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Disagreement in the Norwegian Housing Market

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Abstract

Do differences of opinion affect house prices? This thesis investigates how disagreement affects house prices and housing turnover. We construct a disagreement index using household's beliefs on future house price developments. The main contribution of this study is that the household survey captures real expectations in contrast to many similar studies that use analyst forecasts or volatility based measures. This study finds that higher disagreement is significantly associated with lower future house price returns. A one standard deviation increase of disagreement index translates into a 33.8 basis points lower return the following month. The results are robust when controlling for Norges Bank key house price determinants. Granger causality tests indicate that disagreement has a predictive power for house price returns and not vice versa. Disagreement is insignificant in explaining turnover. Overall, our results lends support to predictions of models with disagreement and helps highlight the importance disagreement has in explaining price movements.

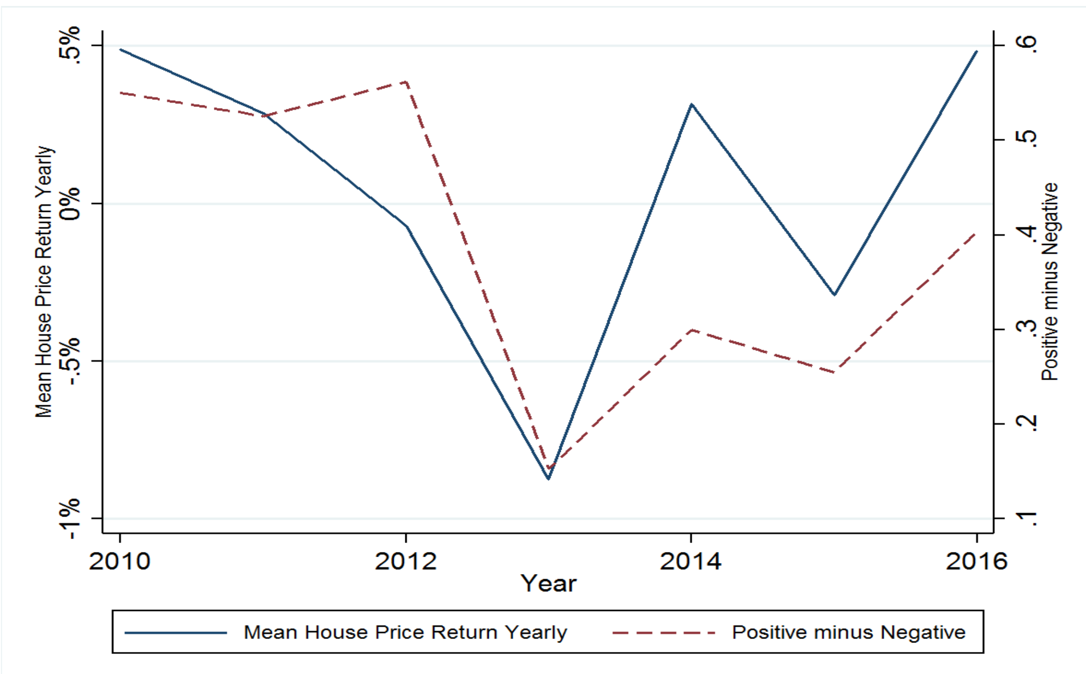
Contents

Introduction

Following the seminal paper by Miller (1977), literature on disagreement, or heterogeneous beliefs, has become increasingly more important in explaining asset-pricing anomalies (Hong and Stein (2007)). However, there is lack of theory and empirical work related to housing markets. This thesis presents an empirical analysis of how disagreement affects house price returns and turnover.

Figure 1.1: Disagreement and return

The figure displays how yearly house price returns correlate with disagreement. Disagreement is calculated as the average yearly proportion of households forecasting positive house prices less the proportion of negative forecasts. Households agree when "positive minus negative" is high. When positive minus negative is low they disagree. Lower returns coincide with higher disagreement.



The first contribution in this paper is constructing a disagreement index using an expectation survey, which directly captures household beliefs. Most previous studies use proxies of investor disagreement such as analyst forecasts (Carlin et al. (2012) or volatility (Berkman and Koch (2008)). Both methods have drawbacks. Analyst surveys represents a well-informed and limited segment of the market (Li and Li (2013)). Volatility can capture disagreement, but will likely measure uncertainty as well. Ellen et al. (2016) makes the distinction between heterogeneous beliefs and uncertainty. Heterogeneous beliefs and uncertainty should have diverging implications for trading volumes. It is expected that heterogeneous beliefs has positive effect on trading volume. Dispersion in investors valuation should lead to higher trading willingness from buyers and sellers. In contrast, uncertainty generally reduces volume and liquidity, as investors are hesitant with taking positions in hope for more certain conditions. The disagreement index in this thesis captures heterogeneous beliefs of market participants more effectively.

The second contribution of this thesis is to investigate disagreement models in the housing market. A wide variety of other markets have been studied, Chen et al. (2002) analyzes disagreement in the stock market, Carlin et al. (2012) measures disagreement in mortgage backed securities market and Buraschi and Whelan (2012) focuses on interest rates. To our knowledge, this is the first attempt to apply disagreement models in a housing market framework.

The results from this empirical analysis indicate that higher disagreement is associated with lower future returns. The results are both statistically and economically significant. One standard deviation of higher disagreement index translates into a 33.8 basis points lower return the following month. Should the standard deviation persist for a year, we expect a yearly return of -4.06 percent. Granger causality tests indicate that disagreement has predictive power for house price returns and not vice versa. The results remain significant when controlling for several other house price drivers, such as real interest rate, unemployment and household income. In this thesis the control variables are based on the paper written for Norges Bank, by Jacobsen and Naug (2004). Jacobsen and Naug documented the most important fundamental factors that drive Norwegian house prices.

Based on the paper by Li and Li (2013) we construct an alternative volume measure which has the benefit of isolating changes in volume that are due to increased housing supply, from changes that are due to growth in the economy. The turnover measure is calculated as number of houses sold divided by total houses listed. In our analysis, disagreement is not significant in explaining turnover.

In this study we show that disagreement is time varying and illustrate how recessions and key economic events interact with disagreement. For robustness, a disagreement index using three different calculation methods is constructed. These three calculation methods include the final measure which is the negative weighted Herfindahl developed by Li and Li (2013). By varying the weighting within the Herfindahl measure we find that the results are robust and not sensitive to weight choices.

The seminal paper by Miller (1977) initiates the work with respect to disagreement and asset prices. Miller (1977) clarifies that in markets with binding short sales constraints, increased disagreement leads to higher stock prices. In the presence of short sale constraints, price tends to only reflect optimistic investor's valuations. The higher the level of disagreement, the more overvalued the stock price will be, which results in lower future returns. The results in this thesis conforms with the literature postulated by Miller.

Harris and Raviv (1993) explain the economic mechanism behind disagreement and trading volume. Trading volume increases when investors interpret information differently or have heterogeneous priors. Further, investors believe absolutely in the validity of their own interpretations. Trading occurs when investors interpretations, or valuations, are switched from an optimistic to a pessimistic state and vice versa. Higher dispersion in beliefs leads to increased change in valuations and more willingness to buy and sell, which generates higher trading volume.

Li and Li (2013) study the effect of belief dispersion on volume in the stock market. They show that disagreement is significantly counter-cyclical. Li and Li (2013) use a household survey on macroeconomic variables, to show that greater belief dispersion is associated with significantly higher stock trading volume. Carlin et al. (2012) investigates disagreement in the mortgage backed securities market. They find that increased disagreement is associated with higher return volatility, higher expected returns and larger trading volume.

This thesis is primarily based on the work by Li and Li (2013) and Carlin et al. (2012). The main contribution of this thesis is analysing the housing market and capturing disagreement directly with household expectations.

Literature Review

2.1 The Underlying Economic Mechanism

2.1.1 Price Mechanism

Miller (1977) describes the disagreement price mechanism. Miller´s work assumes there are two groups of investors, one optimistic and one pessimistic. The arbitrage free equilibrium price will be the average valuations of the two groups. Without short sale possibilities, arbitrage mechanisms will not work properly. Due to short sale constraints, price will tend to only reflect optimistic investor's valuations. Pessimists will sit out of the market and the price will reflect only the markets optimists. Optimistic demand pushes the stock price up.

Banerjee (2010) makes the economic mechanism more intricate by splitting disagreement into *two learning mechanisms*. *The rational expectations* channel where investors beliefs converge in the end, but disagreement arises short term due to differences in interpretation. In the rational expectations channel, disagreement exacerbates volatility and leads to higher expected returns and higher betas. In the second channel investors *agree to disagree*. When investors do not agree about the public signals, it should lead to lower expected returns. In both channels disagreement leads to higher volume.

2.1.2 Volume Mechanism

Heterogeneous beliefs lead to investors interpreting news differently Harris and Raviv (1993). Investors receive the same information, but differ in the way they interpret it. Each individual trader believes absolutely in the validity of his own interpretation, i.e. there is difference in opinion. Trading occurs when investors valuations are switched from an optimistic to pessimistic state and vice versa. Higher dispersion in beliefs leads to more switching of valuations and more willingness to buy and sell, which generates higher trading volume.

Ellen et al. (2016) investigates the economic mechanism behind disagreement. In their paper they make a clear distinction on whether its heterogeneity or uncertainty that causes disagreement. In other literature, disagreement is usually used interchangeably. Heterogeneous beliefs and uncertainty should have diverging implications for trading volumes. It would be expected that heterogeneous beliefs has positive effect on trading volume. Dispersion in investors valuation should lead to higher trading willingness from buyers and sellers. In contrast, uncertainty generally reduces volume and liquidity, as investors experience higher costs in rebalancing their portfolios. Investors are hesitant with taking positions in hope for more certain conditions. This study is conducted in the foreign exchange market. Ellen et al. (2016) concludes that disagreement is a measure of heterogeneous beliefs and not uncertainty. Only in certain periods of turmoil does uncertainty measure disagreement.

2.2 What Causes Disagreement

Empirical studies find several puzzles relating to asset- price and volume, that cannot be explained by traditional asset pricing models with homogeneous agents. The amount of trading in asset markets is much higher than expected by 1) traditional trading models, 2) by investors liquidity demands or 3) for hedging demand, Hong and Stein (2007). The last 30 years, models with disagreement, or heterogeneous beliefs, have had increased importance in explaining these puzzles.

In the mean variance framework of Fama and French (2007), the effect of heterogeneity will cancel out, if the total aggregate of investors hold the market portfolio. Otherwise it can have large price and volume implications. Fama and French argue that the divergence from traditional asset pricing models may be explained by disagreement between unsophisticated investors.

Acemoglu et al. (2007) makes the case that individuals in different settings are uncertain about how to interpret the news they receive. This leads to permanent disagreement. Permanent disagreement can arise for several reasons. First, it can take time before investors interpret the information and their beliefs converge. Second, there could be a difference in belief about the usefulness of the information. Last, agents agree to disagree simply by having different models for their own valuations.

2.2.1 Disagreement Mechanisms

Hong and Stein (2007) sums up three mechanisms that generate disagreement; gradual information flow, limited attention and heterogeneous priors. Gradual information flow relates to how certain relevant information will arrive in the hands of some investors prior to others. This could be due to technology, investor segmentation or specialization. Those who receive the information first, will revise their valuation in a more timely fashion. This will lead to disagreement and higher trading volume as those with relevant information will purchase from those without. Limited attention is similar but focuses on investors inability to assimilate all relevant information. Further, investors do not adjust their valuation for limited information sources when trading with others. The last mechanism is heterogeneous priors. Even if news is distributed and available to all investors, it can still decrease consensus about the fundamental value. Investors interpret the information differently based on their prior beliefs. Investors agree to disagree in equilibrium.

