relationship between oil price and house prices in Stavanger further. As the oil price fell, there were registered a fall in the house prices in Stavanger. Thus, we made a correlation analysis from 2011 to 2017. Here, we found a completely different result. We found high correlation values when the oil prices were leading the house prices in Stavanger. In addition, there were weaker correlation coefficients when house prices were leading the oil price. Less employment and less oil activity in general in Stavanger seems to contribute to the changes in house prices during this time. However, this may look like a special event due to the high impact of the oil crisis in Stavanger (NAV, 2016). At the same time, the housing prices increased in Oslo, which supports the arguments from Cappelen, Eika, and Prestmo (2014) that states that Norway has been more robust to a fall in the oil price.

We need to elaborate our oil price findings further. According to statistics from EIA (U.S. Energy Information Administration), Norway stands for only around 2 percent of the total production of Brent crude oil. Thus, the production from Norway does not significantly affect the oil price development, here especially the Brent crude oil. Therefore, we can consider the oil prices as an exogenous variable, and to look isolated at how the house price leads the oil price may be misleading. In addition, it worth mentioning that oil prices are given in U.S. dollars. The value for the Norwegian krone has an effect on the revenues for Norway. Even though the oil price levels decrease, the Norwegian currency got weaker at the same time. Thus, the decrease in revenues might not be that severe.

The lagged correlation between the oil prices and house prices may come from an uptake in domestic oil production. Therefore, we can explain the development by as activity goes up, such as oil production, more capital inflow and investments in offshore and related tangible assets such as supply vessels and rigs occur. As production increases, the demand may follow. Therefore, one can say that demand is lagged, and thus the price increase is lagged. As production increases, GDP increase. Numbers from Statistics Norway show that the oil production accounts for close to 30 percent of GDP. Activity goes up before the price levels increase, and consequently, the house prices may have increased before the oil price levels. Therefore, it may look like the house prices lead the oil prices. This may explain some of our findings, indicating that house price levels moves upwards or downwards before the oil price do.

It is however clear that the Norwegian house prices cannot affect the overall oil price. Thus, the indication of house prices leading the oil price is probably caused by the fact that the oil price coincides with the business cycle. On the other side, the oil price should have an impact on the house prices, since it affects the general economy. The drastic fall in oil price in 2014 that led to the fall in house prices in Stavanger could be a particular case since it did not make the same impact on the rest of the country.

Monetary policy

Monetary policy has changed a lot over the years, which is seen in the many different levels of key rate. Today it is as low as 0.5 percent, while back in 1992 it was as high as 11 percent. It is highly agreed upon that monetary policy affects the housing prices. Arguably, easier credit access is positively impacting the house price levels. Lower interest rates increase the demand for houses, and thus prices are increased (Favara & Imbs, 2015). In addition, lower interest rates make it easier to repay loans, whereas household wealth increases due to higher disposable income.

When looking at the cyclical movements of key rate and the house prices in chapter 7, we observed periods with both countercyclical and procyclical movements. The most obvious procyclical relationship between the two variables was in relation to the financial crisis in 2008, with the house prices leading the key rate. From around 2010, it is difficult to see a clear relationship between the variables due to the key rate being stable over the years.

From our analysis of correlation and cyclical movements, we found that both key rate and the average lending rate seems to correlate with housing prices for both leading and lagging periods. Higher house price may affect the key rate positively, which thereby puts pressure on the house prices. Key rate may, therefore, be used as price correction for the housing price development as the Norwegian Government may change the key rate after house price fluctuations occur.

The key rate seems to change before the average lending rate. One might explain this as the average lending rate being adjusted after key rate changes, and this change affects the house prices. The other way around, we find a negative correlation when lending rate leads the house

prices. Thus, a higher lending rate negatively correlates with housing prices, leading to a decrease in the house prices. However, the correlation is highest for values indicating that the housing prices lead the lending rate.

In addition, historical development in the housing market in Norway may help us get a better understanding of the effect of monetary policy towards the housing cycle. Kristianiakrakket, the crisis during the interwar period and the banking crisis were all a result of among other things a change in the monetary policy. Therefore, we can say that monetary policy and the house prices have a two-sided relationship where they probably affect each other.

Household debt

Most households finance their housing investment by loans (Røstadsand, 2017). Risk of high household debt is related to changing house prices, as households' wealth decreases and in the worst case, they become technically insolvent (Lunde, 2014). Higher house prices increase the debt levels, and increasing debt levels seem to have a positive effect on the house price development.

We find that the house prices have a leading effect on households' debt as increases in the house prices leads to higher mortgages. When looking at the cyclical movements from chapter 7, we saw a close relationship between the house prices and households debt. The house prices seemed to be leading. From the correlation analysis, we found that house prices seem to affect the households' debt levels positively. The strongest correlation between the two variables is when the house prices lead households' debt by two quarters. These findings were as expected, as we believed to find a clear correlation between house prices and debt levels. As house prices increases, households' need more help to finance their homes. However, our analysis does not give any indications of a two-way interaction that previous research suggest.

As for the monetary policy, we can use the historical development in the Norwegian economy to understand the changes in households' debt. Kristianiakrakket was a result of several reasons, among others an expansionary monetary policy with easier credit access. The banking crisis came as a result of easy credit access and high debt rates. The liberalization resulted in a lending boom, and the housing prices fell dramatically. This development shows that higher debt levels

also bring risk as we have pointed out. Likewise, the easier credit access also contributed to the raising prices before the crisis, supporting that debt levels and house prices correlate.

The fundamentals seen together

Until now, we have looked at each of the fundamentals individually in relation to the housing cycle. However, due to the complexity of the housing cycle, one fundamental cannot fully explain the changes that occur. Further, the fundamentals are expected to have an influence on each other, such that changes in the business cycle would cause or be caused by changes in the oil price, monetary policy or housing construction. Thus, it is essential to discuss the fundamentals together, in relation to the housing cycle.

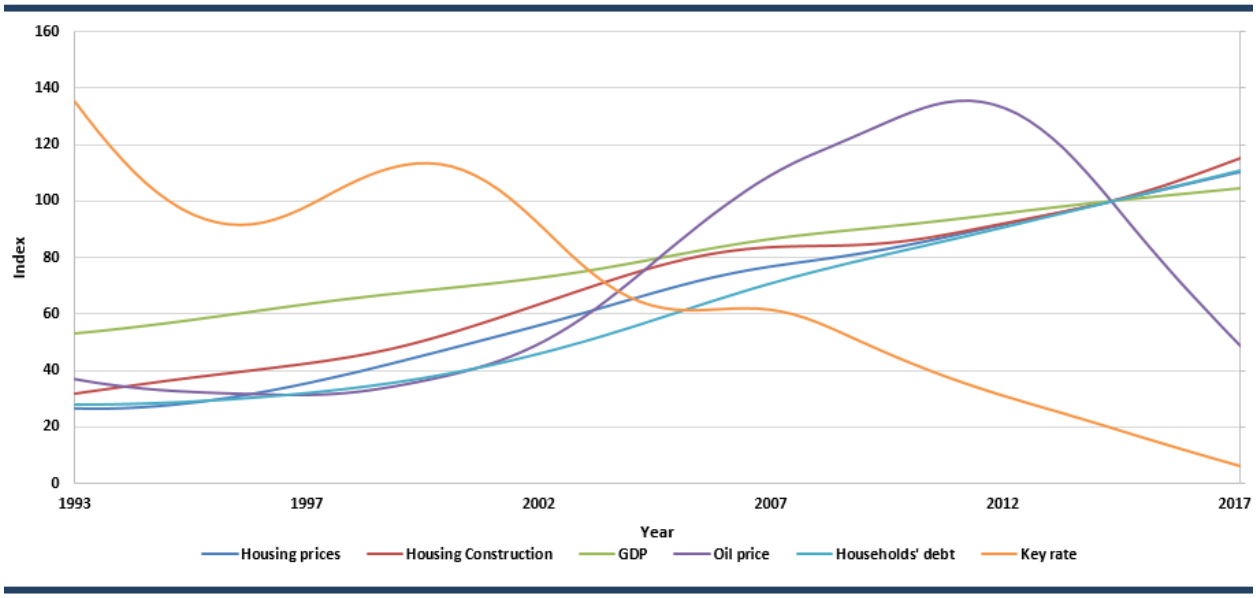
Our correlation analysis and cyclical changes indicate that the house prices seem to be leading to the other fundamentals. The housing construction is the fundamental with the highest correlation with the house prices, which suggests a covariance between the variables. Likewise, we see a positive correlation between the house prices and GDP, oil price, and households' debt. The business cycle, here measured in GDP mainland Norway, will, however, affect and be affected by the economic activity in the country. An increase in the housing construction affects the economic activity and would lead to higher employment and increase in output. This again affects the business cycle. Moreover, oil is a big part of the economy, which also have a relationship to the business cycle. Households' debt is connected to the house prices and housing constructions, as new houses increase quality and then house prices, which leads to the higher need for bank loans to finance house purchases. Monetary policy and debt levels also affect each other.

The relationship between the house prices and key rate and banks' lending rate is somehow different from the other fundamentals. We found positive correlations when the house prices lead the two rates and negative correlations when the rates are leading the house prices. This relationship may be explained by that the Norwegian Government could increase the key rate to curb a large increase in the house prices. The key rate has an influence on the banks' lending rate, which affects the households ability to afford a house. This shows that monetary policy in terms of interest rates has a connection to households' debt as well as a connection to the house

prices and housing construction. The key rate should also have a direct connection to the business cycle, as it would affect the economic activity.

It is important to highlight that the correlation analysis does not say anything about causality and if the different fundamentals actually affect the housing cycle. However, based on existing literature and the correlation analysis, we can argue that the Norwegian housing cycle may be affected in this way.

Figure 33 Trend line of housing prices and fundamentals



Source: Eiendomsverdi, Statistics Norway, EIA

The relationship between the fundamental factors indicates they all move around the business cycle and that the housing cycle thus has a similar relationship to them all. Figure 33 shows the trend line for housing prices and the five fundamentals. Here, we clearly see that most fundamentals and the house prices move together. Key rate points out and shows a different relationship, as previously discussed. In addition, we clearly see the oil price decrease. It is valuable to illustrate this as it shows that the trend for the economic fundamentals and housing cycle has had the same increasing trend, expect key rate and oil prices.

Increase in house prices should make an impact on the housing constructions. A higher amount of housing construction leads to higher employment and higher activity in the real estate market. This has a positive effect on the economic condition and GDP. Thus, housing cycle seems to affect the business cycle through among others housing construction activity (Case & Quigley, 2008). Telle (2017) argues that the increasing housing construction in recent years has been an essential and positive contributor to the Norwegian economy during the recent market downturn. Construction affects the business cycle and employment, and oil prices profoundly relate to the business cycle. In addition, debt levels and monetary policy influence each other. Monetary policy affects the debt amount households' may bear. Increasing house prices raises households' wealth as their house is worth more, and thus they can increase their loan.

10. Conclusion and further research

The purpose of this thesis has been to investigate the Norwegian housing cycle. We tried to answer our problem statement *"How do various macroeconomic fundamentals affect the Norwegian housing cycle?"* We investigated five fundamentals that may affect the housing cycle: housing construction, business cycle, oil price, monetary policy and households' debt. Existing literature and analysis of the cyclical movements was used to answer our problem statement.

Historically, we see that several fundamentals have had a significant influence on the housing cycle. Easy credit access and low interest rates have resulted in credit booms and increasing house prices. In addition, housing construction booms, such as in 1895 drove the prices up, whereas this followed a crash in the prices. Along with monetary policy changes, this led to crashes in the Norwegian housing market. An increasing economic condition has also positively contributed to increasing house prices since the 1980s.