2.3 Disagreement and Price

The literature on disagreement effects for prices is nonuniform. One distinction is short sale constraints, which has important implications for the way disagreement affects prices. Although the scenario with short sale constraints is the most relevant for the study of the housing market, this section reviews both.

2.3.1 Disagreement, Price and Short Sale Constraints

The housing market is characterized by short sale constraints. Other papers on disagreement with short sale constraints, predicts that disagreement is associated with higher contemporaneous prices and lower future returns.

Miller (1977) makes the case that in the presence of binding short sale constraints; disagreement in beliefs will lead to higher stock prices. Because of the market constraints, price will tend to only reflect optimistic investor's valuations. Furthermore, the larger the dispersion of opinion, the more overvalued the contemporaneous stock will be, and lower future returns. Without short sale possibilities, arbitrage mechanisms will not work properly.

Diether et al. (2002) support Millers findings. Their paper use analyst forecasts of individual firm's earnings per share to investigate a cross section of stock returns. Further, they expand short sale constraints to include any friction that inhibits revelation of pessimistic opinion. These frictions affects the relationship between dispersion and future returns negatively. Analyst forecast bias could be one of these frictions, analysts are hesitant to release negative forecasts resulting in an upward bias. Diether et al. (2002) find that stocks with high disagreement in analyst forecast, earn lower returns than otherwise comparable stocks.

Park (2005) and Yu (2010) finds that the same connection holds on the aggregate level of the market portfolio. Yu examines how individual investors beliefs dispersion can have an affect on the value of the total market index, even if the level of disagreement on individual stocks are idiosyncratic. Idiosyncratic meaning disagreement on individual stocks cancel each other out. Higher disagreement on the aggregate level of stocks predicts lower future returns.

2.3.2 Disagreement and Price Without Short Sale Constraints

A large body of theoretical literature in markets without short sale constraints, emphasizes how an increase in dispersion of opinion should lead to a positive risk premium and lower contemporaneous security price.

Varian (1985) initiates the work in this category of literature. Varian´s framework associates disagreement with a positive risk premium. Increase in spread of investors beliefs, can lead to an increase or decrease in asset values depending on the individuals utility function. The paper argues that a decrease in asset value is most probable, the exception being individuals with an abnormally high risk aversion.

David (2008) underlines how disagreement arises because economic agents agree to disagree. Agents receive the same signals but have different beliefs after interpreting the information with their own models. Agents trade based on accuracy of these beliefs. As expected less risk averse investors, generates higher trading volume. David finds a positive risk premium for heterogeneous beliefs.

Xiouros (2012) theoretical model predicts belief dispersion to be positively correlated with trading volume and stock returns. Xiorous describes the fundamental effect between belief dispersion and prices. Increase in belief dispersion decreases demand for financial assets, which in turn leads to a decrease in prices, since supply is a fixed amount. Economic agents have heterogeneous beliefs and wealth dependent risk aversion. They therefore invest differently and an increased holding of financial assets increases their wealth risk. Even though agents increase demand for undervalued assets the net effect is of this asset is negative. He confirms this with empirical tests.

In other asset markets Carlin et al. (2012) investigates disagreement in the mortgage backed securities market. The disagreement variable is made up of a series of forecasts on prepayment speed by wall street mortgage dealers. They find that increased disagreement is associated with higher return volatility, higher expected returns and larger trading volume. They make a clear distinction that volatility isolated does not lead to higher trading volume. It is when higher disagreement is related to volatility that higher trading volumes occur.

2.4 Disagreement and Volume

The theories and empirical models describing the relationship between disagreement and trading volume is more one-sided compared to literature on prices. The evidence points to a positive relationship. In this section the volume literature is reviewed.

Harris and Raviv (1993) models the effect of news on trading prices and volume. In Harris and Raviv's model investors receive the same information, but differ in the way they interpret it. Further, each trader believes absolutely in the validity of his own interpretation, ie. there is difference in opinion. They discover that absolute changes in the mean forecast of the final payoff and volume are positively related.

Using analyst dispersion, Atiase and Amber (1994) document a positive relationship between disagreement and trading volume around earnings announcements. Kandel and Pearson (1995) conduct the same study and their results holds when controlling for price changes.

Hong and Stein (2007) review literature related to heterogeneous beliefs. Hong and Stein document examples, in both cross sectional and time series data, of how volume acts as an indicator of investor sentiment. When price is high compared to fundamentals, trading volume is high as well. Hong and Stein use disagreement models to explain over-exaggerated trading volume. They describe the same connection using short sale constraints as Miller (1977). Millers model has limitations because it is static, consequently Millers model can not speak to volume. In this static model investors take initial positions in the stock but never re-balance their positions before maturity. Therefore, disagreement only arises from the initial dispersion in beliefs.

Later works deploys a dynamic setting which can explain trading volume. This gives a more meaningful and realistic model, which examines changes in level of disagreement over time. In models of Harrison and Kreps (1978) and later updated by Hong et al. (2006) investors update their beliefs continuously based on the interpretation of new information. Heterogeneous beliefs leads to investors interpreting news differently. They highlight that heterogeneous beliefs leads to excessive trading.

Li and Li (2013) study belief dispersion's effect on turnover in stock market. They use a household survey on macroeconomic variables, to show that greater belief dispersion is associated with significantly higher stock trading volume. Li and Li (2013) control for professional forecasts and find that the relationship remains significant. Household's dispersion matters more for trading volume than professional forecasts. Further, they isolate two different aspects of heterogeneous beliefs, (1) dispersion of prior beliefs and (2) dispersion of belief changes. Both can stimulate trading volume. Using a follow up survey issued 6 months later, they track consumer belief changes. They find that dispersion of belief changes is positively correlated with the cumulative turnover rates during the same period.

2.5 Housing Bubbles and Heterogeneous Beliefs

Grytten (2009) characterizes bubbles as:

"Bubbles appear when prices rise continually, because investors believe they can realize a gain from resale as a result of further growth in asset prices. Bubbles can in principle appear in all tradable assets where it is possible to speculate in future price direction and profit."

In models of Harrison and Kreps (1978) and later updated by Hong et al. (2006) describe that due to disagreement, the price of a stock, can even exceed the most optimistic investors valuation, expecting to sell the stock to an even more optimistic trader in the future. This optimism leads to the investor valuing the stock at an even higher price than his already optimistic view. Such speculative behavior leads to bubble component in asset prices. These studies make the connection between asset bubbles and heterogeneous beliefs. Bubbles tend to coincide with frenzied trading Xiong (2013). Xiong describes how individual investors belief dispersion on aggregate can affect the market value. Even if the level of disagreement on individual assets are idiosyncratic and unbiased, intensive fluctuations in heterogeneous beliefs can lead to over-trading and price bubbles.

Constructing the Disagreement Index

We construct a disagreement index using an expectation survey, which directly captures household beliefs. Several other studies, use proxies of investor disagreement such as analyst forecasts (Carlin et al. (2012)) or volatility (Berkman and Koch (2008)). One reason for these approaches is that consistent data on investors forecasts is not readily available or collected to create sufficient data sets. The main contribution in this thesis is using a direct measure of market disagreement. The expectations survey has limitations, characterized by few observations in the data set.

3.1 Expectation survey

The expectation survey (table A.2) is collected by Prognosesenteret and published by EiendomsMegler 1. The survey is nationwide and asks respondents to predict whether house prices are expected to rise, fall or stay at the same level for the next 12 months. The survey has the benefit of being forward-looking, and captures people's beliefs. The data set is limited to 36 observations and spans the time period from 2010 to 2016. The data is collected on a monthly basis from 2010 until 2011, with eight observations per year. From 2012 through 2016, the data is collected quarterly.

The survey asks it´s respondents "How will housing prices develop in the coming 12 months". The responses fall into three qualitative categories: *Increase*, *Decrease* or *No change*. Categorical questions are less complicated for respondents to answer than when they are asked to predict a specific house price level 12 months ahead in time. The benefit with utilizing categorical answers is that it avoids uncontrolled (wild) answers. Categorical answers, as opposed to numerical, poses a challenge when computing a disagreement index. Regular standard deviation calculations are not sufficient.

3.2 Constructing the Disagreement Index

For robustness the disagreement index is constructed in three distinct approaches. The three approaches are from Li and Li (2013), Backmann et al. (2012) and Badarinza and Buchmann (2011).

3.2.1 Index I

Index I is the method of choice in this thesis. Li and Li(2013) make a methodical innovation in order to construct disagreement when beliefs are reported categorically. They construct a variation of the Herfindahl index, which is known as a measure of market concentration. Li and Li (2013) modify this measure to make it the weighted negative Herfindahl Index:

$$WNHI = -\sum_{i=1}^{N} \omega_i p_i^2 \tag{3.1}$$

where p_i is the share of the i_{th} element among N elements. One important feature is that this measure accounts for relative distance between observations. ω_i is used to give lower weight to elements closer to the outer boundaries, and higher weights to elements in the middle. The index gives answers "increase" and "decrease" weights of 1 and "no change" the weight of 2. The negative value of the index makes the index an increasing function of belief dispersion. Its more intuitive that a higher value of the disagreement index indicates greater dispersion. We show robustness by varying the weighting within the Herfindahl Index in Figure A.3. In our baseline analysis, we give a weight of 2 to neutral answers. Further we try smaller weights 1.5 and 1 and observe small differences in values of coefficients. The results are not sensitive to weight choices.

3.2.2 Index II

Backmann et al. (2012) use similar data to construct a dispersion measure across forward-looking surveys. $Frac_t^+$ is defined as the weighted fraction of respondents believing the price will increase, and $Frac_t^-$ as the weighted fraction of respondents believing the price will decrease.

$$FDISP_t = \sqrt{Frac_t^+ + Frac_t^- - (Frac_t^+ - Frac_t^-)^2} \tag{3.2}$$

Where FDISP is the constructed dispersion measure at time t.

3.2.3 Index III

Badarinza and Buchmann (2011) use another approach for measuring disagreement based on categorical survey responses.

$$d_t = \sum_{i=1}^{2} F_t^i (1 - F_t^i) \tag{3.3}$$

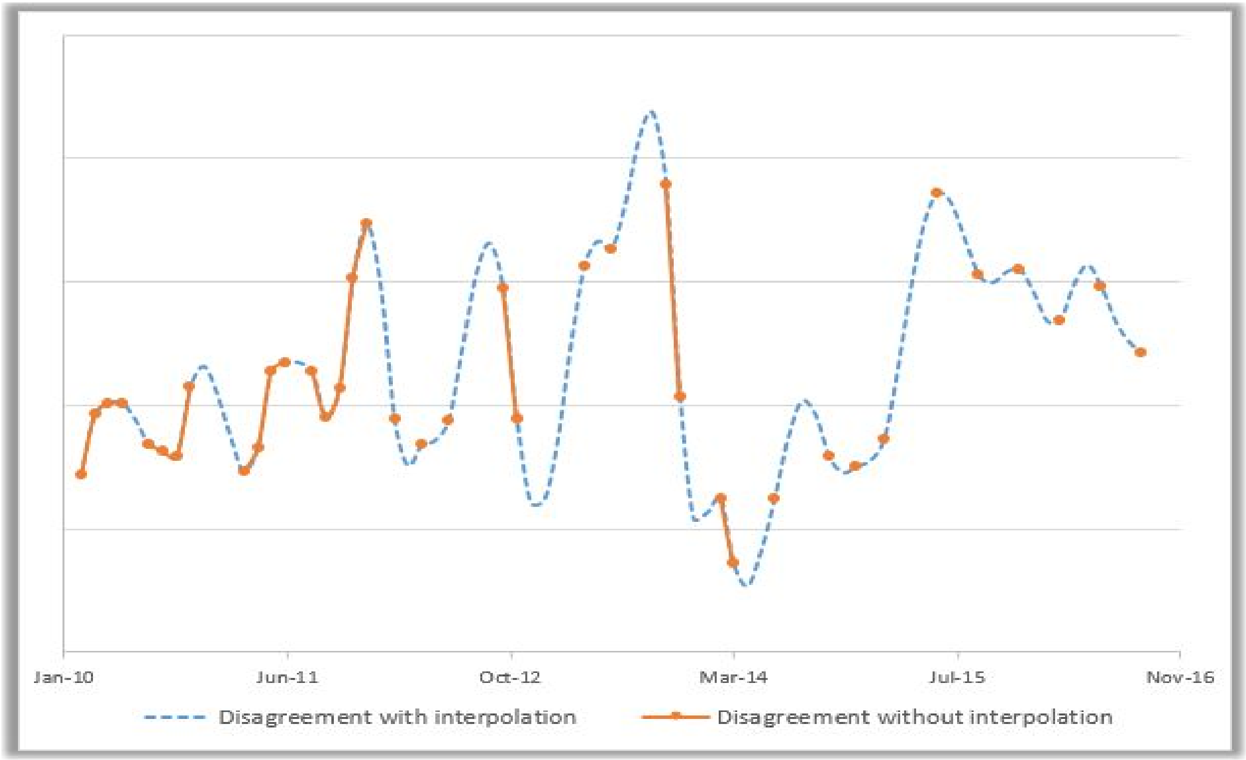
Where F_t^i are the cumulative frequencies at time t for the i_{th} category. Because the neutral frequencies are given a weight of 1, they are kept out of the computation, and i only runs to 2.

3.3 Interpolation

In order to deal with the sparsity problem, we fill the missing data gaps. The method of choice is cubic spline interpolation. Interpolation benefits from being relatively simple compared to other model based approaches Denk and Weber (2011). Cubic spline interpolation is more advanced and meaningful than deterministic or mean imputation approaches. In comparison to other interpolation methods such as linear interpolation, cubic spline interpolation captures curvature in the data set. Cubic spline uses data points in both directions. One weakness using cubic spline method is the weakness at the end of the data series. At the ends of the series only half of the information is available. Wohlrabe (2008) investigates how there in theory are a couple of better and more advanced approaches to deal with mixed frequency forecasts. In practice the most common approaches are either aggregation or interpolation. In Figure 3.1 a robustness analysis for four different interpolation methods, cubic spline, linear, bessel spline and oneway spline interpolation respectively.

Figure 3.1: Interpolated data series versus actual data points

This graph displays the actual data points in conjunction with the interpolated values. The maximum value (Sep. 2013) and minimum (April 2014) are both interpolated values.



3.4 Standardization

When dealing with the disagreement variable, it is beneficial to use standardized values. The disagreement value in itself has no explanatory power. Standardizing is done by subtracting the mean and dividing by the standard error. This makes the mean value equal to zero, and the standard deviation equal to one. An important note when standardizing is that the R^2 does not change, just the coefficient. The interpretation of the coefficient from the regression is based on the change of one standard deviation in disagreement. Essentially, standardized values are reported in z-scores.

3.5 Comparison

Table 3.1 illustrates how the three different disagreement computations capture disagreement. The answers reported in the table are hypothetical in order to show how disagreement is captured based on categorical answers.

Table 3.1: Different computations of disagreement

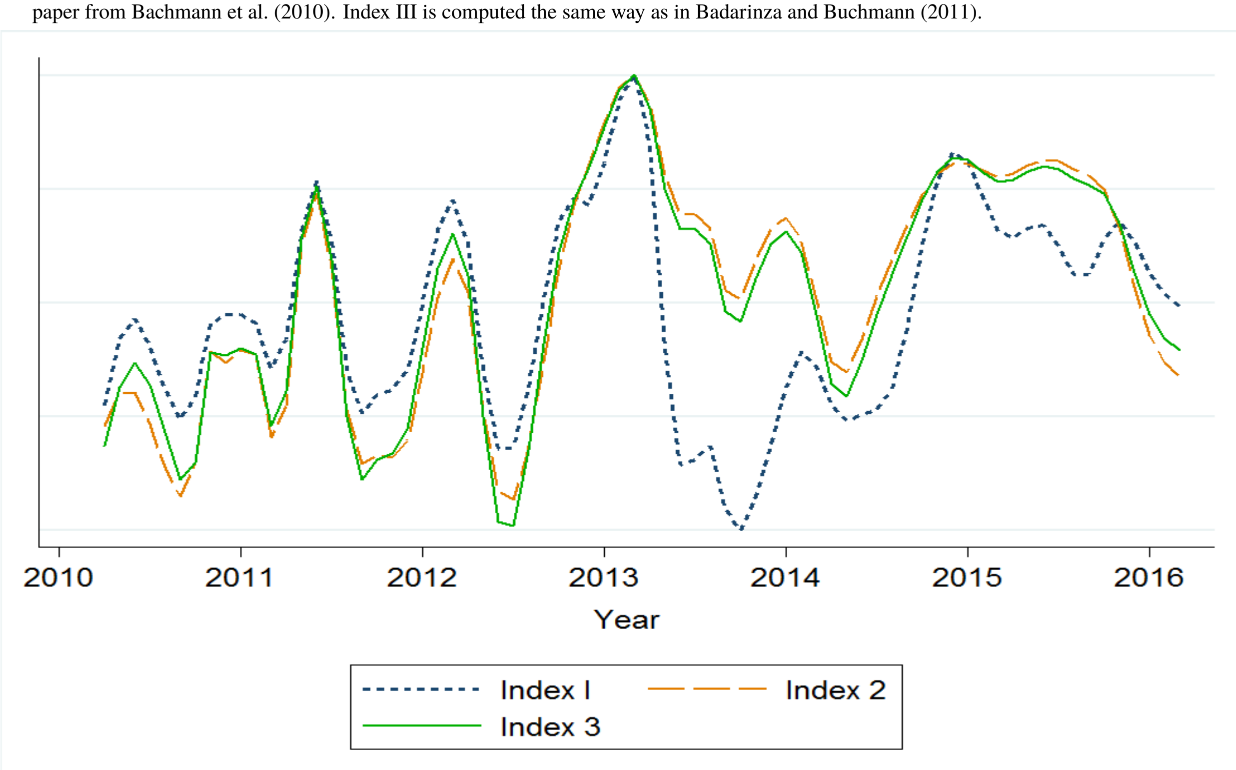
This table illustrates how the different computations capture disagreement. The responses are hypothetical in order to present how the disagreement index works. Note that Index I, the weighted Herfindahl index yields negative values.

Increase	No Change	Decrease	Index I	Index II	Index III
50%	0%	50%	-0.500	1	0.500
33%	33%	34%	-0.442	0.8185	0.446
5%	90%	5%	-1.625	0.3162	0.095
99%	0%	1%	-0.980	0.199	0.020

The extreme result, where 99 percent of the respondents agree that the housing prices will rise over the next year, yields the lowest disagreement value. In contrast the measure where most people disagree (half are predicting an upward movement, and half are predicting a downward movement),yields the highest value of disagreement.

Figure 3.2: Graphical presentation of the different indexes

Disagreement indexes computed in different ways. Index I is computed by the weighted herfindahl method. Index II is computed in line with the paper from Bachmann et al. (2010). Index III is computed the same way as in Badarinza and Buchmann (2011).



The three series are highly correlated. This is depicted graphically in figure 3.2 and the correlation coefficient in table 3.2. Noticeably the correlation between Index II and III is approximately 1. We implement a robustness analyses to show that the relationship presented between disagreement and returns are robust. Figure A.4 reports the final regression model using the different disagreement indexes. The results are similar across the different computations, which is expected based on how these indexes are correlated.

Table 3.2: Cross-correlation table

This table illustrates correlation between the indexes

Variables	**Index I**	**Index II**	**Index III**
Index I	1.000		
Index II	0.641	1.000	
Index III	0.705	0.991	1.000

3.6 Economic Determinance

Graph 3.3 illustrates how key economic events coincide with disagreement. The economic events are explained in table 3.3. The factors are chosen due to their large magnitudes which with high probability will have consequences for the Norwegian economy. Some of the events, such as the Libyan civil war has strong oil price effects and therefore links closely to the Norwegian economy. The illustration exhibits increased disagreement following the economic events. After the oil price drop in June 2014, disagreement increases for an extended period of time until June 2015. The worldwide stock market plummet in August 2011, is followed by a sudden spike in disagreement. Li and Li (2013) construct 5 different macroeconomic disagreement measures and show how the disagreement variable is significantly counter-cyclical. Disagreement rises in recessions. In 3.3 illustrating using recession bands is non applicable because of their nonoccurence during the time period under examination. There is no official business cycle dating agency in Norway. We utilize Norges Bank publication by Aastveit et al. (2014) which dates Norwegian recessions. The recessions are illustrated in figure 3.4.

Figure 3.3: Disagreement in house price predictions with key economic events

This figure displays how the disagreement index interacts with key economic events. The events are explained in table 3.3. These events are expected to have an effect on the Norwegian economy.

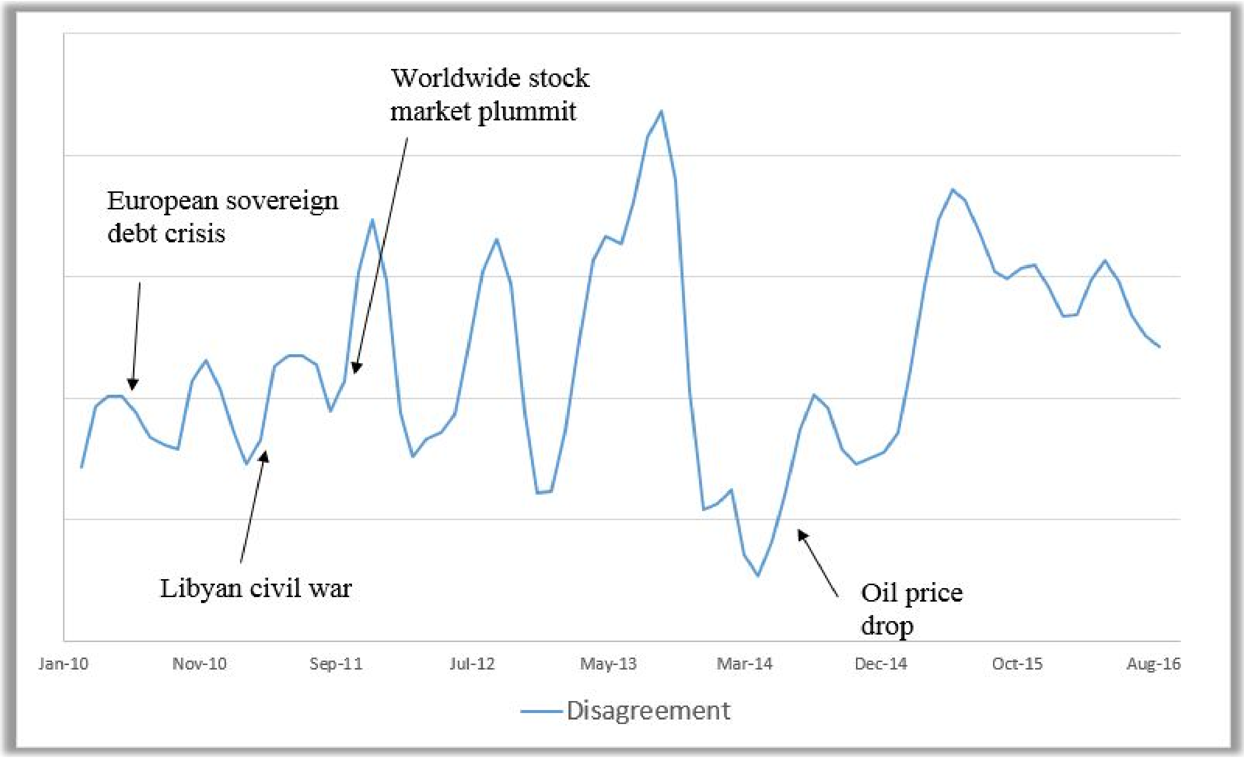


Table 3.3: Key Economic events

This table explains economic events which is expected to have an effect on the Norwegian economy. Figure 3.3 illustrates how disagreement interacts with these events.