The house prices are determined by two factors – supply and demand. The housing supply is more or less given in the short term, as it takes time of constructing houses. However, in the long-term, construction profoundly affects the supply, which put downward pressure on the house prices. However, it may increase the price levels if the demand rises as well. In addition, new houses may have a positive house price effect due to the higher standard.

From the cyclical movements and correlation analysis, we saw that the house prices tend to move before the other fundamentals. Housing construction gave highest correlation values towards housing prices, both leading and lagging. This was also visible from the cyclical movements. Moreover, the four other values also had a positive correlation towards housing prices. As housing prices move upwards or downwards, it seems like the other fundamentals follow the same pattern. However, it was surprising to notice the low correlation values for fundamentals leading the house prices. The key rate seems to be the only leading fundamental when looking at the correlation values. Key rate decrease may seem to put pressure on the housing prices.

The low correlation values of fundamentals leading the house prices were especially surprising for oil prices. We expected that changes in oil prices would lead to changes in house prices. Therefore, it was interesting to analyze Stavanger and Oslo separately, due to the high importance for the oil industry in Stavanger. This gave interesting results, especially when narrowing down the data to values from 2011-2017. Here, correlation values pointed towards an effect from oil prices on house price development, as the house prices seemed to move after the oil price. This is interesting, as oil price indicates a stronger effect in Stavanger.

Throughout this thesis, we have found that the housing cycle is dependent on several macroeconomic fundamentals, and that determining how one fundamental alone affect the housing cycle is very hard. However, it is important to notice that the fundamentals and housing prices move in the same pattern. It is important to highlight that the fundamentals profoundly affect each other, and cannot be analyzed separately. As house price increase, so does construction. Construction leads to higher activity and thus positively impact the business cycle. Oil prices also affect the business cycle, even though we measure it as GDP mainland. In addition, both interest rate and households' debt influence each other. Thus, we can argue that the fundamentals factors affect each other, and the housing prices, and thus the housing cycle. As a part of the same economy, the house prices and the fundamental factors move in the same direction when exposed to the same shocks. Even though they do not necessarily have the same trend line, the cyclical movements have similar characteristics.

Even though this thesis reveals some interesting findings regarding fundamentals affecting the housing cycle, it is crucial to highlight limitations and possible further research. First, the models we use have limitations, as described in the thesis. These are important to take into consideration when analyzing the data. Further, the correlation analysis can only show how the variable moves with each other, but they do not reveal the actual impact from the fundamentals to the housing cycle. Additional analysis, such as regression analysis could be better to detect this. Therefore, we cannot present our findings with absolute certainty. As mentioned, Eiendomsverdi revises their data continuously and may show different data today than when we collected them.

For further research, it would be interesting analyze other fundamentals such as disposable income that may affect the housing cycle in Norway. Some argue that psychological factors

such as expectations to the Norwegian economy and the housing price development (Brun, 2013;Vale, Kutluay, & Yildiz, 2013).

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12. Appendix

Appendix 1: Real house price calculations

	Nominal house prices per squared meter					Real house prices per squared meter				Houses sold					Real House Price Index (Q1 2015 = 100) m2				
Start date	Detached	Terraced House	Apartment	Semi-detached House	CPI	Detached	Terraced House	Apartment	Semi-detached House	Detached	Terraced House	Apartment	Semi-detached House	Weighted real m2	Detached	Terraced House	Apartment	Semi-detached House	Weighted Index
01-10-2017	23,709	32,708	49,138	30,905	104.7	22,651.91	31,249.68	46,947.13	29,527.07	7,499	2,284	14,579	2,387	37,241.18	104	105	110	109	107.97
01-07-2017	23,805	33,428	50,476	31,276	105.5	22,571.11	31,695.32	47,859.67	29,654.87	8,599	2,354	15,271	2,355	37,419.16	104	107	112	109	109.08
01-04-2017	25,304	34,367	51,372	32,249	105.8	23,924.36	32,493.22	48,571.07	30,490.70	9,987	2,788	17,741	2,768	38,325.36	110	110	114	112	112.31
01-01-2017	24,600	33,671	51,775	31,300	106.1	23,192.96	31,745.13	48,813.64	29,509.74	6,953	2,187	14,729	2,201	38,918.84	107	107	114	108	111.34
01-10-2016	23,343	32,076	49,486	30,180	102.0	22,877.82	31,436.79	48,499.84	29,578.57	7,043	2,029	13,923	2,124	38,337.59	105	106	114	109	110.38
01-07-2016	23,090	31,871	49,367	29,364	103.3	22,352.37	30,852.86	47,789.93	28,425.94	8,464	2,354	15,114	2,374	37,151.07	103	104	112	104	108.08
01-04-2016	23,493	32,101	47,586	29,618	104.2	22,546.07	30,807.10	45,667.95	28,424.18	10,267	2,893	18,785	2,910	36,183.97	104	104	107	104	105.69
01-01-2016	22,075	30,207	45,345	28,413	104.7	21,090.76	28,860.19	43,323.25	27,146.18	6,149	2,003	13,522	2,042	34,944.49	97	97	102	100	99.96
01-10-2015	21,859	29,231	43,399	27,668	98.9	22,102.12	29,556.12	43,881.70	27,975.73	7,282	2,015	13,405	2,254	34,933.27	102	100	103	103	102.35
01-07-2015	21,669	29,927	44,710	27,834	99.8	21,705.18	29,976.96	44,784.64	27,880.47	8,525	2,239	15,181	2,316	35,264.21	100	101	105	102	103.02
01-04-2015	22,705	30,341	44,259	28,409	100.2	22,659.68	30,280.44	44,170.66	28,352.30	10,001	2,821	18,341	2,955	35,346.61	104	102	104	104	103.78
01-01-2015	21,922	29,961	43,094	27,495	101.1	21,690.63	29,644.79	42,639.18	27,204.82	7,135	2,370	15,912	2,449	34,813.75	100	100	100	100	100.00
01-10-2014	20,669	28,560	40,404	26,193	97.0	21,308.25	29,443.30	41,653.61	27,003.09	7,618	2,303	13,840	2,428	33,303.43	98	99	98	99	98.14
01-07-2014	20,867	28,758	41,317	26,191	97.7	21,365.53	29,445.05	42,304.10	26,816.72	8,813	2,271	15,530	2,553	33,620.52	99	99	99	99	98.95
01-04-2014	21,344	28,883	40,123	26,986	98.2	21,727.86	29,402.44	40,844.59	27,471.33	9,713	2,655	16,759	2,835	32,898.50	100	99	96	101	97.86
01-01-2014	20,537	28,426	38,689	26,281	98.6	20,828.60	28,829.61	39,238.34	26,654.16	6,571	2,148	14,024	2,265	32,367.28	96	97	92	98	94.06
01-10-2013	19,814	27,875	38,109	25,357	95.0	20,856.84	29,342.11	40,114.74	26,691.58	7,304	2,175	13,022	2,198	32,276.60	96	99	94	98	95.48
01-07-2013	20,197	28,112	40,027	26,347	95.9	21,067.80	29,324.06	41,752.78	27,482.96	8,823	2,157	15,092	2,359	33,206.66	97	99	98	101	98.01
01-04-2013	21,320	29,062	39,920	26,698	96.2	22,169.84	30,220.45	41,511.27	27,762.22	9,428	2,804	17,590	2,809	33,769.20	102	102	97	102	99.56
01-01-2013	20,819	28,659	39,497	25,871	96.6	21,544.33	29,657.47	40,873.06	26,772.34	6,214	2,133	14,388	2,109	33,878.61	99	100	96	98	97.30
01-10-2012	19,359	26,979	37,766	25,032	93.8	20,631.26	28,752.04	40,247.96	26,677.09	7,454	2,178	13,835	2,348	32,379.46	95	97	94	98	95.15
01-07-2012	19,270	27,025	38,277	24,672	94.0	20,492.73	28,739.81	40,705.78	26,237.50	8,718	2,193	14,978	2,421	32,317.00	94	97	95	96	95.36
01-04-2012	20,152	26,938	37,383	25,025	93.4	21,583.72	28,851.84	40,038.91	26,802.93	9,600	2,638	17,018	2,749	32,444.25	100	97	94	99	96.26
01-01-2012	19,578	26,789	36,621	25,006	94.5	20,724.77	28,358.15	38,766.06	26,470.71	6,675	2,203	14,181	2,218	32,015.84	96	96	91	97	93.11
01-10-2011	18,375	25,789	34,873	23,127	93.1	19,743.91	27,710.24	37,470.99	24,849.93	8,025	2,235	13,588	2,357	30,074.58	91	93	88	91	89.63
01-07-2011	18,337	25,530	35,102	23,287	93.7	19,576.87	27,256.23	37,475.44	24,861.57	9,149	2,097	14,320	2,479	29,757.36	90	92	88	91	89.27
01-04-2011	18,705	25,226	34,388	23,155	93.0	20,105.70	27,115.01	36,963.10	24,888.93	9,498	2,397	15,975	2,792	29,871.96	93	91	87	91	89.36
01-01-2011	18,540	25,076	33,783	22,977	93.3	19,864.29	26,867.14	36,196.07	24,618.21	6,152	1,906	13,342	2,079	30,134.30	92	91	85	90	87.60

	Nominal house prices per squared meter					Real house prices per squared meter				Houses sold					Real House Price Index (Q1 2015 = 100) m2				
Start date	Detached	Terraced House	Apartment	Semi-detached House	CPI	Detached	Terraced House	Apartment	Semi-detached House	Detached	Terraced House	Apartment	Semi-detached House	Weighted real m2	Detached	Terraced House	Apartment	Semi-detached House	Weighted Index
01-10-2010	17,296	23,405	32,033	21,436	91.8	18,840.96	25,495.64	34,894.34	23,350.76	7,213	1,793	12,595	2,119	28,270.99	87	86	82	86	84.04
01-07-2010	17,375	23,727	32,221	21,878	92.3	18,817.69	25,697.11	34,896.39	23,694.58	8,362	1,951	13,622	2,274	28,109.76	87	87	82	87	84.23
01-04-2010	17,974	23,431	31,696	22,022	91.7	19,608.00	25,561.09	34,577.45	24,024.00	8,384	2,308	14,434	2,479	28,329.47	90	86	81	88	85.00
01-01-2010	17,126	22,682	30,818	21,455	92.6	18,501.26	24,503.42	33,292.76	23,177.89	5,573	1,623	11,944	1,879	27,788.03	85	83	78	85	80.98
01-10-2009	16,630	21,818	30,043	20,467	89.2	18,650.47	24,468.79	33,693.08	22,953.64	6,876	1,748	11,896	2,028	27,424.83	86	83	79	84	81.90
01-07-2009	16,276	21,538	30,121	20,151	90.0	18,084.44	23,931.11	33,467.78	22,390.00	7,782	1,859	13,036	2,172	26,968.41	83	81	78	82	80.52
01-04-2009	16,583	21,358	29,085	20,371	90.0	18,425.56	23,731.11	32,316.67	22,634.44	7,806	2,073	13,143	2,222	26,463.96	85	80	76	83	79.62
01-01-2009	15,840	20,629	27,920	19,711	90.5	17,502.76	22,794.48	30,850.83	21,780.11	5,582	1,697	11,141	1,805	25,681.33	81	77	72	80	75.72
01-10-2008	15,050	20,370	27,291	18,763	87.0	17,292.23	23,404.83	31,356.95	21,558.41	5,375	1,344	8,470	1,574	25,289.51	80	79	74	79	76.49
01-07-2008	15,648	20,936	28,724	19,490	87.3	17,931.25	23,990.83	32,915.20	22,333.84	7,108	1,794	11,080	2,014	26,376.42	83	81	77	82	79.72
01-04-2008	16,668	21,668	29,442	20,021	88.4	18,855.20	24,511.31	33,305.43	22,648.19	9,098	2,489	15,230	2,667	27,140.07	87	83	78	83	81.68
01-01-2008	16,243	21,908	29,299	20,134	89.2	18,202.84	24,551.36	32,834.14	22,563.32	6,250	1,982	13,018	2,060	27,299.18	84	83	77	83	79.88
01-10-2007	15,650	21,018	29,544	19,390	84.1	18,616.18	25,001.59	35,143.54	23,065.03	7,316	2,097	13,374	2,301	28,368.41	86	84	82	85	83.79
01-07-2007	15,418	21,374	29,917	19,443	84.5	18,238.96	25,284.70	35,390.77	23,000.39	8,584	2,085	14,795	2,334	28,295.96	84	85	83	85	83.64
01-04-2007	16,164	21,187	30,037	19,769	84.4	19,144.10	25,093.17	35,574.81	23,413.74	8,864	2,503	16,320	2,611	28,853.91	88	85	83	86	85.17
01-01-2007	15,394	20,484	29,695	18,723	86.2	17,865.38	23,772.53	34,462.28	21,728.82	6,247	2,095	14,397	2,078	28,315.85	82	80	81	80	81.08
01-10-2006	14,227	19,482	28,328	17,468	83.2	17,092.91	23,406.49	34,034.44	20,986.78	7,906	2,156	16,392	2,301	27,535.53	79	79	80	77	79.26
01-07-2006	14,039	18,730	27,750	17,580	84.3	16,660.21	22,227.06	32,931.17	20,862.34	8,889	2,180	16,636	2,637	26,346.47	77	75	77	77	76.90
01-04-2006	14,133	18,335	26,790	17,486	84.3	16,765.12	21,749.70	31,779.36	20,742.59	8,512	2,399	15,604	2,370	25,616.32	77	73	75	76	75.39
01-01-2006	13,375	17,858	25,934	16,730	85.0	15,735.29	21,009.41	30,510.59	19,682.35	6,047	1,925	13,827	2,033	25,070.43	73	71	72	72	71.82
01-10-2005	12,565	16,651	24,758	15,503	81.4	15,436.12	20,455.77	30,415.23	19,045.45	7,185	2,025	13,832	2,030	24,397.62	71	69	71	70	70.99
01-07-2005	12,395	16,576	24,141	15,387	82.3	15,060.75	20,140.95	29,332.93	18,696.23	8,054	2,056	13,499	2,215	23,237.55	69	68	69	69	68.92
01-04-2005	12,782	16,550	23,632	15,479	82.5	15,499.60	20,068.71	28,656.43	18,770.01	8,789	2,586	14,674	2,474	22,966.20	71	68	67	69	68.72
01-01-2005	12,417	15,784	23,356	15,063	83.0	14,966.25	19,024.51	28,151.06	18,155.48	5,342	1,792	10,400	1,680	22,760.17	69	64	66	67	66.74
01-10-2004	12,410	15,152	22,226	14,583	80.6	15,397.02	18,799.01	27,575.68	18,093.05	6,506	1,875	11,372	1,826	22,338.84	71	63	65	67	66.62
01-07-2004	11,537	14,709	22,001	14,484	81.1	14,231.50	18,144.33	27,139.39	17,866.78	7,682	1,960	11,151	1,906	21,215.68	66	61	64	66	64.27
01-04-2004	11,772	14,843	21,347	14,219	81.0	14,527.35	18,317.15	26,343.48	17,547.10	8,127	2,329	12,386	2,309	20,974.56	67	62	62	64	63.71
01-01-2004	11,542	14,772	21,333	14,000	81.5	14,167.76	18,132.57	26,186.17	17,184.94	5,957	1,943	10,696	1,901	21,095.03	65	61	61	63	62.69

	Nominal house prices per squared meter					Real house prices per squared meter				Houses sold					Real House Price Index (Q1 2015 = 100) m2				
Start date	Detached	Terraced House	Apartment	Semi-detached House	CPI	Detached	Terraced House	Apartment	Semi-detached House	Detached	Terraced House	Apartment	Semi-detached House	Weighted real m2	Detached	Terraced House	Apartment	Semi-detached House	Weighted Index
01-10-2003	10,667	14,009	20,563	13,395	81.8	13,045.66	17,132.90	25,148.39	16,381.98	6,774	1,926	10,911	1,961	19,835.36	60	58	59	60	59.35
01-07-2003	10,613	13,599	19,615	12,746	80.4	13,200.25	16,914.18	24,396.77	15,853.23	8,184	2,202	11,086	2,075	19,052.70	61	57	57	58	58.56
01-04-2003	10,752	13,431	19,024	13,042	80.1	13,428.81	16,774.77	23,760.20	16,288.93	8,019	2,198	10,486	1,999	18,776.65	62	57	56	60	58.36
01-01-2003	10,554	13,719	19,394	12,588	80.5	13,115.99	17,049.30	24,101.91	15,643.74	5,437	1,694	9,117	1,692	19,308.78	60	58	57	58	57.91
01-10-2002	10,382	13,499	19,049	12,388	78.2	13,281.88	17,269.51	24,369.72	15,848.19	6,507	1,796	9,399	1,848	19,221.47	61	58	57	58	58.72
01-07-2002	10,411	13,515	19,242	12,498	78.6	13,239.93	17,187.37	24,470.54	15,894.02	7,693	2,004	9,228	1,968	18,828.88	61	58	57	58	58.89
01-04-2002	10,883	13,721	19,223	12,552	78.6	13,851.93	17,464.15	24,467.12	15,976.24	7,903	2,339	9,745	2,203	19,105.37	64	59	57	59	59.98
01-01-2002	10,479	13,407	19,588	12,482	79.5	13,181.13	16,864.15	24,638.99	15,700.63	5,663	1,672	6,704	1,644	18,735.78	61	57	58	58	58.76
01-10-2001	10,064	13,312	19,066	11,982	77.4	13,008.19	17,206.38	24,643.69	15,487.29	7,052	1,659	6,102	1,777	17,973.23	60	58	58	57	58.65
01-07-2001	9,959	12,959	18,501	11,564	78.3	12,724.45	16,557.50	23,638.42	14,775.13	7,698	1,650	5,227	1,770	16,823.65	59	56	55	54	56.88
01-04-2001	9,855	12,759	18,511	11,453	77.5	12,721.60	16,470.31	23,895.44	14,784.42	6,434	1,373	4,399	1,654	16,885.57	59	56	56	54	57.00
01-01-2001	9,573	12,235	17,781	11,039	77.8	12,309.90	15,732.96	22,864.55	14,195.03	4,534	1,120	6,574	1,144	17,946.81	57	53	54	52	54.51
01-10-2000	9,022	11,803	16,999	11,101	74.7	12,072.26	15,793.49	22,746.21	14,854.15	6,297	1,340	4,654	1,518	16,336.57	56	53	53	55	54.53
01-07-2000	9,190	11,947	17,277	10,877	75.3	12,204.52	15,865.87	22,944.22	14,444.89	6,944	1,435	4,134	1,629	15,973.54	56	54	54	53	54.90
01-04-2000	8,930	11,700	17,523	10,224	75.5	11,822.59	15,489.85	23,199.03	13,535.75	4,873	1,084	3,369	1,294	16,014.62	55	52	54	50	53.67
01-01-2000	8,388	11,034	16,587	10,041	76.2	11,003.06	14,473.98	21,758.20	13,171.40	3,744	829	2,981	1,077	15,321.65	51	49	51	48	50.36
01-10-1999	8,120	10,583	15,355	9,754	72.6	11,179.44	14,570.45	21,140.43	13,429.10	5,748	1,228	4,229	1,501	15,088.30	52	49	50	49	50.40
01-07-1999	7,761	10,282	14,715	9,373	73.2	10,607.29	14,052.85	20,111.62	12,810.48	6,565	1,320	3,836	1,516	13,957.50	49	47	47	47	48.04
01-04-1999	7,538	9,848	14,095	8,778	73.0	10,321.31	13,484.25	19,299.41	12,019.17	4,444	923	3,197	1,185	13,771.34	48	45	45	44	46.21
01-01-1999	7,079	9,450	13,073	8,566	73.9	9,574.84	12,781.79	17,682.15	11,586.11	3,249	814	2,580	873	12,938.75	44	43	41	43	42.93
01-10-1998	7,116	9,122	12,687	8,177	71.0	10,017.83	12,841.86	17,860.63	11,511.50	4,515	1,032	3,312	1,207	13,066.97	46	43	42	42	44.01
01-07-1998	7,215	9,777	13,096	8,636	71.4	10,105.04	13,693.28	18,341.74	12,095.24	5,877	1,252	3,713	1,406	13,197.26	47	46	43	44	45.22
01-04-1998	6,961	9,160	12,978	8,297	71.6	9,726.60	12,799.25	18,134.14	11,593.39	4,496	1,032	2,947	1,140	12,854.64	45	43	43	43	43.69
01-01-1998	6,715	8,756	12,102	8,334	72.0	9,326.39	12,161.11	16,808.33	11,575.00	3,301	786	2,516	886	12,403.56	43	41	39	43	41.54
01-10-1997	6,607	8,508	11,547	7,641	69.5	9,501.92	12,235.86	16,606.42	10,988.97	5,232	1,166	3,733	1,283	12,271.92	44	41	39	40	41.57
01-07-1997	6,466	8,405	11,272	7,433	69.8	9,259.19	12,035.80	16,141.29	10,643.91	5,839	1,370	3,726	1,347	11,808.60	43	41	38	39	40.60
01-04-1997	6,258	7,963	10,937	7,131	70.0	8,944.26	11,381.13	15,631.73	10,192.00	4,466	1,014	3,406	1,161	11,601.48	41	38	37	37	38.96
01-01-1997	5,925	7,995	10,322	6,949	70.4	8,420.18	11,361.91	14,668.88	9,875.41	3,076	727	2,566	801	11,117.31	39	38	34	36	36.91