Event	**Date**	**Description**
OPEC cancels its oil price band	February 2005	The oil price surges in reaction (Only depicted in figure 3.4)
European debt crisis	April 2010	Standard & Poor's downgrades Greece's sovereign credit rating, triggering the decline of the Euro's value and stock markets drop worldwide
Libyan Civil War	February 2011	Libyan Civil War disrupts oil supply and oil price spikes
Worldwide stock market plummet	August 2011	Stock market plummets over concerns on the slow economic growth of the United States and US credit rating being downgraded. Severe volatility of stock market indexes continued for the rest of the year
Oil price drop	June 2014	The oil price plummets hitting the Norwegian petroleum sector hard

3.7 Capturing Disagreement

It is relevant to make the distinction between two types of expectations: expectations about *fundamentals* and expectations about *future house price developments*. Professionals and institutions have expectations for price developments that are tied to fundamentals. Housing market participants, link expectations to future house prices. Case and Shiller(2003) associates the average home buyer as having little or no experience when purchasing homes. Housing market participants input regarding buying and selling is often based on information from media, family members and their own personal view. This thesis applies a household survey which could have different implications for the disagreement index compared to disagreement captured by analyst.

Li and Li (2013) argue that analyst forecasts as disagreement measure may be inaccurate. Analyst forecasts only capture a small and highly qualified sample of the population. In addition, analyst forecasts can be biased due to self-interest. One example is how analysts tend to have similar forecasts, due to the fear of making an incorrect recommendation. Another example, is how analysts may adjust their forecasts to avoid earnings disappointment for their clients. Li and Li (2013) solve these conflicts of interest, by constructing a more direct measure of disagreement using a household survey. They use a survey on several macroeconomic variables. This thesis address the issue directly by using a household survey.

3.8 Structural Differences Between Housing and Stock Market

Most of the empirical work regarding the connection between disagreement and prices or volume, has been carried out on the stock market. The structural differences between the stock market and the housing market may lead to different implications for this study. Short sale constraints in housing market results in prices only reflecting optimistic investors.

Housing market are illiquid and characterized by slower turnover rates than other asset markets. The real estate market in some countries have exchange traded real estate investment securities like REITS. Apart from REITS, house sales are conducted through brokers and homeowner transactions which usually take several months. Consequently, disagreement should have longer response times before being reflected in prices and volume.

Another distinction is high transaction costs. Higher transaction costs diminish returns. This makes real estate less optimal for speculation and housing market participants need stronger inclination in order to buy and sell. Decreased trading willingness should dampen the effect exogenous shocks have on volume and prices.

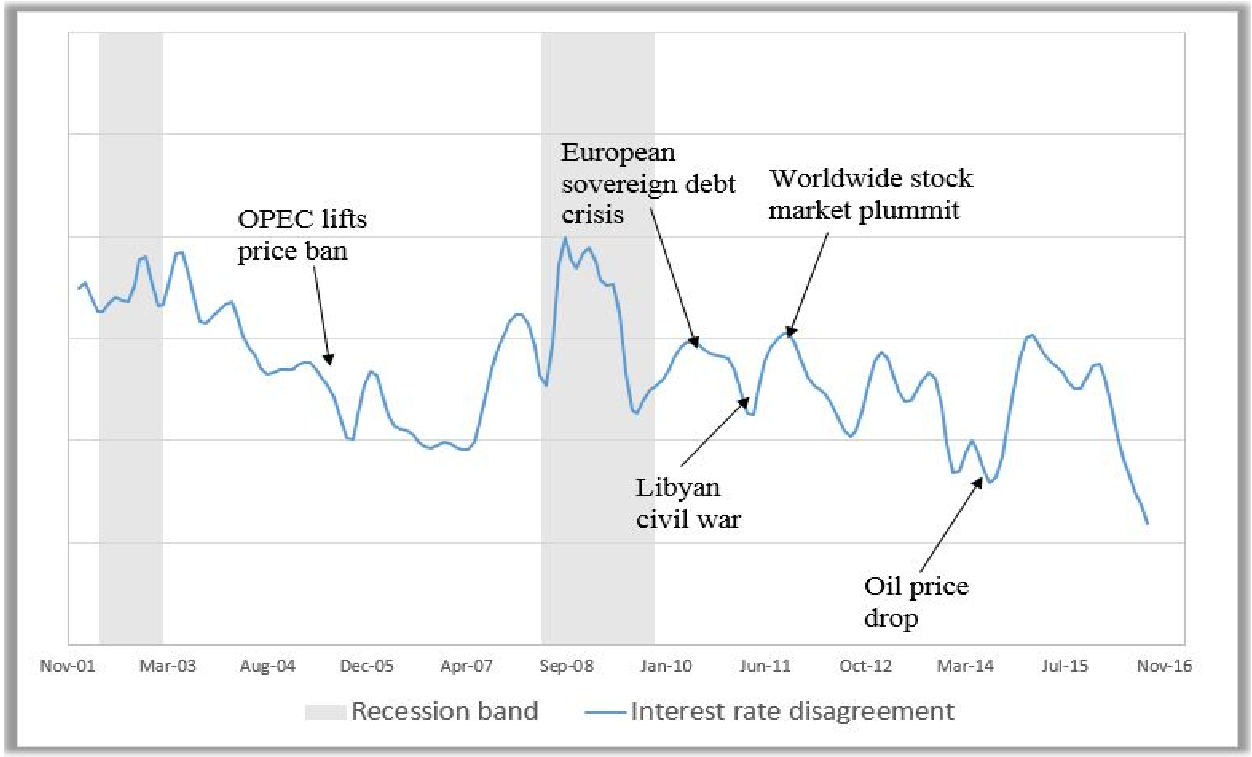
The housing market displays a high degree of information asymmetry. Contradictorily stock markets are transparent and efficient. As a result it is more probable that the real estate market will have more extreme movements in disagreement, due to more heterogeneous expectations.

3.9 Alternative Disagreement Index

We construct two proxy's for disagreement based on interest rate and employment forecasts. The conclusion from this approach is that the two synthetic indexes are unsuccessful proxies for house price disagreement. The house price expectations data is short and limited. In order to make this analysis more comprehensive, we tried expanding the time horizon. The reflection being some similar survey on other house price drivers, might function as a proxy for house price disagreement. Substituting the initial disagreement index with an appropriate proxy, could add statistical power to the results. We use data from a survey conducted by Norges Bank on 12 month forecasts for both interest rates and employment. The forecasts are done by households for the former and business managers for the later. The Norges Bank survey dates back to 2002 and adds 8 years to the time series analysis. The justification for using interest rate and employment data, is that they are important determinants for house prices. Interest rates effect house prices through several channels, prominently through the mortgage rate setting mechanism. When unemployment rises fewer people can afford houses. Unemployment and interest rates are key drivers in Jacobsen and Naug (2004) housing model. We establish two indexes for interest rate and employment. They are named synthetic disagreement and constructed in the same manner as the existing disagreement index. By standardizing both the disagreement index and synthetic indexes, it is easier to compare them and evaluate if they capture overlapping patterns over time. We regressed the synthetic indexes on the disagreement index (not reported as results). The two synthetic indexes are unsuccessful proxies for house price disagreement. Interestingly, interest rate disagreement had significantly predictive power for interest rates (unreported result).

Figure 3.4: Disagreement in interest rate predictions with key economic events & recession bands

This figure displays how the alternative disagreement measure, constructed using interest rate predictions, interacts with key economic events.



Methodology

4.1 Hypotheses

4.1.1 Research Question

Does disagreement affect prices and turnover in the Norwegian housing market?

4.1.2 Development of Hypothesis

We expect that higher disagreement will result in higher contemporaneous prices and lower future returns. The model below consists of the main disagreement index, along with several control variables which capture the fundamental factors that drives housing prices.

$$\begin{aligned}\Delta P_{t+1} = \alpha + \beta_1 Disagreement_t + \beta_2 \Delta P_t + \beta_3 Interestrate_t + \beta_4 Unemployment_t \\ + \beta_5 Turnover_t + \beta_6 Wage_t + \beta_7 Volatility_t + u_t\end{aligned} \tag{4.1}$$

$$H0: \beta_1 = 0$$
$$H1: \beta_1 < 0$$

We expect that when disagreement increases, volume increases. Disagreement and volume is measured contemporaneously in line with findings from the paper by Li and Li (2013).

$$\begin{aligned}Turnover_t = \alpha + \beta_1 Disagreement_t + \beta_2 Interestrate_t + \beta_3 Unemployment_t + \\ \beta_4 Turnover_{t-1} + \beta_5 Volatility_t + \varepsilon_t\end{aligned} \tag{4.2}$$

$$H0: \beta_1 = 0$$
$$H1: \beta_1 > 0$$

To test disagreement *ceteris paribus*, a control for fundamental factors in the housing market must be implemented. As a basis for the house price model, we use Norges Bank empirical model from Jacobsen and Naug (2004) to control for fundamental house price drivers. Jacobsen and Naug use an error correction model to determine the most important fundamental factors that drive Norwegian housing prices. In their study they experimented with a wide range of dependent variables. Their findings conclude that interest rate, household income, unemployment, housing starts and household expectations are the most significant house price drivers, for the period 1990-2004.

Carlin et al. (2012) model a vector-autoregression(VAR) with disagreement, volume and volatility in the mortgage backed securities market. Intuitively, increased volatility from exogenous shocks will lead to higher dispersion about future prices. Including volatility allows them to control for exogenous shocks, and isolate disagreement from volatility. Carlin et al. (2012) find that uncertainty represented by volatility in itself does not lead to higher volume. Rather it is in the presence of disagreement uncertainty leads to higher volume. These findings closely relate to Ellen et al. (2016) who make a clear distinction between disagreement and uncertainty and its asset-price implications. In this thesis the control for volatility is implemented by calculating standard deviations of daily returns on Oslo Stock Exchange.

4.2 Stationarity

In this thesis several of the variables are non-stationary. This is expected of typical macroeconomic variables, they often share a common time trend. A data series contains a unit root when the series is exposed to exogenous shocks, which does not fade away over time. The issue is that these types of non-stationary variables can exhibit high correlation, even though there is no underlying significant relationship. In order to avoid spurious regressions one has to make the variables stationary by first differencing. Stationary variables have constant probability distribution. Mean, variance and auto covariance are constant over time.