	Nominal house prices per squared meter					Real house prices per squared meter				Houses sold					Real House Price Index (Q1 2015 = 100) m2				
Start date	Detached	Terraced House	Apartment	Semi-detached House	CPI	Detached	Terraced House	Apartment	Semi-detached House	Detached	Terraced House	Apartment	Semi-detached House	Weighted real m2	Detached	Terraced House	Apartment	Semi-detached House	Weighted Index
01-10-1996	5,845	7,426	10,045	6,698	67.5	8,663.54	11,006.92	14,888.83	9,927.87	4,790	1,110	3,498	1,177	11,109.43	40	37	35	36	37.60
01-07-1996	5,696	7,438	9,453	6,583	68.0	8,376.47	10,938.24	13,901.47	9,680.88	5,440	1,263	3,392	1,331	10,451.78	39	37	33	36	36.29
01-04-1996	5,459	7,157	9,509	6,499	68.4	7,980.99	10,463.45	13,902.05	9,501.46	4,119	977	3,121	976	10,416.43	37	35	33	35	35.01
01-01-1996	5,348	6,881	9,131	6,378	68.8	7,769.49	9,996.61	13,265.38	9,265.86	2,931	737	2,387	787	10,098.88	36	34	31	34	33.75
01-10-1995	5,270	6,968	8,916	6,420	66.9	7,881.36	10,420.74	13,334.00	9,601.20	4,447	1,135	3,398	1,138	10,190.85	36	35	31	35	34.38
01-07-1995	5,197	6,661	8,635	6,062	67.3	7,718.32	9,892.57	12,824.26	9,002.97	4,928	1,226	3,231	1,223	9,672.89	36	33	30	33	33.36
01-04-1995	5,142	6,622	8,398	6,054	67.5	7,621.54	9,815.22	12,447.63	8,973.32	3,777	1,001	2,773	963	9,604.20	35	33	29	33	32.72
01-01-1995	5,063	6,665	8,354	5,847	67.6	7,485.95	9,854.61	12,351.90	8,645.15	2,713	722	2,398	750	9,650.33	35	33	29	32	32.04
01-10-1994	4,972	6,515	8,134	6,010	65.1	7,633.57	10,002.56	12,488.23	9,227.23	3,962	1,055	3,156	1,058	9,746.74	35	34	29	34	32.86
01-07-1994	4,892	6,563	8,406	5,830	65.6	7,461.11	10,009.66	12,820.54	8,891.71	4,616	1,160	2,986	1,051	9,546.42	34	34	30	33	32.82
01-04-1994	4,691	6,139	8,128	5,779	65.9	7,114.76	9,310.92	12,327.60	8,764.91	3,387	884	2,585	896	9,294.22	33	31	29	32	31.28
01-01-1994	4,529	5,953	7,858	5,327	66.2	6,841.39	8,992.45	11,870.09	8,046.83	2,567	693	2,004	660	8,928.46	32	30	28	30	29.93
01-10-1993	4,421	5,888	7,472	5,032	64.3	6,872.02	9,152.33	11,614.51	7,821.76	3,584	1,035	2,872	860	8,883.44	32	31	27	29	29.75
01-07-1993	4,312	5,666	6,951	4,948	64.9	6,640.66	8,725.87	10,704.83	7,620.12	4,173	960	2,503	833	8,174.52	31	29	25	28	28.60
01-04-1993	4,151	5,443	6,904	5,034	64.9	6,392.71	8,382.44	10,632.44	7,752.57	2,788	747	1,943	719	8,119.65	29	28	25	28	27.79
01-01-1993	4,158	5,635	6,837	4,776	65.1	6,390.37	8,660.35	10,507.68	7,340.16	1,981	530	1,727	485	8,248.16	29	29	25	27	27.42
01-10-1992	4,212	5,409	6,955	4,951	62.7	6,717.70	8,626.79	11,092.50	7,896.33	2,757	643	2,268	696	8,598.58	31	29	26	29	28.80
01-07-1992	4,265	5,461	7,134	5,151	63.4	6,727.13	8,613.56	11,252.37	8,124.61	2,902	749	1,914	676	8,492.70	31	29	26	30	29.24
01-04-1992	4,362	5,510	7,070	5,138	63.6	6,862.09	8,668.07	11,122.18	8,082.85	2,245	586	1,653	566	8,602.92	32	29	26	30	29.33
01-01-1992	4,355	5,834	7,163	5,218	63.8	6,826.02	9,144.20	11,227.27	8,178.68	1,763	563	1,678	451	8,913.67	31	31	26	30	29.31
01-10-1991	4,404	5,668	7,659	5,199	61.3	7,188.25	9,251.36	12,501.09	8,485.85	2,610	735	2,385	649	9,544.36	33	31	29	31	31.29
01-07-1991	4,455	5,823	7,744	5,213	61.9	7,197.09	9,407.11	12,510.50	8,421.65	2,142	629	1,894	549	9,522.75	33	32	29	31	31.38
01-04-1991	4,517	6,174	8,035	5,404	62.1	7,269.85	9,936.70	12,931.87	8,697.42	1,547	557	1,834	435	10,126.14	34	34	30	32	32.03
01-01-1991	5,046	6,242	8,003	5,586	62.4	8,086.54	10,003.21	12,825.32	8,951.92	1,103	428	1,580	371	10,564.62	37	34	30	33	33.11
01-10-1990	5,153	6,267	8,359	5,747	59.0	8,738.84	10,628.04	14,175.81	9,746.18	1,545	623	2,197	481	11,546.62	40	36	33	36	36.08
01-07-1990	5,322	6,480	8,713	5,817	59.6	8,924.54	10,866.41	14,610.96	9,754.61	1,272	509	1,959	416	11,925.84	41	37	34	36	36.82
01-04-1990	5,719	6,547	8,696	6,397	60.0	9,526.37	10,905.61	14,485.29	10,655.75	888	418	1,536	320	12,231.88	44	37	34	39	37.66
01-01-1990	5,518	6,416	8,130	6,242	60.8	9,070.68	10,546.85	13,364.38	10,260.82	653	325	696	270	11,020.02	42	36	31	38	36.45

Appendix 2: Real house prices and HP-calculation

Date	Real house prices	HP-Filter	Cyclical component house prices
01-10-2017	37,241.18	38,334.41	-1,093.23
01-07-2017	37,419.16	38,003.47	-584.31
01-04-2017	38,325.36	37,671.84	653.52
01-01-2017	38,918.84	37,338.49	1,580.36
01-10-2016	38,337.59	37,002.76	1,334.83
01-07-2016	37,151.07	36,665.01	486.07
01-04-2016	36,183.97	36,326.41	-142.45
01-01-2016	34,944.49	35,988.46	-1,043.97
01-10-2015	34,933.27	35,652.55	-719.28
01-07-2015	35,264.21	35,319.43	-55.22
01-04-2015	35,346.61	34,989.38	357.23
01-01-2015	34,813.75	34,662.67	151.08
01-10-2014	33,303.43	34,339.79	-1,036.36
01-07-2014	33,620.52	34,021.31	-400.78
01-04-2014	32,898.50	33,707.16	-808.66
01-01-2014	32,367.28	33,397.02	-1,029.74
01-10-2013	32,276.60	33,090.06	-813.47
01-07-2013	33,206.66	32,784.82	421.84
01-04-2013	33,769.20	32,479.32	1,289.87
01-01-2013	33,878.61	32,171.85	1,706.77
01-10-2012	32,379.46	31,861.48	517.97
01-07-2012	32,317.00	31,548.40	768.60
01-04-2012	32,444.25	31,233.07	1,211.18
01-01-2012	32,015.84	30,916.46	1,099.38
01-10-2011	30,074.58	30,600.29	-525.71
01-07-2011	29,757.36	30,286.97	-529.61
01-04-2011	29,871.96	29,978.58	-106.62
01-01-2011	30,134.30	29,676.86	457.44
01-10-2010	28,270.99	29,383.49	-1,112.50
01-07-2010	28,109.76	29,100.44	-990.68
01-04-2010	28,329.47	28,828.99	-499.52
01-01-2010	27,788.03	28,569.78	-781.75
01-10-2009	27,424.83	28,323.15	-898.33
01-07-2009	26,968.41	28,088.96	-1,120.55
01-04-2009	26,463.96	27,866.50	-1,402.54
01-01-2009	25,681.33	27,654.35	-1,973.02

Date	Real house prices	HP-Filter	Cyclical component house prices
01-10-2008	25,289.51	27,450.23	-2,160.71
01-07-2008	26,376.42	27,250.61	-874.20
01-04-2008	27,140.07	27,050.64	89.43
01-01-2008	27,299.18	26,844.88	454.29
01-10-2007	28,368.41	26,627.99	1,740.42
01-07-2007	28,295.96	26,394.88	1,901.09
01-04-2007	28,853.91	26,141.56	2,712.35
01-01-2007	28,315.85	25,865.23	2,450.62
01-10-2006	27,535.53	25,564.79	1,970.73
01-07-2006	26,346.47	25,240.67	1,105.80
01-04-2006	25,616.32	24,894.51	721.81
01-01-2006	25,070.43	24,528.67	541.77
01-10-2005	24,397.62	24,145.94	251.68
01-07-2005	23,237.55	23,749.48	-511.93
01-04-2005	22,966.20	23,342.56	-376.36
01-01-2005	22,760.17	22,928.17	-168.00
01-10-2004	22,338.84	22,509.05	-170.21
01-07-2004	21,215.68	22,087.83	-872.15
01-04-2004	20,974.56	21,667.04	-692.49
01-01-2004	21,095.03	21,248.67	-153.65
01-10-2003	19,835.36	20,834.27	-998.91
01-07-2003	19,052.70	20,425.29	-1,372.59
01-04-2003	18,776.65	20,022.56	-1,245.90
01-01-2003	19,308.78	19,626.05	-317.28
01-10-2002	19,221.47	19,234.97	-13.50
01-07-2002	18,828.88	18,848.30	-19.41
01-04-2002	19,105.37	18,465.03	640.34
01-01-2002	18,735.78	18,084.14	651.64
01-10-2001	17,973.23	17,705.01	268.22
01-07-2001	16,823.65	17,327.41	-503.76
01-04-2001	16,885.57	16,951.30	-65.73
01-01-2001	17,946.81	16,576.31	1,370.49
01-10-2000	16,336.57	16,202.04	134.53
01-07-2000	15,973.54	15,828.94	144.60
01-04-2000	16,014.62	15,457.54	557.08
01-01-2000	15,321.65	15,088.47	233.18

Date	Real house prices	HP-Filter	Cyclical component house prices
01-10-1999	15,088.30	14,722.71	365.59
01-07-1999	13,957.50	14,361.36	-403.86
01-04-1999	13,771.34	14,005.79	-234.45
01-01-1999	12,938.75	13,657.08	-718.33
01-10-1998	13,066.97	13,316.19	-249.22
01-07-1998	13,197.26	12,983.61	213.65
01-04-1998	12,854.64	12,659.69	194.95
01-01-1998	12,403.56	12,344.91	58.65
01-10-1997	12,271.92	12,039.86	232.06
01-07-1997	11,808.60	11,745.19	63.41
01-04-1997	11,601.48	11,461.67	139.81
01-01-1997	11,117.31	11,190.13	-72.82
01-10-1996	11,109.43	10,931.47	177.97
01-07-1996	10,451.78	10,686.55	-234.78
01-04-1996	10,416.43	10,456.36	-39.93
01-01-1996	10,098.88	10,241.72	-142.83
01-10-1995	10,190.85	10,043.42	147.43
01-07-1995	9,672.89	9,862.19	-189.31
01-04-1995	9,604.20	9,698.83	-94.63
01-01-1995	9,650.33	9,554.02	96.31
01-10-1994	9,746.74	9,428.40	318.34
01-07-1994	9,546.42	9,322.65	223.77
01-04-1994	9,294.22	9,237.65	56.57
01-01-1994	8,928.46	9,174.44	-245.99
01-10-1993	8,883.44	9,134.08	-250.65
01-07-1993	8,174.52	9,117.48	-942.95
01-04-1993	8,119.65	9,125.38	-1,005.73
01-01-1993	8,248.16	9,157.95	-909.79
01-10-1992	8,598.58	9,214.73	-616.14
01-07-1992	8,492.70	9,294.67	-801.97
01-04-1992	8,602.92	9,396.37	-793.45
01-01-1992	8,913.67	9,517.89	-604.22
01-10-1991	9,544.36	9,656.82	-112.46
01-07-1991	9,522.75	9,810.37	-287.62
01-04-1991	10,126.14	9,975.68	150.47
01-01-1991	10,564.62	10,149.68	414.93
01-10-1990	11,546.62	10,329.45	1,217.17
01-07-1990	11,925.84	10,512.28	1,413.56
01-04-1990	12,231.88	10,696.24	1,535.64
01-01-1990	11,020.02	10,880.30	139.72

Appendix 3: Real house prices and HP-calculation for Oslo and Stavanger

Lambda =1600

Date	Stavanger, m2 real house prices	Oslo, m2 real house prices	Trend Stavanger	Trend Oslo	Cyclical movements, Stavanger	Cyclical movements, Oslo
01-01-1991	7,392.63	9,988.78	6,779.57	8,723.97	613.06	1,264.82
01-04-1991	7,599.79	10,192.60	6,861.97	8,831.93	737.82	1,360.66
01-07-1991	6,756.06	9,405.49	6,944.75	8,940.69	-188.69	464.80
01-10-1991	7,416.76	9,177.91	7,028.76	9,051.88	388.00	126.03
01-01-1992	6,597.18	9,960.82	7,114.72	9,167.44	-517.54	793.38
01-04-1992	6,947.04	9,772.42	7,203.61	9,289.36	-256.57	483.05
01-07-1992	7,173.50	9,465.30	7,296.06	9,420.17	-122.56	45.13
01-10-1992	7,194.58	8,393.94	7,392.56	9,562.66	-197.99	-1,168.72
01-01-1993	6,640.88	8,157.79	7,493.53	9,719.68	-852.65	-1,561.89
01-04-1993	7,556.98	8,507.19	7,599.25	9,893.32	-42.26	-1,386.14
01-07-1993	7,669.40	9,080.08	7,709.46	10,084.73	-40.05	-1,004.64
01-10-1993	8,058.03	9,923.32	7,823.89	10,294.15	234.14	-370.83
01-01-1994	8,291.54	10,291.54	7,942.25	10,521.23	349.29	-229.69
01-04-1994	8,889.28	11,132.46	8,064.38	10,765.37	824.90	367.08
01-07-1994	8,421.96	12,019.83	8,190.35	11,025.84	231.62	993.99
01-10-1994	8,213.92	12,280.96	8,320.73	11,302.11	-106.81	978.85
01-01-1995	8,309.51	10,830.46	8,456.25	11,594.30	-146.74	-763.84
01-04-1995	8,101.78	11,319.66	8,597.57	11,903.14	-495.79	-583.47
01-07-1995	8,495.05	12,199.01	8,745.26	12,228.86	-250.21	-29.85
01-10-1995	8,947.66	12,142.07	8,899.57	12,571.35	48.09	-429.28
01-01-1996	8,365.13	11,199.52	9,060.61	12,930.48	-695.48	-1,730.96
01-04-1996	9,192.98	13,102.34	9,228.50	13,305.82	-35.52	-203.48
01-07-1996	9,233.82	13,120.59	9,402.94	13,695.90	-169.12	-575.31
01-10-1996	10,067.19	13,792.00	9,583.61	14,099.10	483.58	-307.10
01-01-1997	9,322.60	14,755.57	9,770.07	14,513.44	-447.47	242.12
01-04-1997	10,066.22	15,357.31	9,962.19	14,936.76	104.03	420.55
01-07-1997	10,331.74	14,901.19	10,159.57	15,367.04	172.17	-465.85
01-10-1997	9,790.99	15,487.54	10,361.86	15,802.53	-570.87	-315.00
01-01-1998	11,248.61	17,694.44	10,568.82	16,241.18	679.80	1,453.26
01-04-1998	10,979.97	18,173.27	10,779.85	16,680.76	200.12	1,492.50
01-07-1998	11,133.05	16,505.60	10,994.80	17,119.93	138.25	-614.32
01-10-1998	11,170.81	17,403.10	11,213.62	17,558.28	-42.81	-155.18
01-01-1999	11,149.23	17,007.21	11,436.34	17,995.04	-287.11	-987.83
01-04-1999	11,746.69	18,980.37	11,663.00	18,429.33	83.70	551.04
01-07-1999	12,776.31	18,460.59	11,893.41	18,859.65	882.90	-399.05
01-10-1999	12,983.02	20,143.64	12,127.47	19,284.83	855.55	858.81
01-01-2000	13,143.86	20,087.01	12,365.63	19,703.49	778.22	383.52
01-04-2000	13,707.86	23,052.07	12,608.86	20,114.75	1,099.00	2,937.32
01-07-2000	13,318.73	20,629.48	12,858.61	20,517.99	460.11	111.49
01-10-2000	13,320.70	20,943.80	13,117.05	20,914.42	203.65	29.38
01-01-2001	12,771.54	21,784.40	13,386.59	21,305.31	-615.06	479.09
01-04-2001	13,092.08	21,848.11	13,669.82	21,691.96	-577.74	156.15
01-07-2001	14,095.40	21,356.47	13,968.90	22,075.97	126.50	-719.49
01-10-2001	13,169.75	21,827.23	14,285.66	22,459.03	-1,115.91	-631.80

Lambda =1600

Date	Stavanger, m2 real house prices	Oslo, m2 real house prices	Trend Stavanger	Trend Oslo	Cyclical movements, Stavanger	Cyclical movements, Oslo
01-01-2002	14,743.40	24,675.47	14,621.99	22,842.39	121.40	1,833.09
01-04-2002	15,577.85	25,299.53	14,979.10	23,226.89	598.75	2,072.64
01-07-2002	15,803.73	24,666.38	15,358.25	23,614.54	445.48	1,051.85
01-10-2002	15,373.56	23,806.82	15,761.10	24,008.61	-387.54	-201.79
01-01-2003	15,637.53	23,445.73	16,189.58	24,413.07	-552.05	-967.34
01-04-2003	15,754.37	23,602.83	16,645.37	24,831.73	-890.99	-1,228.90
01-07-2003	15,962.69	23,334.58	17,129.81	25,267.81	-1,167.12	-1,933.23
01-10-2003	15,851.20	23,461.88	17,643.68	25,723.76	-1,792.48	-2,261.87
01-01-2004	17,354.34	25,409.17	18,187.05	26,200.81	-832.72	-791.65
01-04-2004	17,519.95	25,621.55	18,758.85	26,698.81	-1,238.90	-1,077.25
01-07-2004	18,536.60	26,093.34	19,357.49	27,217.07	-820.89	-1,123.73
01-10-2004	19,584.37	26,766.75	19,980.60	27,754.26	-396.24	-987.51
01-01-2005	19,519.89	26,391.32	20,625.33	28,308.34	-1,105.44	-1,917.02
01-04-2005	19,940.18	28,677.04	21,288.53	28,876.64	-1,348.36	-199.60
01-07-2005	20,252.73	29,716.89	21,966.41	29,455.31	-1,713.68	261.58
01-10-2005	21,820.64	29,057.74	22,654.31	30,040.37	-833.67	-982.63
01-01-2006	22,057.65	29,617.65	23,346.51	30,627.98	-1,288.86	-1,010.34
01-04-2006	24,946.62	32,294.19	24,036.74	31,213.73	909.88	1,080.46
01-07-2006	26,329.51	33,464.00	24,717.97	31,792.54	1,611.53	1,671.46
01-10-2006	27,081.70	33,594.71	25,383.72	32,360.03	1,697.98	1,234.68
01-01-2007	28,818.57	34,196.52	26,028.49	32,912.85	2,790.08	1,283.67
01-04-2007	29,861.43	38,000.39	26,647.88	33,448.42	3,213.54	4,551.98
01-07-2007	30,644.72	37,143.93	27,239.22	33,964.98	3,405.49	3,178.95
01-10-2007	31,614.20	36,327.12	27,801.85	34,463.59	3,812.35	1,863.53
01-01-2008	29,041.84	35,945.09	28,337.22	34,947.33	704.62	997.76
01-04-2008	28,286.20	35,031.67	28,849.19	35,420.40	-562.99	-388.73
01-07-2008	29,117.65	34,380.83	29,342.05	35,887.67	-224.40	-1,506.85
01-10-2008	26,060.13	32,621.98	29,819.73	36,353.74	-3,759.60	-3,731.76
01-01-2009	27,879.56	33,771.27	30,286.03	36,822.27	-2,406.47	-3,051.00
01-04-2009	28,856.67	35,877.78	30,742.39	37,294.60	-1,885.72	-1,416.82
01-07-2009	27,804.44	37,585.56	31,188.76	37,770.14	-3,384.32	-184.59
01-10-2009	33,010.09	38,029.91	31,623.91	38,247.45	1,386.19	-217.54
01-01-2010	31,914.30	39,373.78	32,044.47	38,724.93	-130.18	648.85
01-04-2010	32,114.18	39,412.36	32,447.98	39,200.89	-333.80	211.48
01-07-2010	31,934.30	40,932.13	32,831.85	39,674.01	-897.56	1,258.12
01-10-2010	31,594.77	38,986.93	33,193.32	40,143.11	-1,598.55	-1,156.19

Lambda =1600

Date	Stavanger, m2 real house prices	Oslo, m2 real house prices	Trend Stavanger	Trend Oslo	Cyclical movements, Stavanger	Cyclical movements, Oslo
01-01-2011	33,903.21	41,208.21	33,529.05	40,607.82	374.16	600.39
01-04-2011	34,514.51	42,382.66	33,834.71	41,067.02	679.80	1,315.63
01-07-2011	34,860.85	42,646.98	34,106.19	41,519.98	754.66	1,127.00
01-10-2011	33,186.96	41,643.27	34,339.82	41,966.78	-1,152.86	-323.51
01-01-2012	36,536.70	43,735.00	34,532.39	42,408.21	2,004.31	1,326.79
01-04-2012	35,650.84	45,279.54	34,679.98	42,844.86	970.86	2,434.68
01-07-2012	37,041.12	44,470.40	34,779.92	43,278.16	2,261.20	1,192.24
01-10-2012	36,418.83	43,896.98	34,830.14	43,711.03	1,588.69	185.95
01-01-2013	36,659.19	44,652.29	34,829.99	44,147.17	1,829.20	505.12
01-04-2013	35,018.37	46,542.11	34,779.81	44,590.38	238.56	1,951.73
01-07-2013	36,551.81	45,044.85	34,681.08	45,044.78	1,870.72	0.08
01-10-2013	35,733.68	43,751.58	34,535.44	45,515.69	1,198.24	-1,764.11
01-01-2014	34,256.59	43,506.09	34,345.69	46,008.47	-89.10	-2,502.38
01-04-2014	35,235.49	45,466.24	34,115.38	46,527.33	1,120.11	-1,061.09
01-07-2014	34,896.25	46,005.46	33,848.01	47,074.96	1,048.24	-1,069.50
01-10-2014	34,244.33	45,758.76	33,547.76	47,653.36	696.57	-1,894.60
01-01-2015	33,435.36	45,992.41	33,219.50	48,263.87	215.86	-2,271.45
01-04-2015	33,605.79	46,991.02	32,868.51	48,906.64	737.28	-1,915.62
01-07-2015	32,163.61	48,403.67	32,500.20	49,580.41	-336.59	-1,176.74
01-10-2015	31,045.50	49,136.50	32,120.47	50,282.72	-1,074.97	-1,146.22
01-01-2016	28,242.99	48,660.19	31,734.97	51,010.36	-3,491.98	-2,350.17
01-04-2016	29,224.57	49,692.90	31,348.72	51,759.43	-2,124.16	-2,066.53
01-07-2016	27,773.48	54,723.14	30,964.53	52,524.54	-3,191.06	2,198.59
01-10-2016	30,340.08	55,639.66	30,583.89	53,299.02	-243.80	2,340.64
01-01-2017	30,256.44	57,768.38	30,206.29	54,077.57	50.15	3,690.82
01-04-2017	29,080.05	57,415.06	29,831.07	54,856.34	-751.02	2,558.72
01-07-2017	30,146.97	57,497.79	29,457.62	55,633.82	689.35	1,863.97
01-10-2017	30,148.09	54,436.62	29,084.83	56,410.05	1,063.26	-1,973.43