4.2.1 Testing for Stationarity

One can test stationarity graphically by depicting a data series over time. Non-stationary series typically exhibit a trend. An example is illustrated in figure 5.1 where house prices are non-stationary, and return is stationary. Return is the first difference of house prices, implicating that house prices are integrated of order 1, I(1) . A more concrete test is the expanded augmented Dickey-Fuller test. The expanded version of the Dickey Fuller test takes care of autocorrelation in the error term. Test for unit root:

$$y_t - y_{t-1} = (\phi - 1)y_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta y_{t-1} + \varepsilon_t \tag{4.3}$$

Dickey Fuller tests for null hypothesis that $\phi = 1$ versus the alternative hypothesis $\phi < 1$. k is the number of lags. To estimate the appropriate number of lags, we use "Schwarz-Bayesian information criterion" (SBIC). The Δy_{t-1} will capture the dynamic structure in the variable to make sure that the error term is not auto correlated. The Dickey Fuller tests gives the possibility to specify the trend or nontrend option, depending on the time series variable under examination.

$$y_t - y_{t-1} = \mu + \lambda T + (\phi - 1)y_{t-1} + \varepsilon_t = \mu + \lambda T + \psi y_{t-1} + \varepsilon_t \tag{4.4}$$

Where μ is the constant term and λT is the deterministic trend. A non-stationary time series of order 1 is transformed to be stationary by taking the first difference. The issue with first differencing is that one loses information about long run dynamics. A possible solution to this issue is to test for co-integration and use the co-integrated variables in an error correction model. Error correction models allows combining non-stationary variables, given co-integration, with stationary variables. This allows to model short and long term dynamics together, without losing meaningful information about the long term relationship. We decided against using an error correction model, because the data series is too short for modeling meaningful long run relationships. Secondly, the key variables such as house price return, turnover and the disagreement indexes are all stationary.

4.3 Granger Causality

Granger Causality tests determine whether one time series is useful in forecasting another time series. Granger causality is used to determine whether time series X is likely to influence the change in Y and not vice versa. Granger causality means that if X Granger-causes Y, then X is a useful predictor of Y. Ordinary regressions reflect "mere" correlations. Granger Causality only tests for predictive causality, not true causality, Stock and Watson (2015).

4.4 Normality

In order to conduct multiple regression analysis we test the second statistical assumption pertaining normality. The error term should be normally distributed $\mu_t \backsim N(0, \sigma^2)$. We applied the Jarque-Bera test which investigates skewness and kurtosis in the error term. Skewness measures how asymmetric the distribution of the residuals are. More specifically, how asymmetric the tails are. Kurtosis measures how fat the tails are. If the error terms are normally distributed; skewness should be zero, and kurtosis should be 3.

4.5 Autocorrelation and Heteroskedasticity

The fourth statistical assumption regarding multiple regression analysis is that the variance of errors is constant and finite over all values. This assumption relates to heteroskedasticity and auto-correlation. Heteroskedasticity is when the variance of a variable changes over time. Auto correlation is the correlation between a time series and the lagged version of itself over time. To correct for auto correlation issues, we use the Newey-West variance estimator, which produces consistent estimates in the presences of autocorrelation and heteroskedasticity. In order to combat heteroskedasticity we use the robust command in the regression specifications. The robust command scales the standard error with higher weights for small deviations, and lower weights for higher variations.

Data

5.1 Variables

Table 5.1: Summary statistics

This table reports the summary statistics for all variables included in the analysis. Note; Disagreement have a mean of 0 and standard deviation of 1 due to standardization.

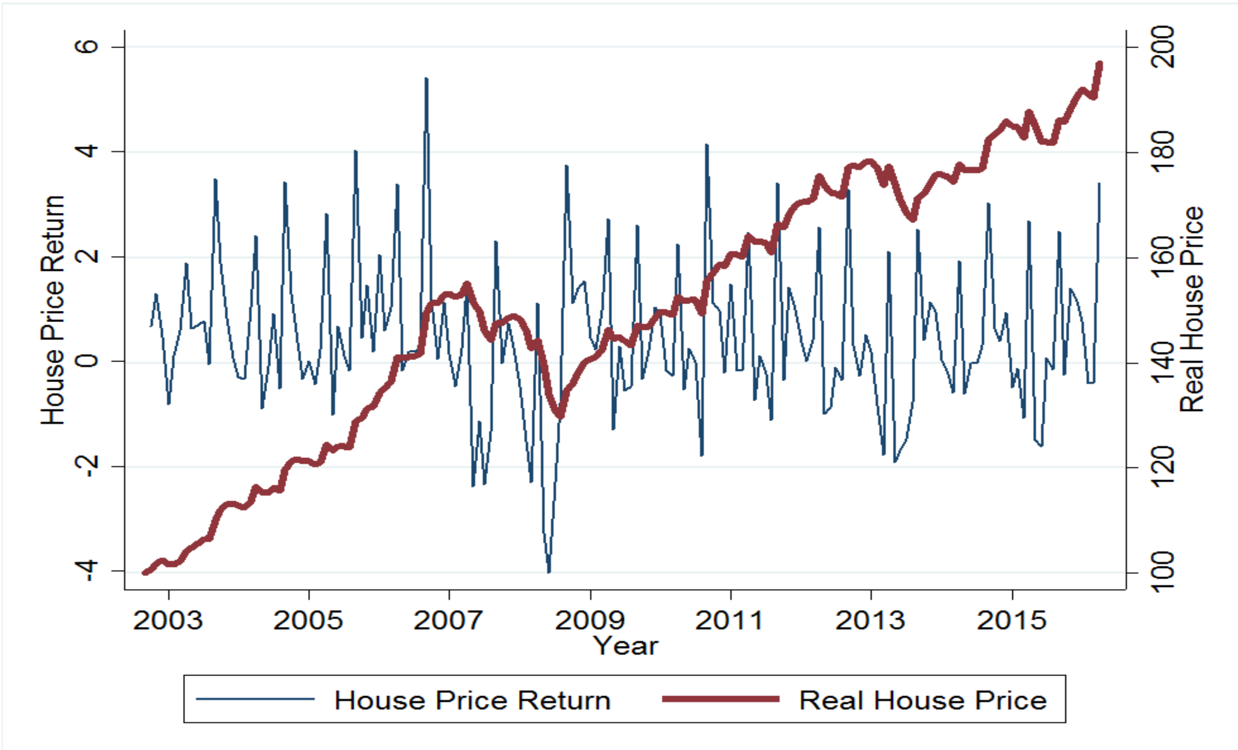
Variable	Mean	Std. Dev.	N	Skewness	Kurtosis
Disagreement	0	1	79	0.243	2.38
Real house return	0.427	1.468	163	0.417	3.91
Turnoverhouse	32.274	7.413	92	-0.531	2.40
Real Wage	27.265	2.883	201	-0.199	1.71
Unemployment	3.568	0.629	199	0.395	2.36
Real Interest rate	3.874	2.324	201	0.774	2.26
Volatility	1.291	0.761	201	2.789	14.62

5.1.1 Housing Prices

House price is the dependent variable in the regression. The data on housing prices is gathered from Eiendom Norge. Eiendom Norge's data is collected monthly, ranging from January 2003 to August 2016. The data is based on house-sales from real estate brokers which is listed on "finn.no". The data contains both primary residence and vacation homes. The house prices are calculated as an index, with January 2003 as the base year (value 100). Eiendom Norge uses an advanced version of the SPAR-methodology(Sales Price Appraisal Ratio). Their approach for appraisal estimation includes a hedonic regression model. The price estimation is done in two steps. First, Eiendom Norge calculates a theoretical housing price valuation by including the following features; type of house, size, number of stories, construction year etc. In the next step, a comparison is made between the actual selling price of the house with the models estimated result. The house price index is made up of the median-level for observed prices and estimated prices. House prices exhibit a great deal of seasonality and therefore the data is seasonally adjusted. Figure 5.1 plots house price returns over time. We expect house price returns to be stationary, this is confirmed with the Dickey Fuller test in table 5.2.

Figure 5.1: Housing prices and housing price return

This graph illustrates house price return versus real house price. House price is reported as an index with January 2003 as the base month (value = 100).



Methodology for estimating house prices

There are two main challenges with measuring house prices:

1. Dwellings are heterogeneous – unequal in size, type, location, features etc.

2. Dwellings are sold infrequently.

Rappaport (2007) explains three different approaches to estimate house price indices. These methods deal with the issue of heterogeneity and infrequent sales in different ways.

- **Method 1 – Average prices**

  The average price method is the simplest of the three methods in the paper by Rappaport. It takes the simple average of all observed house prices. House prices are typically reported based on sales or refinancing. The key shortcoming with this methodology, is that it does not solve the heterogeneity problem.

- **Method 2 – Repeat sales price method**

  Repeat sales method collects data on individual houses over a long period of time. This methodology constructs a transaction based pair on the same house at different points in time, where p_1 is the house price at t_1 and p_2 is the house price at t_2. The repeat sales method deals partly with the heterogeneity issue. Due to the transaction based pair method being based on the same house, factors such as location will be the same across the different time periods. Home improvement may cause the transaction pair to be less comparable than desired. Given the extent of home improvements is just to maintain the condition of the house, the model will be accurate. In many cases, home improvement will increase the quality of the house which causes the model to overestimate the appreciation. Case and Quiqley (1991) discover a transaction bias for houses that are sold repeatedly. Houses with higher historical turnover tend to appreciate more rapidly than houses that are sold less frequently.

- **Method 3 – Hedonic index**

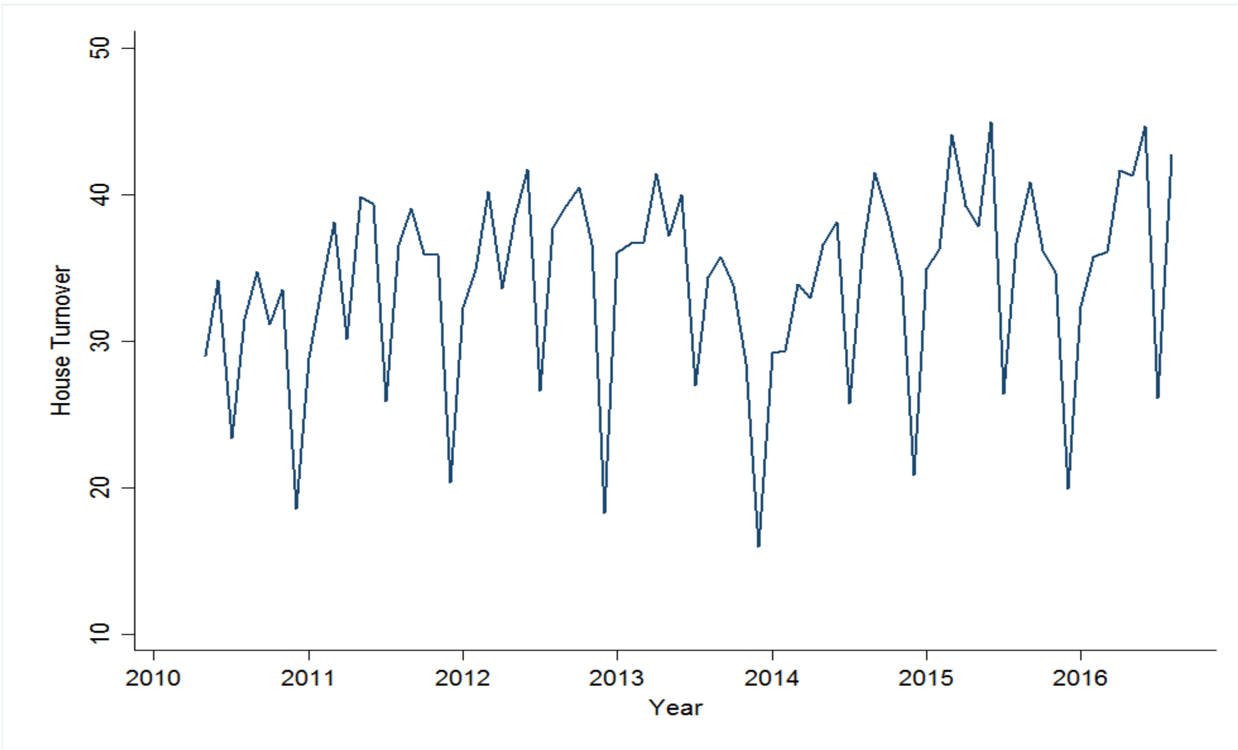
  The Hedonic methodology is based on a hedonic regression model. The regression consists of price estimates of different attributes such as location, size, quality, number of bedrooms, construction year etc. The model “constructs” a hypothetical constant-quality base house. Housing attributes can be inserted into the model which returns a house price estimate. The Hedonic index is the best model for dealing with heterogeneity issues, it can control for the majority of attributes that differentiate houses prices. A limitation of this approach is that it requires a vast amount of data.

5.1.2 Turnover

The turnover data is collected from Eiendom Norge on a monthly basis beginning in January 2003. It is based on sales volume collected from "finn.no". The volume data enables the construction of an alternative measure, house turnover. Turnover is calculated as the total number of houses sold in a month divided by the total number of houses listed ($T = \frac{Houses\ sold}{Houses\ listed}$). Normalizing volume subtracts the increases in volume that are due to the growth of the Norwegian economy. This data is the basis for testing the relationship with turnover and disagreement. In periods of high dispersion, turnover should increase. Turnover exhibits the characteristics similar to that of a stationary series. The Dickey-Fuller test confirms that turnover is stationary. There is seasonality in the turnover series. This is understandable given that activity in the housing market will vary depending on the time of the year. December will typically exhibits less turnover because of Christmas. Similarly, July will have less turnover as a result of summer vacation. We correct for seasonality in the regression model by including month dummies.

Figure 5.2: House turnover

This figure displays turnover over time. There is seasonality in the index, with two dips each year (December and July).



5.2 Control Variables

The scope for this paper is to test the effect of disagreement on prices and turnover. To test disagreement *ceteris paribus*, we control for fundamental factors in the housing market.

5.2.1 Real Interest Rate

According to Jacobsen and Naug (2004), the interest rate is one of the most important price drivers in the housing market and is one of the factors included in the model. The interest rate effects household's willingness to take on mortgages. Interest rates also affects household's cost of living and ability to manage their existing floating mortgages. Rising interest rate should negatively affect housing prices. Norges Bank overnight lending rate is used as the interest rate variable. The interest rate data is collected on a monthly basis. Over a long time horizon, it is expected that interest rates will exhibit stationary characteristics. During the time period under examination, interest rates has fallen more or less continuously. Consequently, this series is non-stationary. This is confirmed by the Dickey-Fuller test.

5.2.2 Household Income

Income is another key fundamental variable that contributes to explaining house prices. Higher wages results in higher borrowing capacity and increases funds available to spend on house financing. Real wage growth increases is expected to have a positive effect on house prices. This analysis uses average monthly wage excluding overtime, for all of Norway. The data is gathered from Statistics Norway and collected on a yearly basis. In order to conduct the analysis, the data is converted from yearly to monthly. This is done by interpolating the yearly data series. Wage variations are small from month to month yet it cannot be excluded due to its importance in determining house prices. The real wage is deflated with CPI to remove any inflation trend. In most industrialized countries the average household income will have an upwards trend reflecting an increase in living standards resulting from higher productivity and technology. Periods of economic expansion tends to force the wage level up, in contradiction during times of recessions, wages tend to remain stagnate. As a consequence, income is expected to be non-stationary.

5.2.3 Unemployment

The development in unemployment is important for household's future expectations. Unemployment is tightly linked to wages. High unemployment results in lower expectations for future wages, and in periods with high unemployment, households tend to postpone purchasing homes. We expect higher unemployment to negatively affect housing prices.

There are two prominent measures for unemployment in Norway. In this study the unemployment data available from Statistics Norway, which is based on an unemployment survey (AKU) is the preferred measure. The second option available is to use the reported statistics from the Norwegian Labour and Welfare Administration (NAV). This unemployment statistic captures registered unemployed persons from ages 15-74. Registered unemployment is a somewhat restricted measure, due to the fact that not all unemployed will register with NAV. Unemployment levels are subject to shocks in the economy, implying a presence of unit root. The Dickey-Fuller test confirms the existence of unit root in unemployment. Changes in unemployment is stationary, implying that the unemployment rate is integrated of order 1.

5.2.4 Volatility

We use OSEBX daily returns to calculate the monthly standard deviation for each month in the sample period. The data is collected from Oslo Stock Exchange. This variable is included to control for general market uncertainty. The volatility variable is the only control variable not included in the Jacobsen and Naug (2004) model. It is included in this thesis because of the interesting distinction between disagreement and uncertainty made in Ellen et al. (2016). Volatility is stationary.

5.2.5 Real Versus Nominal Data

The main argument for adjusting nominal variables to real variables, is that it removes the effect of inflation. The variation in real variables, are now strictly due to underlying changes in the variable and not due to general price movements in the economy.

5.3 Stationarity Test

Table 5.2: Stationarity test

This table presents results from unit root testing employing the Dickey-Fuller test. Variables in which we find presence of unit root are also tested for their first differences

Variable	Test statistic	Number of lags
Disagreement	-5.220***	1
House price return	-12.004***	0
Turnover	-4.867***	1
Real interest rate	-1.384	2
Real wage	-1.508	1
Unemployment	-0.400	1
Volatility	-5.290***	1
ΔReal interest rate	-5.093***	2
ΔReal wage	-12.741***	4
ΔUnemployment	-4.460***	4

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Empirical Results

6.1 Disagreement and Future Returns

Table 6.1 displays the predictive relationship between disagreement and house price returns. We regressed ex post house price returns on ex ante disagreement index. If disagreement is priced in, the disagreement index should have predictive power for future house price returns. This thesis finds empirical evidence that disagreement has both economic and statistical significance across all four models.

The first model only includes the disagreement index and none of the other explanatory variables. The results from model 1 indicate that disagreement has a negative effect on future house price returns. The beta coefficient for the disagreement variable in table 6.1, is -0.338. This implies that the change of one standard deviation of disagreement will translate into a 33.8 basis points lower return the next month. Should the standard deviation persist for a year, we would expect -4.06 percent yearly return. This estimation is in line with literature on returns and disagreement from the papers by Miller (1977) and Chen et al. (2002). Due to short sale constraints, price will tend to only reflect optimistic investor's opinions. With increased disagreement, the more overvalued the contemporaneous stock price will be, and lower future returns.

In Tabel 6.1, model 2, the lagged value of house price return is added. Adding lagged house price returns controls for autocorrelation effects. The significant negative coefficient of lagged return suggests that returns tend to reverse in the next month. One possible interpretation is that the housing market is mean reverting and adjusts to exogenous shocks. Additionally, lagging helps with a possible endogeneity problem.

Model 3 includes real interest rate, unemployment and wage to control for other house price drivers. These

explanatory variables are non-stationary and have been first differenced in order to be validly applied in the model. The real interest rate variable is statistically significant. Mixing variables with different orders of integration implies that the economic interpretation of these explanatory variables is intricate. We justify this approach, with mixing different orders of integration, by referring to

Carlin et al. (2012). They implement the same type of model for disagreement and mortgage returns. We emphasize that the interpretation of explanatory variables is not of key importance here. These additional variables are included due to proven significance for the Norwegian housing market in the paper by Jacobsen and Naug (2004). This model illustrates the key message that disagreement has both economic and statistical significance. We report an adjusted R^2 of about 57.1 percent. Furthermore, the coefficient for house price disagreement is relatively robust across the different models. All three models are adjusted for autocorrelation and heteroscedasticity using Newey-West method.

Table 6.1: Results from the regressions of disagreement on house price returns

This table illustrates the results from regressing house price returns on lagged disagreement. The sample period stretches from March 2010 to September 2016. All models incorporate lagged values (denoted by "L" in the output) to explain future house price returns. Model 3 controls for the fundamental price drivers: turnover, real interest rate, unemployment and income ("D" denotes first differenced variables). Model 4 includes an additional volatility measure to isolate uncertainty from disagreement. *Note:* Wage is reported in thousands

	(1)	(2)	(3)	(4)
	House Price Return	House Price Return	House Price Return	House Price Return
L.Index I	-0.338**	-0.411***	-0.253**	-0.262**
	(-2.133)	(-2.753)	(-2.140)	(-2.331)
L.House Price Return		-0.250**	-0.071	-0.072
		(-2.158)	(-0.738)	(-0.749)
L.House Turnover			-0.139***	-0.138***
			(-7.850)	(-7.584)
LD.Real Interestrate			-4.395**	-4.855**
			(-2.227)	(-2.458)
LD.Unemployment			-1.077	-1.060
			(-1.318)	(-1.327)
LD.Real Wage			-1.485	-1.640
			(-1.551)	(-1.657)
Volatility				0.317*
				(1.686)
Constant	0.388**	0.475***	5.118***	4.721***
	(2.572)	(2.757)	(8.276)	(6.601)
Observations	77	77	77	77
R^2	0.064	0.119	0.605	0.619
Adjusted R^2	0.051	0.095	0.571	0.581

D denotes first differenced variables, *L* denotes lagged variables

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.1.1 Suggestive Evidence on Causal Relationship

So far the findings have explored the correlation between disagreement and house price returns, in additon it is valuable to explore the direction of causality. Specifically, an investigation into whether disagreement Granger-causes house price returns. In order to run a Granger causality test, a test for the appropriate number of lags using Akaike's information criteria is conducted. Next, a vector autoregressive model was run with the same variables as in table 6.1, model 3, with house price returns and the disagreement index. Based on these results, the Granger test presented in table 6.2 displays evidence that the coefficients on the lags of disagreement are not jointly zero in the equation for house price returns. This indicates that the evidence favors the alternative, disagreement Granger-causes house price returns. In contrast, the null hypothesis for the Granger test with house price return on disagreement index is rejected. House price returns do not Granger-cause disagreement. These results coincide with the expectation that disagreement has predictive power for house price returns and not vice versa.

Table 6.2: Granger Causality test

This table summarizes the results from the Granger causality test. Disagreement Granger causes real house price return, and not vice verca.

Equation	**Excluded**	**chi2**	**df**	**Prob > chi2**
Real house price return	Disagreement	17.875	4	0.001
Real house price return	ALL	17.875	4	0.001
Disagreement	Real house price return	5.8681	4	0.209
Disagreement	ALL	5.8681	4	0.209

6.2 Disagreement and Turnover

The second hypothesis is that higher disagreement will cause higher turnover. Turnover is defined as the total number of houses sold in a month divided by the total number of houses listed. We regressed turnover on the contemporaneous disagreement index. The first model only includes disagreement and none of the other explanatory variables. A control for seasonality is implemented by including month dummies. Model 1 indicates that disagreement is statistically significant in explaining house turnover, however with only one variable this is likely due to model misspecification. The disagreement coefficient of 1.119 suggests a change of one standard deviation of disagreement results in a 1.119 percent change in monthly house turnover. The economic interpretation of the coefficient conforms with papers by Harrison and Kreps (1978) and Li and Li (2013). Due to disagreement investors interpret news differently. Trading occurs when investors valuations are switched from an optimistic to pessimistic state and vice versa. Higher dispersion in beliefs leads to more switching of valuations and more willingness to buy and sell, which generates higher trading volume.

In models 2-4, when including lagged house turnover and the control variables from the paper by Jacobsen and Naug (2004), the disagreement variable turns insignificant. The coefficient for disagreement changes and is inconsistent across the different models. Disagreement is not significant in explaining house turnover. There are two possible explanations for these insignificant results. Either disagreement does not have explanatory power on house turnover, or the standard errors are inflated. An implication of the sparsity problem with the expectations data, is that the standard errors most likely will be high. All the control variables are insignificant in model 3. These variables are included in the model for consistency.

Table 6.3: Results from the regression of disagreement on turnover

This table illustrates the contemporaneous relationship between disagreement and turnover. Turnover is measured as the number of houses sold divided by total listed houses. Model 3 controls for the fundamental price drivers: turnover, real interest rate, unemployment and income. Model 4 includes an additional volatility measure to isolate uncertainty from disagreement. Seasonality is dealt with by including month-dummies. The month dummies are not reported in the output. *Note:* Wage is reported in thousands.