Appendix 4: Houses under Construction and HP-calculation

Date	Houses under construction	HP-Trend	Cyclical changes	Cyclical changes, house prices
01-01-1993	13740	13650.28707	89.71292969	-909.7919393
01-04-1993	13188	13904.42124	-716.4212392	-1005.725015
01-07-1993	13642	14158.61148	-516.6114787	-942.9531514
01-10-1993	13936	14412.4661	-476.466096	-250.6470518
01-01-1994	14006	14665.27052	-659.2705164	-245.9860745
01-04-1994	14778	14916.01237	-138.0123737	56.56522642
01-07-1994	16147	15163.26726	983.7327425	223.7722696
01-10-1994	16920	15405.5245	1514.4755	318.3433813
01-01-1995	16265	15641.88827	623.1117341	96.30939874
01-04-1995	16127	15872.40927	254.5907323	-94.62653851
01-07-1995	16797	16097.52766	699.4723378	-189.3056105
01-10-1995	17422	16317.84273	1104.157274	147.4269579
01-01-1996	16068	16534.3909	-466.3909046	-142.8331733
01-04-1996	16153	16748.89874	-595.8987436	-39.93421923
01-07-1996	17299	16962.80129	336.198707	-234.7752333
01-10-1996	17785	17177.16117	607.8388333	177.965544
01-01-1997	17304	17393.2511	-89.25110247	-72.81542505
01-04-1997	17508	17612.72374	-104.7237374	139.8125304
01-07-1997	18927	17837.17593	1089.824073	63.41130259
01-10-1997	19620	18068.13907	1551.860926	232.055535
01-01-1998	18932	18307.82572	624.1742795	58.65121045
01-04-1998	18915	18559.41832	355.5816764	194.9503133
01-07-1998	18801	18826.48945	-25.48944791	213.6537012
01-10-1998	18759	19112.8339	-353.8338968	-249.2216404
01-01-1999	17745	19422.23054	-1677.230543	-718.3310481
01-04-1999	18007	19758.23711	-1751.237113	-234.4482664
01-07-1999	18361	20123.36306	-1762.363063	-403.8606526
01-10-1999	18664	20519.02333	-1855.023329	365.5885834
01-01-2000	19271	20945.53137	-1674.531366	233.1792049
01-04-2000	19855	21402.04124	-1547.041244	557.0796998
01-07-2000	20890	21886.66045	-996.6604462	144.6004842
01-10-2000	22698	22396.52956	301.4704413	134.530154
01-01-2001	22567	22928.16625	-361.1662532	1370.493488
01-04-2001	23742	23478.27662	263.7233795	-65.73079017
01-07-2001	24892	24043.34102	848.6589773	-503.7556473
01-10-2001	25781	24620.00465	1160.995351	268.2177528
01-01-2002	25920	25205.4431	714.5568995	651.6397509
01-04-2002	26367	25797.5576	569.4423998	640.341519
01-07-2002	26666	26394.69597	271.3040306	-19.41336059
01-10-2002	27156	26995.56193	160.4380693	-13.49840862
01-01-2003	27016	27599.02877	-583.0287718	-317.2750892
01-04-2003	27585	28204.07005	-619.0700543	-1245.90195
01-07-2003	27954	28809.29495	-855.2949466	-1372.588123
01-10-2003	28182	29412.9257	-1230.925699	-998.9078747
01-01-2004	27929	30012.65	-2083.65	-153.6460665
01-04-2004	29347	30605.38621	-1258.386214	-692.4883024
01-07-2004	31205	31186.75042	18.24957963	-872.1539397
01-10-2004	33468	31751.57221	1716.427792	-170.2144785
01-01-2005	32899	32294.69257	604.3074274	-168.0012502
01-04-2005	33863	32812.02528	1050.974724	-376.3563952
01-07-2005	33214	33299.86177	-85.86177437	-511.928351
01-10-2005	33985	33755.15038	229.8496198	251.6799329

Date	Houses under construction	HP-Trend	Cyclical changes	Cyclical changes, house prices
01-01-2006	34436	34174.78574	261.2142558	541.7661023
01-04-2006	35231	34555.80617	675.1938272	721.8095922
01-07-2006	36475	34895.41323	1579.586769	1105.800657
01-10-2006	37285	35191.23048	2093.76952	1970.733258
01-01-2007	37628	35441.86872	2186.131276	2450.615226
01-04-2007	38725	35647.24737	3077.752629	2712.347428
01-07-2007	38869	35808.65216	3060.347838	1901.086045
01-10-2007	39150	35929.29243	3220.707566	1740.4157
01-01-2008	38491	36014.29024	2476.70976	454.293655
01-04-2008	37702	36070.78058	1631.219423	89.42751311
01-07-2008	36412	36107.44639	304.553615	-874.1978184
01-10-2008	35832	36133.99011	-301.990115	-2160.71352
01-01-2009	34810	36160.30457	-1350.304565	-1973.021065
01-04-2009	34008	36196.09379	-2188.093789	-1402.538401
01-07-2009	33365	36250.2179	-2885.217901	-1120.547694
01-10-2009	33464	36330.16946	-2866.169456	-898.3261224
01-01-2010	33921	36441.63775	-2520.637748	-781.7489981
01-04-2010	33769	36588.52071	-2819.520715	-499.5210739
01-07-2010	32276	36773.1409	-4497.140895	-990.6833374
01-10-2010	33114	36996.05863	-3882.058629	-1112.497421
01-01-2011	34631	37255.02354	-2624.023541	457.4374778
01-04-2011	37300	37545.35897	-245.3589718	-106.6223957
01-07-2011	38212	37860.74824	351.251755	-529.6099837
01-10-2011	39499	38194.72134	1304.278664	-525.7149072
01-01-2012	40049	38541.02775	1507.972248	1099.37505
01-04-2012	41271	38894.23218	2376.767825	1211.184043
01-07-2012	41649	39249.84177	2399.158231	768.5983451
01-10-2012	41849	39604.84918	2244.150821	517.9713506
01-01-2013	42455	39957.74652	2497.253478	1706.767183
01-04-2013	42998	40308.42851	2689.571489	1289.874155
01-07-2013	42389	40658.35064	1730.649358	421.8350549
01-10-2013	42425	41010.64939	1414.350608	-813.4664773
01-01-2014	41447	41369.5429	77.45710385	-1029.74108
01-04-2014	41829	41740.13326	88.86674366	-808.6581284
01-07-2014	41609	42127.57099	-518.5709865	-400.7845704
01-10-2014	40705	42537.06214	-1832.062142	-1036.357943
01-01-2015	40262	42973.48867	-2711.488672	151.080705
01-04-2015	40827	43440.58748	-2613.587484	357.2311117
01-07-2015	40715	43940.40081	-3225.40081	-55.21570189
01-10-2015	42364	44473.33739	-2109.337386	-719.2798179
01-01-2016	42267	45037.79007	-2770.790072	-1043.970477
01-04-2016	44134	45630.8334	-1496.833396	-142.4450638
01-07-2016	45968	46247.81014	-279.8101385	486.0692898
01-10-2016	47829	46883.12756	945.8724391	1334.828008
01-01-2017	49352	47531.01804	1820.981957	1580.359101
01-04-2017	50571	48186.30513	2384.694866	653.5184082
01-07-2017	51625	48844.9505	2780.049501	-584.311488
01-10-2017	50801	49504.40623	1296.593765	-1093.22784

Appendix 5: Business cycle, GDP and HP-calculation

Date	Real GDP Mainland Norway	HP-trend	Cyclical component GDP
01-10-2017	680,721.00	679,015.64	1,705.36
01-07-2017	676,709.00	676,371.10	337.90
01-04-2017	671,798.00	673,727.63	-1,929.63
01-01-2017	667,559.00	671,086.50	-3,527.50
01-10-2016	663,328.00	668,447.78	-5,119.78
01-07-2016	662,128.00	665,809.35	-3,681.35
01-04-2016	661,617.00	663,165.86	-1,548.86
01-01-2016	658,817.00	660,509.69	-1,692.69
01-10-2015	656,089.00	657,832.22	-1,743.22
01-07-2015	656,967.00	655,123.81	1,843.19
01-04-2015	655,947.00	652,373.69	3,573.31
01-01-2015	653,984.00	649,572.28	4,411.72
01-10-2014	652,129.00	646,712.20	5,416.80
01-07-2014	648,151.00	643,788.85	4,362.15
01-04-2014	646,669.00	640,801.02	5,867.98
01-01-2014	640,602.00	637,750.19	2,851.81
01-10-2013	639,384.00	634,641.55	4,742.45
01-07-2013	634,578.00	631,482.05	3,095.95
01-04-2013	628,429.00	628,281.61	147.39
01-01-2013	628,283.00	625,052.08	3,230.92
01-10-2012	623,758.00	621,805.41	1,952.59
01-07-2012	619,244.00	618,555.56	688.44
01-04-2012	615,039.00	615,317.71	-278.71
01-01-2012	613,469.00	612,107.49	1,361.51
01-10-2011	602,175.00	608,940.34	-6,765.34
01-07-2011	598,065.00	605,832.54	-7,767.54
01-04-2011	595,188.00	602,796.16	-7,608.16
01-01-2011	590,561.00	599,838.42	-9,277.42
01-10-2010	585,203.00	596,961.75	-11,758.75
01-07-2010	586,214.00	594,162.83	-7,948.83
01-04-2010	583,766.00	591,430.95	-7,664.95
01-01-2010	585,423.00	588,750.46	-3,327.46
01-10-2009	576,276.00	586,100.90	-9,824.90
01-07-2009	572,394.00	583,459.75	-11,065.75
01-04-2009	574,110.00	580,798.32	-6,688.32
01-01-2009	573,320.00	578,081.03	-4,761.03

Date	Real GDP Mainland Norway	HP-trend	Cyclical component GDP
01-10-2008	575,873.00	575,268.12	604.88
01-07-2008	589,168.00	572,316.83	16,851.17
01-04-2008	587,082.00	569,184.81	17,897.19
01-01-2008	578,849.00	565,840.21	13,008.79
01-10-2007	583,113.00	562,262.39	20,850.61
01-07-2007	579,561.00	558,438.84	21,122.16
01-04-2007	565,608.00	554,370.06	11,237.94
01-01-2007	563,621.00	550,069.77	13,551.23
01-10-2006	556,840.00	545,558.71	11,281.29
01-07-2006	541,254.00	540,866.08	387.92
01-04-2006	537,980.00	536,028.15	1,951.85
01-01-2006	531,407.00	531,081.42	325.58
01-10-2005	526,621.00	526,063.61	557.39
01-07-2005	517,039.00	521,012.65	-3,973.65
01-04-2005	516,617.00	515,966.80	650.20
01-01-2005	503,012.00	510,961.85	-7,949.85
01-10-2004	500,906.00	506,034.01	-5,128.01
01-07-2004	495,979.00	501,214.51	-5,235.51
01-04-2004	488,865.00	496,531.35	-7,666.35
01-01-2004	485,315.00	492,009.30	-6,694.30
01-10-2003	471,829.00	487,668.31	-15,839.31
01-07-2003	473,694.00	483,524.16	-9,830.16
01-04-2003	466,734.00	479,582.72	-12,848.72
01-01-2003	465,070.00	475,843.72	-10,773.72
01-10-2002	462,610.00	472,298.87	-9,688.87
01-07-2002	466,650.00	468,933.14	-2,283.14
01-04-2002	465,081.00	465,725.42	-644.42
01-01-2002	460,775.00	462,653.22	-1,878.22
01-10-2001	459,821.00	459,693.61	127.39
01-07-2001	453,204.00	456,822.49	-3,618.49
01-04-2001	455,303.00	454,015.87	1,287.13
01-01-2001	459,190.00	451,247.46	7,942.54
01-10-2000	450,443.00	448,491.79	1,951.21
01-07-2000	449,328.00	445,728.36	3,599.64
01-04-2000	445,405.00	442,937.89	2,467.11
01-01-2000	448,789.00	440,103.33	8,685.67

Date	Real GDP Mainland Norway	HP-trend	Cyclical component GDP
01-10-1999	441,719.00	437,209.20	4,509.80
01-07-1999	438,089.00	434,245.43	3,843.57
01-04-1999	431,502.00	431,204.77	297.23
01-01-1999	428,939.00	428,082.38	856.62
01-10-1998	429,673.00	424,873.60	4,799.40
01-07-1998	427,031.00	421,574.30	5,456.70
01-04-1998	424,175.00	418,183.37	5,991.63
01-01-1998	419,230.00	414,703.08	4,526.92
01-10-1997	419,709.00	411,139.47	8,569.53
01-07-1997	412,578.00	407,501.41	5,076.59
01-04-1997	410,955.00	403,803.10	7,151.90
01-01-1997	393,934.00	400,061.94	-6,127.94
01-10-1996	392,634.00	396,299.79	-3,665.79
01-07-1996	391,755.00	392,534.67	-779.67
01-04-1996	384,578.00	388,782.33	-4,204.33
01-01-1996	387,796.00	385,058.02	2,737.98
01-10-1995	376,373.00	381,374.35	-5,001.35
01-07-1995	377,533.00	377,745.67	-212.67
01-04-1995	371,022.00	374,183.18	-3,161.18
01-01-1995	370,842.00	370,697.97	144.03
01-10-1994	366,912.00	367,299.12	-387.12
01-07-1994	362,313.00	363,995.83	-1,682.83
01-04-1994	361,953.00	360,797.05	1,155.95
01-01-1994	355,941.00	357,710.68	-1,769.68
01-10-1993	357,603.00	354,745.32	2,857.68
01-07-1993	348,184.00	351,908.51	-3,724.51
01-04-1993	346,017.00	349,209.53	-3,192.53
01-01-1993	344,527.00	346,655.36	-2,128.36
01-10-1992	343,382.00	344,250.97	-868.97
01-07-1992	340,471.00	342,000.01	-1,529.01
01-04-1992	339,097.00	339,905.58	-808.58
01-01-1992	338,656.00	337,969.83	686.17
01-10-1991	330,845.00	336,194.40	-5,349.40
01-07-1991	333,054.00	334,581.36	-1,527.36
01-04-1991	330,903.00	333,129.43	-2,226.43
01-01-1991	330,452.00	331,836.39	-1,384.39
01-10-1990	327,913.00	330,698.63	-2,785.63
01-07-1990	325,121.00	329,711.65	-4,590.65
01-04-1990	325,393.00	328,869.23	-3,476.23
01-01-1990	326,832.00	328,162.27	-1,330.27

Appendix 6: oil prices and HP-calculations

Start date	Real oil prices, $ per barrel	HP-filter	Cyclical component oil price
01-10-2017	58.40	38.28	20.12
01-07-2017	48.66	41.71	6.95
01-04-2017	47.31	45.15	2.16
01-01-2017	50.79	48.62	2.16
01-10-2016	47.76	52.15	-4.39
01-07-2016	44.37	55.73	-11.37
01-04-2016	43.13	59.41	-16.28
01-01-2016	32.28	63.17	-30.89
01-10-2015	44.65	67.03	-22.38
01-07-2015	51.17	70.97	-19.80
01-04-2015	61.11	74.94	-13.83
01-01-2015	53.51	78.91	-25.40
01-10-2014	81.02	82.82	-1.80
01-07-2014	105.44	86.60	18.85
01-04-2014	111.30	90.17	21.13
01-01-2014	110.00	93.48	16.52
01-10-2013	114.87	96.48	18.38
01-07-2013	114.65	99.14	15.51
01-04-2013	107.06	101.43	5.63
01-01-2013	116.58	103.33	13.26
01-10-2012	117.36	104.83	12.54
01-07-2012	115.33	105.93	9.40
01-04-2012	118.30	106.63	11.67
01-01-2012	124.38	106.95	17.43
01-10-2011	117.47	106.90	10.57
01-07-2011	121.16	106.51	14.65
01-04-2011	126.66	105.81	20.85
01-01-2011	111.03	104.85	6.17
01-10-2010	93.26	103.69	-10.43
01-07-2010	82.93	102.39	-19.45
01-04-2010	85.82	100.99	-15.17
01-01-2010	82.24	99.56	-17.32
01-10-2009	82.89	98.11	-15.21
01-07-2009	76.02	96.67	-20.64
01-04-2009	64.03	95.25	-31.22
01-01-2009	47.96	93.85	-45.89

Start date	Real oil prices, $ per barrel	HP-filter	Cyclical component oil price
01-10-2008	66.95	92.46	-25.51
01-07-2008	134.01	91.02	43.00
01-04-2008	135.06	89.47	45.59
01-01-2008	108.09	87.77	20.32
01-10-2007	104.37	85.91	18.46
01-07-2007	88.06	83.91	4.15
01-04-2007	80.86	81.76	-0.90
01-01-2007	66.55	79.49	-12.94
01-10-2006	71.54	77.12	-5.58
01-07-2006	83.56	74.66	8.91
01-04-2006	81.92	72.11	9.82
01-01-2006	72.15	69.48	2.67
01-10-2005	70.25	66.79	3.47
01-07-2005	74.31	64.06	10.26
01-04-2005	62.24	61.31	0.93
01-01-2005	56.54	58.57	-2.02
01-10-2004	55.32	55.86	-0.54
01-07-2004	50.03	53.22	-3.19
01-04-2004	43.68	50.67	-6.99
01-01-2004	38.91	48.24	-9.32
01-10-2003	35.74	45.93	-10.19
01-07-2003	35.41	43.78	-8.37
01-04-2003	32.64	41.79	-9.14
01-01-2003	39.47	39.95	-0.49
01-10-2002	34.15	38.27	-4.12
01-07-2002	33.93	36.75	-2.82
01-04-2002	31.83	35.37	-3.55
01-01-2002	26.12	34.14	-8.02
01-10-2001	25.16	33.03	-7.88
01-07-2001	32.82	32.05	0.77
01-04-2001	35.02	31.15	3.87
01-01-2001	33.15	30.34	2.81
01-10-2000	40.24	29.58	10.66
01-07-2000	40.93	28.87	12.06
01-04-2000	34.93	28.20	6.73
01-01-2000	35.33	27.56	7.77

Start date	Real oil prices, $ per barrel	HP-filter	Cyclical component oil price
01-10-1999	32.90	26.97	5.93
01-07-1999	27.60	26.42	1.19
01-04-1999	20.98	25.93	-4.95
01-01-1999	14.95	25.51	-10.55
01-10-1998	16.12	25.17	-9.05
01-07-1998	17.23	24.92	-7.69
01-04-1998	18.86	24.75	-5.89
01-01-1998	19.81	24.66	-4.85
01-10-1997	27.21	24.62	2.59
01-07-1997	26.37	24.64	1.73
01-04-1997	25.88	24.69	1.19
01-01-1997	30.60	24.77	5.83
01-10-1996	34.88	24.87	10.01
01-07-1996	30.35	24.97	5.38
01-04-1996	28.74	25.07	3.67
01-01-1996	26.77	25.19	1.59
01-10-1995	25.19	25.32	-0.13
01-07-1995	24.12	25.46	-1.35
01-04-1995	26.92	25.64	1.28
01-01-1995	24.81	25.84	-1.03
01-10-1994	25.41	26.08	-0.66
01-07-1994	25.67	26.36	-0.69
01-04-1994	23.93	26.68	-2.75
01-01-1994	21.09	27.05	-5.96
01-10-1993	23.89	27.48	-3.59
01-07-1993	25.47	27.95	-2.48
01-04-1993	28.28	28.47	-0.20
01-01-1993	27.93	29.04	-1.11
01-10-1992	30.85	29.64	1.21
01-07-1992	31.75	30.27	1.48
01-04-1992	31.18	30.92	0.26
01-01-1992	28.11	31.60	-3.49
01-10-1991	33.90	32.30	1.60
01-07-1991	31.85	33.00	-1.15
01-04-1991	30.33	33.72	-3.38
01-01-1991	34.17	34.43	-0.26
01-10-1990	56.36	35.13	21.23
01-07-1990	41.62	35.82	5.80
01-04-1990	26.89	36.50	-9.60
01-01-1990	32.90	37.17	-4.26

Appendix 7: Monetary policy: key rate and average lending rate from banks, with HP-calculation

Start date	Key rate, percent	HP-Filter	Cyclical component	Average lending rate, percent
01-10-2017	0.50	0.33	0.17	3.41
01-07-2017	0.50	0.39	0.11	3.42
01-04-2017	0.50	0.45	0.05	3.45
01-01-2017	0.50	0.52	-0.02	3.49
01-10-2016	0.50	0.58	-0.08	3.49
01-07-2016	0.50	0.64	-0.14	3.47
01-04-2016	0.50	0.70	-0.20	3.46
01-01-2016	0.50	0.77	-0.27	3.57
01-10-2015	0.75	0.83	-0.08	3.59
01-07-2015	0.75	0.90	-0.15	3.73
01-04-2015	1.00	0.97	0.03	3.97
01-01-2015	1.25	1.03	0.22	4.07
01-10-2014	1.25	1.10	0.15	4.36
01-07-2014	1.50	1.16	0.34	4.55
01-04-2014	1.50	1.23	0.27	4.63
01-01-2014	1.50	1.29	0.21	4.72
01-10-2013	1.50	1.35	0.15	4.74
01-07-2013	1.50	1.42	0.08	4.78
01-04-2013	1.50	1.48	0.02	4.79
01-01-2013	1.50	1.54	-0.04	4.71
01-10-2012	1.50	1.61	-0.11	4.72
01-07-2012	1.50	1.68	-0.18	4.79
01-04-2012	1.50	1.74	-0.24	4.79
01-01-2012	1.50	1.82	-0.32	4.92
01-10-2011	1.75	1.89	-0.14	5.03
01-07-2011	2.25	1.97	0.28	4.89
01-04-2011	2.25	2.05	0.20	4.67
01-01-2011	2.00	2.13	-0.13	4.61
01-10-2010	2.00	2.22	-0.22	4.61
01-07-2010	2.00	2.30	-0.30	4.66
01-04-2010	2.00	2.40	-0.40	4.56
01-01-2010	1.75	2.49	-0.74	4.42
01-10-2009	1.75	2.59	-0.84	4.28
01-07-2009	1.25	2.68	-1.43	4.19
01-04-2009	1.25	2.78	-1.53	4.4
01-01-2009	2.00	2.88	-0.88	5.25

Start date	Key rate, percent	HP-Filter	Cyclical component	Average lending rate, percent
01-10-2008	3.00	2.96	0.04	7.28
01-07-2008	5.75	3.04	2.71	7.8
01-04-2008	5.75	3.11	2.64	7.41
01-01-2008	5.25	3.16	2.09	7
01-10-2007	5.25	3.19	2.06	6.65
01-07-2007	5.00	3.21	1.79	6.11
01-04-2007	4.50	3.22	1.28	5.58
01-01-2007	4.00	3.21	0.79	5.26
01-10-2006	3.50	3.20	0.30	4.7
01-07-2006	3.00	3.19	-0.19	4.4
01-04-2006	2.75	3.18	-0.43	4.22
01-01-2006	2.50	3.18	-0.68	4.06
01-10-2005	2.25	3.20	-0.95	4.02
01-07-2005	2.00	3.22	-1.22	3.94
01-04-2005	1.75	3.27	-1.52	3.82
01-01-2005	1.75	3.34	-1.59	3.93
01-10-2004	1.75	3.43	-1.68	3.99
01-07-2004	1.75	3.55	-1.80	4.07
01-04-2004	1.75	3.69	-1.94	4.08
01-01-2004	1.75	3.85	-2.10	4.27
01-10-2003	2.25	4.03	-1.78	4.66
01-07-2003	2.50	4.22	-1.72	5.14
01-04-2003	4.00	4.43	-0.43	6.74
01-01-2003	5.50	4.64	0.86	7.62
01-10-2002	6.50	4.84	1.66	8.6
01-07-2002	7.00	5.04	1.96	8.7
01-04-2002	6.50	5.22	1.28	8.26
01-01-2002	6.50	5.39	1.11	8.24
01-10-2001	6.50	5.53	0.97	8.59
01-07-2001	7.00	5.65	1.35	8.86
01-04-2001	7.00	5.74	1.26	8.89
01-01-2001	7.00	5.81	1.19	8.88
01-10-2000	7.00	5.86	1.14	8.89
01-07-2000	7.00	5.87	1.13	8.52
01-04-2000	6.25	5.87	0.38	7.83
01-01-2000	5.50	5.84	-0.34	7.52