	(1)	(2)	(3)	(4)
	House Turnover	House Turnover	House Turnover	House Turnover
Index I	1.119***	0.316	0.260	0.250
	(3.014)	(0.884)	(0.788)	(0.748)
L.House Turnover		0.584***	0.562***	0.564***
		(5.322)	(4.785)	(4.751)
D.Real Interestrate			-3.659	-3.841
			(-0.448)	(-0.459)
D.Real Wage			-1.635	-1.902
			(-0.601)	(-0.669)
D.Unemployment			-1.092	-1.256
			(-0.444)	(-0.492)
Volatility				0.196
				(0.374)
Constant	32.694***	21.306***	21.734***	21.512***
	(24.902)	(8.931)	(8.945)	(8.194)
Observations	78	78	77	77
R^2	0.775	0.848	0.859	0.860
Adjusted R^2	0.733	0.817	0.822	0.819

D denotes first differenced variables, *L* denotes lagged variables

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.2.1 Disagreement and Volatility

Ellen et al. (2016) investigates the economic mechanism behind disagreement. In their paper they make a clear distinction on whether its heterogeneity or uncertainty that causes disagreement. Heterogeneous beliefs and uncertainty should have diverging implications for trading volumes. It would be expected that heterogeneous beliefs has positive effect on trading volume. Dispersion in investors valuation should lead to higher trading willingness from buyers and sellers. In contrast, uncertainty generally reduces volume and liquidity, as investors experience higher costs in rebalancing their portfolios. Investors are hesitant with taking positions in hope for more certain conditions.

In table 6.1 and 6.3 model 4, a variable for uncertainty is included to control for volatility. The volatility variable is significant at the ten percent level for house price return, but not at the five percent level. The coefficient changes slightly from -0.253 to -0.262. By including volatility, disagreement is explained separately from uncertainty.

The volatility variable is insignificant in the model for turnover. The relevance is limited due to disagreement not having significance for turnover in this thesis.

The volatility measure is created by using daily returns from Oslo Stock Exchange (OSEBX). We calculate the monthly standard deviation for each month in the sample period. OSEBX is chosen in lack of a more direct measure for housing volatility. Calculating volatility on REITS could be an alternative solution. REITS captures housing market uncertainty more directly than stock market volatility. To our knowledge, traded REITS do not exist in Norway, but this could be applicable in studies of other countries.

6.3 Concerns and Criticism

The primary shortcoming of this study is the lack of data and the need to create additional data points by incorporating a cubic spline interpolation. Cubic spline interpolation uses information from both past and future data points to construct data. The issue of having future information incorporated into our data can possibly have consequences for the significance of the regression results.

The household survey used in this thesis has its limitations. The household survey is short and inconsistent. The survey has infrequent sampling and is of mixed frequency. There was difficulty in finding a data set. We contacted two well-established professors, Ola Grytten and Erling Røed Larsen, known for their research on housing markets. Neither had knowledge of this data existing, but expressed strong interest in obtaining similar data themselves. Further research could apply the ideas from this thesis with an improved and more comprehensive data set.

A concern in any regression model is omitted variable bias. We use the Ramsey's RESET test (unreported results), which tests for omitted variable bias, to investigate if the chosen model is the best-suited functional form. The p-value is not significant, and we cannot reject the null hypothesis that the functional form was correct and there are no omitted values. However, we use a theoretically motivated model from the paper by Jacobsen and Naug (2004) to control for fundamental house price drivers.

Concluding Remarks

This thesis investigates how disagreement affects housing prices and turnover. We argue that a household survey more efficiently captures beliefs of market participants. The use of a household survey diverges from other papers on heterogeneous beliefs which exploit alternative measures. Due to a sparse data set, we use interpolation techniques to create additional data points. This study fills a void by applying the concept of disagreement to the housing market, a previously unattempted approach. We find empirical evidence that there is positive and Granger causal relationship between disagreement and future house price returns. Our analysis concludes that there is not a significant relationship between housing turnover and disagreement. The results remain robust when controlling for choice of interpolation technique, varying weights in the disagreement index and the choice of disagreement index.

The conclusion of this study is relevant by confirming the information contained in the belief structure of the economy is an important component in explaining asset returns. The results in this analysis conforms with the papers by Miller (1977) and Chen et al. (2002) which explain the connection between disagreement and lower future returns in markets with short sale constraints. The link between disagreement and trading volume has been studied by Varian (1985) and Li and Li (2013). They find empirical evidence of a positive relationship between disagreement and trading volume.

There are extensions and improvements that could be made to our work. The utilized household survey is limited. A larger sample size with an expanded time horizon would be preferable. This thesis does not include times of less stable house price developments. The Norwegian housing market has been characterized by growth for a long period. Further research could investigate the use of disagreement in different market states (tranquil and turmoil).

An interesting extension to this study would be to include a housing specific volatility variable. The value being to separate disagreement from uncertainty. Uncertainty and disagreement should have different implications for assets. We control for uncertainty by including a stock market volatility measure. Future research could apply a more direct measure using housing uncertainty, such as volatility of REITS.

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Appendix

Table A.1: Cross-correlation table: Key variables

This table shows correlation between the variables

Variables	Disagreement	House Price Return	House Turnover	Wage	Unemployment	Real Interest rate
Disagreement	1.000					
House Price Return	-0.211	1.000				
House Turnover	0.194	-0.006	1.000			
Wage	0.275	-0.086	0.495	1.000		
Unemployment	0.356	0.115	0.283	0.036	1.000	
Real Interest rate	-0.312	-0.074	-0.360	-0.863	-0.224	1.000

Figure A.1: Disagreement in employment predictions with key economic events & and recession bands

This figure displays how disagreement in employment predictions interacts with key economic events

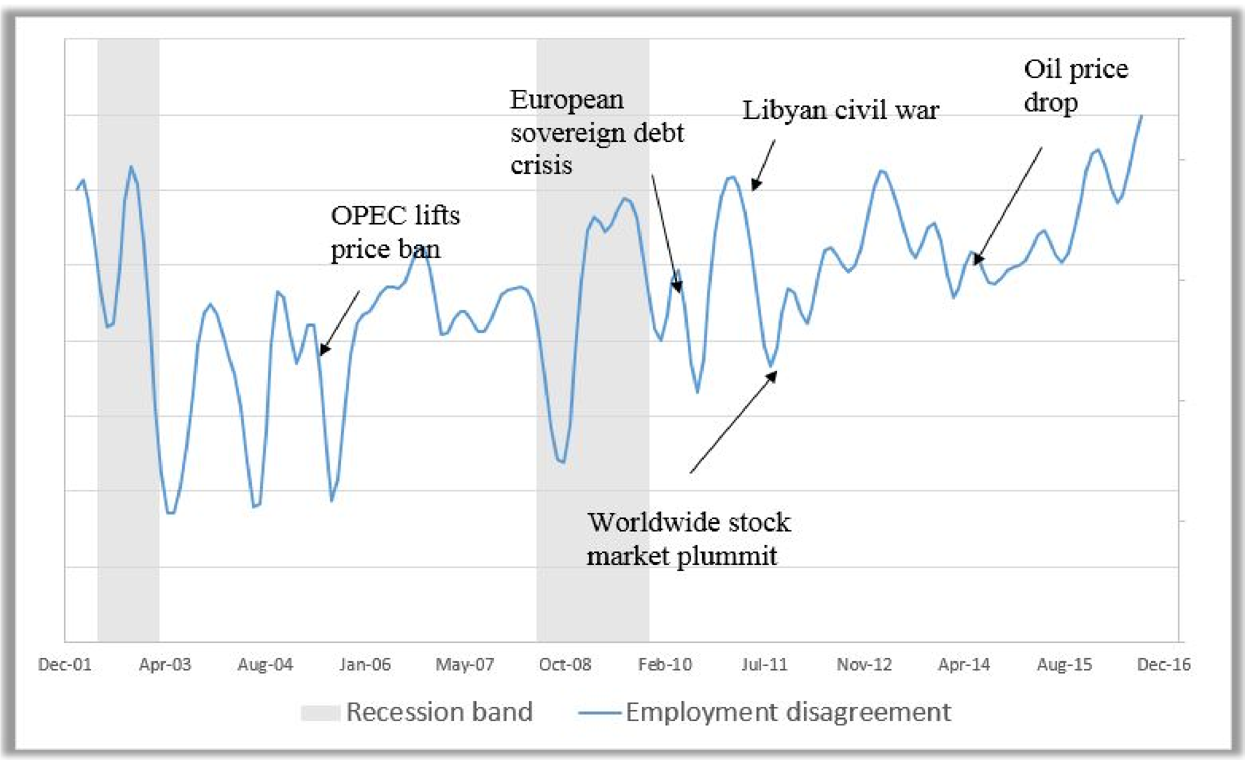


Table A.2: Regressions using different interpolation methods

Using different interpolation methods in order to check for robustness. The regression models are identical, except for the interpolation technique for the disagreement index. The regression model is the same we use for modelling disagreement on house price returns.

	(1)	(2)	(3)	(4)
	House Price Return	House Price Return	House Price Return	House Price Return
L.House Price Return	-0.071	-0.059	-0.075	-0.065
	(-0.738)	(-0.597)	(-0.785)	(-0.658)
L.House Turnover	-0.139***	-0.142***	-0.138***	-0.141***
	(-7.850)	(-8.246)	(-7.810)	(-8.259)
LD.Real Interestrate	-4.395**	-4.294**	-4.490**	-4.393**
	(-2.227)	(-2.115)	(-2.258)	(-2.202)
LD.Unemployment	-1.077	-1.010	-1.085	-1.012
	(-1.318)	(-1.245)	(-1.333)	(-1.241)
LD.Real Wage	-1.485	-1.546	-1.464	-1.521
	(-1.551)	(-1.627)	(-1.534)	(-1.609)
L.Cubic Spline	-0.253**			
	(-2.140)			
L.Linear		-0.213*		
		(-1.872)		
L.Bessel spline			-0.263**	
			(-2.238)	
L.Oneway spline				-0.230**
				(-2.049)
Constant	5.118***	5.213***	5.094***	5.201***
	(8.276)	(8.704)	(8.228)	(8.719)
Observations	77	77	77	77
R^2	0.605	0.596	0.607	0.600
Adjusted R^2	0.571	0.561	0.573	0.565

D denotes first differenced variables, *L* denotes lagged variables

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Regression using different weights in the disagreement index

Varying weights in the disagreement index to check for robustness. The regression models are identical, only varying the weights in the disagreement index.

	(1)	(2)	(3)
	House Price Return	House Price Return	House Price Return
L.House Price Return	-0.071	-0.083	-0.060
	(-0.738)	(-0.989)	(-0.701)
L.House Turnover	-0.139***	-0.140***	-0.145***
	(-7.850)	(-9.205)	(-10.013)
LD.Real Interestrate	-4.395**	-4.771**	-4.419**
	(-2.227)	(-2.464)	(-2.273)
LD.Unemployment	-1.077	-0.977	-0.886
	(-1.318)	(-1.323)	(-1.223)
LD.Real Wage	-1.485	-1.598*	-1.757**
	(-1.551)	(-1.901)	(-2.133)
L.Weight = 2	-0.253**		
	(-2.140)		
L.Weight = 1.5		-0.335***	
		(-3.076)	
L.Weight = 1			-0.312***
			(-2.915)
Constant	5.118***	5.158***	5.343***
	(8.276)	(9.880)	(10.989)
Observations	77	77	77
R^2	0.605	0.628	0.623
Adjusted R^2	0.571	0.597	0.591

D denotes first differenced variables, *L* denotes lagged variables

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.4: Regressions using different disagreement measures

Regression using the different disagreement indexes. Using lagged variables to get a predictive model. The models are identical as the one used in the analysis, the difference between the three models are the different disagreement indexes.