Start date	Key rate, percent	HP-Filter	Cyclical component	Average lending rate, percent
01-10-1999	5.50	5.80	-0.30	7.57
01-07-1999	5.50	5.73	-0.23	7.78
01-04-1999	6.00	5.65	0.35	8.24
01-01-1999	7.00	5.56	1.44	8.89
01-10-1998	8.00	5.46	2.54	9.72
01-07-1998	8.00	5.35	2.65	9.56
01-04-1998	4.50	5.23	-0.73	6.22
01-01-1998	3.75	5.12	-1.37	5.92
01-10-1997	3.50	5.01	-1.51	5.96
01-07-1997	3.50	4.92	-1.42	6.02
01-04-1997	3.25	4.85	-1.60	5.75
01-01-1997	3.25	4.79	-1.54	5.9
01-10-1996	4.00	4.76	-0.76	6.61
01-07-1996	4.50	4.74	-0.24	7
01-04-1996	4.50	4.76	-0.26	7.06
01-01-1996	4.50	4.79	-0.29	7.37
01-10-1995	4.75	4.85	-0.10	7.5
01-07-1995	4.75	4.94	-0.19	7.6
01-04-1995	4.75	5.05	-0.30	7.71
01-01-1995	4.75	5.18	-0.43	7.8
01-10-1994	4.75	5.34	-0.59	8.19
01-07-1994	4.75	5.52	-0.77	8
01-04-1994	4.75	5.72	-0.97	8.05
01-01-1994	4.75	5.94	-1.19	8.49
01-10-1993	5.00	6.18	-1.18	8.87
01-07-1993	5.50	6.44	-0.94	9.75
01-04-1993	6.00	6.71	-0.71	11.14
01-01-1993	7.75	6.99	0.76	12.67
01-10-1992	9.00	7.28	1.72	13.78
01-07-1992	**11.00**	7.56	3.44	13.57
01-04-1992	9.00	7.85	1.15	12.99
01-01-1992	10.00	8.12	1.88	13.2
01-10-1991	8.50	8.40	0.10	13.72
01-07-1991	8.50	8.67	-0.17	13.67
01-04-1991	8.00	8.94	-0.94	13.89
01-01-1991	8.50	9.21	-0.71	14.14
01-10-1990				14.15
01-07-1990				14.23
01-04-1990				14.38
01-01-1990				14.28

Appendix 8: Household debt levels and HP-calculation

Start date	Real debt (mnok)	HP-Filter	Cyclical Component
01-10-2017	3,117,376.43	3,071,620.14	45,756.29
01-07-2017	3,052,753.16	3,043,549.74	9,203.42
01-04-2017	2,997,499.21	3,015,507.94	-18,008.72
01-01-2017	2,932,928.98	2,987,529.08	-54,600.11
01-10-2016	3,005,387.46	2,959,636.27	45,751.19
01-07-2016	2,929,886.74	2,931,818.46	-1,931.73
01-04-2016	2,854,143.95	2,904,093.24	-49,949.28
01-01-2016	2,785,400.64	2,876,476.94	-91,076.30
01-10-2015	2,916,132.46	2,848,954.71	67,177.74
01-07-2015	2,853,219.37	2,821,454.77	31,764.59
01-04-2015	2,800,283.43	2,793,947.32	6,336.12
01-01-2015	2,726,065.96	2,766,422.40	-40,356.44
01-10-2014	2,800,238.14	2,738,874.04	61,364.10
01-07-2014	2,739,411.60	2,711,271.03	28,140.57
01-04-2014	2,679,984.39	2,683,620.51	-3,636.12
01-01-2014	2,624,405.68	2,655,947.22	-31,541.54
01-10-2013	2,691,956.84	2,628,273.60	63,683.24
01-07-2013	2,609,884.21	2,600,602.42	9,281.79
01-04-2013	2,558,287.69	2,572,976.22	-14,688.52
01-01-2013	2,493,453.26	2,545,443.34	-51,990.08
01-10-2012	2,533,829.84	2,518,042.95	15,786.89
01-07-2012	2,479,948.25	2,490,781.74	-10,833.50
01-04-2012	2,457,910.39	2,463,676.24	-5,765.85
01-01-2012	2,378,090.68	2,436,736.23	-58,645.54
01-10-2011	2,429,014.68	2,409,967.86	19,046.82
01-07-2011	2,372,503.56	2,383,340.66	-10,837.11
01-04-2011	2,344,035.11	2,356,836.05	-12,800.94
01-01-2011	2,289,053.57	2,330,428.66	-41,375.09
01-10-2010	2,295,690.63	2,304,085.15	-8,394.51
01-07-2010	2,244,533.94	2,277,746.29	-33,212.35
01-04-2010	2,234,910.55	2,251,347.63	-16,437.08
01-01-2010	2,173,347.14	2,224,803.94	-51,456.81
01-10-2009	2,231,246.36	2,198,019.74	33,226.61
01-07-2009	2,178,476.67	2,170,867.37	7,609.30
01-04-2009	2,145,222.22	2,143,239.95	1,982.28
01-01-2009	2,093,314.92	2,115,035.33	-21,720.42

Start date	Real debt (mnok)	HP-Filter	Cyclical Component
01-10-2008	2,148,375.72	2,086,152.65	62,223.07
01-07-2008	2,111,820.09	2,056,477.41	55,342.68
01-04-2008	2,049,088.24	2,025,934.06	23,154.18
01-01-2008	1,986,372.06	1,994,481.59	-8,109.53
01-10-2007	2,070,281.92	1,962,093.50	108,188.42
01-07-2007	2,003,964.51	1,928,738.19	75,226.32
01-04-2007	1,953,921.44	1,894,451.70	59,469.73
01-01-2007	1,854,054.55	1,859,317.08	-5,262.54
01-10-2006	1,881,372.45	1,823,454.55	57,917.90
01-07-2006	1,799,651.11	1,786,981.03	12,670.07
01-04-2006	1,746,623.96	1,750,049.65	-3,425.69
01-01-2006	1,680,458.82	1,712,821.46	-32,362.64
01-10-2005	1,711,622.85	1,675,455.36	36,167.49
01-07-2005	1,631,703.52	1,638,090.03	-6,386.51
01-04-2005	1,581,448.67	1,600,886.75	-19,438.09
01-01-2005	1,517,367.22	1,564,002.82	-46,635.60
01-10-2004	1,524,029.78	1,527,583.37	-3,553.59
01-07-2004	1,471,005.35	1,491,744.40	-20,739.06
01-04-2004	1,438,463.60	1,456,599.69	-18,136.09
01-01-2004	1,388,229.13	1,422,250.04	-34,020.91
01-10-2003	1,350,379.13	1,388,784.94	-38,405.81
01-07-2003	1,335,286.07	1,356,272.59	-20,986.52
01-04-2003	1,303,172.77	1,324,757.22	-21,584.45
01-01-2003	1,264,645.40	1,294,269.91	-29,624.51
01-10-2002	1,273,450.75	1,264,828.26	8,622.49
01-07-2002	1,238,834.68	1,236,431.37	2,403.31
01-04-2002	1,207,252.44	1,209,083.71	-1,831.27
01-01-2002	1,159,537.11	1,182,791.26	-23,254.15
01-10-2001	1,168,341.66	1,157,558.86	10,782.80
01-07-2001	1,121,638.42	1,133,376.80	-11,738.39
01-04-2001	1,104,056.80	1,110,242.14	-6,185.34
01-01-2001	1,066,784.83	1,088,144.56	-21,359.73
01-10-2000	1,082,045.94	1,067,069.91	14,976.03
01-07-2000	1,051,025.23	1,046,990.68	4,034.55
01-04-2000	1,018,733.01	1,027,888.72	-9,155.71
01-01-2000	981,221.69	1,009,748.39	-28,526.70

Start date	Real debt (mnok)	HP-Filter	Cyclical Component
01-10-1999	1,006,301.06	992,548.34	13,752.72
01-07-1999	971,028.25	976,249.39	-5,221.15
01-04-1999	949,674.58	960,820.96	-11,146.38
01-01-1999	921,028.40	946,229.19	-25,200.79
01-10-1998	951,558.89	932,433.27	19,125.62
01-07-1998	928,998.60	919,376.63	9,621.97
01-04-1998	915,359.11	907,014.67	8,344.44
01-01-1998	889,895.83	895,308.77	-5,412.93
01-10-1997	907,577.66	884,225.55	23,352.11
01-07-1997	885,037.23	873,728.26	11,308.97
01-04-1997	867,374.46	863,794.71	3,579.75
01-01-1997	846,376.60	854,409.81	-8,033.21
01-10-1996	870,683.30	845,560.68	25,122.62
01-07-1996	848,127.94	837,229.44	10,898.50
01-04-1996	829,267.54	829,413.90	-146.36
01-01-1996	814,951.09	822,118.70	-7,167.61
01-10-1995	834,239.28	815,348.35	18,890.93
01-07-1995	813,065.35	809,102.93	3,962.42
01-04-1995	801,332.02	803,394.28	-2,062.26
01-01-1995	792,758.50	798,236.75	-5,478.25
01-10-1994	822,740.02	793,643.39	29,096.63
01-07-1994	809,220.64	789,623.81	19,596.83
01-04-1994	796,741.15	786,205.84	10,535.31
01-01-1994	736,762.84	783,429.54	-46,666.70
01-10-1993	760,311.92	781,341.53	-21,029.61
01-07-1993	734,602.67	779,959.31	-45,356.64
01-04-1993	736,848.05	779,287.19	-42,439.14
01-01-1993	744,047.64	779,301.18	-35,253.54
01-10-1992	788,303.03	779,950.73	8,352.31
01-07-1992	761,703.47	781,163.26	-19,459.79
01-04-1992	769,560.57	782,871.42	-13,310.85
01-01-1992	775,815.05	784,995.70	-9,180.66
01-10-1991	821,601.74	787,448.27	34,153.47
01-07-1991	804,894.99	790,135.55	14,759.44
01-04-1991	808,802.58	792,985.31	15,817.26
01-01-1991	806,193.91	795,934.56	10,259.35
01-10-1990	859,868.85	798,930.17	60,938.68
01-07-1990	818,812.19	801,925.45	16,886.74
01-04-1990	813,038.31	804,911.78	8,126.54
01-01-1990	796,665.21	807,891.08	-11,225.88

Appendix 9: Probability Level for the Correlation Coefficient

Table 9.1

Probability Levels for the Correlation Coefficient

One-Tailed Probabilities[a]

N	.05	.025	.01	.005	.0005
5	.80	.88	.93	.96	.99
6	.73	.81	.88	.92	.97
7	.67	.75	.83	.87	.95
8	.62	.71	.79	.83	.93
9	.58	.67	.75	.80	.90
10	.55	.63	.71	.77	.87
11	.52	.60	.69	.73	.85
12	.50	.58	.66	.71	.82
13	.48	.55	.63	.68	.80
14	.46	.53	.61	.66	.78
15	.44	.51	.59	.64	.76
16	.43	.50	.57	.62	.74
17	.41	.48	.56	.61	.73
18	.40	.47	.54	.59	.71
19	.39	.46	.53	.57	.69
20	.38	.44	.52	.56	.68
22	.36	.42	.49	.54	.65
24	.34	.40	.47	.51	.63
26	.33	.39	.45	.50	.61
28	.32	.37	.44	.48	.59
30	.31	.36	.42	.46	.57
40	.26	.31	.37	.40	.50
50	.23	.28	.33	.36	.45
60	.21	.25	.30	.33	.41
80	.19	.22	.26	.29	.36
100	.17	.20	.23	.26	.32
250	.10	.12	.15	.16	.21
500	.07	.09	.10	.11	.15
1000	.05	.06	.07	.08	.10

[a]One-tailed means the probability of a specific plus or minus correlation or greater. For the probability of an absolute correlation or greater, double the one-tailed probability.

N = number of cases. For partial correlation holding k variables constant, use N = N* − k, where N* is the number of cases for partial correlations.

(vom Saal, 2004)