	(1)	(2)	(3)
	House Price Return	House Price Return	House Price Return
L.House Price Return	-0.071	-0.067	-0.066
	(-0.738)	(-0.790)	(-0.768)
L.House Turnover	-0.001***	-0.001***	-0.001***
	(-7.850)	(-9.787)	(-9.521)
LD.Real Interestrate	-0.044**	-0.045**	-0.045**
	(-2.227)	(-2.345)	(-2.337)
LD.Unemployment	-0.011	-0.010	-0.010
	(-1.318)	(-1.328)	(-1.374)
LD.Real Wage	-0.015	-0.017**	-0.017**
	(-1.551)	(-2.102)	(-2.049)
L.Index I	-0.003**		
	(-2.140)		
L.Index II		-0.003***	
		(-3.004)	
L.Index III			-0.003***
			(-2.936)
Constant	0.051***	0.053***	0.053***
	(8.276)	(10.632)	(10.275)
Observations	77	77	77
R^2	0.605	0.627	0.623
Adjusted R^2	0.571	0.595	0.591

D denotes first differenced variables, *L* denotes lagged variables

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure A.2: Expectation survey

The reported answers from the expectation survey.

Date	Prices will be higher than they are now	Prices will be lower than they are now	Prices will not change	Do not know	TOTAL
Mar-10	55 %	5 %	41 %		101 %
Apr-10	62 %	5 %	32 %		99 %
May-10	58 %	6 %	36 %		100 %
Jun-10	58 %	6 %	36 %		100 %
Aug-10	64 %	4 %	32 %		100 %
Sep-10	61 %	4 %	35 %		100 %
Oct-10	60 %	4 %	36 %		100 %
Nov-10	62 %	6 %	32 %		100 %
Mar-11	70 %	4 %	26 %		100 %
Apr-11	66 %	4 %	30 %		100 %
May-11	57 %	7 %	35 %		99 %
Jun-11	60 %	7 %	33 %		100 %
Aug-11	58 %	7 %	35 %		100 %
Sep-11	65 %	5 %	29 %		99 %
Oct-11	64 %	6 %	30 %		100 %
Nov-11	51 %	12 %	37 %		100 %
Dec-11	48 %	15 %	37 %		100 %
Feb-12	61 %	5 %	34 %		100 %
Apr-12	65 %	4 %	31 %		100 %
Jun-12	66 %	5 %	29 %		100 %
Oct-12	57 %	10 %	33 %		100 %
Nov-12	61 %	5 %	34 %		100 %
Apr-13	56 %	11 %	33 %		100 %
Jun-13	41 %	18 %	41 %		100 %
Oct-13	28 %	31 %	41 %		100 %
Nov-13	24 %	28 %	48 %		100 %
Feb-14	33 %	17 %	50 %		100 %
Mar-14	39 %	11 %	50 %		100 %
Jun-14	33 %	17 %	50 %		100 %
Oct-14	53 %	6 %	41 %		100 %
Dec-14	50 %	7 %	43 %		100 %
Feb-15	42 %	12 %	46 %		100 %
Jun-15	46 %	17 %	37 %		100 %
Sep-15	39%	17%	40%	4%	100%
Dec-15	37%	18%	41%	4%	100%
Mar-16	36 %	18 %	43 %	4 %	100%
Jun-16	54 %	10 %	32 %	5 %	100%
Sep-16	62 %	7 %	28 %	4 %	100%

Source: Boligmeteret - Prognosesenteret

Appendix - Norwegian housing market

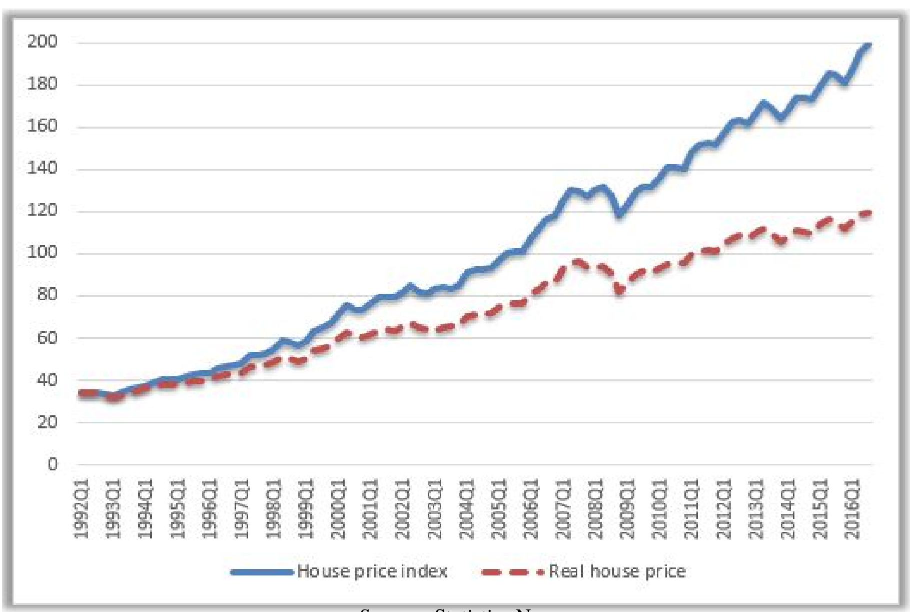
B.1 Housing Price Development

The primary reason for choosing the housing market for this thesis, is due to the interesting characteristics and recent developments in Norwegian housing market. This section highlights some interesting features. Norwegian house prices have experienced rapid price appreciation since the price fall in the 1990s. Except for the financial crises between 2007 and 2009 the real prices have risen continuously. The house price index has grown from 34.3 in the beginning of 1992, to 199,3 in the third quarter of 2016. Figure B.1 shows that the real house prices have grown faster than the general inflation rate.

For figure B.1 we use data from Statistics Norway. This data sample stretches over a longer time horizon than the house price index used in this thesis. However, the data set from statistics Norway is not applicable in our analysis due to its quarterly frequency.

Figure B.1: House price index

This figure displays Norwegian house prices. The house price index is deflated with the CPI to obtain the real house price index. The data is collected from Statistics Norway due to it containing a longer time horizon than the house price index employed in this thesis.



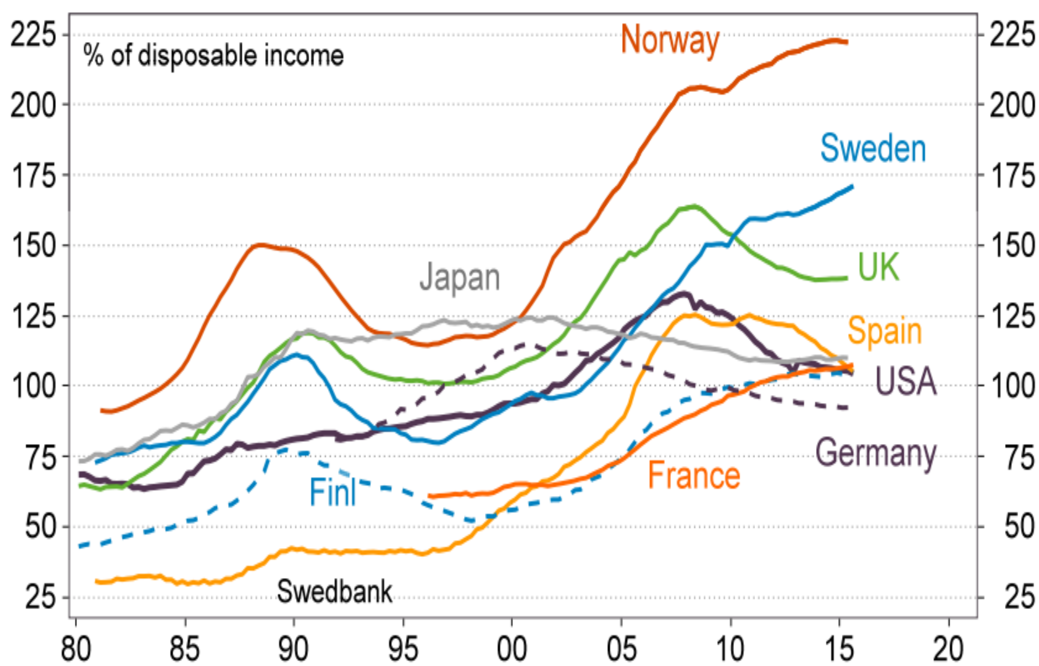
Source: Statistics Norway

B.2 Comparing Norway With Other Countries

The Norwegian interest rates are at a historical low. Low interest rates makes mortgages cheaper and encourages the financing of new home purchases. Most Norwegian households live in mortgage financed homes. Figure B.2 illustrates how Norwegian average household debt is now well over two times disposable income. The debt to disposable income ratio has almost doubled since year 2000. Norway has one the highest relative debt levels compared to other countries. High debt levels combined with rapid house price growth, has been a concern for Norwegian financial stability.

Figure B.2: Household debt in percent of disposable income

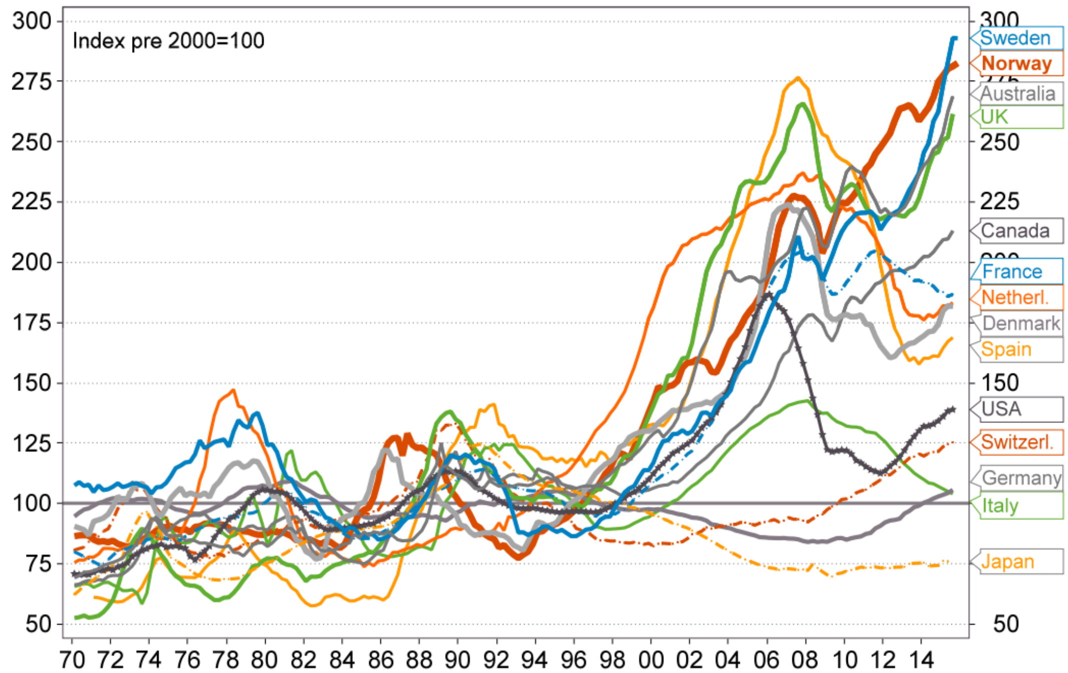
This table illustrates the amount of debt in percent of disposable income accumulated in the Norwegian economy versus other countries. It is reported in percent of disposable income.



Source: Harald Magnus Andreassen - Swedbank

Figure B.3: Real house prices compared to other countries

This figure displays how real house prices in Norway compares to other OECD countries over time.



Source: Harald Magnus Andreassen - Swedbank